RECEIVED

By APHIS BRS Document Control Officer at 3:19 pm, Aug 09, 2010

MONSANTO

KWS

July 29, 2010

Michael C. Gregoire
Deputy Administrator
Biotechnology Regulatory Services
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
4700 River Road, Unit 98
Riverdale, MD 20737

Re: Petition 03-323-01p for Non-Regulated Status, Roundup Ready® Sugarbeet -1; Event H7 Supplemental Request for "Partial Deregulation" or Similar Administrative Action

Dear Mr. Gregoire:

Monsanto Company ("Monsanto") and KWS SAAT AG ("KWS") jointly filed the petition for nonregulated status for Roundup Ready sugarbeet[1] Event H7-1 ("RRSB") which USDA's Animal and Plant Health Inspection Service ("APHIS") previously granted in March 2005. In light of recent developments in litigation, and with the support of thousands of sugarbeet growers nationwide and all sugarbeet cooperatives, processors and seed-producers, Monsanto and KWS jointly submit this supplemental request for "partial deregulation" or similar administrative action, as set forth below.

Background

On March 17, 2005, APHIS granted nonregulated status for RRSB following nearly 100 field trials, a 60-day comment period and issuance of an environmental assessment ("EA") concluding that the event presented "no significant impact on the human environment." In the years thereafter, a majority of our nation's sugarbeet growers adopted RRSB; wide-scale RRSB seed production began by 2006, and the multi-year process to develop appropriate RRSB varieties for growers in 10 states resulted in RRSB cultivation on roughly 95% of all U.S. sugarbeet acreage. The Government of Canada likewise approved RRSB for cultivation and human and animal consumption, and the European Union, Japan, Mexico, South Korea, Australia, New Zealand, China, Colombia, Russia, Singapore, and the Philippines each approved importation of sugar and other products derived from RRSB. Today, RRSB is processed into roughly half of our nation's domestic sugar supply.

---

[1] ® Roundup and Roundup Ready are registered trademarks of Monsanto Technology LLC.

On September 21, 2009, however, a Federal district court in San Francisco ruled that APHIS's 2005 EA for RRSB did not adequately evaluate potential cross-pollination from RRSB seed crops to other crops. The court held that APHIS "did not consider the effects of gene transmission on conventional farmers and consumers of sugar beet seed or of gene transmission to the related crops of red table beets and Swiss chard" and noted that such "seed production takes place primarily in the Willamette Valley of Oregon." *Center for Food Safety v. Vilsack ("CFS")*, No. 08-484, 2009 WL 3047227, *5, 13-14 (N.D. Cal. Sept. 21, 2009). That litigation is currently in the remedies phase, where the plaintiffs in the suit have sought a judicial order halting further planting of RRSB. Representatives of the thousands of sugarbeet growers nationwide along with sugarbeet cooperatives and processors, the seed companies who produce RRSB seed and Monsanto have intervened in this suit to urge the court not to halt ongoing or future RRSB cultivation. Specifically, the district court has been presented with evidence that an order immediately halting RRSB planting would have profound consequences for the nation's growers and many other parties, including that:

- Farming communities could suffer losses exceeding $2 billion;
- Approximately eight sugarbeet processing facilities would close (likely forever);
- More than 5,500 jobs would be lost; and
- The resulting domestic sugar shortages would, under USDA estimates, cost consumers $2.972 billion in 2011 alone.

Recently, the Supreme Court has addressed deregulation of a similar crop, Roundup Ready alfalfa, and provided significant guidance applicable here. *See Monsanto Co. v. Geertson Seed Farms*, No. 09-475, -- S. Ct. --, 2010 WL 2471057 (2010). The Supreme Court concluded that, even where a court has held that APHIS has violated NEPA with respect to a complete deregulation determination,"[a]t that point, it was for the agency [APHIS] to decide whether and to what extent it would pursue a *partial* deregulation." *Id.* at *13. "If ... a limited and temporary deregulation satisfied applicable statutory and regulatory requirements, it could proceed with such a deregulation even if it had not yet finished the onerous EIS required for complete deregulation." *Id.* The Supreme Court went on to identify a combination of geographic restrictions, isolation distances, and enforcement measures that could serve to eliminate any risk of "injury at all, much less irreparable injury." *Id.* at *15.

In light of this recent Supreme Court ruling, the Government has represented to the district court in San Francisco that, in the event the court vacates the existing RRSB deregulation, APHIS has authority to deregulate "in part" to "allow planting to occur under the conditions proposed by APHIS while the EIS is being prepared." As APHIS explained, it could take such action if "[i]ntervenors submitted a new petition or a supplement or amendment to a previous petition for a determination of nonregulated status of RRSB." Federal Defs.' Supp. Br. on Perm. Inj. Relief at 1, 13-14. The Government further explained that the Supreme Court's decision in "*Monsanto* clearly indicates that this type of interim administrative action would be permissible." *Id.* at 14; *see also Monsanto*, 2010 WL 2471057, at *15 (citing "representation from the Solicitor General" that APHIS has authority to do so). Separately, based on its expert analyses and review, APHIS has proposed to the district court a series of carefully tailored interim measures designed to address any potential risk of harm to other parties from continued cultivation of RRSB during the time period necessary for APHIS to reevaluate the RRSB petition for nonregulated status. Although there has been no record of any harm to any grower of any other crops in the multiple years of wide-scale RRSB production without these restrictions in place, the intervenors in this litigation have agreed that these additional interim requirements will reduce further an already negligible potential for any impact to other parties from RRSB.

Request for Interim Measures

With the support of each of the sugarbeet growers, cooperatives, processors and seed companies who have intervened in the pending RRSB litigation, Monsanto and KWS now jointly request that, in the event the court in the RRSB litigation vacates the existing deregulation determination, APHIS grant nonregulated status *in part* or take similar administrative action to authorize continued cultivation of the RRSB crop subject to the carefully tailored interim measures proposed by APHIS. Petitioners believe this request is appropriate in this context because:

(1) As APHIS explained its recent Supplemental Brief, the U.S. Supreme Court has clarified that APHIS has authority to implement interim measures through partial deregulation or similar means for this purpose;

(2) Sugarbeet growers nationwide, along with sugarbeet cooperatives, processors, seed companies and other interests, face significant harm from any halt in RRSB planting, cultivation, harvesting or processing; and

(3) Petitioners are requesting that APHIS implement measures that APHIS has already itself reviewed, analyzed and supported in the litigation context.

Attached to this letter is an Environmental Report, providing additional analysis of the proposed interim measures. The analysis in APHIS's original EA addressing Monsanto and KWS's petition, along with the 5000-page administrative record relating thereto and this Environmental Report all support petitioners' request for partial deregulation or similar administrative action.

Thank you very much for your attention to this matter.

Sincerely,

H. Keith Reding, Ph.D.

H. Keith Reding, Ph.D.
Regulatory Affairs Manager, Monsanto

Philip von dem Bussche
Chairman of the Executive Board of KWS SAAT AG

ppa.

Dr. Peter Hofmann
Head of Sugar Beet Division

ENVIRONMENTAL REPORT
Interim Measures for Cultivation of Roundup Ready® Sugar Beet Event H7-1

July 30, 2010

ACRONYMS AND ABBREVIATIONS

ACCase	acetyl-CoA carboxylase (enzyme)
a.e.	acid equivalent
ALS	acetolactate synthase (enzyme)
AMS	Agricultural Marketing Service (USDA)
AP	Adventitious presence
APHIS	Animal and Plant Health Inspection Service (USDA)
APM	American Public Media
ARS	Agricultural Research Service (ARS)
ASTA	American Seed Trade Association
BNF	Biotechnology Notification Files
BRS	Biotechnology Regulatory Service (USDA APHIS)
CEQ	Council on Environmental Quality
CFIA	Canadian Food Inspection Agency
CFR	Code of Federal Regulations
CFS	Center for Food Safety
CMS	cytoplasmic male sterility
cPAD	chronic Population Adjusted Dose
CTIC	Conservation Technology Information Center
DEIS	Draft Environmental Impact Statement
DNA	Deoxyribonucleic Acid
EA	Environmental Assessment
EC	European Commission (EU)
EEC	Estimated Environmental Concentration
EFSA	European Food Safety Authority
EIQ	Environmental Impact Quotient
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (US)
EPSPS	5-enolpyruvylshikimate-3-phosphate synthase (enzyme)
ER	Environmental Report
ERS	Economic Research Service (USDA)
EU	European Union
FDA	Food and Drug Administration (US)
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act

FONSI	Finding of No Significant Impact
FQPA	Food Quality Protection Act
FSA	Farm Service Agency
FSANZ	Food Standards Australia New Zealand
ft	feet
GE	Genetic engineering or genetically engineered
GM	Genetically modified
GMO	Genetically modified organism
GPS	Global Positioning System
GR	Glyphosate resistant
GT	Glyphosate-tolerant
HQ	Hazard quotient
HTS	Harmonized Tariff Schedule
IM/NRC	Institute of Medicine and National Research Council
IPM	Integrated pest management
IPA	Isopropylamine
ISF	International Seed Federation
NASS	National Agricultural Statistical Service (USDA)
NEPA	National Environmental Policy Act
NOAEL	No-Observed-Adverse-Effect-Level
NOP	National Organic Program
NRC	National Research Council
OECD	Organization for Economic Cooperation and Development
OP	Open-pollinated
OSTP	Office of Science and Technology Policy
PCR	Polymerase chain reaction
PHI	Post Harvest Intervals
PNT	Plant with a Novel Trait
POEA	Polyethoxylated Tallow Amine
PPA	Plant Protection Act
PPE	Personal Protective Equipment
PPI	Pre-plant incorporated (herbicide)
rDNA	Recombinant DNA
RED	Reregistration Eligibility Decision

RfD	Reference Dose
RR	Roundup Ready®
R&D	Research and Development
SBRED	Sugar beet Research and Education Board of Minnesota and North Dakota
SOP	Standard Operating Procedures
TUG	Technology Use Guide
T-DNA	Transferred DNA
UC	University of California
U.S.	United States
USC	United States Code
USDA	US Department of Agriculture
USDC	U.S. District Court
USFWS	U.S. Fish and Wildlife Service
WCBS	West Coast Beet Seed Company
WHO	World Health Organization
WSSA	Weed Science Society of America
WVSSA	Willamette Valley Specialty Seed Association

APPENDICES

TABLES

FIGURES

INTRODUCTION

This Environmental Report (ER) examines the environmental impacts of continued cultivation of Roundup Ready® sugar beet event H7-1 (event H7-1) for a temporary period subject to a range of interim measures, including geographic restrictions, stewardship requirements and other limitations -- identified and analyzed by the US Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) in *Center for Food Safety v. Vilsack*, No. 08-484, N.D. Cal. This ER is provided in connection with the petitioners' supplemental request for non-regulated status *in part* (commonly known as "partial deregulation") for event H7-1. This document is intended to provide information that may be utilized by APHIS in complying with the National Environmental Policy Act (NEPA)[1] and its applicable regulations[2] either in connection with partial deregulation of event H7-1 or for any other regulatory or administrative action by APHIS adopting the interim measures addressed herein. The interim measures are intended to apply until APHIS completes its NEPA review of the petition for nonregulated status for event H7-1 and reaches a final determination regarding the petition.

The sugar produced from sugar beets, which were planted on approximately 1.2 million acres in the US in 2010, accounts for over half the US sugar production. Cash receipts for sugar beets were $1.3 billion in the 2007-2008 crop year. Event H7-1, which has been genetically engineered to be tolerant to the herbicide glyphosate, has been grown on a large scale in the US for multiple years and accounted for approximately 95 percent of the sugar beet planted in the US in the 2009/2010 crop year (USDA NASS, 2010b; USDA ERS, 2009a and 2009b).

1.1 PURPOSE OF THIS ER

1.1.1 Background

In 2003, under the requirements of the Plant Protection Act (PPA),[3] Monsanto Company and KWS SAAT AG (Monsanto/KWS) submitted a petition (Petition No. 03-323-01P) to APHIS for a determination of non-regulated status for event H7-1 and all progeny derived by conventional breeding from this event (Schneider, 2003). APHIS, through its Biotechnology Regulatory Service (BRS), is one of three federal agencies responsible for regulating biotechnology in the US under the Coordinated Framework described in Section 1.4. APHIS regulates genetically engineered (GE) organisms that may be plant pests, the Environmental Protection Agency

[1] NEPA of 1969, as amended; Title 42 of the US Code (42 USC) §§4321-4347
[2] Council on Environmental Quality (CEQ) regulations implement NEPA and are found in Title 40 of the Code of Federal Regulations (40 CFR), Parts 1500 through 1508. The U.S. Department of Agriculture has implemented NEPA regulations, which are found at 7 CFR Part 1b, as has APHIS, and those are found at 7 CFR part 372.
[3] 7 USC §§7701-7786

(EPA) regulates plant incorporated protectants and herbicides used with herbicide-tolerant crops, and the US Department of Health and Human Services' Food and Drug Administration (FDA) regulates food and animal feed. The FDA completed its consultation process for event H7-1 in 2004 and EPA agreed that its previous approval for glyphosate residue in sugar beet roots, tops and dried pulp was also applicable to event H7-1 ((Tarantino, 2004; Bonette, 2004; Schneider, 2003, p. 14). NEPA requires federal agencies to evaluate the potential impact of proposed major federal actions and consider such impacts during the decision-making process. After agency review for safety, including an evaluation of relevant scientific data and all public comments relating to potential plant pest risks and related environmental impacts, APHIS issued an EA pursuant to NEPA in 2005 (USDA APHIS, 2005). Based on that EA, APHIS reached a finding of no significant impact (FONSI) on the environment from the unconfined cultivation and agricultural use of event H7-1 and its progeny (USDA APHIS, 2005, p. 1). Accordingly, in March 2005, APHIS granted non-regulated status to event H7-1 (USDA APHIS, 2005, p. 26).

After event H7-1 was deregulated, the multi-year process of bringing it to commercial production began. Large scale commercial seed production began in 2006 to produce the seed crop used for planting root crops in 2008. Small scale root production occurred in 2006 and 2007. In January 2008, the Organic Seed Alliance, Sierra Club, High Mowing Organic Seeds, and the Center for Food Safety (CFS) filed a lawsuit against the USDA over its decision to deregulate event H7-1, claiming the USDA failed to take a "hard look" at the environmental effects of its decision to deregulate. The plaintiffs in the suit did not seek a preliminary injunction to halt planting. In September 2009, the court granted the plaintiffs' motion for summary judgment in the merits phase of the lawsuit, concluding that APHIS was required to prepare an environmental impact statement (EIS) before approving its deregulation of GE sugar beets. In December 2009, the court issued a schedule for the remedies phase of the lawsuit. At that point, representatives of thousands of family farms that were growing event H7-1 sugar beet root crops along with the four seed companies who produced seed and other interested parties were permitted to participate in the suit.

In May 2010, while the remedies phase of the lawsuit was proceeding, Cindy Smith, the APHIS Administrator, filed a declaration in the suit anticipating completion of the EIS in May 2012 (Smith, 2010b, pp. 7-8) and suggested that the court enter an order imposing certain interim measures that would allow continued cultivation of event H7-1. These interim measures would include geographic restrictions and a range of stewardship requirements, and would apply for a temporary period pending completion of the EIS and the corresponding record of decision (ROD), and implementation of that decision. (Smith, 2010b, pp. 19-22). Alternatively, Administrator Smith proposed that the Court remand the case to APHIS with the intention that APHIS would take action to implement these interim measures administratively. On May 25, 2010, APHIS issued a notice of intent to prepare an EIS and a proposed scope of study (APHIS 2010).

On June 21, 2010, the U.S. Supreme Court ruled in litigation related to Roundup Ready® alfalfa, clarifying that a court in a NEPA case may not preemptively bar APHIS from issuing a "partial deregulation" or taking other administrative action to implement interim measures for cultivation of a genetically engineered crop while the agency completes an EIS evaluating complete deregulation. Monsanto Co. v. Geertson Seed Farms, No. 09-475, 561 U.S. (2010).

1.1.2 Purpose of and need for action.

The purpose of this ER, which has been prepared to support an anticipated EA, is to examine the environmental impacts of implementing interim measures, either through a partial deregulation of event H7-1 lines of glyphosate tolerant sugar beets or certain other administrative means. The interim measures have been identified to address concerns regarding potential impacts related to the planting and cultivation of event H7-1 while the EIS evaluating complete deregulation is being prepared. If APHIS concludes that an EA supports a FONSI for such interim measures, APHIS could decide to implement such measures through "partial deregulation" pending APHIS's determination on complete deregulation.

1.1.3 APHIS proposed interim measures/time frames for implementation

APHIS' proposed interim measures for Roundup Ready® sugar beets (RRSB), to be implemented either through a partial deregulation or other administrative means, are detailed below. These measures are the same as those proposed by Administrator Smith to the court (Smith, 2010b, pp. 19-22), along with time frames for implementation of those measures.

Interim measures Proposed by APHIS to the Court

Administrator Smith proposed the following interim measures in the lawsuit discussed above:

1) *Roundup Ready® Sugar Beet-Free Zone*

The planting of RRSB is prohibited in the entire State of California and in the State of Washington in the following counties west of the Cascades: Clallam, Jefferson, Grays Harbor, Island, Pacific, Mason, Thurston, Lewis, Cowlitz, Clark, Whatcom, Skagit, Snohomish, King, Pierce, Skamania, San Juan, Kitsap, and Wahkiakum Counties. [These counties are shown in this ER in Figure 1-1].

2) *A Coexistence Zone for Beta Seed Crop Production in the Willamette Valley in Oregon*

   a. All parties to this action who grow *Beta* seed crops in the Willamette Valley must adhere to a four mile isolation distance between RRSB seed crops and other *Beta* seed crops.

   b. All parties to this action who grow *Beta* seed crops in the Willamette Valley must follow the Willamette Valley Specialty Seed Association (WVSSA) pinning procedures.

3) *Disclosure of Information Regarding Male Fertile RRSB Seed Crops.*

All growers of RRSB male fertile seed crops must provide locations with GPS coordinates to APHIS/BRS of any RRSB male fertile seed crops in the United States that exist at the time the Court's Order is issued or that are planted at any time during the interim period in which the EIS is being prepared. Information regarding existing plantings must be provided to APHIS within 30 days after issuance of the Order; information regarding future plantings during the interim period must be provided to APHIS within one week after the completion of planting of any RRSB male fertile seed crops. Within 60 days after issuance of the Order, APHIS/BRS shall set up a toll-free number that growers of non-GE *Beta* seed crops may use to request from APHIS/BRS the approximate distances from the nearest RRSB male fertile seed crop to their non-GE *Beta* seed crop.

Upon calling this number, the caller shall certify to APHIS/BRS that the caller is a grower of non-GE *Beta* seed crops or intends to grow non-GE *Beta* seed crops at an existing location in the United States. APHIS/BRS shall only provide to the caller the approximate distance from the nearest RRSB male fertile seed crop location to the caller's non-GE *Beta* seed crop.

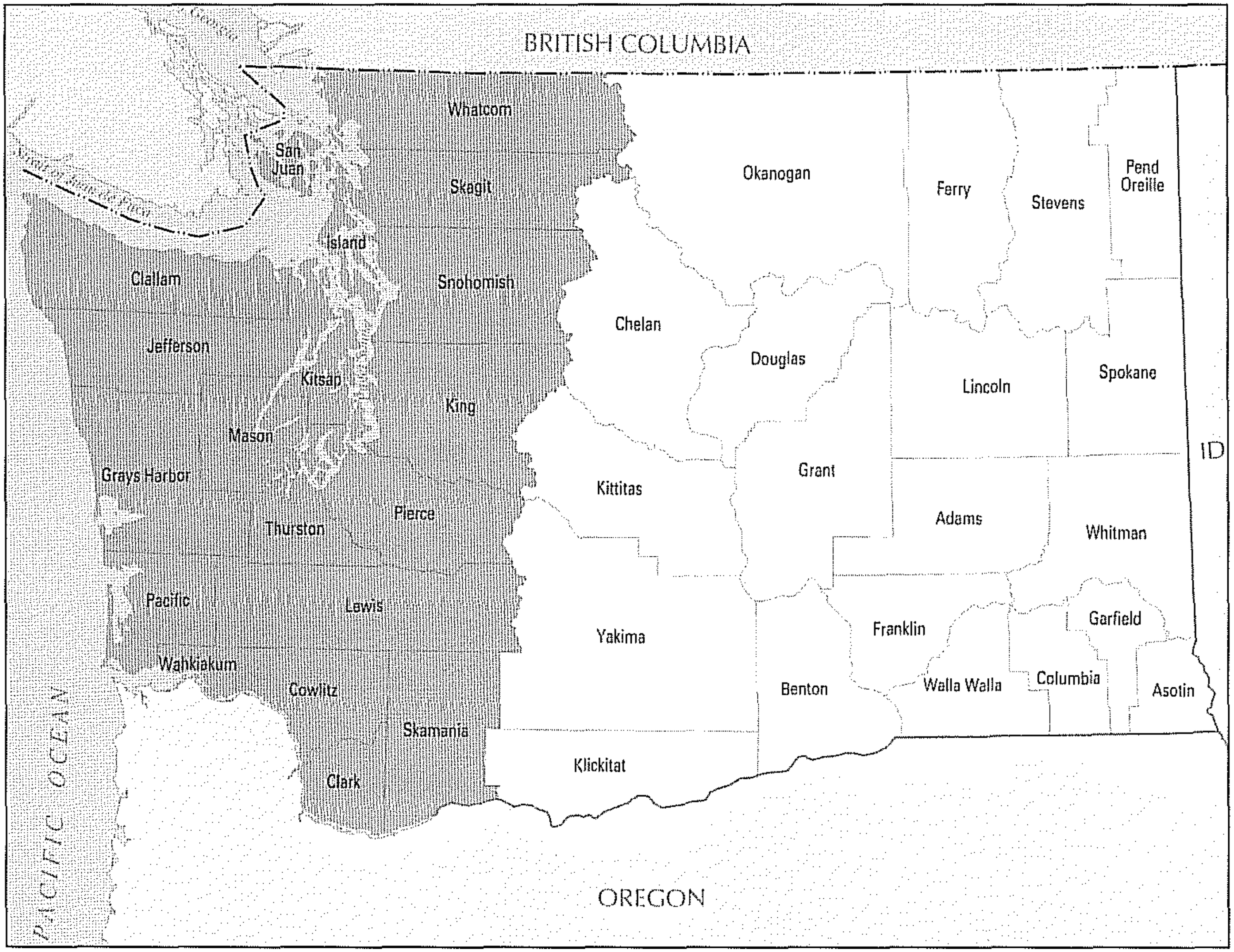


Figure 1-1. Roundup Ready® Sugar Beet-Free Zone

Sources: Smith, 2010b; National Atlas of the United States

4) *Measures to Prevent Mixing of Conventional Sugar Beet Seed and RRSB.*

RRSB seed producers shall follow protocols to ensure that mechanical mixing of material containing the RRSB trait and non-GE *Beta* seeds does not occur. Those protocols shall include:

a. A visual identification system for RRSB material (basic seed, stock seed, transplants (stecklings), and commercial seed) that accompanies seed material throughout the production system to delivery to ultimate purchaser;

b. A companion seed-lot based tracking and tracing system that is fully auditable;

c. Requirements for physical separation of RRSB material at all points in the seed production process from non-GE *Beta* material;

d. Requirements for monitoring, treating, and cleaning of all planting, cultivation and harvesting equipment to prevent RRSB seed, pollen or stecklings from being physically transferred out of production areas by inadvertent means;

e. Requirements for disposal of all unused RRSB stecklings by returning unused stecklings to the nursery field of origin and subsequent destruction through standard agricultural practices (physical destruction with tillage and chemical destruction in the subsequent crop););

f. Requirements for contained seed transport from field to cleaning facility, vehicle cleaning after transport of RRSB seed before use for other purposes, and devitalization of RRSB material derived from cleaning vehicles or processing facilities;

g. Prohibition on grower production of a RRSB seed and chard/red beet seed production on the same location/premises in the same year;

h. Prohibition on RRSB seed grower use or sharing of planting/cultivation equipment that might be used in a non-GE *Beta* seed production in the same growing year;

i. Prohibition on RRSB seed grower use of the same combine to harvest RRSB and non-GE *Beta* seed in the same year;

j. Provisions to force same-year sprouting of any RRSB seed left behind in production field for removal and destruction; plus 3-year monitoring of fields thereafter, along with removal and destruction of any beet plants;

k. Employee training in all aspects of a. through j. above;

l. No RRSB seed shall be cleaned or processed in any processing facility that also cleans and processes red beet or Swiss chard seed;

m. Recordkeeping to document compliance of a-l.

5) *Control of Any Bolters in the RRSB Root Crop Fields.*

All RRSB root crop growers must have contractual measures in place that require RRSB root crop growers to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed.

6) *Control of Any Bolters in Harvested RRSB Root Crop in Outdoor Storage.*

All sugar beet processors or cooperatives that use RRSB must have measures in place to survey, identify, and eliminate any bolters in outdoor storage before they produce pollen or set seed.

7) *Third Party Audit for Compliance.*

APHIS will require third party audits to ensure that RRSB producers comply with requirements in paragraphs two and four above. APHIS expects that AMS [Agricultural Marketing Service], USDA, will be the third party auditor using its AMS-USDA Process Verified Program.

Time frame for Implementation

While certain interim measures could be implemented shortly after APHIS issues its interim order of partial deregulation or takes other administrative action regarding event H7-1 (e.g., Item 3), certain measures may require some additional time to fully implement. This ER makes the following assumptions as to when the various components of the interim measures would be implemented:

(1) *RRSB-free zone.* The sugar beet seed companies have represented that no RRSB sugar beet crops have been or would be planted in California or the subject counties in Washington State. Thus, these restrictions can be implemented immediately.

(2) *Willamette Valley coexistence zone*

While certain isolation distance and pinning requirements have already existed for years, the four-mile isolation distance and the pinning and audit requirements proposed in the interim measures will be implemented in full with the summer 2011 seed crop planting, which will occur in July and August of 2011 (Items 2 and 7). The current isolation distance provided by the Willamette Valley Specialty Seed Association pinning provisions is four miles between sugar beet seed crops on one hand and open-pollinated (OP) red beet or chard seed crops on the other. Most of these crops will have been pinned and planted by the end of August 2010.

3) *Disclosure of information regarding male fertile crops*

Time frames are included in the proposed interim measures, described above.

4) *Measures to prevent mixing of seed*

While these measures have already largely been implemented in the major seed production area, as discussed in Section 2.7.3 of this ER, we assume that full implementation will occur before the 2011 seed harvest.

5) *Control of bolters – root crop fields*

Contracts requiring control of bolters are in place currently for the 2011 spring planting.

6) *Control of bolters – root crop outdoor storage*

These measures will be in place before the 2011 harvest.

7) Third-party audits

Measures would be in place at the time of the partial deregulation or other administrative action imposing the interim measures.

1.2 RATIONALE FOR CREATION OF EVENT H7-1

Event H7-1 offers sugar beet growers a simpler, more flexible, and less expensive alternative for weed control relative to conventional weed control measures.

According to the World Agriculture Series volume *Sugar Beets*, "Weeds have been a major problem in sugar beet since the crop was first grown in the late 1700s" and "unlike insects, diseases and nematodes, weeds occur in all sugar beet fields every year, usually at populations that cause crop failure unless controlled" (May and Wilson, 2006, p. 359). Other researchers, working before the introduction of event H7-1, have reported that "weed management is one of the main production costs with sugar beet" (Odero et al, 2008, p. 50).

As discussed in detail in Section 2.5, prior to widespread cultivation of event H7-1, sugar beet growers used a variety of means to control weeds, and herbicides are a key component. Herbicides are used by virtually all sugar beet growers; in 2000, approximately 98 percent of planted sugar beet acres received one or more herbicide applications (Ali, 2004, Table 4). In the 2000 growing season, 12 different active ingredients formulated as various herbicide products were commonly used in U.S. sugar beet production with a total of about 1.4 million pounds of herbicides applied (USDA APHIS, 2005, pp. 6-7). Typical conventional weed control consists of multiple applications of several different herbicides, often combined with hand or mechanical weeding (Odero et al, 2008).

Glyphosate is little-used for conventional sugar beets (those without glyphosate tolerance) because it damages the plants. With glyphosate-tolerant sugar beets, growers have an additional option for weed control.

1.3 COURT RULING AND ISSUES IDENTIFIED

During the lawsuit discussed above, the court identified certain specific issues as requiring additional analysis by APHIS (US District Court [USDC] 2008). These issues are described below and are addressed in the Affected Environment and Environmental Consequences sections of this ER. Additionally, this ER addresses issues that were not found to be problematic by the court in APHIS' initial EA. These issues are nevertheless addressed again here to ensure full disclosure and analysis of any potential impacts associated with partial deregulation of event H7-1 under the proposed interim measures.

1.3.1 Gene transmission from H7-1 sugar beets in production fields

Sugar beet is largely wind pollinated and has a biennial, two year life cycle when grown for seed; plants develop a large root the first year, then overwinter and flower, producing a seed stalk the second year. When grown to produce sugar, sugar beet roots are harvested during the first year while still in the vegetative (non-flowering) phase. Sugar beets grown for root crops rarely flower and thus rarely produce any pollen. However, certain conditions such as low temperatures after planting and longer day length can occasionally cause the sugar beet to "bolt" or produce a seed stalk (which can ultimately flower) during the first growing season (Bell 1946; Jaggard *et al.* 1983; Durrant and Jaggard 1988). Thus, further analysis to determine the potential for gene transmission from event H7-1 being grown for root production to conventional sugar beets was conducted and is discussed in Section 3.3 of this ER.

1.3.2 Gene transmission to conventional sugar beets in seed production

Unlike sugar beet root production, seed production requires that the plants flower, become pollinated and develop seed. The court concluded that APHIS did not take a "hard look" at the potential for gene transmission in seed production in its initial EA in reference to the 2003 petition, and did not consider the fact that isolation distances set by the Oregon Seed Certification Standards are voluntary; whether the isolation distances were actually followed and are likely to be followed in the future; or if the isolation distances are sufficient to protect the non-GE crops that are inter-fertile with sugar beets. Therefore, further analysis to determine the potential for gene transmission from sugar beets being produced for seed production was conducted and is discussed in Section 3.9 of this ER.

1.3.3 Gene transmission to red table beets and Swiss chard

Cross-pollination between cultivated sugar beet and sexually compatible *Beta* species can occur when these plants grow close together and have overlapping flowering periods. The court found that because sugar beet pollen can travel large distances by wind, and because seed for sugar beets, Swiss chard, and table beets (which are all members of the same species and are all sexually compatible) are all grown in one valley in Oregon (albeit principally in different parts of the same valley), additional analysis is required to determine whether deregulation may significantly affect the environment as a result of any potential cross-pollination. Therefore, further analysis was conducted and is discussed in Sections 3.5 and 3.6 of this ER.

1.3.4 Socioeconomic impacts

The court found that APHIS failed to analyze in its initial EA the socio-economic impacts of deregulating event H7-1 on farmers and processors seeking to avoid GE sugar beets and derived products, stating,

> *Economic effects are relevant and must be addressed in the environmental review "when they are 'interrelated' with 'natural or physical environmental effects.'" Ashley Creek Phosphate Co. v. Norton, 420 F.3d 934, 944 (9th Cir. 2005) (emphasis in original) (quoting 40 C.F.R. 1508.14); see also Geertson Seed Farms v. Johanns, 2007 WL 518624, *7 (N.D. Cal. Feb. 13, 2007). In Geertson Seed Farms, the court found that "the economic effects on the organic and conventional farmers of the government's deregulation decision are interrelated with, and, indeed, a direct result of, the effect on*

*the physical environment; namely, the alteration of a plant specie[s]' DNA through the transmission of the genetically engineered gene to the organic and conventional [crop]." Id., 2007 WL 518624, *8 (emphasis added).*

The court held that APHIS was required to consider these effects in assessing whether the impact of its proposed action of deregulation was significant. Therefore, further analysis was conducted and is discussed in Section 3.17 of this ER.

1.3.5 Willingness of buyers to accept sugar derived from GE sugar beets

The court's ruling included a reference to a 2004 comment from Imperial Sugar, a company that at that time processed sugar beets (but no longer does) and currently produces and markets only cane sugar. Imperial Sugar raised a concern in response to the petition for deregulation that buyers of industrial and consumer sugars have expressed reluctance or opposition to receiving sugar derived from GE sugar beet. Imperial Sugar's opinion was that the industrial buyers' reluctance was caused by their belief that consumers would react negatively to products containing or derived from GE crops. Imperial Sugar was therefore concerned that industrial buyers would be unwilling to test the reaction of consumers by using sugar from event H7-1 in their branded products.

Currently, event H7-1 sugar beet is processed into a large percentage of our domestic sugar supply, and has been well accepted. Nevertheless, further analysis of this issue was conducted and is discussed in Section 3.11 of this ER.

1.3.6 Restrictions/labeling requirements by some countries on GE products

Imperial Sugar also commented that some countries will not allow GE products to be imported and that many nations require labeling of food products with GE content. However, less than two percent of the sugar produced in the US is exported (USDA FAS, 2010), and exports of products derived from event H7-1 sugar beets are expressly allowed in many foreign countries. Further information is available in Section 3.11 of this ER.

1.3.7 Potential for development of glyphosate-resistant weeds

As the adoption of glyphosate-tolerant crops has grown, the use of glyphosate has increased (National Research Council [NRC], 2010, Figures S-1, S-2, and S-3; Young, 2006). Concerns have been expressed that increased use of glyphosate may lead to development of glyphosate-resistant weeds. Further information is available in Sections 2.5 and 3.12 of this ER.

1.3.8 Cumulative effects of increased use of glyphosate

Further analysis of cumulative impacts from increased use of glyphosate was conducted and is discussed in Section 4 of this ER. However, since this ER is intended to address only the period of time until the EIS is completed, cumulative effects are considered for that time period.

1.4 FEDERAL REGULATORY AUTHORITY – COORDINATED FRAMEWORK

Interagency coordination in scientific and technical matters is the responsibility of the federal Office of Science and Technology Policy (OSTP), which was established by law in 1976. A large part of the OSTP's mission is "to ensure that the policies of the Executive Branch are informed by sound science" and to "ensure that the scientific and technical work of the Executive Branch is properly coordinated so as to provide the greatest benefit to society" (OSTP, undated).

In 1986, the OSTP published a "comprehensive federal regulatory policy for ensuring the safety of biotechnology research and products", the *Coordinated Framework for the Regulation of Biotechnology* (Coordinated Framework) (OSTP, 1986). The OSTP concluded that the goal of ensuring biotechnology safety could be achieved within existing laws (OSTP, 1986).

The Coordinated Framework specifies three federal agencies responsible for regulating biotechnology in the US: USDA's APHIS, the EPA, and the FDA. APHIS regulates GE organisms under the Plant Protection Act of 2000 (PPA). EPA regulates plant-incorporated protectants and herbicides used with herbicide-tolerant crops under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Food, Drug, and Cosmetic Act (FFDCA). FDA regulates food (including animal feed, but not including meat and poultry, which is regulated by USDA), including food and feed produced through biotechnology, under the authority of the FFDCA. Products are regulated according to their intended use and some products are regulated by more than one agency. Together, these agencies ensure that the products of modern biotechnology are safe to grow, safe to eat, and safe for the environment. USDA, EPA, and FDA enforce agency-specific regulations to products of biotechnology that are based on the specific nature of each GE organism.

In 2001, in a joint CEQ/OSTP assessment of federal environmental regulations pertaining to agricultural biotechnology, the CEQ and OSTP found that "no significant negative environmental impacts have been associated with the use of any previously approved biotechnology product" (CEQ/OSP, 2001, p. 1).

For glyphosate-tolerant sugar beet event H7-1, the plant is reviewed by USDA and FDA, whereas EPA is responsible for registering the use of the glyphosate herbicide and establishing a tolerance for allowable glyphosate residues. As indicated herein, although certain issues such as weed resistance and impacts of glyphosate on animals or plants are addressed by EPA (not APHIS), this ER nevertheless addresses those issues.

1.4.1 USDA Regulatory Authority

The Animal and Plant Health Inspection Service (APHIS) Biotechnology Regulatory Service (BRS) mission is to protect US agriculture and the environment using a dynamic and science-based regulatory framework that allows for the safe development and use of GE organisms. Under its authority from the PPA, APHIS regulates the introduction (importation, interstate movement, or release into the environment) of certain GE organisms and products.[4] A GE organism is presumed to be a regulated article if the donor organism, recipient organism, vector, or vector agent used in engineering the organism belongs to one of the taxa listed in the regulation[5] and is also presumed to be a plant pest. APHIS also has authority under these rules to regulate a GE organism if it has reason to believe that the GE organism may be a plant pest or APHIS does not have sufficient information to determine that the GE organism is unlikely to pose a plant pest risk.[6]

Under APHIS' regulations a person may petition APHIS to evaluate submitted data and determine that a particular regulated article is unlikely to pose a plant pest risk, and, therefore, should no longer be regulated.[7] The petitioner is required to provide information related to plant pest risk that the agency may use to determine whether the regulated article is unlikely to present a greater plant pest risk than the unmodified organism.[8] If the agency determines that the regulated article is unlikely to pose a plant pest risk, the GE organism will be granted nonregulated status. In such a case, APHIS authorizations (i.e. permits and notifications) would no longer be required for environmental release, importation, or interstate movement of the non-regulated article or its progeny.

It was under these regulations that Monsanto/KWS submitted the petition for a determination of non-regulated status for event H7-1 (Schneider, 2003). Event H7-1 sugar beets were considered regulated because they contain non-coding DNA segments derived from plant

[4] 7 C.F.R. §.340
[5] 7 C.F.R. §.340.2
[6] 7 C.F.R. §.340.1
[7] 7 C.F.R. §.340.6 entitled "Petition for determination of nonregulated status"
[8] *Id.* §340.6(c)(4)

pathogens and the vector agent used to deliver the transforming DNA is a plant pathogen (See Section 3.1 for a discussion of these concepts) (APHIS, 2005, p. 4).

1.4.2 EPA regulatory authority

EPA is responsible for regulation of pesticides (including herbicides such as glyphosate) under the FIFRA.[9] FIFRA requires that all pesticides be registered before distribution, sale, and use, unless exempted by EPA regulation. Before a product is registered as a pesticide under FIFRA, it must be shown that when used in accordance with the label, it will not result in unreasonable adverse effects on the environment. EPA granted the registration of glyphosate for use over the top of sugar beets on March 31, 1999.

Under the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended,[10] pesticides added to (or contained in) raw agricultural commodities generally are considered to be unsafe unless a tolerance or exemption from tolerance has been established. EPA establishes residue tolerances for pesticides under the authority of the FFDCA. EPA is required, before establishing pesticide tolerance to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the Food Quality Protection Act of 1996 (FQPA). The FDA enforces the tolerances set by the EPA. EPA established a tolerance for glyphosate residue found on beets, including sugar, roots, tops, and dried pulp on April 14, 1999 (64 Fed. Reg. 18360).

1.4.3 FDA regulatory authority

In 1992 FDA, which has primary regulatory authority over food and feed safety, published a policy statement in the Federal Register concerning regulation of products derived from new plant varieties, including those genetically engineered (FDA, 1992). Under this policy, FDA uses a consultation process to ensure that human food and animal feed safety issues or other regulatory issues (e.g. labeling) are resolved prior to commercial distribution of a bioengineered food. Monsanto/KWS submitted a food and feed safety and nutritional assessment summary for event H7-1 to FDA in April 2003. FDA completed its consultation process in August 2004 (Tarantino, 2004; Bonette, 2004).

[9] 7 USC §136 et seq.
[10] 21 U.S.C. § 301 et seq.

1.5 THE NATIONAL ORGANIC PROGRAM AND BIOTECHNOLOGY

Congress passed The Organic Foods Production Act of 1990 (OFPA) to avoid the confusion and misrepresentation then taking place in the "organic" marketplace.[11] The OFPA required the USDA to establish a National Organic Program (NOP) to develop uniform standards and a certification process for those producing and handling food products offered for sale as "organically produced."[12] The OFPA requires certification under the NOP, which was finalized in 2000, to be process-based.[13] "The certification process does not guarantee particular attributes of the end product; rather it specifies and audits the methods and procedures by which the product is produced" (Ronald and Fouche, 2006). The NOP defines certain "excluded methods" of breeding that cannot be used in organic production, describing them as "means that are not possible under natural conditions or processes."[14] Along with genetic engineering, three other modern breeding techniques are specified as "excluded methods" in the regulations.[15] Thus, a certified organic grower cannot intentionally plant seeds that were developed by these specific excluded methods. However, because "organic" is based on process and not product, the mere presence of plant materials produced through excluded methods in a crop will not jeopardize the integrity of products labeled as organic, as long as the grower follows the required organic production protocol. Also, other modern breeding methods - for example, induced radiation or chemical mutagenesis - are not specified as excluded methods by the NOP (discussed in Section 3.1.1).

All organic growers' production plans must be approved by an organic certifying agent before the farm can be certified as "organic."[16] Such plans must include, among other things, steps the organic grower is taking to avoid what the NOP refers to as "genetic drift" from any neighboring crops using excluded methods.[17] Certification must include on-site inspections of the farm to verify the procedures set forth in the organic production plan.[18]

Thus, the NOP recognizes the coexistence of organic growers with neighboring growers who may choose to grow products developed using certain methods of biotechnology. So long as an organic grower follows an approved organic method of production that seeks to avoid contact

[11] 7 USC § 6501 *et seq.*
[12] 7 C.F.R. Part 205, announced at 65 Fed. Reg. 80548 (Dec. 21, 2000).
[13] 7 U.S.C. 6503(a).
[14] 7 C.F.R. § 205.2
[15] *Id.*
[16] *See* 7 C.F.R. Part 205, Subpt. E.
[17] *See id.* at 205.201; 65 Fed. Reg. at 80556 (discussing "genetic drift").
[18] 7 C.F.R. § 205.403.

with these specific biotechnology-derived crops, if some residue of the biotechnology-derived plant material is later found in the organic crop (or food produced from it), neither the crop (or food) nor the organic farm is in danger of losing its organic status. No grower or seed producer has lost organic certification due to inadvertent transmission of genetic material from a genetically engineered crop.

In the context of the genetic drift discussion, in the preamble of the NOP regulations, USDA emphasized that it is the use of excluded methods as a production method that is prohibited, not the mere presence of a product of excluded method:

> It is particularly important to remember that organic standards are process based. Certifying agents attest to the ability of organic operations to follow a set of production standards and practices that meet the requirements of the Act and the regulations. This regulation prohibits the use of excluded methods in organic operations. The presence of a detectable residue of a product of excluded methods alone does not necessarily constitute a violation of this regulation. As long as an organic operation has not used excluded methods and takes reasonable steps to avoid contact with the products of excluded methods as detailed in their approved organic system plan, the unintentional presence of the products of excluded methods should not affect the status of an organic product or operation.[19]

The NOP calls for testing only if there is "reason to believe" that a grower has used excluded methods.[20] The preamble states that a "reason to believe" may be triggered by situations such as a formal, written complaint to the certifying agent regarding the practices of a certified organic operation; the proximity of a certified organic operation to a potential source of drift; or the product from a certified organic operation being unaffected when neighboring fields or crops are infested with pests.[21]

This testing provision does not establish a zero tolerance standard for the presence of products of excluded methods in organically labeled food. Rather, it serves as a warning that excluded methods may have been used: "Any detectable residues of . . . a product produced using excluded methods found in or on samples during analysis will serve as a warning indicator to the certifying agent."[22]

> [T]hese regulations do not establish a "zero tolerance" standard. . . [A] positive detection of a product of excluded methods would trigger an investigation by the certifying agent to determine if a violation of organic production or handling standards occurred. The presence of a detectable

[19] 65 Fed. Reg. at 80556.
[20] 7 C.F.R. § 205.670(b).
[21] *See* 65 Fed. Reg. at 80629.
[22] *Id.* at 80628.

residue alone does not necessarily indicate use of a product of excluded methods that would constitute a violation of the standards."[23]

Only if the organic producer intentionally used excluded methods of crop production will that producer be subject to suspension or revocation of organic certification. There is no evidence that any organic grower has lost certification due to unintended presence of GE material.

1.5.1 Non-GMO Project Working Standard

The Non-GMO Project is a non-profit organization created by leading players in the organic industry to "offer consumers a consistent non-GMO choice for organic and natural products that are produced without genetic engineering or recombinant DNA technologies" (Non-GMO Project, 2010a). The Non-GMO Project has created a working standard to implement its goal. The standard sets action thresholds for "GMO" (GE) adventitious presence for certain products. If these action thresholds are exceeded, the participant must investigate the cause of the exceedance and take corrective action (Non-GMO Project, 2010, p. 13). The standard sets a threshold of 0.25% for GE material for the presence of GE traits in non-GE seeds (p. 28), and a 0.9% threshold for non-GE food or feed (p.14).

1.5.2 Growth in organic and GE farming

Expansion of organic farming has succeeded at the same time as the growth of GE crops. Consumer demand for organically produced goods "has shown double-digit growth for well over a decade" and organic products "are now available in nearly 20,000 natural food stores and three of four conventional grocery stores." Organic products "have shifted from being a lifestyle choice for a small share of consumers to being consumed at least occasionally by a majority of Americans" (USDA ERS, 2009c).

1.6 COEXISTENCE IN US AGRICULTURE

1.6.1 Coexistence and biotechnology

Coexistence of different varieties of sexually compatible crops has long been a part of agriculture, especially in seed production, where large investments are made in developing new varieties and high seed purity levels are required by the Federal Seed Act implementing regulations.[24] The aspect of coexistence most relevant to this document is that related to specific methods of crop production. In this context, coexistence refers to the "concurrent cultivation of conventional, organic, and genetically engineered (GE) crops consistent with

[23] *Id.* at 80632.
[24] 7 CFR § 201

underlying consumer preferences and choices" (USDA Advisory Committee, 2008). The differences among these crops that are particularly relevant to coexistence in this ER are in the types of breeding methods (sometimes referred to as "genetic modifications") that are associated with each of the three types of crops.

"**Genetic engineering**" is defined by APHIS regulations as "the genetic modification of organisms by recombinant DNA techniques."[25] Recombinant DNA (rDNA) techniques are discussed in Section 3.1.1 of this ER. While there are many ways to genetically modify a crop, the APHIS definition of GE crops applies only to those developed using rDNA techniques, which are among the more modern breeding methods.

Organic crops are those produced in accordance with the requirements of the NOP, discussed in Section 1.5.

Conventional crops are simply those that are neither GE nor organic. They may be commodity crops (mass produced), or they may be identity preserved, with some characteristic tailored for a specific end user. Identity-preserved usually refers to a "specialty, high-value, premium or niche market" (Massey, 2002). One type of identity preserved product that has been produced since the introduction of GE crops is "non-GE;" however, there are no mandatory standards governing the use and/or marketing of "non-GE" products (USDA Advisory Committee, 2008).

Farmers who want to maximize their profitability must decide whether the higher prices (premiums) they may receive for organic or identity-preserved crops are sufficient to offset the added managerial costs of producing these crops. As researchers have noted, "Although yields on organic farms are sometimes less than those of conventional systems, price premiums make it an attractive option for growers looking for specialized markets and a higher-value product" (Ronald and Fouche, 2006). There is such a niche market for organic red beets and organic Swiss chard. However, no premium or niche market exists for either conventional or organic sugar beets.

1.6.2 USDA position on coexistence and biotechnology

It is USDA's position that all three methods of agricultural production described above can provide benefits to the environment, consumers, and the agricultural economy (Smith, 2010b).

[25] 7 CFR §340.1

1.6.3 Coexistence in US crop production

Since the time GE crops were introduced in the US in the mid-1990s, organic markets have grown and expanded (Smith, 2010b, p. 10).

The USDA Advisory Committee on Biotechnology and 21st Century Agriculture who reported that "coexistence among the three categories of crops is a distinguishing characteristic of U.S. agriculture, and makes it different from some other parts of the world," expressed its belief that US agriculture supports coexistence, and recommended continued government support of coexistence (USDA Advisory Committee, 2008). Among the Committee's findings:

- The U.S. is the largest producer of GE crops in the world.
- The U.S. is one of the largest producers of organic crops in the world.
- The U.S. is one of the largest exporters of conventionally-grown, identity preserved, non-GE crops in the world.
- Some U.S. farmers currently are producing a combination of organic, conventional, and GE crops on the same farm.

Among the coexistence-enabling factors the Committee identified are the existing "legal and regulatory framework that has enabled different markets to develop" without foreclosing the ability of "participants in the food and feed supply chain to establish standards and procedures (e.g., not setting specific mandatory adventitious presence (AP) thresholds and having process-based rather than product-based organic standards)." At the same time, development of practices and testing methods that allow for voluntary thresholds has also enabled coexistence (USDA Advisory Committee, 2008).

As APHIS has previously observed, "studies of coexistence of major GE and non-GE crops in North America and the European Union (E.U.) demonstrated that there has been no significant gene flow from GE crops and that GE and non-GE crops are coexisting with minimal adverse economic effects" (Smith, 2010b, pp. 11-12) (citing Gealy et. al, 2007; Brookes and Barfoot, 2003; Brookes and Barfoot, 2004(a) and (b), and Walz 2004)). In addition, "the agricultural markets and local entities have addressed coexistence through contractual arrangements, management measures, and marketing arrangements. This market-based approach to coexistence has created economic opportunities for all kinds of producers of agricultural products." (*Id.* p. 9). RRSB is one of fifteen glyphosate-tolerant events previously deregulated by USDA. *See* APHIS, EPA, Petitions of Non-Regulated Status Granted or Pending by APHIS as of February 2, 2010, http://www.aphis.usda.gov/brs/not_reg.html.

1.7 ROLE OF THE NATIONAL ACADEMIES IN AGRICULTURAL BIOTECHNOLOGY

The analyses in this ER are based on published, peer-reviewed scientific papers; federal government assessments; assessments from international agencies; information from specialists from many universities; data collected by Monsanto/KWS under controlled conditions; and information from other relevant sources. One resource used for this ER is the National Academies (NA), a private, non-profit institution that advises the nation on scientific and technical matters. It consists of the National Academy of Sciences (NAS), the National Academy of Engineering, the Institute of Medicine (IM) and the National Research Council (NRC) (NA, 2010). Scientists, engineers and health professionals are elected by their peers to the academy and serve *pro bono*. Reports are prepared by committees of members with specialized expertise and reviewed by outside anonymous experts (Alberts, 1999).

The NA has been active in studies related to agricultural biotechnology since the 1970s, works cooperatively with federal agencies, and its reports have provided guidance and recommendations for process improvement to regulatory agencies (Alberts, 1999). The NRC 1989 guidelines for field testing of genetically engineered organisms were used as the basis for agency procedures for field trials (Alberts, 1999; NRC, 1989). In studies in 1987 and 2000 the NRC emphasized that the characteristics of the modified organism should be the object of a risk assessment, and not the methods by which the modifications were accomplished; and that the risks associated with recombinant DNA techniques are the same in kind as risks from other types of genetic modification (NRC, 1987; NRC, 2000). This position was re-iterated in a 2004 study prepared jointly by the IM and the NRC. Whether such compositional changes result in unintended health effects is dependent on the nature of the substances altered and the biological consequences of the compounds. To date, "no adverse health effects attributed to genetic engineering have been documented in the human population" (IM/NRC, 2004, p. 8). In a 2002 report, the NRC "found that the current standards used by the federal government to assure environmental safety of transgenic plants were higher than the standards used in assuring safety of other agricultural practices and technologies" (NRC, 2002). The NRC reports that, while biotechnology is not without risk, since the first commercial introduction of transgenic plants, "biotechnology has provided enormous benefits to agricultural crop production" (NRC, 2008). NRC's latest report on biotechnology in agriculture evaluates the impact of genetically engineered crops on farm sustainability. The authors concluded that an understanding of impacts on all farmers will help ensure that GE technology contributes to sustainability and that commercialized GE traits to date, when used properly, "have been effective at reducing pest problems with economic and environmental benefit to farmers" (NRC, 2010).

1.8 ALTERNATIVES CONSIDERED

In addition to the alternative of partial deregulation or other administrative action implementing the interim conditions (Alternative 2), this ER considers the alternative of full regulation (Alternative 1).

1.8.1 Alternative 1 – No Action (full regulation)

In conducting NEPA review, agencies consider a No Action alternative, which provides a baseline against which action alternatives can be evaluated. This ER identifies the No Action alternative as a return to full regulation – or the *status quo* existing when the petition for deregulation of event H7-1 was initially submitted. Under this alternative, the introduction of event H7-1 lines of glyphosate tolerant sugar beets would be fully regulated and would require permits issued or notifications acknowledged by APHIS until APHIS completes its EIS and issues a Record of Decision (ROD) regarding whether to deregulate H7-1 lines of glyphosate tolerant sugar beets. For purposes of this analysis, we assume that Alternative 1 would not involve widespread event H7-1 sugar beet cultivation, and instead would contemplate a return to conventional sugar beet crops or to crops other than sugar beet. *Note*: As indicated above, the *status quo* is event H7-1 sugar beets comprising 95 percent of the U.S. sugar beet crop.

1.8.2 Alternative 2 – Partial Deregulation with Interim Conditions

Under this alternative, the introduction of event H7-1 lines of glyphosate tolerant sugar beets would be allowed under interim conditions until APHIS completes its EIS,, issues a Record of Decision, and that decision takes effect -- currently anticipated for mid-2012 (Smith, 2010b, p. 8).

This section describes the affected environment and provides other contextual information for an understanding of the environmental consequences analyzed in Section 3.

2.1 SUGAR BEET CHARACTERISTICS AND USES

Sugar beet (*Beta vulgaris L.*) is a biennial plant that was developed in Europe in the 18th century from white fodder (animal feed) beets. Sugar reserves are stored in the sugar beet root during the first growing season for an energy source during overwintering. The roots are harvested for sugar at the end of the first growing season but plants that overwinter in a mild climate will produce flowering stems and seed during the following summer and fall. Sugar beet roots will not survive the winter in any of the growing regions except California (Cattanach et al, 1991).).

Pollination. The sugar beet is cross-pollinated (pollination occurs between plants rather than within single plant) by wind (Cattahach et al, 1991).

Climate. Sugar beets have adapted to a very wide range of climatic conditions. Sugar beets primarily are a temperate zone crop produced in the Northern Hemisphere at latitudes of 30 to 60°N. The sugar beet plant grows until harvested or growth is stopped by a hard freeze. Sugar beets primarily grow tops until the leaf canopy completely covers the soil surface in a field. This normally takes 70 to 90 days from planting. Optimal daytime temperatures are 60 to 80°F for the first 90 days of plant growth. Regions with long day length are most suitable for sugar beet growth. The most favorable environment for producing a sugar beet crop from 90 days after emergence to harvest is bright, sunny days with 65 to 80°F temperatures followed by nighttime temperatures of 40 to 50°F. These environmental conditions maximize yield and quality in a sugar beet crop. Sugar beets are successfully produced under irrigation in areas with very low rainfall and in regions relying on natural rainfall (Cattanach et al, 1991).

Products. Sugar beets contain from 13 to 22 percent sucrose. Sugar beet pulp and molasses are processing by-products used as feed supplements for livestock. These products provide required fiber in rations and increase the palatability of feeds. Molasses by-products from sugar beet processing are used in the alcohol, pharmaceuticals, and bakers' yeast industries (Cattanach et al, 1991).

2.2 ACCEPTANCE OF EVENT H7-1 SUGAR BEETS

Event H7-1 sugar beets were first available for commercial production in 2007 (Lilleboe, 2008). In the 2009/10 crop year, event H7-1 varieties accounted for about 95 percent of planted area, up from about 60 percent in 2008/09 (USDA ERS, 2009a). Since, as noted in Section 1, no event H7-1 sugar beets have been grown in California and California represents approximately 3 percent of US sugar beet production (Table 2-1), 98 percent of the planted 2009/2010 sugar beet crop in the remaining US sugar beet regions was event H7-1.

Table 2-1. US Sugar Beet Production, 2009/2010 Season

Region/State	1,000 short tons	Percent of US Total
Great Lakes		
Michigan	3,318	
Total	3,318	11
Upper Midwest		
Minnesota	10,641	
North Dakota	4,796	
Total	15,437	52
Great Plains		
Colorado	963	
Montana	1,001	
Nebraska	1,294	
Wyoming	678	
Total	3,936	13
Northwest		
Idaho	5,591	
Oregon	395	
Total	5,986	20
Far West		
California	886	
Total	886	3

Source: USDA ERS, 2010a, Table 14

2.3 SUGAR BEET ROOT PRODUCTION

2.3.1 US Production by regions

The US is among the world's largest sugar producers. Unlike most other producing countries, the US has both large and well-developed sugarcane and sugar beet industries. Since the mid-1990s, sugarcane has accounted for about 45 percent of the total sugar produced in the US, and sugar beets for about 55 percent of production. Since 1961, planted sugar beet acreage has fluctuated within the range of 1.1 million (low in 1982) to 1.6 million (high in 1975) (USDA NASS 2010a). Annual cash receipts for sugar beets in the US in the past few years have ranged up to $1.5 billion (USDA ERS, 2009b).

Figure 2-1 shows the five major US sugar beet producing regions, along with 2008 production by county.

Great Lakes. Great Lakes sugar beet production, now entirely in Michigan, occurs in the flat area around Saginaw Bay. Sugar beets grown in the Great Lakes region do not require irrigation. The Great Lakes region also includes Ohio, where sugar beets were last produced in 2004.

Upper Midwest. The Upper Midwest is the largest sugar beet production region in the US, with the majority of this production in the Red River Valley. The Red River flows north into Canada and forms most of the North Dakota-Minnesota border. It flows through a broad, flat valley formed by an ancient glacial lake. The Minnesota River Valley, another broad, flat glacial valley that crosses southern Minnesota and is almost continuous with the Red River Valley, is also a large production area. Irrigation is uncommon in the Red River/Minnesota River Valleys (Ali, 2004). There is another, much smaller Upper Midwest production area along the Montana border of North Dakota, in the valley of the Yellowstone River and its tributaries.

Great Plains. The Northern Great Plains region includes production areas in northern Wyoming and southern Montana. The major sugar beet growing areas in the Northern Great Plains are the sandy loam soils along the Yellowstone River and its tributaries (Mikkelson and Petrof, 1999, p. 2). The Southern Great Plains subregion includes growing areas in western Nebraska, southeastern Wyoming and northeastern Colorado, primarily in the valley of the Platte River and its tributaries. All Great Plains sugar beet production requires irrigation (Thomas et al, 2000, p. 1; Mikkelson and Petrof, 1999, p. 3; McDonald et al, 2003, p. 2).

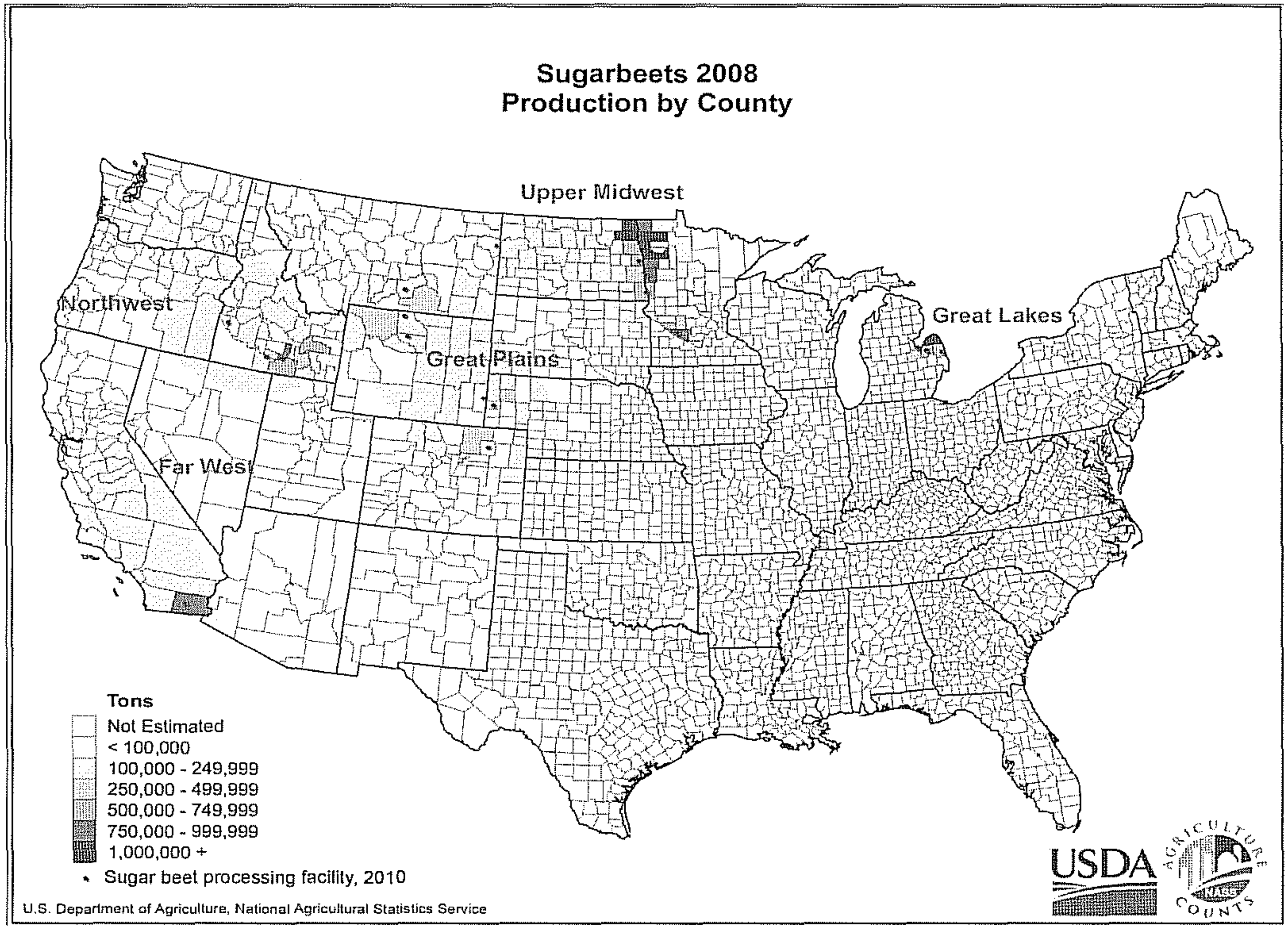


Figure 2-1. US sugar beet regions and 2008 county production.

The Great Plains region previously included New Mexico and Texas, where sugar beets were last harvested in 1997.

Northwest. Most production in the Northwest region is in the sandy loam soil of the Snake River Valley in Idaho. This area also requires irrigation (Traveller and Gallian, 2000, p. 1). In addition, production occurs in southeast Washington state, east of the Cascade mountains.

Far West (California). The only sugar producing area in California is in the Imperial Valley in the far southern end of the state, where the only remaining sugar processing plant in California exists. Production occurred in the Central Valley (near the middle of the state) through 2008; however, the last processing plant in this area closed in 2008. As recently as the 1990s, nearly 30 percent of sugar beet production was in the Central Valley; there were also small areas of production in coastal counties (but production in those regions no longer exist) (California Beet Growers Association, 1998, p.1).

US production for the 2009/2010 season (harvested in 2009 and processed in 2009/2010) is shown in Table 2-1. In 2010, sugar beet was planted on 1.2 million acres (USDA ERS, 2010a, Table 14). Sugar beet production by county from 2005 to 2008, including acres planted, acres harvested, yield per acre, total yield and sucrose percent, is tabulated in Appendix D.

The distribution of planted acreage by state is shown in Figure 2-2.

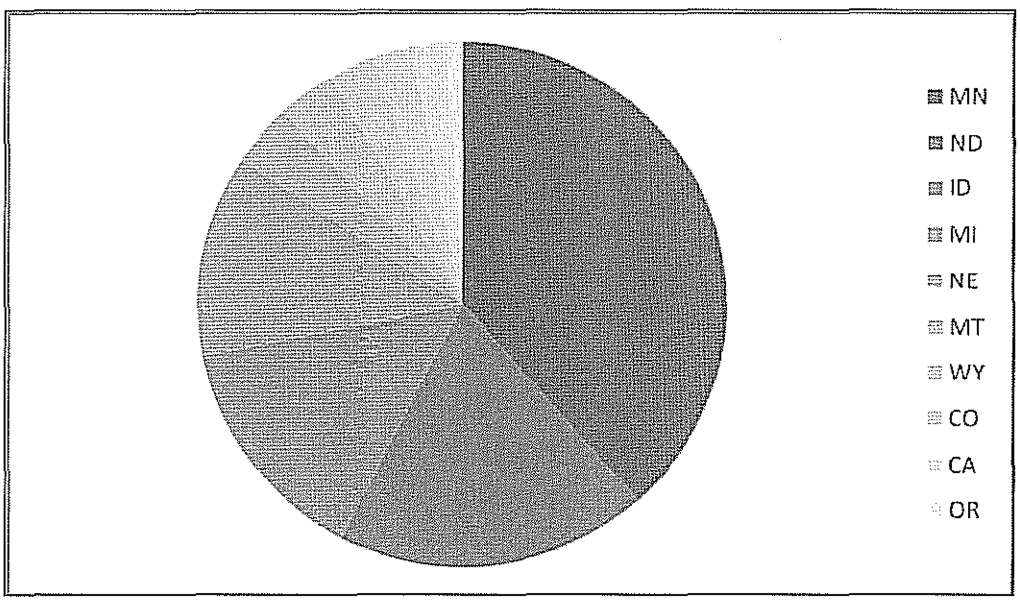


Figure 2-2. 2010 distribution by state of acres planted in sugar beet
Source: USDA NASS, 2010a

2.3.2 Grower-processor relationships

Sugar beet production, more than most crops, requires close coordination between the grower and the processor. The crop is of little value without a processor to extract the sugar, and a sugar processing facility cannot stay in business without a reliable supply of beets (Kaffka and Hills, 1994, p. 2). While a type of syrup can be made on a small scale, home garden production of sugar would be impractical; processing cannot be duplicated successfully in a home kitchen (California Beet Growers Association, 1998, p. 3). Sugar beets are 75 percent water and expensive to transport long distances (Michigan Sugar Company, 2010a). For economic reasons, sugar beets are typically grown within 60 miles of a processing facility, but may be grown up to 100 miles away (Western Sugar Cooperative, 2006a). Locations of the 22 processing facilities in operation in 2010 are shown in Figure 2-2. While existing facilities have been upgraded, no new currently operating processing facilities have been built in the US since 1975. An estimated cost for an average-sized new facility in 1991 was $100 million (Cattanach et al, 1991, p. 16). The cost would be substantially higher today due to inflation and other factors.

Sugar beet production and processing in the US is done almost entirely by grower-owned cooperatives. The cooperatives own the processing facilities and the sugar beet farmers are members of the cooperatives. The members own shares of stock that require them to grow a specified acreage of beets in proportion to their stock ownership in the cooperative and guarantee processing for their beets. US companies are summarized by regions below. Cooperatives are owned by growers who are principally family farmers. According to the 2007 US Census of Agriculture, over 4,000 farms grow sugar beets (USDA ERS 2009b).

Great Lakes. Michigan Sugar Company, the third-largest sugar beet processor in the US, processes all the sugar beets in the Great Lakes region, as well as beets from Ontario, Canada.. The cooperative has over 1,000 grower-shareholders who grow sugar beets on 150,000 acres each year. The sugar beets are processed into sugar at factories in Bay City, Sebewaing, Caro and Croswell. The cooperative employs 450 year-round and 1,200 seasonal employees, generates nearly $400 million in direct economic activity annually in the local communities in which it operate, and annually produces nearly one billion pounds of sugar (Michigan Sugar Company, 2010b).

Upper Midwest. Three cooperatives operate in the Upper Midwest. American Crystal Sugar Company, the largest sugar beet producer in the US, is owned by approximately 3,000 shareholders who raise 500,000 acres of sugar beets in the Red River Valley of Minnesota and North Dakota. The company operates five sugar processing facilities in the Red River Valley: three in Minnesota (Crookston, East Grand Forks and Moorhead) and two in North Dakota (Drayton and Hillsboro). American Crystal also operates a sugar beet processing facility in eastern Montana at Sidney, under the name Sidney Sugars Incorporated. American Crystal's fiscal year 2009 Red River Valley crop averaged 25.4 tons per acre with 17.6 percent sugar content.. In 2009, the company produced approximately 3 billion tons of sugar and 681,000 tons of agri-products (molasses and pulp) (American Crystal Sugar Company, 2009). Minn-Dak Farmers Cooperative, with 450 shareholders, operates a processing facility in Wahpeton, in the far southeast corner of North Dakota. Minn-Dak also operates a yeast factory, which uses molasses from sugar beet processing (Minn-Dak Farmers Cooperative, undated). The Southern Minnesota Beet Sugar Cooperative has approximately 600 shareholders who farm 120,000 acres, and operates a processing facility near Renville, Minnesota (Southern Minnesota Beet Sugar Cooperative, 2010).

Great Plains. The Western Sugar Cooperative, with 135,000 acres and five factories, processes most of the Great Plains sugar beet. Processing facilities are in Fort Morgan, Colorado; Billings, Montana; Scottsbluff, Nebraska; and Lovell and Torrington, Wyoming. Wyoming Sugar Beet Company, LLC is not a cooperative, but works through the Washakie Farmers Cooperative to acquire beets for its plant in Worland, Wyoming (Boland, 2003).

Northwest. The Amalgamated Sugar Company LLC processes all the sugar beet in the Northwest region. Amalgamated is owned by Snake River Sugar Company, a grower-owned cooperative, and is headquartered in Boise, Idaho with processing plants in Paul, Twin Falls, and Nampa, Idaho (Snake River Sugar Company, 2009).

Far West (California). Spreckels Sugar Company, a subsidiary of Southern Minnesota Beet Sugar Cooperative, operates a sugar beet processing facility in Brawley, California, in the Imperial Valley. Yields in the Imperial Valley are higher than anywhere else in the US, averaging approximately 40 tons per acre (Spreckels Sugar, 2009).

2.3.3 Sugar beet cultivation practices

Seed bed preparation and tillage. The objectives of seedbed preparation are to manage crop residue (the leftover vegetative matter from the previous crop), minimize erosion, improve soil structure, and eliminate early season weeds. Tillage, which can be done in fall and spring, can help improve soil structure and eliminate early weeds, but tillage can also increase erosion. No-till, strip tillage in previous crop residues, and other conservation tillage systems (see definitions at left) require more planning and better management (Cattanach et al, 1991). In addition to the reduced tillage methods (noted at left), no-till productions systems do not have any associated tillage where weed control is entirely through chemical means. A survey conducted in 2000, before event H7-1 sugar beets were available, found that use of conventional tillage for sugar beet production varied by region from 64 percent of acreage in the Red River Valley in the Upper Midwest to 96 percent of acreage in the Northwest (California was not included because there was too little data). Growers in the Red River Valley reported using reduced tillage on 16 percent of sugar beet acres and mulch tillage on 20 percent (Ali, 2004). Because weeds can be effectively controlled with glyphosate applications, event H7-1 sugar beets may be grown with less tillage (NRC, 2010, p. 6; Duke and Cerdeira, 2007, p. 3; Wilson, 2009).

Tillage systems *are defined by the amount of crop residue remaining on the soil.*

Conventional tillage *systems leave less than 30 percent of crop residue remaining on the soil when planting another crop.*

Conservation tillage *leaves 30 percent or more of the previous crop residue covering the soil when planting another crop.*

Reduced tillage *leaves 15 to 30 percent of the previous crop residue covering the soil when planting another crop.*

Mulch tillage *disturbs the soil prior to planting. Tillage tools such as chisels, field cultivators, disks or blades are used. Weed control is accomplished with herbicides and/or cultivation.*

No Till *leaves the soil undisturbed.*

With ***strip tillage****, a specific type of conservation tillage, tillage is confined to narrow strips where seeds will be planted. Strip tillage is usually done in the fall. The loosened soil creates a ridge 3 to 4 inches high, which improves soil drainage and warming. By spring, it usually settles down to 1 or 2 inches high, and after planting the field is flat.*

Sources: Ali, 2004, p. 32;

In the Idaho (Northwest), prior to glyphosate tolerant sugar beets conventional tillage was essential for weed control, minimizing soil erosion and improving soil structure (Ali, 2004; Traveller and Gallian, 2000, p. 1). Since the introduction of event H7-1, some farmers in the Northwest have switched to strip tillage and have reported reduced fuel and labor costs and reduced wind erosion (Lilleboe, 2008). Researchers in Idaho found that while conventional tillage was necessary for weed control with conventional beets, the practice has little to no benefit with glyphosate-tolerant sugar beets (Miller and Miller, 2008).

In much of the Great Plains region, conventional sugar beets were cultivated using conservation tillage systems; however, deep tillage, which is used to improve drainage, was utilized to help reduce the risk of soil borne diseases (mainly the beet necrotic yellow vein virus causing rhizomania) (McDonald et al, 2003, p.2). Farmers in the Great Plains have reported that strip tilling and event H7-1 have "been a great marriage," with strip tilling resulting in reduced wind erosion, reduced irrigation requirements and fuel and time savings (Lilleboe, 2010).

Michigan Sugar Company recommends conservation tillage practices to help control erosion resulting from strong early spring wind in the Great Lakes region (Michigan Sugar Company, 2009, p. 2). However, since the introduction of the event H7-1 this growing region has the option of implementing varying methods of reduced tillage systems.

Recent studies by North Dakota State University have found that since the introduction of event H7-1, strip tillage is a viable option for sugar beet production that reduces fuel and fertilizer costs and susceptibility to wind erosion (Overstreet et al, 2009). A member of the Minn-Dak Farmers Cooperative, who farms about 1,100 acres of sugar beets annually, has found that instead of three post-emergence tillage trips across the fields, with event H7-1 he now needs "little to no tillage post-emergence" (Mauch, 2010, p. 3).

Planting and harvesting times. In all regions except the Far West (California), sugar beet root crops are planted in early spring (March through May, depending on latitude and location) and harvested in fall (September through November, also varying with regions) (McDonald et al, 2003; Mikkelson and Petrof, 1999, p 3; Michigan Sugar Company, 2010b).

In the Imperial Valley in California, sugar beets are planted in September and October and harvested from April to July (California Beet Growers Association, 1999, p. 1).

Crop rotations. Sugar beets tend to be grown with other crops in three- to five-year rotations, although sometimes two years is used. The rotation results in improved soil fertility, fewer problems with diseases, and improved yields and quality of beets. The impact of certain soil borne diseases, nematodes (parasitic, microscopic worms) and weeds are minimized through crop rotations (Mikkelson and Petrof, 1999, p. 3; USDA ERS, 2009b, p. 2; Hirnyck et al, 2005, p. 13).

To assess the likelihood that the rotational crops planted after event H7-1 sugar beet would be another glyphosate-tolerant crop an analysis of rotations to other crops was conducted and included in the petition (Schneider, 2003, Table VII-13). This rotational crop table has been updated with crop information from the 2007 planting season and includes projected acreage for recently commercialized glyphosate-tolerant crops (Table 2-2).

2.3.4 Sugar beet bolters and volunteers

Bolting. Sugar beet, if left to grow in a temperate climate, is a biennial plant that produces an enlarged root the first year and flowers in the second year. Typically, the plant is induced to flower through a process called vernalization that occurs during prolonged exposure to cooler temperatures. Occasionally sugar beets will bolt (produce a seed stalk that may ultimately flower) in their first year of production; however, with breeding, bolting tendency has been reduced. Much effort has gone into producing sugar beets that resist bolting, and today's varieties show little bolting (OECD, 2001, p. 15). No difference in bolting characteristics would be expected between conventional and event H7-1 sugar beets, as the introduction of the glyphosate tolerant trait does not affect the bolting characteristics of the sugar beet. In the 2000-2001 variety field trials with lines containing event H7-1 reported in the petition, six of 12 event H7-1 sugar beet varieties had 0.00 percent bolters; for those varieties with bolters, the percentages were 0.03 percent for three; 0.06 percent for two, and 0.19 percent for one. All entries were established as six row plots forty feet in length with six replications at each location in 2000, and four replications at each location in 2001 (Schneider, 2003, Table VI-9). Darmency et al report bolting percents now as low as 0.01 percent (2009, p. 1090). While Darmency et al were referring to conventional sugar beets, event H7-1 would not affect bolting characteristics, and breeders continue to select for low rates of bolting.

For bolting to occur, the plants first require exposure to temperatures around 40 to 42 degrees F (others report 34 to 39 degrees F in the 4 to 5 leaf stage; conditions are variety-dependent), followed by exposure to increasing day length (12 hours or more). Varieties differ in their sensitivity to bolting, with easy bolting lines requiring only a few to 1000 hours of exposure to low temperatures, while bolting-resistant lines may require 2000 hours or more. Beets can de-vernalize when exposed to high temperatures (OECD, 2001, p. 15).

Bolting depletes the root of simple sugars, translocating this stored energy into the above-ground biomass, making the root woody and worthless as a source of sugar. Bolters are taller than the rest of the crop. Thus, bolters are effectively weeds within a sugar beet field. The woody roots that result from bolters can damage harvesting and processing equipment (Ellstrand, 2003, p. 5-7). For these reasons, growers remove bolters. A bolter is evident in a field weeks before the seed stalk would flower to produce pollen or seed. Thus, stewardship can be 100% successful in eliminating any small probability of flowering.

Table 2-2. Rotational crops following US sugar beet production and an estimation of rotational crops as Roundup Ready® crops (all acreages are expressed as 1000 acres)

A	B	C	D	E	F	G	H	I	J	K
State	Total Sugar Beet Acres[1]	Major Crops That Follow Sugar Beet In Rotation[2]	Total Acreage of Rotation Crop in States[1]	Percent of Rotational Crop Rotated Following Sugar Beet[3]	Rotational Crop Acres Following Sugar Beet[2]	Percent Rotational Crop of Total Sugar Beet[4]	Percent Roundup Ready® Rotational Crop Option[5,6]	Acreage of Roundup Ready® Rotational Crop Option[7]	Percent of Sugar Beet Acres Preceding Major Rotations[8]	Estimated Percentage of Roundup Ready® Crops as Major Rotations[9]
CA	50	Barley	130	7.7%	10	20%	NA	0		
		Dry Beans	92	5.4%	5	10%	NA	0		
		Durum	95	10.5%	10	20%	NA	0		
		Oats	260	3.8%	10	20%	NA	0		
		Spring Wheat	530	2.8%	15	30%	NA	0		
			Total: 1,107		**Total: 50**			**Total: 0**	**4.52%**	**0%**
CO	44	Barley	85	5%	4	10%	NA	0		
		Corn	1200	3%	31	70%	52%	16		
		Dry Beans	92	8%	7	15%	NA	0		
		Potato	78	3%	2	5%	NA	0		
			Total: 1,455		**Total: 44**			**Total: 16**	**3.02%**	**1.10%**
ID	212	Alfalfa	730	1.5%	11	5%	50%	6		
		Barley	730	4.4%	32	15%	NA	0		
		Corn	190	3.2%	6	3%	52%	3		
		Dry Beans	95	4.2%	4	2%	NA	0		
		Spring Wheat	530	30.0%	159	75%	NA	0		
			Total: 2,275		**Total: 212**			**Total: 9**	**9.32%**	**0.40%**
MI	180	Corn	2,250	5.2%	117	65%	52%	61		
		Dry Beans	270	6.7%	18	10%	NA	0		
		Soybean	2,050	2.2%	45	25%	91%	41		
			Total: 4,570		**Total: 180**			**Total: 102**	**3.94%**	**2.23%**
MN	505	Barley	210	23.8%	50	10%	NA	0		
		Soybean	7,200	4.9	354	70%	91%	322		
		Spring Wheat	2,000	5.1%	101	20%	NA	0		
			Total: 9,410		**Total: 505**			**Total: 322**	**5.37%**	**3.42%**

Table 2-2. Rotational crops following US sugar beet production and an estimation of rotational crops as Roundup Ready® crops (all acreages are expressed as 1000 acres)

A	B	C	D	E	F	G	H	I	J	K
State	Total Sugar Beet Acres[1]	Major Crops That Follow Sugar Beet In Rotation[2]	Total Acreage of Rotation Crop in States[1]	Percent of Rotational Crop Rotated Following Sugar Beet[3]	Rotational Crop Acres Following Sugar Beet[2]	Percent Rotational Crop of Total Sugar Beet[4]	Percent Roundup Ready® Rotational Crop Option[5,6]	Acreage of Roundup Ready® Rotational Crop Option[7]	Percent of Sugar Beet Acres Preceding Major Rotations[8]	Estimated Percentage of Roundup Ready® Crops as Major Rotations[9]
MT	**58**	Barley	1,200	2.4%	29	50%	NA	0		
		Corn	65	21.5%	14	25%	52%	7		
		Dry Beans	27	33.3%	9	15%	NA	0		
		Spring Wheat	3,750	0.2%	6	10%	NA	0		
			Total: 5,042		**Total: 58**			**Total: 7**	**1.15%**	**0.14%**
ND	**265**	Barley	1,600	2.5%	40	15%	NA	0		
		Corn	1,230	3.3%	40	15%	52%	21		
		Durum	2,100	0.6%	13	5%	NA	0		
		Soybean	2,670	4.0%	106	40%	91%	96		
		Spring Wheat	6,900	1.0%	66	25%	NA	0		
			Total: 14,500		**Total: 265**			**Total: 117**	**1.83%**	**0.81%**
NE	**57**	Corn	8,400	0.3%	29	50%	52%	15		
		Dry Beans	185	11.9%	22	40%	NA	0		
		Winter Wheat	1,650	0.4%	6	10%	NA	0		
			Total: 10,235		**Total: 57**			**Total: 15**	**0.56%**	**0.15%**
WY	**40**	Barley	90	24.4%	22	55%	NA	0		
		Corn	80	12.5%	10	25%	52%	5		
		Dry Beans	32	12.5%	4	10%	NA	0		
		Sugar Beet	40	10%	4	10%	95%	2		
			Total: 242		**Total: 40**			**Total: 7**	**16.53%**	**2.89%**
Overall	**1,411**	Alfalfa	730	1.5%	11	0.8%	50%	6		
		Barley	4,045	4.6%	186	13.2%	NA	0		
		Corn	13,415	1.8%	247	17.5%	52%	128		
		Dry Beans	793	8.7%	69	4.9%	NA	0		

Table 2-2. Rotational crops following US sugar beet production and an estimation of rotational crops as Roundup Ready® crops (all acreages are expressed as 1000 acres)

A	B	C	D	E	F	G	H	I	J	K
State	Total Sugar Beet Acres[1]	Major Crops That Follow Sugar Beet In Rotation[2]	Total Acreage of Rotation Crop in States[1]	Percent of Rotational Crop Rotated Following Sugar Beet[3]	Rotational Crop Acres Following Sugar Beet[2]	Percent Rotational Crop of Total Sugar Beet[4]	Percent Roundup Ready® Rotational Crop Option[5,6]	Acreage of Roundup Ready® Rotational Crop Option[7]	Percent of Sugar Beet Acres Preceding Major Rotations[8]	Estimated Percentage of Roundup Ready® Crops as Major Rotations[9]
		Durum	2195	1.0%	23	1.6%	NA	0		
		Oats	260	3.8%	10	0.7%	NA	0		
		Potato	78	2.6%	2	0.1%	NA	0		
		Soybean	11,920	4.2%	505	35.8%	91%	460		
		Spring Wheat	13,710	2.5%	347	24.6%	NA	0		
		Sugar Beet	40	10%	4	0.3%	95%	2		
		Winter Wheat	1,650	0.4%	6	0.4%	NA	0		
State Totals			Total: 48,836		Total: 1,411			Total: 596	2.89%	1.22%

Legend:

NA denotes not applicable.

1 Acreage planted of the specific crop is based on 2002 planting data (USDA-NASS, 2003).

2 Rotated crops and acreage following sugar beet production are based on communications from individual local experts, i.e., university agronomists, USDA-ARS and Monsanto field personnel.

3 Column E obtained by dividing Column F by Column D and multiplying by 100.

4 Column G obtained by dividing Column F by Column B and multiplying by 100.

5 Roundup Ready® rotational crop penetration rates for corn and soybean are based on 2007 plantings (USDA-NASS, 2007); penetration rates for alfalfa are assumed to be 50% for the purpose of this assessment to represent potential future plantings.

6 Roundup Ready® rotational crop penetration rates for corn and soybean are based on 2007 plantings (USDA-NASS, 2007); penetration rates for sugar beet are assumed to be 95% for the purpose of this assessment to represent potential future plantings.

7 Column I obtained by multiplying Column F by Column H.

8 Column J obtained by dividing Column B by Column D Total and multiplying by 100.

9 Column K obtained by dividing Column I Total by Column D Total and multiplying by 100.

In the Imperial Valley in California, sugar beets are planted in September, grow through the winter months, and are harvested the following April through June. Vernalization occurs more frequently in the Imperial Valley than in the other US regions, where sugar beet is planted in the spring and harvested in the fall. If the winter in the Imperial Valley is unusually cold and harvesting is delayed, some bolters can develop (California Beet Growers Association, 1998, pp. 3-5; Bartsch et al, 2003).

Sugar beet volunteers. Volunteers are plants from a previous crop that are found in subsequent crops. In most crops, volunteers grow from seeds. If sugar beet bolters are allowed to go to seed in certain more temperate climates, the seed may sprout and cause volunteers in later years, in other crops. Groundkeepers are a type of volunteer derived from vegetative tissue (small roots) left in the field after harvest, which can grow in the next season if not controlled.

In most parts of the US where sugar beets are grown, beet roots would not be expected to survive the winter, and therefore groundkeepers would be of little concern (Panella, 2003). Cattanach et al., who focused on production in the northern plains and upper Midwest (including North Dakota and Minnesota), reported that sugar beets could not survive the winter in these areas (1991).

Sugar beets are not good competitors with other crops. Any that survive can be reservoirs for beet diseases and good management practices dictate that they be removed (Kaffka, 1998).

2.4 GENE FLOW

Definition. **Gene flow** has been defined as the "incorporation of genes into the gene pool of one population from one or more populations" (Futuyma, 1998). Gene flow is a basic biological process in plant evolution and in plant breeding, and itself does not pose a risk (Bartsch et al, 2003; Ellstrand, 2006, p. 116).

How gene flow is addressed in this document. In this section we provide some background information on gene flow, which is included in several different discussions of impacts, as follows:

- Potential for gene flow from event H7-1 sugar beet crops to conventional sugar beet crops (Section 3.3)
- Potential for gene flow from event H7-1 sugar beet to crops to organic sugar beet crops (Section 3.4)
- Potential for gene flow from event H7-1 sugar beet crops to other *Beta* crops (Section 3.5)

- Potential for gene flow from event H7-1 sugar beet crops to other *Beta* seed production areas (Section 3.6)
- Potential for gene flow from event H7-1 sugar beet crops to native beets (Section 3.7)
- Potential for gene flow from event H7-1 sugar beets crops to weed beets (Section 3.8)
- Potential for gene flow from event H7-1 sugar beet to any of the above receptors, in sugar beet seed production (Section 3.9)

Hybridization. In plant biology, when gene flow occurs between individuals from genetically distinct populations and a new plant is formed, the new plant is called a hybrid (Ellstrand, 2003, p. 10). Hybridization is usually thought of as the breeding of closely related species resulting in the creation of a plant that has characteristics different from either parent. Usually this occurs through deliberate human efforts; however, it can also occur indirectly from human intervention, or in nature. For example, when plants are moved to a new environment (with or without human intervention), they may hybridize with plants of a closely related species or subspecies in that new location.

For natural hybridization to occur between two distinct populations, the plants from the two populations must flower at the same time, they must be close enough so that the pollen can be carried from the male parent to the female parent, fertilization must occur, and the resulting embryo must be able to develop into a viable seed that can germinate and form a new plant (Ellstrand, 2003, pp. 11-13).

Introgression. Hybridization may occur in one generation, but in most cases, does not continue on its own. If it does, and stable new populations result, the process is called introgression. For introgression to occur, hybridization of offspring back with the parent types (backcrossing) must occur several times. Because hybrids of distantly related species may not produce viable seed, introgression is much less common than hybridization. For example, in studies done with canola and a weedy relative, backcrossing from the hybrids to the weeds occurred at one-hundredth to one-thousandth the rate of the original hybridization (reported in Stewart, 2008, p. 2). Nevertheless, when weed species are introduced to new areas, there is the potential that those introduced plants may hybridize with other closely related species. Novel hybrids therefore may be created. In addition, novel hybrids may be created through back-crossing (i.e. introgression) with parent species which may change the native species with non-native genetic material. Invasive weeds can result from hybridization events, which mix genetic material potentially producing a wide array of genotypes. Some of these genotypes may exhibit increased invasive properties (USDA ARS, 2008).

Characteristics that favor natural hybridization between two populations when the above requirements are met include (Mallory-Smith and Zapiola, 2008, p. 429):

- Presence of feral populations (domestic populations gone wild) and uncontrolled volunteers
- Presence of a high number of highly compatible relatives
- Self-incompatibility
- Large pollen source
- Large amounts of pollen produced
- Lightweight pollen
- Strong winds (wind pollinated)
- Large insect populations (insect pollinated)
- Long pollen viability

Feral populations are discussed in Section 2.9.4. **Volunteers**, which are plants from a previous crop that are found in a later crop, are common in agriculture and were discussed in Section 3.2.3.

Highly compatible relatives of sugar beets present in the US include red table beets, spinach (or leaf) beets, and Swiss chard (discussed in Sections 3.5, 3.6 and 3.9); and weed beets of the same or closely related species (discussed in Section 3.8).

Sugar beets and other members of the species *B. vulgaris* are **self-incompatible**; that is, fertilization does not occur between the male and female parts on the same plant. Self-incompatible plants must outcross: for fertilization to occur, the pollen from the male part of one plant must be caught by the sticky stigma within the flower of the female part of another plant.

Sugar beets are largely pollinated by **wind** (Mallory-Smith and Zapiola, 2008, Table 1; OECD, 2001, p. 21). The potential for longer-distance gene flow increases with higher wind speeds (Mallory-Smith and Zapiola, 2008, p. 3). Depending on wind conditions, wind-borne sugar beet pollen can be distributed horizontally at least 4,500 meters (2.8 miles) (OECD, 2001, p. 22). However, as discussed in Section 3.9, the vast majority of the pollen does not travel these great distances, and the very small amount that does is unlikely to pollinate another plant.

Successful wind-pollinated flowering plants must produce **large amounts of pollen**: the chances of any single wind-blown pollen grain landing on and being held by the stigma of another plant are very small. Pollen occurs in "clouds": scientists have estimated sugar beet pollen production at one billion pollen grains per plant (Schneider, 1942, as reported in OECD, 2001, p. 22). There is great competition within this cloud for the limited available ovules (only one each), and the stray pollen from another source has extremely limited opportunity for success. In a large, densely planted area such as a seed production field, pollination is much more likely from the pollen cloud within the field than from stray pollen from another field (Westgate, 2010, p. 3; Hoffman, 2010a, p. 8)).

While pollen can be maintained for longer periods under laboratory conditions, scientists report that sugar beet **pollen viability** under natural conditions is limited to 24 hours (OECD, 2001, p 22; Hoffman, 2010a, p. 8).

2.5 SUGAR BEET WEED MANAGEMENT

This section addresses weed management in sugar beets. Uncultivated wild beets, including feral beets and weed beets, are described in Section 2.9.

2.5.1 Weed characteristics and concerns

While a weed can be defined as any unwanted plant, problem weeds are those that are competitive and persistent within a given cropping system.

Competition for light, water and nutrients. A grower tries to capture the plant resources - primarily light, water, and plant essential nutrients; however, competitive weeds often secure some of these resources for their growth, at the expense of the crop. Some common characteristics of competitive weeds are rapid seedling establishment, high growth rates, prolific root systems and large leaf areas.

Competition for light is probably the most important weed consideration for sugar beets, particularly in irrigated fields, which promote improved growing conditions. Sugar beets ultimately convert solar energy into sucrose, and reduction in light can have a dramatic impact on yields. Thus, weeds that grow taller than sugar beets, especially those with broad leaves, compete with available sunlight that the sugar beet would have used to make sucrose. Barnyardgrass (*Echinochloa crus-galli*), for example, has broad, flat leaves and can grow up to 5 ft tall, as can Canada thistle (*Cirsium arvense*). Common lambsquarter (*Chenopodium album*) and kochia (*Kochia scoparia*) are fast-growing weeds that can grow to six ft tall and quickly shade sugar beet seedlings. Wild oat (*Avena fatua*) and green foxtail (*Setaria viridis*) grow to heights ranging from approximately 26 to 41 inches. Sugar beet, by comparison, takes months to reach its final height of approximately 22 inches (Tranel, 2003; McDonald et al, 2003, pp. 9-12; Mesbah et al, 1994, p. 1).

A plant's ability to compete for water is determined largely by the volume of soil the roots occupy. Weeds with large root systems are more likely to be detrimental to sugar beets during periods of water stress. Some perennial weeds can store a multi-year food supply in their roots (Tranel, 2003; McDonald et al, 2003, pp. -12; Mesbah et al, 1994, p. 1).

Plants that develop a root system early in the season have long roots relative to the part of the plant above ground and have high uptake potential can compete successfully for nutrients. Simply applying more fertilizer does not solve the problem and may exacerbate it by stimulating weed growth; weeds often absorb nutrients faster and in greater amounts than sugar beets (Mesbah et al, 1994, p. 1).

Weed persistence. Persistent weeds are able to survive year after year on a given piece of land, in spite of a farmer's efforts to control them. Some plants are both competitive and persistent through the production of large numbers of seeds. The bushy wild proso millet (*Panicum miliaceum*), for example, shatters upon contact when mature, and can produce 400 to 12,000 seeds per square foot. While high reproductive rates also contribute to a weed's persistence, dormancy is the most important trait in persistence. Cultivated soils typically contain thousands of seeds per square meter, waiting for the opportunity to germinate. Some weed seeds, for example, velvetleaf (*Abutilon theophrasti)*, can remain viable in the soil for up to 50 years (McDonald et al, 2003, p. 12). Many perennial weed species have the ability to reproduce from root fragments. Canada thistle, for example, has a deep, spreading root system that can continue to send up shoots after the surface plant has been removed multiple times. Some weeds have the ability to alter their characteristic in response to stress; for example, some weeds respond to drought by flowering and going to seed early (Tranel, 2003; McDonald et al, 2003, pp. 9-12).

2.5.2 Sugar beets and weeds

The sugar beet plant is a poor competitor against weeds, especially from emergence until the sugar beet leaves shade the ground. Emerging sugar beets are small, lack vigor, and take approximately two months to shade the ground. Thus, weeds have a long period to become established and compete. To avoid yield loss from weed competition, weeds need to be controlled within four weeks after sugar beet emergence and weed control needs to be maintained throughout the season (Cattanach et al, 1991, p. 6; California Beet Growers Association, 1999, p. 25; McDonald et al, 2003, p. 13; Mikkelson and Petrof, 1999, p 19).

Uncontrolled weeds that emerge with the crop may cause from 30 to 100 percent yield losses (California Beet Growers Association, 1999; p. 25; Sprague, 2009). Increasing weed density causes increasing magnitude of yield loss, although the relationship is not linear: a few weeds may not affect yield, and at high weed populations the weeds begin competing with one another. While yield losses are the major concern, weeds create other problems. Late-season weeds can hinder harvesting operations. For example, infestations of wild mustard can cause loss of small beets during harvesting. Many weed species host pathogens (curly top virus), nematodes (sugar beet cyst nematode) and insects (aphids). High levels of weed control are essential for profitable sugar beet production (California Beet Growers Association, 1999; p. 25; Mikkelson and Petrof, 1999, p 19; Mesbah et al, 1994). Prior to adoption of event H7-1 sugar beets, growers regularly used multiple chemical herbicides to attempt to control weeds. (Cole, 2010a, pp. 12-13; Cole, 2010b, pp. 10-14; Kniss, 2010, p. 5; Wilson, 2010a, p. 9; Hoffman, 2010, p. 12).

2.5.3 Problem weeds in sugar beet production

The USDA Agricultural Research Service (ARS) has identified the following weeds as problem weeds in sugar beets that have previously prevented production of maximum yields to conventional crops: kochia (*Kochia scoparia)*, pigweed (*Amaranthus spp.)*, common lambsquarter (*Chenopodium album)*, nightshade (*Solanum spp.)*, common mallow (*Malva neglecta)*, cocklebur *(Xanthium strumarium),* barnyardgrass (*Enchinochloa crus-galli),* foxtail (*Setaria)*, wild millet (*Panicum miliaceum)*, wild oats (*Avena fatua)*, sowthistle (*Sonchus L.)*, Canada thistle (*Cirsium arvense)*, nutsedge (*Cirsium arvense)*, and dodder (*Cuscuta L.)* (USDA ARS, 2008, p 61). Most of these weeds, and others, are present throughout all the sugar beet growing regions. Weeds are classified as annual or perennial. An annual is a plant that completes its life cycle in one year or less and reproduces only by seed. Annuals are further classified as broadleaf or grass. Perennials are plants that live for more than two years. They may reproduce by seeds, rhizomes (underground creeping stems) or other underground parts.

Kochia (*Kochia scoparia)*, an annual broadleaf plant, is a member of the Goosefoot family, the same family as sugar beet. Weeds in the same family as a crop often thrive in the same growing conditions.

Pigweed (*Amaranthus spp.)* is a broadleaf annual that is a weed problem in many crops. There are several species; redroot pigweed is most common (UC Integrated Pest Management [IPM] 2010).

Common lambsquarter (*Chenopodium album*)is an annual broadleaf in the same family as sugar beets. With its rapid growth and large size it quickly removes soil moisture (McDonald et al, 2003).

Nightshade (*Solanum spp.)* is a broadleaf annual that grows 6-24 inches tall (McDonald et al, 2003).

Common mallow (*Malva neglecta)* and **cocklebur** *(Xanthium strumarium)* are widespread broadleaf annuals.

Barnyardgrass (*Enchinochloa crus-galli*, **foxtail** (*Setaria)*, **wild millet** (*Panicum miliaceum)* and **wild oats** (*Avena fatua)* are annual grasses.

Sowthistle (*Sonchus L.)* is a perennial plant that reaches a height of 3 to 7 feet and reproduces by seed and underground roots.

Canada thistle (*Cirsium arvense)* is a perennial that reproduces by seeds and underground roots and grows 2 to 5 feet tall. The roots extend several feet deep and some distance horizontally. Canada thistle is the most prevalent and persistent non-grass weed in Minnesota, and is the no. 1 noxious weed in Colorado. It is a problem weed in all growing regions. (Durgan, 1998, p. 8; Colorado Department of Agriculture, undated; McDonald et al, 2003, p. 10).

Nutsedges (*Cyperus spp.)* are among the most problematic weeds of agriculture in temperate to tropical zones worldwide. They are difficult to control, often form dense colonies, and can greatly reduce crop yields. Nutsedges reproduce primarily by rhizomes (UC IPM 2010).

Dodder (*Cuscuta L.)* is an annual parasitic weed that grows only by penetrating tissues of host plants to obtain water and nutrients. Each plant produces thousands of seeds that can remain dormant in the soil for years (UC IPM, 2010).

Velvetleaf (*Abutilon theophrasti*) is a broadleaf annual that grows 2-7 feet tall (McDonald et al, p. 12; USDA 1999a, pp. 18-19).

Ragweed (*Ambrosia spp.*) are annual broadleaf weeds that can be very competitive with crops.

2.5.4 Other non-herbicide weed management practices

In addition to crop rotation and tillage, discussed above, sugar beet growers of conventional sugar beets have other non-herbicide means to manage weeds. Narrow row widths (22 – 24 inches) are commonly used by both conventional and sugar beet growers and those growing glyphosate-tolerant sugar beets, for quicker canopy closure (Cattanach et al, 1991; McDonald et al, 2003; Mikkelson and Petrof, 1999, p. 21). With respect to glyphosate-tolerant sugar beets in particular, because these crops do not require cultivation (i.e., in-crop tillage), sugar beet growers are switching to narrow-row production. With narrower rows, glyphoste-tolerant sugar beets can achieve canopy closure earlier in the growing season, which deprives weeds of sunlight and therefore retards late season weed growth (Wilson, 2010b, p. 4). Growers also use weed-free seed. Additionally, nearly all growers scout their fields for weeds (Ali, 2004).

2.5.5 Use of herbicides to control weeds

Herbicide use is regulated by EPA under FIFRA, rather than by APHIS, and EPA has granted glyphosate reduced risk status (Schneider, 2008, p. 4). Herbicides are used by virtually all sugar beet growers; in 2000 approximately 98 percent of planted acres received one or more herbicide applications (Ali, 2004, Table 4). Herbicides may be used before the crop emerges from the ground (pre-emergence) or after (post-emergence). Pre-plant incorporated (PPI) herbicides are mixed in with the soil before planting. The application method, whether PPI, pre-emergence or post-emergence, largely determines when the herbicide will contact plants and the portion of the plant contacted. In selecting a herbicide, a grower must consider, among other factors, the potential adverse effects on the crop, whether the herbicide is registered for use on the crop, residual effects that may limit crops that can be grown in rotation, effectiveness on expected weeds, and cost.

Herbicide mode of action. Herbicides are chemicals that move into a plant and disrupt a vital process. They are classified according to their mode of action, which is the overall manner in which the herbicide affects a plant at the tissue or cellular level. Most herbicides bind to, and thereby block the action of, a specific enzyme.[26]

2.5.6 Weed control with conventional sugar beets

Conventional sugar beet growers use the weed control measures discussed above, plus a variety of herbicides. There are hundreds of commercial herbicides; only a fraction of that total can be appropriate for use with conventional sugar beet (Table 2-3).

[26] An enzyme is a biological catalyst and is usually a protein. Enzymes are discussed in more detail in Section 3.1.1.

The Weed Science Society of America (WSSA) has classified herbicides by group number, based on their mode of action. As shown in Table 2-3, herbicides commonly used with sugar beet include group numbers 1, 2, 3, 4, 5, 8, and 9 (Tranel, 2008, Dexter et al, 1994; Ross and Childs, undated):

Group 1 herbicides inhibit the action of the enzyme ACCase

Group 2 herbicides inhibit the action of the enzyme ALS

Group 3 herbicides inhibit cell division (mitosis inhibitors)

Group 4 herbicides mimic the plant growth hormone auxin and cause uncontrolled cell growth (synthetic auxins)

Group 5 herbicides inhibit photosynthesis

Group 8 herbicides inhibit a single key enzyme involved in fatty acid synthesis

Group 9 herbicides inhibit the action of the enzyme ESPSP

Table 2-4 summarizes the effectiveness of the herbicides in Table 2-3 on the important sugar beet weeds identified by USDA ARS. As the table shows, no single herbicide is effective on all weeds. Some of these herbicides can be mixed together and applied at the same time (tank-mixed). For conventional sugar beets, glyphosate can be applied only pre-emergence. Blank cells indicate no data were available for that source.

Current practices for weed control in conventional sugar beets include tillage, pre-plant incorporation of grass and broadleaf herbicides, and in-crop use of grass and broadleaf herbicide tank mixtures (Dexter and Luecke, 2003; Dexter and Zollinger, 2003; WSSA, 1994). Each of these practices has limitations. Cultivation and pre-plant incorporation of herbicides are associated with narrow windows of application, which is based on a specific weed size or crop stage (Baker et al., 1982; Baker and Johnson, 1979; Campbell and Janzen, 1995; Fawcett, 1995). Additionally, herbicide performance and crop injury are influenced heavily by soil pH, target weed size, crop size, air temperature, and irrigation practices. Morever, many of the currently applied herbicides leave soil residues, whose persistence can impact crop rotation options in subsequent seasons (Dexter and Zollinger, 2003; WSSA, 1994)

Table 2-3. Herbicide applications to sugar beet acres in the US, 2000[1]

Agricultural Chemical (Herbicide)	Trade Name (typical)	WSSA Mode of Action Group No.	Acreage Treated (%)	Number of Applications per Year	Rate per Application (lb/appli./ac)	Rate per Acre (lb/ac)	Total Applied per Year (1,000 lb)
Clethodim	Select	1	46	2.5	0.04	0.11	77
Clopyralid	Stinger	4	74	2.8	0.03	0.09	102
Cycloate	Ro-Neet	8	5	1.0	1.84	1.84	139
Desmedipham	Betanex	5	94	2.8	0.07	0.18	270
EPTC	Eptam	8	6	1.0	2.61	2.64	230
Ethofumesate	Nortron	8	37	2.1	0.06	0.14	82
Glyphosate	(Several)	9	13	1.1	0.39	0.43	86
Phenmedipham	Betamix	5	80	2.6	0.05	0.14	170
Pyrazon	Pyramin	HRAC Group C1	6	1.0	0.82	0.85	76
Quizalofop, ethyl	Assure II	1	10	1.6	0.04	0.06	9
Sethoxydim	Poast	1	11	1.7	0.19	0.33	56
Trifluralin	Treflan HFP	3	5	1.0	0.65	0.66	55
Triflusulfuronmethyl	Upbeet	2	83	2.7	0.008	0.02	29

[1] 1.565 million acres were planted in the US in 2000. All values are averages. Source: National Agriculture Statistics Service (www.usda.gov/nass); www.weedscience.org; www.hracglobalcom.

Table 2-4. Effectiveness of herbicides on major weeds in sugar beets.

Herbicide	Broadleaves						Grasses				Perennials			Parasite
	Kochia	Pigweed	Nightshade	Cocklebur	Common lambsquarter	Common mallow	Wild oats	Barnyardgrass	Wild millet	Foxtail	Sowthistle	Nutsedge	Canada thistle	Dodder
Pre-plant incorporated														
Ro-Neet														
MI Sugar	P	G	F	P	F			G		G	N	G	N	
NDSU	P	F-G	F-G	P	F-G	F-G	F-G	G		G-E			N	
U of ID	P	E	G	P	E	P	F	G		G	P	F	P	P
Pre-emergence														
Nortron														
MI Sugar	F	G	G	F	G			P		F	N	P	N	
NDSU	F-G	G-E	F-G	P	P-F	P	F-G	P		F-G			N	
U of ID	F-G	G-E	F-G	P	G-E	P	F	G		G	G	P	P	P
Pyramin														
MI Sugar	P	G	G	P	E			P		P	N	N	N	
U of ID	P	G-E	F-G	P	G	P	P	P		P	P	P	P	P
Eptam														
NDSU	F	F-G	F-G	P	F-G	F-G	G	G-E		G-E			N	
U of ID	F	F-G	F-P	P	G	P	F-G	G		G	F	F	P	P

E= excellent, G = good, F = fair, P = poor, N = no effect.

Table 2-4. Effectiveness of herbicides on major weeds in sugar beets.

Herbicide	Broadleaves						Grasses				Perennials			Parasite
	Kochia	Pigweed	Nightshade	Cocklebur	Common lambsquarter	Common mallow	Wild oats	Barnyardgrass	Wild millet	Foxtail	Sowthistle	Nutsedge	Canada thistle	Dodder
Post-emergence														
Nortron														
MI Sugar	-	F	G	P	F			P		F	N	N	N	
Pyramin														
MI Sugar	-	F	F	P	F			N		N	P	N	P	
Betamix														
MI Sugar	F	G	F	F	E			P		F	N	N	N	
NDSU	F	G	F-G	P-F	G	P	N	P		F			N	
U of ID	P-F	G-E	F-G	F	E	P	P	P-F		F	E	P	P	P
Betanex														
NDSU	P-F	G-E	F-G	P	G	P	N	P		P			N	
Upbeet														
MI Sugar	-	F	F	F	P			P		P	N	N	P	
NDSU	P-E	F	F	N	P	G	N	N		F-G			N	
U of ID	G	G-E	G	F	G	F	P	P		P	G	P	P	P

Table 2-4. Effectiveness of herbicides on major weeds in sugar beets.

Herbicide	Broadleaves						Grasses				Perennials			Parasite
	Kochia	Pigweed	Nightshade	Cocklebur	Common lambsquarter	Common mallow	Wild oats	Barnyardgrass	Wild millet	Foxtail	Sowthistle	Nutsedge	Canada thistle	Dodder
Stinger														
MI Sugar	N	P	F	E	P			N		N	G	N	G	
NDSU	N	P	F-G	E	P-F	P	N	P		P			G-E	
U of ID	P	P	F-G	E	F	P	P	P		P	G	P	E	P
Progress (a mixture of Betamix plus Nortron)														
MI Sugar	F	G	G	F	E			P		F	N	N	N	
NDSU	F-G	G	G	F	G-E	P	N	P		F-G			N	
Assure II/Select (Assure II only for U of ID)														
MI Sugar	N	N	N	N	N			G		E	N	N	N	
NDSU	N	N	N	N	N	N	E	E		E			N	
U of ID	P	P	P	P	P	P	G-E	E		E	P	P	P	P
Poast														
MI Sugar	N	N	N	N	N			E		E	N	N	N	
U of ID	P	P	P	P	P	P	G-E	E		E	P	P	-	P

E= excellent, G = good, F = fair, P = poor, N = no effect.

Table 2-4. Effectiveness of herbicides on major weeds in sugar beets.

Herbicide	Broadleaves						Grasses				Perennials			Parasite
	Kochia	Pigweed	Nightshade	Cocklebur	Common lambsquarter	Common mallow	Wild oats	Barnyardgrass	Wild millet	Foxtail	Sowthistle	Nutsedge	Canada thistle	Dodder
Glyphosate														
MI Sugar	G	E	G	E	G			E		E	-	F	G	
NDSU	F-E	E	P-G	E	P-E	P-G	G-E	E		E			G-E	
Select														
U of ID	P	P	P	P	P	P	G-E	E		E	P	P	P	P
Treflan HFP														
U of ID	F	G	P	P	F-G	P	F	G		G	P	P	P	P

E= excellent, G = good, F = fair, P = poor, N = no effect.

Blank cells mean no data were available for that source.
Sources: MI Sugar: Michigan Sugar, 2009; NDSU: Stachler and Zollinger, 2009; U of ID: Morishita, 2009

Conventional weed control options are complex due to the need for several applications of multiple tank-mixed herbicides to achieve long-term, broad-spectrum weed control. As an example, a common practice in sugar beet production is to use "micro-rates" of herbicides (Dexter and Zollinger, 2003). This is accomplished by tank mixing multiple herbicides at reduced rates in combination with an oil additive. The components of the tank mixture may include Betanex (desmedipham), Betamix (phenmedipham + desmedipham), Nortron (ethofumesate), Upbeet (triflusulfuron methyl), and Stinger (clopyralid); and Select (chlethodim), if grasses are present. A minimum of three applications is recommended, beginning at the cotyledon growth stage and followed by weekly applications of this herbicide mixture. The intent of the micro-rate program is to lower overall herbicide costs and reduce the potential for crop injury.

A member of the Minn-Dak Farmers Cooperative, who farms about 1,100 acres of sugar beets annually, described his conventional weed control system (Mauch, 2010, pp. 2-3):

> Prior to planting Roundup Ready® sugar beet, my herbicide regimen for conventional beet seed was very complicated and labor intensive. Pre-emergence, I used a combination of Eptam (which is very toxic to the sugar beet) and RoNeet (which is very expensive). Approximately two weeks after the beet plants emerge, I started spraying a mix of BetaMix, Betanex, UpBeet, Nortron and Stinger and adjunctives to make the herbicides stick better to the crops. This would be sprayed four times (approximately once a week). Even after spraying several times, there were still weeds and I then needed to hire manual labor to hoe and pull out the weeds.

This description of the complexity of conventional weed control is similar to that provided by researchers evaluating weed management in sugar beets (Odero et al, 2008). Odero et al evaluated 20 different weed treatment alternatives for conventional sugar beets and found that the following treatment yielded the highest net economic return: PPI treatment with Nortron (ethofumesate), followed by three micro-rate treatments of a tank mixture of Betamix (phenmedipham + desmedipham) and Nortron (ethofumesate), followed by Outlook (dimethenamid-P); with hand-hoeing following each herbicide application.

Other researchers have also found that a combination of herbicides plus hand hoeing is required to effectively control weeds in conventional sugar beets (Dexter and Luecke, 2003).

Hand-weeding is necessary in many situations; however, it is cost-prohibitive as a replacement for herbicides. USDA data shows that in 2000, conventional sugar beet growers spent an average of $94.28/acre for all chemicals (insecticides, herbicides, fungicides, etc.) (Ali, 2004, p. 7). Five-year studies of the cost of hand-weeding sugar beet at the University of California – Davis, as reported by the California Beet Growers Association, found that the cost of hand weeding was between $260 to over $650 per acre (California Beet Growers Association, 1999, p. 29). Using the midyear of 1996 as the base year, this is equivalent to approximately $373 to $914 per acre in 2010 dollars, or approximately three to seven times what sugar beet growers spent on all chemicals. More recently, scientists in Wyoming have found that net returns for optimal herbicide application combined with hand weeding are more than twice the net returns for hand weeding alone (Odero et al, 2008, Table 4).

2.5.7 Weed control with event H7-1

In-crop applications of glyphosate can be made from crop emergence up to 30 days prior to harvest. This flexibility allows the grower a wider window of application, with the application timing based on weed pressure, not on crop stage. Typically only 2-3 post-emergence applications of glyphosate are applied with GE sugar beets (Mauch, 2010; Grant, 2010). The broad spectrum of weed control offered by glyphosate (Table 2-4) reduces the need for tank mixing with additional herbicides. However, the use of other herbicides in combination with or in sequence with glyphosate is recommended as needed under specific conditions to address select weed and/or weed resistance issues.

Monsanto's Technology Use Guide (TUG, 2010, Appendix E) provides specific weed control recommendations for event H7-1 sugar beet. The TUG recommends the use of "mechanical weed control/cultivation and/or residual herbicides" with event H7-1 sugar beets, where appropriate, and "additional herbicide modes of action/residual herbicides and/or mechanical weed control in other Roundup Ready® crops" rotated with event H7-1 (TUG, 2010, p. 40).

2.6 HERBICIDE RESISTANCE

Herbicide resistance is "the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type" (WSSA, 1998).

Herbicide resistance is a result of natural selection. Plants of a given species are not all identical; they are made up of "biotypes" with various genetic traits. Biotypes possess certain traits or characteristics not common to the entire population. Herbicides, that suppress or kill weeds, can exert selection pressure on weed populations. When a herbicide is applied, the plants with resistance to it, which had no special survival qualities before the herbicide was introduced, become the survivors who are then able to reproduce and pass on their genes. With repeated application of the same herbicide and no other herbicide or weed control practice, the resistant biotype becomes the dominant biotype in that weed community. In the mid-1950s, Harper (1957) theorized that annual, repeated use of any herbicide could lead to shifts in weed species composition within a crop-weed community. Similarly, Bandeen et al. (1982) suggested that a normal variability in response to herbicides exists among plant species and tolerance can increase with repeated use of an herbicide. Indeed, as of June 27, 2010, 341 herbicide resistant weed biotypes have been reported to be resistant to 19 different herbicide modes of action (Heap, 2010). Glyphosate-resistant weeds account for 5 percent of the herbicide resistant biotypes while weeds resistant to herbicides that inhibit acetolactate synthase (ALS), such as Upbeet, account for 31 percent of the herbicide resistant biotypes. (Wilson, 2010a, p. 6).

Figure 2-3 shows the increase in herbicide resistant biotypes with time. Among the herbicides commonly used in conventional sugar beet, Assure II, Poast, and Select are ACCase inhibitors; Upbeet is an ALS inhibitor; Treflan HFP is a dinitroaniline; Stinger is a synthetic auxin, and glyphosate is a glycine. Figure 2-3 shows only the number of confirmed resistant biotypes. The total extent and distribution of resistant biotype varies widely. Details of herbicide resistant weed in sugar beets are discussed in Section 3.12.

For as long as herbicide resistance has been a known phenomenon, public sector weed scientist, private sector weed scientist and growers have been identifying methods to address the problem. For instance, when a farmer uses multiple weed control tools to achieve weed control, herbicide resistance biotypes will be controlled and the resistance biotype generally will not become the dominant biotype within a population (Gunsolus, 2002; Cole, 2010a, p. 4). By contrast, weed resistance is known to occur most rapidly in areas where there is a sole reliance on a single herbicide used repeatedly over multiple crop generations for the management of a specific weed spectrum.

When a grower encounters a biotype that is resistant to an herbicide he is using, the grower must use an alternate method of weed control. Management practices that can be used to retard the development of resistance, such as those routinely used by sugar beet growers, include herbicide mixtures, herbicide rotation, crop rotation, and increased cultivation.

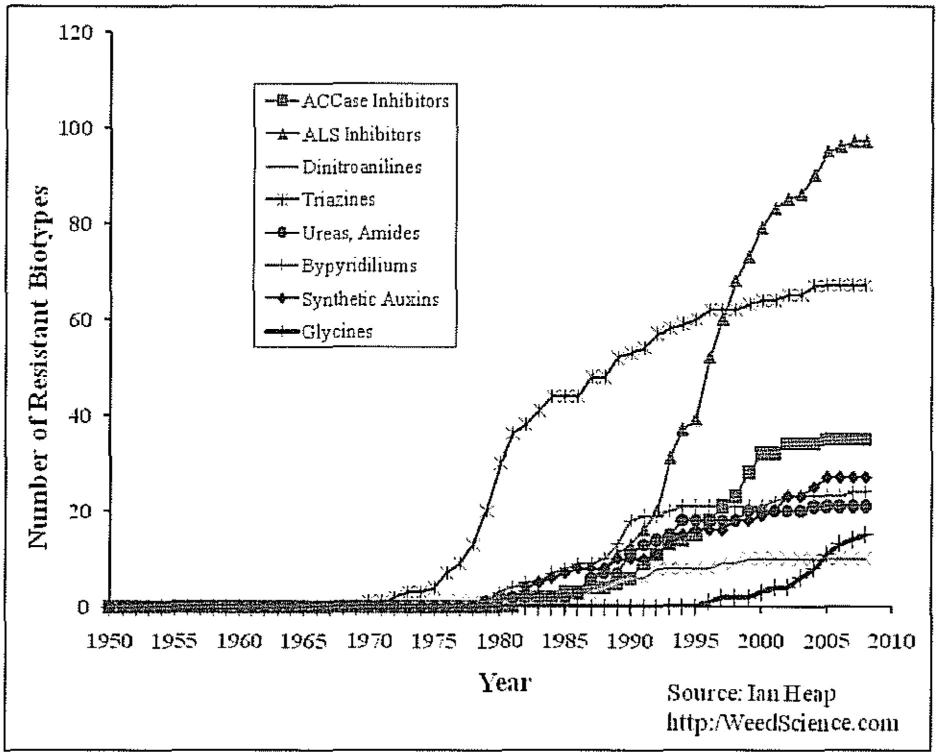


Figure 2-3. Herbicide resistance worldwide

Management practices that can be used to retard the development of resistance, such as those routinely used by sugar beet growers, include herbicide mixtures, herbicide rotation, crop rotation, and cultivation. The WSSA reports: "Weed scientists know that the best defense against weed resistance is to proactively use a combination of agronomic practices, including the judicious use of herbicides with alternative modes of action either concurrently or sequentially" (WSSA, 2010b).

2.7 SUGAR BEET SEED PRODUCTION

2.7.1 Variety development

When developing plant varieties for commercial release, plant breeders select individual plants with desirable characteristics, such as higher yields or pathogen resistance. This breeding involves transferring pollen from one source plant to fertilize another plant. Once plants with the desired traits have been selected, a population of those plants with similar characteristics are classified as varieties.

Commercial sugar beet variety development has been done exclusively by private sugar and seed companies in the US. Currently these are Crystal/ACH, Hilleshog (Syngenta), Seedex, Betaseed (KWS) and SESVanderhave/Holly. As plant breeders continue to develop new germplasm, the identification of desirable traits (e.g., resistance to specific diseases, high sugar content, etc.) is incorporated into the development of new varieties. Due to geographic variability in weather, growing conditions, climate, insect and disease susceptibility vary from region to region, different varieties are developed for different regions. Sugar beet company selection committees in each region establish a list of approved varieties based on coded variety trials, which are designed to give an unbiased evaluation of the genetic potential of all sugar beet variety entries while other variables (stand, fertility, moisture levels, etc.) are kept constant. Growers may grow only those varieties that appear on the sugar beet company approved list for that region. Variety trials insure the use of the most productive varieties to maximize returns to the growers and sugar companies. Trials last 2 to 3 years and involve millions of plants each year.

2.7.2 Hybrids and cytoplasmic male sterility

To produce seed for commercial planting of the chosen variety, some crops, such as cotton and soybeans, rely on the same individual plant to serve as the female (pollen acceptor) and male (pollen donor) to produce seed. Other crops, such as corn and sugar beet, rely on two different varieties, called inbreds, to produce hybrid seed that carries traits from both parent lines. Hybrid varieties typically exhibit greater vigor than the parent lines on which they are based, resulting in plants with higher yields, better resistance to stress, and other desirable traits.

Once a biotech plant such as event H7-1 has been developed, researchers will use that plant to breed the biotech trait to other varieties. In breeding sugar beet varieties for future commercial production, the biotech trait could be maintained on either the male or female plants. For greater breeding flexibility and efficiency in producing new varieties, plant breeders may prefer to breed additional varieties by introducing the biotech trait on male pollinator population of plants and use those plants to fertilize the same male-sterile female plants (Skaracis and De Biaggi, 2005). If the biotech trait is only on the female (male sterile) plant with CMS, as discussed below, that trait cannot be transferred to other plants in order to breed new inbreds. In hybrid sugar beet seed production, although each plant flower contains both male (the anther) and female (the stigma) parts, individual plants can be made female-only, or male sterile. Male sterility results in the failure of plants to produce functional anther, pollen or male gametes (Hovland, 2010, p. 2). In order for seed multiplication of the male sterile or female plant to occur, plant breeders develop a partner line ("O-Type") which is genetically identical to its equivalent male sterile or female line with the exception of its ability to produce pollen. This identical O-Type is then used as the pollinator (male plant) to pollinate the female plant, resulting in offspring that will again be male sterile and not produce pollen. This seed, after meeting quality criteria relative to any impurities, is then used as the male sterile or female basic seed in the commercial seed production fields. This system is known as Cytoplasmic Male Sterility (CMS). It is the system used in many other crops to develop male sterile or female basic seed lines that do not produce pollen. Using female-only plants in seed production ensures that the hybrid seed harvested from those plants will be a cross between the two parent lines. Male and female lines are planted in alternating strips in a sugar beet seed production field, typically with two to four times as many female rows as male rows to maximize the amount of seed collected (Hoffman, 2010a, p.5). Often stecklings (small transplants) are used for the male lines. After pollination occurs, the male plants are destroyed (Holly Hybrids, 2007). Only very rarely would a CMS fertile plant produce pollen and such plants can be identified and rogued.

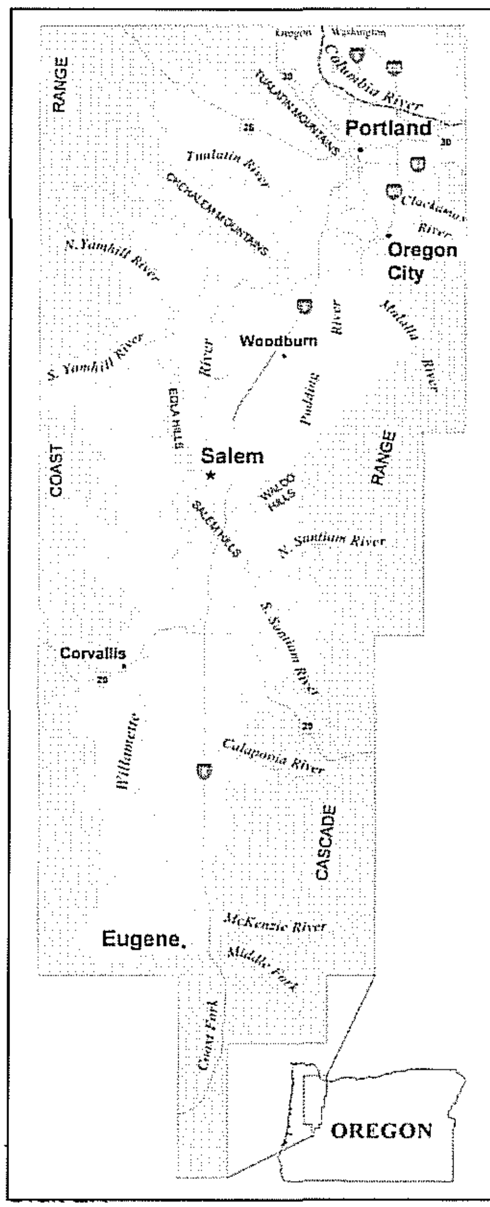


Figure 2-4. Willamette Valley
Source: Givler and Wells, 2001

One producer reports identifying only two pollen-producing plants within a crop of over eleven million total plants (Anfinrud deposition, 2010, 178).

In the Willamette Valley, 78.6% of the 2009-2010 seed crop were grown with the glyphosate-tolerant trait on the female inbred. These female inbreds are male sterile because of the CMS trait and thus are bred not to produce pollen. (Preliminary Injunction Hearing, March 5, 2010, pgs. 17-18; 25). Therefore, the risk of transferring the glyphosate-tolerant trait to other plants from these seed production fields is negligible or zero.

2.7.3 Commercial sugar beet seed production

Willamette Valley

At least ninety-five percent of the Oregon sugar beet seed production (equal to 70% or more of the total US production), is in the Willamette Valley, located between the Coast Range and the Cascade Range (Figure 2-4 at left) (Stankiewicz Gabel, 2010, p. 7). The valley is over 100 miles long. The climate is cool enough for winter vernalization (prolonged exposure to a minimum cool temperature for a prolonged period of time that enables the plant to flower) but warm enough for the roots to live through the winter. Summers are very dry, producing ideal conditions for seed harvesting. While sugar beet is normally a biennial plant, conditions in the valley are such that seed can be produced in one year rather than two. Sugar beet seeds are planted in August or September and vernalize over the winter. The following spring, the plant produces a seed stalk (bolt). Seeds are harvested in late July to August. One seed company, Betaseed, grows the basic and commercial seed for its varieties at the southern and southeastern fringes of the Willamette Valley.. Syngenta develops its varieties elsewhere, and then ships the basic seed to West Coast Beet Seed Company (WCBS) for the commercial production. SESVanderHave develops its varieties both in the Willamette Valley and elsewhere, and ships basic seed produced elsewhere to West Coast Beet Seed Company (WCBS) for seed production. WCBS is jointly owned by a group of sugar beet seed and sugar companies.

With its unique growing conditions, the Willamette Valley is used for seed production for many different kinds of seeds. In addition to seeds, many vegetables are also grown in the valley. It is a major area for production of "most temperate vegetables, herbs and vegetable seeds" (Mansour, 1999). Because high quality and seed purity are important to many growers, and because the valley is the site of varied seed production, sugar beet seed production companies have worked cooperatively to develop and implement protocols to maintain seed purity and quality. Most seed companies, including both WCBS and Betaseed, belong to the Willamette Valley Specialty Seed Association (WVSSA) and follow the guidelines for isolation and minimum separation distances between fields (Appendix A).

WCBS and Betaseed have developed explicit standard operating procedures and grower guidelines that are intended to minimize and/or eliminate the possibility of inadvertent seed mixing (Appendix B).

Maintaining the integrity of seeds

Currently, the WVSSA implements pinning procedures and isolation guidelines for seed production within the Willamette Valley. Pinning procedures identify the geographic location of production fields by placing pins and flags on a map. This is used to establish isolation distances between seed production fields. Additionally, WCBS and Betaseed have instituted protocols and management practices to further maintain the integrity of seed which are essentially the same as required by Item 4 of the interim measures (Section 1.1.3). Seed production and quality control are a significant cost, to seed companies, and these companies within the Willamette Valley and throughout seed production areas carefully control growing conditions and production practices to ensure that seed is pure and of high quality – despite the fact that quality control in seed production carries significant cost.

WCBS Seed Production. WCBS currently produces much of the sugar beet seed for some of the sugar beet seed companies.. WCBS obtains basic seed from these sugar beet companies to further increase these small seed volumes into larger commercial quantities. Management of these fields and planting locations is controlled utilizing a tracking and tracing system distinguishing seed lots from the moment of initial delivery of seed, designated for seed production, to WCBS throughout the subsequent planting and harvest. This management further continues until the delivery of the finished packaged seed to the customer. Some companies further incorporate various computerized and digital tracking systems designed to manage real-time seed batch movement and quality testing. Many of these companies have sealed packaging and specified color coding designations to further identify seed batches/lots. (Meier, 2010, p. 3). Similarly, other companies ship event H7-1 sugar beet seed in packages accompanied by a declarations document that states the event H7-1 status of the basic seed (Anfinrud, 2010, p. 2).

WCBS contracts to individual growers for seed production. WCBS prohibits production of a red beet or Swiss chard seed crop by any WCBS grower in a year in which that grower is producing sugar beet seed, whether genetically engineered (GE) or conventional. WCBS also prohibits the sharing of planting, cultivation and harvesting equipment for red beet/Swiss chard and sugar beet seed, whether they are producing GE or conventional sugar beet seed (Loberg, 2010, p. 2; also in Appendix B of this ER[27]). In addition, WCBS requires its growers, by contract, to adhere to minimum isolation distance within a three mile radius of any GT field (Appendix B).

WCBS maintains control of all material, whether GE or conventional, from point of origin to return of the seed to the seed company (Appendix B). This includes control of the disposal of any excess GE stecklings that are not used for seed production. When those stecklings are not used for seed production and remain in the nursery field, such stecklings are uprooted and

[27] These requirements are in the Appendix B WCBS protocol, under the heading "GM Grower Guidelines." While the title is "guidelines," the protocol is clear that these restrictions are included in WCBS contracts with growers.

mixed into the soil during tillage for soil preparation for the next crop. Destruction occurs with this tillage and is followed by chemical control in the subsequent crop. Stecklings that are removed from the nursery, but are not used, are destroyed or securely disposed. The prevailing method is returning unused stecklings to the nursery field of origin and subsequent destruction through standard agricultural practices (physical destruction with tillage and chemical destruction in the subsequent crop) (Loberg, 2010, p 2; and Appendix B of this ER).

Precleaning of seed at WCBS for shipment to the seed development company takes place in the dedicated WCBS facility. This process removes sticks, chaff, weeds and the like that may be contained in the seed when initially harvested. Because WCBS does not handle red beet or Swiss chard seed, its seed precleaning operations present no opportunity for mechanical mixing of sugar beet seed, whether conventional or GE, with red beet or Swiss chard seed. In years when WCBS produces both GE and conventional sugar beet seed, physical separation requirements and cleaning protocols protect against inadvertent mixing. In 2009, only two growers produced conventional seed for WCBS. All of this conventional seed was pre-cleaned at the end of the season, after completion of the pre-cleaning of the event H7-1 seed and after complete cleaning of the equipment.

After the pre-cleaning, WCBS returns the seeds to the seed development company in sealed containers with color-coded labeling and shipping documents, which are checked upon arrival at seed processing facilities. Syngenta, for example, marks each container with a computer-generated and tracked batch number (Meier, 2010). SESVanderHave labels its event H7-1 seed with an orange triangle. (Anfinrud, 2010, at p. 3).

Betaseed seed production. Betaseed performs its own basic seed production, and like WCBS, it contracts commercial seed production to individual growers. Betaseed has adopted standard operating procedures (SOPs) that require all materials to be adequately identified and tracked through a computerized, bar-coded system from basic seed production to commercial seed production to final processing and shipping. All Betaseed personnel involved in seed production are trained in the SOPs and required to sign an acknowledgement that they have read, understood, and will comply with the SOPs (Lehner, 2010, p. 10).

Betaseed supervises its commercial seed growers' practices for conformance with Betaseed's stewardship requirements. Betaseed's grower contracts provide for such supervision, as well as Betaseed's right to enter the grower's fields and take remedial action if the grower does not comply with Betaseed's instructions. Betaseed pins all of its commercial seed fields in compliance with the WVSSA's pinning rules to ensure that isolation distance guidelines are followed. In addition, Betaseed requires its growers, by contract, to adhere to isolation distances of four miles from other crops that may cross-pollinate with sugar beets.. Betaseed also requires growers to clean their equipment before and after harvesting a sugar beet variety, and to monitor for and eliminate volunteer sugar beets. According to the SOPs, Betaseed personnel are present for the beginning of every harvest by a commercial grower. Betaseed provides bar-coded tote boxes into which the harvested seed is placed for transport to Betaseed's processing facility (Lehner, 2010, pp. 3-5).

Betaseed performs "grow-outs" each year in which it plants samples of its commercial seed lots to ensure that the seed produces the expected variety of plant. Betaseed's grow-out observation plot did not produce any off-types this year (Lehner, 2010, p. 3).

Syngenta seed processing. Syngenta processes sugar beet seed in its facility in Longmont, Colorado that is used only for sugar beet processing; a small percentage of the seed is processed by third party seed vendors in separate facilities dedicated to sugar beet processing (facilities where no red beets or Swiss chard seeds are processed). Processing of seed requires seven months and involves polishing, sorting by size, pelleting, treatment with fungicides and insecticides required by certain customers, coloring, packaging and shipping to growers in sealed packages. Syngenta maintains an extensive tracking and tracing system for every seed lot. This system includes a visual color identification of all RRSB material; a computerized, real-time record of seed batch movement, periodic germination and genetic identity testing; and extensive employee training. Syngenta also uses cleaning protocols to prevent any inadvertent mixing of RRSB and conventional sugar beet seed during processing. The cleaning process requires the removal of all RRSB seeds from the equipment and the plant floor. "Chase" seed is used to ensure that all GT seed has been removed from the equipment (Meier, 2010). with color-coded labels (Meier, 2010).

SESVanderHave seed processing, storage, treating, packaging, warehousing, transportation and distribution. Neither SESVanderHave, its growers nor its contractors are involved in any respect in chard or red beet breeding, production or processing. SESVanderHave's GE protocols require that conventional seed and event H7-1 seed are never handled or processed at the same time. For example, SESVanderHave does not allow its processing contractors to process conventional seed at the same time that they are processing event H7-1 seed. (Anfinrud, 2010, p. 3).

SESVanderHave receiving/storage of unprocessed seed protocols. SESVanderHave has additional GE protocols that apply to unprocessed seed shipped from West Coast Beet Seed. All event H7-1 seed products are identified upon arrival at bulk storage facilities. Shipping documents from West Coast Beet Seed are used to double check the seeds that arrive in Sheridan, Wyoming facilities. Also, proper disposal of reject or spilled seed is established by variety, lot and size. Product is unloaded only after insuring that storage bins and label bins have appropriate markings (event H7-1 products are labeled with an orange triangle). (Anfinrud, 2010, p. 3).

SESVanderHave seed processing/storage protocols. Seed processed on behalf of SESVanderHave by third parties are subject to contractual arrangements that require compliance by processing contractors with SESVanderHave's GE protocols designed to prevent mixing of event H7-1 seed with other seeds during the various processing, treating, packaging, warehousing, transportation and distribution stages. Before dumping seed into the seed processing line, necessary equipment (conveyors, legs, distributors, storage bins) is cleaned. Product is unloaded only after insuring that storage bins have appropriate markings (event H7-1 products are labeled with an orange triangle). A key lock and appropriate label is placed on each bin discharge slide. Once product is in storage bins, the tops of bins are sealed by tinning pipe. If necessary, unloading equipment is cleaned and seed is disposed of in proper manner followed by a documented inspection. Bins with event H7-1 products are labeled with an orange triangle. Processed seed is placed into properly labeled storage totes and clean-down procedures are followed between seed lots. Rejected seed is disposed in a local landfill. All event H7-1 seed totes are labeled with an orange triangle. Totes are then transferred to the warehouse and put in inventory by variety, lot number, warehouse and slot. (Anfinrud, 2010, p. 3).

SESVanderHave treating and packaging protocols. Product to be primed, pelleted, treated and packaged is identified. When event H7-1 seed enters any facility under contract with SESVanderHave, the necessary equipment (legs, distributors, blending system, Delta screen, treater, conveyors, aspirators, and bagging scale) is thoroughly cleaned before the product is introduced. All processes require documentation of weights introduced and weights after contract processing is complete. All contractors have been audited by SESVanderHave personnel to assure compliance with GE protocols. Final packaging of event H7-1 seed is done in approved packages with proper labels. Packaged seed is transferred to the warehouse and put on inventory by variety, lot, treatment, warehouse, and slot. When treating of event H7-1 seed is completed, if necessary, all treating/packaging equipment is cleaned following clean-down procedures. Reject seed is disposed of in an appropriate manner. (Anfinrud, 2010, p. 4).

SESVanderHave warehousing, transportation and distribution protocols. Seed to be shipped is identified by printing delivery orders that identify event H7-1 seed. Warehouse crews stage loads. Each pallet of event H7-1 seed is identified with a cover sheet. Any broken bags during transportation are recovered and returned to the originator for proper repair or disposal. Drivers are informed that event H7-1 seed is present on loads. Sales and marketing personnel confirm that event H7-1 seed shipments are to approved customer locations (Anfinrud, 2010, p. 4).

SESVanderHave Auditing of Compliance with GE Protocols. SESVanderHave audits its contractors' compliance with its GE protocols as well as its own compliance to assure that SESVanderHave's standards of stewardship are maintained. SESVanderHave employees as well as outside consultants have worked on the audits, which have covered production, storage, processing, priming, pelleting, coating, packaging, handling, shipping and distribution of event H7-1 sugar beet seed. (Anfinrud, 2010, p. 4).

Betaseed seed processing. Betaseed processes and packages its own seed for distribution. Betaseed does not produce or process seed of any *Beta* species other than sugar beets, so there is no potential for mixing of GE seed with seed of any other *Beta* species in Betaseed's processing facility (Peters, 2010, p. 2).

Betaseed employs a computerized tracking system to ensure that all of its varieties of seed are kept separate as they are processed. All processing steps are recorded and auditable. Every box of seed that is processed is accompanied by both a human readable label and a bar-code containing information about the seed, including whether it is GE or conventional. Seed cannot be loaded into Betaseed's processing equipment until the bar-code accompanying the seed has been scanned and the seed is determined to be of the intended variety. In the last two seasons, Betaseed has only processed one variety of conventional seed (and only a single lot of this variety in the last season). To avoid the possibility of any mixing of GE seed with the conventional variety, Betaseed processed its conventional seed before processing any of its GE seed. Betaseed thoroughly cleans its entire processing system before and after processing conventional seed (Peters, 2010, pp. 2-4).

Betaseed also conducts bioassay tests on each lot of seed at least twice as the seed is processed through its plant to ensure that lots of GM varieties are glyphosate resistant and that conventional varieties do not contain GM seeds (Peters, 2010, p. 4).

2.8 RED TABLE BEET, SWISS CHARD, AND SPINACH BEET PRODUCTION

2.8.1 Vegetable beet production

In the USDA database, "beets" include red table beets, Swiss chard, and spinach beets (grown for the leaves). In the following discussion, these products are referred to as "vegetable beets." In 2007, the most recent year for which published data are available, 8,412 acres of beets were harvested in the US, on 2,744 farms, for an average of three acres per farm. Approximately 63 percent of the acreage was for processed beets, and the rest for the fresh market (USDA NASS, 2010b). The total value of vegetable beet production in 1999, the most recent year for which USDA has data available, was approximately $7 million. Based on the most recent year for which USDA has both harvested acreage and production value data (1997), the average value of vegetable beet production per acre was approximately $720, which would be roughly $1,000 in 2010, adjusted for inflation (USDA NASS, 2010b).

There is little overlap between areas of major vegetable beet production and sugar beet root production. Over half the 2007 acreage of vegetable beets (59 percent) was in two states, New York and Wisconsin, where sugar beets are not grown. California harvested 979 acres of vegetable beets in 2007. All California counties with five or more harvested acres reported are coastal. [28] Sugar beets are grown only Imperial County in California. Oregon harvested 425 acres of vegetable beets, but no vegetable beet production was reported in the two Oregon counties with sugar beet root crops; however, some vegetable beet crops are grown in the Willamette Valley. One county in Colorado (Larimer), and one county in Michigan (Lapeer), reported both sugar beet and vegetable beet harvests. No more than 7 acres of vegetable beets were harvested in any single Minnesota county. Harvested vegetable beet acreage for all other sugar beet producing states in 2007 was ten acres or less each (Montana, Idaho, Nebraska, North Dakota, and Wyoming) (USDA NASS, 2010b). Although there is little overlap in major production areas, based on USDA FSA (Farm Service Agency) data, vegetable beet crops and sugar beet crops can sometimes be found growing in adjacent fields (Stankiewicz Gabel, 2010, p. 8).

[28] These results, which don't distinguish between organic and conventional, are not completely consistent with the State of California organic results discussed in Section 2.4.3, probably because of variations in the database of growers reporting.

2.8.2 Red table beet and Swiss chard seed production

The most comprehensive data currently available for red table beet and Swiss chard seed production is from the FSA, however, the FSA does not distinguish between organic and conventional. Also, FSA does not include leaf beet seed production, which is apparently minor. According to data from the USDA FSA, red table beet seed in 2009 was grown on approximately 1,130 acres, with 92% grown in Washington State, 7% in Oregon and 1% in California; and Swiss chard seed in 2009 was grown on approximately 166 acres, with 51% grown in Washington State and 49% in California. Based on FSA data, there are no counties where both Swiss chard and table beet seed are grown, and only one county, in the Willamette Valley, where both sugar beet seed and table beet seed are grown. In that county the FSA data lists only two table beet seed fields. The total FSA-reported red table beet seed production in Oregon is approximately 79 acres (Stankiewicz Gabel, 2010, p. 7). There is also minor Swiss chard seed production in Oregon.

Based on older USDA published data, ninety-five percent of US red table beet seed production (650 to 700 acres) occurs within the small-seeded vegetable seed production area of western Washington State that includes Skagit, Island and Snohomish counties (See Figure 2-1 for locations) (Foss, 2007). These data do not exactly match the FSA data because they are for different years, and planting practices change from year to year.

Neither sugar beet root crops nor sugar beet seed crops are grown in the part of western Washington where the majority of the US red table beet and Swiss chard seed production occurs. Very little sugar beet root crop is produced in Washington State; the nearest processing facility is far to the south, in southern Idaho. In 2008, only one county, Benton reported sugar beet production (1,600 acres) (USDA NASS, 2010b). Benton County is in the Columbia Basin on the east side of the Cascade Range. There is no reported production of *Beta* seeds other than minor sugar beet in the Columbia Basin.

Due the extreme distance of this sugar beet production area from the Idaho processing facility, it is very unlikely that anyone would consider growing west of the Cascade range, in the area of other *Beta* production. As set forth in Section 2.3.2, transportation costs and proximity to a processing facility are key limiting factors in where to grow sugar beets.

The locations of red table beet and Swiss chard seed production in California are not known, but sugar beet root crops are grown only in the Imperial Valley, and these are conventional sugar beets.

As discussed in Section 2.7.3, the majority of the US sugar beet seed production occurs in the Willamette Valley where seed production for the various beet products (sugar beet, table beet and chard) is divided along geographical lines. Sugar beet seed is grown in the southern and central portions of the valley, table beet seed is grown in the northern region, and Swiss chard seed is grown at the margins.[29] The total estimated red table beet and Swiss chard seed production in the Willamette Valley in 2010 is 100 to 120 acres (McReynolds, 2010). Based on the FSA data, this appears to be all or virtually all of red table beet and Swiss chard seed production in Oregon.

Commercial seed production for red table beet is similar to that for sugar beet. Seed companies retain ownership of the seed, the growing crop, and the harvested seed. Growers produce and harvest the crop, and are then paid the contract price if the resulting seed meets contract quality criteria, typically an 85 percent seed germination rate and 99 percent purity (Foss, 2007).

Typically, the red table beet crop is planted in seed beds in mid-June. Plants not displaying true varietal characteristics are removed by hand. In October, the beets are topped mechanically, dug, placed in windrows, and covered with about one foot of soil to protect the roots against freezing during the winter. In March or early April, the over-wintered roots (stecklings), are removed from the windrows and brought to Skagit County for transplanting into production fields. Exposure of the roots to the winter season in windrows, followed by transplanting into fields in the spring, vernalizes the stecklings. Seed harvest occurs in late summer and early fall (August to September). The crop is cut, placed in windrows, dried 10 to 14 days in the field, and then threshed mechanically to capture the seed (Foss, 2007).

No information for Swiss chard seed production practices was found.

[29] Morton, 2010, p. 149:24-150:20.

2.8.3 Organic Red Table Beet and Swiss Chard Production

California is the only state for which organic red table beet and Swiss chard production data are publicly available. In USDA's reports, red table beets and Swiss chard are included in the "other vegetable" organic category. California accounts for 76 percent of "other" organic vegetable production within the sugar-beet producing states, and there is very little or no organic production of red table beets, Swiss chard, or leaf beets in the four major sugar beet production states (MN, ND, MI and ID) (Figure 2-5) (USDA, 2010c). The 2007 acreage and dollar value of organic red table beets and Swiss chard in California are shown in Figures 2-6 through 2-9. No data were found for organic seed production of red table beets, Swiss chard or spinach beets.

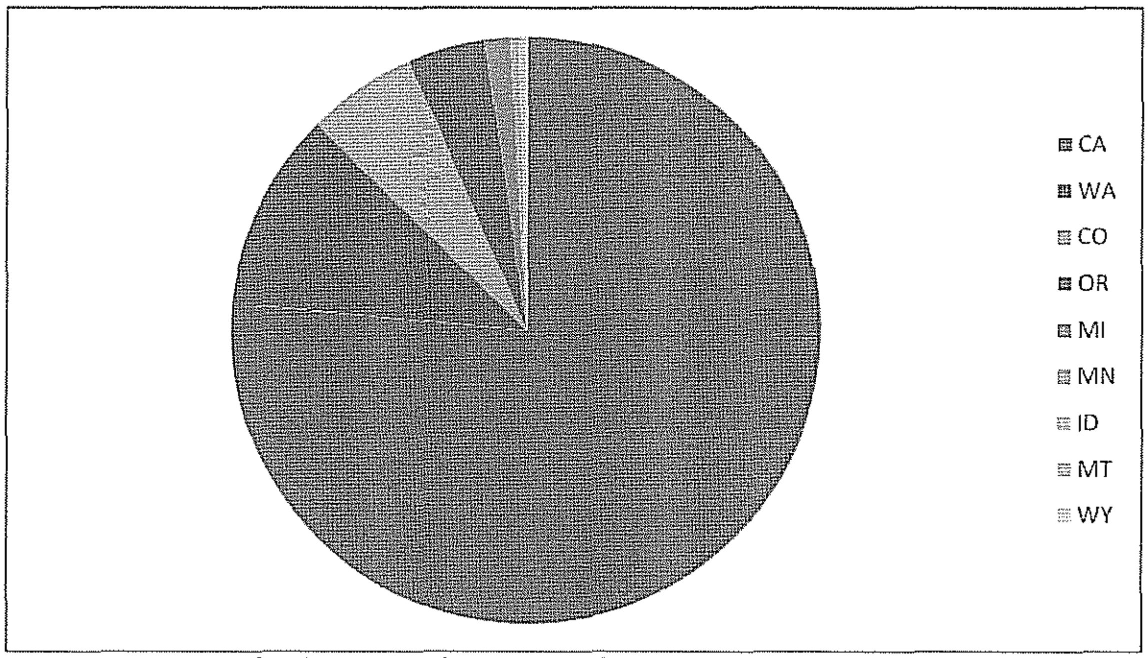


Figure 2-5. Distribution of "other" organic vegetable production across sugar beet producing states, 2008

Source: USDA, 2010c

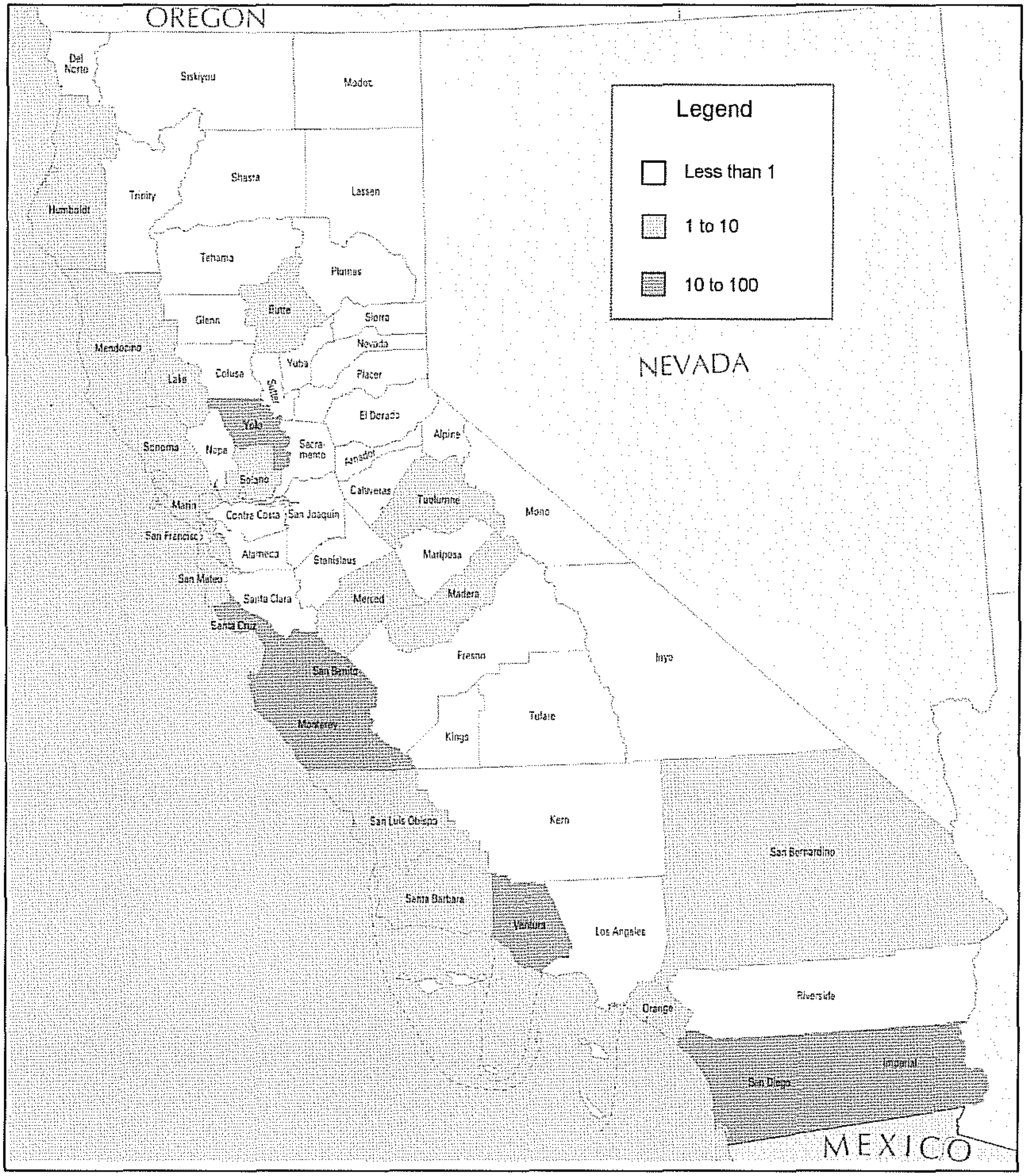


Figure 2-6. California acreage of organic beets (non-sugar), 2007

Source: California Department of Food and Agriculture, 2010

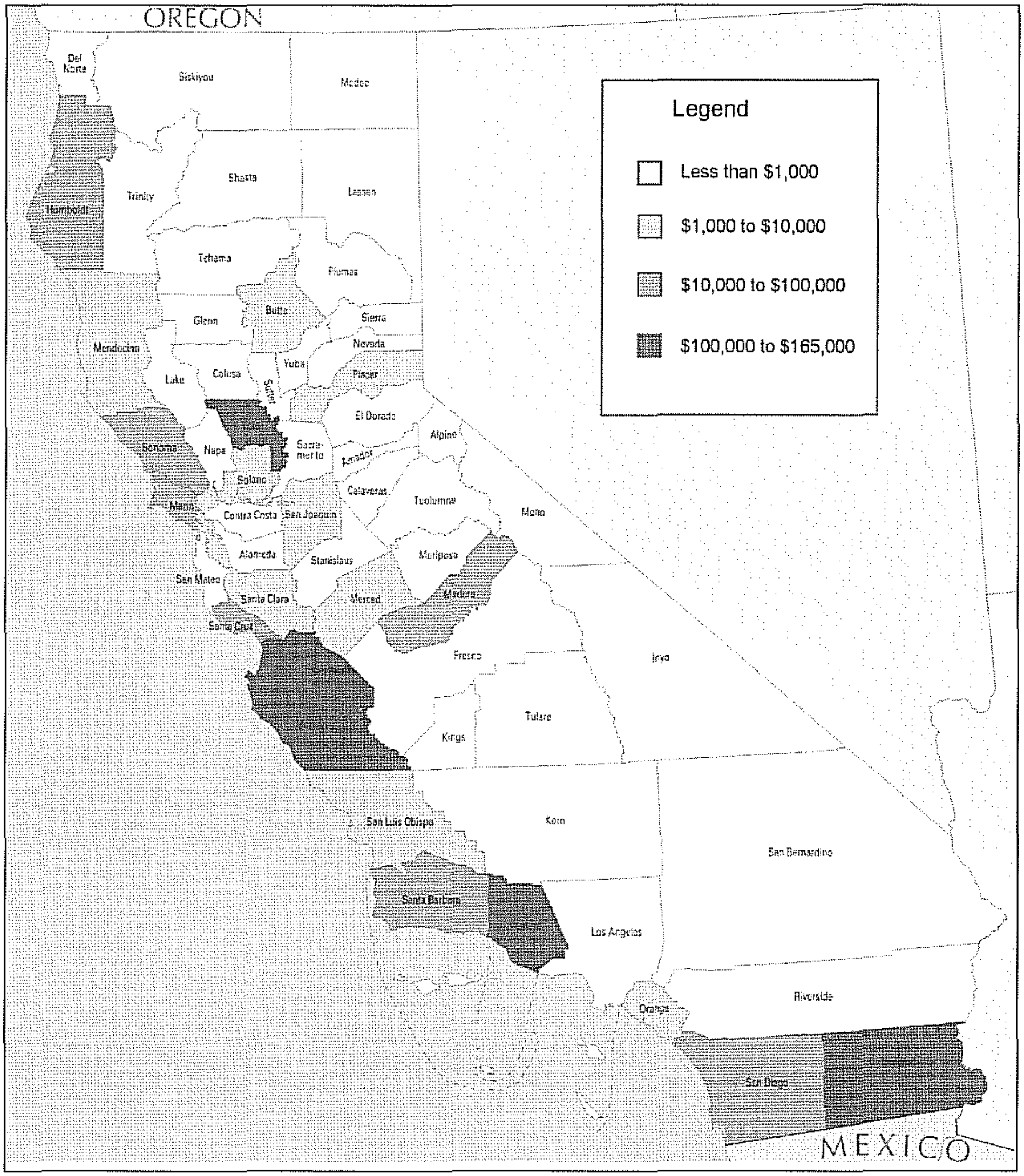


Figure 2-7. California gross sales of organic beets (non-sugar), 2007

Source: California Department of Food and Agriculture, 2010

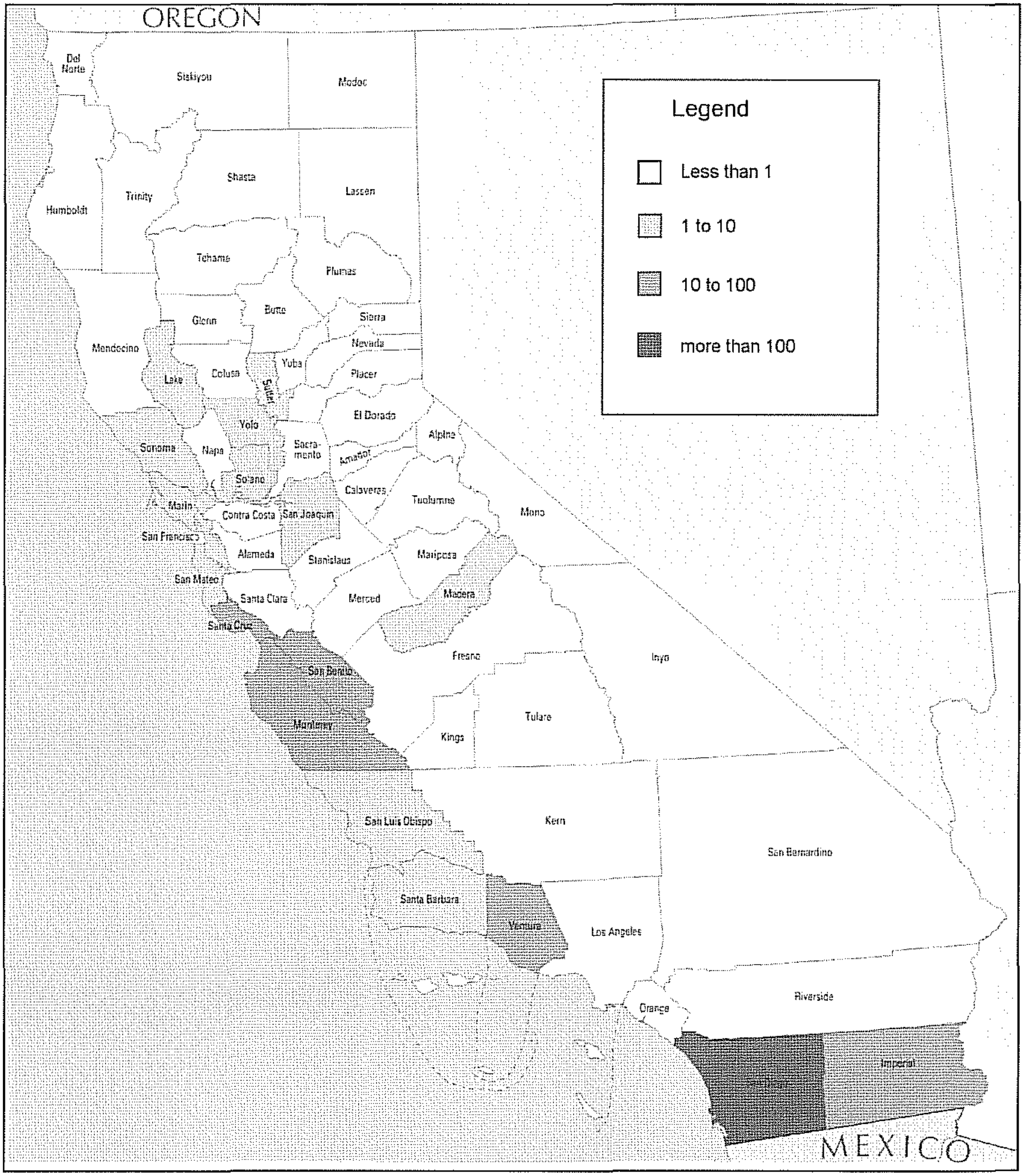


Figure 2-8. California acreage of organic Swiss chard, 2007
Source: California Department of Food and Agriculture, 2010

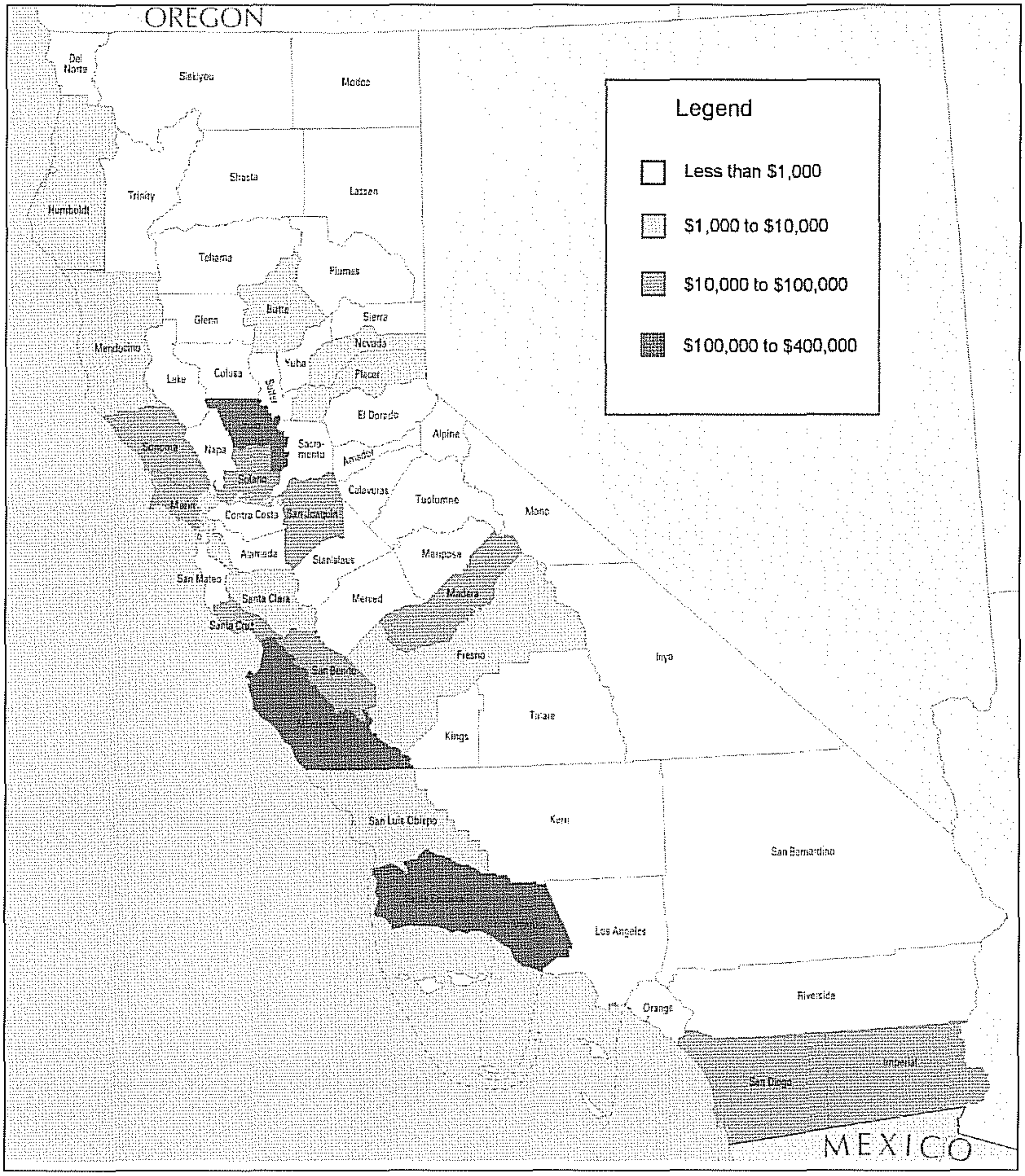


Figure 2-9. California gross sales of organic Swiss chard, 2007

Source: California Department of Food and Agriculture, 2010

2.9 NATIVE AND UNCULTIVATED NON-NATIVE BEETS

Plants that are native to a particular area or ecosystem are those that are not introduced by humans, but occur at those locations without human intervention.

Non-native beets fall into one of three categories: wild plants, weeds and feral beets. Non-native wild beets are those that that were never cultivated, and grow on their own outside of an agricultural/horticultural setting. Weeds, discussed in Section 2.5, included unwanted plants in an agricultural/horticultural setting. Feral beets are those that were originally domesticated, but have escaped cultivation and grow on their own.

2.9.1 Native beets

No native members of the genus *Beta* are found in North America (USDA, 2010a; Mansfeld, 1986, as reported in OECD, 2001, Table 3). Thus, all of the *Beta* species in North America, both cultivated and uncultivated, were introduced through human intervention from outside the continent.

2.9.2 Uncultivated wild beets in the US

Beta species in the US and potential for hybridization with sugar beet

The USDA reports two *Beta* species in the US: *Beta procumbens* and *Beta vulgaris*. Some researchers (e.g., Bartsch and Ellstrand, 1999; Bartsch et al, 2003) consider *Beta macrocarpa* as a separate species; however, USDA ARS reports that the designation was changed in 2000 to *B. vulgaris ssp. macrocarpa* (USDA/ARS, 2010a). *B. procumbens* can be artificially crossed with sugar beet (a *B. vulgaris* subspecies), but the plants usually die at the seedling stage (OECD, 2001, p. 25). In any case, *B. procumbus* in the US has been identified only in Pennsylvania, where sugar beet is not grown (USDA ARS, 2010a). Sugar beet hybridizes with all *B. vulgaris* subspecies, including *B. vulgaris ssp. macrocarpa*. The hybrids are all annuals, flowering in the first year and producing little or no root or sugar yield (Messéan et al, 2009, p. 49).

***B. macrocarpa* (or *B. vulgaris ssp. macrocarpa*).** There is some scientific disagreement about the compatibility of sugar beet and *B. vulgaris ssp. macrocarpa* (referred to hereafter as *B. macrocarpa*, the terminology in all sources except USDA/ARS 2010a). OECD reports that *B. vulgaris* and *B. macrocarpa* are fully compatible and the resulting hybrids are vigorous and fertile (OECD, 2001, p. 24). In contrast, Dr. R.T. Lewellen, a USDA, ARS geneticist who has worked with sugar beet at the USDA/ARS Salinas Research Station for many years has done research on *B. macrocarpa* and has concluded that it does not outcross readily to sugar beet. This is because *B. macrocarpa* usually bolts and flowers too early to cause a risk of hybridization with sugar beet. Additionally, any hybrid of sugar beet and *B. macrocarpa* would possess several genetic factors that pose a challenge to the plants' survival in nature. For example, the hybrid would be mostly pollen sterile and would have disturbed genetic ratios and growth habit. Finally, because *B. macrocarpa* is self-fertile, a cross could only be made with sugar beet by using self-sterile or male sterile sugar beet plants – something which is unlikely to occur in nature (Panella, 2003).

Other researchers have also found that hybridization between *B. macrocarpa* and sugar beet is relatively rare because the flowering times usually do not overlap (Bartsch et al, 2003, p. 108; McFarlane, 1975 as reported in OECD, 2001, p. 24). In addition, based on genetic studies, Bartsch and Ellstrand (1999) report a "strong genetic differentiation between *B. vulgaris* and *B. macrocarpa*, which supports the notion that the latter is a separate species" and find it "remarkable" that hybridization between the two "is still possible" (pp. 1126 and 1129).

Sugar beets have been grown in the Imperial Valley since 1932 (Spreckels Sugar, 2009). As noted above, the earliest dated collected *Beta* specimen is from 1938; however, Bartch and Ellstrand reference observations of uncultivated wild beets in the Imperial Valley from 1928 (Bartsch and Ellstrand, 1999, p. 1126). When Bartsch and Ellstrand did their research in 1998 and found evidence of introgression between *B. macrocarpa* and *B. vulgaris* in two percent of the *B. macrocarpa* tested, sugar beets had been grown in the Imperial Valley for 66 years.

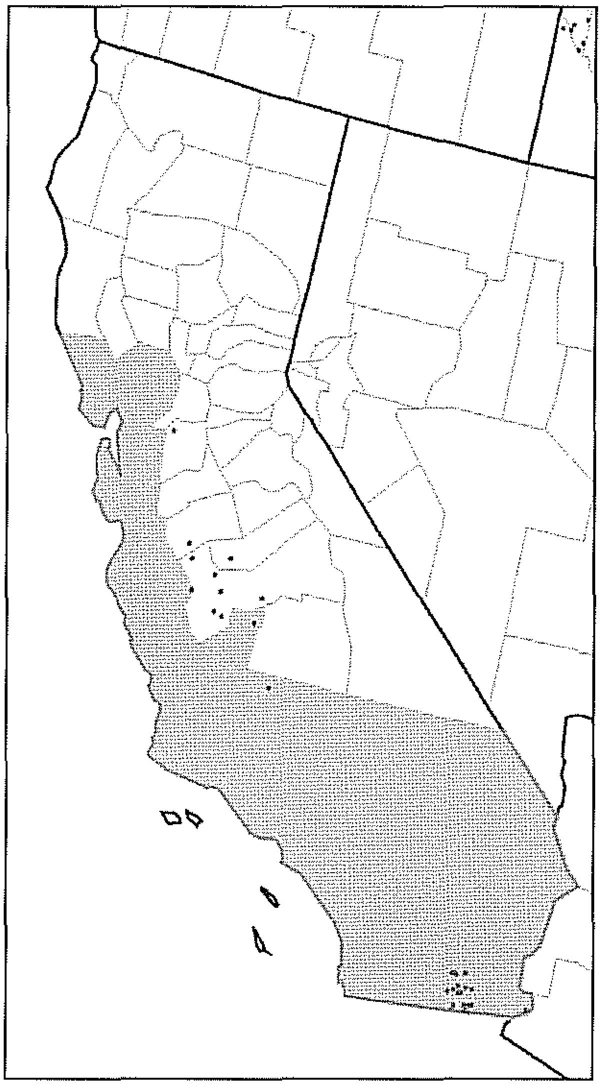


Figure 2-10. All CA counties with *beta* records

Source: Consortium of California Herbaria, 2008

Uncultivated wild beets in California

The USDA/ARS has 13 *B. vulgaris var. maritima*[30] and 7 *B. vulgaris ssp. macrocarpa* collected specimens in its National Plant Germoplasm System, all donated in 1985 by J.S. McFarlane of the USDA ARS Salinas, California office. The two *B. vulgaris ssp. macrocarpa* samples with collection information included were both from the Imperial Valley; one was collected from a sugar beet field in 1968; collection information for the other was not noted (USDA/ARS, 2010a). The Consortium of California, which keeps a database of 16 herbaria (collections of plant specimens) throughout the state, documents 172 *Beta* accessions from 15 counties, collected between 1896 and 2006 (counties show in Figure 2-10 at left) (Consortium of California Herbaria, 2008).

Forty of the specimens are designated *B. macrocarpa*, 19 as *B. vulgaris ssp. maritima*, one simply as *Beta*, and the rest are designated *B. vulgaris*. Seventeen of the accessions are from Imperial County: 14 of these are designated *B. macrocarpa*, one is designated *B. vulgaris*, and one was originally identified as *vulgaris* and later corrected to *macrocarpa*. Imperial County collection dates ranged from 1938 to 1998 (Consortium of California Herberia, 2008). Calflora's database includes herberbia records, plus other documented or recorded observations. California counties with records of *B. vulgaris* or *B. macrocarpa* are shown in Figure 2-12, along with sugar beet production areas (shown as blue dots).

[30] Specimens were originally identified as *Beta vulgaris ssp. maritima*

There have been a number of hypotheses regarding the origin of the California uncultivated wild beets, including that at least some of them are wild (feral) sugar beets (Johnson and Burtch, 1959, as referenced in Bartsch and Ellstrand, 1999, p. 1120). However, based on genetic analysis, Bartsch and Ellstrand (1999) concluded that the uncultivated wild beets in California have two independent and primary genetic origins, one from European *B. macrocarpa* (the uncultivated wild beets found in the Imperial Valley and on the Channel Islands) and one from European *B. vulgaris* (beets from all other areas in California where uncultivated wild beets are found). They found that what they termed the *B. macrocarpa* of the Imperial Valley and the Channel Islands were, with the exception of one population, "genetically identical with a Spanish *B. macrocarpa* from the Mediterranean area of Cartagena" (Bartsch and Ellstrand, 1999, p. 1126). The singe exception was a population in the Imperial Valley of *B. macrocarpa* that showed genetic similarities with *B. vulgaris*, which led them to conclude that the sugar beet (a subspecies of *B. vulgaris*) had introgressed with *B. macrocarpa* (Bartsch and Ellstrand, p. 1126). Bartsch and Ellstrand concluded that the other uncultivated wild beets in California are descended from cultivated Swiss chard and red table beets, European sea beets, and hybridized populations among these (Bartsch and Ellstrand, 1999, p. 1128).

Uncultivated beets in other sugar beet seed or root production regions

One record for uncultivated *B. vulgaris* was found for Oregon: a specimen collected in 1998 from Corvallis in Benton County, by Andrew A. Duncan (Rice, 2010). Two records for uncultivated *B. vulgaris* were found in Michigan, one of which was in Tuscola County, which is in the Great Lakes Region of sugar beet production (USDA 2010a). USDA shows five counties in western Montana with *B. vulgaris* records (Madison, Gallatin, Ravilli, Missoula, Pondera and Cascade), based on Booth and Wright's 1996 *Flora of Montana* (USDA 2010a). None of these counties are in that part of Montana included in the Great Plains Region of sugar beet production (Figure 2-2). In addition, Rice (2010), a more updated source, shows no *Beta* records for Montana (2010). While there is widespread information about uncultivated beets in California, no other information was found other than that summarized here for uncultivated beets in any other sugar beet seed or root production areas. Since these records indicate only "*B. vulgaris*" it is not possible to determine from the information whether these plants are sugar beets or some other subspecies.

In addition, USDA has previously concluded that *BetaB. vulgaris* only poses a weed issue for sugar beet crops in the Imperial Valley of California (USDA APHIS, 2005).

> **DEFINITIONS**
>
> ***Ecosystem*** – *the complex of a community of organisms and its environment.*
>
> ***Species*** – *group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.*
>
> ***Introduction*** - *intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.*
>
> ***Native species*** – *with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or occurs in that ecosystem.*
>
> ***Alien species*** – *with respect to a particular ecosystem, any species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not native to that ecosystem.*
>
> ***Invasive species*** - *alien species whose introduction does or is likely to cause economic damage or environmental harm or harm to human health.*
>
> ***Invasive plants*** – *introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak problems.*
>
> Sources: Executive Order 13112 – Invasive Species (1999); USDA National Agricultural Library, 2010.

2.9.3 Weed beets

Beets (genus *Beta*) generally are not weeds: there are no *Beta* species included in the Weed Science Society of America's (WSSA) list of 3,488 weeds (2010a). No *Beta* species are included among the 1,553 weeds in the USDA database of invasive and noxious weeds (USDA, 2010b).

Weed beets in European sugar beet production

We discuss the problem of weed beets in European production fields because it is a concern in Europe and may raise questions about whether the same issues may occur in the US, and, if so, what impact the use of event H7-1 sugar beet would have. Weed beets have been a serious problem in European sugar beet production since the 1970s (May, 2001; Desplanque et al, 2002; Ellstrand, 2003). In 2000, some sugar beet fields in the EU were growing more weeds than beets (Ellstrand, 2003). Weeds of the same or closely related species as the crop can present special problems. Their seeds and young plants may be indistinguishable, and they will have very similar responses to herbicides. Unlike sugar beets, the weed beets flower in the first year, and produce many seeds. Because they are the same species, any herbicide that is effective on the weed beet will also damage or destroy the sugar beet. Thus, the weed beets must be manually removed, and the grower often does not find that the weed beets are not sugar beets until they bolt. The weed beets form a seed bank that can persist for years. While weed beets and native sea beets grow in many parts of Europe, the weed beets in the production fields apparently do not originate from weeds near the production fields. In the 1990s, the problem was traced to hybridization of weed beets with the sugar beets grown in seed production areas (Ellstrand, 2003, p. 70-73). Sugar beet and sea beet (*B. vulgaris ssp. maritima*) hybridize freely and the resulting progeny are fully fertile. Sugar beet and sea beet also share a common flowering period. Sugar beets are grown in many parts of Europe, but seed production occurs mainly in the temperate climate regions of southwest France and northeast Italy, where weed beets are also present (Bartsch et al, 2003).

While the sugar beets and weed beets introgress with each other, and the weed beets and the native sea beets that grow along much of the Atlantic European and the Mediterranean also introgress with each other, in a century of sugar beet production, gene flow from sugar beets has not altered the genetic diversity of wild sea beets in the region, including in the seed production areas (Bartsch et al, 2003).

Weed beets in the Imperial Valley

In the US, the only reports of weed beets as a problem have been in sugar beet production in the Imperial Valley (Lewellen et al, 2003; Bartsch et al, 2003; Lilleboe, 2009). The weed beet situation in the Imperial Valley is very different from that in Europe. The weed beets in Europe originated from seed production fields, where the sugar beet plants and nearby wild beets all flower at the same time, and the resulting hybrids apparently contaminated the seed supply. Thus, the European weed beets in sugar beet root production fields originated from the inadvertent planting of the weed beet seeds along with the sugar beet seeds. In the Imperial Valley, the weed beets are *B. macrocarpa*, which were present in the Imperial Valley before the introduction of sugar beets, and have coexisted with sugar beets since 1938 with very little hybridization (Bartsch and Ellstrand, 1999; Bartsch et al, 2003).

2.9.4 Feral crops

Based on available data, de-domestication has occurred in only a few crops. These feral crops are of minor importance compared with other weeds (Gressel, 2005). In North America, the feral plants that cause much of the economic damage are imported horticultural plants; for example, Japanese privet (*Ligustrum japonicum*), Japanese honeysuckle (*Lonicera japonica*) and kudzu (*Pueraria lobata*) (Gressel, 2005).

Scientists from Oregon State University report that there are no feral sugar beet crops in the US (Mallory-Smith and Zapiola, 2008, Table 1). As discussed in Section 2.5.3, in California, the only sugar beet growing state with documented beet populations (as opposed to the isolated reports from a few other locations), genetic assessment of uncultivated wild beets has not supported the conclusion that any of these beets are feral crops.

Based on this information, and the poor competitive characteristics of sugar beets, we have concluded that the existence of feral sugar beet crops in the US is unlikely, and any that might exist are negligible.

2.10 FOOD AND FEED USES OF SUGAR BEET

In addition to producing granulated sugar, sugar beet processing facilities produce a co-product known as dried beet pulp. Pulp is the dried fiber residue left after most of the sugar has been extracted from the sliced beets. Dried beet pulp is typically sold as either a shred (with or without molasses added) or in pellet form for animal feed. Beet molasses is produced in quantities ranging from 4 percent to 5 percent of the weight of the beets and contains about 50 percent sugar. Beet molasses is used for production of yeast, chemicals and pharmaceuticals, as well as in the production of mixed cattle feeds (Southern Minnesota Beet Sugar Cooperative, 2010a).

Multiple countries that regulate the importation of biotechnology-derived crops and derived products have granted regulatory approval to event H7-1 sugar beets for food and feed uses, including Japan, Canada, Mexico, European Union, South Korea, Australia, New Zealand, China, Colombia, Russian Federation, Singapore, and the Philippines (FSANZ, 2005; Monsanto/KWS 2007; Berg 2010). Canada and Japan have also approved event H7-1 sugar beets for cultivation in those countries (Sato, 2008; CFIA, 2005).

2.11 PHYSICAL AND BIOLOGICAL ISSUES

The affected environment for land use, air quality, water quality, ecology, threatened and endangered species, and other sensitive wildlife is the area in the sugar beet root producing areas (shown in Figure 2-1) and in the seed producing region in the Willamette Valley, the seed producing region (Figure 2-4). The affected environment for climate is global, as impacts on climate change are global issue.

2.12 SOCIOECONOMICS AND HEALTH

The affected environment for socioeconomic issues includes those individuals or groups who could be economically impacted if their food, feed, or agricultural products are adversely affected by event H7-1. It also includes those who would be economically impacted if event H7-

1 becomes a regulated article: growers of event H7-1 sugar beets, sugar processors, seed companies, and sugar marketers and sugar buyers. Potential impacts to the first group are discussed primarily in Section 3.11 and impacts to the second group are discussed in Section 3.16. The potential for health impacts to individuals who may come into contact with glyphosate-tolerant sugar beets or beet seeds, or sugar or other products derived from glyphosate-tolerant sugar beets is discussed in Sections 3.11 and 3.15. Health effects of potential exposure to herbicides are discussed in Section 3.15.

Section 3 of this ER examines the possible impacts of a partial deregulation of H7-1 or similar administrative action.

3.1 PLANT PEST PROPERTIES AND UNINTENDED EFFECTS

APHIS previously determined, based on scientific analysis and in accordance with its obligations under the Plant Protection Act, that sugar beet event H7-1 is not a plant pest and does not exhibit plant pathogenic properties (USDA APHIS, 2005).

APHIS considered the potential for the transformation process, the introduced DNA sequences, or their expression products to cause or aggravate disease symptoms in sugar beet event H7-1 and its progeny or in other plants. APHIS also addressed the potential for event H7-1 to become a weed or make other plants that it breeds with into weeds.

APHIS also considered whether data indicate that unintended effects would arise from engineering of these plants. APHIS considered information from the scientific literature as well as laboratory and field data collected during the trials with event H7-1 that was provided by Monsanto/KWS in its petition (included in Schneider, 2003).

Based on the analysis summarized below, there are no impacts resulting from plant pest properties, introduced or aggravated disease symptoms, or unintended effects under any of the alternatives. Details of the Monsanto/KWS studies are included in the petition (Schneider, 2003).

3.1.1 Background

Plant genetic modification

Plant genetic modification by humans ranges from the simple approach of selection – where seeds of plants with desired traits are saved and replanted – to complex methods such as the use of recombinant DNA (rDNA; see definitions on next page). Crossing (and then recrossing) two sexually compatible plants by taking the pollen from one plant and brushing it onto the pistil of another is still the mainstay of modern plant breeding (IM/NRC, 2004). Both conventional breeding and rDNA methods can involve changes in the sequence, order, and regulation of genes in a plant and can use many of the same enzymes. However, with conventional breeding all the tens of thousands of genes in the plant are involved, and with the rDNA method only a few genes are involved. In classical breeding, crosses can be accomplished only between closely related species, and therefore only traits that are already present in those species can be targeted. In contrast, the rDNA approach can use genes from any living organism, thus opening the door to vast potential in trait development (Lemaux, 2008, p. 774; AMA, 2000).

Other examples of plant genetic modification include cell fusion (the protective cell wall is stripped and cells are fused by some external force) and induced mutagenesis (inducing mutations in seeds by ionizing radiation or carcinogenic chemicals) (Ronald and Adamchak p. 88). Mutagenic techniques, which have been in use since the late 1920s, create random mutations and are limited by their inability to target a desired trait (FDA, 1992; Lundqvist, 2009, p. 39).

Agrobacterium

Agrobacterium tumefaciens (*Agrobacterium*) is a soil microbe that has been called "nature's own genetic engineer" because of its ability to transfer a fragment of its own DNA into a host plant (AMA, 2000). (See definitions at right.) The transferred DNA is stably integrated into the plant DNA, and the plant incorporates and expresses the transferred genes. The transferred DNA (T-DNA) reprograms the host plant cells to grow into callus tissue and produce certain amino acid derivatives that are a food source for the *Agrobacterium*. On a macro scale, the callus tissue growth is called crown gall disease. In the early 1980s scientists developed strains of *Agrobacterium* with T-DNA that lacked the disease-carrying genes ("disarmed" *Agrobacterium*). *Agrobacterium* transformation system has been utilized in the development of a large number of genetically engineered plants in commercial production (IM/NRC, 2004, pp. 28-29). The method uses a DNA molecule called a **vector**

DEFINITIONS

Nucleotide – *basic building block of nucleic acids such as DNA. Each nucleotide is made up of a nitrogen-containing group, a sugar, and a phosphate group.*

Nucleic acid – *a chain of nucleotides.*

DNA – *deoxyribonucleic acid – a type of nucleic acid that acts as the genetic material in most living things.*

Chromosome – *a DNA molecule containing all or parts of the genome of an organism, which has the ability to replicate.*

Genome – *the complete set of genes in an organism.*

Gene – *the basic unit of heredity; it is a segment of DNA on a specific site on a chromosome.*

Amino acid – *one of 20 chemical building blocks for proteins; there are also nonprotein amino acids.*

Catalyst – *a chemical that speeds up a chemical reaction but is not changed by the chemical reaction.*

Enzyme – *a biological catalyst; usually a protein.*

Recombinant DNA (rDNA) techniques – *procedures used to join together DNA segments. Under appropriate conditions, a rDNA molecule can enter a cell and replicate there.*

Mutation – *any change in the base sequence of DNA.*

Diploid – *containing two sets of chromosomes (one from each parent0.*

Sources: Sadava, 2008; IM/NRC, 2004; biology online; GMO Safety, 2010a.

that serves as a carrier to insert T-DNA that contains specific genetic elements. These genetic elements are organized into a **gene cassette,** which consists of a gene encoding for a single biological function plus other genetic elements necessary for the expression of that gene when introduced into the plant. Other elements in the gene cassette include a **promoter**, which can be thought of as the "on switch" for the gene encoding for the desired trait; and a targeting sequence, which makes sure the gene product, typically a protein, ends up in the right location within the cell (such as the chloroplast).

Unintended effects from breeding

Most crops naturally produce allergens, toxins or other antinutritional substances; these often serve the plant as natural defense compounds against pests or pathogens (FDA, 1992). Plant breeders typically monitor the levels of antinutritional substances relevant to their crop. For example, solanine is a naturally-occurring toxin produced by potatoes and is part of the plant's defense against insects and fungus. Potato breeders typically monitor solanine levels and reject lines that generate too much of it (IM/NRC, 2004).

Scientists from the Institute of Medicine (IM) and the National Research Council (NRC) ranked breeding methods according to their relative likelihood of producing unintended effects, which they hypothesized would correspond to the degree of genetic disruption associated with the method. Selection from a homogeneous population was ranked at one end of the spectrum (less likely to produce unintended effects) and induced mutagenesis (from chemicals or radiation) was ranked at the other end (more likely). *Agrobacterium* transfer of rDNA was among the methods ranked in between (IM/NRC, 2004, Figure ES-1). Recent studies in Europe comparing transgenic and conventional barley suggest that conventional breeding may cause more unintended effects than rDNA methods, likely because of the very large number of genes that are affected in conventional breeding techniques (Sonnewald, 2010). These results are consistent with those observed by APHIS with event H7-1 and many other plants produced through rDNA methods: except for the intended trait, the GE plant is found to be substantially equivalent to its non-GE counterpart.

Glyphosate tolerance

As discussed in Section 2, glyphosate acts by inhibiting the action of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase, EPSPS, in plants. EPSPS is a catalyst for a reaction necessary for the production of certain amino acids essential for plant growth. When plants are treated with glyphosate the EPSPS enzyme is inhibited, they cannot produce the amino acids needed for continued growth and eventually die. The EPSPS protein and the reaction it catalyzes are present in all plants and microbes. There are variations in the amino acid sequence of EPSPS among different plants and bacteria. Glyphosate tolerance is achieved by introducing an EPSPS enzyme, termed CP4 EPSPS, that is not inhibited in the presence of glyphosate. An *Agrobacterium* strain (designated CP4) was the source of the *cp4 epsps* gene that encodes for the CP4 EPSPS enzyme (Schneider, 2003). The CP4 EPSPS enzyme carries out the same enzymatic reaction in the plant as the native EPSPS; however, when plants that contain the CP4 EPSPS are sprayed with glyphosate, they are able to continue to produce the essential amino acids needed for plant growth. The objective of the genetic modification in event H7-1 was to simplify and improve weed management practices in sugar beet by conferring tolerance to glyphosate.

Transformation system

Event H7-1 was developed using a disarmed *Agrobacterium*-mediated transformation of a sugar beet variety used in plant breeding. Cotyledons (part of the seed embryo) derived from sterile seedlings of the diploid sugar beet line 3S0057 were used as the explant source. An explant is any portion of a plant that is to be used to initiate culture. These cotyledons were immersed in an *Agrobacterium* suspension and co-cultured for two to four days. The explants were then transferred to selective media containing 500 mg/l carbenicillin to eliminate the *Agrobacteria*. Glyphosate was used for selection of glyphosate-tolerant tissue, with tissue containing a genetic insertion to confer glyphosate tolerance assigned a unique number, such as event H7-1. After approximately seven weeks, the developed plantlets were transferred to rooting media and placed in a greenhouse. All subsequently developed event H7-1 sugar beet breeding lines and variety candidates were derived by traditional plant-breeding methods (Schneider, 2003, pp. 20-21).

DNA sequences inserted into sugar beet event H7-1

Data supplied in the petition and reviewed by APHIS (Section V.A., pp 29-44) support the conclusion that event H7-1 contains the following gene cassette:

1) a promoter from a modified figwort mosaic virus,

2) targeting sequence from the plant *Arabidopsis thaliana*,

3) the EPSPS gene from *Agrobacterium* sp. strain CP4, and

4) a portion of a gene from pea that directs genetic processing

This same gene cassette is present in other Roundup Ready® cotton and canola, which have previously been deregulated by USDA (Schneider, 2003, p. 24). The non-coding promoter is from the plant pathogen figwort mosaic virus. The promoter cannot cause plant disease and serves a purely regulatory function for the EPSPS gene. The CP4 EPSPS gene does not cause disease and has a history of safe use in a number of genetically engineered plants (e.g., corn, cotton and soybean varieties).

3.1.2 Evaluation of intended effects

Analysis of inheritance

Data was provided and reviewed by APHIS that demonstrates stable integration and inheritance of the EPSPS gene cassette over several breeding generations. Statistical analyses show that glyphosate tolerance is inherited as a dominant trait in a typical Mendelian manner (Schneider, 2003, Table V-2, pp. 45-46).

Analysis of gene expression

The level of CP4 EPSPS protein was determined from tissues collected from field trials with event H7-1 conducted at several locations. Using standard laboratory techniques, protein concentrations from H7-1 beet leaves and processed roots (brei) were determined (Schneider, 2003, Table V-3, p. 50). EPSPS proteins are ubiquitous in plants and microorganisms and have not been associated with hazards from consumption or to the environment. Crops that contain the CP4 EPSPS protein have been granted non-regulated status have included corn, soybean, cotton, rapeseed and sugar beet (USDA APHIS, 2010a). In 2009, significant acreages of corn (59 million acres or 68% of the total corn acres), upland cotton (6.3 million acres or 71% of the total cotton acres) and soybean (70.5 million acres or 91% of the total soybean acres) grown in the US were planted with herbicide tolerant varieties (USDA NASS, 2010c). Although the data include all herbicide tolerant varieties, glyphosate tolerant ones (containing CP4 EPSPS) predominate. All have also undergone FDA review (FDA, 2010).

Analysis of the intended trait

Numerous field trials were conducted in the US (Schneider, 2003, Tables VI-4 to VI-6) and in Europe (Schneider, 2003, Table VI-7) to evaluate event H7-1 in different genetic backgrounds and in different environments. Standard field trials evaluated 1) agronomic performance, 2) disease and pest resistance performance, 3) steckling (seedling) production and 4) seed multiplication. Standard industry farming practices for the various locales was used in these trials. These practices would typically include control measures for weeds, diseases and insects. Where glyphosate was used in trials, no negative impacts from application glyphosate were noted.

3.1.3 Evaluation of possible unintended effects

Disease and pest susceptibility

In trials conducted from 1998 to 2002, qualitative and quantitative data addressing disease susceptibility and overall agronomic performance of event H7-1 were collected to assess possible effects from introduction of the CP4 EPSPS gene cassette. As summarized below, information collected from these trials indicate that event H7-1 does not alter sugar beet's susceptibility to diseases and pests. Experience in production fields since 2007 supports this conclusion.

Nursery trials in US. During the 2000 and 2001 growing seasons, quantitative data was collected from variety trials at Betaseed nurseries for comparison of varieties with event H7-1 to conventional varieties for relative resistance to four common sugar beet diseases: *Cercospora* leaf spot, *Aphanomyces* root rot, *Rhizoctonia* root rot, and curly top virus. In these trials, results of season-long testing for disease susceptibility from one to three varieties with the H7-1 event were compared with four conventional varieties. The results indicated that the disease susceptibility of the H7-1 varieties was within the range of the conventional varieties (Schneider, 2003, Section A.1).

Field trials in US. A total of 98 separate Monsanto/KWS field trials were conducted in the US from 1998 to 2002 included comparative evaluation of susceptibility to the four diseases evaluated in the nursery trials, plus several fungal seedling diseases and Rhizomania (Schneider, 2003, Section VI.A.2). Together, these are the major diseases of economic importance affecting sugar beet production in the US (Schneider, 2003, p. 60). At all but six trial locations there were no differences observed between the event H7-1 varieties and the conventional comparators. At one trial site increased susceptibility to powdery mildew was noted while at three other sites decreased susceptibility was noted. At two trial sites increased susceptibility to *Cercospora* leaf spot was also noted. Given the interactions between the environment, the genetic backgrounds of the cultivars used and some inherent genetic variability within sugar beet varieties, these results are not unexpected and do not indicate an increased pest risk. A similar likely insignificant difference was noted in a greenhouse trial using different *Fusarium* fungus isolates. Other researchers have suggested that it may be difficult to predict field results from greenhouse/ laboratory experiments control lines or differences outside the range of conventional sugar beet norms.

Field trials in Europe. Additional field trials were conducted with event H7-1 in Europe in 1998 and 1999 and monitored for several diseases and nematode worms. No diseases or nematode symptoms were reported in any of the trials for either event H7-1 or conventional control sugar beets (Schneider, 2003, Section A.3).

Gene silencing

In evolutionary biology, a homologous trait is one derived from a common ancestor that appears in multiple species. Homology may be manifested on a macro scale, for example, in the similarity in mammal forelimbs, and on a genetic scale, in DNA sequences. Al-Kaff, et al.(1998) have noted gene silencing effects when transgenic plants have been infected by a virus with DNA sequence homology to a portion of the introduced genes. The only virus-derived DNA in the event H7-1 gene cassette is the promoter, which is from the figwort mosaic virus. None of the viral diseases of beet is related to figwort mosaic virus (Whitney and Duffus, 1986) so silencing of the EPSPS gene would not be expected, and has not been observed.

Compositional evaluation

Monsanto/KWS compared the composition of event H7-1 sugar beets with conventional sugar beets derived from the same parent line ("near isogenic control line"). To eliminate the influence of normal genetic variation between different hereditary lines and varieties, isogenic lines are usually used as a standard for comparison (GMO Safety, 2010a). The analysis of H7-1 sugar beets for compositional changes was included in Section VI.C of the petition (Schneider, 2003) and was also part of the Monsanto/KWS submission to FDA in the consultation process (See Section 3.11 for a discussion of the FDA consultation process and results). While FDA uses these data as indicators of possible nutritional changes, APHIS views them as a general indicator of possible unintended changes.

Compositional analyses evaluating carbohydrates, proteins, fiber, fat, sugars, the antinutrient saponin, and eighteen amino acids (a total of 55 statistical comparisons) in tops (leaves) and roots (brei) identified seven statistically different values compared with the near isogenic control line. All analyses fell within the range of values observed for both the near isogenic control line and conventional sugar beet varieties, providing additional evidence that event H7-1 sugar beet does not exhibit unexpected or unintended effects (Schneider, 2003).

3.2 WEEDINESS PROPERTIES, VOLUNTEERS AND FERAL CROPS

This section addresses two questions:

1. What are the weediness properties of sugar beet?
2. Is the event H7-1 sugar beet more likely to become a weed than a conventional sugar beet?

3.2.1 Weediness properties of sugar beet

As discussed in Section 2.5, sugar beets (*B. vulgaris*) are poor competitors with both weeds and other crops (i.e., beet can compete only with members of their own species). This is discussed in Section 3.8.

3.2.2 Event H7-1 sugar beet and weediness

Some scientists, for example, Ellstrand, 2006, have raised the question of "unintended crop descendents from transgenic crops." Ellstrand states (p. 116): "The possibility of unintended reproduction by transgenic crops has raised questions about whether their descendents might cause problems. These problems have fallen into two broad categories: first, the direct feral descendents of the crops may prove to be new weeds or invasive plants, and second, that unintended hybrids between transgenic crops and other plants could lead to certain problems." This section discusses the weediness properties of H7-1 sugar beet, and addresses the concern of direct descendents of the crop that "may prove to be new weeds or invasive plants." Hybridization is addressed in several later sections.

Event H7-1 was field tested in North America from 1998 to 2003 and in Europe from 1998 to 1999. In these trials, no differences were observed between H7-1 lines and non-transgenic lines with respect to the plants' ability to persist or compete as a weed (Schneider, 2003; USDA APHIS, 2005). In these evaluations, APHIS considered data relating to plant vigor, bolting, seedling emergence, seed germination, seed dormancy and other characteristics (USDA APHIS, 2005).

In a separate evaluation, the Canadian Food Inspection Agency (CFIA), whose responsibilities include regulation of the introduction of animal food and plants (including crops) to Canada, reached the same conclusion about the weediness potential of event H7-1 compared with non-transgenic sugar beet. In 2005, the CFIA authorized the "unconfined release into the environment and livestock feed use of the sugar beet event H7-1" (CFIA, 2005). In its evaluation of event H7-1, CFIA "determined that germination, flowering, root yield, susceptibility to plant pests and diseases typical to sugar beet and bolting percentage were within the normal range of expression of these traits currently displayed by commercial sugar beet hybrids" (CFIA, 2005). The CFIA reached the following conclusions (CFIA, 2005):

> No competitive advantage was conferred to these plants, other than that conferred by tolerance to glyphosate herbicide. Resistance to Roundup® agricultural herbicides will not, in itself, render sugar beet weedy or invasive of natural habitats since none of the reproductive or growth characteristics were modified.
>
> The above considerations, together with the fact that the novel traits have no intended effects on weediness or invasiveness, led the CFIA to conclude that the H7-1 sugar beet event has no altered weed or invasiveness potential compared to currently commercialized sugar beet.

Thus, the potential for event H7-1 to become a weed or invasive plant was determined to to be no greater than conventional sugar beets. Neither sugar beets or other beta species plants are considered a weed issue in any state other than California.

3.2.3 Sugar beet volunteers

Volunteers, which are plants from a previous crop that are found in a later crop, may result from bolters or groundkeepers. Refer to Section 2.3.4 for a detailed discussion.

Root production

While several scientists have reported that volunteer glyphosate tolerant plants could in theory become a problem in rotational crops when both rotational crops are glyphosate tolerant, none provided specific information or data relevant to sugar beets (e.g., Cerdeira and Duke, 2006; Owen and Zelaya, 2005; York et al, 204; NRC, 2010). Since sugar beet is grown for the vegetable and not the seed, volunteers in a root crop could occur only from the rare plant that has bolted, if it is allowed to go to seed. Groundkeepers are cold sensitive and only rarely survive winter conditions in most sugar beet production areas (Grant, 2010,p. 7; Cattanach et al, 1991; Panella, 2003).

As discussed in Section 2.3.4, bolters deplete the sugar content of the root and cause problems with harvesting. Thus, good management practices and the grower's own interest dictate removal of bolters. Sugar beet varieties are specifically bred to make bolters rare. Volunteers are unlikely even if bolters are not removed because a series of unlikely events must each coincide to produce volunteers. If a bolter is not removed, it must be pollinated by another bolter, and be allowed to go to seed; the seed must then survive the winter freeze and germinate. And even if this does occur, the resulting volunteer would need to successfully compete with the next year's crop, and could be controlled by mechanical means or by several registered herbicides other than glyphosate that can be used on sugar beet volunteers (Meister, 2009). Depending on the rotation crops chosen to follow sugar beet (in the normal 3-4 year rotation), growers can use tillage and/or herbicides. Examples of some herbicides are methylsulfuron methyl, 2,4-dichlorophenoxyacetic acid (2,4 D) and 3,6-dichloro-o-anisic acid (dicamba) for the control of any volunteers prior to planting and after crop emergence.

Seed production

Control of volunteers is more of a concern with seed production, for both conventional and event H7-1 sugar beet, to maintain seed purity. As discussed in Section 2.7.3, WCBS and Betaseed control all seed production in the Willamette Valley. WCBS has detailed requirements in it protocol (in Appendix B of this ER) for post-harvest field management. After harvesting, the fields are shallow tilled and irrigated to promote sprouting of shattered seeds (unless sufficient rainfall to promote sprouting has occurred). Fall plowing is not allowed. After the seed is allowed to sprout, it is controlled by herbicides or other means. All equipment is cleaned according to WCBS procedures before it leave the fields. Fields used for growing event H7-1 are inspected by WCBS "for a minimum of five years or until no volunteers are noted (Appendix B). Betaseed has similar requirements.

3.2.4 Impact summary

Alternative 1

Under Alternative 1, there would be no impact from event H7-1 1 on weediness or volunteers.

Alternative 2

Weediness properties. Based on the information summarized in the subsection, APHIS has concluded that sugar beet does not exhibit weediness properties, and that event H7-1 does not exhibit any altered weediness properties when compared with conventional sugar beet. Therefore, Alternative 2 would not impact the weediness characteristics of sugar beet.

Feral crops. As explained in Section 2.9, the existence of feral sugar beet crops in the US is highly unlikely, and any population that may exist would be negligible. Because there are no known or suspected feral crops of sugar beets in the US, Alternative 2 would not impact feral sugar beet crops.

Volunteers in root crop fields. Volunteers resulting from root crops are generally not a concern because the crop is harvested in the vegetative stage, bolters are generally rogued (removed), and the occasional volunteer would be unlikely to survive the winter freeze and could be controlled by other means than glyphosate. The interim measures further reduce the potential for any volunteers resulting from a root crop by requiring complete control of bolters. Under the proposed interim measures, all event H7-1 root crop growers will have measures in place that require them to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed (Item 5). Therefore, no or negligible impacts from event H7-1 volunteers in root crop fields would be expected under Alternative 2.

Volunteers in seed production fields. Managing volunteers in seed production fields is an important part of seed growers' efforts to maintain seed purity. WCBS and Betaseed have protocols in place to force same-year sprouting of seed left behind in the production field, plus long-term monitoring (five years for WCBS) of production fields to identify and remove any volunteers. The interim measures contain a universal requirement to force same-year sprouting, of any event H7-1 seed left behind in the production field, and subsequent removal and destruction of plants (Item 4.j); 3-year monitoring of fields for volunteers along with removal and destruction (Item 4j); employee training (Item 4k); recordkeeping to document compliance (Item 4m); and third-party audits for compliance (Item 7). Given the existing industry standards coupled with the mandates of the interim measures to control volunteers, no or negligible impacts from event H7-1 volunteers in seed production fields would be expected under Alternative 2.

3.3 IMPACTS OF EVENT H7-1 SUGAR BEET ROOT CROPS ON CONVENTIONAL SUGAR BEET CROPS

This section considers the possibility of impacts from event H7-1 sugar beet crops on conventional sugar beet crops through gene flow (refer to Section 2.4 for a general discussion of gene flow), or by mixing in harvesting, transportation, stockpiling, or processing.

3.3.1 Pollen sources in production fields

As discussed throughout this document, in production fields sugar beets are grown for their roots and are harvested before they flower. The only sources of event H7-1 pollen in production fields would be from uncontrolled bolters. Refer to Section 2.3.4 for a detailed discussion of bolting.

3.3.2 Potential for gene flow in root production fields

Because sugar beets are harvested in the vegetative stage, before they flower, there is little potential for cross-pollination between root production fields. Cross-pollination, if it occurred could potentially result in adventitious (inadvertent) presence of genetic material from the crop in one field into a nearby crop's field. Scientists from Oregon State University report that for sugar beet "gene flow via pollen or seed in root production fields is generally not an issue" (Mallory-Smith and Zapiola, 2008, p. 433). Messéan et al concur: "the potential for adventitious presence of GM material in non-GM sugar beet production is low through cross-pollination since the harvest is vegetative" (2009, p. 49). The European Commission (the executive body of the European Union [EU]) Scientific Committee on Plants (2001) also assessed the potential for adventitious presence of event H7-1 sugar beet at various stages of farm production. The Committee identified seed production as the major potential source of adventitious presence, with other sources, including planting, cultivation, cross-pollination, volunteers, harvesting and production all with no or minor potential contributions (p. 8).

Because pollen dispersal is a concern with sugar beet seed production, it is discussed in detail in the analysis of impacts in seed production (Section 3.9). The Section 3.9 discussion evaluates distances over which cross pollination may occur; this is an issue with little relevance to root production.

3.3.3 Potential for mixing of event H7-1 and conventional sugar beets

As discussed in Section 2.2, 95 percent of sugar beet seeds planted in the US in 2010 were glyphosate-tolerant. Except in California, where only conventional sugar beet has been grown to date, production, processing and marketing within the industry no longer distinguishes between event H7-1 and conventional sugar beet crops—they are processed and marketed together. The 22 sugar beet processing facilities in the US process a combination of event H7-1 and conventional sugar beets. As discussed in Section 2.3, no currently operating sugar beet processing facilities have been built in the US since 1975. Because a processing facility is required for sugar production, the 22 processing facilities account for all the beet sugar produced in the US. Markets have been available for the sugar, beet pulp, molasses and other products (Kaffka and Hills, 1994, p. 2; California Beet Growers Association, 1998; Western Sugar Cooperative, 2006a; Michigan Sugar Company, 2010b; American Crystal Sugar

Company, 2009; Minn-Dak Farmers Cooperative, undated; Snake River Sugar Company, 2009).

3.3.4 Consequences of gene flow in production fields

We have found no reports of cross-pollination between event H7-1 sugar beet root production fields and conventional sugar beet crops since event H7-1 sugar beets were first grown in production fields in limited quantities the US in 2006. As discussed above, because sugar beets are harvested in the vegetative stage, bolters are uncommon, and it is good management practice to remove bolters, pollen movement, or gene flow between event H7-1 and conventional crops is expected to be minimal.

If bolters occurred in two nearby fields, one with event H7-1 and one with conventional sugar beets, and the bolters were not controlled and were allowed to flower, a conventional plant could potentially become fertilized with event H7-1 pollen, and the resulting seeds may contain the event H7-1 trait. This occurrence would not affect the conventional sugar beet crop because it would be harvested before these new resulting seeds grew into sugar beet plants, if they did. If the seeds germinated and the resulting plants survived the winter, which is unlikely in most sugar beet production areas, the volunteer plants would appear in the conventional sugar beet farmer's next rotational crop, and (if they survived) would be treated as weeds, as described in Section 3.3, and would be eliminated.

There is evidence that growers pay close attention to bolters. All growers that submitted declarations in the sugar beet litigation declared that bolters are easy to spot in their fields and if seen they would destroy them. There is no evidence that we have seen to the contrary. Any conventional sugar beet grower concerned about this occurrence could prevent it by controlling bolters in his sugar beet crop, which is normally stewardship for any sugar beet crop.

3.3.5 Potential consequences from mechanical mixing

With the exception of the Imperial Valley where only conventional sugar beets have been grown, grown, commingling of harvested beets from H7-1 seed and conventional seed has occurred since 2007, with no consequences.

3.3.6 Impact Summary

Alternative 1

Under Alternative 1, there would be no gene flow impact from event H7-1 root crop production to conventional sugar beet crops.

Alternative 2

Gene flow. Even without the interim measures, impacts from event H7-1 sugar beet root crops to conventional sugar beet root crops have not occurred and would not be expected because: 1) sugar beets are harvested in the vegetative stage, before they flower; 2) if bolting and cross-pollination occurred in nearby fields, the root crop would not be affected; 3) any conventional grower who wanted to be certain of preventing cross pollination could do so by controlling bolters in his own root production fields; 4) a volunteer event H7-1 hybrid appearing in a subsequent crop resulting from cross pollination in root production fields can be controlled using standard weed control practices and would not likely survive the winter in most growing areas in any event.

The interim measures further reduce the potential for gene flow from event H7-1 root crops to conventional root crops by requiring complete control of bolters. Under the proposed interim measures, commercial event H7-1 root crop growers will have measures in place that require them to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed (Item 5). Item 6 of the interim measures requires event H7-1 processors or cooperatives to survey, identify, and eliminate any bolters in outdoor storage before they produce pollen or set seed. Therefore, no or negligible impacts from gene flow from event H7-1 sugar beet root crops to conventional sugar beet root crops would be expected under Alternative 2.

Mixing of harvested beets. Currently, by mutual agreement among growers, cooperatives, processors and marketers, event H7-1 sugar beets and conventional sugar beets are harvested, transported, stockpiled, processed and marketed without distinction in all areas except California, where event H7-1 sugar beet has not been grown. No impacts have occurred and none are expected. Through the interim measure (Item 1) prohibiting planting of event H7-1 in California, this status quo will be maintained. Therefore, under Alternative 2, no impacts are expected resulting from mechanical mixing of event H7-1 and conventional sugar beets.

3.4 IMPACTS OFOF EVENT H7-1 ROOT CROPS ON ORGANIC SUGAR BEET CROPS

Based on all available information, we have concluded that there is essentially no organic sugar beet production in the US. The only reference to organic sugar beet production we found was from the State of California, where 0.02 to 0.03 acre of sugar beet production in Los Angeles County was reported from 2002 to 2007, with most recent annual sales of five dollars (California Department of Food and Agriculture, 2010). California is by far the largest producer of organic commodities in the US, accounting for approximately one-third of sales in 2008 (USDA, 2010c, Table 1). USDA tracks production of a number of organic crops, but not organic sugar beets. Although no other information was found, similar production may be occurring in other states.

We have found no other information about organic sugar beet production in the US. As discussed in Section 2.3, all the commercial sugar beet grown in the US is processed into sugar at one of the 22 processing facilities, none of which process organic sugar beets.

3.4.1 Impact summary

Based on the above discussion, neither alternative would be expected to result in impacts to organic sugar beet production, because there is essentially zero organic sugar beet production in the US.

There is a substantial European organic sugar beet business, and American organic farmers may in the future decide to grow organic sugar beets. This would most likely be small-scale production, as no processing facility would be available. The presence of event H7-1 sugar beet would not inhibit the development of an organic sugar beet industry. As discussed in Section 3.4, a grower of organic sugar beets could ensure no cross-pollination from event H7-1 fields by controlling any bolters in his sugar beet crop. As discussed in Section 3.9, organic sugar beet seed is available from European suppliers. Therefore, Alternative 2 is not expected to result in impacts to organic farmers who may choose to grow sugar beets in the future.

3.5 IMPACTS OFOF EVENT H7-1 ROOT CROPS ON OTHER *BETA* (NON-SEED) CROPS

The cultivated forms of *B. vulgaris*, including sugar beet, red table beet, Swiss chard, and spinach (leaf) beets are all varietal members of the subspecies *vulgaris* (*B. vulgaris* ssp. *vulgaris*) (OECD, 2001, Table 2). They are all biennial and all are sexually compatible with sugar beets (OECD, 2001). Whether grown for leaves or roots, beet crops are all harvested in their first year before they produce seed. In addition, as discussed in Section 2.8.1, there is virtually no overlap between sugar beet root production areas and major areas of production of other *Beta* crops.

Most growers purchase seed for their table beet crops; however, a few organic gardeners may allow part of their crop to vernalize then to go to seed and then save the seed for replanting. If a sugar beet production root crop was grown close to a table beet crop that was allowed to go to seed and the sugar beet crop had uncontrolled bolters that flowered at the same time as the other beet crop, there would be some very small potential for hybridization between the sugar beet and other beet. Based on the discussion in Section 3.3, this occurrence would be expected to be exceedingly rare and unlikely to occur. The situation would be no different for event H7-1 or conventional sugar beet. There is no indication that this has occurred since wide scale H7-1 beet root production began in 2008.

3.5.1 Impact summary

Alternative 1

Under Alternative 1, there would be no impacts from event H7-1 root crop production on other *Beta* crops.

Alternative 2

Assuming no interim measure provisions, impacts from event H7-1 sugar beet root crops to conventional sugar beet root crops have not occurred and would not be expected because: 1) sugar beets are harvested in the vegetative stage, before they flower; 2) if bolting and cross-pollination occurred between event H7-1 and other *Beta* vegetable crops, the harvested crop would not be affected; 3) any grower of *Beta* vegetable crops who wanted to be certain of preventing cross pollination could do so by controlling bolters in her own vegetable crop fields; 4) a volunteer event H7-1 hybrid appearing in a subsequent crop resulting from cross pollination can be controlled using standard weed control practices and 5) major production of sugar beet root crops and other *Beta* vegetable crops do not coincide. In addition, among the sugar beet production areas, organic *Beta* vegetable growers, who may sometimes save their own seed, are concentrated in California, where only conventional sugar beet is grown.

The interim measures further reduce the potential for gene flow from event H7-1 root crops to other *Beta* vegetable crops by requiring complete control of bolters. Under the proposed interim measures, all event H7-1 root crop growers will have measures in place that require them to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed (Item 5). Item 6 of the interim measures requires event H7-1 processors or cooperatives to survey, identify, and eliminate any bolters in outdoor storage before they produce pollen or set seed. Therefore, no or negligible impacts from gene flow from event H7-1 sugar beet root crops to other *Beta* vegetable crops would be expected under Alternative 2. The prohibition on growing event H7-1 in California (interim measure Item 1), where the majority of the organic *Beta* vegetable crops in sugar beet production areas is grown, will further reduce the potential for any impact.

In the multiple years of cultivation to date of GT sugar beet on a wide scale, there are no indications that gene flow has occurred.[31]

3.6 IMPACTS OF EVENT H7-1 SUGAR BEET ROOT CROPS ON OTHER *BETA* SEED PRODUCTION AREAS

As discussed in Section 2.8, nearly all red table beet and Swiss chard seed production occurs in western Washington State and in California, where event H7-1 sugar beet root crops are not grown. A small amount of red table beet and Swiss chard seed production occurs in the Willamette Valley, where sugar beet root crops are not grown. Spinach beet seed production, if it exists separately from red table beet and Swiss chard production, is apparently very small.

3.6.1 Impact summary

Alternative 1

Under Alternative 1, there would be no impacts from event H7-1 production on other *Beta* crops.

Alternative 2

Even without the interim measures, impacts from event H7-1 sugar beet root crops to seed production areas for red table beets and Swiss chard (other *Beta* seed crops) have not occurred and would not be expected because: 1) sugar beets are harvested in the vegetative stage, before they flower; 2) seed production for red table beets and Swiss chard does not occur in or near the same geographic areas as event H7-7 sugar beet root production.

Even if the unlikely event there were isolated areas of other *Beta* seed crops outside the main production areas (seed savers) and near sugar beet root crops, the interim measures further reduce the potential for gene flow from event H7-1 root crops to other *Beta* seed crops by requiring complete control of bolters. Under the proposed interim measures, all event H7-1 root

[31] Hofer Decl. (Dkt. #48) ¶ 14; Berg Decl. (Dkt. #39) ¶ 15; Grant Decl. (Dkt. #45) ¶ 18; Lehner Decl. (Dkt. #252) ¶ 6.

crop growers will have measures in place that require them to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed (Item 5). Item 6 of the interim measures requires event H7-1 processors or cooperatives to survey, identify, and eliminate any bolters in outdoor storage before they produce pollen or set seed. Therefore, no or negligible impacts from gene flow from event H7-1 sugar beet root crops to other *Beta* seed crops would be expected under Alternative 2. The prohibition on growing event H7-1 in California and the Western Washington counties where the majority of the US red table beet and Swiss chard seed production occurs (interim measure Item 1), will further reduce the potential for any impact. In the multiple years of wide scale cultivation of H7-1 sugar beets, there have been no indications that that any gene flow has occurred [32]

3.7 IMPACTS OF EVENT H7-1 ROOT CROPS ON NATIVE BEETS

As discussed in Section 2.9, no native members of the genus *Beta* are found in North America. Therefore, gene flow to native beets will not occur under either alternative.

The absence of native *Beta* plants in North American is an important difference for sugar beet production concerns (both event H7-1 and conventional) from other regions of the world, in particular, the EU, where "[i]t is considered essential to preserve the diversity of sea beet [wild *B. vulgaris ssp. maritima*] for any long term plant breeding strategy, and for conservation and study in its own right" (Messéan et al, 2009, p. 40).

3.7.1 Impact summary

Because there are no native beet populations in the US, there would be no impact with either alternative.

3.8 IMPACTS OF EVENT H7-1 CROPS ON NON-NATIVE WILD AND WEEDBEETS

Non-native wild and weed beets are described in detail in Section 2.9. Except for isolated reports in Michigan and Oregon, all the known populations of non-native wild and weed beets in sugar beet root production states occur in California, where event H7-1 sugar beets are not grown. As discussed in Section 2.9, *B. macrocarpa* weed beets are a weed issue in the Imperial Valley, the only major sugar beet production area in California. Even so, research in 1998 found only minor introgression between the sugar beets and *B. macrocarpa* after 66 years of coexistence in the Imperial Valley (Bartsch and Ellstrand, 1999).

[32] Hofer Decl. . (Dkt. . #48) ¶ 14; Berg Decl. . (Dkt. . #39) ¶ 15; Grant Decl. . (Dkt. . #45) ¶ 18; Lehner Decl. . (Dkt. . #252) ¶ 6.

3.8.1 Impact summary

Alternative 1

Under Alternative 1, there would be no effect of gene flow from event H7-1 to non-native wild or weed beets.

Alternative 2

APHIS has previously concluded that there are no issues with weed beet populations in the U.S. outside California. Within the states where event H7-1 root crops are grown, there are reports of non-native wild beets from Montana, Oregon and Michigan. The reports from Montana are dated; more recent data do not indicate the presence of non-native wild or weed beets in Montana. Also, the report was from a part of Montana where sugar beets root crops are not grown. The single report from Oregon is from an area where sugar beet root crops are not grown. One of the Michigan reports was from a county where sugar beet crops are produced. No additional information was found, and weed beets are not reported as a weed problem in sugar beet root production in Michigan (Michigan Sugar Company, 2009). Based on the absence of any information about any uncultivated beet populations in Michigan (and the challenges in surviving winter) non-native wild or weed beet populations are expected to be nonexistent or minor. The only potential for impact from a sugar beet root crop would be by gene flow from an uncontrolled bolter, assuming any non-native wild or weed beet is close enough to the bolter and flowering at the same time, so that it might be pollinated. Based on this information, the potential for impact from sugar beet root production crops on non-native wild or weed beets appears to be negligible. It would be non-existent with the proposed interim measures. Under the proposed interim measures, all event H7-1 root crop growers will have measures in place that require them to survey, identify, and eliminate any bolters in their root crop fields before they produce pollen or set seed (Item 5). Item 6 of the interim measures requires event H7-1 processors or cooperatives to survey, identify, and eliminate any bolters in outdoor storage before they produce pollen or set seed In the multiple years of H7-1 cultivation to date, there have been no issues identified with wild or weed beets.

Non-native wild and weed beet populations exist in California. However, no event H7-1 commercial crops have been grown in California, and Item 1 of the interim measures prohibits growing event H7-1 crops in California.

Therefore, under Alternative 2, no impacts to non-native wild or weed beets would be expected.

3.9 IMPACTS OF EVENT H7-1 SEED PRODUCTION ON CONVENTIONAL SUGAR BEET AND OTHER *BETA* SEED CROPS

It is possible, without proper stewardship, for cross-pollination and gene flow between crop types during seed production, because that is where pollination happens. Also, absent appropriate stewardship measures, physical mixing of seeds is possible during harvesting, seed cleaning, packaging and transport.

3.9.1 Maintaining seed purity, identify and quality

The Federal Seed Act and its implementing regulations[33] establish basic standards for certification of seed, which are carried out by state seed certifying agencies. A state seed certifying agency is created by state law, has authority to certify seed, and has standards and procedures approved by USDA "to assure the genetic purity and identity of the seed certified." Seed certifying agencies' standards and procedures must meet or exceed those specified in the USDA regulations.[34]

However, sugar beet seed is generally not certified, and seed companies have established their own standards, as described in Section 2. There are certified wheat, soybean and corn seed growers who produce their seed to sell to farmers for planting their commercial crops. This issue is not relevant in sugar beets, because <u>none</u> of the sugar beet root growers harvest any sugar beet seed. All sugar beet seed producers sell all of their seed to seed companies to be sold to farmers. Even if sugar beet root growers could save some seed, they have no means for processing it (so it would work in a planter) and providing the appropriate seed treatments and would never take the risk of trying to plant it because of the uncertainty of what they have.

While sugar beet seed is generally not certified, the Oregon Seed Certification Service (OSCS) standards for certified seed and the corresponding isolation distances are reported here, as additional data points on what to expect in seed purity from a given isolation distance. The OSCS has set the following standards for those items for certified sugar beet seed (OSCS, 1993):

- Pure seed, minimum: 99.00%
- Other crops, maximum: 0.10%
- Inert matter, maximum: 1.00%

[33] 7 C.F.R. §CFR 201
[34] 7 U.S.C. §USC 1551(a)(25) and 7 C.F.R. §CFR 201.67

- Weed seed, maximum: 0.10%

Minimum isolation distances required for certified seed are as follows (OSCS, 1993):

- From sugar beet pollen of similar ploidy or between fields where male sterility is not used – 2,600 ft (0.49 mile)
- From other pollinator or genus *Beta* that is not a sugar beet – 8,000 ft (1.5 mile)

The maximum specified OSCS required isolation distance for sugar beet seed production is 10,200 ft (1.9 miles, from other, non-sugar beet *Beta* species) for "stock" seed which has a maximum allowable concentration of "other crop" seed of 0.00% (OSCS, 1993).

3.9.2 Summary of practices for sugar beet seed production

All of the sugar beet seed in the Willamette Valley is produced by either West Coast Beet Seed Company (WCBSC) or by Betaseed (see Section 2.7 of this ER). WCBSC has developed explicit standard operating procedures and grower guidelines that are intended to minimize and/or eliminate the possibility of pollen-flow between fields of related Beta species (See Section 2.7 and Appendix B). Both WCBS and Betaseed belong to the Willamette Valley Specialty Seed Association (WVSSA) and follow the guidelines for isolation and minimum separation distances between fields (Appendix A). The minimum isolation distance from event H7-1 ("GMO") sugar beet and all other open pollinated Beta crops, in both the WCBS protocol and the WVSSA guidelines is four miles. All growers of commercial specialty seed in the Willamette Valley are members of the WVSSA (Loberg, 2010). This includes all commercial companies raising Beta species. The isolation distances required by WVSSA between Event H7-1 sugar beets and other Beta species such as chard or table beets is 2.1 miles further than the maximum required OCCS isolation distance for stock seed discussed above.

Principles of quality assurance for sugar beet seed production have been set forth in an industry-endorsed Code of Conduct (Appendix C). The Sugar Beet Code of Conduct adopted by the beet group of the International Seed Federation (ISF) describes the measures the sugar beet seed industry has taken to deliver high quality varieties, including measures to minimize adventitious presence of transgenic sugar beet seed in non-transgenic Beta seed. The Code of Conduct document has been agreed on by Syngenta Seeds, SESVanderHave, Danisco Seed, Fr. Strube Saatzucht KG, A. Dieckmann-Heimburg, KWS (owns Betaseed), and affiliated companies.

3.9.3 Sugar beet seed production since 2007

Commercial H7-1 sugar beet seed has been produced since 2005, with the first major seed production year in 2006. The total acreage of H7-1 sugar beet in the Willamette Valley since 2008 has been between 4000 and 5000 acres (Gabel, 2010, p. 7; Pierson, 2010, p.10). Only one grower who sells organic beet or chard seed has been identified in the Willamette Valley. That grower produced chard seed on approximately 1-3 acres at the Western margin of the Willamette Valley. He has tested his organic chard seed using a PCR test capable of detecting 0.01% GE content during this period (Morton, 2010, 61:15-62:6). That seed has been tested each year since 2007 and to date has not detected the presence of any H7-1 sugar beet. (Hoffman, 2010a, p. 15; Morton, 2010, 36:8-17, 75:19-77:13, 99:6-21, 112:10-14; Stearns, 2010, 40:4-15, 49:6-16).

In May 2009, an incident was reported involving event H7-1 steckling disposal that raised questions regarding one sugar beet seed company's stewardship and disposal requirements for those materials (Roseboro, 2009). Stecklings are sugar beet roots that may be transplanted into hybrid sugar beet fields. In or around May 2009, the Pro Bark garden store in Corvalis, Oregon procured a quantity of peat moss from Betaseed. Betaseed had used the peat moss to transport a shipment of sugar beet stecklings, and after the shipment had been transplanted, some quantity of stecklings remained in the peat moss. After Pro Bark obtained the peat moss Pro Bark mixed it with potting soil and offered it for sale as a fertile soil mixture. Betaseed learned that the mix was being sold and that it contained some stecklings, and at that point, Pro Bark's records indicated that it had sold portions of the mixture to thirty customers located in the Corvalis and Albany area. Betaseed repossessed the portion of the mixture that had not been sold. Betaseed personnel visited twenty of the thirty customers who had purchased portions of the mixture and removed any stecklings or steckling fragments found in the mixture. The owner of Pro Bark contacted seven additional purchasers and requested that they inspect for and destroy any stecklings they had purchased (Lehner 2010, pp 7-10.)

Betaseed reported that the stecklings found in the mixture after repossessing it were not likely to survive and produce pollen. Most of the stecklings were fragmented, rotting or dead. Also, because a large percentage of Betaseed hybrid sugar beet fields in the Willamette Valley in 2009 had the event H7-1 gene only on the non-pollinating female plant (see Section 2.7), the shipment of stecklings that Betaseed had transported in the peat moss was composed of less than 5% H7-1 male pollinators. Therefore, according to Betaseed, the chances that any steckling in the peat moss was intact, alive and a male H7-1 pollinator were remote. In addition, given the time of year when the fertile mixture was sold, cross-pollination would have been very unlikely even if the stecklings had been able to produce pollen, and there were no subsequent reports of any cross-pollination from the stecklings. Betaseed subsequently revised its Standard Operating Procedures to provide for proper disposal of the peat moss in which it transports stecklings (Lehner, 2010, pp. 7-10).

3.9.4 Measured sugar beet pollen dispersal

Many studies have been done to measure distances over which cross-pollination may occur in *Beta* species, with a range of results (e.g., Bartsch et al, 2003; Chamberlain, 1967; Darmency et al, 2009; Darmency et al, 2007; Fenart et al, 2007). Darmency et al (2009) summarized a literature review of studies on pollen flow in sugar beet (values reported in meters converted to feet):

Authors	Maximum dispersal
Alibert et al (2005)	2.1% at 700 ft
Archimowitsch (1949)	0.3% at 2,000 ft
Bateman (1947)	0.07% at 62 ft
Brants et al (1992)	8% at 250 ft
Dark (1971)	0.1% at 100 ft
Dark (1971)	3,900 ft max (using a pollen trap, not hybrid seed production)
Darmency et al (2007)	1.3% at 920 ft
Jensen and Bogh (1942)	2,600 ft max (using a pollen trap, not hybrid seed production)
Madsen (1994)	0.31% at 250 ft
Saeglitz et al (2000)	40% at 660 ft
Scott and Longden (1970)	26 ft max (using a pollen trap, not hybrid seed production)
Stewart and Cambell (1952)	10% at 50 ft
Vigouroux et al (1999)	1.2% at 50 ft

Note: The maximum dispersal was "the highest rate at the farthest distance to which pollen or hybrids were found in the study".

Darmency et al (2009, p. 1085) note that the experiments "were hardly comparable because the experimental design varied widely." The researchers also found that nearly all fertilization from pollen source occurs near the field (within about 0.3 miles). The summary table does not make distinction between mere pollen presence and actual hybridization, which, as discussed previously, can be very different. Darmency et al did not report how many, if any, of these studies used isolated bait plants rather than groups of receptor plants that would be producing their own pollen cloud, which, as discussed above, could make a substantial difference (i.e., the percentages of pollination by an outside source are much smaller with competition). Also, in their own experiments, even when the pollen reached the target plant and hybridization did occur, Darmency et al found a large drop in germination rates in seeds produced by plants removed from the source, with approximately 40 percent at the source dropping to one percent at around 1,000 feet from the source (2009, p. 1087).

3.9.5 Modeled sugar beet pollen dispersal

Research scientists specializing in modeling pollen dispersal have modeled the sugar beet pollen dispersal for outcrossing to the organic *Beta* production field of a Plaintiff's declarant who believed his fields would be cross-pollinated by event H7-1. The nearest event H7-1 field was 6.9 miles distant. Using conservative assumptions and modeling conditions for the three days during the "pollen shed" period when wind conditions were most likely to result in cross-pollination (June 22, 23, and 27), the modelers obtained the following results for likelihood of outcrossing: June 22, 1 in 4.9 million; June 23, one in 1.1 billion; and June 27, 1 in 222 million. The risk of any successful pollination in these circumstances is highly remote.

3.9.6 Site-specific assessment of cross-pollination potential in the Willamette Valley

This discussion focuses on the Willamette Valley because it is the only known location where event H7-1 commercial seed production and commercial seed production of Swiss chard and red table beet coexist. At least three qualified scientists have evaluated the potential for gene flow from event H7-1 to other *Beta* seed crops in the Willamette Valley: Mark Westgate, PhD, whose results are summarized above; Neil Hoffman, Ph.D. and Leonard Panella, Ph.D. Westgate is a professor of crop production and physiology at Iowa State University, whose "scientific research focuses on understanding environmental factors that affect pollination and seed formation" (Westgate, 2010, p. 1). Hoffman is a plant physiologist who is currently an APHIS official. Among his previous positions were professor of plant biology at the Carnegie Institution and Stanford University (Hoffman 2010a, p. 1). Panella, a plant geneticist, is research leader of the sugar beet research unit at the USDA ARS Crop Research Laboratory in Fort Collins, Colorado (Panella, 2010, p. 1).

Westgate explains that most pollen falls within the "immediately surrounding" area of the source field. In addition, many other factors affect the possibility of cross pollination in two *Beta* seed production fields, including receptiveness of the female, wind and humidity conditions, viability of the pollen, and competition (see Section 2.4 for a general discussion of these factors). For example, Swiss chard and table beets that are grown for seed are primarily open pollinated (all plants produce pollen) rather than hybrids using male sterile females, as is used in the production of most sugar beet seed (discussed in Section 2.7). The pollen cloud in an open pollinated field is "typically four times more dense than the local pollen cloud for a standard hybrid field" with "billions" of pollen grains per square meter making it much more difficult for a small amount of the stray pollen that might be carried on the wind from another field to compete in the open pollinated fields (Westgate, p. . 5). Westgate concludes, in general, "when all the principal factors affecting pollination are considered, the probability of pollination of table beet or chard fields by sugar beet pollen in the Willamette Valley is infinitesimally small" (Westgate, 2010, p. 6).

Hoffman indicates that nearly all fertilization from a pollen source (99.9%) occurs within the first 500 m (about 0.3 miles), and that any pollen that might reach another downwind field would have to compete with pollen from that field. Based on his assessment of conditions in the Willamette Valley, Hoffman concluded that the 4-mile isolation distance (as articulated in Interim measure No. 2) "to isolate unlike sexually compatible crops such as Swiss chard, table beets and sugar beets is more than 12 times the distance needed to reduce cross-pollination between RRSB and Swiss chard to 0.1% (1 seed in 1000) in a worst case scenario without competition from a local pollen source" (Hoffman, 2010a, p. 14). Hoffman expects the level of gene flow to be less than one seed in 10,000 (0.01%) with a four mile isolation distance. Panella concurred with Hoffman's analysis and conclusion (Panella, 2010, p. 5). Carol Mallory-Smith, PhD, professor in the Department of Agriculture at Oregon State University in the Willamette Valley, concluded that the "proposed restrictions [interim measure including a 4 mile isolation distance] will provide significant safeguards to protect Beta species seed producers while the EIS is being conducted" and that the risk of geneflow would be "extremely low." (Mallory-Smith, 2010, pp. 1-2).

3.9.7 Use of event H7-1 trait on male-sterile female

Seed production companies use a hybrid seed production system in which the event H7-1 trait is on the female (male sterile plants) in a large proportion of commercial seed production fields. In the Willamette Valley at least two seed companies use this system exclusively (Anfinrud, 2010, pp. 1-2; Lehner, 2010, pp. 5-6; Meier, 2010, p. 8). Essentially zero event H7-1 pollen is produced by these "female side" seed production fields. As a result of these methods, 78.6% of the currently growing GE sugar beet seed crop in the Willamette Valley is male-sterile female. Because these plants produce virtually zero pollen, they eliminate any realistic risk for unintentional spread of the GE trait.

3.9.8 Red table beet offtypes

Seed companies growing sugar beets in the Willamette Valley occasionally find a very small percentage of off-types from red table beet crops. Seed companies have indicated a very low level of off-types in sugar beet crops, and one seed company reports that its latest "observation plots did not produce any off-types" (Lehner, 2010, p. 3). Customers (i.e., growers of commercial sugar beet root crops) have likewise indicated that after inspecting the millions of plants grown in variety trials conducted over several years, "the number of chard or red beet off-types were so small as to be, for all intents and purposes, not quantifiable." (Grant, 2010, p.6; Berg, 2010, p. 5; Hofer, 2010, p.4). Seed companies regularly perform grow out tests to determine if there are any issues with off-types (Lehner, 2010, p.3; Hovland, 2010, pp. 2-3). Red table beet offtypes in sugar beet fields could occur due to nearby backyard gardeners growing red table beets, or might occur from open pollinated red table beet fields upwind from sugar beet fields. (Anfinrud, 2010, 109:13-17). In an open pollinated field, every plant sheds pollen (Stander, 2010, p. 2). Thus an acre of open pollinated red table beets would produce far more pollen than an acre of hybrid sugar beet fields, where the only one-fourth to one-third of the plants produce pollen (Westgate, 2010, p. 5). The Willamette Valley Specialty Seed Association pinning guidelines and isolation distances require 4 mile isolation distances between open pollinated red beet and sugar beet fields, in order to limit red beet off types in sugar beet fields (Stander, 2010, p. 2). The potential for sugar beet gene transmission to open pollinated red beet fields is very low, because as indicated, a greater volume of pollen per acre are shed by the open pollinated field (Westgate, 2010, p. 5) (indicating "billions" of pollen grains per square meter shed by an open pollinated red beet field).).

3.9.9 No sensitivity to event H7-1 by conventional sugar beet growers; Stewardship regarding mechanical mixing

There is no indication of sensitivity by customers for conventional sugar beet seed to the possibility of an inadvertent presence of event H7-1 genetic material in the conventional seed (Pierson, 2010, p. 17). First, there is currently no market in the U.S. for organic sugar beets (Pierson, 2010, p. 17). Second, in most areas where both event H7-1 and conventional sugar beets are grown, both types of beets would be combined and processed together, with no effort to differentiate between sugar from H7-1 and conventional beets (Pierson, 2010, pp. 16-17). The sugar from conventional beets does not differ chemically or in any other way from the sugar from H7-1 beets (Hoffman, 2010, p. 16).

As set forth in Section 2.7.3, each of the seed companies producing H7-1 seed utilizes detailed measures to address the possibility of mechanical mixing of H7-1 and conventional sugar beet seed. These measures would be subject to audit under the interim measures to ensure that they continue to be utilized and are successful.

Because seed production for red beet and chard seed crops is completely separate from sugar beet seed production, there is virtually no risk of mechanical mixing. As discussed in Section 2.8, the two types of production employ different growers, different equipment and different facilties. Accordingly, there is no significant risk of mixing.

3.9.10 Question of zero tolerance

We have identified one organic seed producer who has chosen to produce organic chard seed (among several other organic crops) in the Willamette Valley. This organic producer has approximately one to three acres of production on the Western margin of the Valley. He has indicated that he faces a risk of genetic transfer from event H7-1 seed fields, and that he sells to customers for his organic chard with **zero tolerance** for any level of outcrossing with event H7-1. That producer has tested his chard seeds since 2007 with a PCR genetic test and found no indications of event H7-1 traits in his crops. To date, he has not lost sales due to a risk of cross pollination from Event H7-1. He reports that the costs of the PCR testing for multiple years since 2007 have totaled roughly $700, and that a positive test for event H7-1 for his crop could negatively affect the reputation that producer has with his customers. That seed producer has also indicated in public statements through the media that he is not concerned about a risk of cross-pollination from event H7-1 seed fields where the GE trait is on the female non-pollinator (Morton, 2009, 9:12-19). A seed retailer who buys from that producer has reported that he has multiple sources for chard seed outside the Willamette Valley, including in California, but continues to purchase from that producer nevertheless.

In addition, both that seed producer and the seed retailer have participated in the development of a consensus standard setting a threshold for the presence of GE traits in organic food products and in seed. The Non-GMO Project Working Standard, sponsored by leading players in the organic industry (including Whole Foods), specifically permits crops to be verified "non-GMO" despite the presence of a low level of biotech content—0.25% for GE sugar beet seed and other *Beta* seed crops (Non-GMO Project, 2010, pp. 25, 34) and 0.9% in organic food and feed. Section 2.4.3 of the Working Standard explains that its product content standards apply to the crops listed on Appendix B, plus "close relatives of these crops that are subject to cross pollination" (Non-GMO Project, 2010, p. 12). Appendix B specifically lists "sugar beets" as one of those crops "with GMO Risk" subject to the standard, and also expressly identifies "chard" and "table beets" as close relatives for which cross-pollination is possible (Non-GMO Project, 2010, p. 34). Section 2.6 explains that "[t]he Non-GMO Project has established" a 0.1% GMO content threshold for "seed and other propagation materials" for all crops listed in Appendix B, but the standards include a specific variance of 0.25% for sugar beet seeds and other crops identified (Non-GMO Project, 2010, pp. 14, 34). This 0.25% level is thus the Working Standard's current threshold for "non-GMO" sugar beet seed and other *Beta* seed crops.

Other commercial producers of sugar beet, red beet or chard seed in the Willamette Valley have all consented to and abide by the Willamette Valley Specialty Seed Association standards, discussed in Section 2.7 and Appendix A.

3.9.11 Seed availability

As discussed in Section 2.7, sugar beet variety development is competitive, technological, and expensive multi-year activity. Seed companies develop varieties with traits they expect growers to want, and the sugar beet companies seed selection committees chose the varieties they wish to grow. It is a market-driven process, where the grower cooperatives themselves determine what is available for planting. Every year, each sugar beet company has a number of varieties that growers may choose from. As the popularity of event H7-1 sugar beet among growers has grown, there have been fewer available conventional varieties and more event H7-1 varieties; however, conventional varieties have been available. There is no organic sugar beet seed production in the sugar beet seed production areas.

Conventional and/or organic sugar beet seeds are available from some US seed suppliers (conventional), and from European seed companies (conventional and organic). (SESVaderHave, 2010; Millington Seed Company, 2010). KWS has some 250 varieties of sugar beet seeds available, including organic (KWS, Grain, 2008). Organic sugar beet is a noteworthy crop in the EU (Eurostat, 2010). Not all organic beets are processed into sugar; some are used to produce a syrup that is integrated into organic food preparations (Ceddia and Cerezo, 2008).

3.9.12 Impact Summary

Alternative 1

Under Alternative 1, there would be no gene flow impacts to growers of organic or conventional *Beta* seed from the production of event H7-1 sugar beet seed.

Alternative 2

Under Alternative 2, no or negligible impacts from event H7-1 seed production on growers of organic or conventional *Beta* seed are expected for the following reasons:

- The large majority of red beet and chard seed crops are grown in different geographic areas than are Event H7-1 sugarbeets.
- Even in the Willamette Valley (where most sugarbeet seed crops and a limited acreage of other beta species seed crops are grown), there have been no reported impacts since H7-1 commercial seed production began in 2006, and with the proposed interim measures, the potential for impacts would be further reduced.
- Based on 1) the use in the majority of the event H7-1 seed production of the trait on the male-sterile female; 2) results of sugar beet pollination outcrossing data in the published scientific literature; 3) site-specific modeling; 4) the relationship between expected seed purity levels and isolation distances determined by the OSCS; 5) the results of experience and testing in the Willamette Valley seed production area since 2007 and, 6) the analysis and conclusions of qualified scientists who specifically addressed this issue, the 4-mile isolation distance (Interim measure Item 2) is expected to result in eliminating any significant risk that cross-pollination of organic or conventional red beet or chard crops will occur, and if it happens, make the rate of outcrossing very low if not undetectable -- likely at rates of less than 1 in 10,000 (less than one seed in 10,000 with the event H7-1 trait). This is, for example, far less than the non-GMO Project proposed tolerance levels for sugar beet and other *Beta* seed (0.25%) (Non-GMO Project, 2010),
- The use of hybrids with the event H7-1 trait on the female, in combination with the disclosure requirements regarding male fertile event H7-1 seed crops (Interim measure Item 3) will drastically reduce the potential for cross-pollination. For the large majority of H7-1 seed fields (with the trait on the female), there is essentially zero risk of crossing with a red beet or chard seed crop. For those fields with the H7-1 gene on the male pollinator, the isolation distances will reduce any risk significantly, and producers of red beet and chard can ascertain what those distances are and take appropriate measures (to position their fields, scout for off-types, conduct genetic testing, or through other means discussed herein) if they are concerned about any level of risk.
- The interim measure to prevent seed mixing (Interim measure Item 4), which makes current seed and steckling production and handling practices mandatory (described in Section 2), will make the potentially low level presence of event H7-1 in conventional sugar beet seed negligible and will eliminate adventitious presence of event H7-1 in other *Beta* seeds.

Conventional sugar beet seed will continue to be available as long as growers continue to choose it in the variety trials. Growers who purchase seed purchase a specific variety, which is labeled as such.

In addition, in the event unwanted transmission of H7-1 traits to a red beet or chard crop did occur, there are multiple means for a seed producer to address it. First, because a seed producer of red beet or chard growing beta species typically will inspect each plant remove any off-types from his production fields, any preexisting unwanted cross between a sugar beet and red beet or chard plant can be addressed before seed is produced with an unwanted trait

(Stander, 2010, pp. 3 - 4). Second, once seed is produced, a grower typically will perform grow-out tests on a sample of the seed to confirm that the seed is producing plants without undesired off-types. This can also identify any issues. Third, multiple types of genetic testing can be conducted to confirm the lack of any H7-1 trait (Hovland, 2010, pp. 2 - 3). While PCR testing is available with a very high level of sensitivity (to 0.01%), inexpensive genetic strip tests capable of identifying H7-1 are also available for $2 to $4 per test, with a sensitivity of approximately 0.1% (Stander, 2010, pp. 4 - 5). Such testing may be utilized in a manner that employs samples from multiple seed plants and reduces the number of tests required per field. In the event of a positive test, the seed producer may use additional testing to isolate the source of the portion of his field producing that result (*Id).* Further, retailers of seed with sensitivity to H7-1 content may also conduct grow out tests, or utilize the same genetic testing methods to address any concerns they may have (*Id*)

As discussed in Section 3.17, in light of the above factors, the socioeconomic impacts on farmers growing red table beet and Swiss chard seed are negligible.

3.10 LIVESTOCK PRODUCTION SYSTEMS

The only impacts to livestock production systems would be related to animal feed, which is discussed in Section 3.11.

3.11 FOOD AND FEED

Both food (sugar and molasses derivatives) and animal feed (molasses and beet pulp) are derived from sugar beets. In this section we summarize the large body of scientific evidence that has been developed that supports the conclusion that food and feed derived from event H7-1 sugar beets are as safe and healthy as food and feed derived from conventional sugar beets. While the evidence has largely been developed by Monsanto and/or KWS and the contract research organizations supported by Monsanto and/or KWS, it has been evaluated and peer reviewed by panels of government scientists from the US, Canada, the European Union (EU), Japan, Australia, New Zealand, Mexico, South Korea, the Russian Federation, China, Singapore, Colombia and the Philippines, all of whom have approved, or recommended for approval, the use of products from event H7-1 in their countries (FSANZ, 2005; Monsanto/KWS 2007; Berg 2010).

We begin with a summary of FDA's authority and policy under the federal Food, Drug and Cosmetic Act (FFDCA) with regard to ensuring the safety of food and feed derived from new plant varieties developed using rDNA methods. We then document each element FDA evaluated in its consultation process. Then we summarize the evaluations and conclusions of several other international scientific oversight groups.

3.11.1 FDA authority and policy

FDA policy statement. In 1992, the FDA issued a policy statement clarifying its interpretation of the FFDCA, regarding foods (including animal feed) derived from new plant varieties, including plants developed by the newer methods of genetic modification, including rDNA. The purpose of the policy is "to ensure that relevant scientific, safety, and regulatory issues are resolved prior to the introduction of such products into the marketplace" (FDA, 1992). FDA is the "primary federal agency responsible for ensuring the safety of commercial food and food additives, except meat and poultry products" and "FDA has ample authority under the act's [FFDCA] safety provisions to regulate and ensure the safety of foods derived from new plant varieties, including plants developed by new techniques. This includes authority to require, where necessary, a premarket safety review by FDA prior to marketing of the food" (FDA, 1992). Under section 402(a)(1) of the FFDCA, a food is adulterated and thus unlawful "if it bears or contains an added poisonous or deleterious substance that may render the food injurious to health or a naturally occurring substance that is ordinarily injurious" (FDA, 1992).

FDA has the authority to ensure safety of new foods. FDA considers its existing statutory authority under the FFDCA and its implementing regulations "to be fully adequate to ensure the safety of new food ingredients and foods derived from new varieties of plants, regardless of the process by which such foods and ingredients are produced" (FDA, 1992). "The existing tools provide this assurance because they impose a clear legal duty on producers to assure the safety of foods they offer to consumers; this legal duty is backed up by strong enforcement powers; and FDA has authority to require premarket review and approval in cases where such review is required to protect public health" (FDA, 1992).

Developers have the responsibility to evaluate the safety of new foods. "It is the responsibility of the producer of a new food to evaluate the safety of the food and assure that the safety requirement of section 402(a)(1) of the act is met. FDA provides guidance to the industry regarding prudent, scientific approaches to evaluating the safety of foods derived from new plant varieties, including the safety of the added substances that are subject to section 402(a)(1) of the act. FDA encourages informal consultation between producers and FDA scientists to ensure that safety concerns are resolved" (FDA, 1992).

Foods developed by new methods do not present greater safety concerns. "FDA believes that the new techniques are extensions at the molecular level of traditional methods and will be used to achieve the same goals as pursued with traditional plant breeding. The agency is not aware of any information showing that foods derived by these new methods differ from other foods in any meaningful or uniform way, or that, as a class, foods developed by the new techniques present any different or greater safety concern than foods developed by traditional plant breeding" (FDA, 1992).

FDA's goal is to ensure the safety of all food and feed. "The goal of the FDA's evaluation of information on new plant varieties provided by developers during the consultation process is to ensure that human food and animal feed safety issues or other regulatory issues (e.g. labeling) are resolved prior to commercial distribution" (FDA, 1997).

3.11.2 FDA biotechnology consultation note to the file BNF 000090

FDA makes the contents of its biotechnology notification files (BNFs) available on the internet (see reference FDA, 2004; event H7-1 is BNF 000090)[35]. FDA documented its consultation with Monsanto/KWS on event H7-1 in a note to the file dated August 7, 2004 (Bonette, 2004). That information is summarized below.

Characterization, inheritance, and stability of the introduced DNA

Using standard analytical techniques, Monsanto/KWS verified that event H7-1 contained a single copy of the EPSPS cassette, and that all components were intact (Bonnette, 2004; Schneider, 2003, p. 43).

Monsanto/KWS conducted crosses using conventional breeding techniques resulting in 27 breeding experiments over four generations. These studies indicate that the introduced trait (glyphosate tolerance) was stably inherited as a dominant trait (Bonette, 2004; Schneider, 2003, p. 44).

Using standard analytical techniques, Monsanto/KWS demonstrated the stable integration of the T-DNA over three generations (Bonette, 2004; Schneider, 2003, p. 47).

Introduced substance – CP4 EPSPS enzyme

As discussed in Section 3.1.1, EPSPS is a catalyst for a reaction necessary for the production of certain aromatic amino acids essential for plant growth and has a similar function in bacteria

[35] http://www.accessdata.fda.gov/scripts/fcn/fcnDetailNavigation.cfm?rpt=bioListing&id=19

and fungi (for example, baker's yeast). While EPSPS is present in plants, bacteria and fungi, it is not present in animals; animals do not make their own aromatic amino acids, but rather obtain them from the foods they consume. Thus, EPSPS is normally present in food and feeds derived from plant and microbial sources (Harrison et al, 1996). There are variations in the genetic makeup (amino acid sequences) of EPSPS among different plants and bacteria. The EPSPS from *Agrobacterium* sp. strain CP4 is just one variant of EPSPS. A unique characteristic of the CP4 EPSPS is that, unlike EPSPS enzymes commonly found in plants, it retains its catalytic activity in the presence of glyphosate (Bonnette, 2004; Schneider, 2003, pp 50-51; Padgette et al, 1995).

Concentrations in sugar beet. In 1999, field trials were conducted at six distinct field locations distributed across Europe in the major sugar beet production areas. The event H7-1 sugar beets were treated with a Roundup agricultural herbicide. Samples of brei (root tissue processed using standard sugar beet industry methods) and top (leaf) tissues were collected and analyzed for levels of the CP4 EPSPS protein. On average, concentrations of the CP4 EPSPS protein, on a fresh weight basis, were similar in the leaf tissue (161 μg/g) and in the root tissue (181 μg/g). The range of mean levels of the CP4 EPSPS protein in top (leaf) tissue was 112 to 201 μg/g and in root (brei) were 145 to 202 μg/g across the sites (Schneider, 2003).

Toxicity of CP4 EPSPS. Studies were conducted on mice, using CP4 EPSPS doses of 400, 100 and 40 milligrams (mg) of CP4 EPSPS per kilogram of body weight per day (mg/kg body wt –d). For a typical 0.03-kg mouse, the 400 mg/kg body wt/d dose equated to 12 mg CP4 EPSPS per mouse per day. The study was designed to reflect a 1,000-fold factor of safety on the highest possible human exposure to CP4-EPSPS, based on assumed exposures to soybean, potato, tomato and corn at the time the study was done (Harrison et al, 1996)[36]. The daily CP4 EPSPS content in the maximum mouse exposure was equivalent to the amount in approximately 160 pounds of H7-1 sugar beets. No treatment-related adverse effects were observed, and there were no significant difference in any measured endpoints between the CP4 EPSPS treated mice and the control group (Harrison, et al, 1996, p. 735).

Monsanto/KWS also compared the amino acid sequence of CP4 EPSPS to protein sequences in the public domain ALLPEPTIDES database using the FASTA algorithm, and reported no biologically relevant sequence similarities between CP4 EPSPS protein and known protein

[36] Note that this was a theoretical exercise as no glyphosate tolerant potatoes or tomatoes are commercially grown.

toxins were observed (Bonnette, 2004). A peptide is a molecule consisting of several linked amino acids (GMO Safety, 2010a).

Allergenicity. Allergens can be derived from many sources: in animal hair, pollen, insect bites, dust mites, plants, pharmaceuticals, and food. Approximately 20,000 allergens have been identified. Most allergens in food are high molecular weight proteins and are rather resistant to gastric acid and digestive enzymes (GMO Safety, 2010a).

Monsanto/KWS searched a comprehensive database of allergens (Hileman et al, 2002) containing sequences of known allergens, for amino acid homology to the CP4-EPSPS protein, and concluded that there was no immunologically significant amino acid sequence homology between the CP4 EPSPS protein and amino acid sequences of allergens in the database (Bonnette, 2004).

Monsanto/KWS discussed two studies relevant to the mammalian digestibility of CP4 EPSPS. In the first study, the CP4 EPSPS protein was exposed to simulated gastric (stomach) and intestinal fluids that were prepared according to the US Pharmacopoeia (1990). The half-life of the CP4 EPSPS protein was reported to be less than 15 seconds in the gastric fluid, greatly minimizing any potential for the protein to be absorbed in the intestine. The half-life was less than ten minutes in the simulated intestinal fluid (Harrison et al, 1996, p 738). The second study reported similar results (Bonnette, 2004).

Food and feed uses of sugar beet

The main food use of sugar beet is for the extraction of sucrose from sugar beet roots through a process involving hot water extraction, followed by purification, evaporation, and centrifuge separation of sucrose crystals (granular sugar). Refined sucrose does not contain protein or other genetic material. This process also yields sugar beet molasses and sugar beet pulp, which are often pelleted and used in animal feed. The leafy sugar beet "tops" are usually left in the field, but they may occasionally be fed to ruminant animals (Bonnette, 2004).

Compositional analysis

To assess whether sugar beet event H7-1 is as safe and nutritious as conventional sugar beet varieties, Monsanto/KWS compared the composition of the hybrid lines containing event H7-1, produced through conventional breeding, to the composition of the corresponding non-transgenic, control. Tops (leaves) and brei (processed roots) were analyzed using standard methods or other suitable methods (Bonnette, 2004).

These analyses included proximate values (crude ash, crude fiber, crude fat, crude protein and dry matter), carbohydrates, quality parameters, saponins (naturally-occurring antinutrients that have a bitter taste and can act as a deterrent to foraging), and eighteen amino acids. Quality parameters measured in root samples included percent sucrose, invert sugar, sodium, potassium and alpha-amino nitrogen. All analyses were conducted as a single analysis for the root (brei) and top (leaf) samples collected as three replica samples from each of five field trials sited. Fifty-five statistical comparisons were made with the control line, of which seven were found to be statistically different ($p<0.05$). Based on the statistical methods, three of these seven would have been expected based on chance. In all seven cases, the ranges for the statistically different components in event H7-1 significantly overlapped or fell completely within the range of values observed for the control, the conventional reference varieties and for available published values from conventional sugar beet varieties (Schneider, 2003, Section C).

Conclusion

Based on the data submitted, the FDA considered the consultation process to be complete, and acknowledged this in a note to the file and a letter to Monsanto (Bonnette, 2004; Tarantino, 2004).

3.11.3 Health Canada approval 2005

Health Canada's Food Directorate has legislated responsibility for premarket assessment of "novel foods." Under Canadian regulations, sugar derived from event H7-1 sugar beet is a novel food because it is derived from a plant that has been genetically modified to exhibit characteristics that were not previously observed in the plant (Health Canada, 2005).

Health Canada "conducted a comprehensive assessment of this sugar beet according to its *Guidelines for the Safety Assessment of Novel Foods*," reviewing the same information Monsanto/KWS provided to FDA in its consultation, and made the following conclusion (Health Canada, 2005:

> Health Canada's review of the information presented in support of the food use of sugar from glyphosate tolerant sugar beet lines containing event H7-1 concluded that the food use of sugar from sugar beet lines containing this event does not raise concerns related to safety. Health Canada is of the opinion that sugar from sugar beet lines containing event H7-1is as safe and nutritious as sugar from current commercial sugar beet varieties.

3.11.4 Canadian Food Inspection Agency (CFIA) approval 2005

The CFIA evaluated event H7-1 both as a crop to be potentially grown in Canada, and as livestock feed, and approved both uses in 2005. Based its evaluation of data provided by Monsanto/KWS, and as summarized in its Decision Document DD2005-54, the CFIA "determined that this plant with a novel trait (PNT) and novel feed does not present altered environmental risk nor does it present livestock feed safety concerns when compared to currently commercialized sugar beet varieties in Canada" (CFIA, 2005).

3.11.5 EFSA risk assessment and EC authorization

The European Food Safety Authority (EFSA) is an independent European agency funded by the EU budget for the purpose of assessing risks associated with the food chain. Risk assessment is a specialized field of applied science that involves reviewing scientific data and studies to evaluate risks associated with certain hazards (EFSA 2010). EFSA conducts risk assessment, but does not have authority to authorize use. The European Commission (EC), which is the executive body of the EU, determines whether or not a genetically modified item will be authorized for use in the EU.

Scope and process. The scope of the Monsanto/KWS application to the EFSA was for food and feed, and not as a crop intended for cultivation in the EU (EFSA, 2006, p. 1). The EFSA used the same data Monsanto/KWS provided to the FDA, Health Canada, and the CFIA, and also requested additional information. The Scientific Panel on Genetically Modified Organisms (GMO Panel) developed an opinion that was then adopted by the EFSA. Subsequently, in 2007, the EC authorized "the placing on the market of food and feed produced from genetically modified sugar beet H7-1" (EC, 2007). During the EFSA risk assessment process, Member states comment on the draft decisions and can request further analysis; the GMO Panel also can request additional information from the applicant.

Detectable presence of CP4 EPSPS. The GMO Panel reported that if the CP4 EPSPS protein was present in the sugar, which was unlikely, it was below the detection limit of 0.004 parts per million (ppm). No DNA was detected in the sugar and the molasses is also "free from DNA and protein (limit of detection 0.002 ppm)." The CP4 EPSPS protein is present in pulp at levels around 500 ppm on a dry weight basis (EFSA, 2006, p. 9).

Safety of the CP4 EPSPS protein. The GMO Panel noted the "long history of dietary exposure to EPSPS proteins" for humans and animals the fact that "previous applications for glyphosate tolerant crops containing the CP4 EPSPS protein have been evaluated and found to be safe for human and/or animal consumption in previous [EFSA] opinions." The GMO Panel concluded that "a toxicological assessment of new constituents is not applicable" (EFSA, 2006, p 10).

Additional toxicity study. In response to EFSA information requests, Monsanto/KWs conducted a 90-day toxicity study, feeding processed pulp to rats, which did not indicate any adverse effects. The GMO Panel reported additional studies of sugar beet pulp to sheep, also with no adverse effects (EFSA, 2006)[37].

Allergenicity. In addition to evaluating the potential allergenicity of the CP4 EPSPS protein, the GMO Panel considered whether the insertion of the transgene could result in modifications of the pattern of expression of other potentially allergenic proteins within the sugar beet plant. The Panel did not consider the issue to be relevant, as sugar beet is not a major allergenic food, and overexpression of an existing protein "would be unlikely to alter the overall allergenicity of the whole plant (EFSA, 2006, p. 12).[38]

No need for post-market monitoring. The GMO Panel noted "No risks to human and animal health were identified in studies of the CP4 EPSPS protein expressed in sugar beet H7-1, and in studies of the genetically modified sugar beet itself. Thus, foods and feeds produced from sugar beet H7-1 is as safe and nutritious as foods and feeds derived from conventional sugar beets." The Panel recommended no post-market monitoring (EFSA, 2006, p. 13).

Conclusions. The GMO Panel stated the following in its conclusions (EFSA, 2006, p. 13):

- Sugar and molasses have been shown to be free from DNA and protein
- Animals fed with pulp will be exposed to the CP4 EPSPS protein
- The CP4 EPSPS protein has been evaluated and found to be safe for human and/or animal consumption
- The molecular characterization and the comparative compositional analysis did not indicate the occurrence of any unintended effects due to the genetic modification
- Products from sugar beet H7-1 are safe as food and feed
- The nutritional value of the sugar beet H7-1 and the derived sugar beet products is comparable to that of the analogous products from conventional sugar beet
- The risk of allergenicity is of no concern with this product

3.11.6 Other approvals

Japan approved the use of event H7-1 in feed 2003, in food in 2005, and the environmental in 2007 (Sato, 2008). Studies by the Japanese National Food Research Institute have confirmed that there is no detectable DNA in sugar from sugar beets, with the conclusions that "sugar beet

[37] http://jas.fass.org/cgi/content/full/83/2/400
[38] http://jas.fass.org/cgi/content/full/83/2/400

DNA was degraded at an early stage of sugar processing" (Oguchi et al, 2009). Event H7-1 has also been approved for food and feed use in Mexico, South Korea, Australia, New Zealand, China, Colombia, the Russian Federation, Singapore and the Philippines (FSANZ, 2005; Monsanto/KWS 2007; Berg 2010).

3.11.7 Willingness of the buyer to accept sugar from event H7-1

Market concerns about willingness of buyers to accept sugar, molasses, and/or pulp derived from event H7-1 have not resulted in any perceptible change in the demand for US-produced beet sugar or other fractions. Based on the regulatory approvals obtained in domestic and international markets, sugar, molasses, and pulp derived from event H7-1 is being successfully marketed.

As summarized above, there is a large body of scientific evidence that has been reviewed and validated by several international scientific panels that supports the safety of the sugar and other fractions derived from event H7-1 for food and feed use. If there are consumers who do not wish to purchase sugar made from event H7-1 for reasons other than safety and health, they have the option of buying sugar made from sugarcane, which is not currently produced using lines that were developed using modern biotechnology. However, the majority of food products containing beet sugar, such as cakes, candy, ice cream and other sweets, are likely to contain sugar derived from sugar beet varieties containing event H7-1. Most commercial food and beverage products are also likely to contain corn or soy products derived from biotech crops (Goldsbrough, 2000).

3.11.8 Impacts

Based on the scientific evidence summarized in this section, impacts on food and feed are not expected with either alternative. Food and feed derived from event H7-1 is equivalent to food and feed derived from conventional sugar beets. Because both conventional and event H7-1 sugar beets are processed in the same facilities, there is no distinction in the US between food and feed derived from conventional and event H7-1 sugar beets. Markets are available for all the food and feed produced. Because there is no commercial organic sugar beet industry in the US, organic sugar beet production is not impacted in any way.

Aside from sugar, the other products from sugar beets (molasses and pulp) are not major consumer items and can easily be avoided by consumers who do not wish to be exposed to GE products. As discussed above, there is no detectable DNA in processed sugar; however, consumers who wish to avoid all products derived from GE crops can purchase cane sugar rather than beet sugar. While processed foods, the situation is similar to that for corn and soy products: even without event H7-1, it would be very difficult for a consumer to avoid products derived from GE crops.

3.12 WEED CONTROL AND GLYPHOSATE RESISTANCE

As indicted in Section 1, EPA is responsible for regulation of glyphosate and thus for issues of weed resistance to glyphosate (EPA, 2003).. This report nevertheless analyzes those issues. APHIS's 2005 EA did so as well, and the court did not find a deficiency in that analysis. APHIS has performed other herbicide resistance analyses in many E As conducted as part of the petition review process (see http://www.aphis.usda.gov/biotechnology/not_reg.html).

3.12.1 Herbicide-resistant weeds

As explained in Section 2.5, not all weed species respond the same to every herbicide mode of action. Instead, a weed species can have a natural resistance to a particular mode of action, and if a grower employs only that mode of action, over time, the naturally resistant species will overtake other weed species in that area. This is often referred to as a shift in the weed population. It is for this reason that growers may need to use multiple products to control the full spectrum of weeds in a field.

Sugar beet weed management, including major weeds in sugar beets, herbicides used, herbicide mode of action and herbicide resistance, was discussed in Section 2.4. Table 3-1 summarizes the major sugar beet weeds in terms of resistance to herbicide groups used in sugar beets for the states where sugar beets are grown commercially. A weed is listed for a state when herbicide resistance has been confirmed. The table does not show the extent of the weeds with the noted resistance; this would vary widely. References for the table are included at the bottom of the table.

As of June 27, 2010, 194 herbicide-resistant weed species (341 herbicide resistant weed biotypes) have been documented worldwide (Heap, 2010). These species have been reported to be resistant to 19 different herbicide modes of action (Heap, 2010). Approximately five

Table 3-1 Major sugar beet weeds with resistance to herbicides groups used in sugar beets[1]

California

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Echinochloa crus-galli*	Barnyardgrass	2000	ACCase inhibitor
2. *Echinochloa crus-galli*	Barnyardgrass	2000	fatty acid synthesis inhibitor.

Colorado

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Aramanthus retroflexus*	Redroot pigweed	1982	photosystems II inhibitors
2. *Kochia scoparia*	Kochia	1982	photosystems II inhibitors
3. *Kochia scoparia*	Kochia	1989	ALS inhibitors
4. *Avena fatua*	Wild Oat	1997	ACCase inhibitors

Idaho

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Kochia scoparia*	Kochia	1989	ALS inhibitors
2. *Avena fatua*	Wild Oat	1992	ACCase inhibitors
3. *Avena fatua*	Wild Oat	1993	fatty acid synthesis inhibitor.
4. *Kochia scoparia*	Kochia	1997	synthetic auxins
5. *Aramantus retroflexus*	Redroot pigweed	2005	photosystems II inhibitors

Michigan

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Chenopodium album*	Lambsquarters	1975	photosystems II inhibitors.
2. *Amaranthus tuberculatus*	Tall waterhemp	2000	ALS inhibitors
3. *Amaranthus powellis*	Powell Amaranth	2001	photosystem II inhibitors
4. *Amaranthus powellis*	Powell Amaranth	2001	ureas and amides
5. *Amaranthus retroflexus*	Redroot Pigweed	2001	photosystems II inhibitors.
6. *Chenopodium album*	Lambsquarters	2001	ALS inhibitors
7. *Amaranthus hybridus*	Smooth Pigweed	2002	ALS inhibitors
8. *Abutilon theophrasti*	Velvetleaf	2004	photosystems II inhibitors
9. *Solanum ptycanthum*	East. Black nightshade	2004	photosystems II inhibitors
10. *Solanum ptycanthum*	East. Black nightshade	2004	photosystems II inhibitors.
11. *Kochia scoparia*	Kochia	2005	ALS inhibitors
12. *Setaria faberi*	Giant Foxtail	2006	ALS inhibitors

Minnesota

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Chenopodium album*	Lambsquarters	1982	photosystems II inhibitors. (PI)
2. Abutilon *theophrasti*	Velvetleaf	1991	PI
3. *Amaranthus retroflexus*	Redroot Pigweed	1991	PI
4. *Avena fatua*	Wild Oat	1991	ACCase inhibitors
5. Amaranthus tuburculatus	Tall Waterhemp	2007	glycine, ALS, PI
6. Ambrosia trifida	Giant ragweed	2006	glycine, ALS inhibitors, PI
7. *Kochia scoparia*	Kochia	1994	ALS inhibitors
8. *Xanthium strumarium*	Common cocklebur	1994	ALS inhibitors
7. *Setaria faberi*	Giant Foxtail	1996	ALS inhibitors
9. *Setaria viridis*	Robust White Foxtail (var. robusta-alba Schreiber)	1996	ALS inhibitors
10. *Setaria lutescens*	Yellow Foxtail	1997	ALS inhibitors
11. *Ambrosia trifida*	Giant ragweed	2006	glycines
12. *Amaranthus tuberculatus*	Tall waterhemp	2007	glycines

Montana

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Kochia scoparia*	Kochia	1984	photosystems II inhibitors
2. *Kochia scoparia*	Kochia	1989	ALS inhibitors
3. *Avena fatua*	Wild Oat	1990	fatty acid synthesis inhibitor.
4. *Avena fatua*	Wild Oat	1990	ACCase inhibitors
5. *Kochia scoparia*	Kochia	1995	synthetic auxins
6. *Avena fatua*	Wild Oat	1996	ALS inhibitors
7. *Avena fatua*	Wild Oat	2002	ACCase inhibitors

Nebraska

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Amaranthus tuberculatus*	Tall waterhemp	1996	photosystem II inhibitors

North Dakota

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Kochia scoparia*	Kochia	1987	ALS inhibitors
2. *Setaria viridis*	Green Foxtail	1989	mitois inhibitors
3. *Avena fatua*	Wild Oat	1991	ACCase inhibitors
4. *Kochia scoparia*	Kochia	1995	synthetic auxins
5. *Avena fatua*	Wild Oat	1996	ALS inhibitors
6. *Kochia scoparia*	Kochia	1998	photosystems II inhibitors
7. *Amaranthus retroflexus*	Redroot Pigweed	1999	ALS inhibitors
8. *Solanum ptycanthum*	Eastern Blk.Nightshade	1999	ALS inhibitors

Oregon

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Avena fatua*	Wild Oat	1190	ACCase inhibitors
2. *Avena fatua*	Wild Oat	1990	mitosis inhibitors
3. *Kochia scoparia*	Kochia	1993	ALS inhibitors
4. *Amaranthus retroflexus*	Redroot Pigweed	1994	photosystems II inhibitors.

Washington

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Kochia scoparia*	Kochia	1989	ALS inhibitors
2. *Avena fatua*	Wild Oat	1991	ACCase inhibitors
3. *Amaranthus powellis*	Powell Amaranth	1992	photosystem II inhibitors
4. *Sonchus asper*	Spiny Sowthistle	2000	ALS inhibitors

Wyoming

Species	Common Name	Year[2]	Herbicide Mode of Action
1. *Kochia scoparia*	Kochia	1984	photosystems II inhibitors
2. *Kochia scoparia*	Kochia	1996	ALS inhibitors

Legend:

[1] *Source: Heap, I. The International Survey of Herbicide-resistant Weeds. Online. Internet. Accessed on June 21, 2010 at: www.weedscience.com.*

[2] *Year resistance was first reported.*

percent of resistant species have resistance to EPSPS inhibitors (glycines, which include glyphosate). Refer to Figure 2-3 for the distribution by herbicide mode of action.

Measures to reduce the development of herbicide resistance are discussed in Section 2.5.

3.12.2 Glyphosate-resistant weeds

As discussed in Section 2.5, herbicide resistance is not a unique or new phenomenon. The development of weeds resistant to a particular herbicide mode of action is an issue that growers have faced for decades. As with other herbicide modes of action, not all weeds respond the same to glyphosate, and some species naturally vary in their tolerance to the herbicide.

Because of the nature of glyphosate and its high degree of specificity, generally speaking, there is a reduced potential that there will be a selection for weed resistance. Glyphosate is a nonselective, foliar-applied, broad spectrum, post-emergent herbicide compared to many other herbicide groups. It operates by binding to a specific enzyme in plants thereby interfering with the plant's required metabolic process. Glyphosate is the only herbicide that binds with this enzyme, and therefore it is highly specific (Cole, 2010a, p5).

Currently in the U.S., there are two known mechanisms of glyphosate resistance. The first is the exclusion mechanism in which glyphosate is either prevented from moving to growing cells or from reaching the target protein. Mechanisms that confer this form of resistance are relatively rare and are not common across plant species. The second mechanism, gene amplification, results from an increase in enzyme gene copies in the plant which leads to higher levels of resistance to glyphosate (Cole, 2010a, p.5).

Accordingly, while glyphosate has been used extensively for over three decades, there have been relatively few cases of resistance development, as compared to many other herbicides and when considering the substantial glyphosate-treated acreage worldwide (approximately 1 billion acres) and the total number of weeds that the herbicide can control. In the U.S., there are ten weed species where glyphosate-resistant biotypes are known to exist in certain areas of the country (19 weeds have been reported to have developed glyphosate resistance at some location worldwide). These resistant weeds represent a relatively small minority of the overall weed population. For example, in 2009, approximately 135 million of the 173 acres of corn, soybeans and cotton in the U.S. were planted with a herbicide tolerant variety, with the most common tolerance trait being glyphosate tolerance (USDA NASS, 2009a). At the same time, only about 6% of the total planted corn, soybean and cotton acres in the U.S. are estimated to have some level of presence of weeds resistant to glyphosate (Ian Heap as reported by WSSA, 2010).

A weed scientist from the University of Wyoming who specializes in sugar beet weed control, has testified that in the coming years, "it is highly unlikely that the use of glyphosate in connection with GR [glyphosate resistant] sugar beet will result in the same conditions that have led to GR weeds in other GR crops" (Kniss, 2010, p. 3). This is in part because of the fundamentally different growing practices with sugar beet. Kniss reports that more diverse cropping systems (with more rotations and herbicide modes of action), such as those used with sugar beets "are less likely to result in weed resistance issues" (Kniss, 2010, p. 3). Approximately half of the GR weeds noted worldwide to date have been found in non-GR cropping systems (such as orchards). In the U.S., of the confirmed GR weeds, two evolved where there was no GR crop use (roadsides, vineyards, and tree crops) (Kniss, 2010a, p. 2).

GR sugar beet production systems are different than other GR crops, in part because multiple year crop rotations are an integral component of effect weed and pest management programs for the sugar beet crop in all sugar beet growing regions (Kniss, 2010a, p. 3). Given that the sugar beet crop is susceptible to many diseases, nematodes, and insects, multiple crop rotation is required to limit the economic impact of those pests. As such, sugar beet production grower agreements with sugar processers will typically prohibit growers from planting a sugar beet crop in consecutive years (Kniss, 2010a, p. 3).

Instead, sugar beets are generally grown on a three- to four-year rotation. While other GR crops may be included in the rotation with GR sugar beets (with the exact rotation varying in different sugar beet growing regions) (Table 2-2), "the crop rotation in itself will reduce the potential for herbicide resistant weed development due to changing cultural practices between crops (such as planting date, harvest date, tillage practices, etc.)" (Kniss, 2010, p. 4).

As discussed above, the characteristics of glyphosate itself reduce the potential for the development of herbicide resistance as compared to other herbicide families. As such, certain herbicide families have been classified according to their risk of resistant weed development. Beckie (2006) lists acetolactate synthase (ALS) and acetyl CoA carboxylase (ACCase) inhibiting herbicides as "High" risk for resistance development, while glyphosate is considered a "Low" risk herbicide for the development of herbicide resistant weeds. ALS and ACCase inhibiting herbicides are commonly used in conventional sugar beet production, and weeds resistant to these two herbicide groups are widely distributed across sugar beet growing regions of the U.S.

(Kniss, 2010a, p4) (Figure 2-4). Glyphosate tolerant sugar beets can help delay resistance to these herbicides (Kniss, 2010, pp. 4 - 5):

> In fact, glyphosate resistant sugar beet adds to the diversity of herbicide modes of action in many sugar beet crop rotations because it introduces a new mode of action (glyphosate) into the rotation with non-glyphosate-resistant crops, that tend to rely heavily upon acetolactate synthase ("ALS") inhibitors. ALS inhibiting herbicides pose a far greater risk of developing weed resistance than does glyphosate. By adding glyphosate to their crop rotations, growers of GR sugar beet actually decrease the likelihood of developing resistance to ALS inhibitors, just as the use of other crops and alternative modes of action in rotation with GR sugar beet reduce the likelihood of glyphosate resistant weeds.

Use of herbicides with different modes of action, either concurrently or sequentially, is an important defense against weed resistance (Weed Science Society of American [WSSA], 2010b). "Use of a single product or mode of action for weed management is not sustainable. Some of the best and most sustainable approaches to prevent resistance include diversified weed management practices, rotation of modes of action and especially the use of multiple product ingredients with differing modes of action" (WSSA, 2010).

The WSSA reports higher levels of awareness among growers regarding the need to minimize the potential for development of glyphosate resistance: "In a market research study that surveyed 350 growers in 2005 and again in 2009, in response to the question, 'are you doing anything to proactively minimize the potential for resistance to glyphosate to develop,' 67% said yes in 2005 and 87% said yes in 2009" (David Shaw, as reported in WSSA, 2010). "In a 2007 survey of 400 corn, soybean and cotton growers, resistance management programs were often or always used by 70% or more of all three grower groups" (Frisvold and Hurley as reported by WSSA, 2010). There is widespread information available from universities and other sources regarding glyphosate resistance. Public universities (i.e. North Dakota State University, University of Minnesota), herbicide manufacturers (i.e. www.weedresistancemanagement.com, www.resistancefighter.com) and crop commodity groups (i.e. National Corn Growers Association, American Soybean Association) have internet web sites with information on prevention and management of herbicide resistance. An example of information provided by public universities is Dr. Don Morishita, a weed scientist at the University of Idaho, who advises sugar beet growers on weed resistance management strategies (Dumas, 2008). The Sugar Industry Biotech Council provides weed resistance resources on its website. Monsanto includes information on weed resistance management practices in its Technology Use Guide that is mailed annually to all licensed growers. The sugar beet industry associations also hold annual meetings where weed resistance management practices and other stewardship measures are included as part of the proceedings.

Sugar beet growers in particular have strong financial and practical interests in managing weeds effectively to reduce the development of herbicide resistance in order to maximize yield potential. Sugar beets are a high-value crop, and competition from weeds for moisture and light can negatively impact yields and the overall value of the crop. The development of glyphosate-resistant weeds harms the economic return per acre for the individual farmer and the entire sugar beet industry (Cole, 2010a, p11).

As such, strategies and recommendations to delay the development of glyphosate-resistant weeds have been developed for event H7-1 sugar beets (TUG, Appendix E). Specifically, the TUG recommends the use of "mechanical weed control/cultivation and/or residual herbicides" with event H7-1 sugar beets, where appropriate, and "additional herbicide modes of action/residual herbicides and/or mechanical weed control in other Roundup Ready® crops" rotated with event H7-1 (TUG, 2010, p. 40). In addition to the financial incentive to follow these recommendations, all Roundup Ready technology users, including sugar beet growers, are contractually obligated through the Monsanto Technology Stewardship Agreement to follow the TUG.

3.12.3 Impact summary

Alternative 1

Under Alternative 1, there would be no effect of event H7-1 on the potential for weeds to develop resistance to glyphosate, given that glyphosate use is minimal with conventional sugar beets. Growers would continue to use conventional weed control methods, including other herbicide modes of action, to the extent such conventional herbicides are available (see Section 2.5). A return to conventional herbicides could have consequences for development of further resistance to those herbicides.

As discussed above, glyphosate use in GR sugar beet has proven to be an effective tool against weeds resistant to non-glyphosate herbicides, such as ALS-inhibitors and ACCase-inhibitors. If the planting of H7-1 sugar beets is substantially curtailed, a valuable tool for herbicide resistant weed management will be unavailable to sugar beet growers, and the impact of weeds resistant to other herbicides may increase, although the impact would likely be small since sugar beets are a relatively small crop (Kniss, 2010a, p. 7).

Alternative 2

Under Alternative 2, impacts, if any, with respect to the development of glyphosate-tolerant weeds in sugar beet crops in the timeframe considered in this ER are expected to be very small. First, sugar beets are a relatively small crop, (event H7-1 accounts for less than one percent of the glyphosate-resistant crops grown in the US), suggesting that the likelihood for the development of new glyphosate-resistant weed populations when compared to other herbicide resistant crops is smaller. Second, as discussed above, the nature of glyphosate itself and the growing practices for sugar beets makes it less likely that new glyphosate-resistant weed populations will develop in sugar beets as a result of the use of glyphosate in sugar beets. Additionally, there is a high level of awareness about the potential for glyphosate resistant weeds and many readily available resources to assist growers with management strategies. Indeed, event H7-1 growers are required to follow Monsanto's TUG, including its recommendations for adopting growing practices aimed at reducing the development of glyphosate-resistant weed populations. Finally, because herbicide resistance is a heritable trait, it takes multiple growing seasons for herbicide tolerant weeds to emerge and become the predominant biotype in a specific area (Cole, 2010a, p. 4). Researchers have concluded that even if growers completely relied on only one herbicide, it is likely to take at least five years for a herbicide-resistant weed population to develop (Kniss, 2010a, p4; Beckie 2006, Neve, 2008; Werth et al., 2008). This is a reason why crop monitoring and follow up by University and industry weed scientist in cases of suspected resistance are important parts of all herbicide resistance stewardship programs.

3.13 PHYSICAL

3.13.1 Land Use

As discussed in Section 2.3, acreage planted in sugar beets in the US has changed little over the past 50 years (since 1961), ranging from a low of 1.1 million acres in 1982 (slightly less than the 2008 acreage) to a high of 1.6 million acres in 1975. Table 3-2 shows planted sugar beet acreage for the last six years. While there have been changes within individual states, overall the range is small. As discussed in Section 2, a small part of the sugar beet crop was event

Table 3-2 Sugar Beet Acres Planted 2005 to 2010

Location	2005	2006	2007	2008	2009	2010
California	44,400	43,300	40,000	26,000	25,300	25,000
Colorado	36,400	42,100	32,000	33,800	35,100	29,800
Idaho	169,000	188,000	169,000	131,000	164,000	169,000
Michigan	154,000	155,000	150,000	137,000	138,000	147,000
Minnesota	491,000	504,000	486,000	440,000	464,000	445,000
Montana	53,900	53,600	47,500	31,700	38,400	42,400
Nebraska	48,400	61,300	47,500	45,200	53,000	46,000
North Dakota	255,000	261,000	252,000	208,000	225,000	227,000
Oregon	9,800	13,100	12,000	6,700	10,600	11,000
Washington	1,700	2,000	2,000	1,600	---	---
Wyoming	36,200	42,800	30,800	29,700	32,400	32,000
US Total	1,299,800	1,366,200	1,268,800	1,090,700	1,185,800	1,174,200

Source: USDA NASS, 2010

H7-1 in 2007, and in 2010, 95 percent of the planted crop was event H7-1. During this time period, the planted sugar beet acreage remained within the range of pre-event H7-1 plantings since 1961.

As discussed in Section 2, sugar beet production is highly structured, vertically integrated, and centered on production facilities that are grower owned.. To maintain a healthy industry, production cannot fluctuate much from year to year: a certain level of production is needed to support the major investment of a processing facility, and a processing facility has limited capacity. The sugar beet grower is bound to the local processing facility and the local processing facility is bound to the sugar beet grower. Barring some unusual disruption in the industry, large fluctuations from year to year would not be expected.

Crop data also provides no indication that the introduction and widespread adoption of GE crops in general has resulted in any significant change to the total US acreage devoted to agricultural production. The acres in the US planted to principal crops, which include corn, sorghum, oats, barley, winter wheat, rye, durum, spring wheat, rice, soybean, peanuts, sunflower, cotton, dry edible beans, potatoes, canola, proso millet, and sugar beets, has remained relatively constant over the past 25 years (USDA NASS, 2010). From 1983 to 1995, the average yearly acreage of principal crops was 328 million (USDA NASS, 2010). Biotechnology-derived crops were introduced in 1996, and in 2009, 321 million acres of principal crops were planted, which is not a significant change (USDA NASS, 2009a).

Alternative 1

Under Alternative 1, plantings of event H7-1 sugar beet would be limited and only occur under notification or permit issued by APHIS. Growers would not have the option of planting event H7-1 sugar beets. Since sugar beet growers are farmers who also grow other crops, those who would have grown sugar beets could most likely grow some crop, but they could nevertheless suffer significant losses as a result (See Section 2.3). They may choose to grow conventional beets or other crops. A number of factors may influence this decision, including availability of herbicides for conventional sugar beets, availability and cost of specialty cultivating equipment, availability of desirable varieties of sugar beet, and the potential penalty or lost ownership shares in the cooperative for not growing sugar beets. In the short term (the term considered by this ER), Alternative 1 could potentially result in a large decrease in sugar beet production. However, changes in land use would not be expected and the land use is likely to remain agricultural.

Alternative 2

Under Alternative 2, growers who choose to do so could continue to plant event H7-1 sugar beets. Sugar beet acreage would be expected to be similar to the levels of the past 50 years. Land use that is agricultural would be expected to remain so and other land use would not be impacted.

3.13.2 Air Quality and Climate

Alternative 1

Under Alternative 1, plantings of event H7-1 sugar beet would be limited and only occur under notification or permit issued by APHIS. Because the use of glyphosate as a post-emergence herbicide has resulted and is expected to continue to result in an increase in conservation tillage practices, an increase in the use of mechanical tilling would be expected under Alternative 1, if growers would choose to plant conventional sugar beets. If growers would choose other crops, the effects would depend on what the other crops would be. Emissions related to global warming, ozone depletion, summer smog and carcinogenicity, among others, were found to be lower in glyphosate-tolerant crop systems than conventional systems (Bennett et al., 2004). Therefore, Alternative 1 would be expected to have slightly greater impacts on air quality and climate, if growers planted conventional sugar beets rather than event H7-1 sugar beets.

Alternative 2

Under Alternative 2, growers who choose to do so could continue to plant event H7-1 sugar beets. The continued use of event H7-1 sugar beets may result in continued increases in conservation tillage, as discussed in Section 2 (changing to conservation tillage practice is gradual, as it often requires different management practices and often requires new equipment). Therefore, Alternative 2 would lead to a small but positive impact on air quality and climate relative to Alternative 1.

3.13.3 Surface water quality

Surface water may be impacted from sugar beet production by runoff from sugar beet fields that carries soil particles and herbicides or other pesticides to streams, rivers, lakes, wetlands and other water bodies. As discussed below, based on existing data, the soil component of runoff is a much more important contributor to surface water impacts than is the pesticide component.

Alternative 1

Under Alternative 1, plantings of event H7-1 sugar beet would be limited and only occur under notification or permit issued by APHIS. Under Alternative 1, growers who are now growing event H7-1 sugar beets and who would choose to grow conventional sugar beets would need to use other practices for weed management. These practices would likely consist of some combination of herbicide use and increased tillage (beyond conservation tillage).

If Alternative 1 would result in increased use of tillage for weed control, overall adverse surface water impacts are likely to be greater than with Alternative 2. Tillage causes widespread soil disturbance. Thus, wind and water erosion, topsoil loss and the resulting sedimentation and turbidity in streams are likely to increase with increased tillage. In 2009, based on the states' water quality reports, EPA identified sedimentation and turbidity as two of the top 10 causes of impairment to surface water in the U.S. in general; in 2007, EPA identified sedimentation/siltation as the leading cause of impairment to rivers and streams in particular (EPA, 2009, p. 15; EPA, 2007, p. 9). Although a comprehensive data set has not yet been developed to prove the point, EPA has projected conservation tillage to be "the major soil protection method and candidate best management practice for improving surface water quality" (EPA, 2002). EPA identifies conservation tillage as the first of its CORE 4 agricultural management practices for water quality protection (EPA, 2008a).

Based on the states' water quality reports to EPA, which EPA makes available through its National Assessment Database, pesticides in general and herbicides in particular are a relatively minor contributor to impairment of surface water in the U.S., compared to sedimentation/siltation and turbidity (EPA 2008b). Of the pesticides that were reported as contributing to impairment, almost all are previously used, highly persistent chemicals that are no longer registered for use in the U.S. Only one herbicide, atrazine, was found (EPA 2008b).

In summary, based on EPA data, herbicides in general are very minor contributors to surface water impairment in the U.S., whereas sedimentation/siltation and turbidity are major contributors. Alternative 1, compared with Alternative 2, would likely result in a different mix of herbicides used and may result in increased tillage. Increased tillage could contribute to adverse surface water impacts through increased runoff of soil particles to surface water bodies.

Alternative 2

Alternative 2 would result in continued application of glyphosate herbicides to event H7-1 sugar beets. Herbicides that adsorb strongly, such as glyphosate, are less likely to degrade or volatilize (USDA APHIS, 2009).

Other herbicides used on sugar beets have varying chemical fates, but, in general, most are more persistent and are characterized by higher mobility in soils, making them more apt to continually contaminate surrounding water systems.

3.13.4 Groundwater quality

Alternative 1

Under Alternative 1, if growers choose to grow conventional sugar beets, the potential for impacts to groundwater would be similar to that prior to the widespread adoption of event H7-1 sugar beets. If herbicides are used that do not bind strongly to soil particles, and have a higher potential to leach into groundwater, the potential for migration to groundwater may be higher than with Alternative 2.

Alternative 2

Because glyphosate binds strongly to soil, and has a low potential to leach into groundwater, it is unlikely to impact groundwater.

3.14 BIOLOGICAL

Potential environmental effects of pesticide use are carefully considered as a part of the FIFRA pesticide registration process. Prior to the approval of a new pesticide or a new use of that pesticide (including a change in pesticide application rates and/or timing) and before reregistering an existing pesticide, EPA must consider the potential for environmental effects and make a determination that no unreasonable adverse effects to the environment will be caused by the new pesticide, new use or continued use.

To make this determination, EPA requires a comprehensive set of environmental fate and ecotoxicological data on the pesticide's active ingredient (US 40 CFR Part 158). EPA uses these data to assess the pesticide's potential environmental risk (exposure/hazard). The required data include both short- and long-term hazard data on representative organisms that are used to predict hazards to terrestrial animals (birds, nontarget insects, and mammals), aquatic animals (freshwater fish and invertebrates, estuarine and marine organisms), and nontarget plants (terrestrial and aquatic).

Information regarding the impacts of glyphosate on the biological environment is summarized below. Additional information on this topic is also being considered in the USDA APHIS Draft Environmental Impact Statement (DEIS) on the Deregulation of Glyphosate Tolerant Alfalfa (Docket No. APHIS-2007-0044). This information is applicable to the use of glyphosate in event H7-1 sugar beet since the maximum single in-crop application rate for GT alfalfa (1.55 lb a.e./A) is greater than the maximum single in-crop application rate for sugar beet (1.125 lb a.e./A).

3.14.1 Plant and Animal Exposure to Glyphosate

Animals

The equivalence of the CP4 EPSPS enzyme to native EPSPS except for tolerance to glyphosate is discussed in Sections 3.1 and 3.11. A number of researchers have conducted laboratory investigations with different types of arthropods exposed to genetically engineered crops containing the CP4 EPSPS protein (Goldstein, 2003; Boongird et al., 2003; Jamornman, et al., 2003; Harvey et al., 2003). Representative pollinators, soil organisms, beneficial arthropods and pest species were exposed to tissues (pollen, seed, and foliage) from GE crops that contain the CP4 EPSPS protein, to evaluate potential toxicity. These studies, although varying in design, all reported a lack of toxicity observed in various species exposed to these crops (Nahas et al., 2001; Dunfield and Germida, 2003, Siciliano and Germida 1999).

As a part of the reregistration evaluation under FIFRA, EPA conducted an ecological assessment for glyphosate. This assessment compared the results from toxicity tests with glyphosate conducted with various plant and animal species to a conservative estimate of glyphosate exposure in the environment, the Estimated Environmental Concentration (EEC). .

Glyphosate is practically nontoxic to slightly toxic to birds, freshwater fish, marine and estuarine species, aquatic invertebrates and mammals and practically nontoxic to honey bees (which are used to assess effects on nontarget insects in general) (EPA, 1993, pp. 50, 38 - 40, 45, 47, 48 - 50). Glyphosate has a low octanol-water coefficient, indicating that it has a tendency to remain in the water phase rather than move from the water phase into fatty substances; therefore, it is not expected to accumulate in fish or other animal tissues.

In the Reregistration Eligibility Decision (RED) for glyphosate (EPA, 1993, p. 53), the exposure estimates were determined assuming an application rate of 5.0625 lb a.e., which exceeds the maximum labelled use rate for a single application for agricultural purposes. When the EECs were calculated for aquatic plants and animals, the direct application of this rate to water was assumed. Based on this assessment, EPA concluded that effects to birds, mammals, fish and invertebrates are minimal based on available data (EPA, 1993).

The glyphosate end-use products used in agriculture contain a surfactant to facilitate the uptake of glyphosate into the plant (Ashton and Crafts, 1981). Depending on the surfactant used, the toxicity of the end-use product may range from practically nontoxic to moderately toxic to fish and aquatic invertebrates (EPA, 1993, pp. 42 - 45). For this reason, the 1993 Glyphosate RED stated that some formulated end-use products of glyphosate needed to be labeled as "Toxic to fish" if they were labeled for direct application to water bodies. Due to the associated hazard to fish and other aquatic organisms, glyphosate end-use products that are labeled for applications to water bodies generally do not contain surfactant, or contain a surfactant approved for direct application to water bodies.

Soil Microorganisms

Microorganisms produce aromatic amino acids through the shikimate pathway, similar to plants. Since glyphosate inhibits this pathway, it could be expected that glyphosate would be toxic to microorganisms. However, field studies show that glyphosate has little effect on soil microorganisms, and, in some cases, field studies have shown an increase in microbial activity due to the presence of glyphosate (USDA FS, 2003).

Based on the data available on glyphosate usage, chemical fate, and toxicity, glyphosate is not expected to pose an acute or chronic risk to the following categories of wildlife: (EPA, 1993)

- birds,
- mammals,
- terrestrial invertebrates,
- aquatic invertebrates, and
- fish
- soil microorganisms

Alternative 1

Under Alternative 1, the potential for impacts to animal species may be greater than with Alternative 2 because of the return to greater use of additional herbicides, potentially with higher toxicities.

Alternative 2

As stated previously, Alternative 2 is expected to result in the continued use and application of glyphosate-based herbicide formulations. This could result in continued glyphosate exposure to animal species within and adjacent to those fields through drift, as discussed previously, and a decrease in exposure to other herbicides from runoff and/ or drift (USDA APHIS, 2009).

. . . . .Considering the potential for aquatic exposure to glyphosate formulations from terrestrial uses, EPA recently evaluated the effect of glyphosate and its formulations on another amphibian species, the California red-legged frog, and concluded that aquatic exposure to glyphosate or its formulations posed no risk to this threatened species (EPA, 2008b). Because EPA considered a wide range of application rates in their evaluation for the red-legged frog, this conclusion can also be applied to amphibians exposed to glyphosate from applications on event H7-1 sugar beet. Any possible adverse impacts to amphibians resulting from the deregulation of event H7-1 sugar beet may be offset by the shift from other herbicides used in sugar beet cultivation, which are considered to have higher environmental impacts in general. . Additionally, amphibian habitat in watersheds where event H7-1 sugar beet is produced could be improved through conservation tillage, resulting in decreased soil erosion, decreased sedimentation in runoff, and decreased turbidity in ponds, lakes, and rivers fed by surface waters.

Plants

Glyphosate is a non-selective herbicide with post-emergence activity on essentially all annual and perennial plants. As discussed in Section 3.1.1, this activity is due to inhibition of EPSPS, an enzyme involved in aromatic amino acid synthesis. As with any herbicide, a risk exists that spray drift could pose issues for plants on the borders of the target fieldHowever, EPA takes the potential for spray drift into account when conducting the risk assessment it uses to establish pesticide application rates and direction for use, which are designed to minimize spray drift risks.. As discussed earlier, glyphosate binds tightly to agricultural soils and is not likely to move offsite dissolved in water. Moreover, glyphosate is not taken up from agricultural soil by plants. However, because drift is a potential means of exposure to non-target plants adjacent to an event H7-1 sugar beet field; Monsanto conducted a threatened and endangered (TE) species risk assessment to evaluate the impacts to plants (and animals) from the use of glyphosate-based herbicides in conjunction with glyphosate-tolerant plants. The complete assessment was submitted to APHIS and has been reviewed by APHIS scientists to support the petition for deregulation of glyphosate-tolerant alfalfa. The assessment is available on the APHIS, BRS website at http://www.aphis.usda.gov/biotechnology/alfalfa_documents.shtml

The assessment identified some plant, but no animal, species for which glyphosate when aerially applied could pose issues in areas bordering fields in certain locations where sugar beets are grown. To address any such risks, Monsanto developed Pre-Serve, a web-based program designed to eliminate any potential impacts on TE plants resulting from the agricultural use of herbicides that contain glyphosate.

Pre-Serve instructs growers to observe specific precautions when spraying glyphosate herbicides on Roundup Ready® crops near TE plant species that may be at risk. Only a very small percentage of glyphosate applications will require mitigation measures. This is because the vast majority of U.S. cropland is outside of the Pre-Serve Use Limitation Areas – areas where threatened or endangered plant species may be present – and most glyphosate applications are made using ground application equipment at rates below 3.5 pounds of active ingredient per acre (lb a.e./acre), which will not impact the TE plant species.

Growers who are licensed to purchase and use seeds containing Roundup Ready® technology are required contractually to follow the requirements in Monsanto's Technology Use Guide. This includes the requirement to access the Pre-Serve website (www.pre-serve.org) or contact Monsanto before applying glyphosate-based herbicide products to crops grown from these seeds. This website will guide growers and applicators through a user-friendly, four-step process to determine whether their fields are located within Use Limitation Areas and, if so, to identify the mitigation measures that must be taken. For fields located within Use Limitation Areas, the following mandatory steps must be taken to reduce potential risks to TE plant species:

- Ground applications are limited to rates of less than 3.5 lb a.e./acre (most uses).
- Aerial applications may be prohibited in buffer zones along perimeters of fields. The size of buffer zones can be minimized by employing a coarser spray droplet size.
- In specified counties, aerial applicators will be required to observe a new maximum use rate of 0.92 lb a.e./acre (26 fl. oz/A Roundup PowerMAX® or WeatherMAX®) if using medium spray droplets[39], but can apply the current full labeled rate (1.55 lb a.e./acre or 44 fl. oz/acre of Roundup PowerMAX or WeatherMAX) if using coarse spray droplets.

In addition to the instructions provided by Pre-Serve, mitigations from local, state or federal protection programs and/or landowner agreements may apply. Monsanto's licensees are required to follow these measures where applicable. .

® Roundup Ready is a registered trademark of Monsanto Technology LLC.

[39] In counties where listed plant species observations were present, but not within 250 ft of a relevant land use, actual separation distance was not assessed. In these counties aerial application rates with medium sized droplets are restricted to 0.92 lb a.e./acre to avoid exposure to listed TE plant species that might be within 417 ft of the application area, and thus within an area where aerial application at 1.55 lb a.e./acre using medium-sized spray droplets would present a potential risk based on the Tier 1 assessment. This restriction will be eliminated in many cases by further distance assessments.

The Pre-Serve web-based system, as described above, enables growers and applicators to take steps where necessary to avoid potential effects to TE plant species from application of glyphosate-based agricultural herbicides.

Alternative 1

Under Alternative 1, the rates and volumes of glyphosate applications on sugar beet crops would likely return to the level of use that existed prior to the deregulation of event H7-1 sugar beets. Growers would use an array of other herbicides, some of which may be applied at greater volumes compared to glyphosate. The herbicides used in conventional sugar beet systems have been found, in general, to have somewhat greater human health or environmental impacts than glyphosate (USDA, 2004). This is consistent with the EPA decision to grant reduced risk status for glyphosate use in glyphosate-tolerant sugar beets.**Error! Bookmark not defined.** Comparison of results from terrestrial and aquatic plant studies with predicted exposure from herbicide use suggests that most of the herbicides used in conventional sugar beet systems may have more effect than glyphosate on aquatic or terrestrial plant species. These herbicides are selective herbicides that kill only particular groups of plants such as annual grasses, perennial grasses, or broadleaf weed species and thus require the use of more than one herbicide to achieve satisfactory weed control.

Alternative 2

Alternative 2 is expected to result in continued use and application of glyphosate-based herbicide formulations. This could result in some incidental glyphosate exposure to terrestrial and aquatic plants in the vicinity of event H7-1 beet fields by spray drift. The EPA has concluded that glyphosate use on event H7-1 sugar beet can be considered to pose reduced risk compared to other herbicides used for weed control in conventional sugar beets.[40]

. . Hundreds of millions of acres of other GT crops have been treated with glyphosate for over ten years with minimal impact to adjacent non-target terrestrial plants including crops when appropriate drift minimization measures are practiced. Because glyphosate binds strongly to soil particles and has no herbicidal activity after binding to soil, no effects on aquatic plants will result from surface water runoff from glyphosate use on event H7-1 sugar beet in accordance with labeled directions for use.. Conservation tillage and no tillage practices that are possible

[40] A reduced risk decision is made at the use level based on a comparison between the proposed use of the pesticide and existing alternatives currently registered on that use site. A list of decisions regarding Reduced Risk Status can be found at: http://www.epa.gov/opprd001/workplan/reducedrisk.html

when glyphosate is used have the potential to decrease surface water runoff and sedimentation which further benefits aquatic organisms.

3.14.2 Threatened and Endangered Species

As the action agency for pesticide registrations EPA has the responsibility to conduct an assessment of effects of a registration action on endangered species. The EPA Endangered Species Protection Program web site, http://www.epa.gov/espp/, describes the EPA assessment process for endangered species. Some of the elements of that process, generally taken from the web site, are summarized below.

When registering a pesticide or reassessing the potential ecological risks from use of a currently registered pesticide, EPA evaluates extensive exposure and ecological effects data to determine how a pesticide will move through and break down in the environment. Risks to birds, fish, invertebrates, mammals and plants are routinely assessed and used in EPA's determinations of whether a pesticide may be licensed for use in the U.S.

EPA's core pesticide risk assessment and regulatory processes ensure that protections are in place for all populations of nontarget species. Because endangered species may need specific protection, EPA has developed risk assessment procedures described in the Overview of the Ecological Risk Assessment Process (U.S. EPA, 2004d, p. 7) to determine whether individuals of a listed species have the potential to be harmed by a pesticide, and if so, what specific protections may be appropriate. EPA's conclusion regarding the potential risks a pesticide may pose to a listed species and any designated critical habitat for the species, after conducting a thorough ecological risk assessment, results in an "effects determination."

As a part of the endangered species effects assessment for the California red-legged frog, EPA evaluated the effect of glyphosate at rates up to 7.95 lb a.e./A on fish, amphibians, aquatic invertebrates, aquatic plants, birds, mammals, and terrestrial invertebrates. This assessment determined that at the maximum application rate for in-crop applications of glyphosate to GT sugar beets (1.125 lb a.e./A) there would be no effects of glyphosate on the following taxa of threatened and endangered species: fish, amphibians, birds, and mammals. EPA also determined that glyphosate formulations would have no effect on threatened or endangered fish, amphibians, birds, and mammals. Although not specifically discussed in the assessment, from the EEC's and effects endpoints presented, it can also be determined that there would be no effects of glyphosate or its formulations on threatened or endangered vascular aquatic plants, and aquatic invertebrates (EPA, 2008b).2008). non-endangered small .H7-1 .

Monsanto has designed a web-based program (www.Pre-Serve.org), designed to ensure no effect of glyphosate applications on threatened and endangered plant species. Pre-Serve instructs growers to observe specific precautions when spraying glyphosate herbicides on glyphosate-tolerant crops near threatened and endangered plant species that may be at risk. According to the U.S. Fish and Wildlife Service Endangered Species website, there are no TE terrestrial invertebrates in Colorado, Idaho, Nebraska, North Dakota, South Dakota, and Wyoming. [41] In other states, TE small terrestrial invertebrates, if present, are at no more risk than from applications of glyphosate to conventionally grown sugar beets.

Alternative 1

Under Alternative 1, the potential for impacts to threatened and endangered species may be greater than with Alternative 2 because of the use of certain herbicides with potentially higher toxicities.

Alternative 2

As indicated, EPA is responsible for and has previously conducted analyses regarding glyphosate impacts. Only two percent of glyphosate is applied aerially to all agricultural crops in the US (USDA APHIS, 2009). Given that aerial application in event H7-1 sugar beets is not expected to be any different than other agricultural production systems, approximately two percent of glyphosate used in event H7-1 sugar beets is expected to be applied aerially. Additionally, the use of buffer zones, based on the Pre-Serve program, between the sugar beet field and any potential threatened or endangered plant populations can prevent any adverse impacts due to drift of glyphosate from aerial applications (USDA APHIS, 2009), so that there will be no effect on endangered species.

We evaluated the potential for deleterious effects or significant impacts on non-target organisms, including those on the US Fish and Wildlife Service (USFWS) threatened and endangered species list, from cultivation of event H7-1 sugar beet and its progeny. The enzyme CP4 EPSPS that confers glyphosate tolerance is from the bacterium Agrobacterium sp. strain CP4. This gene is similar to the gene that is normally present in sugar beets and is not known

---

[41] http://www.fws.gov/endangered/species/index.html

to have any toxic property (Schneider, 2003). Field observations of event H7-1 sugar beet event H7-1 revealed no negative effects on non-target organisms (Schneider, 2003). The lack of known toxicity for this enzyme suggests no potential for deleterious effects on beneficial organisms such as bees and earthworms. The high specificity of the enzyme for its substrates makes it unlikely that the introduced enzyme would metabolize endogenous substrates to produce compounds toxic to beneficial organisms (Schneider, 2003).

3.15 HUMAN HEALTH AND SAFETY

3.15.1 Consumer Health and Safety

Alternative 1

Under Alternative 1, the potential for impacts to consumers may be greater than with Alternative 2 because of the use of herbicides with higher toxicities.

Alternative 2

The general public is not at a high risk of exposure to substantial levels of glyphosate under typical use conditions (EPA, 1993; USDA FS, 2003). Under Alternative 2, exposure to glyphosate would not increase beyond that currently experienced, since 95 percent of sugar beet is already event H7- 1. According to the EPA Glyphosate Fact Sheet (1993) glyphosate is of relatively low oral and dermal acute toxicity and has been placed in Toxicity Category III for these effects (Toxicity Category I indicates the highest degree of acute toxicity, and Category IV the lowest). The acute inhalation toxicity study was waived by EPA because glyphosate is nonvolatile and available adequate inhalation studies with end-use products show low toxicity.

The use of glyphosate herbicide does not appear to result in adverse effects on development, reproduction, or endocrine systems in humans and other mammals. Under present and expected conditions of use, glyphosate herbicide does not pose a health risk to humans (EPA, 1993).

Additionally, the nature of glyphosate residue in plants and animals is adequately understood, and studies with a variety of plants indicate that uptake of glyphosate from soil is limited. The material that is taken up is readily translocated throughout the plant. In animals, ingested or absorbed most glyphosate is essentially not metabolized and is rapidly eliminated in urine and feces. Enforcement methods are available to detect residues of glyphosate in or on plant commodities, in water, and in animal commodities (EPA, 1993).

EPA conducted a dietary risk assessment for glyphosate based on a worst-case risk scenario, that is, assuming that 100 percent of all possible commodities/acreage were treated, and assuming that tolerance-level residues remained in/on all treated commodities. Based on the assessment, EPA concluded that the chronic dietary risk posed by glyphosate food uses is minimal (EPA, 1993).

The addition of another GT crop to agricultural production may lead to a greater chance that a GT crop, including GT sugar beets may be grown near other food crops. This could lead to higher exposure to glyphosate in the diet of the general public because there would be a greater chance for glyphosate residue to reach food crops via spray drift. Nonetheless, such increase risk of exposure to glyphosate residue will not result in increased risks to the general population because the current upper estimates of risk are based on highly conservative fruit and vegetable intake rates with an assumed high estimated amount of glyphosate residue. Glyphosate is registered for use as a direct application to weeds in several fruits and vegetables and tolerances are established in the consumable commodities of these crops. The current aggregate dietary risk assessment completed by EPA concludes there is no concern for any subpopulation regarding exposure to glyphosate, including the use on many fruits and vegetables and GT sugar beet (71 FR 76180, 2006). Moreover, the potential exists for decreases in the applications and subsequent residues of more toxic herbicides if GT sugar beet is deregulated.

3.15.2 Hazard Identification and Exposure Assessment for Field Workers

Alternative 1

Under Alternative 1, the potential for impacts to field workers may be greater than with Alternative 2 because of the increased need for hard labor to remove weeds and the use of herbicides with higher toxicities.

Alternative 2

According to the RED document for glyphosate (EPA, 1993), glyphosate is of relatively low oral and dermal acute toxicity. For this reason, glyphosate has been assigned to Toxicity Categories III and IV for these effects (i.e., Toxicity Category I indicates the highest degree of acute toxicity, and Category IV the lowest). An acute inhalation study was waived by EPA because glyphosate is a non-volatile solid, and the studies conducted on the end-use product formulation are considered sufficient (EPA, 1993). Expert toxicological reviews from US EPA (1993) and the World Health Organization (WHO, 2004) are in agreement that glyphosate does not pose any human acute exposure concerns for dietary exposures and thus negated the need to establish an acute reference dose.

With regard to subchronic and chronic toxicity, one of the more consistent effects of exposure to glyphosate at high doses is reduced body weight gain compared to controls. Body weight loss is not seen in multiple subchronic studies, but has at times been noted in some chronic studies at excessively high doses ≥ 20,000 ppm in diet (WHO, 2004). Other general and non-specific signs of toxicity from subchronic and chronic exposure to glyphosate include changes in liver weight, blood chemistry (may suggest mild liver toxicity), and liver pathology (USDA FS, 2003). Glyphosate is not considered a carcinogen; it has been classified by EPA as a Group E carcinogen (evidence of non-carcinogenicity for humans) (EPA, 1993; 2006).

EPA has considered in its human health analysis the potential applicator and bystander exposure resulting from increased glyphosate use. Based on the toxicity of glyphosate and its registered uses, including use on glyphosate-tolerant crops, EPA has concluded that occupational exposures (short-term dermal and inhalation) to glyphosate are not of concern because no short-term dermal or inhalation toxicity endpoints have been identified for glyphosate (71 FR 76180, 2006).

Additional evidence to support the EPA conclusion can be found in the *Farm Family Exposure Study*, a biomonitoring study of pesticide applicators conducted by independent investigators (Acquavella, et al. 2004). This biomonitoring study determined that the highest estimated bodily adsorption of glyphosate as the result of routine labeled applications of registered glyphosate-based agricultural herbicides to crops, including glyphosate-tolerant crops, was approximately 400 times lower than the RfD established for glyphosate. Furthermore, investigators determined that 40 percent of applicators did not have detectable exposure on the day of application, and 54 percent of the applicators had an estimated bodily adsorption of glyphosate more than 1000 times lower than the RfD (Acquavella, *et al.*, 2004). Use patterns and rates for glyphosate tolerant sugar beet are typical of most glyphosate agronomic practices. Therefore, the deregulation of glyphosate-tolerant sugar beet would not significantly increase the exposure risk to pesticide applicators.

Finally, the biomonitoring study also found little evidence of detectable exposure to individuals on the farm who were not actively involved in or located in the immediate vicinity of labeled applications of glyphosate-based agricultural herbicides to crops. Considering the similarity of the use pattern and application rates of the glyphosate products in this study compared to those registered for use on glyphosate-tolerant sugar beet and glyphosate-tolerant crops in general, bystander exposure attributed to the use of glyphosate on glyphosate-tolerant crops is expected to be negligible. Therefore, the use of currently registered pesticide products containing glyphosate in accordance with the labeling will not pose unreasonable risks or adverse effects to humans or the environment. In general, the herbicidal activity of glyphosate is due primarily to a metabolic pathway that does not occur in humans or other animals, and, thus, this mechanism of action is not directly relevant to the human health risk assessment. EPA considers glyphosate to be of low acute and chronic toxicity by the dermal route of exposure. Glyphosate is considered a Category IV dermal toxicant and is expected to cause only slight skin irritation (USDA APHIS, 2009).

3.16 ECONOMIC IMPACTS

3.16.1 Sugar beet processing

Approximately 54% of the U.S. domestic sugar production comes from sugar beets (USDA Farm Service Agency [FSA], 2010). Refined sugar from sugar beets is the product of a multi-year cycle and involves beet seed suppliers, sugar beet growers, sugar beet processors, sugar users and consumers (USDA FSA, 2010). As part of that process, beet seed suppliers plant the commercial sugar beet seed crop in the fall of Year 1, which produces the commercial seeds harvested in the fall of Year 2. The commercial seed is processed over the winter and sold to sugar beet growers who plant it in the spring. Sugar beet growers harvest the beet root in the fall of Year 3 and deliver them to beet processing facilities owned by the beet processors. Beet sugar is extracted by beet processors beginning in the fall of Year 3 and throughout Year 4. The sugar produced from these beets is purchased by food manufacturers and consumers (USDA FSA, 2010).

Of the sugar beet root crop planted in the spring of 2009, 95 percent was reported to be event H7-1 sugar beet seed. This is also the same for the sugar beet root crop planted in the spring of 2010, and harvested in the fall of 2010. This represents 98 percent of the sugar beet root crop outside of California, where, as discussed in Section 2, event H7-1 has not been grown (USDA FSA, 2010). The harvesting of the 2010 root crop will begin between late August and early September, depending of the projected size of the sugar beet crop. The bigger the crop, the earlier the harvest will begin to make sure it is completed before the ground freezes. By late August, most of the crop's sugar will have been contracted for sale (USDA FSA, 2010). The economic impact of preventing that crop from being harvested and processed is discussed below.

3.16.2 USDA's role in sugar marketing

The domestic sugar market is closely managed by USDA's sugar program and therefore, not governed solely by supply and demand. USDA controls domestically produced sugar through the Flexible Sugar Marketing Allotment Program, and controls foreign imports through the raw and refined sugar tariff-rate quotas (TRQs). Unlimited amounts of refined sugar can be imported under a high duty of 16.3 cents per pound and raw sugar of 15.36 cents per pound. Under section 156 of the Federal Agriculture Improvement and Reform Act of 1996, as amended by the Food Conservation, and Energy Act of 2008 (the Farm Bill), and the Harmonized Tariff Schedule of the United States (HTS), USDA is required to establish a range of acceptable market conditions, which means maintaining a price floor in potentially oversupplied situations by removing surplus supply, and maintaining "adequate supply" in potentially undersupplied market situations (USDA FSA, 2010). The minimum raw and refined sugar prices that the sugar program must support are the levels that would cause sugar beet and sugarcane processors to forfeit their sugar that was put up as collateral under the USDA sugar nonrecourse loan program. Sugar nonrecourse loans support raw cane sugar prices at 21 cents per pound and refined beet sugar prices at 24 cents per pound. The nonrecourse loans support price because forfeiting the sugar collateral completely extinguishes the borrower's debt, thus sugar beet and sugarcane processors are assured of getting at least the USDA loan proceeds for their sugar. Loan collateral forfeiture also removes surplus sugar out of the market because the government is limited by the Farm Bill in its sugar disposal options (USDA FSA, 2010).

At the other end of the range, the objective of maintaining "adequate supply" (as described in the Farm Bill) or "adequate supply at reasonable prices" (described in HTS) requires USDA to increase supply under tight markets, which will make domestic prices lower than they would otherwise be. However, there is no maximum sugar price strategy stipulated in federal law, as there is a minimum sugar price. Under the Flexible Sugar Marketing Allotments Program, the sugar beet processors are guaranteed a market share of 46 percent of the domestic market. If the sector cannot fulfill its quota, USDA is required to increase imports to maintain adequate supply (USDA FSA, 2010).

3.16.3 Economic Impacts

Alternative 2 is not expected to result in adverse economic impacts. Growers and seed producers would continue to use and sell event H7-1 seed and crops and seek return on their investments. This section discusses the economic impacts of Alternative 1.

Economic implications of a halt in event H7-1 sugar beet cultivation

Should the unrestricted use of event H7-1 sugar beets be impacted, effectively removing the product from the market, an estimated 4.25 million tons of beet sugar would be removed from the market (USDA FSA, 2010). This sugar is expected to supply about 40 percent of U.S. sugar consumption during 2011.

Because the federal government has a major effect on sugar supply, and hence sugar price, the market reaction to a reduction in refined beet sugar is somewhat determined by USDA's supply management response. USDA has recently reacted to two similar, but smaller, events in 2005 and 2008 (temporary loss of cane refineries) that demonstrate the potential effect from a reduction in sugar. In both cases, U.S. refined sugar prices averaged about 18 cents per pound above the world refined sugar price, even as USDA increased the world refined quota to moderate U.S. sugar prices (USDA FSA, 2010). However, an action that effectively precludes further planting, cultivation, processing, or other use of event H7-1 sugar beets would cause greater disruption and greater harm to the U.S. sugar market than caused by the 2005 or 2008 disruptions because the reduction, 4.25 million tons, is 20 times larger than the loss of supply in 2005 and 10 times larger than the loss in 2008 (USDA FSA, 2010). Prices increased substantially in those years, but were never high enough to cause sugar to be imported off the world market at the high tariff rate of 16.3 cents per pound. Under the scenario where event H7-1 sugar beet is effectively precluded, world sugar could enter under a high tariff and set the refined price in the U.S. market (USDA, 2010).

Additionally, USDA learned from the temporary loss of cane refineries in 2005 and 2008 that many U.S. food manufacturers have difficulty using imported refined sugar because of differences in product quality or packaging. After the 2005 and 2008 events, a new business developed to clean, repackage, or liquefy imported refined sugar for domestic use. This was required because domestic food companies would not use the crystallized imported sugar in its original packaging (USDA FSA, 2010).

U.S. sugar cane refiners are expected to run at near full capacity in 2011, therefore, they will not have the capacity to refine imported raw cane sugar to replace the 4.25 million tons of beet sugar lost. Normally, USDA would increase the raw sugar TRQ to alleviate domestic sugar shortages. However, in 2011, domestic needs for sugar would have to be filled by increasing refined sugar imports by 6 times from an average of 690,000 tons over the past 3 years (USDA FSA, 2010). This increase in refined sugar imports may cause an extensive disruption in the current refined sugar distribution system. For example, the 2.6 million tons would require about 250,000 containers on at least 330 ships by the end of September 2010 (USDA FSA, 2010).

If sugar beet root crop growers cannot harvest, they will experience an economic hardship because they will have incurred all the costs of producing the 2010 root crop except for harvesting. Further, they would incur the cost to destroy the crop to prepare the land for the next crop, and to prevent the sugar beet root crop from overwintering and reaching the flowering stage in 2011. Sugar beet processors are currently contracting FY 2011 beet sugar at 38 cents per pound (USDA FSA, 2010). Therefore, sugar beet growers and cooperative owners would also experience lost revenue estimated at $3.23 billion (4.25 million tons X 0.38 $/lb X 2000 lbs/ton) (USDA FSA, 2010).

Sugar beet processing factories, and the local economies organized around them, would experience economic hardship if beet processing factories were prevented from purchasing, processing, or selling sugar from event H7-1 sugar beets. The sugar beet processing factories would be idled, thousands of jobs would be lost and the livelihoods of many rural communities would be at stake (USDA FSA, 2010)Dr. Richard Sexton, an agricultural economist and an authority on agricultural cooperatives, recently conducted an investigation as to what the economic impact would be on growers and processors if the growing of GT sugarbeets was enjoined in 2011 and 2012. His results are particularly insightful because they rely, in part, on direct interviews and written surveys with each of the eight sugarbeet processing companies. Dr Sexton estimated that the consequences on a ban of GT sugarbeets in 2011 are: 1) 8 of 21 sugarbeet processing plants would close (and unlikely to reopen); 2) grower crop income would be reduced by approximately $253 million; 3) sugarbeet processor worker salaries would be reduced by about $138 million dollars; and 4) the adverse economic impact on the local economies where sugarbeets are grown and processed would be approximately $1.1 billion. If a ban continued through 2012, Dr. Sexton estimated that processor full-time and seasonal employment would be lowered by approximately 1,570 workers, grower income would be reduced further by another $282 million and the adverse economic impact would be $964 million in lower net revenue to growers and their communities (Sexton 2010). Also, a. A 2004 study by the University of Idaho found that if sugar beet production and processing ceased in Idaho and alternative crops were planted instead, Idaho would lose over 3,000 jobs and farm incomes would decline (given returns to corn, wheat, and other production options based on 2004 projections). Sugar beet growers generally produce other crops, and their land would not remain idle; they have the equipment and expertise to produce other crops. The longer-term concern, however, is in terms of the impact on infrastructure, as some companies may not survive closing down for one season (USDA FSA, 2010).

Additionally, individual sugar cooperative shareholders are significantly penalized for not fulfilling their contract. For example, one cooperative member stated that, "I currently own 485 shares that are valued at $350 each and I am required to produce 485 acres of sugar beets annually to Western for processing. By contract, I am subject to an economic penalty of $350 per share if my annual share of sugar beets is not delivered to Western for processing. Western has enforced this penalty against growers in the past" (Hofer, 2010).

Sugar Beet Seed Production and Availability

Only sugar beets grown from approved varieties can be utilized by growers for sugar beet production. The processor seed committee will establish a list of approved varieties from which growers may select. Once a variety has been approved for commercial production by the processor seed committee, the seed producer produces the seed in the quantities projected to be sold to the processor's growers. Seed suppliers must predict years in advance the likely demand for new varieties. If a seed supplier over predicts likely demand, the excess seed may be inventoried for a period that does not exceed the viability of the seed (Manning, 2010).

The approved varieties have undergone extensive multi-year planting trials to determine how well each variety tolerates exposure to particular diseases and pests known to infest the growing region, particular growing conditions such as exposure to particular weather conditions, and the variety's ability to deliver acceptable yields per ton and sugar content (Manning, 2010).

The approved variety list denotes sugar beet varieties that may be delivered to the processor for sugar production. As a cooperative member, a grower has a contract to deliver sugar beet from a specified number of acres. Sugar beet varieties that do not make the approved variety lists cannot be delivered to the processor for sugar production because they do not meet the standards set forth by the processor. A grower is not permitted by the processor to plant a sugar beet variety not on the approved list (Manning, 2010).

When event H7-1 sugar beet was deregulated in 2005, the industry began production of event H7-1 sugar beet seed. The majority of conventional seed varieties and seed available for the 2011 crop year originated prior to 2007. Consequently, some approved varieties, including the genetic traits of those seed, and the inventory of some conventional seed now available were based on production decisions made many years ago (Manning, 2010). Certain seed producers have not engaged in new varietal development for conventional sugar beet since 2006/2007. Some processors have no conventional seed on their current approved variety list, while others still list some conventional seed varieties (Manning, 2010). Manning looked at the availability of sugar beet seed should event H7-1 sugar beet seed be unavailable. Based on Manning's analysis, all sugar beet growing regions in the U.S. would experience a shortfall of sugar beet seed to plant (Manning, 2010). The USDA FSA (2010) also stated that domestically-produced conventional sugar beet seed is in short supply because domestic seed companies have reduced production of conventional beet seed in recent years.

Sugar beet seed produced outside the United States may not be suitable for commercial production in the U.S. Certain sugar beet seed varieties produced in the European Union (EU) or elsewhere have not undergone extensive multi-year variety trials in the U.S to determine if that variety meets the standards for disease resistance required by growers and beet processors.

The limited availability of conventional seed could severely restrict plantings of sugar beets in 2011 and sugar production in 2012 (USDA FSA, 2010). Based on information provided by sugar beet seed producers and buyers, UDSA FSA (2010) estimates that prohibiting the harvest of event H7-1 sugar beet seed in 2010, would reduce projected sugar beet root crop acreage by 37 percent in 2011. Based on that estimate, the reduction in acres planted for sugar beet production would lower beet sugar production by an estimated 1.6 million tons in 2012 (lost acreage with unchanged yields and unchanged sugar recovery)(USDA FSA, 2010). The economic impact of a reduction in beet sugar supply on consumer costs and grower incomes in 2012 would be severe (USDA FSA, 2010). However, the severity would be mitigated depending on the degree to which sugar users and consumers reduce their consumption of sugar or switch to non-sugar sweeteners. Manufacturers and consumers will have time to reduce their beet sugar use and manufacturing costs if a decision to prohibit event H7-1 sugar beets is announced at least a year before it affects domestic supply. USDA FSA (2010) estimates that U.S. demand for sugar could fall 1 percent due to the higher sugar costs in 2012.

If event H7-1 sugar beet seed could not be planted in the spring of 2011 to grow the root crop, the 2012 U.S. refined sugar price is expected to rise from 33 cents per pound to 41 cents per pound, which includes transportation, product modification costs necessary to be suitable for American users, and the premium the U.S. Sugar Program provides domestic growers. Sugar users and consumers would pay a total of $1.6 billion additional for sugar in 2012 even if they consume less due to the higher sugar prices. Growers and processors are projected to experience a loss of 700 million in lost 2012 sugar beet and sugar sales (USDA FSA, 2010).

A summary of the projected costs from an action that effectively precludes the planting, cultivation, and processing of event H7-1 sugar beets on sugar users and consumers and sugar beet growers and processors over the next two years is shown in Table 3-3.

Herbicide Shortages

The availability of herbicides is another factor that will likely affect a growers' decision to plant conventional sugar beet varieties. The advent of event H7-1 sugar beets caused a decline in the use of certain herbicides that were used with conventional sugar beet crops. The manufacturers of these herbicides have reduced production. Should growers plant conventional seed, the herbicides may not be available unless the manufacturers ramp up production to meet anticipated demands. This decision must be made far in advance of when the herbicides would be needed (Manning, 2010).

Table 3-3. Production Loss and Project Costs from an event H7-1 Sugar Beet Injunction

Parent Seed Planted	Commercial Seed Produced	Commercial Seed Planted	Harvest/ Sales Year	Expected Sugar Production	Sugar Production Lost	Cost to Growers	Cost to Users/ Consumers
				(1,000 tons)		(Million $)	
fall 2008	fall 2009	spring 2010	2011	4,477	4,253	3,232	2,972
fall 2009	fall 2010	spring 2011	2012	4,396	1,627	658	1,592

Source: USDA FSA, 2010

3.17 SOCIAL AND ECONOMIC IMPACTS ON RED BEET AND CHARD GROWERS

Seed Production

In contrast to the very significant social and economic impacts identified in section 3.16 if H7-1 sugarbeet cultivation were halted, the effect of continued cultivation subject to the proposed interim measures would be minimal. As indicated in Section 2.8, most red beet and chard seed crops are grown in areas outside the Willamette Valley in Oregon where the large majority of sugarbeet seed crops are grown. The geographic limitations in the interim measures would preclude H7-1 seed cultivation in those areas and remove any chance of gene transfer between the crops. In the Willamette Valley, there is limited production of red beet and chard seed. See Section 2.8. The majority of such seed producers in those areas have agreed to and comply with the existing Willamette Valley Specialty Seed Association isolation distances for those areas, and have not reported issues or losses due to genetic transfer. There appears to be only very limited organic red beet and chard seed production in the Willamette Valley, and no indication of genetic transmission in the years since H7-1 seed cultivation began on a large scale in 2006. Although one identified organic grower has chosen to grow chard (among other organic crops) in the Western margins of the Valley, that grower has tested his crops on repeated occasions with PCR tests over multiple years and found no indication of gene flow from H7-1 crops.

In addition, in the years since 2006, seed companies producing H7-1 seed in the Willamette Valley have increasingly employed a "gene on the female" nonpollinator approach for H7-1 production fields, meaning that those fields shed virtually zero pollen that could transmit H7-1 genetic material. As a consequence, as discussed in Section 1.5, even an organic grower who chose to market and sell chard seed with a "zero tolerance" for H7-1 genetic material would face no risk from such fields.

The organic community's consensus Non-GMO Project Working Standard does not require zero tolerance – it contemplates a tolerance for GE traits in verified Non-GMO seed or 0.25%. The National Organic Program is a process-based standard; no organic grower has ever lost organic certification due to an unintended trace presence of a GE trait. Further, if an organic grower sensitive to H7-1 genetic material wished to ensure "zero tolerance," relatively inexpensive testing is available to do so, and common seed production methodologies can be employed to maintain a "zero tolerance" for organic seed if desired. This is discussed in Sections 1.5 and 1.6. There is also no realistic prospect of mechanical mixing between red beet and chard seed and H7-1 seed because the two production processes are entirely separate. As discussed in Section 2.7, seed is processed in different facilities, and no common equipment is used.

Under APHIS's proposed interim measures, each seed company producing H7-1 would be subject to third party audits of compliance with the standards to ensure that the measures remained in place and were effective. Accordingly, Alternative 2 would have no or negligible social or economic impacts on red beet and chard crops, Alternative 1, by contrast, would have highly significant negative impacts on nationwide sugarbeet production, as discussed above.

Root Crop Production

As indicated above, including in Sections 2.8 there is little or no overlap of H7-1 root crop production and red beet and chard seed production. To the extent certain red beet or chard seed savers may exist in root crop production areas (none have been identified), the measures for roguing bolters and related stewardship render the potential for genetic transmission from H7-1 negligible. As indicated, Alternative 2 would have no or negligible social or economic impacts on red beet and chard crops, By contrast, Alternative 1 would have highly significant impacts across multiple growing areas.

Consumer Acceptance of the Sugar from Event H7-1 Sugar beets

Since wide-scale production of event H7-1 sugar began, there has been no indication of significant concern regarding acceptance of H7-1 sugar producers of food products with sugar derived from these products or from consumers. The sugar is identical chemically to sugar from conventional sugarbeets (Baker, 2010a, pp. 2-3; Hoffman, 2010a, p. 10). In addition as indicated in Section 3.11.2, food and feed issues have been reviewed by FDA. This FDA review has not been challenged

For any consumers who are nevertheless concerned about the source of this sugar, there are alternatives available. Cane sugar and other sweeteners are readily available for instance. And certain public interest groups, including the Institute for Responsible Technology, have publicized the readily available alternatives to sugarbeet sugar and other sweeteners derived from biotechnology (Burkam, 2010, p. 58).

This section discusses the cumulative impacts that may be associated with Alternative 2, when combined with other recent past, present, and reasonably foreseeable future actions within the affected environment. Alternative 2 is expected to be maintained for a short time duration, and an EIS will specifically address the environmental impacts associated with full deregulationin . Cumulative impacts that will occur before the EIS is completed are expected to be negligible. By contrast, as indicated in Section 3.16, the specific and cumulative impacts of Alternative 1 are expected to be significant for growers nationwide.

Cumulative impacts occur when the effects of an action are added to the effects of other actions occurring in a specific geographic area and timeframe. The cumulative impact analysis follows CEQ's guidance: Considering Cumulative Effects Under the National Environmental Policy Act (CEQ, 1997). The steps associated with the analysis include:

- Specify the class of actions for which effects are to be analyzed.
- Designate the appropriate time and space domain in which the relevant actions occur.
- Identify and characterize the set of receptors to be assessed.
- Determine the magnitude of effects on the receptors and whether those effects are accumulating.

4.1 CLASS OF ACTIONS TO BE ANALYZED

This analysis addresses large, regional and national-scale trends and issues that have impacts that may accumulate with those of the proposed interim measures.

4.2 GEOGRAPHIC AND TEMPORAL BOUNDARIES FOR THE ANALYSIS

As described in Section 2, over the past 10 years, the number of acres planted annually in sugar beets in the US has ranged from 1.1 to 1.4 million (USDA ERS, 2009, Table 14). Event H7-1 sugar beets are produced in five major regions in the US, and commercial production of seeds takes place in the Willamette Valley of Oregon. Therefore, the spatial domain for past, present, and reasonably foreseeable future actions considers the five growing regions for issues associated with growing event H7-1 sugar beets; the Willamette Valley for issues associated with seed production; and the nation, and in some cases international areas, for issues associated with consumption of sugar beet food and feed products. Also, as indicated, the measures at issue would apply for a limited time period, estimated at less than 2 years.

RESOURCES ANALYZED

Issues evaluated in this cumulative impacts analysis include some of the resource areas discussed in Chapters 2 and 3 including land use, air quality and climate, water quality, biological, and human health and safety. In addition, specific topics analyzed include: cumulative impacts related to any possibility of development of glyphosate resistant weeds, and cumulative impacts of potential increased glyphosate usage with the cultivation of glyphosate tolerant crops.

4.3 PARTIAL.CUMULATIVE IMPACTS RELATED TO THE DEVELOPMENT OF GLYPHOSATE RESISTANT WEEDS

Glyphosate offers many benefits to the grower as a weed control product. Glyphosate controls a broad spectrum of grass and broadleaf weed species present in sugar beet production fields, has flexible use timings, and when used in glyphosate-tolerant crops, has a very high level of crop safety (see petition 03-323-01p, Tables VII-4 and VII-4, pages 90 and 92, respectively). As the adoption of glyphosate-tolerant crops has grown, the use of glyphosate has increased over the past several years. With the increased use of glyphosate, there is also the potential for increased selection pressure for the development of glyphosate-resistant weeds (Section VIII).

Because a glyphosate-based herbicide program is currently being used with event H7-1 sugar beet, glyphosate use for event H7-1 is not expected to increase beyond current levels, as market penetration is already at 95 percent. Current levels of glyphosate use in event H7-1 sugar beets are a minor (approximately 0.7 percent) amount of total US glyphosate use. Additionally, with Alternative 2, growers still would have the currently available weed control tools (e.g., non-glyposate herbicides and cultural practices described in Section VII.B of petition 03-323-01p on page 88) needed on a small scale to manage any glyphosate-resistant weeds, whether they are present in sugar beet or other crop production fields.

4.4 CUMULATIVE IMPACTS OF POTENTIAL INCREASED GLYPHOSATE USAGE WITH THE CULTIVATION OF GLYPHOSATE TOLERANT CROPS

Studies of the relationship between genetically engineered crops and herbicide use has shown that an increase in glyphosate tolerant crops can result in a decrease in mechanical tillage (Brimner et al., 2005; Fernandez-Cornejo, 2006; Gianessi and Reigner, 2006; Kleter et. al., 2007; Sankula, 2006; Johnson et al., 2008). The potential cumulative impact from this reduction in mechanical tillage is discussed in the following sections.

According to the USDA ERS (2009), US farmers have adopted genetically engineered crops widely since their introduction in 1996. Soybeans and cotton genetically engineered with herbicide-tolerant traits have been the most widely and rapidly adopted GE crops in the US, followed by insect-resistant cotton and corn. Figure 4-1 shows the percentage of acres of genetically engineered crops in the US between 1996 and 2009.

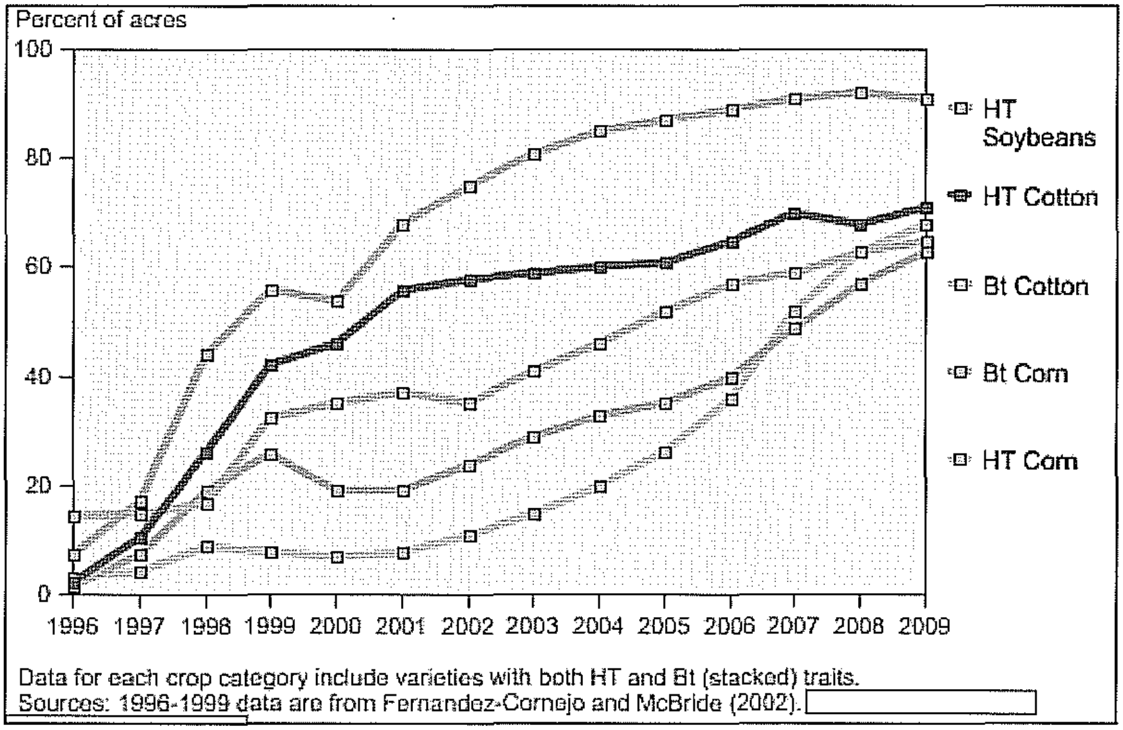


Figure 4-1 Growth in Adoption of Genetically Engineered Crops in US
Source: Graph from USDA ERS, 2009

Herbicide-tolerant crops, which are engineered to survive application of specific herbicides that previously would have damaged the crop , provide farmers with a broader variety of options for effective weed control. Based on USDA survey data, herbicide tolerant soybeans went from 17 percent of US soybean acreage in 1997, to 68 percent in 2001 and 91 percent in 2009. Plantings of herbicide tolerant cotton expanded from approximately 10 percent of US acreage in 1997 to 56 percent in 2001 and 71 percent in 2009. The adoption of herbicide tolerant corn, was slower in previous years, but has reached 68 percent of US corn acreage in 2009 (USDA ERS, 2009).

Corn growers use the largest volume of herbicides. Approximately 96 percent of the 62.2 million acres used for growing corn in the 10 major corn-producing States were treated with more than 164 million pounds of herbicides in 1997 (USDA ERS, 2009). Soybean production in the US also uses a large amount of herbicides. Approximately 97 percent of the 66.2 million soybean acres in the 19 major soybean producing States were treated with more than 78 million pounds of herbicides in 1997 (USDA ERS, 2009). Cotton production relies heavily on herbicides to control weeds, often requiring applications of two or more herbicides at planting and postemergence herbicides later in the season (Culpepper and York, 1998). Close to 28 million pounds of herbicides were applied to 97 percent of the 13 million acres devoted to upland cotton production in the 12 major cotton-producing States in 1997 (USDA ERS, 2009).

Pesticide use on corn and soybeans has declined since the introduction of GE corn and soybeans in 1996. Several studies have analyzed the agronomic, environmental, and economic effects of adopting GE crops, including actual pesticide use changes associated with growing GE crops (McBride and Brooks, 2000; Fernandez-Cornejo, Klotz-Ingram, and Jans, 1999, 2002; Giannessi and Carpenter, 1999; Culpepper and York, 1998; Marra et al., 1998; Falck-Zepeda and Traxler, 1998; Fernandez-Cornejo and Klotz-Ingram, 1998; Gibson et al., 1997; ReJesus et al., 1997; Stark, 1997). Many of these studies have concluded that herbicide use is reduced with herbicide-tolerant varieties (USDA ERS, 2009).

Studies conducted by the USDA also show an overall reduction in pesticide use related to the increased adoption of GE crops. Based on the adoption of GE crops between 1997 and 1998 (except for herbicide-tolerant corn, which is modeled for 1996-97), the decline in pesticide use was estimated to be 19.1 million acre-treatments, 6.2 percent of total treatments (USDA ERS, 2009). Most of the decline in pesticide acre treatments was from less herbicide used on soybeans, accounting for more than 80 percent of the reduction (16 million acre-treatments) (USDA ERS, 2009).

The adoption of herbicide-tolerant crops such as event H7-1 sugar beets, glyphosate-tolerant soybeans, and glyphosate-tolerant corn results in the substitution of glyphosate for previously used herbicides. The glyphosate tolerant crops allow farmers to limit and simplify herbicide treatments based around use of glyphosate, while a conventional weed control program can involve multiple applications of several herbicides. In addition, and more importantly, herbicide-tolerant crops often allow farmers to use more benign herbicides (USDA ERS, 2009).

There are known benefits associated with the use of glyphosate herbicides compared to herbicides currently used by sugar beet producers. Glyphosate has documented favorable characteristics with regard to risk to human health, non-target species, and the environment

(Malik et al., 1989; Geisy et al., 2000; Williams et al., 2000). Glyphosate is classified by the EPA as a Group E pesticide (evidence of non-carcinogenicity for humans) (57 FR 8739). In 1998, the EPA granted Reduced Risk status for an expedited review of the submitted residue data package supporting the use of glyphosate, as Roundup Ultra herbicide (EPA Registration No. 524-475) for use in glyphosate tolerant sugar beets. Reduced Risk status was granted by EPA based on a detailed hazard comparison of glyphosate to alternative herbicides available for weed control in sugar beet production (Reduced Risk petition document: MRID 44560501), and an overall conclusion that weed control with Roundup Ultra herbicide offers a substantial benefit to sugar beet growers in the form of reduced risk to human health, non-target species, and the environment.

4.4.1 Land Use, Air Quality and Climate

As discussed in Section 3, sugar beet acreage has fluctuated little for the past 50 years, was not impacted by the introduction of event H7-1, and is not expected to be impacted by continued use of event H7-1. Therefore, as discussed in Section 3, Alternative 2 is not expected to impact land use. As it is not expected to directly or indirectly impact land use, Alternative 2 would not have cumulative impacts on land use.

As discussed in Section 3, Alternative 2 is expected to continue to have small positive impacts on air quality and climate, primarily resulting from reduced tillage. Consequently, Alternative 2 is not expected to have any adverse cumulative impacts on air quality or climate.

4.4.2 Water Quality

As discussed in Section 3, the advent of glyphosate tolerant crops and the use of post-emergent herbicides that could be applied over a crop during the growing season have facilitated the use of conservation tillage farming practices, since weeds could be controlled after crop growth without tilling the soil (USDA ERS, 2009). The use of glyphosate tolerant crops (particularly soybeans) has intensified that trend since it often allows a more effective and less costly weed control regime than using other post-emergent herbicides (USDA ERS, 2009; Carpenter and Gianessi, 1999).

The impact of conservation tillage (including no-till, ridge-till, and mulch-till) in controlling soil erosion and soil degradation is well documented (Edwards, 1995; Sandretto, 1997). By leaving substantial amounts of plant matter over the soil surface, conservation tillage 1) reduces soil erosion by wind; 2) reduces soil erosion by water; 3) increases water infiltration and moisture retention; 4) reduces surface sediment and water runoff; and 5) reduces chemical runoff (USDA ERS, 2009).

Glyphosate maypotentially be found in surface water runoff when erosion conditions lead to the loss of surface particles. However, as discussed in Section 3, partial deregulation of glyphosate tolerant crops typically leads to an increase in conservation tillage and no tillage systems, which would result in less mechanical disturbance of the soil during sugar beet cultivation and thereby decrease the loss of surface soil. Because of this, and the fact that glyphosate binds strongly to soil particles, no-tillage and conservation tillage are expected to further reduce the likelihood of any impact surface water runoff (Wiebe and Gollehon, 2006). Therefore, no cumulative adverse impacts to surface water or groundwater are anticipated.

4.4.3 Biological

For non-target terrestrial species, available ecological assessments in EPA RED (EPA, 2003) documents or registration review summary documents provide the support that the use of glyphosate represents reductions in chronic risk to birds compared to trifluralin and sethoxydim, in acute risk to small mammals in comparison to EPTC, in chronic risk to mammals from quizalofop-p-ethyl, in acute risk to endangered birds and mammals from pyrazon, and in chronic risk to mammals and potentially birds from cycloate. For all other sugar beet herbicide products, as well as glyphosate, no significant risks to birds or other non-target terrestrial species were indicated in the available information.

For non-target aquatic species, Tables 4-1, 4-2, and 4-3 provide summaries of the estimated exposure and hazard information for the traditional herbicides used in conventional sugar beet production, and present quantitative comparisons of the derived Risk Quotients. Exposure, defined as the EEC, was calculated for all products using the standard assumptions (assuming aerial application) of 5 percent drift of spray applied to a one-acre field onto water and 5 percent runoff from 10 treated acres into a one-acre pond six feet in depth. Herbicide treatments were based on the maximum single application rate taken from product labels. Hazard information (LC50 or EC50) for each active ingredient was taken from the EPA Ecotoxicology One-Liner Database (if available) or other EPA source documents and summarized in Tables 4-1, 4-2 , and 4-3 as the upper and lower values from the range of values reported. Hazard information for the end-use formulated products is generally not readily available, thus this analysis is a comparison based solely on the active ingredients. Any label warnings and other available hazard and/or risk descriptions for non-target aquatic species are also included. The Risk

Quotient is determined for each active ingredient by dividing the EEC by the hazard (LC50 or EC50) value.

Plants potentially at risk from the use of glyphosate are potentially at risk from the use of any herbicide. Like most herbicides, plants are highly sensitive to glyphosate. Monsanto has developed a program named Pre-Serve to address aerial spraying in areas where threatened plants may be located. Following label use instructions and use limitations described in Pre-Serve swould address any such risk of exposure. Federal law requires pesticides to be used in accordance with the label.. Because glyphosate binds strongly to soil particles, conservation tillage and no tillage practices provide additional assurance that the impact to aquatic plants through decreasing soil-laden runoff are negligible.

The labels for products containing desmedipham, phenmedipham, sethoxydim, clethodim and trifluralin include warnings of toxicity or adverse effects to fish, and/or aquatic invertebrates and/or aquatic plants. Risk Quotients that exceed the Trigger Value of 0.5 for aquatic animals and 1.0 for aquatic plants are highlighted in bold text in Tables 4-1, 4-2, and 4-3 as exceeding a Level of Concern, based on EPA Ecological Effects Rejection Analysis and Deterministic Risk Characterization Approach. Current sugar beet herbicide products containing triflusulfuron, trifluralin, and pyrazon are shown to exceed these Levels of ConcernAs supported by the EPA designation of reduced risk for application of glyphosate to H7-1 sugar beet,. glyphosate is a more environmentally preferred herbicide compared to other herbicides currently used in sugar beet production since glyphosate is generally less toxic and has favorable degradation properties.

4.4.4 Human Health and Safety

A tolerance increase was required to support approval for the use of glyphosate in the event H7-1 sugar beet-cropping system compared to the limited pre-emergent use of glyphosate in conventional sugar beet production. However, the potential health effects of pesticide residues that may be present in food, regardless of whether they result from uses in conventional or glyphosate tolerant crops, are carefully considered by EPA before establishing maximum residue limits or tolerances.

Before establishing a tolerance in an agricultural commodity, EPA must find that the potential resulting residues covered by the proposed tolerance will be "safe". Section 408(b)(2)(A)(ii) of the FFDCA [21 USC 346a(b)(2)(A)(i)] defines "safe" as a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue. As part of this determination, the total maximum theoretical level of residue present in all food commodities with approved uses for the pesticide must not exceed the EPA established Reference Dose (RfD), or chronic Population Adjusted Dose (cPAD). Following a comprehensive review of the results of toxicological studies conducted on the pesticide, the RfD is set by applying appropriate uncertainty factors to the most appropriate No-Observed-Adverse-Effect-Level (NOAEL).

In 1999, EPA conducted a dietary exposure risk assessment and concluded that the incremental dietary exposure associated with the use of glyphosate on glyphosate tolerant sugar beet did not pose a concern to human health (64 FR 18360, 1999). . .

Table 4-1 Comparison of Potential Effects of Glyphosate and Sugar Beet Herbicides on Freshwater Fish

Active Ingredient	Max. lb/acre (single appl.)	EEC[1] (ppm)	Fish LC_{50} (a.i.)[2] Range (ppm)		Fish Risk Quotient[3] Range		Classification / Label Warnings
			low	high	worst	best	
Glyphosate	1.125	0.038	45	140	0.0008	0.0003	
Clethodim	0.09	0.003	19	>33	0.0002	<0.0001	
Clopyralid	0.25	0.008	104	125	0.0001	0.0001	
Cycloate	4.0	0.135	4.5	7	0.03	0.02	
Desmedipham	1.2	0.040	1.7	6	0.024	0.007	Toxic to fish.
EPTC	4.2	0.142	11.5	27	0.012	0.005	
Ethofumesate	3.6	0.121	0.75	>320	0.16	<0.0004	
Phenmedipham	0.6	0.020	1.41	3.98	0.014	0.005	
Pyrazon	7.3	0.246	NA	NA	NA	NA	
Quizalofop-p-ethyl	0.17	0.006	0.17	10.72	0.034	0.00	
Sethoxydim	0.47	0.016	170	265	0.0001	0.0001	Toxic to aquatic organisms.
Trifluralin[4]	0.72	0.024	0.0084	0.210	**2.9**	0.12	Extremely toxic to freshwater, marine and estuarine fish.
Triflusulfuron	0.08	0.0027	<640	<760	>0.000004	>0.000004	

NA = information not available

[1] EEC refers to the Estimated Environmental Concentration, which assumes that a one-acre pond, six feet deep receives 5% drift from a one-acre field and 5% runoff from a 10-acre field.

[2] Aquatic LC_{50} values obtained from the 2010 EPA Ecotoxicology One-Liner Database.

[3] Risk Quotient is EEC/LC_{50}. Risk Quotient **Bolded** if > 0.5 = Level of Concern [criteria from EPA Ecological Effects, Rejection Analysis]. Risk Quotients >0.1 result in classification for Restricted Use (http://www.epa.gov/oppefed1/ecorisk_ders/toera_risk.htm#Deterministic).

[4] Toxicity values are from the Trifluralin Reregistration Eligibility Document, United States Environmental Protection Agency, April 1996.

Table 4-2 Comparison of Potential Effects of Glyphosate and Sugar Beet Herbicides on Freshwater Aquatic Invertebrates

Active Ingredient	Max. lb/acre (single appl.)	EEC[1] (ppm)	Invertebrate EC_{50} (a.i.)[2] Range (ppm)		Invertebrate Risk Quotient[3] Range		Classification / Label Warnings
			low	high	worst	best	
Glyphosate	1.125	0.038	134	780	0.0003	0.00005	
Clethodim[4]	0.09	0.003	20.2	NA	0.0002	NA	
Clopyralid	0.25	0.008	225	NA	0.00004	NA	
Cycloate	4.0	0.135	2.6	24	0.052	0.006	
Desmedipham	1.2	0.040	1.88	NA	0.021	NA	
EPTC	4.2	0.142	3.5	66	0.040	0.002	
Ethofumesate	3.6	0.121	64	294	0.002	0.0004	
Phenmedipham	0.6	0.020	3.2	14	0.006	0.001	Toxic to fish and aquatic organisms.
Pyrazon	7.3	0.246	NA	NA	NA	NA	
Quizalofop-p-ethyl	0.17	0.006	2.12	6.4	0.003	0.001	
Sethoxydim	0.47	0.016	78	NA	0.0002	NA	Toxic to aquatic organisms.
Trifluralin[5]	0.72	0.024	0.56	2.2	0.043	0.011	Extremely toxic to aquatic invertebrates.
Triflusulfuron	0.08	0.0027	960	NA	0.000003	NA	

NA = information not available or not applicable

1 EEC refers to the Estimated Environmental Concentration, which assumes that a one-acre pond, six feet deep receives 5% drift from a one-acre field and 5% runoff from a 10-acre field.

2 Aquatic Invertebrate EC_{50} values obtained from the 2010 EPA Ecotoxicology One-Liner Database.

3 Risk Quotient is EEC/EC_{50}. Risk Quotient **Bolded** if > 0.5 = Level of Concern [criteria from EPA Ecological Effects, Rejection Analysis]

4 EC_{50} value is from a study using a 25.6% ai concentration.

5 Toxicity values are from the Trifluralin Reregistration Eligibility Document, United States Environmental Protection Agency, April 1996.

Table 4-3 Comparison of Potential Effects of Glyphosate and Sugar Beet Herbicides on Aquatic Plants (Algae and Duckweed)

Active Ingredient	Max. lb/acre (single appl.)	EEC[1] (ppm)	Aquatic Plant EC_{50} (a.i.)[2] Range (ppm)		Aquatic Plant Risk Quotient[3] Range		Classification / Label Warnings
			low	high	worst	best	
Glyphosate	1.125	0.038	0.8	38.6	0.047	0.001	
Clethodim	0.09	0.003	1.34	>11.4	0.0023	<0.0003	May pose hazard to federally listed endangered plants.
Clopyralid	0.25	0.008	6.9	NA	0.001	NA	
Cycloate	4.0	0.134	NA	NA	NA	NA	
Desmedipham	1.2	0.040	0.044	>0.33	0.909	<0.123	
EPTC	4.2	0.141	1.36	41	0.104	0.003	
Ethofumesate	3.6	0.121	>2.76	>39	<0.044	<0.003	
Phenmedipham	0.6	0.020	0.19	>0.32	0.106	<0.064	Toxic to aquatic organisms.
Pyrazon	7.3	0.245	0.17	>4.6	**1.441**	<0.053	
Quizalofop-p-ethyl	0.17	0.006	>0.082	>1.77	<0.069	<0.004	
Sethoxydim	0.47	0.016	>0.27	>5.6	<0.059	<0.003	Toxic to aquatic organisms.
Trifluralin	0.72	0.024	0.015	5.0	**1.60**	0.005	Extremely toxic to aquatic invertebrates.
Triflusulfuron[4]	0.08	0.0027	0.0028	0.123	0.96	0.022	

NA = information not available or not applicable.

[1] EEC refers to the Estimated Environmental Concentration, which that a one-acre pond, six feet deep receives 5% drift from a one-acre field and 5% runoff from a 10-acre field.

[2] Aquatic EC_{50} values obtained from the 2010 EPA Ecotoxicology One-Liner Database except for the values for phenmedipham which are from the Reregistration Eligibility Decision for Phenmedipham..

[3] Risk Quotient is EEC/EC_{50}. Risk Quotient **Bolded** if > 1.0 = Level of Concern [criteria from EPA Ecological Effects, Rejection Analysis].

[4] Toxicity values are from the Regulatory Note REG99-03 from the Pest Management Regulatory Agency of Canada.

In a recent risk assessment supporting establishment of certain new food crop tolerances for glyphosate, EPA estimated that chronic (daily dietary) exposure to glyphosate from all food and water sources would use only 2 percent of the glyphosate RfD (1.75 mg/kg/day) for the general US population and 7 percent of the RfD for the highest potentially exposed subgroup population (71 FR 76180, 2006).

The cumulative impacts from use of glyphosate on sugar beets was considered. ,

Biomonitoring of pesticide applicators conducted by independent investigators has shown that bodily adsorption of glyphosate as the result of routine, labeled applications of registered glyphosate-based agricultural herbicides to crops, including to glyphosate tolerant sugar beet, was thousands of times less than the allowable daily intake level established for glyphosate (Acquavella et al., 2004). Given similarity to current use pattern, herbicide label rates, and the percentage of cultivate acres for sugar beets, the continued use of event H7-1 sugar beet through partial deregulation will not significantly increase the exposure risk to pesticide applicators. Furthermore, EPA, the European Commission, the WHO, and independent scientists have concluded that glyphosate is not mutagenic or carcinogenic, not a teratogen nor a reproductive toxicant, and that there is no evidence of neurotoxicity associated with glyphosate (EPA, 1993; EC, 2002; WHO, 2004, and Williams et al., 2000).

Bystander exposure to glyphosate as a result of pesticide application to event H7-1 sugar beet would be negligible, since such applications would occur in an agricultural setting in relatively rural sugar beet fields, not in an urban setting.

Presented below is an brief, comparative analysis of the hazard/risk characteristics of glyphosate, the active ingredient in Roundup WeatherMAX® herbicide (EPA Registration No. 524-537), to the most commonly used herbicides applied in conventional sugar beet production, based on total pounds of active ingredient applied (USDA-NASS, 2001). A detailed assessment of the potential chronic human health risks compared to traditional products will not be presented in this comparison. The assessment is based on information obtained from various sources, including product-specific labeling, EPA Reregistration Eligibility Documents (RED, EPA, 1993), EPA RED Fact Sheets, product-specific Federal Register publications, the EPA

® Roundup UltraMAX is a registered trademark of Monsanto Technology LLC

Ecotoxicology One-Liner database[42], the USDA Pesticide Properties database[43], and other public sources of product-specific toxicological and environmental profile information. The assessment shows that in the majority of cases, weed control with glyphosate, formulated and sold as Roundup WeatherMAX herbicide, in the event H7-1 sugar beet system offers the benefit of less risk from potential exposure for applicators and handlers of concentrated product and a reduced potential to impact non-target species and water quality.

Table 4-4 provides a comparison of product-specific labeling for herbicides commonly used for weed control in sugar beet production, including required precautionary statements associated with acute exposure hazards and environmental risk concerns. Although most alternative products carry the same signal word as Roundup WeatherMAX herbicide (CAUTION), the associated precautionary statements of each of the alternative herbicide products are indicative of toxicity findings that represent a greater acute exposure risk than Roundup WeatherMAX. Nearly every sugar beet herbicide product evaluated has more restrictive requirements for the use of Personal Protective Equipment (PPE) than those required for Roundup WeatherMAX herbicide, indicating a greater need to reduce the risk of acute exposure, and, in some cases, the risk of longer-term or chronic exposure, for applicators and handlers of these other products.

The comparative analyses provided in this section are summarized in Table 4-5 and show those areas for which glyphosate (designated with a checkmark ✓), using Roundup WeatherMAX herbicide in the comparison, offers the benefit of potential risk reduction compared to the most commonly used sugar beet herbicides in sugar beet production. In this cumulative comparison, glyphosate offers potential benefits over all the traditional sugar beet herbicides in at least one and up to four risk assessment categories. These comparisons demonstrate the benefits to applicators, mixers and non-target organisms from the use of glyphosate in the event H7-1 sugar beet system.

4.4.5 Summary of Potential Cumulative Impacts from Increased Use of Glyphosate

When considering the impact that the use of glyphosate in the event H7-1 sugar beet system could have on the human environment in conjunction with the use of glyphosate in other glyphosate tolerant crops already being cultivated in the same affected environments, the facts suggest that this use will have little or noadditive effect Additionally, use of glyphosate.

[42] EPA Ecotoxicology One-Liner database: http://www.ipmcenters.org/Ecotox/index.cfm
[43] USDA Pesticide Properties database: ttp://www.ars.usda.gov/Services/docs.htm?docid=14199

Alternatively, this has the potential to reduce risks to the affected environment from the use of other, more harmful, herbicides. This is supported by the assessment of the environmental and worker safety hazards associated with glyphosate when compared to other available herbicides used for weed control in sugar beet production. Based on such an assessment, EPA granted reduced risk status for this use of glyphosate, and expedited the review of supporting residue data. Therefore, there is no reasonably anticipated adverse cumulative impact on human health or the environment from the use of glyphosate associated specifically with the deregulation of event H7-1 sugar beets

For a discussion of coexistence of H7-1 and conventional beta species crops, see Sections 1.6 and 2.4..

Table 4-4 Alternative Herbicides for Weed Control in Sugar Beets - Label Comparison / Exposure Mitigation

Active Ingredient(s)	Product Brand	Label Signal Word	Sugar Beet PHI[a] (days)	Max. lb ai/acre (single appl.)	Max. lb. ai/acre (season)	Label Precautionary Statements / Special Directions / Other Information	Applicator and Handler PPE[b] Required to Mitigate Exposure Risks
Glyphosate	Roundup WeatherMAX	Caution	30	1.125	6	Causes moderate eye irritation. Harmful if inhaled. Do not store in steel. Four resistant weed biotypes confirmed to date.	Long-sleeved shirt, long pants, shoes plus socks. When handling this concentrated product or its application solutions of 30% or greater, must also wear chemical-resistant gloves.
Clethodim[c]	Select 2 EC or Prisim	Warning	40	0.09	0.25	Causes substantial, but temporary, eye injury. Harmful if swallowed or inhaled. Potential skin sensitizer. Warnings and precautions for runoff and drift. Use of the product may pose hazard to federally listed endangered plant species. Warnings for repeated use leading to selection of resistant weed biotypes. Crop injury warnings.	Long-sleeved shirt, long pants, shoes plus socks, chemical-resistant gloves, protective eyewear. Do not reuse heavily contaminated clothing.
Clopyralid	Stinger	Caution	45	0.25	0.25	Causes eye injury. Harmful if inhaled or absorbed through skin. Warning for leaching to groundwater under certain conditions. Crop injury warnings for 1) use of treated plant material or manure from animals grazed in treated areas, as mulch or compost; and 2) spreading of treated soil. Up to 18-month rotation restrictions to many crops due to risk of injury; field bioassay recommended.	Long-sleeved shirt, long pants, waterproof gloves, shoes plus socks.

Table 4-4 Alternative Herbicides for Weed Control in Sugar Beets - Label Comparison / Exposure Mitigation

Active Ingredient(s)	Product Brand	Label Signal Word	Sugar Beet PHI[a] (days)	Max. lb ai/acre (single appl.)	Max. lb. ai/acre (season)	Label Precautionary Statements / Special Directions / Other Information	Applicator and Handler PPE[b] Required to Mitigate Exposure Risks
Cycloate	Ro-neet	Caution	NA; preplant incorporation	4	4	Harmful if swallowed. Avoid contamination of food or feed. Soil incorporation or soil injection required. Crop injury concerns dependent on soil type.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks. Added PPE in California for a non-closed system; for mixers/loaders: chemical resistant clothing, full face respirator; for applicators: coveralls, plus half-face respirator, 93 gallon limit for 21-day period.
Desmedipham[d]	Betanex	Caution	75	1.2	1.92	Harmful if swallowed. Causes moderate eye irritation. Prolonged or frequent repeated skin contact may cause allergic reaction. This product contains the toxic inert ingredient isophorone. This product is toxic to fish. Do not apply where runoff is likely to occur. Sugar beet injury possible under many situations.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks, protective eyewear.

Table 4-4 Alternative Herbicides for Weed Control in Sugar Beets - Label Comparison / Exposure Mitigation

Active Ingredient(s)	Product Brand	Label Signal Word	Sugar Beet PHI[a] (days)	Max. lb ai/acre (single appl.)	Max. lb. ai/acre (season)	Label Precautionary Statements / Special Directions / Other Information	Applicator and Handler PPE[b] Required to Mitigate Exposure Risks
Desmedipham/ phenmedipham	Betamix	Warning	75	1.2	1.92	Causes substantial, but temporary, eye injury. Harmful if swallowed or absorbed through skin. This product contains the toxic inert ingredient isophorone. This product is toxic to fish and aquatic organisms. Drift and runoff...may be hazardous to fish and aquatic organisms. Physical hazard: Combustible. Sugar beet injury possible under many situations; evening applications recommended. Rotation restriction of 120 days for cereals.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks, protective eyewear.
EPTC[e]	Eptam	Caution	NA; preplant incorporation or very early postemergence	4.2	5.6	Harmful if swallowed. Avoid breathing spray mist. Incorporation or soil injection required unless applied through irrigation.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks.
Ethofumesate	Nortron	Caution	90	3.6	4	Harmful if swallowed, inhaled or absorbed through skin. Rotation restrictions of 6 to 12 months for crops other than sugar beets or ryegrass. Do not graze livestock on treated crops.	Long-sleeved shirt, long pants, waterproof gloves, shoes plus socks.

Table 4-4 Alternative Herbicides for Weed Control in Sugar Beets - Label Comparison / Exposure Mitigation

Active Ingredient(s)	Product Brand	Label Signal Word	Sugar Beet PHI[a] (days)	Max. lb ai/acre (single appl.)	Max. lb. ai/acre (season)	Label Precautionary Statements / Special Directions / Other Information	Applicator and Handler PPE[b] Required to Mitigate Exposure Risks
Pyrazon	Pyramix DF	Caution	0	7.3	7.3	Harmful if swallowed, inhaled or absorbed through skin. Avoid breathing dust or spray mist. Causes moderate eye irritation. Significant crop injury warning statements, depending on soil moisture level, soil type (organic matter content, loam, sandy, etc.), and temperature at time of application, application method, and tank mix products.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks. Do not reuse clothing heavily contaminated with this product's concentrate.
Quizalofop-p-ethyl	Assure II	Danger	45 days, except 60 days for feeding of tops	0.17	0.17	Causes severe eye irritation. May irritate skin, nose and throat. May be harmful if absorbed through skin, swallowed or inhaled. This product contains petroleum-based distallates. Rotation restriction of 120 days for crops not labeled. Need spray adjuvant added.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus sock, protective eyewear. Do not reuse clothing heavily contaminated with this product's concentrate.
Sethoxydim[f]	Poast	Warning	60	0.40	0.8	Causes substantial, but temporary, eye injury. Harmful if swallowed. This product is toxic to aquatic organisms. Crop injury warnings. Multiple confirmed resistant weed biotypes.	Coveralls over short-sleeved shirt and short pants, chemical-resistant gloves, chemical-resistant footwear, protective eyewear, chemical-resistant headgear for overhead exposure, chemical-resistant apron for cleaning, mixing, loading.

Table 4-4 Alternative Herbicides for Weed Control in Sugar Beets - Label Comparison / Exposure Mitigation

Active Ingredient(s)	Product Brand	Label Signal Word	Sugar Beet PHI[a] (days)	Max. lb ai/acre (single appl.)	Max. lb. ai/acre (season)	Label Precautionary Statements / Special Directions / Other Information	Applicator and Handler PPE[b] Required to Mitigate Exposure Risks
Trifluralin[g]	Treflan HFP	Caution	NA; one application between first true leaf and 6 inch stage	0.72	4.0	Causes moderate eye irritation, harmful if swallowed, potential skin sensitizer. This product contains aromatic hydrocarbon and can be extremely toxic if swallowed. This pesticide is extremely toxic to freshwater marine and estuarine fish and aquatic invertebrates. Soil incorporation required within 24 hrs of application. Crop injury warnings. Crop rotation restrictions ranging from 5 to 21 months. Confirmed multiple resistant weed biotypes.	Long-sleeved shirt, long pants, shoes plus socks, chemical-resistant gloves, protective eyewear. Do not reuse clothing heavily contaminated with this product's concentrate.
Triflusulfuron	Upbeet	Caution	60	0.008	0.08	Resistant weed biotypes; multiple MOA resistance. Need spray adjuvant added.	Long-sleeved shirt, long pants, chemical-resistant gloves, shoes plus socks.

NA indicates not applicable.

[a] PHI – Post Harvest Interval.

[b] PPE – Personal Protective Equipment.

[c] Based on recent clethodim tolerance action (67 FR 46893, Final Rule, July 17, 2002) percent-crop-treated market data necessary to refine chronic dietary exposure estimates; per label statement: concern for risks to endangered plant species.

[d] 1996 desmedipham RED: concern for Margins of Exposure (MOE) for dermal exposure to mixers and loaders; additional concern for applicator inhalation exposure to wettable-powder formulations requiring limits on application rate per acre and number of acres treated per day; low to moderate chronic risk to birds.

[e] 1999 EPTC RED ; 10x FQPA UF retained due to neurotoxic effects; developmental neurotoxicity study required; reversible Cholinesterase inhibitor; Tier 3 refinements using average residues and percent crop treated data for chronic dietary assessment; concern for risk to applicators and handlers from dermal and inhalation exposure; concern for risks to small mammals and non-target plants, including endangered species from run-off and spray drift.

[f] Based on recent sethoxydim tolerance actions (66 FR 51587, Final Rule, Oct.10, 2001), aPAD includes additional 3x FQPA UF for acute exposure to females 13+ yrs of age, due to fetal effects seen in rat developmental tox study; anticipated residues and percent-crop-treated data necessary to refine chronic exposure assessment.

[g] 1995 Trifluralin RED: concern for cancer risk to applicators, handlers and field workers; moderately to highly toxic to fish and aquatic invertebrates; chronic risk concern for birds due to evidence of egg cracking in avian study.

Table 4-5 Potential Reduction in Risk from Use of Glyphosate Compared to Traditional Herbicides Used in US Sugar Beet Production

Active Ingredients[1]	Human Health Risk		Non-Target Species Risks					Groundwater Contamination	Total Number of Areas for Potential Risk Reduction
	Acute	Chronic	Mammals	Fish	Aquatic Invertebrates	Aquatic Plants	Avian		
Clethodim	✓	✓						✓	3
Clopyralid	✓							✓	2
Cycloate	✓		✓				✓	✓	4
Desmedipham	✓	✓						✓	3
EPTC	✓	✓	✓					✓	4
Ethofumesate	✓			✓				✓	3
Phenmedipham	✓								1
Pyrazon	✓		✓			✓	✓	✓	5
Quizalofop-p-ethyl	✓		✓					✓	3
Sethoxydim	✓	✓					✓		3
Trifluralin	✓	✓		✓	✓	✓	✓		6
Triflusulfuron	✓								1

[1] Traditional herbicides are compared to glyphosate, using the label from Roundup WeatherMAX herbicide.
✓ Indicates there is a potential for reduction in risk category by using Roundup agricultural herbicides.

REFERENCES

Acquavella J.F., Alexander, B.H., Mandel, J.S., Gustin, C., Baker, B., Chapman, P., and Bleeke, M. 2004. Glyphosate biomonitoring for farmer-applicators and their families: Results from the farm family exposure study. Environ Health Perspect. 112:321-326.

Alberts, 1999. Testimony of Bruce Alberts, president of the National Academy of Science, before the US Senate Committee on Agriculture, Nutrition and Forestry. October 7.

Ali, 2004. Mir B. Ali. Characteristics and production costs of U.Ssugarbeet. sugar beet farms. USDA statistical bulletin no. 974-8.

Al-Kaff et al, 1998. Al-Kaff, N.S., S.N. Covey, M.M. Kreike, A.M. Page, R. Pinder and P.J. Dale. 1998. Transcriptional and Posttranscriptional Plant Gene Silencing in Response to a Pathogen. Science 279: 2113-2115

AMA, 2000. American Medical Association. Report 10 of the Council on Scientific Affairs (I-00). Genetically modified food and crops. Accessed on June 22, 2010 at: http://www.ama-assn.org/ama/no-index/about-ama/13595.shtml

American Crystal Sugar Company, 2009. Annual Report. Accessed on May 30, 2010 at: http://www.crystalsugar.com/coopprofile/annual.aspx.

American Crystal Sugar Company, undated. Producing sugar beet seed. Accessed on June 3, 2010 at: http://www.crystalsugar.com/agronomy/bs.new/producingseed.aspx

American Public Media (APM). 2009. *Bitter fight developing over sugar beets.* November 19, 2009.

Anfinrud, 2010. Declaration of Mark Anfinrud in support of the intervenors' opposition to PL permanent injunction case no. 080484.

APHIS 2007. About APHIS. U.S. Department of Agriculture Animal and Plant Health Inspection Service. Accessed on May 6, 2010 at http://www.aphis.usda.gov/about_aphis/.

APHIS 2010. Notice of intent to prepare an environmental impact statement and proposed scope of study. 75 Fed. Reg. 29969-72 (May 28, 2010).

Armstrong and Sprague, 2010. Jon-Joseph Armstrong, Oklahoma State University and Christy Sprague, Michigan State University. Weed management in wide- and narrow-row glyphosate-resistant sugar beets. Weed Technology. Accessed on July 23, 2010 at: http://wssa.allenpress.com/perlserv/?request=get-pdf&doi=10.1614%2FWT-D-10-00033.1

Baker, 2010. C.J. Baker. Stakes high as beet suit hearing arrives. Powell Tribune, Powell, WY. Accessed on June 11, 2010 at: http://powelltribune.com/index.php/content/view/3108/58/

Baker, J.L. and Johnson, H.P. 1979. The effect of tillage systems on pesticides in runoff from small watersheds. Transactions of the American Society of Agricultural Engineers 0001-2351/79/2203-0554. Pp. 554-559.

Baker, J.L., Laflen, J.M., and Hartwig, R.O. 1982. Effects of corn residue and herbicide placement on herbicide runoff losses. Transactions of the American Society of Agricultural Engineers 0001-2351/82/2502-0340. Pp. 340-343.

Bandeen, J. D., G. R. Stephenson, and E. R. Cowett. 1982. Discovery anddistribution of herbicide-resistant weeds in North America. Pages 9–30 in H.M. LeBaron and J. Gressel, eds. Herbicide Resistance in Plants. New York: J.Wiley.

Bartsch and Ellstrand, 1999. D. Bartsch and N.C. Ellstrand. Genetic evidence for the origin of California wild beets. Theoretical and Applied Genetics.

Bartsch et al, 2003. Bartsch, D., Cuguen, J., Biancardi, E., and Sweet, J. 2003. Environmental implications of gene flow from sugar beet to wild beet – current status and future research needs. Env. Bio. Res. 2:105-115.

Bartsch, D., Driessen, S., Gathmann, A., Hoffmann, A., Lehnen, M., Muecher, T. Saeglitz, C., Wehres, U., and Schuphan, I. 2002. Monitoring the environmental consequences of gene flow from transgenic sugar beet. *In* Gene Flow Workshop, The Ohio State University, Pp. 78-93.

Bell, G.D.H. 1946. Induced bolting and anthesis in sugar beet and the effect of selection of physiological types. J. Ag. Sci. 36:167-184.

Bennett, R., Phipps, R., Strange, A., and Grey, P. 2004. "Environmental and Human Health Impacts of Growing Genetically Modified Herbicide-Tolerant Sugar Beet: a Life-Cycle Assessment." *Plant Biotechnology Journal* 2(4):273-278.

Berg, 2010. Declaration of David Berg in support of the intervenors' opposition to PL permanent injunction case no. 080484.

Boland, 2003. Michael Boland. Wyoming Sugar Company, LLC. Arthur Capper Cooperative Center Case Study Series 03-02. Accessed on May 30, 2010 at: www.agmrc.org/.../wyomingsugarcompany_5253A0C0B243F.pdf

Bonnette, 2004. Richard E. Bonnette, FDA. Biotechnology consultation note to the file, BNF No. 00090. Subject: Glyphosate-tolerant sugar beet event H7-1. August 7. Accessed on June 26, 2010 at: http://www.fda.gov/Food/Biotechnology/Submissions/ucm155775.htm

Boongird, S., T. Suavansri, T. Anantachaiyong, and S. Rattithumkul. 2003. Effect of Roundup Ready Corn NK603 on foraging behavior and colony development of *Apis mellifera* L. under greenhouse condition. Proc. Sixth Nat. Plant Protect. Conf. Thailand, 24th - 27th Nov 2003, p26-27, Abstract.

Brimhall et al., 1965. Phil B. Brimhall, Earl. W. Chamberlain, and H.P. Perry. Competition of annual weeds and sugar beets. Weeds, Vol. 13, No. 1. (Jan 1965), pp. 33-35. Weed Science Society of America.

Brimner, T.A., Gallivan, G.J., and Stephenson, G.R. 2005. "Influence of Herbicide-Resistant Canola on the Environmental Impact of Weed Management." *Pest Management Science* 64:441-456.61(1):47-52.

California Beet Growers Association, 1998. The sugar beet industry in California. Accessed on May 30, 2010 at: http://sugarbeet.ucdavis.edu/sugar_industry.html.

California Beet Growers Association, 1999. Crop profile for sugar beets in California. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

California Department of Food and Agriculture, 2010. California organic program. Accessed on June 20, 2010 at: http://www.cdfa.ca.gov/is/i_&_c/organic.html.

Campbell, C.A. and Janzen, H.H. 1995. Effect of tillage on soil organic matter. Farming for a better environment. Pp. 9-11.

Cattanach et al, 1991. A.W. Cattanach and A.G. Dexter, Extension sugar beet specialists, North Dakota State University, Fargo, ND and University of Minnesota Extension Services, St. Paul, MN; and E.S. Oplinger, Department of Agronomy, College of Agriculture and Life Sciences Cooperative Extension Service, University of Wisconsin-Madison, WI. Sugar beets. Accessed on June 28, 2010 at: http://www.hort.purdue.edu/newcrop/afcm/sugar beet.html

Ceddia and Cerezo, 2008. Michele Graziano Ceddia and Emilio Redriguez Cerezo. A descriptive analysis of conventional, organic and GM crop and certified seed production in the UE. European Commission Joint Research Centre.

CEQ/OSTP, 2001. Council on Environmental Quality and Office of Science and Technology Policy. Case studies of environmental regulation. Accessed on July 5, 2010 at: http://www.whitehouse.gov/administration/eop/ostp/library/archives

Cerdeira and Duke, 2006. A.L. Cerdeira and S.O. Duke. The current status and environmental impacts of glyphosate–resistant crops: A review. Journal of Environmental Quality.

CFIA, 2005. Canadian Food Inspection Agency. Decision document DD2005-54 Determination of the safety of Monsanto Canada Inc. and KWS SAAT AG's Roundup Ready® Sugar Beet (*Beta vulgaris ssp. vulgaris* L.) Event H7-1. Issued September 2005. Accessed on June 16, 2010 at: http://www.inspection.gc.ca/english/plaveg/bio/dd/dd0554e.shtml#a1.

Chamberlain, 1967. A.C. Chamberlain. Cross-pollination between fields of sugar beet. Atomic Research Establishment, Harwell.

Codex Alimentarius Commission, 2003. Guideline for the conduct of food safety assessment of foods derived from recombinant – DNA plants. CAC/GL-2003. Accessed on June 27, 2010 at: ftp://ftp.fao.org/es/esn/food/guide_plants_en.pdf

Cole, 2010a. Declaration of Richard Cole, PhD in support of the intervenors' opposition to PL preliminary injunction motion case no. 08-00484, February 10, 2010.

Cole, 2010b. Declaration of Richard Cole, PhD in support of the intervenors' opposition to PL permanent injunction case no. 08-00484, May 2, 2010.

Colorado Department of Agriculture, undated. Noxious weed management program. Online. Accessed on June 1, 2010 at: http://www.colorado.gov/cs/Satellite/Agriculture-Main/CDAG/1178305828928.

Conservation Technology Information Center (CTIC). 2000. Conservation for Agriculture's Future. Top 10 conservation tillage benefits. [http://www.ctic.purdue.edu/Core4/CTSurvey/10Benefits.html]

Consortium of California Herbaria, 2008. Jepson on-line interchange. Accessed on June 14, 2010 at: http://ucjeps.berkeley.edu/cgi-bin/get_consort.pl.

Cornell Public Seed Initiative, undated. Basic concepts of seed production. Accessed on June 20, 2010 at: http://www.plbr.cornell.edu/psi/NOVIC%20Seed.htm

Council on Environmental Quality (CEQ). 1997. *Considering Cumulative Effects Under the National Environmental Policy Act.*

Culpepper, A.S., and A.C. York. 1998. "Weed Management in Glyphosate-Tolerant Cotton," *The Journal of Cotton Science,* 4:174-185.

Darmency et al, 2007. Darmency, H., Vigouroux, Y., Gestat De Garambe, T., Richard-Molard, M., and Muchembled, C. 2007. Transgene escape in sugar beet production fields: data from six years farm scale monitoring. Environ. Biosafety Res. 6:197-206.

Darmency et al, 2009. H. Darmency, E.K. Klein, T. G. De Garanbé, P. H. Gouyon, M. Richard-Molard, and C. Muchembled. Pollen dispersal in sugar beet production fields. Theor. Appl. Genet.

Desplanque et al, 2003. Benoit Desplanque. Genetic diversity and gene flow between wild, cultivated and weedy forms of Beta vulgaris L. (Chenopodiaceae), assessed by RFLP and microsatellite markers. Theortical and applied genetics, 98.

Desplanque et al. 2002. Benoit Desplanque, Nina Hautekeete, and Hen Van Dijk. Transgenic weed beets: possible, probable, avoidable?

Dexter and Luecke, 2003. A.G. Dexter and J.L. Luecke. Survey of weed control and production practices on sugar beet in eastern North Dakota and Minnesota - 2002. pp. 35- 64. In 2002 Sugar beet Research and Extension Reports, North Dakota State University Extension, Vol. 33.

Dexter et al, 1994. Alan G. Dexter, North Dakota State University and the University of Minnesota; Jeffrey L. Gunsolus, University of Minnesota; and William S. Curran, Pennsylvania State University. Herbicidal Mode of Action and Sugar beet Injury Symptons. Accessed on June 2, 2010 at: http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/a1085w.htm#Herbicide.

Dexter, A.G. and Zollinger, R.K. 2003. Weed Control Guide for Sugar beet. Pp. 3-34. *In* 2002 Sugar beet Research and Extension Reports, North Dakota State University Extension, Vol. 33.

Duke and Cerdeira, 2007. Risks and benefits of glyphosate-resistant crops. http://www.isb.vt.edu/articles/jan0702.htm

Dumas, 2008. Carol Ryan Dumas. Weed scientists tells do's, don'ts of Roundup Ready sugar beets. Farm and Ranch Guide. Accessed on July 25, 2010 at:

http://www.farmandranchguide.com/articles/2008/03/27/ag_news/production_news/product12.tx t

Dunfield, K.E. and J.J. Germida. 2003. Seasonal changes in the rhizosphere microbial communities associated with field-grown genetically modified canola (*Brassica napus*). Appl. Environ. Micro. 69:7310-7318.

Durgan, 1998. Beverly Durgan. Identification of the noxious weeds of Minnesota. University of Minnesota Extension. Accessed on June 1, 2010 at: www.mda.state.mn.us/news/publications/.../noxiousweedspresentation.pdf.

Durrant, M.J. and Jaggard, K.W. 1988. Sugar beet seed advancement to increase establishment and decrease bolting. J. Ag. Sci. 110:367-374.

EC (European Commission). 2002. Report for the Active Substance Glyphosate, Directive 6511/VI/99, January 21. Accessed December 13, 2007 at: http://europa.eu.int/comm/food/fs/ph_ps/pro/eva/existing/list1_en.htm .

EC, 2007. European Commission. Commission decision of 24 October 2007 authorising the placing on the market of food and feed produced from genetically modified sugar beet H7-1 (KM-000K71-4) pursuant ot the Regulation (EC) No. 1829/2003 of the European Parliament and of the Council. Official Journal of the European Union. 27.10.2007; L283/69.

Edwards, W.M. "Effects of Tillage and Residue Management on Water for Crops," *Crop Residue Management to Reduce Erosion and Improve Soil Quality: Appalachia and Northeast Region*. R.L. Blevins and W.C. Moldenhauer, eds., U.S. Dept. of Agriculture, Agricultural Research Service, Conservation Research Report No. 41, 1995.

EFSA, 2006. European Food Safety Authority. Opinion of the Scientific Panel on Genetically Modified Organisms on an application (reference EFSA-GMO-UK-2004-08) for the placing on the market of products produced from glyphosate-tolerant genetically modified sugar beet H7-1, for food and feed uses, under Regulation 9EC) No1829/2003 from KWS SAAT and Monsanto, The EFSA Journal (2006) 431, 1-18.

EFSA, 2010. European Food Safety Authority web site. Accessed on June 27, 2010 at: http://www.efsa.europa.eu/.

Ellstrand, 2003. Norman C. Ellstrand. Dangerous liaisons? When cultivated plants mate with their wild relatives (syntheses in ecology and evolution). The Johns Hopkins University Press.

Ellstrand, 2006. Norman C. Ellstrand. When crop transgenes wander in California, should we worry? California Agriculture: Vol. 60, No. 3, p. 116.

EPA, 1993. United States Environmental Protection Agency. "Reregistration Eligibility Decision (RED): Glyphosate." Technical Report, Office of Prevention, Pesticides and Toxic Substances. EPA 738-R-93-014.

EPA, 1996. Federal Register Notice, Plant Pesticide Inert Ingredient CP4 Enolpyruvylshikimate-3-D and the Genetic Material Necessary for Its Production in All Plants. Access on June 17, 2010 at: http://www.epa.gov/fedrgstr/EPA-PEST/1996/August/Day-02/pr-840.html. August 2, 1996.

EPA 2002. Website description of *Environmental Implications of Conservation Tillage: A Systems Approach*, by G. Bailey, L. Mulkey and R. Swank. EPA/600/D-85/147 (NTIS PBB5237089). Accessed on May 19, 2010 at: http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=39100&fed_org_id=770&SIType=PR&TIMSType=&showCriteria=0&address=nerl&view=citation&keyword=Pesticides&sortBy=pubDateYear&count=100&dateBeginPublishedPresented=

EPA. 2004. Overview of the ecological risk assessment process in the office of pesticide programs. U.S. Environmental Protection Agency Endangered and threatened species effects determinations. Http://epa.gov/espp/consultation/ecorisk-overview.pdf.

EPA, 2005. United States Environmental Protection Agency. "Glyphosate New Use (bent-grass): Environmental Fate and Effects Risk Assessment." Technical Report, Office of Prevention, Pesticides, and Toxic Substances/ Environmental Fate and Effects Division. Authored by Termes, S. & Rieder, D. 2005. Terrestrial Residue Exposure) simulation model TREX Version 1.2.3. http://www.epa.gov/oppefed1/models/terrestrial/index.htm#trex, August 5, 2005.

EPA 2007. *National Water Quality Inventory: Report to Congress, 2002 Reporting Cycle: Findings*. Accessed on May 19, 2010 at: http://www.epa.gov/305b/2002report/.

EPA 2008a. Agricultural Management Practices for Water Quality Protection. Website, accessed on May 19, 2010 at: http://www.epa.gov/watertrain/agmodule/.

EPA, 2008b. Risks of Glyphosate Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*). Pesticide Effects Determination http://www.epa.gov/espp/litstatus/effects/redleg-frog/glyphosate/determination.pdf

EPA 2009. *National Water Quality Inventory: Report to Congress, 2004 Reporting Cycle: Findings*. Accessed on May 19, 2010 at: http://www.epa.gov/owow/305b/2004report/.

European Commission Scientific Committee on Plants, 2001. Opinion of the Scientific Committee on Plants concerning the adventitious presence of GM seeds in conventional seeds. Opinion adopted by the Committee on 7 March 2001.

Eurostat, 2010. Eurostat newsrelease. Organic area up by 21% in the EU between 2005 and 2008. March. Accessed on July 22, 2010 at: http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/5-01032010-BP/EN/5-01032010-BP-EN.PDF

Falck-Zepeda, J.B. and G. Traxler. 1998. "Rent Creation and Distribution from Transgenic Cotton in the U.S." Department of Agricultural Economics and Rural Sociology, Auburn University, AL. Prepared for the symposium entitled "Intellectual Property Rights and Agricultural Research Impacts," NC-208 and CIMMYT, El Batan, Mexico, Mar. 5-7, 1998.

Fawcett, R.S. 1995. Agricultural tillage systems: Impacts on nutrient and pesticide runoff and leaching. Soil and Water Conservation. Pp. 48-50.

FDA, 1992. U.S. Food and Drug Administration. Statement of policy – foods derived from new plant varieties. Guidance to industry for foods derived from new plant varieties. FDA Federal Register, Volume 57 – 1992, 22984-23005, Friday, May 29, 1992, Notices. Accessed on June 27, 2010 at: http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/Biotechnology/ucm096095.htm

FDA, 1997. U.S. Food and Drug Administration. Consultation procedures under FDA's 1992 statement of policy – foods derived from new plant varieties. June 1996, revised October 1997. Office of Premarket Approval, Center for Food Safety and Applied Nutrition and Office of Surveillance and Compliance, Center for Veterinary Medicine. Accessed on June 27, 2010 at: http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/Biotechnology/ucm096126.htm

FDA, 2004. U.S. Food and Drug Administration. List of Completed Consultations on Bioengineered Foods; biotechnology notification file (BNF) no. 90. Accessed on June 26, 2010 at: http://www.accessdata.fda.gov/scripts/fcn/fcnDetailNavigation.cfm?rpt=bioListing&id=19

FDA, 2006. U.S. Food and Drug Administration. Recommendations for the early food safety evaluation of new non-pesticidal proteins produced by new plant varieties intended for food use. November 2004, revised June 2006. Center for Food Safety and Applied Nutrition and Center for Veterinary Medicine. Accessed on June 27, 2010 at: U.S. Food and Drug Administration (FDA). 2004.

FDA, 2010. US Food and Drug Administration. Completed consultations on bioengineered food. Accessed on July 5, 2010 at: http://www.accessdata.fda.gov/scripts/fcn/fcnNavigation.cfm?rpt=bioListing

Fénart et al, 2007. S. Fénart, F. Austerlitz, J. Cuguen, and J.F. Arnaud. Long distance pollen-mediated gene flow at a landscape level: the weed beet as a case study. Jour. Mol. Ecol.

Fernandez-Cornejo, J. 2006. Agricultural Resources and Environmental Indicators (AREI), Chapter 3.3: "Biotechnology and Agriculture." USDA Economic Research Service. http://www.ers.usda.gov/publications/arei/eib16/Chapter3/3.3/.

Fernandez-Cornejo, J., and C. Klotz-Ingram. 1998. "Economic, Environmental, and Policy Impacts of Using Genetically Engineered Crops for Pest Management." Selected paper presented at the 1998 Northeastern Agricultural and Resource Economics Association meetings. Ithaca, NY, June 22-23, 1998.

Fernandez-Cornejo, J., C. Klotz-Ingram, and S. Jans. 2002. "Farm-Level Effects of Adopting Herbicide-Tolerant Soybeans in the U.S.A." *Journal of Agricultural and Applied Economics*, April 2002.

Fernandez-Cornejo, J., C. Klotz-Ingram, and S. Jans. 1999. "Farm-Level Effects of Adopting Genetically Engineered Crops in the U.S.A." *Proceedings of NE-165 Conference, Transitions in Agbiotech: Economics of Strategy and Policy*. William H. Lesser, ed., Washington, DC, June 24-25, 1999.

Flachowsky, 2007. Gerhard Flachowsky. Feeds from genetically engineered plants. ISB News Rep. Accessed on June 22, 2010 at: http://www.isb.vt.edu/articles/mar0702.htm

Floyd, 2006. Don Floyd. Measuring wind speeds for small turbine sites. Oregon State University. Accessed on June 30, 2010 at: extension.oregonstate.edu/catalog/pdf/ec/ec1163-e.pdf

Foss, 2007. Carrie R. Foss, Washington State University. Crop profile for table beet seed in Washington.

FSANZ, 2005. Food Standards Australia and New Zealand. First Review Report, Application A525. Food derived from herbicide-tolerant sugar beet line H7-1.

FSANZ, 2010. Standards Australia and New Zealand, web site. Accessed on June 27, 2010 at: http://www.foodstandards.gov.au/

Futuyma, 1998. Douglas J. Futuyma. Evolutionary Biology. 3rd ed. Sinauer Associates, Sunderland, Massachusetts.

GAO, 2008. US Government Accountability Office. Report to the Committee on Agriculture, Nutrition, and Forestry, US Senate. GAO-09-60.

Gianessi, L. and Reigner, N. 2006. "Pesticide Use in U.S. Crop Protection Production: 2002 - With Comparison to 1992 & 1997 – Fungicides and Herbicides." Report, Crop Life Foundation, Washington, D.C. "Insecticides & Other Pesticides." Technical report, Crop Life Foundation, Crop Protection Research Institute.
http://www.croplifefoundation.org/Documents/PUD/NPUD%202002/Fung%20&%20Herb%202002%20Data%20Report.pdf.

Gianessi, L.P. and J.E. Carpenter. 1999. *Agricultural Biotechnology: Insect Control Benefits*, National Center For Food And Agricultural Policy, Washington, DC, July 1999.
http://www.bio.org/food&ag/ncfap.htm

Gibson VI, J.W., D. Laughlin, R.G. Lutrell, D. Parker, J. Reed, and A. Harris. 1997. "Comparison of Costs and Returns Associated with *Heliothis* Resistant *Bt* Cotton to Non-Resistant Varieties," Proceedings of the Beltwide Cotton Conferences, 1997.

Giesy, J.P., Dobson, S., and Solomon, K.R. 2000. "Ecotoxicological Risk Assessment for Roundup Herbicide." *Rev. Environ. Contam. Toxicol.* 167: 35-120.

Givler and Wells, 2001. R.W. Givler and R.E. Wells. United States Geological Survey. Color shaded relief map of the Willamette Valley, Oregon.

GMO Safety, 2010a. Glossary. Accessed on June 27, 2010 at: http://www.gmo-safety.eu/glossary.html

Goldsbrough, 2000. Peter Goldsbrough, Purdue University. Quiz yourself about foods made from genetically modified crops. Accessed on July 25, 2010 at: http://www.hort.purdue.edu/hort/courses/hort250/gm%20food%20quiz

Goldstein, S.M. 2003. Life History Observations of Three Generations of Folsomia candida (Willem) (Collembola: Isotomidae) Fed Yeast and Roundup Ready Soybeans and Corn. p83. Masters Thesis. Michigan State University.

Grain, 2008. Whose harvest? The politics of organic seed certification. Accessed on July 22, 2010 at: http://www.grain.org/briefings/?id=207

Grant, 2010. Declaration of Duane Grant representing Snake River Cooperative, for the United States District Court for the Northern District of California, San Francisco Division, regarding Center for Food Safety, et al., Plaintiffs, v. Civ. No. 08-CV-00484 (JSW) Thomas J. Vilsack, et al., Defendants. May 7, 2010.

Gressel, 2005. J. Gressel, editor. Crop ferality and volunteerism. CRC Press, Taylor and Francis Group, Boca Raton, FL.

Gunsolus, 2002. J.L. Gunsolus, University of Minnesota. Herbicide resistant weeds. WW-06077. Reviewed 2008. Accessed on June 1, 2010 at: http://mn4h.net/distribution/cropsystems/DC6077.html#Figure 1.

Harrison et al, 1996. Harrison, L., M. Bailey, M. Naylor, J. Ream, B. Hammond, D. Nida, B. Burnette, T. Nickson, T. Mitsky, M. Taylor, R. Fuchs and S. Padgette. 1996. The expressed protein in glyphosate-tolerant soybean, 5-enolpyruvylshikimate-3-phosphate synthase from Agrobacterium sp. strain CP4, is rapidly digested in vitro and is not toxic to acutely gavaged mice. American Institute of Nutrition, Vol. 126, No. 3, pp. 728-740.

Harper, J. L. 1957. Ecological aspects of weed control. Outlook Agric.

1:197–205.

Harvey, T.L., Martin, T.J. and Seifers, D. 2003. Effect of Roundup ready Wheat on greenbug, Russian wheat aphid, and wheat curl mite. J. Agri and Urb. Entomoml 20(4).

Health Canada, 2005. Glyphosate Tolerant Sugar Beet Event H7-1. Accessed on June 16, 2010 at: http://www.hc-sc.gc.ca/fn-an/gmf-agm/appro/august100_final-eng.php.

Heap, 2010. The International survey of herbicide resistant weeds. Online. Accessed on June 27, 2010 at: www.weedscience.com.

Hileman et al, 200. Ronald E. Hileman, Andre Silvanovich, Richard E. Goodman, Elena A. Rice, Gyula Holleschak, James D. Atwood, and Susan L. Hefle. Bioinformation methods for Allergenicity assessment using a comprehensive allergen database. International Archives of Allergy and Immunology 2002; 128: 280-291.

Hirnyck et al, 2005. Ronda Hirnyck, Lisa Downey, Sally O'Neal Coates. Pest management strategy for Western U.S. sugar beet production. Summaryof a workshop held December 15-16, 2004 at Boise, ID.

Hofer, Michael. 2010. Second Declaration of Michael Hofer representing Western Sugar Cooperative, for the United States District Court for the Northern District of California, San Francisco Division, regarding Center for Food Safety, et al., Plaintiffs, v. Civ. No. 08-CV-00484 (JSW) Thomas J. Vilsack, et al., Defendants. May 7, 2010.

Hoffman, 2010a. First declaration of Neil Hoffman in support of the intervenors' opposition to motion for permanent injunction case no. 080484. February 12.

Hoffman, 2010c. Third declaration of Neil Hoffman in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Holly Hybrids, 2007. Commercial production. Accessed on July 6, 2010 at: http://www.beetseed.com/agronomy/life_cycle3.php

Holm, L., Pancho, J.V., Herbarger, J.P., and Plucknett, D.L. 1979. A geographical atlas of world weeds. John Wily and Sons, New York.

Holm, L., Pancho, J.V., Herbarger, J.P., and Plucknett, D.L. 1979. A geographical atlas of world weeds. John Wily and Sons, New York.

Holm, L., Pancho, J.V., Herbarger, J.P., and Plucknett, D.L. 1991. A geographical atlas of world weeds. Kreiger Publ. Co., Malabar, FL.

Hovland, 2010. Declaration of Bruce J. Hovland in support of the intervenors' opposition to PL preliminary injunction motion case no. 08-00484.

Hoyland, 2010. Declaration of Bruce Hoyland in support of the intervenors' opposition to PL preliminary injunction motion case no. 080484.

Huffman, et al, 2003. Huffman, W.E., J.F. Shogren, M. Rousu, and A. Tegene. Consumer willingness to pay for genetically modified food labels in a market with diverse information: Evidence from experimental auctions. Journal of Agricultural and Resource Economics 28(3):481–502.

IM/NRC, 2004. Institute of Medicine and National Research Council of the National Academies. Safety of genetically engineered foods: approaches to assessing unintended effects of genetically engineered foods on human health. National Academies Press.

Jaggard, K.W., Wickens, R., Webb, J.D., and Scott, R.K. 1983. Effects of sowing date on plant establishment and bolting and the influence of these factors on yields of sugar beet. J. Ag. Sci. 101:147-161.

Jamornman, S., S. Sopa, S. Kumsri, T. Anantachaiyong, and S. Rattithumkul. 2003. Effect of Roundup Ready corn NK603 on green lacewing - Mallada basalis (Walker) under laboratory conditions. Proc. Sixth Nat. Plant Prot. Conf. 24-27 , Nov., 2003. Pp 28-29.

Johnson and Burtch, 1959. R.T. Johnson and L.M. Burtch. The problem of wild annual sugar beets in California. J Am Sugar Beet Technol 10:311-317.

Kaffka and Hills, 1994. Stephen Kaffka and F. Jackson Hills, University of California, Davis. Encyclopedia of agriculture science, volume 4. Academic Press, Inc. Accessed on May 30, 2010 at: http://sugarbeet.ucdavis.edu/sbchap.html.

Kaffka, 1998. Stephen Kaffka, University of California, Davis. The effects of the El Nino on the sugar beet industry. Accessed June 7, 2010 at: http://sugarbeet.ucdavis.edu/notes/June98.html

Kaffka and Peterson, 2000. Stephen Kaffka and Gary Peterson. The comparison of transgenic and non-transgenic sugarbeet cultivars in 2000. Sugar beet notes no. 10.

Kalaitzandonakes and Magnier, 2004. Nicholas Kalaitzandonakes and Alexandre Magnier. Biotech labeling standards and compliance costs , seed production. Choices.

Kleter, G.A., Bhula, R., Bodnaruk, K., Carazo, E., Felsot, A.S., Harris, C.A., Katayama, A., Kuiper, H.A., Racke, K.D., Rubin, B., Shevah, Y., Stephenson, G.R., Tanaka, K., Unsworth, J., Wauchope, R.D., and Wong, S. 2007. "Altered Pesticide Use on Transgenic Crops and the Associated General Impact from an Environmental Perspective." *Pest Management Science* 63:1107-1115.

Kniss, 2010. Declaration of Andrew Kniss in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Kovach, A.J., Petzoldt, C., Degni, J., and Tette, J. 1992. "A Method to Measure the Environmental Impact of Pesticides." New York's Food and Life Sciences Bulletin', NYS Agricultural Experiment Station, Cornell University, Geneva, NY, 139. 8 pp. Annually updated. www.nysipm.cornell.edu/publications/EIQ.html.

Kovach, A.J., Petzoldt, C., Degni, J., and Tette, J. 2007. "A Method to Measure the Environmental Impact of Pesticides." Technical report, Cornell University. http://nysipm.cornell.edu/publications/eiq/files/EIQ_values07.pdf.Kulp, Elvin. 1999. Washington State University. Crop profile for sugar beets in Washington. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

Kriete et al, 1996. Kriete G, Niehaus K, Perlick AM, Puhler A, Broer I (1996) Male sterility in transgenic tobacco plants induced by tapetum-specific deacetylation of the externally applied non-toxic compound N-acetyl-L-phosphinothricin. Plant J 9: 809–818.

Kulp, 1999. Elvin L. Kulp, Washington State University. Crop profile for sugar beets in Washington. . Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

KWS, 2009a. KWS SAAT AG continues to grow in tough economic times. Accessed on July 22, 2010 at: http://www.kws.de/aw/KWS/company_info/investor_relations/News/News/~ddkt/KWS_SAAT_AG_continues_to_grow_in_tough_e/

KWS, 2009b. KWS SAAT AG annual report 2008/2009.

Lajmanovich, R.C., Sandoval, M.T. and Peltzer, P.M.C., et al. 2003. "Induction of mortality and malformation in *Scinax nasicus* Tadpoles Exposed to Glyphosate Formulations." *Bulletin of EnvironnmentalEnvironmental Contamination Toxicology* 70:612-618.

Lange, W., Brandenburg, W.A., and Bock, T.S.Md. 1999. Taxonomy and cultonomy of beet (*Beta vulgaris* L.). Bot. J. Linn. Soc. 130:81-96.

Lehner, 2010. Declaration of Lehner in support of the intervenors' opposition to motion for permanent injunction case no. 080484

Lemaux, 2008. Peggy Lemaux, Department of Plant and Microbial Biology, University of California, Berkeley. Genetically engineered plants and foods: a scientist's analysis of the issues (part I). Annu. Rev. Plan. Biol. 59:771-812.

Lemaux, 2009. Peggy Lemaux, Department of Plant and Microbial Biology, University of California, Berkeley. Genetically engineered plants and foods: a scientist's analysis of the issues (part II). Annu. Rev. Plan. Biol. 59:771-812.

Lewellen et al, 2003. R.T. Lewellen, H-Y Liu, W.M. Wintermatel, and J.L. Sears, Inheritance of beet necrotic yellow vein virus (BNYVV) systemic infection in crosses between sugar beet and *Beta macrocarpa*. Proceedings of the 1st joint IIRB-ASSBT Congress, San Antonio.

Lilleboe, 2008. Don Lilleboe, sugar beet farmer. Idaho beet growers catch strip-till fever. Accessed on July 22, 2010 at: http://www.sugarpub.com/event/article/id/52/

Lilleboe, 2009. Don Lilleboe, sugar beet farmer. Nonstop farming. Accessed on July 22, 2010 at: http://www.sugarpub.com/event/article/id/76/

Lilleboe, 2010. Don Lilleboe, sugar beet farmer, Nebraska growers pleased with benefits of strip till. Accessed on July 22, 2010 at: http://www.sugarpub.com/event/article/id/106/

Loberg, 2010. Greg Loberg, manager of West Coast Beet Seed Company. Declaration of Greg Loberg in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Lundqvist, 2009. Eight years of Scandinavian barley mutation genetics and breeding. In Induced plant mutations in the genomics era, FAO, Rome, 2009.

Malik, J., Barry, G., and Kishore, G. 1989. The Herbicide Glyphosate. BioFactors. 2:17-25.

Mallory-Smith and Zapiola, 2008. Carol Mallory-Smith and Maria Zapiola, Oregon State University, Crop and Soil Science. Review: gene flow from glyphosate-resistant crops.

Mallory-Smith, 2010. Declaration of Carol Mallory-Smith in case no. 080484. June 15.

Manning, 2010. . Declaration of Susan Manning in support of the intervenors' opposition to motion for permanent injunction case no. 080484. May 7.

Mansfeld R. 1986. Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen), vol. 1, 2nd ed., Springer Verlag, Berlin, Heidelberg, New York

Mansour, 1999. Bill Mansour, extension specialist, Oregon State University. Willamette valley vegetable crops. Accessed on July 23, 2010 at: http://www.hort.purdue.edu/newcrop/cropmap/oregon/crop/wv-veg.html.

Marra, M., G. Carlson, and B. Hubbell. 1998. "Economic Impacts of the First Crop Biotechnologies." http://www.ag.econ.ncsu.edu/faculty/marra/firstcrop/imp001.gif.

Massey, 2002. Raymond Massey, crop economist, University of Missouri. Identify preserved crops. File A4-53. Accessed on June 30, 2010 at: http://www.extension.iastate.edu/agdm/crops/html/a4-53.html

Mauch, 2010. Declaration of Russell Mauch in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

May and Wilson, 2006. Mike J. May and Robert G. Wilson. Weeds and weed control. Chapter 14 in Sugar Beet, A. Philip Draycott, ed. Blackwell Publishing.

May, 2001. Mike May. Crop protection in sugar beet. Pesticide outlook. Royal Society of Chemistry.

McBride, W.D., and N. Brooks. "Survey Evidence on Producer Use and Costs of Genetically Modified Seed," *Agribusiness* 16(1):6-20. 2000.

McDonald et al, 2003. Sandra K. McDonald, Lindsay Hofsteen, and Lisa Downey, Colorado State University. Crop profile for sugar beets in Colorado. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

McFarlane,1975. J.S. McFarlane. Naturally occurring hybrids between sugar beet and *Beta macrocarpa* in the Imperial Valley of California. J. Am. Soc. Sugar Beet Technol. 18:245-251.

McReynolds, 2010. Email from Robert McReynolds, Oregon State University. April 29.

Meier, 2010. Declaration of Bryan Meier in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Meister, 2009. Crop Protection Handbook. Published by Meister. ISBN: 1892829215

Mesbach, A. and Miller, S.D. 2004. Weed control and glyphosate-tolerant sugar beet response to herbicide treatments. J. Sugar Beet Res. 101-114.

Mesbah et al, 1994. Abdelouhab Mesbah, Stephen D. Miller, K. James Fornstrom, and David E. Legg. Sugar beet – weed interactions. University of Wyoming Agricultural Experiment Station. B-998. Accessed on June 1, 2010 at: ces.uwyo.edu/PUBS/Wy998.pdf

Messéan et al, 2006. A. Messéan, F. Angevin, M. Gómez-Barbero, K. Menrad, and E. Rodríguez-Cerezo. New case studies on the coexistence of GM and non-GM crops in European agriculture. European Commission Directorate-General Joint Research Centre. Accessed on June 16, 2010 at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1345.

Messéan et al, 2009. Antoine Messéan, Geoff Squire, Joe Perry, Frédérique Angevin, Manuel Gomez, Peter Townsend, Christophe Sausse, Broder Breckling, Stephen Langrell, Saso Dzeroski, and Jeremy Sweet. Sustainable introduction of GM crops into European agriculture: a summary report of the FP6 SIGMEA research project. In Agronomie – Environnement, Vol 16, No 1, January – February.

Messeguer, 2002. Joaquima Messeguer. Gene flow assessment in transgenic plants. Review of plant biotechnology and applied genetics.

Michigan Sugar Company, 2009. 2009 growers' guide for producing quality sugar beets. Accessed on May 31 at: http://www.michigansugar.com/agriculture/guide.php.

Michigan Sugar Company, 2010a. Producing sugar. Accessed on May 30, 2010 at: http://www.michigansugar.com/about/education/production.php.

Michigan Sugar Company, 2010b. About Michigan Sugar Company. Accessed on May 30, 2010 at: http://www.michigansugar.com/about/index.php.

Mikkelson and Petrof, 1999. Martha Mikkelson and Reeves Petrof, Montana State University. Crop Profile for Sugar Beets in Montana. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site

Miller and Miller, 2008. Jeff S. Miller and Tery D. Miller. The value of cultivation with Roundup Ready sugar beets. Presented at the University of Idaho Snake River Sugar beet Conference on January 11, 2008. Accessed on July 22, 2010 at: millerresearch.com/reports/Value%20of%20cultivation.pdf

Millington Seed Company, 2010. Big buck blend sugar beet seeds. Accessed on July 22, 2010 at: http://www.millingtonseed.com/Vegetable/sugar_beet_seeds.htm.

Minn-Dak Farmers Cooperative, undated. History. Accessed on May 30, 2010 at: http://www.mdf.coop/Web%202007/About%20MD/History.html.

Monsanto, 2004. Roundup UltraMAX II® Herbicide Label. Monsanto Company. St. Louis, Missouri, 63167 USA. http://www.greenbook.net/Docs/Label/L72631.pdf.

Monsanto, 2005. Roundup Weather Max® Herbicide. Material Safety Data Sheet. Version 1.0. St. Louis, MO. Accessed on June 17, 2010 at: http://www.monsanto.com/monsanto/ag_products/pdf/labels_msds/roundup_weathermax_msds.pdf.

Monsanto, 2006. Roundup Original Max® Herbicide. Material Safety Data Sheet. Version 1.1. St. Louis, MO. EPA Reg. No. 524-539. Accessed on June 17, 2010 at: http://www.monsanto.com/monsanto/ag_products/pdf/labels_msds/roundup_orig_max_msds.pdf.

Monsanto, 2007. Honcho MSDS Version 2.0. Monsanto Company. St. Louis, Missouri, 63167 USA. http://www.monsanto.com/monsanto/ag_products/pdf/labels_msds/honcho_msds.pdf.

Monsanto, 2007a. HonchoPlus MSDS Version 2.0. Monsanto Company, St. Louis, Missouri, 63167 USA.

Monsanto, 2010. Accessed on June 22, 2010 at: http://www.monsanto.com/products/benefits/conservation_till/what_is.asp

Monsanto/KWS, 2007. Monsanto-KWS SAAT AG. Roundup Ready – Sugar Beet H7-1 Herbicide tolerance key facts.

Morishita, 2009. Don W. Morishita, University of Idaho. Herbicides for weed control in sugar beets. Pacific Northwest weed management handbook. Extension services of University of Idaho, Oregon State University and Washington State University. Accessed on June 1, 2010 at: http://uspest.org/pnw/weeds?18W_SUGB03.dat

Morton, 2009. Food Freedom Interview with Frank Morton, Seed Freedom Activist, Part III (transcript), recording available at http://www.blogtalkradio.com/PeacePortal/2009/04/02/Food-Freedom-Interview-with-Frank-Morton-Seed-Freedom-Activist-Part-3 (Apr. 2, 2009)

Morton, 2010. United States District Court for the Northern District of California, San Francisco Division. Case No. 3:08-cv-00484-JWS. Declaration Frank Morton. June 2.

NA, 2010. National Academies, Accessed on July 5, 2010 at: http://www.nationalacademies.org/about/

Nahas, E. 2001. Environmental monitoring of the post-commercialization of the Roundup Ready soybean in Brazil, Report 2. Pp 1-29. Microbiological Parameters.

NAS, 1987. National Academy of Science. Introduction of recombinant DNA-engineered organisms into the environment: key issues. National Academies Press.

Non-GMO Project, 2010. Non-GMO project working standard, v6, dated June 7. Accessed on July 23, 2010 at: http://www.nongmoproject.org/common/non-gmo-project-standard/ngp-standard-v6-2nd-comment-period-2/.

Non-GMO Project, 2010a. Who we are and what we do. Accessed on July 23, 2010 at: http://www.nongmoproject.org/retailers/about/.

North Dakota Department of Agriculture, 2003. Noxious weeds team. Online. Accessed on June 1, 2010 at: http://www.agdepartment.com/Programs/Plant/NoxiousWeeds.html.

Norton, 2010. Jay Norton, University of Wyoming. Unharvested sugar beets could impact this year's crops in Big Horn Basin. High Plains/Midwest Ag Journal. Accessed on June 14, 2010 at: http://www.hpj.com/archives/2010/apr10/apr5/0219WYUnharvestedSugarBeets.cfm.

NRC, 1986. National Research Council of the National Academies. Committee on strategies for the management of pesticide resistant pest populations. Pesticide resistance: strategies and tactics for management. National Academies Press.

NRC, 1989. National Research Council of the National Academies. Field testing genetically modified organisms: framework for decision. National Academies Press.

NRC, 2000. National Research Council of the National Academies. Genetically modified pest-protected plants: science and regulation. National Academies Press, Washington, D.C.

NRC, 2002. National Research Council. Committee on environmental impacts associated with commercialization of transgenic plants board on agricultural resources, division on life and earth sciences. Environmental effects of transgenic plants: the scope and adequacy of regulation. National Academies Press.

NRC, 2008. National Research Council. Planning committee for the workshop on research to improve the evaluation of genetically engineered organisms on terrestrial and aquatic wildlife and habitats. National Academies Press.

NRC, 2010. National Research Council of the National Academies. The impact of genetically engineered crops on farm sustainability in the United States. National academies press.

Odero et al, 2008. Dennis C. Odero, Abdel O. Mesbah, and Stephen D. Miller, University of Wyoming. Economics of weed management systems in sugar beet. Journal of Sugar Beet Research, Vol 45.

OECD, 2001. Organization for Economic Cooperation and Development. Consensus Document on the biology of *Beta vulgaris* L. (Sugar Beet). *In* Series on Harmonization of Regulatory Oversight in Biotechnology.

Oguchi et al, 2009. T. Oguchi, M. Onishi, Y. Chikagawa, T. Kodama, E. Suzuki, M. Kashahara, H. Akiyama, R. Teshima, S. Futo, A. Hino, S. Furui and K. Kitta. Investigation of residual DNAs in sugar from sugar beet (*Beta vulgaris* L.). Shokuhin Eiseigaku Zasshi. National Agricultural and Food Research Organization, National Food Research Institute, Tsukuba, Ibaraki, Japan. Abstract.

OSCS, 1993. Oregon Seed Certification Service. Certification Standards – Sugar beet. Revised February 10.

OSTP, 1986. US Office of Science and Technology Policy. Coordinated Framework for Regulation of Biotechnology. 51 FR 23302, June 26.

OSTP, undated. US Office of Science and Technology Policy. About OSTP. Accessed on July 5, 2010 at: http://www.whitehouse.gov/administration/eop/ostp/about

OSU, 2010. Oregon State University. 2010 Oregon Certified Seed Handbook.

Owen and Zelaya, 2005. Michael DK Owen and Ian A Zelaya, Iowa State University. Herbicide-resistant crops and weeds resistant to herbicides. In Pest management science.

Overstreet et al, 2009. Laura Overstreet, Norm Cattanach and David Franzen, University of North Dakota. Strip tillage in sugar beet rotations/summary of 2008 Red River Valley research. Accessed on July 22, 2010 at: http://www.sugarpub.com/event/article/id/69/

Padgette, S.R., K.H. Kolacz, X. Delannay, D.B. Re, B.J. Lavallee, C.N. Tinius, W.K. Rhodes, Y.I. Otero, G.F. Barry, D.A. Eichholtz, V.M. Peschke, D.L. Nida, N.B. Taylor, and G.M. Kishore. 1995. Development, identification, and characterization of a glyphosate-tolerant soybean line. Crop Sci. 35:1451–1461

Padgette, S.R., Re, D.B., Barry, G.F., Eichholtz, D.E., Delannay, X., Fuchs, R.L., et al. 1996. New weed control opportunities: Development of soybeans with a Roundup Ready gene. In S.O. Duke (Ed.), *Herbicide-Resistant Crops* (pp. 53-84). Boca Raton: CRC Press.

Panella, 2003. Leonard (Lee) Panella, USDA ARS, Chair, Sugar beet Crop Germoplasm Committee. Letter to Dr. J.R. Stander, Betaseed, Inc., September 25. Included as Appendix 2 of event H7-1 petition (Schneider, 2003).

Panella, 2010. Declaration of Leonard Panella in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Peterson, R.K.D. and Shama, L.M. 2005. "A Comparative Risk Assessment of Genetically Engineered, Mutagenic, and Conventional Wheat Production Systems." *Transgenic Research* 14:859–875.

Pierson, 2010. Declaration Pierson, for the United States District Court for the Northern District of California, San Francisco Division, regarding Center for Food Safety, et al., Plaintiffs, v. Civ. No. 08-CV-00484 (JSW) Thomas J. Vilsack, et al., Defendants.

Reiten, 2009. Joel Reiten. Seed production contracting: guidelines for organic seed producers. Accessed on June 16, 2010 at: http://www.extension.org/article/18333.

ReJesus, R.M., J.K. Greene, M.D. Hamming, and C.E. Curtis. 1997. "Economic Analysis of Insect Management Strategies for Transgenic Bt Cotton Production in South Carolina." *Proceedings of the Beltwide Cotton Conferences, Cotton Economics and Marketing Conference* (1):247-251.

Relyea, R.A. 2005. "The Lethal Impact of Roundup on Aquatic and Terrestrial Amphibians." *Ecological Applications* 15(4):1118-1124.Ross, Merrill A. and Daniel J. Childs. undated. Department of Plant Botany and Plant Pathology, Purdue University. Herbicide mode of action summary. Accessed on June 2, 2010 at: http://www.ces.purdue.edu/extmedia/ws/ws-23-w.html.

Rice, 2010. Rice, P.M. . INVADERS Database System (http://invader.dbs.umt.edu). Division of Biological Sciences, University of Montana, Missoula, MT 59812-4824. Accessed on June 14, 2010.

Ronald and Adamchak, 2008. Pamela C. Ronald and Raoul W. Adamchak. Tomorrow's table: organic farming, genetics, and the future of food. Oxford University Press.

Ronald and Fouche, 2006. Pamela C. Ronald, Professor of Plant Pathology and Chair, Plant Genomics Program, University of California, Davis; and Benny Fouche, University of California Cooperative Extension Farm Advisor. Genetic engineering and organic production systems. Agricultural biotechnology in California series. Publication 8188.

Roseboro, 2009. Ken Roseboro. Frankenfood in the Valley - GM sugar beets pose contamination threat to organic produce. Eugene Weekly. http://www.eugeneweekly.com/2009/08/20/analysis.html

Ross and Childs, undated. Merrill A. Ross and Daniel J. Childs, Department of Plant Botany and Plant Pathology, Purdue University. Herbicide mode of action summary. Accessed on June 2, 2010 at: http://www.ces.purdue.edu/extmedia/ws/ws-23-w.html

Sadava, 2008. David Sadava. Understanding genetics: DNA, genes, and their real-world applications. The Teaching Company.

Sandretto, C. 1997. "Crop Residue Management," *Agricultural Resources and Environmental Indicators*, AH-712, pp. 155-174. USDA, Economic Research Service.

Sankula, S. 2006. "Quantification of the Impacts on U.S. Agriculture of Biotechnology-Derived Crops Planted in 2005." Technical Report, National Center for Food and Agricultural Policy. http://www.ncfap.org/documents/Quantification%20of%20the%20Impacts%20on%20US%20Agriculture%20of%20Biotechnology.pdf.

Sato, 2008. Suguru Sato. Japan biotechnology annual report. USDA Foreign Agricultural Service GAIN report JA8047.

SBREB, 2010. Sugar beet Research and Education Board of Minnesota and North Dakota. 2010 Production guide. Accessed on May 31, 2010 at: http://www.sbreb.org/Production/production.htm.

Schneider F. 1942. Züchtung der Beta-Rüben. In: Handbuch der Pflanzenzüchtung, vol. 4, Verlag Paul Parey, Berlin, Hamburg.

Schneider, 2003. Submitted by Ronald W. Schneider. Monsanto Company, St. Louis, MO, USA and KWS SAAT AG, Einbeck, Germany. Petition for determination of nonregulated status for Roundup Ready® sugar beet event H7-1. November 17.

SESVanderHave, 2010. Sugar beets for food plots. Accessed on July 22, 2010 at: http://www.beetseed.com/store.php

Siciliano, S.D., and Germida, J.J. 1999. Taxonomic diversity of bacteria associated with the roots of field-grown transgenic Brassica napus cv. Quest, compared to the non-transgenic B. napus cv. Excel and B. rapa cv. Parkland. FEMS Microbiol. Ecol. 29: 273-272.

Skaracis, G.N. and M. De Biaggi. 2005. Conventional Breed Methods; Production of Commercial Varieties, p. 199. In: Genetics and Breeding of Sugar Beet, E. Biancardi, L.G. Campbell, G. N. Skaracis, and M.D. Biaggi, eds. Sciences Publishers, Ind., Enfield, NH. USA.

Smith, 2010a. Cindy Smith, APHIS Administrator. Declaration of Cindy J. Smith in US District Court for the Northern District of California, San Francisco Division, Center for Food Safety, et al, v. Tom Vilsack et al. February 12, 2010.

Smith, 2010b. Cindy Smith, APHIS Administrator. Declaration of Cindy J. Smith in US District Court for the Northern District of California, San Francisco Division, Center for Food Safety, et al, v. Tom Vilsack et al. May 7, 2010.

Snake River Sugar Company, 2009. FAQs. Accessed on May 30, 2010 at: http://www.amalgamatedsugar.com/.

Sonnewald, 2010. Professor Uwe Sonnewald, University of Erlangen-Nuremberg. Interview, reported April 19, GMO Safety. Accessed on June 27, 2010 at: http://www.gmo-safety.eu/news/1146.impact-transgenes-basically-limited-immediate-function.html

Southern Minnesota Beet Sugar Cooperative, 2010. SMBSC Facts. Accessed on May 30, 2010 at: http://www.smbsc.com/facts.php.

Southern Minnesota Beet Sugar Cooperative, 2010a. By-products marketing. Accessed on July 25, 2010 at: http://www.smbsc.com/Products/ByProductsMarketing.aspx

Sprague, 2007. Christy Sprague, Michigan State University. Research may help sugar beet growers reap sweeter future. Accessed on July 23, 2010 at: http://www.maes.msu.edu/news/news_December2007.htm#sugar

Spreckels Sugar, 2006. Our company. Accessed on May 30, 2010 at: http://www.spreckelssugar.com/.

Spreckels Sugar, 2009. Growing sugar beets in California. Accessed on May 30, 2010 at: http://www.spreckelssugar.com/about.php.

Stachler and Zollinger, 2009. Jeff Stachler and Richard K. Zollinger, North Dakota State University. Weed control guide for sugar beet. Accessed on June 1, 2010 at: http://www.sbreb.org/research/weed/weed09/weed09.htm.

Stachler, 2010. Jeff Stachler, North Dakota State Univesity. Scouting for glyphosate resistance (full video). Accessed on July 25, 2010 at: http://www.ag.ndsu.edu/glyphosateresistance

Stander, 2010. Declaration of Stander, for the United States District Court for the Northern District of California, San Francisco Division, regarding Center for Food Safety, et al., Plaintiffs, v. Civ. No. 08-CV-00484 (JSW) Thomas J. Vilsack, et al., Defendants.

Stankiewicz Gabel, 2010. United States District Court for the Northern District of California, San Francisco Division. Case No. 3:08-cv-00484-JWS. Declaration of Rebecca L. Stankiewicz Gabel. February 12.

Stark Jr., C.R. 1997. "Economics of Transgenic Cotton: Some Indications Based on Georgia Producers." *Beltwide Cotton Conference Proceedings,* Cotton Economics and Marketing Conference.

Stewart et al, 2003. C.N. Stewart, Jr., M.D. Halfhill, and S.I. Warwick. Transgene introgression from genetically modified crops to their wild relatives. Nature Reviews Genetics 4.

Stewart, 2008. C.N. Stewart, Jr. University of Tennessee. Gene flow and the risk of transgene spread. Accessed on June 16, 2010 at: agribiotech.info/.../Stewart-GeneFlow%20Mar%208%20-%2003.pdf

Sugar Industry Biotech Council, http://www.sugarindustrybiotechcouncil.org/food-industry/regulatory-approval/ visited June 1, 2010

Sundermeier and Reeder, undated. Alan Sundermeier and Randall Reeder. Fall strip tillage systems: an introduction. Ohio State University Fact Sheet. Access on June 28, 2010 at: http://ohioline.osu.edu/aex-fact/0507.html

Sylvester, R. Member of the Michigan Sugar Company Board of Directors and sugar beet grower. Personal communication. July, 2007.

Tarantino, 2004. Laura Tarantino, PhD, Director, Office of Food Additive Safety, Center for Food Safety and Applied Nutrition, U.S. FDA. Letter to Ronald W. Schneider, Monsanto Company, dated August 17, 2004; Subject: Biotechnology consultation agency response letter BNF No. 00090. Accessed on June 26, 2010 at: http://www.fda.gov/Food/Biotechnology/Submissions/ucm155747.htm

Thomas et al, 2000. John A. Thomas and Gary Hein, Panhandle Research and Extension Center; Shripat Kamble, University of Nebraska, Lincoln. Crop profile for sugar beets in Nebraska. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

Tranel, 2003. Patrick J. Tranel, University of Illinois. Weeds and weed control strategies, Chapter 17 in Plants, genes and crop biotechnology, second edition. Maarten J. Chrispeels and David E. Sadava, editors. Jones and Bartlett publishers.

Traveller and Gallian, 2000. Del J. Traveller, Amalgamated Sugar Company; and John J. Gallian, University of Idaho. Crop profile for sugar beets in Idaho. Accessed on May 30, 2010 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

UC IPM, 2010. University of California integrated pest management. Accessed on June 2 at: http://www.ipm.ucdavis.edu/PMG/weeds_multi.html#BROAD.

USDA 1999a. U.S. Department of Agriculture. Crop profile for sugar beets in Michigan. Accessed on May 30 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

USDA 1999b. U.S. Department of Agriculture. Crop profile for sugar beets in Oregon. Accessed on May 30 at: http://www.ipmcenters.org/cropprofiles/ListCropProfiles.cfm?typeorg=crop&USDARegion=National%20Site.

USDA 2003. Invasive and noxious weeds. Michigan state-listed noxious weeds. Online. Accessed on June 1, 2010 at: http://plants.usda.gov/java/noxious?rptType=State&statefips=26.

USDA 2009a. U.S. Department of Agriculture, Natural Resource Conservation Service. Understanding seed certification and seed labels.

USDA 2010a. U.S. Department of Agriculture plants database. Accessed on June 14, 2010 at: http://plants.usda.gov/java/profile?symbol=BETA.

USDA 2010b. Invasive and noxious weeds database. Accessed on June 14, 2010 at: http://plants.usda.gov/java/invasiveOne?startChar=B

USDA 2010c. U.S. Department of Agriculture. 2008 organic survey. Accessed on July 5, 2010 at: http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Organics/

USDA 2010d. U.S. Department of Agriculture. USDA-approved state programs. Accessed on June 20, 2010 at: http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateA&topNav=NationalOrganicProgram&leftNav=NationalOrganicProgram&page=NOPSOPsUSDAApproved&description=Approved%20State%20Programs&acct=nopgeninfo

USDA Advisory Committee, 2008. What issues should USDA consider regarding coexistence among diverse agricultural systems in a dynamic, evolving, and complex marketplace? A consensus response prepared by the USDA Advisory Committee on Biotechnology and 21st Century Agriculture. Accessed on June 30, 2010 at: http://www.usda.gov/documents/Coex_final.doc

USDA APHIS, 2005. U.S. Department of Agriculture, Animal and Plant Health Inspection Service. USDA/APHIS Environmental Assessment and Finding of No Significant Impact. Includes determination of non-regulated status for glyphosate tolerant sugar beet event H7-1 (OECD unique identifier KM-000H71-4) as Appendix D; determination signed by Cindy Smith, Deputy Administrator, Biotechnology Regulatory Services, APHIS, March 4, 2005. Accessed on June 28, 2010 at: http://www.aphis.usda.gov/biotechnology/not_reg.html

USDA APHIS, 2007. U.S. Department of Agriculture, Animal and Plant Health Inspection Service. About APHIS. Accessed on May 6, 2010 at http://www.aphis.usda.gov/about_aphis/.

USDA APHIS, 2009. U.S. Department of Agriculture, Animal and Plant Health Inspection Service. Draft Environmental Impact Statement, Glyphosate-Tolerant Alfalfa Events J101 and J163: Request for Nonregulated Status. November 2009.

USDA APHIS, 2010. U.S. Department of Agriculture, Animal and Plant Health Inspection Service. National Environmental Policy Act Decision and Finding of No Significant Impact, Syngenta Biotechnology Incorporated, MIR162 Maize, SYN-IR162-4. April.

USDA APHIS, 2010a. U.S. Department of Agriculture, Animal and Plant Health Inspection Service. Petitions of nonregulated status granted or pending by APHIS as of May 12, 2010. Accessed on June 26, 2010 at: http://www.aphis.usda.gov/brs/not_reg.html

USDA ARS, 1962. Improving corn. Accessed on June 30, 2010 at: http://www.ars.usda.gov/is/timeline/corn.htm

USDA ARS, 2008. U.S. Department of Agriculture, Agriculture Research Service. NP304 Crop Protection and Quarantine Action Plan 2008-2013, Appendix I. Accessed on June 1, 2010 at: www.ars.usda.gov/.../NP304CropProtectionandQuarantineAppendixI.pdf

USDA ARS, 2010a. U.S. Department of Agriculture, Agriculture Research Service. National Genetic Resources ProgramGermplasm Resources Information Network - (GRIN) [Online Database].National Germplasm Resources Laboratory, Beltsville, Maryland. Accessed on June 14, 2010 at: http://www.ars-grin.gov/cgi-bin/npgs/acc/display.pl?1441384

USDA ARS, 2010b. U.S. Department of Agriculture, Agriculture Research Service. National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. Accessed on June 14, 2010 at: http://www.ars-grin.gov/cgi-bin/npgs/html/tax_stat.pl?taxno=7050&country=United%20States&unavail=&type=

USDA ERS, 2009a. U. S. Department of Agriculture, Economic Research Service. Adoption of Genetically Engineered Crops in the U.S. updated on July 1, 2009. Accessed on June 22, 2010 at: http://www.ers.usda.gov/data/biotechcrops/.

USDA ERS, 2009b. U. S. Department of Agriculture, Economic Research Service. Briefing room: sugars and sweeteners. Accessed on May 30, 2010 at: http://www.ers.usda.gov/Briefing/Sugar/Background.htm.

USDA ERS, 2009c. U. S. Department of Agriculture, Economic Research Service. Briefing room: organic agriculture – organic market overview. Accessed on July 23, 2010 at: http://www.ers.usda.gov/briefing/organic/demand.htm.

USDA ERS, 2010a. U. S. Department of Agriculture, Economic Research Service. Briefing room: sugars and sweeteners. Sugar and sweeteners yearbook tables. Accessed on July 6, 2010 at: http://www.ers.usda.gov/Briefing/Sugar/data.htm#yearbook

USDA FAS, 2010. U.S. Department of Agriculture, Foreign Agriculture Service. Sugar: world production, supply and distribution. May 2010. Accessed on June 23, 2010 at: http://www.fas.usda.gov/htp/sugar/2010/sugarMay2010.pdf.

USDA FSA, 2010. U.S. Department of Agriculture, Farm Service Agency. Second Declaration of Daniel Colacicco, for the United States District Court for the Northern District of California, San Francisco Division, regarding Center for Food Safety, et al., Plaintiffs, v. Civ. No. 08-CV-00484 (JSW) Thomas J. Vilsack, et al., Defendants. May 7, 2010.

USDA NASS 1998. U.S. Department of Agriculture, National Agricultural Statistics. *Agricultural Prices: 1997 Summary,* July 1998.

USDA NASS 2010a. U.S. Department of Agriculture, National Agricultural Statistics Service. U.S. Crop Acreage Down Slightly in 2009, But Corn and Soybean Acres Up. Accessed on June 14, 2010 at: http://www.nass.usda.gov/Newsroom/2009/06_30_2009.asp.

USDA NASS 2010b. U.S. Department of Agriculture, National Agricultural Statistics Service. Accessed on June 29, 2010 at: http://quickstats.nass.usda.gov/#42911035-7FB5-37FA-AAC1-47F474ABB0A2.

USDA NASS, 2009a. U.S. Department of Agriculture, National Agricultural Statistics Service. Acreage. Accessed on June 26, 2010 at: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1000

USDA NASS, 2009b. U.S. Department of Agriculture, National Agricultural Statistics Service. Agricultural statistics 2008. Accessed on June 28, 2010 at: http://www.nass.usda.gov/Publications/Ag_Statistics/2008/index.asp

USDA NASS, 2010c. U.S. Department of Agriculture, National Agricultural Statistics Service. Acreage. Accessed on July 5, 2010 at: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1000

USDA NASS. 2007. Agricultural Statistics 2006, Chapter II – Statistics of Cotton, Tobacco, Sugar Crops, and Honey. United States Department of Agriculture, National Agriculture Statistics Service, Washington, D.C.

USDA National Agricultural Library, 2010. Accessed on June 17, 2010 at: http://www.invasivespeciesinfo.gov/plants/main.shtml

USDA, 2010c. 2007 Census of Agriculture, Organic Production Survey (2008). Volume 3, Special Studies, Part 2. Accessed on June 20, 2010 at : http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Organics/

USDA-NASS. 2003. Prospective Plantings: 2003 Summary. United States Department of Agriculture, National Agricultural Statistics Service, Agricultural Statistics Board, Washington, DC. CR Pr 2-4 (3-03), March.

USDC, 2008. United States District Court for the Northern District of California San Francisco Division. Center for Food Safety, et al., Plaintiffs, v. Thomas J. Vilsack, et al. Defendants. No. C 08-00484 JSWUS District Court 2008

USDC, 2010. Second Declaration of Cindy Smith. May 7, 2010.

Wauchope, R.D., T.M. Buttler, A.G Hornsby, P.W.M., Augustijn-Beckers, and J.P. Burt. 1993. "The SCS/ARS/CES Pesticide Properties Database for Environmental Decisionmaking," *Reviews of Environmental Contamination and Toxicology.* G.W. Ware, ed., Vol. 123, New York: Springer Verlag.

Western Sugar Cooperative, 2006a. Sugar beet process. Accessed on May 30, 2010 at: http://www.westernsugar.com/ProductionAndProcessing.aspx.

Western Sugar Cooperative, 2006b. Manufacturing Locations. Accessed on May 30, 2010 at: http://www.westernsugar.com/ManufacturingLocations.aspx.

Westgate, 2010. Declaration of Mark Westgate in support of the intervenors' opposition to motion for permanent injunction case no. 080484.

Whitney, E.D. and J.E. Duffus. 1986. Compendium of Beet Diseases and Insects. pp. 26-32.

WHO/FAO, 2006. Word Health Organization and Food and Agriculture Organization of the United Nations. Understanding the Codex Alimentarius. Third edition.

Wiebe and Gollehon, 2006 Wiebe, K. and Gollehon, N. 2006. "Information Bulletin 16 Agricultural Resources and Environmental Indicators 2006 Edition." Technical report, USDA. http://turfweeds.contentsrvr.net/plant.php?do=view&batch=&id=184http://www.er

s.usda.gov/publications/arei/eib16/eib16.pdf.World Health Organization (WHO), Food and Agricultural Organization of the United Nations (FAO). 2005. Pesticide Residues in Food – 2005, Joint FAO/WHO Meeting on Pesticide Residues, Evaluations Part I - Residues, Volume 1. September 20 – 29, 2005.

Williams, G.M., Kroes, R., and Munro, I. 2000. Safety evaluation and risk assessment of the herbicide Roundup and its active ingredient, glyphosate for humans. Pp. 117-165. *In* Regulatory Toxicology and Pharmacology, Vol. 31.

Wilson, 2009. Robert G. Wilson, University of Nebraska-Lincoln. Roundup Ready crops: how have they changed things? Accessed on July 22, 2010 at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1020&context=panpressrel

Wilson, 2010a. Robert G. Wilson, PhD in support of intervenors' opposition to PL permanent injustion case no. 08-00484. May 6, 2010.

Wilson, 2010a. Robert G. Wilson, PhD in support of intervenors' reply to PL permanent injustion case no. 08-00484. June 17, 2010.

World Health Organization (WHO). 2004. Pesticides in food – 2004. Report of the Joint Meeting of the and Agriculture Organization of the United Nations (FAO) Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues (JMPR). Rome, Italy, 20-29 September 2004. FAO Plant Production and Protection Paper 178. World Health Organization and Food and Agriculture Organization of the United Nations, Rome, Italy. Accessed on June 17, 2010 at: http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/JMPR/2008_JMPR_Evaluations.pdf.

WSSA, 1994. Weed Science Society of America. Herbicide Handbook, 7th edition. Ed. William H. Ahrens. Weed Society of America, 1508 West University Avenue. Champaign, Illinois. ISBN# 0-911733-18-3.

WSSA, 1998. Weed Science Society of America. Resistance and tolerance definitions. Accessed on July 20, 2010 at: http://www.wssa.net/Weeds/Resistance/definitions.htm

WSSA, 2010a. Weed Science Society of America. Composite List of Weeds as compiled by the Standardized Plant Names subcommittee. Accessed on June 16, 2010 at: http://wssa.net/Weeds/ID/WeedNames/namesearch.php.

WSSA, 2010b. Weed Society of America. WSSA supports NRC findings on weed control. Accessed on June 16, 2010 at: http://www.wssa.net/

York et al, 2004. A.C. York, A.M. Steward, P.R. Vidrine and A.S. Culpepper. Control of voluntgeer glyphosate-resistant cotton in glyphosate-resistant soybean. Weed Technol. 18:532.

Young, 2006. Bryan G. Young. Changes in Herbicide Use Patterns and Production Practices Resulting from Glyphosate- Resistant Crops. Weed Tech. 20:301-307.

Zollinger, 2009. Rich Zollinger. 2009 North Dakota Weed Control Guide. North Dakota State University Extension Service.

Zollinger, 2010. Rich Zollinger. 2010 North Dakota Weed Control Guide. North Dakota State University Extension Service. W-253. January. Accessed on May 31, 2010 at: http://www.ag.ndsu.edu/weeds/weed-control-guides/nd-weed-control-guide-1.

Appendix A

Willamette Valley Specialty Seed Association (WVSSA) specialty seed production isolation guidelines and Columbia basin vegetable seed field isolation standards

WVSSA Specialty Seed Production Isolation Guidelines

Beta species (Beets and Swiss chard)

Must be pinned at the Beta species maps

Four Separate Groups: Sugar beets, Table beets, Fodder beets, Swiss chard

Between one O.P. and another of the same color and group	1 mile
Between Hybrid of the same color and group	1 mile
Between Hybrid and O.P. of the same color and group	2 mile
Between different colors within a group	3 mile
Between stock-seed and a Hybrid within a group	2 mile
Between stock-seed and O.P. within a group	3 mile
Between Hybrids of different groups	3 mile
Between Hybrid and O.P. of different groups	4 mile

Between GMO's and any other Beta species no closer than (And is excluded from exception to lessen this distance)	3 mile

Brassica species **(Fall types – 9 chromosomes)**

Includes: Cabbage, Kale, Kohlrabi, Brussel Sprouts, etc.

Between O.P. of the same color and group	1 mile
Between O.P. of different color	2 mile
Between O.P. cabbage and non-heading cultivars (Savoy, Kale, Brussel Sprouts, Collards and Cauliflower)	2 mile

Between Hybrids and Hybrids and O.P. of the same color and group	2 mile
Between Hybrids and O.P. of different colors or group	3 mile
Between Hybrid cabbage and non-heading cultivars	3 mile

Brassica species **(Spring types – 6 groups)**

1 Turnip types – 10 chromosomes (Japanese type, purple top, strap leaf, Shogoin)
2 Chinese Mustard types – 10 chromosomes (komatsuna, mizuna, mibuna, tatsoi)
3 Chinese Cabbage types – 10 chromosomes (heading, semi-heading, non-heading)
4 Pak Choi types – 10 chromosomes
5 Choi Sum types – 10 chromosomes
6 Indian Mustard types – 18 chromosomes (Florida broadleaf, southern giant curled, red mustard, Chinese mustard, leaf mustard)

SPECIAL ATTENTION MUST BE PAID TO THESE CROPS AS THERE IS A VERY WIDE RANGE OF PHENOTYPES THAT CAN CROSS. IF THERE IS ANY DOUBT, CHECK WITH THE OTHER COMPANY REP. BEFORE PINNING & PLANTING.

Between any 10 chromosome and any 18 chromosome types	Physical separation
Between O.P. of the same group	1 mile
Between O.P. of different groups	1.5 mile
Between Hybrids or Hybrids and O.P. of same group and phenotype	2 mile

Between Hybrids of different groups or phenotype	2.5 mile
Between Hybrids and O.P. of different groups or phenotype	3 mile

***Brassica* species Canola**

Must be grown under permit from Oregon Department of Agriculture.	
GMO type Canola or Rapeseed is not allowed to be grown	
between any other specialty seed crops.	3 mile
Allium cepa (Onion)	
Male parent used to pin hybrids	

Onion Hybrid

Between Hybrid and O.P. of different color	3 mile
Between Hybrid and O.P. of same color, different shape	2 mile
Between Hybrid and O.P. of same color, shape and type	2 mile
Between Hybrid of same color, shape and type	1 mile
Onions Open Pollinated	
Between Hybrid and O.P. of different color or shape	3 mile
Between O.P. of different color	3 mile
Between O.P. of same color, but different shape	2 mile
Between Hybrid of same color and shape	2 mile
Between O.P. of same color, type and shape	1 mile

Allium fistulosum (Bunching Onions)

Between another variety of fistulosum	1 mile

Allium porrum or Allium ampleoprasum (Leek)

Between another variety of Leek	2 mile

***Allium* other species (Chives)**	no distance

***Umbelliferous* other species (Parsley, Dill, Parsnips, etc.)**

Between same types	1 mile
Between Hybrid and O.P. of similar types	2 mile
Between different types	3 mile

Rhaphanus sativus (Radish)

Between O.P. varieties of same color and or shape	1 mile
Between Hybrids or Hybrid and O.P. type	2 mile
Between Hybrid and O.P. of different colors and or shape	3 mile
Between Red globes or from White tip type	1 mile
Between Long Red from any other Red type	2 mile
Between Any Red from any other White type	3 mile
Spinacit used to pin hybrids	
Between O.P. of the same leaf shape type	1 mile
Between O.P. of different leaf shape type	3 mile
Between Hybrid and O.P. type	3 mile

Cichorium intybus **(Chicory)**

Includes: raddichio, chicory, witloof, fodder root

Between O.P. type or endiva species	1 mile
Between Hybrids or Hybrid and O.P. type	2 mile

Cichorium endiva **(Endive)**

Includes: endive, escarole, frizze

Between O.P. type or intybus species	**1 mile**

Cucumis sativus **(Cucumber)**

Types: Slicer, Pickle, White spine, Black spine, Beta alpha.

Between O.P. of the same type	1 mile
Between O.P. of different type or spine color	2 mile
Between Hybrid and O.P. type	3 mile
Between Hybrid of different type or spine color	3 mile

Cucurbita **species (Squash)**

Includes: pepo, moshchata, mixta, maxima

Between Similar types, shape and color	1 mile
Between Same or Different species	1 mile
Between another Hybrid of similar variety	1 mile
Between Hybrid and O.P. of similar type and shape	1.5 mile
Between O.P. or Hybrid of different type, shape or color	2 mile

Flowers

All Flowers need to be pinned
Between ones that cross pollinate 1 mile
Includes: Chrysanthemums, Sunflowers, Helianthus, Poppies, etc.
Multiple non-crossing flowers at one location can be pinned with one pin denoting flowers
Consult company representatives on general pinned flower locations

All other seed crops need to be pinned.

For isolation distances consult company representatives

WVSSA

Specialty Seed Production

Pinning Rules

To facilitate communication and protect the specialty seed industry in the Willamette and Tualatin Valleys of Oregon, isolation mapping procedures have been drafted and agreed upon by the Willamette Valley Specialty Seed Association (WVSSA). The procedures and isolation distances as outlined below have been set up to ensure quality seed production of all vegetable and other specialty seed in the designated areas from potential cross pollination. The isolation control area of interest referred to as the Willamette and Tualatin Valleys includes the counties of; Multnomah, Washington, Clackamas, Yamhill, Polk, Marion, Benton, Linn, and Lane.

Maps

The association has four separate maps for the purpose of pinning and maintaining appropriate isolation distances. There are two for non-*Beta* species, and two for *Beta* species. The maps are then divided by the North and South valley isolation areas. They are established at four different locations as follows:

Non-*Beta* Species Locations

Map1 - North Valley Pinning
OSU Extension Service Marion County Phone: 503-588-5301
At: 3180 Center NE, Salem, Oregon 97301 Room 1361

Map 2 - South Valley Pinning
OSU Extension Service Linn County Phone: 541-967-3871
At: 104 4th Ave SW, Albany, Oregon 97321 Room 102

***Beta* Species Locations**

Map 3 - North Valley Pinning
West Coast Beet Seed Phone: 503-393-4600
At: 2380 Claxter Rd NE, Salem, Oregon 97303.

Map 4 - South Valley Pinning
Betaseed, Inc. Phone: 541-926-0161
At: 34303 Hwy 99 E, Tangent, Oregon 97389

The non-*Beta* types are to be pinned at the non-*Beta* locations in respect to their valley area.
The North map is for pinning isolations: Including and North of Township 9 South.
The South map is for pinning isolations: Including and South of Township 9 South.
Fields located within Township 9 S. must be pinned on both North and South maps.

The *Beta* types are to be pinned at the *Beta* locations in respect to their valley area.
The North map is for pinning isolations: Including and North of Township 11 South.
The South map is for pinning isolations: Including and South of Township 12 South.

Pinning Procedures

To identify production fields for location on the map, pins and flags will be used to mark the isolation. On the non-*Beta* maps, different color flags are used to separate the major crop types.

1. Must have approved pinning rights and abide by the guidelines of the WVSSA.
2. Observe the dates covered under the priority pinning.
3. Check for acceptable isolation distance on the maps.
4. Use proper flag to pin the field.

Written on each flag will be: Party name, Crop type, Hybrid or O.P., Legal location.

5. Fill out pinning card at time of pinning.

6. At non-*Beta* maps, have Extension personal date stamp card and place in lock box.
7. At *Beta* maps, pin as set up at each location, date stamp card and place in lock box.
8. Contact any companies involved if isolation guidelines are in question.

Pins will be placed as close to the center of the field to be planted as possible. This will be done to facilitate proper isolation distances to other fields. The isolation is not valid if that isolation is pinned incorrectly.

The map cannot be pinned until an established agreement has been made with the grower for planting the crop. The map cannot be pinned on a speculative basis in order to reserve isolation. Upon cancellation of an intended production prior to planting the pin must be removed within 5 days. Upon abandonment of an established production, the pin must be marked failed. A penalty may be assessed of $50.00 if in violation and payment is required to remain a member in good standing.

Pinning Priority

The WVSSA allows the grower to hold the right to the isolation in his perspective farming area for the following year, to produce the same crop within a one-mile radius to the prior year's isolation. The grower maintains the right to elect the contracting company. The isolation right, known as a prior year's priority can only be held for the specific grower until the dates specified below.

A prior year's priority is only valid until the following dates:
For non-*Beta* species: Annuals - March 1st   Biennials - August 1st
For *Beta* species: Transplants - February 1st   Direct seeded - August 1st
After these dates, all isolations are available on a first come basis.

Pinning Rights:

The contracting company or responsible seed representative, who is a member of the WVSSA, may do the pinning. The intent is for the contracting company or responsible seed representative to do the pinning. The representative appointed by a company may also do the pinning if the company is a member of the WVSSA. Oregon State University is considered here as a non-due paying member that has pinning privileges.

The contracting company or responsible seed representative with a grower agreement acts as the grower's appointed representative in establishing the isolation. Individual growers are to allow their contracting company or responsible seed representative who is a member of the WVSSA, to establish the isolation. Growers are allowed to be members of the WVSSA and would be considered as a responsible seed representative and as a member would be allowed to pin isolations for their farms under their own agreements. The contracting company or responsible seed representative agrees to abide by the pinning and isolation guidelines of the WVSSA.

New pinning parties need to contact an officer of the WVSSA for eligibility approval a membership is required prior to pinning. The responsible party may be required to have membership approval by the association. The association may elect to appoint a representative to meet with the new parties at the appropriate isolation map to clarify pinning practices.

Membership and Pinning Fees:
The member or responsible party for the seed is subject to fees as established by the WVSSA. Fees are inclusive of the WVSSA annual membership dues of $150.00 per year, or a Homestead membership fee of $5.00 per year. The pinning fees are; $10.00 per OP crop, $25.00 per Hybrid crop, and $25.00 Multi-crop fee. Annual dues for the current year and pinning fees for the prior year's pinning are assessed at the beginning of each year. If dues and pinning fees are not received, pinning rights may be revoked.

A multi-crop fee may apply when producing multiple crop species of an OP in one location, and one acre or less. Only one per member is allowed and is intended for research farms, and small commercial farms used for seed production. The multi-crop fee is not a pin, crop pins must be used to pin different species, and multi-crop must be designated on each card turned in.

A Homestead membership fee and no pinning fees may apply for a Homestead non-voting member when producing in one location non commercial OP seed crops. Intended for the seed saver this member is not eligible for the pinning priority and is required to follow WVSSA rules and to be accompanied by a designated appointee when pinning the map. Crop pins must be used to pin different species, and Homestead must be designated on each card turned in.

Exceptions Agreements
There are two exception agreements, the Isolation Distance Encroachment, and the One Year Isolation Deferral. The Encroachment exception applies to an established crop isolation where one company agrees to allow another company to produce a like crop under less than the set isolation distance. The deferral applies to an established crop isolation where one grower and company agrees to allow another grower and company to produce a like crop for one year, and the established grower retains the isolation priority.
The parties involved prior to planting a specific crop must agree upon any exception to the established isolation for the specific crop year. The exception agreement needs to be in writing annually and to include the right to the isolation the following year. There are exception agreement forms available for this use. All parties must agree and all other WVSSA isolation rules must be followed.

Securing Isolations
At all maps a system of cards and a lock box will be used and parties using the maps must follow the WVSSA rules. Fields must be currently identified for both the past and present crop year. Failure to pull pins will result in a penalty under the WVSSA.

At the non-*Beta* maps, at the time of opening the lock box, a representative from two different companies of the WVSSA, in addition to an Extension Agent, are required to be present. The lock box will be emptied annually when the prior crop year's map is cleared.

At the *Beta* maps, the procedures for pinning must be followed at each location. The cards will be date stamped, except not by an Extension Agent, and placed in lock box. The lock box can only be opened and will be emptied annually by two members of the WVSSA.

The purpose of the lock box is: 1.To use as the archive and formal record of posting of pins. 2. To review established pinning priority rights. 3. To be used for pinning dispute resolutions. Any discrepancies over pinning locations will be solved through the cards. The cards will be used for accuracy of pinning and in case of arbitration. Pinning cards will be archived indefinitely.

Arbitration

Should all precautions fail in preventing potential cross-pollination problems between seed companies or responsible seed representative, and or growers, the WVSSA suggests the following system or arbitration: Fields not pinned will be considered at fault in event of arbitration. If the parties agree to arbitration by the three-person committee, they agree to abide by the committee's recommendation. The two contesting seed companies or responsible seed representative, in consultation with their growers, each chooses an outside field representative from the WVSSA. The arbitrators, A and B, are suggested to a neutral facilitator who notifies them of their role. They do not know whom they represent and together choose a third committeeman. Arbitrators A, B and C agree to hear the facts of each seed company. Maximum would be two representatives on each side of the issue. After both parties present the facts, only the arbitration committee, A, B and C, remain in the room to discuss the facts fully. They agree to a solution before leaving the room and the chairman will deliver the recommendation immediately to both parties.

Columbia Basin Vegetable Seed Field Isolation Dates[1]

With a valid "release"[2], vegetable seed company representatives may reserve fields for vegetable seed production as follows:

Annuals and carryover onions[3]	February 1 or closest weekday thereafter
Onion and other biennials (except carrots)	March 1 or closest weekday thereafter
Carrots and fall planted annuals	June 1 or closest weekday thereafter

---

[1] These dates for crops are as per agreement at the January 21, 2005 meeting of the Columbia Basin Vegetable Seed Field Representatives Association.

[2] A release must include the production company, crop, and crop year for placement in Columbia Basin production and either the number of fields or number of acres.

[3] Carryover onion crops may be repined with priority between February 1 and March 1, after which priority is lost.

Columbia Basin Vegetable Seed Field Isolation Standards*

All genetically modified crops will be designated as GMO.

CARROT FAMILY (*Apiaceae*)

CARROT (Pinned by Group and Type)

Groups: Hybrid and Open Pollinated

Types:
Chantenay (Danvers, Red Cored, Royal, etc.)
American Market (Imperator, etc.)
Early (Amsterdam, Baby Carrot, etc.)
Medium (Nantes, etc.)
Late (Flakkee, Berticum, etc.)
Round and Odd Shapes (Paris Forcing, etc.)
Oriental (Usually short Chantenay shape)

Distance:
Between Hybrids .... 2 miles
Between Hybrids and Open Pollinated .... 2 miles ♦
Between Types within Groups .... 1 mile
Between Varieties of same Type .... ½ mile
Between same Varieties for different companies .... ¼ mile

Off-color carrots should be grown outside main production area and pinned by color with a minimum isolation distance of 5 miles from other colors.

♦ Note: A 3 mile isolation will be permitted between Hybrid and Open Pollinated carrots where requested.

PARSLEY Between all Types and Varieties .... 1 mile

CORIANDER (cilantro or Chinese parsley) Between all Types and Varieties 1 mile

MUSTARD FAMILY (*Cruciferae*)

RADISH (Pinned by Group and/or Type...Understood to be O.P. unless otherwise noted)

Groups: Hybrid and Open Pollinated

Types:
Round Red
Round Red Forcing
Crimson Giant
Round Red White Tip
Half Long White Tip
Long Red
Icicle (and related forms)
Round White
Purple
Black
Other

* Standards as of March 1, 2006 as agreed upon by the Columbia Basin Seed Field Representatives Association. Revised 03/06.

RADISH Cont'd.

Daikon (assumed to be white rooting type unless specified)
Daikon Sprouting
Daikon, Red
Daikon, Green

Distance: ....Between Hybrid and Open Pollinated...2 miles
Between any red Type and any white type..........................2 miles
Between any round white, icicle Type, purple, black, or any Daikon Types and any other radish....................................2 miles
Between Round Red, Crimson Giant, Long Red, round White Tip, and Half Long White Tip..1 mile
Between Daikon, Sprouting, and any other Daikon of same color 1 mile
Between Round Red and Round Red Forcing....................½ mile
Between Round Red Varieties (unless negotiated between companies) ½ mile

RAPESEED

Canola and other Oilseed Types ....3 miles

Genetically modified Canola and other Oilseed Types will be designated as GMO

OTHER CRUCIFERS (Pinned by crop name and chromosome number)

All Groups or Types ....2 miles

ONION FAMILY (*Alliaceae*)

ONION (Pinned by Group and Type)

(*Allium cepa*)

Groups: Hybrid and Open Pollinated

Hybrid: (Should be posted as male parent)
From Hybrid or O.P. of different color ....3 miles
From Hybrid or O.P. of same color, but different shape (i.e. Globe vs. Flat) 2 miles
From O.P. of same color and shape..2 miles
From Hybrid of same color, but different shape..2 miles
From Hybrid of same color, shape, and Type (i.e. Yellow Spanish vs. Yellow Spanish) 1 mile
From *Allium fistulosum*, Chives, or Leek...None

Open Pollinated:
From Hybrid or O.P. of different color or shape ....3 miles
From O.P. of same color, but different shape (i.e. Yellow Globe vs. Yellow Ebenezer) 2 miles
From Hybrid of same color and shape...2 miles

From O.P. of same color, but different Type (i.e. Yellow Spanish vs. Yellow Globe) 1 ½ miles
From O.P. of same color, Type, and shape (i.e. Yellow Spanish vs. Yellow Spanish) 1 mile
From *Allium fistulosum*, Chives, or Leek..None

(*Allium fistulosum*)

Open Pollinated:
From *Allium cepa,* Chives, or Leek ....None
From another variety of *Allium fistulosum* (i.e. Tokyo Long White vs. He-Shi-Ko) 1 mile

ONION Cont'd.

Hybrid:
From any O.P. or Hybrid *A. fistulosum* ....2 miles

(*Allium cepa-fistulosum* cross) CFC
tetraploid double chromosome

Open Pollinated:
From *Allium cepa* or *Allium fistulosum* of the same color ....None
From *Allium cepa* or *Allium fistulosum* of a different color ....None
From another Variety of CFC of the same color ....1 mile
From another Variety of CFC of a different color ....3 miles

CHIVES

From *Allium cepa, Allium fistulosum,* or Leek ....None
From another Variety of chives ....1 mile

LEEK

From *Allium cepa, Allium fistulosum*, Chives ....None
From another Variety of Leek ....1 mile

GOOSEFOOT FAMILY (*Chenopodiaceae*)

BEETS

Between all Beets, Swiss Chard, and Mangels ....3 miles

Sugar Beet Types:
Diploid
Tetraploid

From Sugar Beets of the same or different Type..2 miles

Genetically modified Sugar Beets will be designated as GMO

Appendix B

West Coast Beet Seed Company protocol for genetically modified (GM) seed production and GM grower guidelines

PROTOCOL FOR GENETICALLY MODIFIED (GM) SEED PRODUCTION
(Direct-Seeded, Transplants, Nurseries, Plots)

DETECTION

1. West Coast Beet Seed Company will request the help of Members to set up assay for QC (detection) of Roundup Ready (RR) gene in sugar beet seed lots.

2. West Coast Beet Seed Company will, from time-to-time, add additional assay of QC (detection) for other events as needed.

3. West Coast Beet Seed Company will conduct the assay for QC of RR on all RR seed lots. For the protection of West Coast Beet Seed Company and to learn if the processes are meeting the desirable criteria, random testing of non-GMO seed lots will be conducted. West Coast Beet Seed Company may consider using zones, based on distances from the GM source, for determining this random testing. Members have the option of requesting all of their lots be tested. Members have the option of requesting this information in written form.

4. The shipping document will indicate that the shipment contains GM seed.

5. West Coast Beet Seed Company assigns a lot number to the potential seed lot prior to the item being planted. This number stays with the seed lot and becomes a permanent record for this lot.

6. West Coast Beet Seed Company will inform members of all past events grown so members can test their seed lots.

ISOLATION

1. West Coast Beet Seed Company's goal is to develop an agreement with sugar beet, chard, and red beet seed companies to avoid cross contamination and to develop a program to inform each other as to the locations of present and past GM and non-GM seed productions.

2. Within a three mile radius of any RR field, West Coast Beet Seed Company will monitor for any volunteers in any fields used for sugar beet production, over a minimum of the past five years or until no volunteers are observed.

3. West Coast Beet Seed Company will monitor GM fields for a minimum of five years or until no volunteers are present. This will protect chard, red beet, and sugar beet seed production in the area. The removal of the volunteers will be done under the supervision of West Coast Beet Seed Company representatives and recorded in a log book. The costs will be shared between West Coast Beet Seed Company and the grower.

4. West Coast Beet Seed Company will maintain a minimum three-mile isolation between GM and non-GM sugar beet production. The isolation between GM pollinators/productions where the same event is present will be a minimum of one mile.

The isolation between sugar beet, chard, and red beet will be a minimum of three miles until an agreement can be reached with the other companies.

STOCK SEED/STECKLINGS/SEED TAGS

1. West Coast Beet Seed Company has adopted an orange color tagging system to visually identify GM material (GM stock seed, GM stecklings, GM seed in tote boxes, cotton or burlap bags, GM seed samples, and member's shipping containers). The orange colored tags identify the product as GM and it is to be treated according to the protocol. In respect to each Member company's policies, GM material going to or coming from West Coast Beet Seed Company will be tagged with the preferred identification of that member company.

Member Requirements:

1. Prior to GM stock seed being shipped to West Coast Beet Seed Company, the members will send a document (Movement Traceability Form) identifying the stock seed items (I. D. code number, etc.) that will be GM.

2. Each GM stock seed bag arriving from members will already contain an orange tag marked in writing, stating it is GM seed. The stock seed bags can also contain the Member company's GM identifying colored tag, code, symbol, etc.

   A. If stock seed arrives and there are any inconsistencies in the paperwork, orange tagging, non-orange tagging, or any other inconsistency of labeling, the warehouse personnel will notify the Manager and the seed will be put on hold until the member clears the issue and backs it up with the proper documents. The seed will be stored on a separate pallet in the GM portion of the warehouse. The pallet will be marked clearly in a manner to prevent it from being prepared for planting.

West Coast Beet Seed Company's Requirements:

1. The GM stock seed will be stored separately from the conventional stock seed. The area will be in the main building, along the east wall, near the Warehouse Manager's office and will be identified in a clear manner.

   A. Non-GM seed will be stored in the northwest warehouse, of the main building, by the main dock.

2. The GM stock seed will be prepared for grower disbursement in the main building, along the east wall, near the Warehouse Manager's office.

   A. A sample of the GM stock seed will be held in a separate area of the warehouse for five years. This sample will be labeled with the orange colored tag and the preferred identification of the member company.

3. Once the GM stock seed is prepared for the grower, it will be labeled with an orange tag indicating to the grower that they have in their possession GM seed.

4. Accompanying the GM stock seed will be a written document declaring that the seed is GM.

5. The stock seed for GM and non-GM productions will not be transported to the growers in the same vehicle at the same time. The field staff will be trained properly at least once a year in the handling of GM seed and all seed movement will be documented.

6. The field supervisors are responsible for collecting the remaining stock seed from the growers immediately after planting. The Warehouse Manager will log in the stock seed. When GM stock seed is returned from the growers after planting, sealed bags will be returned to the member. Opened bags will be incinerated at the County garbage burning facility to prevent use of potentially grower-contaminated seed.

   The Member will be informed, in writing, of the amount, location, and date destroyed. The Member also will be informed, in writing, as to amount being returned to them.

GM NURSERY

1. The GM nursery will be kept separate from the conventional nursery.

   A. The owner of the nursery ground will have given West Coast Beet Seed Company written permission to plant GM stock seed.

2. The GM stock seed for the nursery will be handled the same as any other GM stock seed (Information from member, orange tag, stored in separate area, etc.) (see above "STOCK SEED/STECKLINGS/SEED TAGS").

3. The digging equipment will be completely clean of any stecklings before entering or leaving the GM nursery. West Coast supervisors will sign a document stating they have personally inspected the equipment after cleaning and found it to be free from any stecklings.

4. All GM stecklings will be stored in sacks that are marked with a GM orange tag. The stecklings will be stored in a cooler or warehouse separate from non-GM stecklings.

5. There will be a separate GM observation nursery and it will be isolated in the area where GM productions of the same event(s) are being grown.

GROWING THE CROP

(Planters, tillers/flail, sprayers, separators, male removal, swathers, combines, tote boxes, hauling, tarps/lids)

Any equipment (planter, transplanter, sprayer, flail, tiller, tractor, irrigation equipment, vehicle, separator, clipper, swather, combine, tote box, post-harvest tilling equipment, seed cleaning equipment, or any other equipment) must be monitored, treated, cleaned, and the process documented, according to West Coast Beet Seed Company's policies.

The intent is to prevent seed, pollen, or stecklings from being transferred out of the area of control or transferred to where they could contaminate other Beta species productions (details of the methods are found in other parts of this protocol).

1. West Coast Beet Seed Company will use only designated totes for GM seed harvest by growers. Phase one will be metal totes only. Phase two will be metal totes and designated wood totes.

   A. During transportation, the totes will be covered with a West Coast Beet Seed Company approved high-quality tarp or high-quality lid.

2. Trucks transporting commercial GM seed will not carry non-GM seed on the same load.

3. Growers will not be allowed to transfer bulk seed to totes at third party locations (i.e. grain elevators) unless, in the opinion of West Coast Beet Seed Company and upon approval of the member company(ies), the seed can be transferred in a manner that would allow complete and easy transfer without contamination of equipment or surrounding area. To avoid spillage, growers must not transfer seed from one tote to another.

4. Any pesticide application made during the flowering period needs to be done by aerial applications. If aerial application is not possible, then West Coast Beet Seed Company will use its operator and modified equipment to spray. If the grower has high clearance spray equipment that does not leave his farm, then we can consider using this equipment.

   The Member will be notified in advance as to which productions West Coast Beet Seed Company will use its equipment for spraying after flowering begins.

5. When the GM production is in bloom, any person who enters the field (grower or their workers if they would be going to any other Beta species production, West Coast Beet Company staff or temporary workers, Member or their representatives), will wear disposable coveralls. They are to be removed and disposed of after each use. The disposable clothing will be stored in a separate, closed container so that live pollen cannot escape the area or be transferred into another field.

   A. Clean, disposable, coveralls will be kept in a closed container prior to use. These coveralls will be furnished at West Coast Beet Seed Company's expense. West Coast Beet Seed Company's field supervisor is responsible for the disbursement of the disposable clothes, for having people wear them, for training people how to dispose of them, and finally to control the good use of them.

SEED CLEANING, STORAGE, SHIPPING CONTAINERS, AND SCREENINGS DISPOSAL

1. GM seed will be delivered in designated totes. The totes will be affixed with all appropriate tags, including a GM orange tag which will designate it as containing GM seed.

A. These totes will be stored in a designated portion of the warehouse(s) physically separated from non-GM seed. The seed will also be unloaded in a separate area and only GM designated and marked equipment (brooms, conveyors, etc.) will be used for GM seed.

B. The field-run samples also will be affixed with a GM orange tag and these samples will be stored separately from non-GM samples. This requirement will be added to the scale house procedures and policies. Scale house personnel will be trained in these procedures, each year, prior to seed delivery.

2. West Coast Beet Seed Company will, in the beginning years, utilize one or two of the cleaning lines to process GM seed. The GM seed will be cleaned at the end of the processing period to avoid potential problems.

A. The Company shall not clean conventional and GM seed simultaneously, except in an emergency. In the event of an emergency and the Company must clean conventional and GM seed simultaneously, a physical barrier, such as a plastic wall, shall be put in place to avoid contamination.

B. All cleaning equipment will be thoroughly cleaned prior to and after cleaning GM seed. This will ensure that all GM seed has been removed from equipment prior to any non-GM seed being introduced after that point. (Detailed instructions of cleaning the equipment are already in place).

C. A permanent log is kept for the cleaning sequence.

3. West Coast Beet Seed Company will draw a representative <u>clean seed sample</u> and tag it with a GM orange tag.

A. Part of this sample will be tagged with a GM orange tag and sent to Agri Seed Testing for germination and purity testing. Agri Seed Testing will be informed that the seed is GM. Agri Seed Testing holds their samples for three (3) years and then will destroy them by incineration in the County garbage burning facility.

B. Part of the sample will be tested via the QC assay method for the event(s). (This will be expanded to include how this information will be disseminated). See DETECTION category number 3, paragraph 1 above.

C. A minimum of one (1) pound will be stored in a separate area for five years labeled with an orange tag and the preferred identification of the member company.

D. Members at their request will be sent their requested amount of properly labeled, clean seed samples.

4. Screenings from GM production will be delivered to either the pellet mill or composting facility.

A. West Coast Beet Seed Company will check yearly with the pellet mill company to see if the feed pellets will be sold where GM is presently not allowed (Europe)[44]. West Coast Beet Seed Company will keep members informed on the result of this discussion.

B. In the future, regulated screenings can be delivered to a landfill if required.

5. Shipping of GM seed to members will be in new containers (boxes, poly tote bags, etc.). The containers will be affixed with a GM orange tag and the preferred identification of the member company. Shipping containers (cardboard boxes and poly bags), because they are known to hold some seed in crevices, will not be allowed to be reused at this time. Therefore, West Coast Beet Seed Company would prohibit GM shipping containers from being returned for reuse.

A. The paperwork that goes with the seed will indicate seed in truck contains GM seed.

B. For the protection of West Coast Beet Seed Company and its members, GM and non-GM seed will not be shipped on the same truckload to the Members' facilities.

GM GROWER GUIDELINES

The policy for the grower guidelines will include the following revised requirements:

1. The policy will be a part of the Grower Contract.

2. The grower will have only a GM production (of one event) or a non-GM production; not both in a given year. This applies to growers who grow only for West Coast Beet Seed Company and to those growers who grow for both West Coast Beet Seed Company and another sugar beet seed company.

A. The grower will not raise a GM crop and a chard or red beet seed production in the same year.

3. The grower will use precaution in the field to eliminate seed from remaining loose on the transport deck prior to leaving the field.

A. Clean off deck of loose seed prior to leaving field. This is part of the protocol that will be reviewed with the Grower.

B. (West Coast Beet Seed Company will work on designing a method to prevent seed from falling between boxes. We may also promote bulk hauling to the plant and transfer to boxes).

4. Grower cannot use/share any equipment that might be used in a non-GM sugar beet, chard, or red beet seed production in the same growing year.

---

[44] Import of food and feed products derived from Roundup Ready sugar beet event H7-1 was approved by the European Union in October, 2007.

5. Grower cannot use same combine to combine GM sugar beet, non-GM sugar beet, chard, or red beet seed in same year.

    A. The grower will combine 200 acres of another crop between combining any beta species.

6. We want a rotation of five crop plantings since the last beta species was grown on the field for seed.

7. Grower training on all aspects of GM growing handling will be conducted by management and field staff.

RECORDKEEPING

1. West Coast Beet Seed Company will continue to maintain a permanent GPS computerized mapping system to record all productions including year, item number, and lot number.

2. West Coast Beet Seed Company maintains a yearly and ongoing computerized log where all important activities of the production are recorded (Crop Tracker). The Grower may collect information, but the final responsibility for this data collection is the field supervisor.

3. Crop histories of herbicide and crop are collected each year prior to planting.

4. West Coast Beet Seed Company will develop a method for tracking all movement of GM seed from the time West Coast Beet Seed Company receives the stock seed, to the final processing and shipment to the member. This information will be communicated to the members upon request. The members may also request additional information when necessary for stewardship of the GM crops.

INSPECTION

New disposable clothing will be used by West Coast personnel, grower, custom contractor, and member company personnel when entering the field when pollen is present. After each use, the clothing will be discarded into a sealed container and then disposed of in customary container (garbage can, dump box).

RISK ANALYSIS

The protocol needs to be continually reviewed. During the review and handling of the crop, new areas of concern may become evident. When this occurs, the concern must be addressed and solutions implemented. Final approval of any changes to the contracts must be approved by the Contract Committee and recommended by the committee to the Board of Directors in a timely fashion.

TRAINING

1. All West Coast Beet Seed Company employees will be trained in all areas of the protocol. Date, time, personnel attending, type of training and instructor should be recorded for all training sessions and appropriately filed.

   A. West Coast will train personnel on these policies and procedures. Written training documents will be reviewed and approved by the board.

2. West Coast Beet Seed Company employees that deal with specific areas will have extensive and continual training in the specific area.

3. Both West Coast Beet Seed Company growers and personnel will be trained in the relevant areas of the protocol. Date, time, attendees, type of training and instruction should be recorded for all training sessions and appropriately filed.

4. Part of the training will include the following West Coast Beet Seed Company policy: Operators discovering evidence of spillage or GM seed out of place immediately will inform their supervisor, the head of department, and the West Coast Beet Seed Company Manager. At first evidence of the problem, appropriate action will be taken to halt the release of any additional seed, pollen, or plant material. The problem will be evaluated immediately to prevent a reoccurrence. Appropriate individuals or companies will be informed of the situation.

GM Grower Guidelines

I. The following are guidelines to which all West Coast Beet Seed Company commercial growers are required to adhere in the contract production of genetically modified (GM) sugar beet seed. If questions arise with this production, contact West Coast Beet Seed Company's fieldmen for clarification or explanation.

   Direct seeded and transplant productions will adhere to the guidelines, except with reference to transplanting. West Coast Beet Seed Company will perform the transplanting in winter/spring.

   A. **Field Selection:** Genetic purity is of the utmost concern with this type of seed production. Field selection encompasses many characteristics, but the main features that are necessary include fields with <u>required isolation</u> of at least three miles from non-GM productions and one mile between GM pollinators/productions, the least chance of having volunteer beets from previous productions, good fertility, favorable location (not likely to flood), available for timely plantings into pre-irrigated conditions, good irrigation systems, and good water availability. At a minimum, a rotation of five crops since the last beta species were grown for seed is required.

   B. **Planting:** Stock seed will carry an <u>orange tag</u> to indicate GM. The goal is to plant into fertilized, pH adjusted as necessary, and pre-irrigated fields to ensure timely establishment of desired stands. It is desirable to have a population of 4-5 beets per foot of row in all lines for direct-seeded production.

Stock seed normally is limited in supply, so close monitoring of seed drop is essential to establishing uniform stands across the entire planting. Stock seed will be stored safely to ensure no seed is lost inadvertently or released into the environment inadvertently. All unused stock seed will be returned to company personnel in a timely manner.

Planters must be monitored both before and after planting to ensure that the proper seed is being planted. After planting, the planter and the tractor need to be cleaned in the field to remove 100% of the seed prior to moving the planter to another location. The intent is to prevent seed from being transferred out of the area of control or transferred to where it could contaminate other beta species productions.

C. **Irrigation:** Fall irrigation of direct-seeded production should start after planting, as necessary, and continue through emergence and stand establishment.
Spring irrigation of direct seeded and transplant production should begin as the soil moisture drops and crop growth requires supplemental moisture. Spring irrigation should continue as the crop grows and matures to the point that additional moisture is no longer beneficial to production of a quality crop.

West Coast Beet Seed Company personnel will determine the timing of the last irrigation.

Irrigation equipment will be cleaned of any live GM pollen before leaving the field. If this is not possible, then irrigation equipment should be left by the field for 24 hours before moving to another location.

D. **Disposable Clothing Requirements:** When the GM production is in bloom, any person who enters the field, and who may enter another Beta species production that same day, will wear disposable coveralls. These will be furnished at West Coast's expense and they are to be removed and disposed of after each use. This will prevent live pollen from being transferred to another field.

E. **Care of the Crop:** The crop will be cared for in the best interest of obtaining a high quality and high-yielding production. Management practices of individual fields vary and shall be approved by West Coast Beet Seed Company's field staff. Recommendations by Company representatives will be carried out in a timely and efficient manner.

1. Any pesticide application made during the flowering period needs to be done by aerial applications. If aerial application is not possible, then West Coast Beet Seed Company will use its operator and modified equipment to spray. If the grower has high clearance spray equipment that does not leave his farm, then we can consider using this equipment.

F. **Pollinator Removal:** Removal of pollinator in a timely manner is very important to production of high quality seed. Pollinator destruction will be completed within the time frame agreed upon with West Coast Beet Seed Company representatives. West Coast Beet Seed Company representatives will approve destruction methods and equipment. Equipment **will not** be used in another beet field until thoroughly cleaned of pollen and/or seed and inspected by West Coast Beet Seed Company field supervisor or his representative.

1. Any equipment (flail, tiller, separator, tractor, vehicle) must be cleaned to kill all live pollen before leaving the field according to West Coast Beet Seed Company's policies.

   The intent is to prevent pollen from being transferred out of the area of control or transferred to where it could contaminate other Beta species productions.

G. **Swathing:** Swathing will be done in a timely manner as directed by West Coast Beet Seed Company representatives. Swathers will be inspected by West Coast Beet Seed Company's field supervisor for cleanliness prior to and after cutting. Swathers will be cleaned in the field after swathing to ensure that no seed is released into any adjacent field or area.

H. **Combining:** West Coast Beet Seed Company will approve the cleanliness of the growers combine. Before use, the combine must have threshed at least 200 acres of another crop since it was used last to combine any other Beta species. Approval for grower combine usage will be determined on a case-by-case basis and will depend on previous crops combined and acreage.

Combines must be cleaned before they leave the field to ensure no seed is moved into adjacent areas. Combined seed will be placed in designated tote boxes within the confines of the existing field. Grower will clean off the truck deck in the field to ensure seed is not spilled during transport. West Coast Beet Seed Company's supervisor will approve the cleanliness of the grower's combine before leaving the field.

I. **Bulk Seed:** Growers will not be allowed to transfer bulk seed to totes at third party locations (i.e. grain elevators) unless, upon approval of West Coast Beet Seed Company, the seed can be transferred in a manner that would allow complete and easy transfer without contamination of equipment or surrounding area. To avoid spillage, growers must not transfer seed from one tote to another.

J. **Hauling Seed:** All loads of seed shall be covered with West Coast Beet Seed Company approved, high-quality tarps and/or sealed with lids so no seed can be lost during transport. GM and non-GM seed **<u>will not</u>** be hauled simultaneously on the same truck.

K. **Post-Harvest Field Management:** Fields will be shallow tilled after harvest to a depth of not more than 3". To promote sprouting of the shattered seed, full irrigation is required, unless a West Coast Beet Seed Company representative determines adequate rainfall has occurred to promote the required sprouting. <u>Fields will not be fall plowed for any reason.</u> Control of sprouted seed is essential to prevent any pollen release and seed formation in future crops.

All tractors and tillage equipment must be monitored and cleaned according to West Coast Beet Seed Company's policies before leaving the field.

The intent is to prevent seed from being transferred out of the area of control or transferred to where it could contaminate other Beta species productions.

L. Fields will be inspected by West Coast Beet Seed Company for a minimum of five years or until no volunteers are noted.

M. All of these actions will be recorded at West Coast Beet Seed Company in order to establish a record of adherence to GM policy, whether the actions were taken by the grower, the company, or by both in a shared responsibility.

Appendix C

International Seed Federation Code of Conduct

International Seed Federation

CODE OF CONDUCT
(adopted by the ISF Sugar and Fodder Beet Commission)

Principles of quality assurance in beet seed production.
(Final version of 22 October 2007)

Summary

The principles and measures highlighted in this paper aims to the adventitious presence of GM[45] beet seed in conventional sugar beet and fodder beet, as well as the adventitious presence of other GMOs[46] in GM sugar beet and fodder beet seed. The adventitious presence of GMOs can only be minimized but not totally excluded because seed production occurs in open fields under natural conditions. There is a strong necessity for practicable rules and regulations governing a high level of purity for seed of conventional varieties relating to adventitious presence of GMOs and for seed of GM varieties relating to adventitious presence of other GMOs.

1. Objective

The objective of this industry position paper for the quality assurance of sugar beet and fodder beet (hereinafter referred to as "beet seed") is to describe the measures the seed industry has taken to minimize the likelihood of adventitious presence of GM beet seed in conventional seed or adventitious presence of different GMOs in GM beet seed. The Industry recommends to apply the same measures to table beet and/or Swiss chard seed production[3].

This objective is accomplished by implementing guidelines and operating procedures (preventive measures) covering every step from the stage of R&D activities up to delivery of commercial beet seed to the customer. In addition to these measures, actions are undertaken to control the various steps of this process.

2. Deregulation of GM beet events

The status of deregulation of GM sugar beet events varies according to territories. Similarly, requirements set up by regulators may vary by country. Therefore principles adopted by the industry must reflect these regional differences.

---

[45] GM: Genetically modified
[46] GMO: Genetically modified organism
This code of conduct has up to now been agreed upon by the following companies: Danisco Seed, Dieckmann GmbH & Co. KG, Fr. Strube Saatzucht GmbH & Co. KG, Maison Florimond Desprez S.A.S., KWS SAAT AG, SESVanderHave, Syngenta Seeds and their affiliated companies. It is open for adoption by other seed companies producing sugar and/or fodder beet seeds.

2.1. USA

There are three GM sugar beet events which have been deregulated in the USA. One of the three events is commercialized since 2007.

2.2. Europe

No GM beet events are deregulated at this moment in Europe. As of today no commercialization of GM beet seed can take place in Europe. There is one sugar beet event undergoing the European deregulation process. This process has not been finalized. Similarly there is one fodder beet event undergoing deregulation but the process is still in progress.

2.3. Other territories in the world

There is one sugar beet event undergoing a deregulation process in certain countries.

3. Adventitious presence of GM beet seed

3.1. Adventitious presence in conventional seed

Adventitious presence of GM sugar beet seed in conventional beet seed cannot be totally excluded. As of today, there are no official thresholds governing the adventitious presence of GM seed in conventional seed in Europe. There is an urgent need for such a threshold to be in place in Europe due to the market introduction of the first GM sugar beet in the US. Thresholds will vary and some territories or countries may not regulate adventitious presence.

Adventitious presence of GM seed in conventional seed would result from the presence of GM seed or GM plants in other beet seed production at some stage of seed production or processing.

Three possible main sources of adventitious presence of GM seed in conventional seed productions are identified:

- Spread of GM pollen to multiplications of conventional seed.
- Unintentional mixing-up of plants during transplanting.
- Unintended traces of GM seed during harvest, transport, processing or storage.

Quality assurance systems have been implemented to address the issues posed by the adventitious presence. These consist in preventive measures and testing procedures for adventitious presence. They are presented in section 5.

3.2. Adventitious presence in GM seed

Adventitious presence of unintended GM seed in GM seed production would result from the presence of GM seed of another event in a production of a given event at some stage of seed production or processing of GM seed.

Similar measures as above in point (3.1) are addressing this case.

4. Pre-commercial and commercial production of GM beet seed

4.1. Europe

There are currently no pre-commercial or commercial productions of GM beet seed in Europe.

Until now, production of GM beet seed in Europe is limited to R&D[47] activities only.

Quality assurance measures that would be taken in the future for commercial seed production in Europe will be focused on the separation of GM seed and conventional seed during the whole production procedure (e.g. multiplication and processing steps).

In addition to this, tests for adventitious presence and traces of GM beet seed in commercial beet seed lots are performed.

4.2. USA

There are commercial productions of GM beet seed of one deregulated event in the USA.

Quality assurance systems to prevent adventitious presence and traces of GM seed as presented in the data sheet of the Annex have been implemented by the seed industry.
These measures are focused on the separation of GM seed and conventional seed during the whole production procedure (e.g. multiplication and processing steps).

In addition to this, tests for adventitious presence of GM seed in the GM commercial seed lots were implemented (this refers to traces of another event in a GM seed production based on an intended event).

5. Principles for preventive measures and testing procedures for adventitious presence in R&D, in conventional and in GM beet seed production

This section describes main measures (preventive measures and testing procedures) to ensure a high level of purity for beet seed regarding AP[48] of GM. Three base cases cover all situations encountered either as producer of conventional seed or as producer of GM seed.

The guidelines for preventive and control measures have thus been divided into three parts:

1. R&D activities related to GM seed (all stages of the seed development up to the basic seed production) – Data sheet in Annex 1
2. Production of conventional seed for commercialization – Data sheet in Annex 2
3. Production of GM seed for commercialization – Data sheet in Annex 3

The following sections outline general preventive and control measures to ensure a high level of purity regarding AP for conventional seed and/or GM seed.

5.1 Preventive measures

[47] R&D: Research and development
[48] AP: adventitious presence

Several principles are implemented in all types of activities and operations by each company:

- A quality assurance system is implemented, whereby every GM plant material is recorded and can therefore be traced.
- SOPs[49] are written for all aspects of the handling of GM beet plants and GM beet seed and the staff is trained and briefed on their use and application.
- Conventional and GM seed are handled separately, and specific labels or the unique identifier will be used for all GM material.
- The above mentioned breeding companies have agreed in sharing information on the locations and traits of their respective GM seed production worldwide.

5.2 Testing procedures

- Testing for adventitious presence of GM in conventional seed lots and for unintended events in GM seed lots.
- Exchange information on detection methods of such traits which are shortly before production.

More detailed information can be found in the Annexes.

Annex 1
Data sheet for "R&D activities for GM and Non-GM (all stages of seed development up to the basic seed production of regulated and deregulated GM beet)".

Preventive measures

- All activities involving GM beet plants and GM beet seed are subject of national and international regulations which are adhered to by the breeding companies.
- By sharing information between breeding companies about the locations and traits of their respective GM seed production, companies will have the opportunity to redefine their location of seed production in case it is located close to a conventional seed or another GM event production area.
- Minimum of four years of rotation between GM beet seed-crop and conventional beet root-crop.
- Isolation distance of at least 1.5 miles between GM and conventional or other GM event seed production.
- Bolting plants of *Beta* species are removed within a radius of at least 1000 m around GM multiplications before flowering.
- SOPs are written for all aspects of the handling of GM beet plants and GM beet seed and the staff is trained and briefed on their use and application.
- Transport of GM seed only in closed containers or bags.
- Storage of GM seed in dedicated areas separated from conventional seed.
- Careful cleaning of all machinery is carried out before and after each step in the production process of a GM seed lot or separate production lines (different GM, Non-GM) are used in the production process.
- Monitoring for volunteer beets is done at fields or locations used for GM seed production
- Shallow post harvest tillage

[49] SOP: standard operating procedure

Testing procedures

- Seed lots are tested for the adventitious presence of GM and GM seed lots for unintended GMO before shipment to third parties, for example:
    - Testing of conventional seed lots used for variety trials.
    - Testing of GM seed lots used for variety trials.
    - Testing of conventional seed lots used in field trials by research institutes and/or industry.
    - Testing of GM seed lots used in field trials by research institutes and/or industry.

- Basic seed lots used for commercial production are tested by either PCR or immunological tests and/or herbicide application in case of herbicide tolerance traits.
- Seeds are sampled after harvesting or before pelleting according to internationally accepted sampling techniques.

Annex 2
Data sheet for "Production of conventional beet seed for commercialization"

Preventive measures

- The above mentioned breeding companies have agreed in sharing information on the locations and traits of their respective GM seed multiplications worldwide.
- In addition, as part of the information sharing, breeding companies will exchange information on detection methods of such traits which are shortly before production.
- Isolation distance of at least 1.5 miles between GM and conventional seed production.
- Bolting plants of *Beta* species are removed before flowering within a radius of 1000 m around GM multiplications.
- Minimum of four years crop rotation in seed production.
- Separation of conventional and GM seed during processing
- The order of lots processed and pelleted is thoroughly recorded.
- Careful cleaning of all machinery is carried out before and after each step in the production process or use of separate production lines (GM, Non-GM) in the production process

Testing procedures

- Conventional seed lots are tested for adventitious presence of GM seed by either PCR or immunological tests and/or herbicide application.
- Seeds are sampled after harvesting or before pelleting according to internationally accepted sampling techniques.

Annex 3
Data sheet for "Production of GM seed for commercialization"

Preventive measures

- All activities involving GM beet plants and GM beet seed are subject of national and international regulations which are adhered to by the breeding companies.
- SOPs are written for all aspects of the handling of GM beet plants and GM beet seed and the staff is trained and briefed on their use and application.
- The above mentioned breeding companies have agreed in sharing information on the locations and traits of their respective GM seed multiplications worldwide.
- In addition, as part of the information sharing, breeding companies will exchange information on the appropriate detection method for GM traits.
- A quality assurance system is implemented, whereby every GM plant material is recorded and can therefore be traced.
- Isolation distance of at least 1.5 miles between GM and conventional seed production.
- Bolting plants of *Beta* species are removed before flowering within a radius of 1000 m around GM multiplications.
- The order of lots processed and pelleted is thoroughly recorded.
- Careful cleaning of all machinery is carried out before and after each step in the production process or use of separate production lines (GM, Non-GM) in the production process

Testing procedures

- GM seed is tested by either PCR or immunological tests and/or herbicide application in case of herbicide tolerance traits.

Seeds are sampled after harvesting or before pelleting according to internationally accepted sampling techniques.

Appendix D

Sugar Beet Production by County and State

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	California	Fresno	6,000	5,600	31.7	154,000	16.26
Sugarbeets	2008	California	Kings	1,100	1,000	36.0	36,000	16.66
Sugarbeets	2008	California	D51 Combined Counties	500	500	36.0	18,000	15.62
Sugarbeets	2008	California	D51 San Joaquin Valley	7,600	7,300	32.6	238,000	16.26
Sugarbeets	2008	California	Imperial	18,500	18,100	42.5	770,000	16.65
Sugarbeets	2008	California	D80 Southern California	18,500	18,100	42.5	770,000	16.65
Sugarbeets	**2008**	**California**	**State Total**	**26,100**	**25,400**	**39.7**	**1,008,000**	**16.56**
Sugarbeets	2008	Colorado	Boulder	500	500	22.6	11,300	16.78
Sugarbeets	2008	Colorado	Larimer	2,800	2,100	24.0	50,400	16.17
Sugarbeets	2008	Colorado	Logan	4,300	3,800	24.7	93,800	15.75
Sugarbeets	2008	Colorado	Morgan	1,800	1,500	24.6	36,900	14.88
Sugarbeets	2008	Colorado	Sedgwick	1,400	1,300	27.4	35,600	16.62
Sugarbeets	2008	Colorado	Weld	11,700	9,200	27.9	257,000	16.01
Sugarbeets	2008	Colorado	D20 Northeast	22,300	18,400	25.4	455,000	15.95
Sugarbeets	2008	Colorado	Phillips	4,200	3,400	24.9	84,600	16.69
Sugarbeets	2008	Colorado	Washington	1,500	1,300	27.2	35,300	16.00
Sugarbeets	2008	Colorado	Yuma	5,000	4,700	27.9	131,000	16.41
Sugarbeets	2008	Colorado	D60 Combined Counties	800	800	27.6	22,100	16.36
Sugarbeets	2008	Colorado	D60 East Central	11,500	10,200	26.8	273,000	16.44
Sugarbeets	**2008**	**Colorado**	**State Total**	**33,800**	**28,600**	**26.5**	**758,000**	**16.13**
Sugarbeets	2008	Idaho	Ada	1,600	1,500	36.0	54,000	15.78
Sugarbeets	2008	Idaho	Canyon	6,700	6,200	35.8	222,000	16.20
Sugarbeets	2008	Idaho	Elmore	5,800	5,300	31.6	167,500	15.84
Sugarbeets	2008	Idaho	Owyhee	2,700	2,600	35.6	92,500	16.08
Sugarbeets	2008	Idaho	Washington	1,200	1,100	34.3	37,700	16.98
Sugarbeets	2008	Idaho	D70 Combined Counties	1,000	800	32.9	26,300	16.21
Sugarbeets	2008	Idaho	D70 Southwest	19,000	17,500	34.3	600,000	16.09
Sugarbeets	2008	Idaho	Blaine	800	800	31.3	25,000	17.29
Sugarbeets	2008	Idaho	Cassia	25,400	20,100	29.9	600,000	17.79
Sugarbeets	2008	Idaho	Gooding	1,000	600	33.3	20,000	17.76
Sugarbeets	2008	Idaho	Jerome	11,000	9,700	32.6	316,000	17.69
Sugarbeets	2008	Idaho	Lincoln	3,700	3,100	29.0	90,000	16.32
Sugarbeets	2008	Idaho	Minidoka	30,100	29,100	29.4	856,000	17.93
Sugarbeets	2008	Idaho	Twin Falls	7,900	5,600	31.6	177,000	17.12
Sugarbeets	2008	Idaho	D80 South Central	80,000	69,000	30.2	2,084,000	17.79
Sugarbeets	2008	Idaho	Bingham	20,000	18,500	31.4	580,000	17.32
Sugarbeets	2008	Idaho	Power	12,000	11,000	32.3	355,000	17.18
Sugarbeets	2008	Idaho	D90 East	32,000	29,500	31.7	935,000	17.27
Sugarbeets	**2008**	**Idaho**	**State Total**	**131,000**	**116,000**	**31.2**	**3,619,000**	**17.37**
Sugarbeets	2008	Michigan	D30 Combined Counties	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	D30 Northeast	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	Gladwin	900	900	22.2	20,000	17.80
Sugarbeets	2008	Michigan	Gratiot	10,100	10,000	24.0	240,000	15.00
Sugarbeets	2008	Michigan	Isabella	700	700	24.3	17,000	17.70
Sugarbeets	2008	Michigan	Midland	3,000	3,000	26.3	79,000	15.90
Sugarbeets	2008	Michigan	Montcalm	400	400	27.5	11,000	17.50
Sugarbeets	2008	Michigan	D50 Central	15,100	15,000	24.5	367,000	15.00
Sugarbeets	2008	Michigan	Arenac	3,100	3,100	28.1	87,000	15.30
Sugarbeets	2008	Michigan	Bay	12,600	12,600	27.1	341,000	15.00
Sugarbeets	2008	Michigan	Huron	45,800	45,800	28.5	1,306,000	15.30
Sugarbeets	2008	Michigan	Saginaw	15,300	15,300	25.2	432,000	15.00
Sugarbeets	2008	Michigan	Sanilac	21,200	21,100	32.2	680,000	15.10
Sugarbeets	2008	Michigan	Tuscola	18,500	18,100	30.1	544,000	15.30
Sugarbeets	2008	Michigan	D60 East Central	116,500	116,000	29.2	3,390,000	15.20
Sugarbeets	2008	Michigan	Clinton	700	500	28.0	14,000	17.50
Sugarbeets	2008	Michigan	Ionia	500	300	30.0	9,000	17.50
Sugarbeets	2008	Michigan	Shiawassee	1,300	1,300	30.0	39,000	17.20
Sugarbeets	2008	Michigan	D80 South Central	2,500	2,100	29.5	62,000	17.30
Sugarbeets	2008	Michigan	Genesee	300	300	26.7	8,000	15.10
Sugarbeets	2008	Michigan	Lapeer	1,100	1,100	30.0	33,000	17.30
Sugarbeets	2008	Michigan	St. Clair	1,200	1,200	26.7	32,000	15.70
Sugarbeets	2008	Michigan	D90 Southeast	2,600	2,600	28.1	73,000	15.00
Sugarbeets	**2008**	**Michigan**	**State Total**	**137,000**	**136,000**	**28.7**	**3,903,000**	**15.10**
Sugarbeets	2008	Minnesota	Becker	6,600	7,300	21.4	156,000	17.10
Sugarbeets	2008	Minnesota	Clay	46,000	36,000	23.0	875,100	16.80
Sugarbeets	2008	Minnesota	Kittson	33,000	32,700	25.0	817,000	16.10
Sugarbeets	2008	Minnesota	Mahnomen	2,700	1,700	22.2	37,800	17.00
Sugarbeets	2008	Minnesota	Marshall	41,500	41,200	24.8	1,020,300	17.80
Sugarbeets	2008	Minnesota	Norman	38,100	35,000	24.2	846,500	17.10
Sugarbeets	2008	Minnesota	Polk	89,000	88,200	26.5	2,335,000	17.50
Sugarbeets	2008	Minnesota	Red Lake	1,200	1,100	25.8	28,400	17.30
Sugarbeets	2008	Minnesota	D10 Combined Counties	400	300	26.3	6,500	17.30
Sugarbeets	2008	Minnesota	D10 Northwest	261,500	245,500	24.9	6,124,900	17.50
Sugarbeets	2008	Minnesota	Chippewa	30,000	29,800	23.0	684,200	17.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	California	Fresno	6,000	5,800	31.7	154,000	16.26
Sugarbeets	2008	California	Kings	1,100	1,000	36.0	36,000	16.66
Sugarbeets	2008	California	D51 Combined Counties	500	500	36.0	18,000	15.82
Sugarbeets	2008	California	D51 San Joaquin Valley	7,600	7,300	32.6	238,000	16.26
Sugarbeets	2008	California	Imperial	15,500	18,100	42.5	770,000	16.65
Sugarbeets	2008	California	D80 Southern California	15,500	15,100	42.5	770,000	16.65
Sugarbeets	**2008**	**California**	**State Total**	**26,100**	**25,400**	**39.7**	**1,008,000**	**16.56**
Sugarbeets	2008	Colorado	Boulder	500	500	22.6	11,300	16.78
Sugarbeets	2008	Colorado	Larimer	2,800	2,100	24.0	50,400	16.17
Sugarbeets	2008	Colorado	Logan	4,300	3,800	24.7	93,800	15.75
Sugarbeets	2008	Colorado	Morgan	1,600	1,500	24.6	36,900	14.86
Sugarbeets	2008	Colorado	Sedgwick	1,400	1,300	27.4	35,600	16.62
Sugarbeets	2008	Colorado	Weld	11,700	9,200	27.9	257,000	16.01
Sugarbeets	2008	Colorado	D20 Northeast	22,300	18,400	26.4	455,000	15.95
Sugarbeets	2008	Colorado	Phillips	4,200	3,400	24.9	84,600	16.69
Sugarbeets	2008	Colorado	Washington	1,500	1,300	27.2	35,300	16.00
Sugarbeets	2008	Colorado	Yuma	5,000	4,700	27.9	131,000	16.41
Sugarbeets	2008	Colorado	D60 Combined Counties	800	800	27.6	22,100	16.36
Sugarbeets	2008	Colorado	D60 East Central	11,500	10,200	26.8	273,000	16.44
Sugarbeets	**2008**	**Colorado**	**State Total**	**33,800**	**28,600**	**26.5**	**758,000**	**16.13**
Sugarbeets	2008	Idaho	Ada	1,600	1,500	36.0	54,000	15.78
Sugarbeets	2008	Idaho	Canyon	6,700	6,200	35.8	222,000	16.20
Sugarbeets	2008	Idaho	Elmore	5,800	5,300	31.6	167,500	15.84
Sugarbeets	2008	Idaho	Owyhee	2,700	2,600	35.6	92,500	16.08
Sugarbeets	2008	Idaho	Washington	1,200	1,100	34.3	37,700	16.98
Sugarbeets	2008	Idaho	D70 Combined Counties	1,000	800	32.9	26,300	16.21
Sugarbeets	2008	Idaho	D70 Southwest	19,000	17,500	34.3	600,000	16.09
Sugarbeets	2008	Idaho	Blaine	900	800	31.3	25,000	17.29
Sugarbeets	2008	Idaho	Cassia	25,400	20,100	29.9	600,000	17.79
Sugarbeets	2008	Idaho	Gooding	1,000	600	33.3	20,000	17.76
Sugarbeets	2008	Idaho	Jerome	11,000	9,700	32.6	316,000	17.69
Sugarbeets	2008	Idaho	Lincoln	3,700	3,100	29.0	90,000	16.32
Sugarbeets	2008	Idaho	Minidoka	30,100	29,100	29.4	856,000	17.93
Sugarbeets	2008	Idaho	Twin Falls	7,900	5,600	31.6	177,000	17.12
Sugarbeets	2008	Idaho	D80 South Central	80,000	68,000	30.2	2,054,000	17.79
Sugarbeets	2008	Idaho	Bingham	20,000	18,500	31.4	580,000	17.32
Sugarbeets	2008	Idaho	Power	12,000	11,000	32.3	355,000	17.18
Sugarbeets	2008	Idaho	D90 East	32,000	29,500	31.7	935,000	17.27
Sugarbeets	**2008**	**Idaho**	**State Total**	**131,000**	**116,000**	**31.2**	**3,619,000**	**17.37**
Sugarbeets	2008	Michigan	D30 Combined Counties	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	D30 Northeast	300	300	36.7	11,000	16.10
Sugarbeets	2008	Michigan	Gladwin	900	900	22.2	20,000	17.80
Sugarbeets	2008	Michigan	Gratiot	10,100	10,000	24.0	240,000	16.00
Sugarbeets	2008	Michigan	Isabella	700	700	24.3	17,000	17.70
Sugarbeets	2008	Michigan	Midland	3,000	3,000	26.3	79,000	16.00
Sugarbeets	2008	Michigan	Montcalm	400	400	27.5	11,000	17.50
Sugarbeets	2008	Michigan	D50 Central	15,100	15,000	24.5	367,000	16.00
Sugarbeets	2008	Michigan	Arenac	3,100	3,100	28.1	87,000	16.30
Sugarbeets	2008	Michigan	Bay	12,600	12,600	27.1	341,000	16.00
Sugarbeets	2008	Michigan	Huron	45,800	45,200	28.5	1,308,000	16.30
Sugarbeets	2008	Michigan	Saginaw	15,300	15,300	25.2	432,000	16.00
Sugarbeets	2008	Michigan	Sanilac	21,200	21,100	32.2	680,000	16.10
Sugarbeets	2008	Michigan	Tuscola	18,500	18,100	30.1	544,000	16.30
Sugarbeets	2008	Michigan	D60 East Central	116,500	116,000	29.2	3,390,000	16.20
Sugarbeets	2008	Michigan	Clinton	700	500	28.0	14,000	17.50
Sugarbeets	2008	Michigan	Ionia	500	300	30.0	9,000	17.50
Sugarbeets	2008	Michigan	Shiawassee	1,300	1,300	30.0	39,000	17.20
Sugarbeets	2008	Michigan	D80 South Central	2,500	2,100	29.5	62,000	17.30
Sugarbeets	2008	Michigan	Genesee	300	300	28.7	8,000	16.10
Sugarbeets	2008	Michigan	Lapeer	1,100	1,100	30.0	33,000	17.30
Sugarbeets	2008	Michigan	St. Clair	1,200	1,200	26.7	32,000	15.70
Sugarbeets	2008	Michigan	D90 Southeast	2,600	2,600	28.1	73,000	16.00
Sugarbeets	**2008**	**Michigan**	**State Total**	**137,000**	**136,000**	**28.7**	**3,903,000**	**16.10**
Sugarbeets	2008	Minnesota	Becker	5,600	7,300	21.4	156,000	17.10
Sugarbeets	2008	Minnesota	Clay	46,000	38,000	23.0	875,100	16.80
Sugarbeets	2008	Minnesota	Kittson	33,000	32,700	25.0	817,000	16.10
Sugarbeets	2008	Minnesota	Mahnomen	2,700	1,700	22.2	37,800	17.00
Sugarbeets	2008	Minnesota	Marshall	41,500	41,200	24.8	1,020,300	17.00
Sugarbeets	2008	Minnesota	Norman	39,100	36,000	24.2	846,500	17.10
Sugarbeets	2008	Minnesota	Polk	89,000	88,200	26.5	2,335,000	17.50
Sugarbeets	2008	Minnesota	Red Lake	1,200	1,100	25.8	28,400	17.30
Sugarbeets	2008	Minnesota	D10 Combined Counties	400	300	25.3	5,500	17.30
Sugarbeets	2008	Minnesota	D10 Northwest	261,500	245,500	24.9	6,124,900	17.50
Sugarbeets	2008	Minnesota	Chippewa	30,000	28,800	23.0	664,200	17.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	California	Fresno	6,000	5,800	31.7	154,000	16.20
Sugarbeets	2008	California	Kings	1,100	1,000	36.0	36,000	16.88
Sugarbeets	2008	California	D51 Combined Counties	500	500	36.0	18,000	15.82
Sugarbeets	2008	California	D51 San Joaquin Valley	7,600	7,300	32.6	238,000	16.26
Sugarbeets	2008	California	Imperial	18,500	18,100	42.5	770,000	16.65
Sugarbeets	2008	California	D80 Southern California	18,500	18,100	42.5	770,000	16.65
Sugarbeets	**2008**	**California**	**State Total**	**26,100**	**25,400**	**39.7**	**1,008,000**	**16.56**
Sugarbeets	2008	Colorado	Boulder	500	500	22.6	11,300	16.78
Sugarbeets	2008	Colorado	Larimer	2,800	2,100	24.0	50,400	16.17
Sugarbeets	2008	Colorado	Logan	4,300	3,800	24.7	93,800	15.75
Sugarbeets	2008	Colorado	Morgan	1,800	1,500	24.6	36,900	14.86
Sugarbeets	2008	Colorado	Sedgwick	1,400	1,300	27.4	35,600	16.62
Sugarbeets	2008	Colorado	Weld	11,700	9,200	27.9	257,000	16.01
Sugarbeets	2008	Colorado	D20 Northeast	22,300	18,400	26.4	455,000	15.95
Sugarbeets	2008	Colorado	Phillips	4,200	3,400	24.9	84,600	16.89
Sugarbeets	2008	Colorado	Washington	1,500	1,300	27.2	35,300	16.00
Sugarbeets	2008	Colorado	Yuma	5,000	4,700	27.9	131,000	16.41
Sugarbeets	2008	Colorado	D60 Combined Counties	800	800	27.6	22,100	16.38
Sugarbeets	2008	Colorado	D60 East Central	11,500	10,200	26.8	273,000	16.44
Sugarbeets	**2008**	**Colorado**	**State Total**	**33,800**	**28,600**	**26.5**	**758,000**	**16.13**
Sugarbeets	2008	Idaho	Ada	1,600	1,500	36.0	54,000	15.76
Sugarbeets	2008	Idaho	Canyon	6,700	6,200	35.8	222,000	16.20
Sugarbeets	2008	Idaho	Elmore	5,800	5,300	31.6	167,500	15.84
Sugarbeets	2008	Idaho	Owyhee	2,700	2,600	35.6	92,500	16.08
Sugarbeets	2008	Idaho	Washington	1,200	1,100	34.3	37,700	16.98
Sugarbeets	2008	Idaho	D70 Combined Counties	1,000	800	32.9	26,300	16.21
Sugarbeets	2008	Idaho	D70 Southwest	19,000	17,500	34.3	600,000	16.09
Sugarbeets	2008	Idaho	Blaine	900	800	31.3	25,000	17.29
Sugarbeets	2008	Idaho	Cassia	25,400	20,100	29.9	600,000	17.79
Sugarbeets	2008	Idaho	Gooding	1,000	600	33.3	20,000	17.76
Sugarbeets	2008	Idaho	Jerome	11,000	9,700	32.6	316,000	17.69
Sugarbeets	2008	Idaho	Lincoln	3,700	3,100	29.0	90,000	16.32
Sugarbeets	2008	Idaho	Minidoka	30,100	29,100	29.4	856,000	17.93
Sugarbeets	2008	Idaho	Twin Falls	7,900	5,600	31.6	177,000	17.12
Sugarbeets	2008	Idaho	D80 South Central	80,000	69,000	30.2	2,084,000	17.79
Sugarbeets	2008	Idaho	Bingham	20,000	18,500	31.4	580,000	17.32
Sugarbeets	2008	Idaho	Power	12,000	11,000	32.3	355,000	17.18
Sugarbeets	2008	Idaho	D90 East	32,000	29,500	31.7	935,000	17.27
Sugarbeets	**2008**	**Idaho**	**State Total**	**131,000**	**116,000**	**31.2**	**3,619,000**	**17.37**
Sugarbeets	2008	Michigan	D30 Combined Counties	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	D30 Northeast	300	300	36.7	11,000	16.10
Sugarbeets	2008	Michigan	Gladwin	900	900	22.2	20,000	17.80
Sugarbeets	2008	Michigan	Gratiot	10,100	10,000	24.0	240,000	19.00
Sugarbeets	2008	Michigan	Isabella	700	700	24.3	17,000	17.70
Sugarbeets	2008	Michigan	Midland	3,000	3,000	26.3	79,000	16.00
Sugarbeets	2008	Michigan	Montcalm	400	400	27.5	11,000	17.50
Sugarbeets	2008	Michigan	D50 Central	15,100	15,000	24.5	367,000	18.00
Sugarbeets	2008	Michigan	Arenac	3,100	3,100	28.1	87,000	16.30
Sugarbeets	2008	Michigan	Bay	12,800	12,600	27.1	341,000	19.00
Sugarbeets	2008	Michigan	Huron	45,800	45,200	28.5	1,308,000	16.30
Sugarbeets	2008	Michigan	Saginaw	15,300	15,300	28.2	432,000	19.00
Sugarbeets	2008	Michigan	Sanilac	21,200	21,100	32.2	680,000	19.10
Sugarbeets	2008	Michigan	Tuscola	18,500	18,100	30.1	544,000	16.30
Sugarbeets	2008	Michigan	D60 East Central	116,500	116,000	29.2	3,390,000	15.20
Sugarbeets	2008	Michigan	Clinton	700	500	28.0	14,000	17.50
Sugarbeets	2008	Michigan	Ionia	500	300	30.0	9,000	17.50
Sugarbeets	2008	Michigan	Shiawassee	1,300	1,300	30.0	39,000	17.20
Sugarbeets	2008	Michigan	D80 South Central	2,500	2,100	29.5	62,000	17.30
Sugarbeets	2008	Michigan	Genesee	300	300	26.7	8,000	19.10
Sugarbeets	2008	Michigan	Lapeer	1,100	1,100	30.0	33,000	17.30
Sugarbeets	2008	Michigan	St. Clair	1,200	1,200	26.7	32,000	16.70
Sugarbeets	2008	Michigan	D90 Southeast	2,600	2,600	28.1	73,000	15.00
Sugarbeets	**2008**	**Michigan**	**State Total**	**137,000**	**136,000**	**28.7**	**3,903,000**	**18.10**
Sugarbeets	2008	Minnesota	Becker	5,600	7,300	21.4	156,000	17.10
Sugarbeets	2008	Minnesota	Clay	46,000	38,000	23.0	875,100	16.80
Sugarbeets	2008	Minnesota	Kittson	33,000	32,700	25.0	817,000	16.10
Sugarbeets	2008	Minnesota	Mahnomen	2,700	1,700	22.2	37,800	17.00
Sugarbeets	2008	Minnesota	Marshall	41,500	41,200	24.8	1,020,300	17.90
Sugarbeets	2008	Minnesota	Norman	39,100	35,000	24.2	848,600	17.10
Sugarbeets	2008	Minnesota	Polk	89,000	88,200	26.5	2,335,000	17.50
Sugarbeets	2008	Minnesota	Red Lake	1,200	1,100	25.8	28,400	17.30
Sugarbeets	2008	Minnesota	D10 Combined Counties	400	300	25.3	8,500	17.30
Sugarbeets	2008	Minnesota	D10 Northwest	261,500	245,500	24.9	6,124,900	17.50
Sugarbeets	2008	Minnesota	Chippewa	30,000	29,800	23.0	654,200	17.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	California	Fresno	6,000	5,800	31.7	184,000	16.26
Sugarbeets	2008	California	Kings	1,100	1,000	36.0	36,000	16.66
Sugarbeets	2008	California	D51 Combined Counties	500	500	36.0	18,000	15.62
Sugarbeets	2008	California	D51 San Joaquin Valley	7,600	7,300	32.6	238,000	16.26
Sugarbeets	2008	California	Imperial	15,500	18,100	42.5	778,000	16.65
Sugarbeets	2008	California	D80 Southern California	15,500	16,100	42.5	770,000	16.65
Sugarbeets	**2008**	**California**	**State Total**	**26,100**	**25,400**	**39.7**	**1,008,000**	**16.56**
Sugarbeets	2008	Colorado	Boulder	500	500	22.6	11,300	16.78
Sugarbeets	2008	Colorado	Larimer	2,800	2,100	24.0	50,400	16.17
Sugarbeets	2008	Colorado	Logan	4,300	3,800	24.7	93,800	15.75
Sugarbeets	2008	Colorado	Morgan	1,600	1,500	24.6	36,900	14.86
Sugarbeets	2008	Colorado	Sedgwick	1,400	1,300	27.4	35,600	16.62
Sugarbeets	2008	Colorado	Weld	11,700	9,200	27.9	257,000	16.01
Sugarbeets	2008	Colorado	D20 Northeast	22,300	18,400	26.4	485,000	15.95
Sugarbeets	2008	Colorado	Phillips	4,200	3,400	24.9	84,600	16.89
Sugarbeets	2008	Colorado	Washington	1,500	1,300	27.2	35,300	16.00
Sugarbeets	2008	Colorado	Yuma	5,000	4,700	27.9	131,000	16.41
Sugarbeets	2008	Colorado	D80 Combined Counties	800	800	27.6	22,100	16.38
Sugarbeets	2008	Colorado	D80 East Central	11,500	10,200	26.8	273,000	16.44
Sugarbeets	**2008**	**Colorado**	**State Total**	**33,800**	**28,600**	**26.5**	**758,000**	**16.13**
Sugarbeets	2008	Idaho	Ada	1,600	1,500	36.0	54,000	15.78
Sugarbeets	2008	Idaho	Canyon	6,700	6,300	35.2	222,000	16.20
Sugarbeets	2008	Idaho	Elmore	5,800	5,300	31.6	167,500	15.84
Sugarbeets	2008	Idaho	Owyhee	2,700	2,600	35.6	92,500	16.08
Sugarbeets	2008	Idaho	Washington	1,200	1,100	34.3	37,700	16.86
Sugarbeets	2008	Idaho	D70 Combined Counties	1,000	800	32.9	26,300	16.21
Sugarbeets	2008	Idaho	D70 Southwest	19,000	17,500	34.3	600,000	16.09
Sugarbeets	2008	Idaho	Blaine	800	800	31.3	25,000	17.29
Sugarbeets	2008	Idaho	Cassia	25,400	20,100	29.9	600,000	17.79
Sugarbeets	2008	Idaho	Gooding	1,000	600	33.3	20,000	17.76
Sugarbeets	2008	Idaho	Jerome	11,000	9,700	32.6	316,000	17.69
Sugarbeets	2008	Idaho	Lincoln	3,700	3,100	29.0	90,000	15.32
Sugarbeets	2008	Idaho	Minidoka	30,100	29,100	29.4	856,000	17.93
Sugarbeets	2008	Idaho	Twin Falls	7,900	5,600	31.6	177,000	17.12
Sugarbeets	2008	Idaho	D80 South Central	80,000	68,000	30.2	2,054,000	17.79
Sugarbeets	2008	Idaho	Bingham	20,000	18,500	31.4	580,000	17.32
Sugarbeets	2008	Idaho	Power	12,000	11,000	32.3	355,000	17.18
Sugarbeets	2008	Idaho	D90 East	32,000	29,500	31.7	935,000	17.27
Sugarbeets	**2008**	**Idaho**	**State Total**	**131,000**	**116,000**	**31.2**	**3,619,000**	**17.37**
Sugarbeets	2008	Michigan	D30 Combined Counties	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	D30 Northeast	300	300	36.7	11,000	15.10
Sugarbeets	2008	Michigan	Gladwin	900	900	22.2	20,000	17.80
Sugarbeets	2008	Michigan	Gratiot	10,100	10,000	24.0	240,000	15.00
Sugarbeets	2008	Michigan	Isabella	700	700	24.3	17,000	17.70
Sugarbeets	2008	Michigan	Midland	3,000	3,000	26.3	79,000	15.00
Sugarbeets	2008	Michigan	Montcalm	400	400	27.5	11,000	17.50
Sugarbeets	2008	Michigan	D50 Central	15,100	15,000	24.5	367,000	15.00
Sugarbeets	2008	Michigan	Arenac	3,100	3,100	28.1	57,000	15.30
Sugarbeets	2008	Michigan	Bay	12,600	12,600	27.1	341,000	15.00
Sugarbeets	2008	Michigan	Huron	45,800	45,800	28.5	1,308,000	19.30
Sugarbeets	2008	Michigan	Saginaw	15,300	15,300	25.2	432,000	16.00
Sugarbeets	2008	Michigan	Sanilac	21,200	21,100	32.2	680,000	15.10
Sugarbeets	2008	Michigan	Tuscola	16,500	18,100	30.1	544,000	16.30
Sugarbeets	2008	Michigan	D60 East Central	116,500	116,000	29.2	3,390,000	15.20
Sugarbeets	2008	Michigan	Clinton	700	500	28.0	14,000	17.50
Sugarbeets	2008	Michigan	Ionia	500	300	30.0	9,000	17.50
Sugarbeets	2008	Michigan	Shiawassee	1,300	1,300	30.0	39,000	17.20
Sugarbeets	2008	Michigan	D80 South Central	2,500	2,100	29.5	62,000	17.30
Sugarbeets	2008	Michigan	Genesee	300	300	26.7	8,000	15.10
Sugarbeets	2008	Michigan	Lapeer	1,100	1,100	30.0	33,000	17.30
Sugarbeets	2008	Michigan	St. Clair	1,200	1,200	26.7	32,000	15.70
Sugarbeets	2008	Michigan	D90 Southeast	2,600	2,600	28.1	73,000	15.00
Sugarbeets	**2008**	**Michigan**	**State Total**	**137,000**	**136,000**	**28.7**	**3,903,000**	**18.10**
Sugarbeets	2008	Minnesota	Becker	5,600	7,300	21.4	156,000	17.10
Sugarbeets	2008	Minnesota	Clay	46,000	38,000	23.0	875,100	16.80
Sugarbeets	2008	Minnesota	Kittson	33,000	32,700	25.0	817,000	16.10
Sugarbeets	2008	Minnesota	Mahnomen	2,700	1,700	22.2	37,800	17.00
Sugarbeets	2008	Minnesota	Marshall	41,500	41,200	24.8	1,020,300	17.80
Sugarbeets	2008	Minnesota	Norman	38,100	35,000	24.2	846,500	17.10
Sugarbeets	2008	Minnesota	Polk	89,000	88,200	26.5	2,335,000	17.50
Sugarbeets	2008	Minnesota	Red Lake	1,200	1,100	25.8	28,400	17.30
Sugarbeets	2008	Minnesota	D10 Combined Counties	400	300	25.3	8,500	17.30
Sugarbeets	2008	Minnesota	D10 Northwest	261,500	245,500	24.9	6,124,900	17.50
Sugarbeets	2008	Minnesota	Chippewa	30,000	29,800	23.0	684,200	17.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Minnesota	Grant	9,400	9,300	22.1	205,500	16.70
Sugarbeets	2008	Minnesota	Otter Tail	3,400	3,100	23.7	73,500	16.40
Sugarbeets	2008	Minnesota	Pope	1,600	1,500	21.9	32,900	17.50
Sugarbeets	2008	Minnesota	Stevens	4,400	4,300	25.0	107,300	17.20
Sugarbeets	2008	Minnesota	Swift	6,400	6,200	25.8	160,100	17.40
Sugarbeets	2008	Minnesota	Traverse	6,600	6,200	22.3	152,500	17.00
Sugarbeets	2008	Minnesota	Wilkin	45,100	25,700	25.4	653,000	16.30
Sugarbeets	2008	Minnesota	Yellow Medicine	3,200	3,100	21.5	66,600	17.00
Sugarbeets	2008	Minnesota	D40 Combined Counties	900	800	20.9	16,700	17.16
Sugarbeets	2008	Minnesota	D40 West Central	116,000	92,000	23.7	2,182,300	16.80
Sugarbeets	2008	Minnesota	Kandiyohi	14,500	14,400	26.2	376,500	17.20
Sugarbeets	2008	Minnesota	McLeod	1,500	1,400	24.4	34,100	16.70
Sugarbeets	2008	Minnesota	Renville	32,700	32,500	25.2	520,300	17.00
Sugarbeets	2008	Minnesota	Sibley	3,200	3,200	24.9	79,700	16.60
Sugarbeets	2008	Minnesota	Stearns	2,100	2,000	22.4	44,700	17.30
Sugarbeets	2008	Minnesota	D50 Combined Counties	3,500	3,400	26.6	92,500	17.00
Sugarbeets	2008	Minnesota	D50 Central	57,500	56,900	25.4	1,445,900	17.00
Sugarbeets	2008	Minnesota	Lyon	400	400	15.3	6,100	17.80
Sugarbeets	2008	Minnesota	Redwood	3,500	3,400	22.6	76,800	16.70
Sugarbeets	2008	Minnesota	D70 Combined Counties	300	200	15.5	3,700	17.20
Sugarbeets	2008	Minnesota	D70 Southwest	4,200	4,000	21.7	86,600	16.80
Sugarbeets	2008	Minnesota	D98 Combined Districts	800	600	25.5	15,300	16.56
Sugarbeets	**2008**	**Minnesota**	**State Total**	**440,000**	**399,000**	**24.7**	**9,855,000**	**17.25**
Sugarbeets	2008	Montana	D30 Combined Counties	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	D30 Northeast	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	Big Horn	9,100	8,800	28.8	253,000	16.91
Sugarbeets	2008	Montana	Carbon	3,500	3,500	24.0	83,900	16.84
Sugarbeets	2008	Montana	Yellowstone	6,700	6,000	25.9	155,200	16.98
Sugarbeets	2008	Montana	D80 Combined Counties	3,500	3,500	25.8	100,700	17.18
Sugarbeets	2008	Montana	D80 South Central	22,800	21,800	27.2	592,800	16.96
Sugarbeets	2008	Montana	Rosebud	2,000	2,000	29.2	58,300	17.36
Sugarbeets	2008	Montana	D90 Southeast	2,000	2,000	29.2	58,300	17.36
Sugarbeets	**2008**	**Montana**	**State Total**	**31,700**	**30,700**	**26.8**	**823,000**	**17.27**
Sugarbeets	2008	Nebraska	Banner	700	400	20.8	8,300	17.17
Sugarbeets	2008	Nebraska	Box Butte	18,800	17,300	22.5	389,600	17.19
Sugarbeets	2008	Nebraska	Cheyenne	1,900	1,100	24.8	27,300	17.22
Sugarbeets	2008	Nebraska	Kimball	2,800	2,600	21.3	55,400	17.36
Sugarbeets	2008	Nebraska	Morrill	5,800	4,100	22.7	93,100	16.34
Sugarbeets	2008	Nebraska	Scotts Bluff	7,600	5,700	23.1	131,900	16.31
Sugarbeets	2008	Nebraska	Sheridan	2,500	2,400	22.1	53,100	16.85
Sugarbeets	2008	Nebraska	D10 Combined Counties	700	700	21.6	15,100	17.05
Sugarbeets	2008	Nebraska	D10 Northwest	41,100	34,300	22.5	772,800	16.94
Sugarbeets	2008	Nebraska	Chase	700	600	17.5	10,500	16.04
Sugarbeets	2008	Nebraska	Keith	2,600	1,800	25.0	45,000	17.32
Sugarbeets	2008	Nebraska	Perkins	800	600	24.5	14,700	17.03
Sugarbeets	2008	Nebraska	D70 Southwest	4,100	3,000	23.4	70,200	17.01
Sugarbeets	**2008**	**Nebraska**	**State Total**	**45,200**	**37,300**	**22.6**	**843,000**	**16.94**
Sugarbeets	2008	North Dakota	Williams	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	D10 Northwest	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	Grand Forks	27,200	27,000	26.7	720,000	17.65
Sugarbeets	2008	North Dakota	Pembina	59,000	58,300	25.6	1,492,000	17.78
Sugarbeets	2008	North Dakota	Walsh	40,800	40,400	26.1	1,056,000	18.07
Sugarbeets	2008	North Dakota	D30 Northeast	127,000	125,700	26.0	3,268,000	17.85
Sugarbeets	2008	North Dakota	McKenzie	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	D40 West Central	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	Cass	17,800	16,500	25.3	418,000	17.08
Sugarbeets	2008	North Dakota	Steele	400	400	30.0	12,000	16.72
Sugarbeets	2008	North Dakota	Traill	25,200	24,900	26.1	651,000	17.48
Sugarbeets	2008	North Dakota	D60 East Central	43,500	41,800	25.9	1,081,000	17.32
Sugarbeets	2008	North Dakota	Richland	26,800	21,400	25.9	554,000	16.37
Sugarbeets	2008	North Dakota	D90 Combined Counties	400	400	30.0	12,000	16.40
Sugarbeets	2008	North Dakota	D90 Southeast	29,200	21,800	26.0	566,000	16.37
Sugarbeets	**2008**	**North Dakota**	**State Total**	**208,000**	**197,000**	**25.9**	**5,102,000**	**17.58**
Sugarbeets	2008	Oregon	Union	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	D30 Northeast	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	Malheur	5,200	4,500	34.7	156,000	16.09
Sugarbeets	2008	Oregon	D80 Southeast	5,200	4,500	34.7	156,000	16.09
Sugarbeets	**2008**	**Oregon**	**State Total**	**6,700**	**5,900**	**33.1**	**195,000**	**16.34**
Sugarbeets	2008	Washington	Benton	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	D20 Central	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	State Total	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Wyoming	Big Horn	8,300	8,100	23.4	189,300	17.46
Sugarbeets	2008	Wyoming	Fremont	1,500	1,500	20.1	30,200	15.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Minnesota	Grant	9,400	9,300	22.1	205,500	16.70
Sugarbeets	2008	Minnesota	Otter Tail	3,400	3,100	23.7	73,500	16.40
Sugarbeets	2008	Minnesota	Pope	1,600	1,500	21.9	32,900	17.50
Sugarbeets	2008	Minnesota	Stevens	4,400	4,300	25.0	107,300	17.20
Sugarbeets	2008	Minnesota	Swift	6,400	6,200	25.8	160,100	17.40
Sugarbeets	2008	Minnesota	Traverse	6,800	6,800	22.3	152,500	17.00
Sugarbeets	2008	Minnesota	Wilkin	45,100	25,700	25.4	653,000	16.30
Sugarbeets	2008	Minnesota	Yellow Medicine	3,200	3,100	21.5	66,600	17.00
Sugarbeets	2008	Minnesota	D40 Combined Counties	800	800	20.9	16,700	17.16
Sugarbeets	2008	Minnesota	D40 West Central	116,000	92,000	23.7	2,182,300	16.80
Sugarbeets	2008	Minnesota	Kandiyohi	14,500	14,400	26.2	376,600	17.20
Sugarbeets	2008	Minnesota	McLeod	1,500	1,400	24.4	34,100	16.70
Sugarbeets	2008	Minnesota	Renville	32,700	32,500	25.2	820,300	17.00
Sugarbeets	2008	Minnesota	Sibley	3,200	3,200	24.9	79,700	16.60
Sugarbeets	2008	Minnesota	Stearns	2,100	2,000	22.4	44,700	17.30
Sugarbeets	2008	Minnesota	D50 Combined Counties	3,500	3,400	26.6	90,500	17.00
Sugarbeets	2008	Minnesota	D50 Central	57,500	56,900	25.4	1,445,900	17.00
Sugarbeets	2008	Minnesota	Lyon	400	400	15.3	6,100	17.60
Sugarbeets	2008	Minnesota	Redwood	3,600	3,400	22.6	76,800	16.70
Sugarbeets	2008	Minnesota	D70 Combined Counties	300	200	16.5	3,700	17.20
Sugarbeets	2008	Minnesota	D70 Southwest	4,200	4,000	21.7	86,800	16.80
Sugarbeets	2008	Minnesota	D98 Combined Districts	600	600	25.5	15,300	16.56
Sugarbeets	**2008**	**Minnesota**	**State Total**	**440,000**	**399,000**	**24.7**	**9,855,000**	**17.25**
Sugarbeets	2008	Montana	D30 Combined Counties	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	D30 Northeast	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	Big Horn	9,100	8,800	28.8	253,000	16.91
Sugarbeets	2008	Montana	Carbon	3,500	3,500	24.0	83,900	16.84
Sugarbeets	2008	Montana	Yellowstone	6,700	6,000	25.9	155,200	16.96
Sugarbeets	2008	Montana	D80 Combined Counties	3,500	3,500	29.6	103,700	17.16
Sugarbeets	2008	Montana	D80 South Central	22,800	21,800	27.2	592,600	16.96
Sugarbeets	2008	Montana	Rosebud	2,000	2,000	29.2	58,300	17.36
Sugarbeets	2008	Montana	D90 Southeast	2,000	2,000	29.2	58,300	17.36
Sugarbeets	**2008**	**Montana**	**State Total**	**31,700**	**30,700**	**26.8**	**823,000**	**17.27**
Sugarbeets	2008	Nebraska	Banner	700	400	20.8	8,300	17.17
Sugarbeets	2008	Nebraska	Box Butte	15,800	15,900	22.5	358,600	17.10
Sugarbeets	2008	Nebraska	Cheyenne	1,900	1,100	24.8	27,300	17.22
Sugarbeets	2008	Nebraska	Kimball	2,800	2,600	21.3	55,400	17.36
Sugarbeets	2008	Nebraska	Morrill	5,800	4,100	22.7	93,100	16.34
Sugarbeets	2008	Nebraska	Scotts Bluff	7,800	5,700	23.1	131,900	16.31
Sugarbeets	2008	Nebraska	Sheridan	2,500	2,400	22.1	53,100	16.85
Sugarbeets	2008	Nebraska	D10 Combined Counties	700	700	21.6	15,100	17.05
Sugarbeets	2008	Nebraska	D10 Northwest	41,100	34,300	22.5	772,600	16.94
Sugarbeets	2008	Nebraska	Chase	700	600	17.5	10,500	16.04
Sugarbeets	2008	Nebraska	Keith	2,600	1,800	25.0	45,000	17.32
Sugarbeets	2008	Nebraska	Perkins	800	600	24.5	14,700	17.03
Sugarbeets	2008	Nebraska	D70 Southwest	4,100	3,000	23.4	70,200	17.01
Sugarbeets	**2008**	**Nebraska**	**State Total**	**45,200**	**37,300**	**22.6**	**843,000**	**16.94**
Sugarbeets	2008	North Dakota	Williams	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	D10 Northwest	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	Grand Forks	27,200	27,000	26.7	720,000	17.65
Sugarbeets	2008	North Dakota	Pembina	59,000	58,300	25.6	1,492,000	17.78
Sugarbeets	2008	North Dakota	Walsh	40,800	40,400	26.1	1,056,000	16.07
Sugarbeets	2008	North Dakota	D30 Northeast	127,000	125,700	26.0	3,268,000	17.85
Sugarbeets	2008	North Dakota	McKenzie	6,200	5,800	24.8	144,000	16.18
Sugarbeets	2008	North Dakota	D40 West Central	6,200	5,800	24.8	144,000	16.18
Sugarbeets	2008	North Dakota	Cass	17,800	16,500	25.3	418,000	17.08
Sugarbeets	2008	North Dakota	Steele	400	400	30.0	12,000	16.72
Sugarbeets	2008	North Dakota	Traill	25,200	24,900	26.1	651,000	17.46
Sugarbeets	2008	North Dakota	D60 East Central	43,600	41,800	25.9	1,081,000	17.32
Sugarbeets	2008	North Dakota	Richland	25,800	21,400	25.9	554,000	16.37
Sugarbeets	2008	North Dakota	D90 Combined Counties	400	400	30.0	12,000	16.40
Sugarbeets	2008	North Dakota	D90 Southeast	29,200	21,800	26.0	566,000	16.37
Sugarbeets	**2008**	**North Dakota**	**State Total**	**208,000**	**197,000**	**25.9**	**5,102,000**	**17.58**
Sugarbeets	2008	Oregon	Union	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	D30 Northeast	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	Malheur	5,200	4,500	34.7	156,000	16.09
Sugarbeets	2008	Oregon	D80 Southeast	5,200	4,500	34.7	156,000	16.09
Sugarbeets	**2008**	**Oregon**	**State Total**	**6,700**	**5,900**	**33.1**	**195,000**	**16.34**
Sugarbeets	2008	Washington	Benton	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	D20 Central	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	State Total	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Wyoming	Big Horn	6,300	6,100	23.4	142,300	17.46
Sugarbeets	2008	Wyoming	Fremont	1,500	1,500	20.1	30,200	16.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Minnesota	Grant	9,400	9,300	22.1	205,500	16.70
Sugarbeets	2008	Minnesota	Otter Tail	3,400	3,100	23.7	73,500	16.40
Sugarbeets	2008	Minnesota	Pope	1,600	1,500	21.9	32,900	17.50
Sugarbeets	2008	Minnesota	Stevens	4,400	4,300	25.0	107,300	17.20
Sugarbeets	2008	Minnesota	Swift	6,400	6,200	25.8	160,100	17.40
Sugarbeets	2008	Minnesota	Traverse	6,600	6,200	22.3	152,500	17.00
Sugarbeets	2008	Minnesota	Wilkin	46,100	25,700	25.4	653,000	16.30
Sugarbeets	2008	Minnesota	Yellow Medicine	3,200	3,100	21.5	66,600	17.00
Sugarbeets	2008	Minnesota	D40 Combined Counties	800	800	20.9	16,700	17.18
Sugarbeets	2008	Minnesota	D40 West Central	116,000	92,000	23.7	2,182,300	16.60
Sugarbeets	2008	Minnesota	Kandiyohi	14,500	14,400	26.2	376,600	17.20
Sugarbeets	2008	Minnesota	McLeod	1,500	1,400	24.4	34,100	16.70
Sugarbeets	2008	Minnesota	Renville	32,700	32,500	25.2	820,300	17.00
Sugarbeets	2008	Minnesota	Sibley	3,200	3,200	24.9	79,700	16.60
Sugarbeets	2008	Minnesota	Stearns	2,100	2,000	22.4	44,700	17.30
Sugarbeets	2008	Minnesota	D50 Combined Counties	3,500	3,400	26.6	90,500	17.00
Sugarbeets	2008	Minnesota	D50 Central	57,500	56,900	25.4	1,445,900	17.00
Sugarbeets	2008	Minnesota	Lyon	400	400	15.3	6,100	17.60
Sugarbeets	2008	Minnesota	Redwood	3,500	3,400	22.6	76,800	16.70
Sugarbeets	2008	Minnesota	D70 Combined Counties	300	200	15.5	3,700	17.20
Sugarbeets	2008	Minnesota	D70 Southwest	4,200	4,000	21.7	86,600	16.80
Sugarbeets	2008	Minnesota	D98 Combined Districts	800	600	25.5	15,300	16.56
Sugarbeets	**2008**	**Minnesota**	**State Total**	**440,000**	**399,000**	**24.7**	**9,855,000**	**17.25**
Sugarbeets	2008	Montana	D30 Combined Counties	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	D30 Northeast	6,900	6,900	24.9	171,900	16.32
Sugarbeets	2008	Montana	Big Horn	9,100	8,800	28.8	253,000	16.91
Sugarbeets	2008	Montana	Carbon	3,500	3,500	24.0	83,900	16.84
Sugarbeets	2008	Montana	Yellowstone	6,700	6,000	25.9	155,200	16.98
Sugarbeets	2008	Montana	D80 Combined Counties	3,500	3,500	28.8	100,700	17.18
Sugarbeets	2008	Montana	D80 South Central	22,800	21,800	27.2	592,800	16.96
Sugarbeets	2008	Montana	Rosebud	2,000	2,000	29.2	58,300	17.36
Sugarbeets	2008	Montana	D90 Southeast	2,000	2,000	29.2	58,300	17.36
Sugarbeets	**2008**	**Montana**	**State Total**	**31,700**	**30,700**	**26.8**	**823,000**	**17.27**
Sugarbeets	2008	Nebraska	Banner	700	400	20.8	8,300	17.17
Sugarbeets	2008	Nebraska	Box Butte	18,900	17,300	22.5	388,600	17.19
Sugarbeets	2008	Nebraska	Cheyenne	1,800	1,100	24.8	27,300	17.22
Sugarbeets	2008	Nebraska	Kimball	2,800	2,600	21.3	55,400	17.36
Sugarbeets	2008	Nebraska	Morrill	5,800	4,100	22.7	93,100	16.34
Sugarbeets	2008	Nebraska	Scotts Bluff	7,800	5,700	23.1	131,800	16.31
Sugarbeets	2008	Nebraska	Sheridan	2,600	2,400	22.1	53,100	16.65
Sugarbeets	2008	Nebraska	D10 Combined Counties	700	700	21.6	15,100	17.05
Sugarbeets	2008	Nebraska	D10 Northwest	41,100	34,300	22.5	772,800	16.94
Sugarbeets	2008	Nebraska	Chase	700	600	17.5	10,500	16.04
Sugarbeets	2008	Nebraska	Keith	2,600	1,800	25.0	45,000	17.32
Sugarbeets	2008	Nebraska	Perkins	800	600	24.5	14,700	17.03
Sugarbeets	2008	Nebraska	D70 Southwest	4,100	3,000	23.4	70,200	17.01
Sugarbeets	**2008**	**Nebraska**	**State Total**	**45,200**	**37,300**	**22.6**	**843,000**	**16.94**
Sugarbeets	2008	North Dakota	Williams	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	D10 Northwest	2,100	1,900	22.6	43,000	17.50
Sugarbeets	2008	North Dakota	Grand Forks	27,200	27,000	26.7	720,000	17.65
Sugarbeets	2008	North Dakota	Pembina	59,000	58,300	25.6	1,492,000	17.76
Sugarbeets	2008	North Dakota	Walsh	40,800	40,400	26.1	1,055,000	16.07
Sugarbeets	2008	North Dakota	D30 Northeast	127,000	125,700	26.0	3,268,000	17.86
Sugarbeets	2008	North Dakota	McKenzie	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	D40 West Central	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	Cass	17,900	16,500	25.3	418,000	17.08
Sugarbeets	2008	North Dakota	Steele	400	400	30.0	12,000	16.72
Sugarbeets	2008	North Dakota	Traill	25,200	24,900	26.1	651,000	17.48
Sugarbeets	2008	North Dakota	D60 East Central	43,500	41,800	25.9	1,081,000	17.32
Sugarbeets	2008	North Dakota	Richland	25,800	21,400	25.9	554,000	16.37
Sugarbeets	2008	North Dakota	D90 Combined Counties	400	400	30.0	12,000	16.40
Sugarbeets	2008	North Dakota	D90 Southeast	29,200	21,800	26.0	566,000	16.37
Sugarbeets	**2008**	**North Dakota**	**State Total**	**208,000**	**197,000**	**25.9**	**5,102,000**	**17.58**
Sugarbeets	2008	Oregon	Union	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	D30 Northeast	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	Malheur	5,200	4,500	34.7	156,000	16.09
Sugarbeets	2008	Oregon	D80 Southeast	5,200	4,500	34.7	156,000	16.09
Sugarbeets	**2008**	**Oregon**	**State Total**	**6,700**	**5,900**	**33.1**	**195,000**	**16.34**
Sugarbeets	2008	Washington	Benton	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	D20 Central	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	State Total	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Wyoming	Big Horn	6,300	6,100	23.4	159,300	17.46
Sugarbeets	2008	Wyoming	Fremont	1,500	1,500	20.1	30,200	16.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Minnesota	Grant	9,400	9,300	22.1	205,500	16.70
Sugarbeets	2008	Minnesota	Otter Tail	3,400	3,100	23.7	73,500	16.40
Sugarbeets	2008	Minnesota	Pope	1,600	1,500	21.9	32,900	17.60
Sugarbeets	2008	Minnesota	Stevens	4,400	4,300	25.0	107,300	17.20
Sugarbeets	2008	Minnesota	Swift	6,400	6,200	25.8	160,100	17.40
Sugarbeets	2008	Minnesota	Traverse	6,600	6,200	22.3	152,500	17.00
Sugarbeets	2008	Minnesota	Wilkin	45,100	25,700	25.4	653,000	16.30
Sugarbeets	2008	Minnesota	Yellow Medicine	3,200	3,100	21.5	66,600	17.00
Sugarbeets	2008	Minnesota	D40 Combined Counties	900	800	20.9	16,700	17.18
Sugarbeets	2008	Minnesota	D40 West Central	116,000	92,000	23.7	2,182,300	16.80
Sugarbeets	2008	Minnesota	Kandiyohi	14,500	14,400	26.2	376,600	17.20
Sugarbeets	2008	Minnesota	McLeod	1,500	1,400	24.4	34,100	16.70
Sugarbeets	2008	Minnesota	Renville	32,700	32,500	25.2	820,300	17.00
Sugarbeets	2008	Minnesota	Sibley	3,200	3,200	24.9	79,700	16.60
Sugarbeets	2008	Minnesota	Stearns	2,100	2,000	22.4	44,700	17.30
Sugarbeets	2008	Minnesota	D50 Combined Counties	3,500	3,400	26.6	90,500	17.00
Sugarbeets	2008	Minnesota	D50 Central	57,500	56,900	25.4	1,445,900	17.00
Sugarbeets	2008	Minnesota	Lyon	400	400	15.3	6,100	17.60
Sugarbeets	2008	Minnesota	Redwood	3,600	3,400	22.6	76,800	16.70
Sugarbeets	2008	Minnesota	D70 Combined Counties	300	200	16.5	3,700	17.20
Sugarbeets	2008	Minnesota	D70 Southwest	4,200	4,000	21.7	85,600	16.80
Sugarbeets	2008	Minnesota	D98 Combined Districts	800	600	25.5	15,300	16.56
Sugarbeets	**2008**	**Minnesota**	**State Total**	**440,000**	**399,000**	**24.7**	**9,855,000**	**17.25**
Sugarbeets	2008	Montana	D30 Combined Counties	6,900	6,900	24.9	171,900	15.32
Sugarbeets	2008	Montana	D30 Northeast	6,900	6,900	24.9	171,900	15.32
Sugarbeets	2008	Montana	Big Horn	9,100	8,200	28.2	253,000	16.81
Sugarbeets	2008	Montana	Carbon	3,500	3,500	24.0	83,900	16.84
Sugarbeets	2008	Montana	Yellowstone	6,700	6,000	25.9	155,200	16.98
Sugarbeets	2008	Montana	D80 Combined Counties	3,500	3,500	25.8	100,700	17.18
Sugarbeets	2008	Montana	D80 South Central	22,800	21,200	27.2	592,800	16.96
Sugarbeets	2008	Montana	Rosebud	2,000	2,000	29.2	58,300	17.36
Sugarbeets	2008	Montana	D90 Southeast	2,000	2,000	29.2	58,300	17.36
Sugarbeets	**2008**	**Montana**	**State Total**	**31,700**	**30,700**	**26.8**	**823,000**	**17.27**
Sugarbeets	2008	Nebraska	Banner	700	400	20.8	8,300	17.17
Sugarbeets	2008	Nebraska	Box Butte	16,900	17,300	22.5	358,600	17.19
Sugarbeets	2008	Nebraska	Cheyenne	1,900	1,100	24.8	27,300	17.22
Sugarbeets	2008	Nebraska	Kimball	2,800	2,600	21.3	55,400	17.38
Sugarbeets	2008	Nebraska	Morrill	5,600	4,100	22.7	93,100	16.34
Sugarbeets	2008	Nebraska	Scotts Bluff	7,800	5,700	23.1	131,800	16.31
Sugarbeets	2008	Nebraska	Sheridan	2,600	2,400	22.1	53,100	16.85
Sugarbeets	2008	Nebraska	D10 Combined Counties	700	700	21.6	15,100	17.05
Sugarbeets	2008	Nebraska	D10 Northwest	41,100	34,300	22.5	772,500	16.94
Sugarbeets	2008	Nebraska	Chase	700	600	17.5	10,500	16.04
Sugarbeets	2008	Nebraska	Keith	2,600	1,800	25.0	45,000	17.32
Sugarbeets	2008	Nebraska	Perkins	800	600	24.5	14,700	17.03
Sugarbeets	2008	Nebraska	D70 Southwest	4,100	3,000	23.4	70,200	17.01
Sugarbeets	**2008**	**Nebraska**	**State Total**	**45,200**	**37,300**	**22.6**	**843,000**	**16.94**
Sugarbeets	2008	North Dakota	Williams	2,100	1,900	22.6	43,000	17.60
Sugarbeets	2008	North Dakota	D10 Northwest	2,100	1,900	22.6	43,000	17.60
Sugarbeets	2008	North Dakota	Grand Forks	27,200	27,000	26.7	720,000	17.65
Sugarbeets	2008	North Dakota	Pembina	59,000	58,300	25.6	1,492,000	17.78
Sugarbeets	2008	North Dakota	Walsh	40,800	40,400	26.1	1,056,000	18.07
Sugarbeets	2008	North Dakota	D30 Northeast	127,000	125,700	26.0	3,268,000	17.85
Sugarbeets	2008	North Dakota	McKenzie	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	D40 West Central	6,200	5,800	24.8	144,000	15.18
Sugarbeets	2008	North Dakota	Cass	17,800	16,500	25.3	418,000	17.08
Sugarbeets	2008	North Dakota	Steele	400	400	30.0	12,000	16.72
Sugarbeets	2008	North Dakota	Traill	25,200	24,900	26.1	651,000	17.48
Sugarbeets	2008	North Dakota	D60 East Central	43,600	41,800	25.9	1,081,000	17.32
Sugarbeets	2008	North Dakota	Richland	28,800	21,400	25.9	554,000	16.37
Sugarbeets	2008	North Dakota	D90 Combined Counties	400	400	30.0	12,000	16.40
Sugarbeets	2008	North Dakota	D90 Southeast	29,200	21,800	26.0	566,000	16.37
Sugarbeets	**2008**	**North Dakota**	**State Total**	**208,000**	**197,000**	**25.9**	**5,102,000**	**17.58**
Sugarbeets	2008	Oregon	Union	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	D30 Northeast	1,500	1,400	27.9	39,000	17.32
Sugarbeets	2008	Oregon	Malheur	5,200	4,500	34.7	156,000	16.09
Sugarbeets	2008	Oregon	D80 Southeast	5,200	4,500	34.7	156,000	16.09
Sugarbeets	**2008**	**Oregon**	**State Total**	**6,700**	**5,900**	**33.1**	**195,000**	**16.34**
Sugarbeets	2008	Washington	Benton	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	D20 Central	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Washington	State Total	1,600	1,600	41.9	67,000	16.51
Sugarbeets	2008	Wyoming	Big Horn	8,300	8,100	23.4	189,300	17.46
Sugarbeets	2008	Wyoming	Fremont	1,500	1,500	20.1	30,200	19.00

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Wyoming	Park	10,300	9,900	25.4	251,900	17.69
Sugarbeets	2008	Wyoming	Washakie	5,700	5,500	27.0	148,400	17.40
Sugarbeets	2008	Wyoming	D10 Northwest	25,800	25,000	24.8	619,500	17.58
Sugarbeets	2008	Wyoming	Goshen	1,200	1,100	21.5	23,700	17.04
Sugarbeets	2008	Wyoming	Laramie	500	300	20.7	6,200	17.72
Sugarbeets	2008	Wyoming	Platte	2,200	700	20.4	14,300	17.11
Sugarbeets	2008	Wyoming	D50 Southeast	3,900	2,100	21.0	44,200	17.29
Sugarbeets	**2008**	**Wyoming**	**State Total**	**29,700**	**27,100**	**24.5**	**664,000**	**17.56**
Sugarbeets	2007	California	Fresno	9,200	9,200	30.8	283,000	15.61
Sugarbeets	2007	California	Kern	3,200	3,100	34.2	106,000	15.27
Sugarbeets	2007	California	Kings	1,300	1,300	30.8	40,000	14.63
Sugarbeets	2007	California	Merced	2,200	2,200	29.1	64,000	17.66
Sugarbeets	2007	California	D51 Combined Counties	400	400	35.0	14,000	15.68
Sugarbeets	2007	California	D51 San Joaquin Valley	16,300	16,200	31.3	507,000	15.72
Sugarbeets	2007	California	Imperial	23,700	22,900	41.9	959,000	16.38
Sugarbeets	2007	California	D80 Southern California	23,700	22,900	41.9	959,000	16.38
Sugarbeets	**2007**	**California**	**State Total**	**40,000**	**39,100**	**37.5**	**1,466,000**	**16.15**
Sugarbeets	2007	Colorado	Boulder	600	500	29.2	14,600	15.89
Sugarbeets	2007	Colorado	Larimer	2,400	2,300	24.7	56,900	16.00
Sugarbeets	2007	Colorado	Logan	4,000	3,700	22.7	84,000	15.32
Sugarbeets	2007	Colorado	Morgan	1,600	1,400	26.6	37,200	14.99
Sugarbeets	2007	Colorado	Sedgwick	1,000	800	23.4	18,700	16.28
Sugarbeets	2007	Colorado	Weld	11,800	10,700	28.3	302,500	15.31
Sugarbeets	2007	Colorado	D20 Northeast	21,300	19,400	26.5	514,000	15.42
Sugarbeets	2007	Colorado	Kit Carson	700	700	24.4	17,100	15.72
Sugarbeets	2007	Colorado	Phillips	3,300	3,000	19.9	59,700	16.21
Sugarbeets	2007	Colorado	Washington	700	600	26.8	16,100	15.08
Sugarbeets	2007	Colorado	Yuma	5,700	5,300	29.0	153,500	15.38
Sugarbeets	2007	Colorado	D60 Combined Counties	300	200	23.0	4,600	16.25
Sugarbeets	2007	Colorado	D60 East Central	10,700	9,200	25.6	251,000	15.60
Sugarbeets	**2007**	**Colorado**	**State Total**	**32,000**	**29,200**	**26.2**	**765,000**	**15.48**
Sugarbeets	2007	Idaho	Ada	2,100	2,000	33.5	67,000	15.50
Sugarbeets	2007	Idaho	Canyon	11,100	10,900	36.8	401,000	15.50
Sugarbeets	2007	Idaho	Elmore	8,800	8,700	30.9	269,000	16.53
Sugarbeets	2007	Idaho	Owyhee	3,200	3,200	34.1	109,000	16.04
Sugarbeets	2007	Idaho	Washington	1,400	1,300	35.4	46,000	15.49
Sugarbeets	2007	Idaho	D70 Combined Counties	1,400	1,400	34.3	48,000	16.23
Sugarbeets	2007	Idaho	D70 Southwest	28,000	27,500	34.2	940,000	15.89
Sugarbeets	2007	Idaho	Blaine	600	600	33.3	20,000	15.97
Sugarbeets	2007	Idaho	Cassia	31,700	31,600	35.6	1,125,000	16.41
Sugarbeets	2007	Idaho	Gooding	1,400	1,300	34.6	45,000	15.88
Sugarbeets	2007	Idaho	Jerome	12,700	12,500	34.5	431,000	16.50
Sugarbeets	2007	Idaho	Lincoln	6,200	6,100	30.7	187,000	16.48
Sugarbeets	2007	Idaho	Minidoka	42,300	41,900	33.2	1,391,000	16.19
Sugarbeets	2007	Idaho	Twin Falls	10,100	10,000	34.1	341,000	16.20
Sugarbeets	2007	Idaho	D80 South Central	105,000	104,000	34.0	3,540,000	16.31
Sugarbeets	2007	Idaho	Bingham	22,900	22,700	35.8	812,000	15.95
Sugarbeets	2007	Idaho	Power	13,100	12,800	35.4	453,000	15.85
Sugarbeets	2007	Idaho	D90 East	36,000	35,500	35.6	1,265,000	15.91
Sugarbeets	**2007**	**Idaho**	**State Total**	**169,000**	**167,000**	**34.4**	**5,745,000**	**16.15**
Sugarbeets	2007	Michigan	Gladwin	1,000	1,000	17.0	17,000	16.50
Sugarbeets	2007	Michigan	Gratiot	11,200	11,000	21.1	232,000	16.10
Sugarbeets	2007	Michigan	Isabella	600	500	20.0	10,000	17.60
Sugarbeets	2007	Michigan	Midland	2,800	2,800	20.4	57,000	16.10
Sugarbeets	2007	Michigan	Montcalm	500	500	22.0	11,000	17.70
Sugarbeets	2007	Michigan	D50 Central	16,000	15,800	20.7	327,000	16.10
Sugarbeets	2007	Michigan	Arenac	3,600	3,600	19.4	70,000	16.90
Sugarbeets	2007	Michigan	Bay	14,800	14,700	20.6	303,000	17.80
Sugarbeets	2007	Michigan	Huron	52,700	52,600	24.9	1,310,000	16.10
Sugarbeets	2007	Michigan	Saginaw	16,100	16,000	24.7	395,000	17.80
Sugarbeets	2007	Michigan	Sanilac	20,600	20,500	22.1	453,000	16.50
Sugarbeets	2007	Michigan	Tuscola	20,000	19,900	25.6	509,000	16.10
Sugarbeets	2007	Michigan	D60 East Central	128,000	127,300	23.9	3,040,000	16.10
Sugarbeets	2007	Michigan	Clinton	2,250	2,250	20.0	45,000	17.00
Sugarbeets	2007	Michigan	Ionia	500	500	22.0	11,000	17.60
Sugarbeets	2007	Michigan	Shiawassee	750	750	18.7	14,000	17.20
Sugarbeets	2007	Michigan	D80 South Central	3,500	3,500	20.0	70,000	17.10
Sugarbeets	2007	Michigan	Lapeer	1,000	1,000	23.0	23,000	16.30
Sugarbeets	2007	Michigan	D90 Combined Counties	1,000	1,000	20.0	20,000	16.40
Sugarbeets	2007	Michigan	D90 Southeast	2,000	2,000	21.5	43,000	16.30
Sugarbeets	2007	Michigan	D98 Combined Districts	500	400	17.5	7,000	17.90
Sugarbeets	**2007**	**Michigan**	**State Total**	**150,000**	**149,000**	**23.4**	**3,487,000**	**16.10**
Sugarbeets	2007	Minnesota	Becker	11,000	10,900	24.5	267,000	17.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Wyoming	Park	10,300	9,900	25.4	251,900	17.69
Sugarbeets	2008	Wyoming	Washakie	5,700	5,500	27.0	148,400	17.40
Sugarbeets	2008	Wyoming	D10 Northwest	25,800	25,000	24.8	619,500	17.58
Sugarbeets	2008	Wyoming	Goshen	1,200	1,100	21.5	23,700	17.04
Sugarbeets	2008	Wyoming	Laramie	500	300	20.7	6,200	17.72
Sugarbeets	2008	Wyoming	Platte	2,200	700	20.4	14,300	17.11
Sugarbeets	2008	Wyoming	D50 Southeast	3,900	2,100	21.0	44,200	17.29
Sugarbeets	**2008**	**Wyoming**	**State Total**	**29,700**	**27,100**	**24.5**	**664,000**	**17.56**
Sugarbeets	2007	California	Fresno	9,200	9,200	30.8	283,000	15.61
Sugarbeets	2007	California	Kern	3,200	3,100	34.2	106,000	15.27
Sugarbeets	2007	California	Kings	1,300	1,300	30.8	40,000	14.63
Sugarbeets	2007	California	Merced	2,200	2,200	29.1	64,000	17.66
Sugarbeets	2007	California	D51 Combined Counties	400	400	35.0	14,000	15.66
Sugarbeets	2007	California	D51 San Joaquin Valley	16,300	16,200	31.3	507,000	15.72
Sugarbeets	2007	California	Imperial	23,700	22,900	41.9	959,000	16.38
Sugarbeets	2007	California	D80 Southern California	23,700	22,900	41.9	959,000	16.38
Sugarbeets	**2007**	**California**	**State Total**	**40,000**	**39,100**	**37.5**	**1,466,000**	**16.15**
Sugarbeets	2007	Colorado	Boulder	500	500	29.2	14,600	15.89
Sugarbeets	2007	Colorado	Larimer	2,400	2,300	24.7	56,900	16.00
Sugarbeets	2007	Colorado	Logan	4,000	3,700	22.7	84,000	15.32
Sugarbeets	2007	Colorado	Morgan	1,600	1,400	26.6	37,200	14.09
Sugarbeets	2007	Colorado	Sedgwick	1,000	800	23.4	18,700	16.28
Sugarbeets	2007	Colorado	Weld	11,800	10,700	28.3	302,600	15.31
Sugarbeets	2007	Colorado	D20 Northeast	21,300	19,400	26.5	514,000	15.42
Sugarbeets	2007	Colorado	Kit Carson	700	700	24.4	17,100	15.72
Sugarbeets	2007	Colorado	Phillips	3,300	3,000	19.9	59,700	16.21
Sugarbeets	2007	Colorado	Washington	700	600	26.8	16,100	15.08
Sugarbeets	2007	Colorado	Yuma	5,700	5,300	29.0	153,500	15.38
Sugarbeets	2007	Colorado	D60 Combined Counties	300	200	23.0	4,600	16.25
Sugarbeets	2007	Colorado	D60 East Central	10,700	9,800	25.6	251,000	15.60
Sugarbeets	**2007**	**Colorado**	**State Total**	**32,000**	**29,200**	**26.2**	**765,000**	**15.48**
Sugarbeets	2007	Idaho	Ada	2,100	2,000	33.5	67,000	15.50
Sugarbeets	2007	Idaho	Canyon	11,100	10,900	36.8	401,000	15.50
Sugarbeets	2007	Idaho	Elmore	5,800	6,700	30.9	269,000	16.53
Sugarbeets	2007	Idaho	Owyhee	3,200	3,200	34.1	109,000	16.04
Sugarbeets	2007	Idaho	Washington	1,400	1,300	35.4	46,000	15.49
Sugarbeets	2007	Idaho	D70 Combined Counties	1,400	1,400	34.3	48,000	16.23
Sugarbeets	2007	Idaho	D70 Southwest	28,000	27,500	34.2	940,000	15.89
Sugarbeets	2007	Idaho	Blaine	600	600	33.3	20,000	15.97
Sugarbeets	2007	Idaho	Cassia	31,700	31,600	35.6	1,125,000	16.41
Sugarbeets	2007	Idaho	Gooding	1,400	1,300	34.6	45,000	15.68
Sugarbeets	2007	Idaho	Jerome	12,700	12,500	34.5	431,000	16.50
Sugarbeets	2007	Idaho	Lincoln	6,200	6,100	30.7	167,000	16.48
Sugarbeets	2007	Idaho	Minidoka	42,300	41,900	33.2	1,391,000	16.19
Sugarbeets	2007	Idaho	Twin Falls	10,100	10,000	34.1	341,000	16.20
Sugarbeets	2007	Idaho	D80 South Central	105,000	104,000	34.0	3,540,000	16.31
Sugarbeets	2007	Idaho	Bingham	22,900	22,700	35.8	812,000	15.95
Sugarbeets	2007	Idaho	Power	13,100	12,800	35.4	453,000	15.85
Sugarbeets	2007	Idaho	D90 East	36,000	35,500	35.6	1,265,000	15.91
Sugarbeets	**2007**	**Idaho**	**State Total**	**169,000**	**167,000**	**34.4**	**5,745,000**	**16.15**
Sugarbeets	2007	Michigan	Gladwin	1,000	1,000	17.0	17,000	18.50
Sugarbeets	2007	Michigan	Gratiot	11,200	11,000	21.1	232,000	16.10
Sugarbeets	2007	Michigan	Isabella	500	500	20.0	10,000	17.60
Sugarbeets	2007	Michigan	Midland	2,800	2,800	20.4	57,000	16.10
Sugarbeets	2007	Michigan	Montcalm	500	500	22.0	11,000	17.70
Sugarbeets	2007	Michigan	D50 Central	16,000	15,800	20.7	327,000	16.10
Sugarbeets	2007	Michigan	Arenac	3,800	3,800	18.4	70,000	18.90
Sugarbeets	2007	Michigan	Bay	14,800	14,700	20.6	303,000	17.80
Sugarbeets	2007	Michigan	Huron	52,700	52,600	24.9	1,310,000	16.10
Sugarbeets	2007	Michigan	Saginaw	16,100	16,000	24.7	395,000	17.80
Sugarbeets	2007	Michigan	Sanilac	20,800	20,500	22.1	453,000	16.50
Sugarbeets	2007	Michigan	Tuscola	20,000	19,900	25.6	509,000	16.10
Sugarbeets	2007	Michigan	D60 East Central	128,000	127,300	23.9	3,040,000	16.10
Sugarbeets	2007	Michigan	Clinton	2,250	2,250	20.0	45,000	17.00
Sugarbeets	2007	Michigan	Ionia	500	500	22.0	11,000	17.60
Sugarbeets	2007	Michigan	Shiawassee	750	750	18.7	14,000	17.20
Sugarbeets	2007	Michigan	D80 South Central	3,500	3,500	20.0	70,000	17.10
Sugarbeets	2007	Michigan	Lapeer	1,000	1,000	23.0	23,000	16.30
Sugarbeets	2007	Michigan	D90 Combined Counties	1,000	1,000	20.0	20,000	16.40
Sugarbeets	2007	Michigan	D90 Southeast	2,000	2,000	21.5	43,000	16.30
Sugarbeets	2007	Michigan	D98 Combined Districts	500	400	17.5	7,000	17.90
Sugarbeets	**2007**	**Michigan**	**State Total**	**150,000**	**149,000**	**23.4**	**3,487,000**	**16.10**
Sugarbeets	2007	Minnesota	Becker	11,000	10,900	24.5	267,000	17.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Wyoming	Park	10,300	9,900	25.4	251,900	17.69
Sugarbeets	2008	Wyoming	Washakie	5,700	5,500	27.0	148,400	17.40
Sugarbeets	2008	Wyoming	D10 Northwest	25,800	25,000	24.8	619,500	17.56
Sugarbeets	2008	Wyoming	Goshen	1,200	1,100	21.5	23,700	17.04
Sugarbeets	2008	Wyoming	Laramie	500	300	20.7	6,200	17.72
Sugarbeets	2008	Wyoming	Platte	2,200	700	20.4	14,300	17.11
Sugarbeets	2008	Wyoming	D50 Southeast	3,900	2,100	21.0	44,200	17.29
Sugarbeets	**2008**	**Wyoming**	**State Total**	**29,700**	**27,100**	**24.5**	**664,000**	**17.56**
Sugarbeets	2007	California	Fresno	9,200	9,200	30.8	283,000	15.61
Sugarbeets	2007	California	Kern	3,200	3,100	34.2	106,000	15.27
Sugarbeets	2007	California	Kings	1,300	1,300	30.8	40,000	14.63
Sugarbeets	2007	California	Merced	2,200	2,200	29.1	64,000	17.66
Sugarbeets	2007	California	D51 Combined Counties	400	400	35.0	14,000	15.68
Sugarbeets	2007	California	D51 San Joaquin Valley	16,300	16,200	31.3	507,000	15.72
Sugarbeets	2007	California	Imperial	23,700	22,900	41.9	959,000	16.38
Sugarbeets	2007	California	D80 Southern California	23,700	22,900	41.9	959,000	16.38
Sugarbeets	**2007**	**California**	**State Total**	**40,000**	**39,100**	**37.5**	**1,466,000**	**16.15**
Sugarbeets	2007	Colorado	Boulder	600	500	29.2	14,600	15.89
Sugarbeets	2007	Colorado	Larimer	2,400	2,300	24.7	56,800	16.00
Sugarbeets	2007	Colorado	Logan	4,000	3,700	22.7	54,000	15.32
Sugarbeets	2007	Colorado	Morgan	1,600	1,400	26.6	37,200	14.89
Sugarbeets	2007	Colorado	Sedgwick	1,000	800	23.4	18,700	16.28
Sugarbeets	2007	Colorado	Weld	11,600	10,700	28.3	302,600	15.31
Sugarbeets	2007	Colorado	D20 Northeast	21,300	19,400	26.5	514,000	15.42
Sugarbeets	2007	Colorado	Kit Carson	700	700	24.4	17,100	15.72
Sugarbeets	2007	Colorado	Phillips	3,300	3,000	19.9	59,700	16.21
Sugarbeets	2007	Colorado	Washington	700	600	26.8	16,100	15.08
Sugarbeets	2007	Colorado	Yuma	5,700	5,300	29.0	153,500	15.38
Sugarbeets	2007	Colorado	D60 Combined Counties	300	200	23.0	4,600	16.25
Sugarbeets	2007	Colorado	D60 East Central	10,700	9,800	25.6	251,000	15.60
Sugarbeets	**2007**	**Colorado**	**State Total**	**32,000**	**29,200**	**26.2**	**765,000**	**15.48**
Sugarbeets	2007	Idaho	Ada	2,100	2,000	33.5	67,000	15.50
Sugarbeets	2007	Idaho	Canyon	11,100	10,900	36.8	401,000	15.50
Sugarbeets	2007	Idaho	Elmore	5,800	8,700	30.9	269,000	16.53
Sugarbeets	2007	Idaho	Owyhee	3,200	3,200	34.1	109,000	16.04
Sugarbeets	2007	Idaho	Washington	1,400	1,300	35.4	46,000	15.49
Sugarbeets	2007	Idaho	D70 Combined Counties	1,400	1,400	34.3	48,000	16.23
Sugarbeets	2007	Idaho	D70 Southwest	25,000	27,500	34.2	940,000	15.69
Sugarbeets	2007	Idaho	Blaine	600	600	33.3	20,000	15.97
Sugarbeets	2007	Idaho	Cassia	31,700	31,600	35.6	1,125,000	16.41
Sugarbeets	2007	Idaho	Gooding	1,400	1,300	34.6	45,000	15.68
Sugarbeets	2007	Idaho	Jerome	12,700	12,500	34.5	431,000	16.50
Sugarbeets	2007	Idaho	Lincoln	6,200	6,100	30.7	157,000	16.48
Sugarbeets	2007	Idaho	Minidoka	42,300	41,900	33.2	1,391,000	16.19
Sugarbeets	2007	Idaho	Twin Falls	10,100	10,000	34.1	341,000	16.20
Sugarbeets	2007	Idaho	D80 South Central	105,000	104,000	34.0	3,540,000	16.31
Sugarbeets	2007	Idaho	Bingham	22,900	22,700	35.8	812,000	15.95
Sugarbeets	2007	Idaho	Power	13,100	12,800	35.4	453,000	15.85
Sugarbeets	2007	Idaho	D90 East	36,000	35,500	35.6	1,265,000	15.91
Sugarbeets	**2007**	**Idaho**	**State Total**	**169,000**	**167,000**	**34.4**	**5,745,000**	**16.15**
Sugarbeets	2007	Michigan	Gladwin	1,000	1,000	17.0	17,000	18.50
Sugarbeets	2007	Michigan	Gratiot	11,200	11,000	21.1	232,000	18.10
Sugarbeets	2007	Michigan	Isabella	500	500	20.0	10,000	17.60
Sugarbeets	2007	Michigan	Midland	2,600	2,800	20.4	57,000	18.10
Sugarbeets	2007	Michigan	Montcalm	500	500	22.0	11,000	17.70
Sugarbeets	2007	Michigan	D50 Central	16,000	15,800	20.7	327,000	18.10
Sugarbeets	2007	Michigan	Arenac	3,600	3,600	19.4	70,000	18.90
Sugarbeets	2007	Michigan	Bay	14,800	14,700	20.6	303,000	17.80
Sugarbeets	2007	Michigan	Huron	52,700	52,600	24.9	1,310,000	18.10
Sugarbeets	2007	Michigan	Saginaw	16,100	16,000	24.7	395,000	17.80
Sugarbeets	2007	Michigan	Sanilac	20,600	20,500	22.1	453,000	18.50
Sugarbeets	2007	Michigan	Tuscola	20,000	19,900	25.6	509,000	18.10
Sugarbeets	2007	Michigan	D60 East Central	128,000	127,300	23.9	3,040,000	18.10
Sugarbeets	2007	Michigan	Clinton	2,250	2,250	20.0	45,000	17.00
Sugarbeets	2007	Michigan	Ionia	500	500	22.0	11,000	17.60
Sugarbeets	2007	Michigan	Shiawassee	750	750	18.7	14,000	17.20
Sugarbeets	2007	Michigan	D80 South Central	3,500	3,500	20.0	70,000	17.10
Sugarbeets	2007	Michigan	Lapeer	1,000	1,000	23.0	23,000	18.30
Sugarbeets	2007	Michigan	D90 Combined Counties	1,000	1,000	20.0	20,000	18.40
Sugarbeets	2007	Michigan	D90 Southeast	2,000	2,000	21.5	43,000	18.30
Sugarbeets	2007	Michigan	D98 Combined Districts	500	400	17.5	7,000	17.90
Sugarbeets	**2007**	**Michigan**	**State Total**	**150,000**	**149,000**	**23.4**	**3,487,000**	**18.10**
Sugarbeets	2007	Minnesota	Becker	11,000	10,900	24.5	267,000	17.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2008	Wyoming	Park	10,300	9,900	25.4	251,900	17.69
Sugarbeets	2008	Wyoming	Washakie	5,700	5,500	27.0	148,400	17.40
Sugarbeets	2008	Wyoming	D10 Northwest	25,800	25,000	24.8	619,500	17.58
Sugarbeets	2008	Wyoming	Goshen	1,200	1,100	21.5	23,700	17.04
Sugarbeets	2008	Wyoming	Laramie	500	300	20.7	6,200	17.72
Sugarbeets	2008	Wyoming	Platte	2,200	700	20.4	14,300	17.11
Sugarbeets	2008	Wyoming	D50 Southeast	3,900	2,100	21.0	44,200	17.29
Sugarbeets	**2008**	**Wyoming**	**State Total**	**29,700**	**27,100**	**24.5**	**664,000**	**17.56**
Sugarbeets	2007	California	Fresno	9,200	9,200	30.8	283,000	15.61
Sugarbeets	2007	California	Kern	3,200	3,100	34.2	106,000	15.27
Sugarbeets	2007	California	Kings	1,300	1,300	30.8	40,000	14.63
Sugarbeets	2007	California	Merced	2,200	2,200	29.1	64,000	17.66
Sugarbeets	2007	California	D51 Combined Counties	400	400	35.0	14,000	15.68
Sugarbeets	2007	California	D51 San Joaquin Valley	16,300	16,200	31.3	507,000	15.72
Sugarbeets	2007	California	Imperial	23,700	22,900	41.9	959,000	16.38
Sugarbeets	2007	California	D80 Southern California	23,700	22,900	41.9	959,000	16.38
Sugarbeets	**2007**	**California**	**State Total**	**40,000**	**39,100**	**37.5**	**1,466,000**	**16.15**
Sugarbeets	2007	Colorado	Boulder	500	500	29.2	14,600	15.69
Sugarbeets	2007	Colorado	Larimer	2,400	2,300	24.7	56,900	16.00
Sugarbeets	2007	Colorado	Logan	4,000	3,700	22.7	84,000	15.32
Sugarbeets	2007	Colorado	Morgan	1,600	1,400	26.6	37,200	14.89
Sugarbeets	2007	Colorado	Sedgwick	1,000	800	23.4	18,700	16.28
Sugarbeets	2007	Colorado	Weld	11,800	10,700	28.3	302,600	15.31
Sugarbeets	2007	Colorado	D20 Northeast	21,300	19,400	26.5	514,000	15.42
Sugarbeets	2007	Colorado	Kit Carson	700	700	24.4	17,100	15.72
Sugarbeets	2007	Colorado	Phillips	3,300	3,000	19.9	59,700	16.21
Sugarbeets	2007	Colorado	Washington	700	600	26.8	16,100	15.08
Sugarbeets	2007	Colorado	Yuma	5,700	5,300	29.0	153,500	15.38
Sugarbeets	2007	Colorado	D60 Combined Counties	300	200	23.0	4,600	16.25
Sugarbeets	2007	Colorado	D60 East Central	10,700	9,800	25.6	251,000	15.60
Sugarbeets	**2007**	**Colorado**	**State Total**	**32,000**	**29,200**	**26.2**	**765,000**	**15.48**
Sugarbeets	2007	Idaho	Ada	2,100	2,000	33.5	67,000	15.50
Sugarbeets	2007	Idaho	Canyon	11,100	10,900	36.8	401,000	15.50
Sugarbeets	2007	Idaho	Elmore	5,800	8,700	30.9	269,000	16.53
Sugarbeets	2007	Idaho	Owyhee	3,200	3,200	34.1	109,000	16.04
Sugarbeets	2007	Idaho	Washington	1,400	1,300	35.4	46,000	15.49
Sugarbeets	2007	Idaho	D70 Combined Counties	1,400	1,400	34.3	48,000	16.23
Sugarbeets	2007	Idaho	D70 Southwest	25,000	27,500	34.2	940,000	15.89
Sugarbeets	2007	Idaho	Blaine	600	600	33.3	20,000	15.97
Sugarbeets	2007	Idaho	Cassia	31,700	31,600	35.6	1,125,000	16.41
Sugarbeets	2007	Idaho	Gooding	1,400	1,300	34.6	45,000	15.68
Sugarbeets	2007	Idaho	Jerome	12,700	12,500	34.5	431,000	16.50
Sugarbeets	2007	Idaho	Lincoln	6,200	6,100	30.7	187,000	16.48
Sugarbeets	2007	Idaho	Minidoka	42,300	41,900	33.2	1,391,000	16.19
Sugarbeets	2007	Idaho	Twin Falls	10,100	10,000	34.1	341,000	16.20
Sugarbeets	2007	Idaho	D80 South Central	105,000	104,000	34.0	3,540,000	16.31
Sugarbeets	2007	Idaho	Bingham	22,900	22,700	35.8	812,000	15.95
Sugarbeets	2007	Idaho	Power	13,100	12,800	35.4	453,000	15.85
Sugarbeets	2007	Idaho	D90 East	36,000	35,500	35.8	1,265,000	15.91
Sugarbeets	**2007**	**Idaho**	**State Total**	**169,000**	**167,000**	**34.4**	**5,745,000**	**16.15**
Sugarbeets	2007	Michigan	Gladwin	1,000	1,000	17.0	17,000	18.50
Sugarbeets	2007	Michigan	Gratiot	11,200	11,000	21.1	232,000	18.10
Sugarbeets	2007	Michigan	Isabella	500	500	20.0	10,000	17.60
Sugarbeets	2007	Michigan	Midland	2,800	2,800	20.4	57,000	18.10
Sugarbeets	2007	Michigan	Montcalm	500	500	22.0	11,000	17.70
Sugarbeets	2007	Michigan	D50 Central	16,000	15,800	20.7	327,000	18.10
Sugarbeets	2007	Michigan	Arenac	3,600	3,600	19.4	70,000	15.90
Sugarbeets	2007	Michigan	Bay	14,800	14,700	20.6	303,000	17.80
Sugarbeets	2007	Michigan	Huron	52,700	52,600	24.9	1,310,000	15.10
Sugarbeets	2007	Michigan	Saginaw	16,100	16,000	24.7	395,000	17.80
Sugarbeets	2007	Michigan	Sanilac	20,800	20,500	22.1	453,000	15.50
Sugarbeets	2007	Michigan	Tuscola	20,000	19,800	25.6	509,000	15.10
Sugarbeets	2007	Michigan	D60 East Central	128,000	127,300	23.9	3,040,000	15.10
Sugarbeets	2007	Michigan	Clinton	2,250	2,250	20.0	45,000	17.00
Sugarbeets	2007	Michigan	Ionia	500	500	22.0	11,000	17.60
Sugarbeets	2007	Michigan	Shiawassee	750	750	15.7	14,000	17.20
Sugarbeets	2007	Michigan	D80 South Central	3,500	3,500	20.0	70,000	17.10
Sugarbeets	2007	Michigan	Lapeer	1,000	1,000	23.0	23,000	15.30
Sugarbeets	2007	Michigan	D90 Combined Counties	1,000	1,000	20.0	20,000	15.40
Sugarbeets	2007	Michigan	D90 Southeast	2,000	2,000	21.5	43,000	15.30
Sugarbeets	2007	Michigan	D98 Combined Districts	500	400	17.5	7,000	17.90
Sugarbeets	**2007**	**Michigan**	**State Total**	**150,000**	**149,000**	**23.4**	**3,487,000**	**18.10**
Sugarbeets	2007	Minnesota	Becker	11,000	10,900	24.5	267,000	17.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	Minnesota	Clay	52,200	51,200	21.6	1,105,400	17.10
Sugarbeets	2007	Minnesota	Kittson	36,900	36,600	20.4	747,400	15.90
Sugarbeets	2007	Minnesota	Mahnomen	5,500	5,500	23.9	131,500	17.60
Sugarbeets	2007	Minnesota	Marshall	46,300	45,700	22.9	1,046,000	15.90
Sugarbeets	2007	Minnesota	Norman	45,300	47,700	24.3	1,159,400	17.70
Sugarbeets	2007	Minnesota	Polk	103,600	99,200	25.6	2,553,400	15.20
Sugarbeets	2007	Minnesota	D10 Combined Counties	1,700	1,600	25.4	40,600	17.90
Sugarbeets	2007	Minnesota	D10 Northwest	302,500	292,000	23.6	7,051,500	16.00
Sugarbeets	2007	Minnesota	Chippewa	30,600	30,600	26.0	794,700	16.20
Sugarbeets	2007	Minnesota	Grant	10,300	10,200	19.8	202,300	16.90
Sugarbeets	2007	Minnesota	Otter Tail	2,300	2,300	18.9	43,500	17.20
Sugarbeets	2007	Minnesota	Pope	2,600	2,600	26.3	65,300	16.40
Sugarbeets	2007	Minnesota	Stevens	5,100	5,100	27.2	138,500	16.50
Sugarbeets	2007	Minnesota	Swift	6,200	6,100	25.5	155,300	16.50
Sugarbeets	2007	Minnesota	Traverse	6,500	6,400	20.8	132,900	17.20
Sugarbeets	2007	Minnesota	Wilkin	50,600	49,500	20.1	994,900	17.80
Sugarbeets	2007	Minnesota	Yellow Medicine	4,000	4,000	27.6	110,400	16.20
Sugarbeets	2007	Minnesota	D40 Combined Counties	900	900	23.4	21,100	17.00
Sugarbeets	2007	Minnesota	D40 West Central	119,100	117,700	22.6	2,662,200	17.00
Sugarbeets	2007	Minnesota	Kandiyohi	14,400	14,400	26.3	378,000	16.30
Sugarbeets	2007	Minnesota	McLeod	2,300	2,300	27.0	62,000	16.00
Sugarbeets	2007	Minnesota	Renville	35,400	35,300	27.4	966,500	15.90
Sugarbeets	2007	Minnesota	Sibley	2,100	2,100	30.0	63,000	15.60
Sugarbeets	2007	Minnesota	Stearns	2,500	2,500	24.1	60,300	16.20
Sugarbeets	2007	Minnesota	D50 Combined Counties	2,000	2,000	27.4	54,700	16.00
Sugarbeets	2007	Minnesota	D50 Central	56,700	56,600	27.0	1,552,700	16.00
Sugarbeets	2007	Minnesota	Redwood	4,600	4,600	27.1	124,500	15.70
Sugarbeets	2007	Minnesota	D70 Combined Counties	500	500	20.0	10,000	16.20
Sugarbeets	2007	Minnesota	D70 Southwest	5,100	5,100	26.4	134,500	15.80
Sugarbeets	2007	Minnesota	D98 Combined Districts	600	600	25.0	15,800	16.00
Sugarbeets	**2007**	**Minnesota**	**State Total**	**486,000**	**481,000**	**23.8**	**11,448,000**	**17.50**
Sugarbeets	2007	Montana	Dawson	2,360	2,360	22.7	53,500	17.84
Sugarbeets	2007	Montana	Richland	13,900	13,840	24.0	331,500	15.10
Sugarbeets	2007	Montana	D30 Combined Counties	1,930	1,920	22.2	42,800	17.94
Sugarbeets	2007	Montana	D30 Northeast	18,190	18,130	23.6	427,500	15.05
Sugarbeets	2007	Montana	Big Horn	9,670	9,670	26.6	257,000	15.46
Sugarbeets	2007	Montana	Carbon	3,560	3,530	25.6	90,400	16.31
Sugarbeets	2007	Montana	Treasure	3,320	3,320	27.8	92,200	15.37
Sugarbeets	2007	Montana	Yellowstone	7,640	7,430	22.9	170,000	15.94
Sugarbeets	2007	Montana	D80 Combined Counties	180	180	31.7	5,700	16.00
Sugarbeets	2007	Montana	D80 South Central	24,380	24,130	25.5	615,300	15.71
Sugarbeets	2007	Montana	Custer	660	650	25.5	16,600	17.21
Sugarbeets	2007	Montana	Prairie	1,780	1,780	23.6	42,000	15.07
Sugarbeets	2007	Montana	D90 Combined Counties	2,490	2,310	25.7	59,300	15.53
Sugarbeets	2007	Montana	D90 Southeast	4,920	4,740	24.9	117,900	16.68
Sugarbeets	**2007**	**Montana**	**State Total**	**47,500**	**47,000**	**24.7**	**1,161,000**	**16.67**
Sugarbeets	2007	Nebraska	Box Butte	20,100	19,900	23.8	474,300	17.16
Sugarbeets	2007	Nebraska	Cheyenne	1,800	1,800	23.9	43,100	16.60
Sugarbeets	2007	Nebraska	Deuel	600	600	19.3	11,600	16.09
Sugarbeets	2007	Nebraska	Kimball	3,300	3,100	25.3	78,500	16.67
Sugarbeets	2007	Nebraska	Morrill	5,200	4,900	22.8	111,700	15.83
Sugarbeets	2007	Nebraska	Scotts Bluff	7,100	6,500	23.1	150,300	15.58
Sugarbeets	2007	Nebraska	Sheridan	2,900	2,400	23.0	55,200	16.54
Sugarbeets	2007	Nebraska	Sioux	500	500	26.2	13,100	15.79
Sugarbeets	2007	Nebraska	D10 Combined Counties	500	500	21.4	10,700	17.31
Sugarbeets	2007	Nebraska	D10 Northwest	42,000	40,200	23.6	948,500	16.61
Sugarbeets	2007	Nebraska	Chase	2,700	2,500	22.2	55,400	15.51
Sugarbeets	2007	Nebraska	Keith	2,000	1,300	23.2	30,200	16.08
Sugarbeets	2007	Nebraska	Perkins	800	300	23.0	6,900	15.17
Sugarbeets	2007	Nebraska	D70 Southwest	5,500	4,100	22.6	92,500	15.67
Sugarbeets	**2007**	**Nebraska**	**State Total**	**47,500**	**44,300**	**23.5**	**1,041,000**	**16.52**
Sugarbeets	2007	North Dakota	Williams	4,100	4,000	21.0	54,000	15.97
Sugarbeets	2007	North Dakota	D10 Northwest	4,100	4,000	21.0	54,000	15.97
Sugarbeets	2007	North Dakota	Grand Forks	30,900	30,600	25.5	780,000	17.85
Sugarbeets	2007	North Dakota	Pembina	79,100	78,200	22.9	1,791,000	16.25
Sugarbeets	2007	North Dakota	Walsh	44,000	43,100	23.5	1,014,000	15.19
Sugarbeets	2007	North Dakota	D30 Northeast	154,000	151,900	23.6	3,585,000	16.17
Sugarbeets	2007	North Dakota	McKenzie	10,600	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	D40 West Central	10,600	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	Cass	24,600	23,800	22.5	535,000	17.46
Sugarbeets	2007	North Dakota	Steele	300	300	26.7	8,000	16.53
Sugarbeets	2007	North Dakota	Traill	27,400	26,600	24.1	641,000	17.66
Sugarbeets	2007	North Dakota	D60 East Central	52,300	50,700	23.4	1,184,000	17.56

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	Minnesota	Clay	52,200	51,200	21.6	1,106,400	17.10
Sugarbeets	2007	Minnesota	Kittson	36,800	36,600	20.4	747,400	15.80
Sugarbeets	2007	Minnesota	Mahnomen	5,500	5,500	23.9	131,500	17.60
Sugarbeets	2007	Minnesota	Marshall	46,300	45,700	22.9	1,046,000	15.80
Sugarbeets	2007	Minnesota	Norman	46,300	47,700	24.3	1,159,400	17.70
Sugarbeets	2007	Minnesota	Polk	102,600	99,200	25.6	2,553,400	16.20
Sugarbeets	2007	Minnesota	D10 Combined Counties	1,700	1,600	25.4	40,600	17.90
Sugarbeets	2007	Minnesota	D10 Northwest	302,500	298,000	23.6	7,051,500	16.00
Sugarbeets	2007	Minnesota	Chippewa	30,600	30,600	26.0	794,700	16.20
Sugarbeets	2007	Minnesota	Grant	10,300	10,200	19.8	202,300	16.80
Sugarbeets	2007	Minnesota	Otter Tail	2,300	2,300	18.9	43,500	17.20
Sugarbeets	2007	Minnesota	Pope	2,600	2,600	26.3	68,300	16.40
Sugarbeets	2007	Minnesota	Stevens	5,100	5,100	27.2	138,600	16.50
Sugarbeets	2007	Minnesota	Swift	6,200	6,100	25.5	155,300	16.50
Sugarbeets	2007	Minnesota	Traverse	6,500	6,400	20.8	132,900	17.20
Sugarbeets	2007	Minnesota	Wilkin	50,600	49,500	20.1	994,900	17.80
Sugarbeets	2007	Minnesota	Yellow Medicine	4,000	4,000	27.6	110,400	16.20
Sugarbeets	2007	Minnesota	D40 Combined Counties	900	900	23.4	21,100	17.00
Sugarbeets	2007	Minnesota	D40 West Central	119,100	117,700	22.6	2,662,200	17.00
Sugarbeets	2007	Minnesota	Kandiyohi	14,400	14,400	26.3	378,000	16.30
Sugarbeets	2007	Minnesota	McLeod	2,300	2,300	27.0	62,000	16.00
Sugarbeets	2007	Minnesota	Renville	35,400	35,300	27.4	966,600	15.90
Sugarbeets	2007	Minnesota	Sibley	2,100	2,100	29.0	60,900	15.60
Sugarbeets	2007	Minnesota	Stearns	2,500	2,500	24.1	60,300	16.20
Sugarbeets	2007	Minnesota	D50 Combined Counties	2,000	2,000	27.4	54,700	16.00
Sugarbeets	2007	Minnesota	D50 Central	55,700	56,600	27.0	1,582,700	16.00
Sugarbeets	2007	Minnesota	Redwood	4,600	4,600	27.1	124,500	15.70
Sugarbeets	2007	Minnesota	D70 Combined Counties	500	500	20.0	10,000	16.20
Sugarbeets	2007	Minnesota	D70 Southwest	5,100	5,100	26.4	134,500	15.80
Sugarbeets	2007	Minnesota	D98 Combined Districts	600	600	28.0	16,800	16.00
Sugarbeets	**2007**	**Minnesota**	**State Total**	**486,000**	**481,000**	**23.8**	**11,448,000**	**17.50**
Sugarbeets	2007	Montana	Dawson	2,360	2,360	22.7	53,500	17.84
Sugarbeets	2007	Montana	Richland	13,800	13,840	24.0	331,500	15.10
Sugarbeets	2007	Montana	D30 Combined Counties	1,930	1,930	22.2	42,800	17.94
Sugarbeets	2007	Montana	D30 Northeast	18,180	18,130	23.6	427,600	15.05
Sugarbeets	2007	Montana	Big Horn	9,670	9,670	26.6	257,000	15.46
Sugarbeets	2007	Montana	Carbon	3,580	3,530	25.6	90,400	16.31
Sugarbeets	2007	Montana	Treasure	3,320	3,320	27.8	92,200	15.37
Sugarbeets	2007	Montana	Yellowstone	7,640	7,430	22.9	170,000	15.94
Sugarbeets	2007	Montana	D20 Combined Counties	180	180	31.7	5,700	16.00
Sugarbeets	2007	Montana	D20 South Central	24,390	24,130	25.5	615,300	15.71
Sugarbeets	2007	Montana	Custer	650	650	25.5	16,600	17.21
Sugarbeets	2007	Montana	Prairie	1,780	1,780	23.6	42,000	15.07
Sugarbeets	2007	Montana	D90 Combined Counties	2,490	2,310	25.7	59,300	15.53
Sugarbeets	2007	Montana	D90 Southeast	4,920	4,740	24.9	117,900	15.68
Sugarbeets	**2007**	**Montana**	**State Total**	**47,500**	**47,000**	**24.7**	**1,161,000**	**16.67**
Sugarbeets	2007	Nebraska	Box Butte	20,100	19,900	23.8	474,300	17.16
Sugarbeets	2007	Nebraska	Cheyenne	1,800	1,800	23.9	43,100	16.60
Sugarbeets	2007	Nebraska	Deuel	600	600	19.3	11,600	16.09
Sugarbeets	2007	Nebraska	Kimball	3,300	3,100	25.3	78,500	16.67
Sugarbeets	2007	Nebraska	Morrill	5,200	4,900	22.8	111,700	15.63
Sugarbeets	2007	Nebraska	Scotts Bluff	7,100	6,600	23.1	152,300	15.58
Sugarbeets	2007	Nebraska	Sheridan	2,900	2,400	23.0	55,200	16.54
Sugarbeets	2007	Nebraska	Sioux	500	500	26.2	13,100	15.79
Sugarbeets	2007	Nebraska	D10 Combined Counties	500	500	21.4	10,700	17.31
Sugarbeets	2007	Nebraska	D10 Northwest	42,000	40,200	23.6	948,500	16.61
Sugarbeets	2007	Nebraska	Chase	2,700	2,500	22.2	55,400	15.51
Sugarbeets	2007	Nebraska	Keith	2,000	1,300	23.2	30,200	16.08
Sugarbeets	2007	Nebraska	Perkins	600	300	23.0	6,900	15.17
Sugarbeets	2007	Nebraska	D70 Southwest	5,500	4,100	22.6	92,600	15.67
Sugarbeets	**2007**	**Nebraska**	**State Total**	**47,500**	**44,300**	**23.5**	**1,041,000**	**16.52**
Sugarbeets	2007	North Dakota	Williams	4,100	4,000	21.0	84,000	15.97
Sugarbeets	2007	North Dakota	D10 Northwest	4,100	4,000	21.0	84,000	15.97
Sugarbeets	2007	North Dakota	Grand Forks	30,900	30,600	25.5	780,000	17.85
Sugarbeets	2007	North Dakota	Pembina	79,100	78,200	22.9	1,791,000	16.25
Sugarbeets	2007	North Dakota	Walsh	44,000	43,100	23.5	1,014,000	16.19
Sugarbeets	2007	North Dakota	D30 Northeast	154,000	151,900	23.6	3,585,000	16.17
Sugarbeets	2007	North Dakota	McKenzie	10,500	10,400	24.7	257,000	16.69
Sugarbeets	2007	North Dakota	D40 West Central	10,500	10,400	24.7	257,000	16.69
Sugarbeets	2007	North Dakota	Cass	24,600	23,800	22.5	535,000	17.46
Sugarbeets	2007	North Dakota	Steele	300	300	26.7	8,000	16.53
Sugarbeets	2007	North Dakota	Traill	27,400	26,600	24.1	641,000	17.66
Sugarbeets	2007	North Dakota	D60 East Central	52,300	50,700	23.4	1,184,000	17.56

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	Minnesota	Clay	52,200	51,200	21.6	1,106,400	17.10
Sugarbeets	2007	Minnesota	Kittson	36,800	36,600	20.4	747,400	15.90
Sugarbeets	2007	Minnesota	Mahnomen	5,500	5,500	23.9	131,600	17.60
Sugarbeets	2007	Minnesota	Marshall	46,300	45,700	22.9	1,046,000	15.90
Sugarbeets	2007	Minnesota	Norman	45,300	47,700	24.3	1,159,400	17.70
Sugarbeets	2007	Minnesota	Polk	100,600	99,800	25.6	2,553,400	16.20
Sugarbeets	2007	Minnesota	D10 Combined Counties	1,700	1,600	25.4	40,600	17.90
Sugarbeets	2007	Minnesota	D10 Northwest	302,500	299,000	23.6	7,051,600	16.00
Sugarbeets	2007	Minnesota	Chippewa	30,600	30,600	26.0	794,700	16.20
Sugarbeets	2007	Minnesota	Grant	10,300	10,200	19.8	202,300	16.90
Sugarbeets	2007	Minnesota	Otter Tail	2,300	2,300	18.9	43,500	17.20
Sugarbeets	2007	Minnesota	Pope	2,600	2,600	26.3	68,300	16.40
Sugarbeets	2007	Minnesota	Stevens	5,100	5,100	27.2	138,600	16.50
Sugarbeets	2007	Minnesota	Swift	6,200	6,100	25.5	155,300	16.50
Sugarbeets	2007	Minnesota	Traverse	6,500	6,400	20.8	132,900	17.20
Sugarbeets	2007	Minnesota	Wilkin	50,600	49,500	20.1	994,900	17.80
Sugarbeets	2007	Minnesota	Yellow Medicine	4,000	4,000	27.6	110,400	16.20
Sugarbeets	2007	Minnesota	D40 Combined Counties	900	900	23.4	21,100	17.00
Sugarbeets	2007	Minnesota	D40 West Central	119,100	117,700	22.6	2,662,200	17.00
Sugarbeets	2007	Minnesota	Kandiyohi	14,400	14,400	26.3	378,000	16.30
Sugarbeets	2007	Minnesota	McLeod	2,300	2,300	27.0	62,000	16.00
Sugarbeets	2007	Minnesota	Renville	35,400	35,300	27.4	966,500	15.90
Sugarbeets	2007	Minnesota	Sibley	2,100	2,100	29.0	60,900	15.60
Sugarbeets	2007	Minnesota	Stearns	2,500	2,500	24.1	60,300	16.20
Sugarbeets	2007	Minnesota	D50 Combined Counties	2,000	2,000	27.4	54,700	16.00
Sugarbeets	2007	Minnesota	D50 Central	56,700	56,600	27.0	1,552,700	16.00
Sugarbeets	2007	Minnesota	Redwood	4,600	4,600	27.1	124,500	15.70
Sugarbeets	2007	Minnesota	D70 Combined Counties	500	500	20.0	10,000	16.20
Sugarbeets	2007	Minnesota	D70 Southwest	5,100	5,100	26.4	134,500	15.80
Sugarbeets	2007	Minnesota	D98 Combined Districts	600	600	28.0	16,800	16.00
Sugarbeets	**2007**	**Minnesota**	**State Total**	**486,000**	**481,000**	**23.8**	**11,448,000**	**17.50**
Sugarbeets	2007	Montana	Dawson	2,360	2,360	22.7	53,500	17.84
Sugarbeets	2007	Montana	Richland	13,900	13,840	24.0	331,500	16.10
Sugarbeets	2007	Montana	D30 Combined Counties	1,930	1,930	22.2	42,800	17.94
Sugarbeets	2007	Montana	D30 Northeast	18,190	18,130	23.6	427,800	16.05
Sugarbeets	2007	Montana	Big Horn	9,670	9,670	26.6	257,000	15.46
Sugarbeets	2007	Montana	Carbon	3,560	3,530	25.6	90,400	16.31
Sugarbeets	2007	Montana	Treasure	3,320	3,320	27.8	92,200	15.37
Sugarbeets	2007	Montana	Yellowstone	7,640	7,430	22.9	170,000	15.94
Sugarbeets	2007	Montana	D80 Combined Counties	180	180	31.7	5,700	16.00
Sugarbeets	2007	Montana	D80 South Central	24,390	24,130	25.5	615,300	15.71
Sugarbeets	2007	Montana	Custer	650	650	25.5	16,600	17.21
Sugarbeets	2007	Montana	Prairie	1,780	1,780	23.6	42,000	16.07
Sugarbeets	2007	Montana	D90 Combined Counties	2,490	2,310	25.7	59,300	15.53
Sugarbeets	2007	Montana	D90 Southeast	4,920	4,740	24.9	117,900	16.68
Sugarbeets	**2007**	**Montana**	**State Total**	**47,500**	**47,000**	**24.7**	**1,161,000**	**16.67**
Sugarbeets	2007	Nebraska	Box Butte	20,100	19,900	23.8	474,300	17.16
Sugarbeets	2007	Nebraska	Cheyenne	1,800	1,800	23.9	43,100	16.60
Sugarbeets	2007	Nebraska	Deuel	600	600	19.3	11,600	16.09
Sugarbeets	2007	Nebraska	Kimball	3,300	3,100	25.3	78,500	16.67
Sugarbeets	2007	Nebraska	Morrill	5,200	4,900	22.8	111,700	15.83
Sugarbeets	2007	Nebraska	Scotts Bluff	7,100	6,500	23.1	150,300	15.58
Sugarbeets	2007	Nebraska	Sheridan	2,900	2,400	23.0	55,200	16.54
Sugarbeets	2007	Nebraska	Sioux	500	500	26.2	13,100	15.79
Sugarbeets	2007	Nebraska	D10 Combined Counties	500	500	21.4	10,700	17.31
Sugarbeets	2007	Nebraska	D10 Northwest	42,000	40,200	23.6	948,500	16.61
Sugarbeets	2007	Nebraska	Chase	2,700	2,500	22.2	55,400	15.51
Sugarbeets	2007	Nebraska	Keith	2,000	1,300	23.2	30,200	16.08
Sugarbeets	2007	Nebraska	Perkins	800	300	23.0	6,900	15.17
Sugarbeets	2007	Nebraska	D70 Southwest	5,500	4,100	22.6	92,500	15.67
Sugarbeets	**2007**	**Nebraska**	**State Total**	**47,500**	**44,300**	**23.5**	**1,041,000**	**16.52**
Sugarbeets	2007	North Dakota	Williams	4,100	4,000	21.0	84,000	15.97
Sugarbeets	2007	North Dakota	D10 Northwest	4,100	4,000	21.0	84,000	15.97
Sugarbeets	2007	North Dakota	Grand Forks	30,800	30,600	25.5	780,000	17.95
Sugarbeets	2007	North Dakota	Pembina	79,100	78,200	22.9	1,791,000	16.25
Sugarbeets	2007	North Dakota	Walsh	44,000	43,100	23.5	1,014,000	16.19
Sugarbeets	2007	North Dakota	D30 Northeast	154,000	151,900	23.6	3,585,000	16.17
Sugarbeets	2007	North Dakota	McKenzie	10,500	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	D40 West Central	10,500	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	Cass	24,600	23,800	22.5	535,000	17.48
Sugarbeets	2007	North Dakota	Steele	300	300	26.7	8,000	16.53
Sugarbeets	2007	North Dakota	Traill	27,400	26,600	24.1	641,000	17.66
Sugarbeets	2007	North Dakota	D60 East Central	52,300	50,700	23.4	1,184,000	17.56

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	Minnesota	Clay	52,200	51,200	21.6	1,105,400	17.10
Sugarbeets	2007	Minnesota	Kittson	36,900	36,600	20.4	747,400	15.90
Sugarbeets	2007	Minnesota	Mahnomen	5,500	5,500	23.9	131,500	17.60
Sugarbeets	2007	Minnesota	Marshall	46,300	45,700	22.9	1,046,000	16.90
Sugarbeets	2007	Minnesota	Norman	48,300	47,700	24.3	1,159,400	17.70
Sugarbeets	2007	Minnesota	Polk	100,600	99,200	25.6	2,553,400	15.20
Sugarbeets	2007	Minnesota	D10 Combined Counties	1,700	1,600	25.4	40,600	17.90
Sugarbeets	2007	Minnesota	D10 Northwest	302,500	299,000	23.6	7,051,500	16.00
Sugarbeets	2007	Minnesota	Chippewa	30,600	30,600	26.0	794,700	16.20
Sugarbeets	2007	Minnesota	Grant	10,300	10,200	19.8	202,300	16.90
Sugarbeets	2007	Minnesota	Otter Tail	2,300	2,300	18.9	43,500	17.20
Sugarbeets	2007	Minnesota	Pope	2,600	2,600	26.3	68,300	16.40
Sugarbeets	2007	Minnesota	Stevens	5,100	5,100	27.2	138,500	16.50
Sugarbeets	2007	Minnesota	Swift	6,200	6,100	25.5	155,300	16.50
Sugarbeets	2007	Minnesota	Traverse	6,500	6,400	20.8	132,900	17.20
Sugarbeets	2007	Minnesota	Wilkin	50,600	49,500	20.1	994,900	17.60
Sugarbeets	2007	Minnesota	Yellow Medicine	4,000	4,000	27.6	110,400	16.20
Sugarbeets	2007	Minnesota	D40 Combined Counties	900	900	23.4	21,100	17.00
Sugarbeets	2007	Minnesota	D40 West Central	119,100	117,700	22.6	2,662,200	17.00
Sugarbeets	2007	Minnesota	Kandiyohi	14,400	14,400	26.3	378,000	16.30
Sugarbeets	2007	Minnesota	McLeod	2,300	2,300	27.0	62,000	16.00
Sugarbeets	2007	Minnesota	Renville	35,400	35,300	27.4	966,500	15.90
Sugarbeets	2007	Minnesota	Sibley	2,100	2,100	29.0	60,900	15.60
Sugarbeets	2007	Minnesota	Stearns	2,500	2,500	24.1	60,300	16.20
Sugarbeets	2007	Minnesota	D50 Combined Counties	2,000	2,000	27.4	54,700	16.00
Sugarbeets	2007	Minnesota	D50 Central	56,700	56,600	27.0	1,582,700	16.00
Sugarbeets	2007	Minnesota	Redwood	4,600	4,600	27.1	124,500	15.70
Sugarbeets	2007	Minnesota	D70 Combined Counties	500	500	20.0	10,000	16.20
Sugarbeets	2007	Minnesota	D70 Southwest	5,100	5,100	26.4	134,500	15.80
Sugarbeets	2007	Minnesota	D98 Combined Districts	600	600	28.0	16,800	16.00
Sugarbeets	**2007**	**Minnesota**	**State Total**	**486,000**	**481,000**	**23.8**	**11,448,000**	**17.50**
Sugarbeets	2007	Montana	Dawson	2,360	2,360	22.7	53,500	17.84
Sugarbeets	2007	Montana	Richland	13,900	13,840	24.0	331,500	15.10
Sugarbeets	2007	Montana	D30 Combined Counties	1,930	1,930	22.2	42,800	17.94
Sugarbeets	2007	Montana	D30 Northeast	18,190	18,130	23.6	427,800	15.06
Sugarbeets	2007	Montana	Big Horn	9,670	9,670	26.6	257,000	15.46
Sugarbeets	2007	Montana	Carbon	3,580	3,530	25.6	90,400	16.31
Sugarbeets	2007	Montana	Treasure	3,320	3,320	27.8	92,200	15.37
Sugarbeets	2007	Montana	Yellowstone	7,640	7,430	22.9	170,000	15.94
Sugarbeets	2007	Montana	D20 Combined Counties	180	180	31.7	5,700	16.00
Sugarbeets	2007	Montana	D20 South Central	24,390	24,130	25.5	615,300	15.71
Sugarbeets	2007	Montana	Custer	650	650	25.5	16,600	17.21
Sugarbeets	2007	Montana	Prairie	1,780	1,720	23.6	42,000	16.07
Sugarbeets	2007	Montana	D90 Combined Counties	2,490	2,310	25.7	59,300	15.63
Sugarbeets	2007	Montana	D90 Southeast	4,920	4,740	24.9	117,900	16.66
Sugarbeets	**2007**	**Montana**	**State Total**	**47,500**	**47,000**	**24.7**	**1,161,000**	**16.67**
Sugarbeets	2007	Nebraska	Box Butte	20,100	19,900	23.8	474,300	17.16
Sugarbeets	2007	Nebraska	Cheyenne	1,800	1,800	23.9	43,100	16.60
Sugarbeets	2007	Nebraska	Deuel	600	600	19.3	11,600	16.09
Sugarbeets	2007	Nebraska	Kimball	3,300	3,100	25.3	78,500	16.67
Sugarbeets	2007	Nebraska	Morrill	5,200	4,900	22.8	111,700	15.63
Sugarbeets	2007	Nebraska	Scotts Bluff	7,100	6,500	23.1	150,300	15.58
Sugarbeets	2007	Nebraska	Sheridan	2,900	2,400	23.0	55,200	16.54
Sugarbeets	2007	Nebraska	Sioux	500	500	26.2	13,100	15.79
Sugarbeets	2007	Nebraska	D10 Combined Counties	500	500	21.4	10,700	17.31
Sugarbeets	2007	Nebraska	D10 Northwest	42,000	40,200	23.6	948,500	16.61
Sugarbeets	2007	Nebraska	Chase	2,700	2,500	22.2	55,400	15.51
Sugarbeets	2007	Nebraska	Keith	2,000	1,300	23.2	30,200	16.08
Sugarbeets	2007	Nebraska	Perkins	800	300	23.0	6,900	15.17
Sugarbeets	2007	Nebraska	D70 Southwest	5,500	4,100	22.6	92,500	15.67
Sugarbeets	**2007**	**Nebraska**	**State Total**	**47,500**	**44,300**	**23.5**	**1,041,000**	**16.52**
Sugarbeets	2007	North Dakota	Williams	4,100	4,000	21.0	54,000	15.97
Sugarbeets	2007	North Dakota	D10 Northwest	4,100	4,000	21.0	54,000	15.97
Sugarbeets	2007	North Dakota	Grand Forks	30,900	30,600	25.5	780,000	17.06
Sugarbeets	2007	North Dakota	Pembina	79,100	78,200	22.9	1,791,000	15.25
Sugarbeets	2007	North Dakota	Walsh	44,000	43,100	23.5	1,014,000	15.19
Sugarbeets	2007	North Dakota	D30 Northeast	154,000	151,900	23.6	3,585,000	16.17
Sugarbeets	2007	North Dakota	McKenzie	10,500	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	D40 West Central	10,500	10,400	24.7	257,000	15.69
Sugarbeets	2007	North Dakota	Cass	24,600	23,800	22.5	535,000	17.46
Sugarbeets	2007	North Dakota	Steele	300	300	26.7	8,000	16.53
Sugarbeets	2007	North Dakota	Traill	27,400	26,600	24.1	641,000	17.66
Sugarbeets	2007	North Dakota	D60 East Central	52,300	50,700	23.4	1,184,000	17.56

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	North Dakota	Richland	30,400	29,400	19.7	580,000	17.08
Sugarbeets	2007	North Dakota	D90 Combined Counties	700	600	26.7	16,000	16.71
Sugarbeets	2007	North Dakota	D90 Southeast	31,100	30,000	19.9	596,000	17.07
Sugarbeets	**2007**	**North Dakota**	**State Total**	**252,000**	**247,000**	**23.1**	**5,706,000**	**17.96**
Sugarbeets	2007	Oregon	Union	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	D30 Northeast	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	Malheur	9,900	9,000	33.3	300,000	15.69
Sugarbeets	2007	Oregon	D80 Southeast	9,900	9,000	33.3	300,000	15.69
Sugarbeets	**2007**	**Oregon**	**State Total**	**12,000**	**11,000**	**31.9**	**351,000**	**16.65**
Sugarbeets	2007	Washington	Benton	2,000	2,000	42.0	84,000	16.38
Sugarbeets	2007	Washington	D20 Central	2,000	2,000	42.0	84,000	16.38
Sugarbeets	**2007**	**Washington**	**State Total**	**2,000**	**2,000**	**42.0**	**84,000**	**16.38**
Sugarbeets	2007	Wyoming	Big Horn	6,700	6,500	18.9	123,000	16.88
Sugarbeets	2007	Wyoming	Fremont	1,400	1,400	24.3	34,000	17.21
Sugarbeets	2007	Wyoming	Park	11,800	11,600	21.9	254,000	16.87
Sugarbeets	2007	Wyoming	Washakie	6,700	6,600	24.1	159,000	16.63
Sugarbeets	2007	Wyoming	D10 Northwest	26,600	26,100	21.8	570,000	16.83
Sugarbeets	2007	Wyoming	Goshen	1,200	1,200	23.5	28,200	16.14
Sugarbeets	2007	Wyoming	Laramie	800	800	21.1	16,900	16.34
Sugarbeets	2007	Wyoming	Platte	2,100	2,100	20.4	42,900	17.21
Sugarbeets	2007	Wyoming	D50 Southeast	4,200	4,100	21.5	88,000	16.70
Sugarbeets	**2007**	**Wyoming**	**State Total**	**30,800**	**30,200**	**21.8**	**658,000**	**16.81**
Sugarbeets	2006	California	Fresno	11,100	11,000	31.0	341,000	15.06
Sugarbeets	2006	California	Kern	3,900	3,900	34.4	134,000	14.75
Sugarbeets	2006	California	Kings	1,700	1,700	29.4	50,000	13.98
Sugarbeets	2006	California	Merced	2,400	2,400	29.2	70,000	15.00
Sugarbeets	2006	California	D51 Combined Counties	500	500	30.0	15,000	15.05
Sugarbeets	2006	California	D51 San Joaquin Valley	19,600	19,500	31.3	610,000	15.26
Sugarbeets	2006	California	Imperial	23,700	23,600	40.1	946,000	16.50
Sugarbeets	2006	California	D80 Southern California	23,700	23,600	40.1	946,000	16.50
Sugarbeets	**2006**	**California**	**State Total**	**43,300**	**43,100**	**36.1**	**1,556,000**	**16.01**
Sugarbeets	2006	Colorado	Boulder	1,000	700	11.1	7,800	16.45
Sugarbeets	2006	Colorado	Larimer	3,300	2,700	17.4	47,000	17.33
Sugarbeets	2006	Colorado	Logan	4,900	4,500	20.8	93,400	15.53
Sugarbeets	2006	Colorado	Morgan	2,300	2,300	25.9	59,500	15.86
Sugarbeets	2006	Colorado	Sedgwick	2,000	1,900	22.3	42,300	16.86
Sugarbeets	2006	Colorado	Weld	15,100	12,700	21.0	267,000	16.30
Sugarbeets	2006	Colorado	D20 Northeast	25,600	24,800	20.8	517,000	16.25
Sugarbeets	2006	Colorado	Adams	600	500	24.0	12,000	16.49
Sugarbeets	2006	Colorado	Kit Carson	600	600	28.7	17,200	16.31
Sugarbeets	2006	Colorado	Phillips	4,100	4,000	27.7	110,500	15.70
Sugarbeets	2006	Colorado	Washington	1,600	1,500	22.8	34,200	15.67
Sugarbeets	2006	Colorado	Yuma	6,600	6,600	30.0	197,500	16.09
Sugarbeets	2006	Colorado	D60 East Central	13,500	13,200	28.2	372,000	15.95
Sugarbeets	**2006**	**Colorado**	**State Total**	**42,100**	**38,000**	**23.4**	**889,000**	**16.09**
Sugarbeets	2006	Idaho	Ada	2,800	2,800	35.0	98,000	17.65
Sugarbeets	2006	Idaho	Canyon	11,400	11,300	34.6	391,000	16.45
Sugarbeets	2006	Idaho	Elmore	10,600	10,500	31.2	328,000	16.98
Sugarbeets	2006	Idaho	Owyhee	4,800	4,700	30.4	143,000	16.77
Sugarbeets	2006	Idaho	Washington	1,800	1,800	27.2	49,000	16.42
Sugarbeets	2006	Idaho	D70 Combined Counties	1,500	1,400	29.3	41,000	16.64
Sugarbeets	2006	Idaho	D70 Southwest	33,000	32,500	32.3	1,050,000	16.79
Sugarbeets	2006	Idaho	Cassia	33,800	33,600	30.5	1,025,000	17.42
Sugarbeets	2006	Idaho	Jerome	15,100	15,000	30.5	458,000	17.43
Sugarbeets	2006	Idaho	Lincoln	5,900	5,900	28.1	166,000	17.82
Sugarbeets	2006	Idaho	Minidoka	47,500	47,400	31.3	1,484,000	17.31
Sugarbeets	2006	Idaho	Twin Falls	12,800	12,700	32.5	413,000	17.02
Sugarbeets	2006	Idaho	D80 Combined Counties	2,900	2,900	33.4	97,000	16.68
Sugarbeets	2006	Idaho	D80 South Central	118,000	117,500	31.0	3,643,000	17.33
Sugarbeets	2006	Idaho	Bingham	23,200	23,200	33.9	786,000	17.22
Sugarbeets	2006	Idaho	Power	13,800	13,800	32.5	449,000	17.15
Sugarbeets	2006	Idaho	D90 East	37,000	37,000	33.4	1,235,000	17.19
Sugarbeets	**2006**	**Idaho**	**State Total**	**188,000**	**187,000**	**31.7**	**5,928,000**	**17.11**
Sugarbeets	2006	Michigan	D30 Combined Counties	500	500	16.0	8,000	17.50
Sugarbeets	2006	Michigan	D30 Northeast	500	500	16.0	8,000	17.50
Sugarbeets	2006	Michigan	Gladwin	1,000	1,000	19.0	19,000	16.50
Sugarbeets	2006	Michigan	Gratiot	11,600	11,200	18.8	210,000	17.80
Sugarbeets	2006	Michigan	Midland	4,000	3,900	19.2	75,000	16.10
Sugarbeets	2006	Michigan	D50 Combined Counties	900	900	17.8	16,000	17.20
Sugarbeets	2006	Michigan	D50 Central	17,500	17,000	18.8	320,000	17.90
Sugarbeets	2006	Michigan	Arenac	3,500	3,500	21.1	74,000	16.30
Sugarbeets	2006	Michigan	Bay	14,700	14,600	20.3	296,000	15.10
Sugarbeets	2006	Michigan	Huron	55,500	55,400	24.9	1,380,000	15.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	North Dakota	Richland	30,400	29,400	19.7	580,000	17.08
Sugarbeets	2007	North Dakota	D90 Combined Counties	700	600	26.7	16,000	16.71
Sugarbeets	2007	North Dakota	D90 Southeast	31,100	30,000	19.9	596,000	17.07
Sugarbeets	**2007**	**North Dakota**	**State Total**	**252,000**	**247,000**	**23.1**	**5,706,000**	**17.96**
Sugarbeets	2007	Oregon	Union	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	D30 Northeast	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	Malheur	9,900	9,000	33.3	300,000	15.69
Sugarbeets	2007	Oregon	D80 Southeast	9,900	9,000	33.3	300,000	15.69
Sugarbeets	**2007**	**Oregon**	**State Total**	**12,000**	**11,000**	**31.9**	**351,000**	**16.65**
Sugarbeets	2007	Washington	Benton	2,000	2,000	42.0	84,000	16.38
Sugarbeets	2007	Washington	D20 Central	2,000	2,000	42.0	84,000	16.38
Sugarbeets	**2007**	**Washington**	**State Total**	**2,000**	**2,000**	**42.0**	**84,000**	**16.38**
Sugarbeets	2007	Wyoming	Big Horn	6,700	6,500	18.9	123,000	16.88
Sugarbeets	2007	Wyoming	Fremont	1,400	1,400	24.3	34,000	17.21
Sugarbeets	2007	Wyoming	Park	11,800	11,600	21.9	254,000	16.87
Sugarbeets	2007	Wyoming	Washakie	6,700	6,600	24.1	159,000	16.63
Sugarbeets	2007	Wyoming	D10 Northwest	26,600	26,100	21.8	570,000	16.83
Sugarbeets	2007	Wyoming	Goshen	1,200	1,200	23.5	28,200	16.14
Sugarbeets	2007	Wyoming	Laramie	900	800	21.1	16,900	16.34
Sugarbeets	2007	Wyoming	Platte	2,100	2,100	20.4	42,900	17.21
Sugarbeets	2007	Wyoming	D50 Southeast	4,200	4,100	21.5	88,000	16.70
Sugarbeets	**2007**	**Wyoming**	**State Total**	**30,800**	**30,200**	**21.8**	**658,000**	**16.81**
Sugarbeets	2006	California	Fresno	11,100	11,000	31.0	341,000	15.06
Sugarbeets	2006	California	Kern	3,900	3,900	34.4	134,000	14.75
Sugarbeets	2006	California	Kings	1,700	1,700	29.4	50,000	13.98
Sugarbeets	2006	California	Merced	2,400	2,400	29.2	70,000	15.00
Sugarbeets	2006	California	D51 Combined Counties	500	500	30.0	15,000	15.05
Sugarbeets	2006	California	D51 San Joaquin Valley	19,600	19,500	31.3	610,000	15.26
Sugarbeets	2006	California	Imperial	23,700	23,600	40.1	946,000	16.50
Sugarbeets	2006	California	D80 Southern California	23,700	23,600	40.1	946,000	16.50
Sugarbeets	**2006**	**California**	**State Total**	**43,300**	**43,100**	**36.1**	**1,556,000**	**16.01**
Sugarbeets	2006	Colorado	Boulder	1,000	700	11.1	7,800	16.45
Sugarbeets	2006	Colorado	Larimer	3,300	2,700	17.4	47,000	17.33
Sugarbeets	2006	Colorado	Logan	4,900	4,500	20.8	93,400	15.53
Sugarbeets	2006	Colorado	Morgan	2,300	2,300	25.9	59,500	15.86
Sugarbeets	2006	Colorado	Sedgwick	2,000	1,900	22.3	42,300	16.86
Sugarbeets	2006	Colorado	Weld	15,100	12,700	21.0	267,000	16.30
Sugarbeets	2006	Colorado	D20 Northeast	25,600	24,800	20.8	517,000	16.25
Sugarbeets	2006	Colorado	Adams	600	500	24.0	12,000	16.49
Sugarbeets	2006	Colorado	Kit Carson	600	600	28.7	17,200	16.31
Sugarbeets	2006	Colorado	Phillips	4,100	4,000	27.7	110,500	15.70
Sugarbeets	2006	Colorado	Washington	1,600	1,500	22.8	34,200	15.57
Sugarbeets	2006	Colorado	Yuma	6,600	6,600	30.0	197,500	16.09
Sugarbeets	2006	Colorado	D80 East Central	13,500	13,200	25.2	372,000	15.95
Sugarbeets	**2006**	**Colorado**	**State Total**	**42,100**	**38,000**	**23.4**	**889,000**	**16.09**
Sugarbeets	2006	Idaho	Ada	2,800	2,800	35.0	98,000	17.65
Sugarbeets	2006	Idaho	Canyon	11,400	11,300	34.6	391,000	16.45
Sugarbeets	2006	Idaho	Elmore	10,600	10,500	31.2	328,000	16.96
Sugarbeets	2006	Idaho	Owyhee	4,800	4,700	30.4	143,000	16.77
Sugarbeets	2006	Idaho	Washington	1,900	1,800	27.2	49,000	16.42
Sugarbeets	2006	Idaho	D70 Combined Counties	1,500	1,400	29.3	41,000	16.84
Sugarbeets	2006	Idaho	D70 Southwest	33,000	32,500	32.3	1,050,000	16.79
Sugarbeets	2006	Idaho	Cassia	33,800	33,600	30.5	1,025,000	17.42
Sugarbeets	2006	Idaho	Jerome	15,100	15,000	30.6	459,000	17.43
Sugarbeets	2006	Idaho	Lincoln	5,900	5,900	28.1	166,000	17.62
Sugarbeets	2006	Idaho	Minidoka	47,500	47,400	31.3	1,484,000	17.31
Sugarbeets	2006	Idaho	Twin Falls	12,800	12,700	32.5	413,000	17.02
Sugarbeets	2006	Idaho	D80 Combined Counties	2,900	2,900	33.4	97,000	16.86
Sugarbeets	2006	Idaho	D80 South Central	118,000	117,500	31.0	3,643,000	17.33
Sugarbeets	2006	Idaho	Bingham	23,200	23,200	33.9	786,000	17.22
Sugarbeets	2006	Idaho	Power	13,800	13,800	32.5	449,000	17.15
Sugarbeets	2006	Idaho	D90 East	37,000	37,000	33.4	1,235,000	17.19
Sugarbeets	**2006**	**Idaho**	**State Total**	**188,000**	**187,000**	**31.7**	**5,928,000**	**17.11**
Sugarbeets	2006	Michigan	D30 Combined Counties	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	D30 Northeast	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	Gladwin	1,000	1,000	19.0	19,000	15.50
Sugarbeets	2006	Michigan	Gratiot	11,600	11,200	18.8	210,000	17.80
Sugarbeets	2006	Michigan	Midland	4,000	3,900	19.2	75,000	15.10
Sugarbeets	2006	Michigan	D50 Combined Counties	900	900	17.8	16,000	17.20
Sugarbeets	2006	Michigan	D50 Central	17,500	17,000	18.8	320,000	17.90
Sugarbeets	2006	Michigan	Arenac	3,500	3,500	21.1	74,000	15.30
Sugarbeets	2006	Michigan	Bay	14,700	14,600	20.3	296,000	15.10
Sugarbeets	2006	Michigan	Huron	55,500	55,400	24.9	1,380,000	15.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	North Dakota	Richland	30,400	29,400	19.7	580,000	17.06
Sugarbeets	2007	North Dakota	D90 Combined Counties	700	600	26.7	16,000	16.71
Sugarbeets	2007	North Dakota	D90 Southeast	31,100	30,000	19.9	596,000	17.07
Sugarbeets	**2007**	**North Dakota**	**State Total**	**252,000**	**247,000**	**23.1**	**5,706,000**	**17.96**
Sugarbeets	2007	Oregon	Union	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	D30 Northeast	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	Malheur	9,900	9,000	33.3	300,000	15.69
Sugarbeets	2007	Oregon	D80 Southeast	9,900	9,000	33.3	300,000	15.69
Sugarbeets	**2007**	**Oregon**	**State Total**	**12,000**	**11,000**	**31.9**	**351,000**	**16.65**
Sugarbeets	2007	Washington	Benton	2,000	2,000	42.0	84,000	16.38
Sugarbeets	2007	Washington	D20 Central	2,000	2,000	42.0	84,000	16.38
Sugarbeets	**2007**	**Washington**	**State Total**	**2,000**	**2,000**	**42.0**	**84,000**	**16.38**
Sugarbeets	2007	Wyoming	Big Horn	6,700	6,500	18.9	123,000	16.88
Sugarbeets	2007	Wyoming	Fremont	1,400	1,400	24.3	34,000	17.21
Sugarbeets	2007	Wyoming	Park	11,800	11,600	21.9	254,000	16.87
Sugarbeets	2007	Wyoming	Washakie	6,700	6,600	24.1	159,000	16.63
Sugarbeets	2007	Wyoming	D10 Northwest	26,600	26,100	21.8	570,000	16.83
Sugarbeets	2007	Wyoming	Goshen	1,200	1,200	23.5	28,200	16.14
Sugarbeets	2007	Wyoming	Laramie	900	800	21.1	16,900	16.34
Sugarbeets	2007	Wyoming	Platte	2,100	2,100	20.4	42,900	17.21
Sugarbeets	2007	Wyoming	D50 Southeast	4,200	4,100	21.5	88,000	16.70
Sugarbeets	**2007**	**Wyoming**	**State Total**	**30,800**	**30,200**	**21.8**	**658,000**	**16.81**
Sugarbeets	2006	California	Fresno	11,100	11,000	31.0	341,000	15.06
Sugarbeets	2006	California	Kern	3,900	3,900	34.4	134,000	14.76
Sugarbeets	2006	California	Kings	1,700	1,700	29.4	50,000	13.98
Sugarbeets	2006	California	Merced	2,400	2,400	29.2	70,000	15.00
Sugarbeets	2006	California	D51 Combined Counties	500	500	30.0	15,000	15.05
Sugarbeets	2006	California	D51 San Joaquin Valley	19,600	19,500	31.3	610,000	15.26
Sugarbeets	2006	California	Imperial	23,700	23,600	40.1	946,000	16.50
Sugarbeets	2006	California	D80 Southern California	23,700	23,600	40.1	946,000	16.50
Sugarbeets	**2006**	**California**	**State Total**	**43,300**	**43,100**	**36.1**	**1,556,000**	**16.01**
Sugarbeets	2006	Colorado	Boulder	1,000	700	11.1	7,600	16.45
Sugarbeets	2006	Colorado	Larimer	3,300	2,700	17.4	47,000	17.33
Sugarbeets	2006	Colorado	Logan	4,900	4,500	20.8	93,400	15.53
Sugarbeets	2006	Colorado	Morgan	2,300	2,300	25.9	59,500	15.86
Sugarbeets	2006	Colorado	Sedgwick	2,000	1,900	22.3	42,300	16.86
Sugarbeets	2006	Colorado	Weld	15,100	12,700	21.0	267,000	16.30
Sugarbeets	2006	Colorado	D20 Northeast	28,600	24,800	20.8	517,000	16.25
Sugarbeets	2006	Colorado	Adams	600	500	24.0	12,000	16.49
Sugarbeets	2006	Colorado	Kit Carson	600	600	28.7	17,200	16.31
Sugarbeets	2006	Colorado	Phillips	4,100	4,000	27.7	110,600	15.70
Sugarbeets	2006	Colorado	Washington	1,600	1,500	22.8	34,200	15.57
Sugarbeets	2006	Colorado	Yuma	6,600	6,600	30.0	197,600	16.09
Sugarbeets	2006	Colorado	D60 East Central	13,500	13,200	28.2	372,000	15.95
Sugarbeets	**2006**	**Colorado**	**State Total**	**42,100**	**38,000**	**23.4**	**889,000**	**16.09**
Sugarbeets	2006	Idaho	Ada	2,800	2,800	35.0	98,000	17.65
Sugarbeets	2006	Idaho	Canyon	11,400	11,300	34.6	391,000	16.45
Sugarbeets	2006	Idaho	Elmore	10,600	10,500	31.2	328,000	16.98
Sugarbeets	2006	Idaho	Owyhee	4,800	4,700	30.4	143,000	16.77
Sugarbeets	2006	Idaho	Washington	1,900	1,800	27.2	49,000	16.42
Sugarbeets	2006	Idaho	D70 Combined Counties	1,500	1,400	29.3	41,000	16.84
Sugarbeets	2006	Idaho	D70 Southwest	33,000	32,500	32.3	1,050,000	16.79
Sugarbeets	2006	Idaho	Cassia	33,800	33,600	30.5	1,025,000	17.42
Sugarbeets	2006	Idaho	Jerome	15,100	15,000	30.5	458,000	17.43
Sugarbeets	2006	Idaho	Lincoln	5,900	5,900	28.1	166,000	17.62
Sugarbeets	2006	Idaho	Minidoka	47,500	47,400	31.3	1,484,000	17.31
Sugarbeets	2006	Idaho	Twin Falls	12,800	12,700	32.5	413,000	17.02
Sugarbeets	2006	Idaho	D80 Combined Counties	2,900	2,900	33.4	97,000	16.66
Sugarbeets	2006	Idaho	D80 South Central	118,000	117,500	31.0	3,643,000	17.33
Sugarbeets	2006	Idaho	Bingham	23,200	23,200	33.9	786,000	17.22
Sugarbeets	2006	Idaho	Power	13,800	13,800	32.5	449,000	17.15
Sugarbeets	2006	Idaho	D90 East	37,000	37,000	33.4	1,235,000	17.19
Sugarbeets	**2006**	**Idaho**	**State Total**	**188,000**	**187,000**	**31.7**	**5,928,000**	**17.11**
Sugarbeets	2006	Michigan	D30 Combined Counties	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	D30 Northeast	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	Gladwin	1,000	1,000	19.0	19,000	15.50
Sugarbeets	2006	Michigan	Gratiot	11,600	11,200	18.8	210,000	17.80
Sugarbeets	2006	Michigan	Midland	4,000	3,900	19.2	75,000	15.10
Sugarbeets	2006	Michigan	D50 Combined Counties	900	900	17.8	16,000	17.20
Sugarbeets	2006	Michigan	D50 Central	17,500	17,000	18.8	320,000	17.90
Sugarbeets	2006	Michigan	Arenac	3,500	3,500	21.1	74,000	15.30
Sugarbeets	2006	Michigan	Bay	14,700	14,600	20.3	296,000	15.10
Sugarbeets	2006	Michigan	Huron	55,500	55,400	24.9	1,380,000	15.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2007	North Dakota	Richland	30,400	29,400	19.7	580,000	17.08
Sugarbeets	2007	North Dakota	D90 Combined Counties	700	600	26.7	16,000	16.71
Sugarbeets	2007	North Dakota	D90 Southeast	31,100	30,000	19.9	596,000	17.07
Sugarbeets	**2007**	**North Dakota**	**State Total**	**252,000**	**247,000**	**23.1**	**5,706,000**	**17.96**
Sugarbeets	2007	Oregon	Union	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	D30 Northeast	2,100	2,000	25.5	51,000	16.91
Sugarbeets	2007	Oregon	Malheur	9,900	9,000	33.3	300,000	15.69
Sugarbeets	2007	Oregon	D80 Southeast	9,900	9,000	33.3	300,000	15.69
Sugarbeets	**2007**	**Oregon**	**State Total**	**12,000**	**11,000**	**31.9**	**351,000**	**16.65**
Sugarbeets	2007	Washington	Benton	2,000	2,000	42.0	84,000	16.38
Sugarbeets	2007	Washington	D20 Central	2,000	2,000	42.0	84,000	16.38
Sugarbeets	**2007**	**Washington**	**State Total**	**2,000**	**2,000**	**42.0**	**84,000**	**16.38**
Sugarbeets	2007	Wyoming	Big Horn	6,700	6,500	18.9	123,000	16.88
Sugarbeets	2007	Wyoming	Fremont	1,400	1,400	24.3	34,000	17.21
Sugarbeets	2007	Wyoming	Park	11,600	11,600	21.9	254,000	16.67
Sugarbeets	2007	Wyoming	Washakie	6,700	6,600	24.1	159,000	16.63
Sugarbeets	2007	Wyoming	D10 Northwest	26,600	26,100	21.8	570,000	16.83
Sugarbeets	2007	Wyoming	Goshen	1,200	1,200	23.5	28,200	16.14
Sugarbeets	2007	Wyoming	Laramie	900	800	21.1	16,900	16.34
Sugarbeets	2007	Wyoming	Platte	2,100	2,100	20.4	42,900	17.21
Sugarbeets	2007	Wyoming	D50 Southeast	4,200	4,100	21.5	88,000	16.70
Sugarbeets	**2007**	**Wyoming**	**State Total**	**30,800**	**30,200**	**21.8**	**658,000**	**16.81**
Sugarbeets	2006	California	Fresno	11,100	11,000	31.0	341,000	15.06
Sugarbeets	2006	California	Kern	3,900	3,900	34.4	134,000	14.75
Sugarbeets	2006	California	Kings	1,700	1,700	29.4	50,000	13.88
Sugarbeets	2006	California	Merced	2,400	2,400	29.2	70,000	15.00
Sugarbeets	2006	California	D51 Combined Counties	500	500	30.0	15,000	15.05
Sugarbeets	2006	California	D51 San Joaquin Valley	19,600	19,500	31.3	610,000	15.26
Sugarbeets	2006	California	Imperial	23,700	23,600	40.1	946,000	16.50
Sugarbeets	2006	California	D80 Southern California	23,700	23,600	40.1	946,000	16.50
Sugarbeets	**2006**	**California**	**State Total**	**43,300**	**43,100**	**36.1**	**1,556,000**	**16.01**
Sugarbeets	2006	Colorado	Boulder	1,000	700	11.1	7,800	16.45
Sugarbeets	2006	Colorado	Larimer	3,300	2,700	17.4	47,000	17.33
Sugarbeets	2006	Colorado	Logan	4,900	4,500	20.8	93,400	15.53
Sugarbeets	2006	Colorado	Morgan	2,300	2,300	25.9	59,500	15.86
Sugarbeets	2006	Colorado	Sedgwick	2,000	1,900	22.3	42,300	16.86
Sugarbeets	2006	Colorado	Weld	15,100	12,700	21.0	267,000	16.30
Sugarbeets	2006	Colorado	D20 Northeast	25,600	24,800	20.8	517,000	16.25
Sugarbeets	2006	Colorado	Adams	600	500	24.0	12,000	16.49
Sugarbeets	2006	Colorado	Kit Carson	600	600	28.7	17,200	16.31
Sugarbeets	2006	Colorado	Phillips	4,100	4,000	27.7	110,500	15.70
Sugarbeets	2006	Colorado	Washington	1,600	1,500	22.8	34,200	15.67
Sugarbeets	2006	Colorado	Yuma	6,600	6,600	30.0	197,500	16.09
Sugarbeets	2006	Colorado	D60 East Central	13,500	13,200	25.2	372,000	15.95
Sugarbeets	**2006**	**Colorado**	**State Total**	**42,100**	**38,000**	**23.4**	**889,000**	**16.09**
Sugarbeets	2006	Idaho	Ada	2,800	2,800	35.0	98,000	17.65
Sugarbeets	2006	Idaho	Canyon	11,400	11,300	34.6	391,000	16.45
Sugarbeets	2006	Idaho	Elmore	10,600	10,500	31.2	328,000	16.98
Sugarbeets	2006	Idaho	Owyhee	4,800	4,700	30.4	143,000	16.77
Sugarbeets	2006	Idaho	Washington	1,900	1,800	27.2	49,000	16.42
Sugarbeets	2006	Idaho	D70 Combined Counties	1,500	1,400	29.3	41,000	16.84
Sugarbeets	2006	Idaho	D70 Southwest	33,000	32,600	32.3	1,050,000	16.79
Sugarbeets	2006	Idaho	Cassia	33,600	33,600	30.5	1,025,000	17.42
Sugarbeets	2006	Idaho	Jerome	15,100	15,000	30.5	458,000	17.43
Sugarbeets	2006	Idaho	Lincoln	5,900	5,900	28.1	166,000	17.62
Sugarbeets	2006	Idaho	Minidoka	47,500	47,400	31.3	1,484,000	17.31
Sugarbeets	2006	Idaho	Twin Falls	12,800	12,700	32.5	413,000	17.02
Sugarbeets	2006	Idaho	D80 Combined Counties	2,900	2,900	33.4	97,000	16.68
Sugarbeets	2006	Idaho	D80 South Central	118,000	117,500	31.0	3,643,000	17.33
Sugarbeets	2006	Idaho	Bingham	23,200	23,200	33.9	786,000	17.22
Sugarbeets	2006	Idaho	Power	13,800	13,800	32.5	449,000	17.16
Sugarbeets	2006	Idaho	D90 East	37,000	37,000	33.4	1,235,000	17.19
Sugarbeets	**2006**	**Idaho**	**State Total**	**188,000**	**187,000**	**31.7**	**5,928,000**	**17.11**
Sugarbeets	2006	Michigan	D30 Combined Counties	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	D30 Northeast	500	500	18.0	9,000	17.50
Sugarbeets	2006	Michigan	Gladwin	1,000	1,000	19.0	19,000	16.50
Sugarbeets	2006	Michigan	Gratiot	11,600	11,200	18.8	210,000	17.80
Sugarbeets	2006	Michigan	Midland	4,000	3,900	19.2	75,000	15.10
Sugarbeets	2006	Michigan	D50 Combined Counties	900	900	17.8	16,000	17.20
Sugarbeets	2006	Michigan	D50 Central	17,500	17,000	18.8	320,000	17.00
Sugarbeets	2006	Michigan	Arenac	3,500	3,500	21.1	74,000	16.30
Sugarbeets	2006	Michigan	Bay	14,700	14,600	20.3	296,000	16.10
Sugarbeets	2006	Michigan	Huron	55,500	55,400	24.9	1,380,000	16.30

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Michigan	Saginaw	17,000	16,900	22.4	378,000	17.80
Sugarbeets	2006	Michigan	Sanilac	20,200	20,100	24.8	498,000	17.30
Sugarbeets	2006	Michigan	Tuscola	21,100	21,000	24.5	514,000	19.20
Sugarbeets	2006	Michigan	D60 East Central	132,000	131,500	23.9	3,140,000	16.10
Sugarbeets	2006	Michigan	Clinton	1,500	1,500	18.7	28,000	15.30
Sugarbeets	2006	Michigan	Ionia	500	500	22.0	11,000	21.10
Sugarbeets	2006	Michigan	Shiawassee	800	800	20.0	16,000	17.60
Sugarbeets	2006	Michigan	D80 South Central	2,800	2,800	19.6	55,000	15.70
Sugarbeets	2006	Michigan	Lapeer	900	900	24.4	22,000	17.30
Sugarbeets	2006	Michigan	D90 Combined Counties	1,300	1,300	20.8	27,000	17.20
Sugarbeets	2006	Michigan	D90 Southeast	2,200	2,200	22.3	49,000	17.20
Sugarbeets	**2006**	**Michigan**	**State Total**	**155,000**	**154,000**	**23.2**	**3,573,000**	**16.10**
Sugarbeets	2006	Minnesota	Becker	10,400	9,800	27.2	266,500	15.40
Sugarbeets	2006	Minnesota	Clay	56,400	52,700	25.9	1,367,100	16.10
Sugarbeets	2006	Minnesota	Kittson	36,500	36,100	23.5	825,300	18.00
Sugarbeets	2006	Minnesota	Mahnomen	5,100	4,400	24.1	105,900	15.20
Sugarbeets	2006	Minnesota	Marshall	45,700	41,500	22.9	949,300	16.50
Sugarbeets	2006	Minnesota	Norman	46,200	42,100	26.3	1,106,200	17.80
Sugarbeets	2006	Minnesota	Polk	102,400	93,300	24.8	2,314,500	15.00
Sugarbeets	2006	Minnesota	Red Lake	1,900	1,700	22.8	38,700	17.70
Sugarbeets	2006	Minnesota	D10 Combined Counties	400	400	22.3	8,900	17.90
Sugarbeets	2006	Minnesota	D10 Northwest	307,000	281,000	24.8	6,952,500	16.20
Sugarbeets	2006	Minnesota	Chippewa	32,200	32,200	23.2	747,300	16.50
Sugarbeets	2006	Minnesota	Grant	11,600	11,500	23.4	269,400	16.80
Sugarbeets	2006	Minnesota	Otter Tail	4,400	4,300	27.4	118,000	16.80
Sugarbeets	2006	Minnesota	Pope	3,600	3,600	24.8	89,400	16.90
Sugarbeets	2006	Minnesota	Stevens	4,100	4,100	25.5	104,700	17.00
Sugarbeets	2006	Minnesota	Swift	5,900	5,900	23.8	140,700	16.80
Sugarbeets	2006	Minnesota	Traverse	9,600	9,500	24.6	234,000	16.90
Sugarbeets	2006	Minnesota	Wilkin	50,900	50,400	26.7	1,343,400	17.20
Sugarbeets	2006	Minnesota	Yellow Medicine	3,600	3,600	23.8	85,700	16.70
Sugarbeets	2006	Minnesota	D40 Combined Counties	1,100	1,100	23.8	26,200	16.90
Sugarbeets	2006	Minnesota	D40 West Central	127,000	126,200	25.0	3,158,500	16.90
Sugarbeets	2006	Minnesota	Kandiyohi	16,400	16,300	25.6	416,600	16.60
Sugarbeets	2006	Minnesota	McLeod	2,700	2,700	22.6	61,000	16.90
Sugarbeets	2006	Minnesota	Meeker	2,300	2,300	25.5	58,600	16.80
Sugarbeets	2006	Minnesota	Renville	39,400	39,300	24.8	975,400	16.70
Sugarbeets	2006	Minnesota	Sibley	2,300	2,300	25.4	58,500	16.80
Sugarbeets	2006	Minnesota	Stearns	2,100	2,100	26.2	55,000	16.30
Sugarbeets	2006	Minnesota	D50 Central	65,200	65,000	25.0	1,625,100	16.70
Sugarbeets	2006	Minnesota	Redwood	3,800	3,800	23.3	88,500	16.50
Sugarbeets	2006	Minnesota	D70 Combined Counties	600	600	24.2	14,500	17.10
Sugarbeets	2006	Minnesota	D70 Southwest	4,400	4,400	23.4	103,000	16.60
Sugarbeets	2006	Minnesota	D98 Combined Districts	400	400	18.3	7,300	17.20
Sugarbeets	**2006**	**Minnesota**	**State Total**	**504,000**	**477,000**	**24.9**	**11,877,000**	**17.60**
Sugarbeets	2006	Montana	Dawson	2,830	2,820	20.9	59,000	17.26
Sugarbeets	2006	Montana	Richland	15,530	15,450	25.0	387,000	17.58
Sugarbeets	2006	Montana	Roosevelt	2,180	2,160	26.4	57,000	17.67
Sugarbeets	2006	Montana	D30 Northeast	20,640	20,430	24.6	503,000	17.55
Sugarbeets	2006	Montana	Big Horn	8,880	7,900	31.0	245,000	15.51
Sugarbeets	2006	Montana	Carbon	4,560	4,490	24.9	112,000	16.29
Sugarbeets	2006	Montana	Treasure	3,660	3,090	31.4	97,000	15.70
Sugarbeets	2006	Montana	Yellowstone	9,420	7,830	28.2	220,500	15.81
Sugarbeets	2006	Montana	D80 Combined Counties	320	280	32.9	9,200	16.32
Sugarbeets	2006	Montana	D80 South Central	27,860	23,590	29.0	683,700	15.71
Sugarbeets	2006	Montana	Custer	1,160	1,010	27.1	27,400	16.64
Sugarbeets	2006	Montana	Prairie	1,600	1,570	21.8	34,300	17.78
Sugarbeets	2006	Montana	Rosebud	2,340	1,900	32.4	61,600	15.92
Sugarbeets	2006	Montana	D90 Southeast	5,100	4,420	27.6	123,300	16.56
Sugarbeets	**2006**	**Montana**	**State Total**	**53,600**	**48,500**	**27.0**	**1,310,000**	**16.50**
Sugarbeets	2006	Nebraska	Banner	800	700	16.4	11,500	17.76
Sugarbeets	2006	Nebraska	Box Butte	23,000	22,700	23.0	521,700	17.51
Sugarbeets	2006	Nebraska	Cheyenne	2,900	2,900	24.4	70,900	17.96
Sugarbeets	2006	Nebraska	Deuel	800	800	23.8	19,000	16.66
Sugarbeets	2006	Nebraska	Kimball	4,600	4,300	21.2	91,300	17.70
Sugarbeets	2006	Nebraska	Morrill	5,400	5,100	23.3	118,700	16.16
Sugarbeets	2006	Nebraska	Scotts Bluff	11,500	10,100	23.0	231,900	16.22
Sugarbeets	2006	Nebraska	Sheridan	3,700	3,000	22.4	67,100	17.06
Sugarbeets	2006	Nebraska	D10 Combined Counties	1,000	900	26.1	23,500	16.97
Sugarbeets	2006	Nebraska	D10 Northwest	53,700	50,500	22.9	1,155,500	17.11
Sugarbeets	2006	Nebraska	Chase	3,800	3,800	28.4	108,100	15.40
Sugarbeets	2006	Nebraska	Keith	1,900	1,600	23.6	37,700	16.76
Sugarbeets	2006	Nebraska	Perkins	1,900	1,900	24.1	45,700	16.40

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Nebraska	D70 Southwest	7,600	7,300	26.2	191,500	15.91
Sugarbeets	**2006**	**Nebraska**	**State Total**	**61,300**	**57,800**	**23.3**	**1,347,000**	**16.94**
Sugarbeets	2006	North Dakota	Williams	4,500	4,500	23.8	107,000	17.98
Sugarbeets	2006	North Dakota	D10 Northwest	4,500	4,500	23.8	107,000	17.98
Sugarbeets	2006	North Dakota	Grand Forks	32,900	30,400	27.0	822,000	17.65
Sugarbeets	2006	North Dakota	Pembina	79,700	73,200	25.9	1,522,000	15.59
Sugarbeets	2006	North Dakota	Walsh	45,600	41,600	25.3	1,054,000	15.44
Sugarbeets	2006	North Dakota	D30 Northeast	158,200	145,200	26.0	3,782,000	16.34
Sugarbeets	2006	North Dakota	McKenzie	10,800	10,700	25.4	272,000	17.78
Sugarbeets	2006	North Dakota	D40 West Central	10,800	10,700	25.4	272,000	17.76
Sugarbeets	2006	North Dakota	Cass	26,700	24,700	26.4	651,000	17.94
Sugarbeets	2006	North Dakota	Traill	29,200	26,900	27.1	730,000	17.58
Sugarbeets	2006	North Dakota	D60 Combined Counties	200	100	30.0	3,000	17.24
Sugarbeets	2006	North Dakota	D60 East Central	56,100	51,700	26.8	1,384,000	17.75
Sugarbeets	2006	North Dakota	Ransom	100	100	30.0	3,000	16.63
Sugarbeets	2006	North Dakota	Richland	31,300	30,800	25.4	753,000	16.99
Sugarbeets	2006	North Dakota	D90 Southeast	31,400	30,900	25.4	756,000	16.99
Sugarbeets	**2006**	**North Dakota**	**State Total**	**261,000**	**243,000**	**26.0**	**6,318,000**	**18.01**
Sugarbeets	2006	Oregon	Union	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	D30 Northeast	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	Malheur	10,800	10,800	31.3	337,700	16.08
Sugarbeets	2006	Oregon	D80 Southeast	10,800	10,200	31.3	337,700	16.08
Sugarbeets	**2006**	**Oregon**	**State Total**	**13,100**	**13,100**	**30.1**	**394,000**	**17.15**
Sugarbeets	2006	Washington	Benton	2,000	2,000	37.0	74,000	16.40
Sugarbeets	2006	Washington	D20 Central	2,000	2,000	37.0	74,000	16.40
Sugarbeets	**2006**	**Washington**	**State Total**	**2,000**	**2,000**	**37.0**	**74,000**	**16.40**
Sugarbeets	2006	Wyoming	Big Horn	12,400	11,300	18.0	203,500	17.00
Sugarbeets	2006	Wyoming	Fremont	2,900	2,200	18.7	41,200	17.13
Sugarbeets	2006	Wyoming	Park	12,700	12,600	22.2	280,000	17.10
Sugarbeets	2006	Wyoming	Washakie	9,400	9,100	19.6	178,000	17.23
Sugarbeets	2006	Wyoming	D10 Northwest	37,400	35,200	20.0	703,000	17.10
Sugarbeets	2006	Wyoming	Goshen	1,600	1,400	21.9	30,600	17.35
Sugarbeets	2006	Wyoming	Laramie	1,000	900	20.7	18,600	17.48
Sugarbeets	2006	Wyoming	Platte	2,800	2,600	17.6	45,800	15.27
Sugarbeets	2006	Wyoming	D80 Southeast	5,400	4,900	19.4	95,000	17.81
Sugarbeets	**2006**	**Wyoming**	**State Total**	**42,800**	**40,100**	**19.9**	**798,000**	**17.18**
Sugarbeets	2005	California	Fresno	11,000	10,700	35.5	380,000	14.72
Sugarbeets	2005	California	Kern	4,700	4,700	40.4	190,000	14.07
Sugarbeets	2005	California	Kings	800	800	28.8	23,000	15.22
Sugarbeets	2005	California	Merced	3,600	3,600	31.1	112,000	15.43
Sugarbeets	2005	California	D51 Combined Counties	900	900	31.1	28,000	14.95
Sugarbeets	2005	California	D51 San Joaquin Valley	21,000	20,700	35.4	733,000	14.68
Sugarbeets	2005	California	Imperial	23,400	23,400	35.6	903,000	16.68
Sugarbeets	2005	California	D80 Southern California	23,400	23,400	35.6	903,000	16.68
Sugarbeets	**2005**	**California**	**State Total**	**44,400**	**44,100**	**37.1**	**1,636,000**	**15.79**
Sugarbeets	2005	Colorado	Boulder	700	600	25.3	15,200	16.83
Sugarbeets	2005	Colorado	Larimer	2,700	2,700	21.5	58,100	16.88
Sugarbeets	2005	Colorado	Logan	4,500	4,300	21.9	94,200	15.08
Sugarbeets	2005	Colorado	Morgan	2,400	2,200	26.0	57,100	15.43
Sugarbeets	2005	Colorado	Sedgwick	1,900	1,800	21.9	39,400	16.01
Sugarbeets	2005	Colorado	Weld	13,700	13,300	25.3	336,000	16.13
Sugarbeets	2005	Colorado	D20 Northeast	25,900	24,900	24.1	600,000	15.98
Sugarbeets	2005	Colorado	Adams	400	400	21.5	8,600	16.51
Sugarbeets	2005	Colorado	Kit Carson	500	500	23.8	11,900	15.34
Sugarbeets	2005	Colorado	Phillips	2,800	2,800	25.0	69,900	15.77
Sugarbeets	2005	Colorado	Washington	1,400	1,300	22.8	29,600	15.39
Sugarbeets	2005	Colorado	Yuma	5,400	4,400	25.7	113,000	15.45
Sugarbeets	2005	Colorado	D60 East Central	10,500	9,400	24.8	233,000	15.57
Sugarbeets	**2005**	**Colorado**	**State Total**	**36,400**	**34,300**	**24.3**	**833,000**	**15.87**
Sugarbeets	2005	Idaho	Ada	2,900	2,800	30.0	54,000	16.48
Sugarbeets	2005	Idaho	Canyon	10,100	9,900	29.9	296,000	16.45
Sugarbeets	2005	Idaho	Elmore	7,700	7,600	25.8	196,000	17.43
Sugarbeets	2005	Idaho	Owyhee	5,200	4,800	29.2	140,000	16.68
Sugarbeets	2005	Idaho	Payette	1,400	1,300	28.5	37,000	16.23
Sugarbeets	2005	Idaho	Washington	1,500	1,400	30.7	43,000	16.32
Sugarbeets	2005	Idaho	D70 Combined Counties	200	200	20.0	4,000	16.28
Sugarbeets	2005	Idaho	D70 Southwest	29,000	28,000	28.6	800,000	16.72
Sugarbeets	2005	Idaho	Cassia	30,600	30,500	26.8	817,000	17.84
Sugarbeets	2005	Idaho	Gooding	2,000	2,000	24.0	48,000	17.10
Sugarbeets	2005	Idaho	Jerome	14,000	13,900	25.2	350,000	17.90
Sugarbeets	2005	Idaho	Lincoln	5,000	7,800	24.0	157,000	17.85
Sugarbeets	2005	Idaho	Minidoka	42,600	42,400	26.0	1,104,000	17.82
Sugarbeets	2005	Idaho	Twin Falls	10,400	10,400	26.3	274,000	17.49

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Michigan	Saginaw	17,000	16,900	22.4	378,000	17.90
Sugarbeets	2006	Michigan	Sanilac	20,200	20,100	24.8	498,000	17.30
Sugarbeets	2006	Michigan	Tuscola	21,100	21,000	24.5	514,000	18.20
Sugarbeets	2006	Michigan	D60 East Central	132,000	131,500	23.9	3,140,000	18.10
Sugarbeets	2006	Michigan	Clinton	1,500	1,500	16.7	25,000	18.30
Sugarbeets	2006	Michigan	Ionia	500	500	22.0	11,000	21.10
Sugarbeets	2006	Michigan	Shiawassee	800	800	20.0	16,000	17.60
Sugarbeets	2006	Michigan	D20 South Central	2,800	2,800	19.6	55,000	18.70
Sugarbeets	2006	Michigan	Lapeer	900	900	24.4	22,000	17.30
Sugarbeets	2006	Michigan	D90 Combined Counties	1,300	1,300	20.8	27,000	17.20
Sugarbeets	2006	Michigan	D90 Southeast	2,200	2,200	22.3	49,000	17.20
Sugarbeets	**2006**	**Michigan**	**State Total**	**155,000**	**154,000**	**23.2**	**3,573,000**	**18.10**
Sugarbeets	2006	Minnesota	Becker	10,400	9,200	27.2	250,500	18.40
Sugarbeets	2006	Minnesota	Clay	56,400	52,700	25.9	1,367,100	18.10
Sugarbeets	2006	Minnesota	Kittson	36,500	35,100	23.5	825,300	18.00
Sugarbeets	2006	Minnesota	Mahnomen	5,100	4,400	24.1	105,900	18.20
Sugarbeets	2006	Minnesota	Marshall	45,700	41,500	22.9	949,300	18.50
Sugarbeets	2006	Minnesota	Norman	46,200	42,100	26.3	1,108,200	17.80
Sugarbeets	2006	Minnesota	Polk	102,400	93,300	24.8	2,314,600	18.00
Sugarbeets	2006	Minnesota	Red Lake	1,900	1,700	22.8	38,700	17.70
Sugarbeets	2006	Minnesota	D10 Combined Counties	400	400	22.3	8,900	17.90
Sugarbeets	2006	Minnesota	D10 Northwest	307,000	281,000	24.8	6,962,500	18.20
Sugarbeets	2006	Minnesota	Chippewa	32,200	32,200	23.2	747,300	16.50
Sugarbeets	2006	Minnesota	Grant	11,600	11,500	23.4	269,400	16.80
Sugarbeets	2006	Minnesota	Otter Tail	4,400	4,300	27.4	118,000	16.80
Sugarbeets	2006	Minnesota	Pope	3,800	3,600	24.8	89,400	16.80
Sugarbeets	2006	Minnesota	Stevens	4,100	4,100	25.5	104,700	17.00
Sugarbeets	2006	Minnesota	Swift	5,900	5,900	23.8	140,700	16.80
Sugarbeets	2006	Minnesota	Traverse	9,600	9,500	24.6	234,000	16.90
Sugarbeets	2006	Minnesota	Wilkin	50,900	50,400	26.7	1,343,400	17.20
Sugarbeets	2006	Minnesota	Yellow Medicine	3,600	3,600	23.8	85,700	16.70
Sugarbeets	2006	Minnesota	D40 Combined Counties	1,100	1,100	23.8	26,200	16.90
Sugarbeets	2006	Minnesota	D40 West Central	127,000	126,200	25.0	3,158,500	16.90
Sugarbeets	2006	Minnesota	Kandiyohi	16,400	16,300	25.6	416,600	16.60
Sugarbeets	2006	Minnesota	McLeod	2,700	2,700	22.6	61,000	16.90
Sugarbeets	2006	Minnesota	Meeker	2,300	2,300	25.5	58,600	16.80
Sugarbeets	2006	Minnesota	Renville	39,400	39,300	24.8	975,400	16.70
Sugarbeets	2006	Minnesota	Sibley	2,300	2,300	25.4	58,500	16.80
Sugarbeets	2006	Minnesota	Stearns	2,100	2,100	26.2	55,000	16.30
Sugarbeets	2006	Minnesota	D50 Central	65,200	65,000	25.0	1,625,100	16.70
Sugarbeets	2006	Minnesota	Redwood	3,800	3,800	23.3	88,500	16.50
Sugarbeets	2006	Minnesota	D70 Combined Counties	600	600	24.2	14,500	17.10
Sugarbeets	2006	Minnesota	D70 Southwest	4,400	4,400	23.4	103,000	16.60
Sugarbeets	2006	Minnesota	D98 Combined Districts	400	400	18.3	7,300	17.20
Sugarbeets	**2006**	**Minnesota**	**State Total**	**504,000**	**477,000**	**24.9**	**11,877,000**	**17.60**
Sugarbeets	2006	Montana	Dawson	2,830	2,820	20.9	59,000	17.26
Sugarbeets	2006	Montana	Richland	15,530	15,450	23.0	357,000	17.58
Sugarbeets	2006	Montana	Roosevelt	2,180	2,160	26.4	57,000	17.87
Sugarbeets	2006	Montana	D30 Northeast	20,640	20,430	24.6	502,000	17.55
Sugarbeets	2006	Montana	Big Horn	9,880	7,900	31.0	245,000	15.51
Sugarbeets	2006	Montana	Carbon	4,560	4,490	24.9	112,000	16.29
Sugarbeets	2006	Montana	Treasure	3,660	3,090	31.4	97,000	15.70
Sugarbeets	2006	Montana	Yellowstone	9,420	7,830	28.2	220,500	15.61
Sugarbeets	2006	Montana	D80 Combined Counties	320	280	32.9	9,200	16.32
Sugarbeets	2006	Montana	D80 South Central	27,880	23,590	28.0	663,700	15.71
Sugarbeets	2006	Montana	Custer	1,160	1,010	27.1	27,400	16.84
Sugarbeets	2006	Montana	Prairie	1,600	1,570	21.8	34,300	17.78
Sugarbeets	2006	Montana	Rosebud	2,340	1,900	32.4	61,600	15.92
Sugarbeets	2006	Montana	D90 Southeast	5,100	4,480	27.5	123,300	16.56
Sugarbeets	**2006**	**Montana**	**State Total**	**53,600**	**48,500**	**27.0**	**1,310,000**	**16.50**
Sugarbeets	2006	Nebraska	Banner	800	700	16.4	11,500	17.76
Sugarbeets	2006	Nebraska	Box Butte	23,000	22,700	23.0	521,700	17.51
Sugarbeets	2006	Nebraska	Cheyenne	2,900	2,900	24.4	70,800	17.98
Sugarbeets	2006	Nebraska	Deuel	800	800	23.8	19,000	16.66
Sugarbeets	2006	Nebraska	Kimball	4,800	4,300	21.2	91,300	17.70
Sugarbeets	2006	Nebraska	Morrill	5,400	5,100	23.3	118,700	16.16
Sugarbeets	2006	Nebraska	Scotts Bluff	11,500	10,100	23.0	231,500	16.22
Sugarbeets	2006	Nebraska	Sheridan	3,700	3,000	22.4	67,100	17.06
Sugarbeets	2006	Nebraska	D10 Combined Counties	1,000	900	26.1	23,500	16.87
Sugarbeets	2006	Nebraska	D10 Northwest	53,700	50,500	22.9	1,155,500	17.11
Sugarbeets	2006	Nebraska	Chase	3,800	3,800	28.4	108,100	15.40
Sugarbeets	2006	Nebraska	Keith	1,900	1,600	23.6	37,700	16.76
Sugarbeets	2006	Nebraska	Perkins	1,900	1,900	24.1	45,700	16.40

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Nebraska	D70 Southwest	7,800	7,300	26.2	191,500	15.91
Sugarbeets	**2006**	**Nebraska**	**State Total**	**61,300**	**57,800**	**23.3**	**1,347,000**	**16.94**
Sugarbeets	2006	North Dakota	Williams	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	D10 Northwest	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	Grand Forks	32,900	30,400	27.0	822,000	17.65
Sugarbeets	2006	North Dakota	Pembina	79,700	73,200	25.9	1,892,000	15.58
Sugarbeets	2006	North Dakota	Walsh	45,600	41,600	25.3	1,054,000	16.44
Sugarbeets	2006	North Dakota	D30 Northeast	158,200	145,200	26.0	3,769,000	16.34
Sugarbeets	2006	North Dakota	McKenzie	10,800	10,700	25.4	272,000	17.76
Sugarbeets	2006	North Dakota	D40 West Central	10,800	10,700	25.4	272,000	17.76
Sugarbeets	2006	North Dakota	Cass	26,700	24,700	26.4	651,000	17.94
Sugarbeets	2006	North Dakota	Traill	29,200	26,900	27.1	730,000	17.58
Sugarbeets	2006	North Dakota	D60 Combined Counties	200	100	30.0	3,000	17.24
Sugarbeets	2006	North Dakota	D60 East Central	56,100	51,700	26.8	1,384,000	17.75
Sugarbeets	2006	North Dakota	Ransom	100	100	30.0	3,000	16.83
Sugarbeets	2006	North Dakota	Richland	31,300	30,200	25.4	753,000	16.99
Sugarbeets	2006	North Dakota	D90 Southeast	31,400	30,900	25.4	756,000	16.99
Sugarbeets	**2006**	**North Dakota**	**State Total**	**261,000**	**243,000**	**26.0**	**6,318,000**	**18.01**
Sugarbeets	2006	Oregon	Union	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	D30 Northeast	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	Malheur	10,800	10,800	31.3	337,700	16.09
Sugarbeets	2006	Oregon	D80 Southeast	10,800	10,800	31.3	337,700	16.09
Sugarbeets	**2006**	**Oregon**	**State Total**	**13,100**	**13,100**	**30.1**	**394,000**	**17.15**
Sugarbeets	2006	Washington	Benton	2,000	2,000	37.0	74,000	16.40
Sugarbeets	2006	Washington	D20 Central	2,000	2,000	37.0	74,000	16.40
Sugarbeets	**2006**	**Washington**	**State Total**	**2,000**	**2,000**	**37.0**	**74,000**	**16.40**
Sugarbeets	2006	Wyoming	Big Horn	12,400	11,300	18.0	203,600	17.00
Sugarbeets	2006	Wyoming	Fremont	2,900	2,200	18.7	41,200	17.13
Sugarbeets	2006	Wyoming	Park	12,700	12,600	22.2	280,000	17.10
Sugarbeets	2006	Wyoming	Washakie	9,400	9,100	19.6	178,000	17.23
Sugarbeets	2006	Wyoming	D10 Northwest	37,400	35,200	20.0	703,000	17.10
Sugarbeets	2006	Wyoming	Goshen	1,600	1,400	21.9	30,600	17.35
Sugarbeets	2006	Wyoming	Laramie	1,000	900	20.7	18,600	17.48
Sugarbeets	2006	Wyoming	Platte	2,800	2,600	17.6	45,800	16.27
Sugarbeets	2006	Wyoming	D80 Southeast	5,400	4,900	19.4	95,000	17.81
Sugarbeets	**2006**	**Wyoming**	**State Total**	**42,800**	**40,100**	**19.9**	**798,000**	**17.18**
Sugarbeets	2005	California	Fresno	11,000	10,700	35.5	380,000	14.72
Sugarbeets	2005	California	Kern	4,700	4,700	40.4	190,000	14.07
Sugarbeets	2005	California	Kings	800	800	28.8	23,000	15.22
Sugarbeets	2005	California	Merced	3,600	3,600	31.1	112,000	15.43
Sugarbeets	2005	California	D51 Combined Counties	900	900	31.1	28,000	14.95
Sugarbeets	2005	California	D51 San Joaquin Valley	21,000	20,700	35.4	733,000	14.68
Sugarbeets	2005	California	Imperial	23,400	23,400	38.6	903,000	16.68
Sugarbeets	2005	California	D80 Southern California	23,400	23,400	38.6	903,000	16.68
Sugarbeets	**2005**	**California**	**State Total**	**44,400**	**44,100**	**37.1**	**1,636,000**	**15.79**
Sugarbeets	2005	Colorado	Boulder	700	600	25.3	15,200	16.83
Sugarbeets	2005	Colorado	Larimer	2,700	2,700	21.5	58,100	16.88
Sugarbeets	2005	Colorado	Logan	4,500	4,300	21.9	94,200	15.06
Sugarbeets	2005	Colorado	Morgan	2,400	2,200	26.0	57,100	15.43
Sugarbeets	2005	Colorado	Sedgwick	1,800	1,800	21.9	39,400	16.01
Sugarbeets	2005	Colorado	Weld	13,700	13,300	25.3	336,000	16.13
Sugarbeets	2005	Colorado	D20 Northeast	25,800	24,900	24.1	600,000	15.98
Sugarbeets	2005	Colorado	Adams	400	400	21.5	8,600	16.51
Sugarbeets	2005	Colorado	Kit Carson	500	500	23.8	11,900	15.34
Sugarbeets	2005	Colorado	Phillips	2,800	2,800	25.0	69,900	15.77
Sugarbeets	2005	Colorado	Washington	1,400	1,300	22.8	29,600	15.38
Sugarbeets	2005	Colorado	Yuma	5,400	4,400	25.7	113,000	15.45
Sugarbeets	2005	Colorado	D60 East Central	10,500	9,400	24.8	233,000	15.57
Sugarbeets	**2005**	**Colorado**	**State Total**	**36,400**	**34,300**	**24.3**	**833,000**	**15.87**
Sugarbeets	2005	Idaho	Ada	2,900	2,800	30.0	84,000	16.46
Sugarbeets	2005	Idaho	Canyon	10,100	9,900	29.9	296,000	16.45
Sugarbeets	2005	Idaho	Elmore	7,700	7,600	25.8	196,000	17.43
Sugarbeets	2005	Idaho	Owyhee	5,200	4,800	29.2	140,000	16.66
Sugarbeets	2005	Idaho	Payette	1,400	1,300	28.5	37,000	16.23
Sugarbeets	2005	Idaho	Washington	1,500	1,400	30.7	43,000	16.32
Sugarbeets	2005	Idaho	D70 Combined Counties	200	200	20.0	4,000	16.26
Sugarbeets	2005	Idaho	D70 Southwest	29,000	28,000	28.6	800,000	16.72
Sugarbeets	2005	Idaho	Cassia	30,600	30,500	26.8	817,000	17.84
Sugarbeets	2005	Idaho	Gooding	2,000	2,000	24.0	48,000	17.10
Sugarbeets	2005	Idaho	Jerome	14,000	13,900	25.2	350,000	17.90
Sugarbeets	2005	Idaho	Lincoln	5,000	7,800	24.0	187,000	17.65
Sugarbeets	2005	Idaho	Minidoka	42,600	42,400	26.0	1,104,000	17.62
Sugarbeets	2005	Idaho	Twin Falls	10,400	10,400	26.3	274,000	17.49

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Michigan	Saginaw	17,000	16,900	22.4	378,000	17.80
Sugarbeets	2006	Michigan	Sanilac	20,200	20,100	24.8	498,000	17.30
Sugarbeets	2006	Michigan	Tuscola	21,100	21,000	24.5	514,000	15.20
Sugarbeets	2006	Michigan	D60 East Central	132,000	131,500	23.9	3,140,000	15.10
Sugarbeets	2006	Michigan	Clinton	1,500	1,500	18.7	28,000	15.30
Sugarbeets	2006	Michigan	Ionia	500	500	22.0	11,000	21.10
Sugarbeets	2006	Michigan	Shiawassee	800	800	20.0	16,000	17.60
Sugarbeets	2006	Michigan	D80 South Central	2,800	2,800	19.6	55,000	15.70
Sugarbeets	2006	Michigan	Lapeer	900	900	24.4	22,000	17.30
Sugarbeets	2006	Michigan	D90 Combined Counties	1,300	1,300	20.8	27,000	17.20
Sugarbeets	2006	Michigan	D90 Southeast	2,200	2,200	22.3	49,000	17.20
Sugarbeets	**2006**	**Michigan**	**State Total**	**155,000**	**154,000**	**23.2**	**3,573,000**	**16.10**
Sugarbeets	2006	Minnesota	Becker	10,400	9,800	27.2	266,500	15.40
Sugarbeets	2006	Minnesota	Clay	56,400	52,700	25.9	1,367,100	15.10
Sugarbeets	2006	Minnesota	Kittson	36,500	36,100	23.5	525,300	18.00
Sugarbeets	2006	Minnesota	Mahnomen	5,100	4,400	24.1	105,900	15.20
Sugarbeets	2006	Minnesota	Marshall	45,700	41,500	22.9	949,300	15.50
Sugarbeets	2006	Minnesota	Norman	46,200	42,100	26.3	1,108,200	17.80
Sugarbeets	2006	Minnesota	Polk	102,400	93,300	24.8	2,314,500	15.00
Sugarbeets	2006	Minnesota	Red Lake	1,900	1,700	22.8	38,700	17.70
Sugarbeets	2006	Minnesota	D10 Combined Counties	400	400	22.3	8,900	17.80
Sugarbeets	2006	Minnesota	D10 Northwest	307,000	281,000	24.8	6,982,500	16.20
Sugarbeets	2006	Minnesota	Chippewa	32,200	32,200	23.2	747,300	16.50
Sugarbeets	2006	Minnesota	Grant	11,600	11,500	23.4	269,400	16.80
Sugarbeets	2006	Minnesota	Otter Tail	4,400	4,300	27.4	118,000	16.80
Sugarbeets	2006	Minnesota	Pope	3,600	3,600	24.8	89,400	16.90
Sugarbeets	2006	Minnesota	Stevens	4,100	4,100	25.5	104,700	17.00
Sugarbeets	2006	Minnesota	Swift	5,900	5,900	23.8	140,700	16.80
Sugarbeets	2006	Minnesota	Traverse	9,600	9,500	24.6	234,000	16.90
Sugarbeets	2006	Minnesota	Wilkin	50,900	50,400	26.7	1,343,400	17.20
Sugarbeets	2006	Minnesota	Yellow Medicine	3,600	3,600	23.8	85,700	16.70
Sugarbeets	2006	Minnesota	D40 Combined Counties	1,100	1,100	23.8	26,200	16.90
Sugarbeets	2006	Minnesota	D40 West Central	127,000	126,200	25.0	3,158,600	16.90
Sugarbeets	2006	Minnesota	Kandiyohi	16,400	16,300	25.6	416,600	16.80
Sugarbeets	2006	Minnesota	McLeod	2,700	2,700	22.6	61,000	16.90
Sugarbeets	2006	Minnesota	Meeker	2,300	2,300	25.5	58,600	16.80
Sugarbeets	2006	Minnesota	Renville	39,400	39,300	24.8	975,400	16.70
Sugarbeets	2006	Minnesota	Sibley	2,300	2,300	26.4	59,500	16.80
Sugarbeets	2006	Minnesota	Stearns	2,100	2,100	26.2	55,000	16.30
Sugarbeets	2006	Minnesota	D60 Central	65,200	65,000	25.0	1,625,100	16.70
Sugarbeets	2006	Minnesota	Redwood	3,800	3,800	23.3	88,500	16.50
Sugarbeets	2006	Minnesota	D70 Combined Counties	600	600	24.2	14,500	17.10
Sugarbeets	2006	Minnesota	D70 Southwest	4,400	4,400	23.4	103,000	16.60
Sugarbeets	2006	Minnesota	D98 Combined Districts	400	400	18.3	7,300	17.20
Sugarbeets	**2006**	**Minnesota**	**State Total**	**504,000**	**477,000**	**24.9**	**11,877,000**	**17.60**
Sugarbeets	2006	Montana	Dawson	2,930	2,820	20.9	59,000	17.26
Sugarbeets	2006	Montana	Richland	15,530	15,450	25.0	357,000	17.58
Sugarbeets	2006	Montana	Roosevelt	2,180	2,160	26.4	57,000	17.67
Sugarbeets	2006	Montana	D30 Northeast	20,640	20,430	24.6	503,000	17.55
Sugarbeets	2006	Montana	Big Horn	9,880	7,900	31.0	245,000	15.51
Sugarbeets	2006	Montana	Carbon	4,560	4,490	24.9	112,000	16.29
Sugarbeets	2006	Montana	Treasure	3,880	3,090	31.4	97,000	15.70
Sugarbeets	2006	Montana	Yellowstone	9,420	7,830	28.2	220,500	15.61
Sugarbeets	2006	Montana	D80 Combined Counties	320	280	32.9	9,200	16.32
Sugarbeets	2006	Montana	D80 South Central	27,860	23,590	28.0	653,700	15.71
Sugarbeets	2006	Montana	Custer	1,160	1,010	27.1	27,400	16.64
Sugarbeets	2006	Montana	Prairie	1,600	1,570	21.8	34,300	17.78
Sugarbeets	2006	Montana	Rosebud	2,340	1,900	32.4	61,600	15.92
Sugarbeets	2006	Montana	D90 Southeast	5,100	4,420	27.5	123,300	16.56
Sugarbeets	**2006**	**Montana**	**State Total**	**53,600**	**48,500**	**27.0**	**1,310,000**	**16.50**
Sugarbeets	2006	Nebraska	Banner	800	700	16.4	11,500	17.76
Sugarbeets	2006	Nebraska	Box Butte	23,000	22,700	23.0	521,700	17.51
Sugarbeets	2006	Nebraska	Cheyenne	2,900	2,900	24.4	70,900	17.88
Sugarbeets	2006	Nebraska	Deuel	800	800	23.8	19,000	16.66
Sugarbeets	2006	Nebraska	Kimball	4,600	4,300	21.2	91,300	17.70
Sugarbeets	2006	Nebraska	Morrill	5,400	5,100	23.3	118,700	16.16
Sugarbeets	2006	Nebraska	Scotts Bluff	11,500	10,100	23.0	231,600	16.22
Sugarbeets	2006	Nebraska	Sheridan	3,700	3,000	22.4	67,100	17.06
Sugarbeets	2006	Nebraska	D10 Combined Counties	1,000	900	26.1	23,500	16.97
Sugarbeets	2006	Nebraska	D10 Northwest	53,700	50,500	22.9	1,155,500	17.11
Sugarbeets	2006	Nebraska	Chase	3,800	3,800	28.4	108,100	15.40
Sugarbeets	2006	Nebraska	Keith	1,900	1,600	23.6	37,700	16.76
Sugarbeets	2006	Nebraska	Perkins	1,900	1,900	24.1	45,700	16.40

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Nebraska	D70 Southwest	7,800	7,300	26.2	191,500	15.91
Sugarbeets	**2006**	**Nebraska**	**State Total**	**61,300**	**57,800**	**23.3**	**1,347,000**	**16.94**
Sugarbeets	2006	North Dakota	Williams	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	D10 Northwest	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	Grand Forks	32,900	30,400	27.0	822,000	17.65
Sugarbeets	2006	North Dakota	Pembina	79,700	73,200	25.9	1,822,000	15.59
Sugarbeets	2006	North Dakota	Walsh	45,600	41,600	25.3	1,054,000	15.44
Sugarbeets	2006	North Dakota	D30 Northeast	158,200	145,200	26.0	3,782,000	15.34
Sugarbeets	2006	North Dakota	McKenzie	10,800	10,700	25.4	272,000	17.78
Sugarbeets	2006	North Dakota	D40 West Central	10,800	10,700	25.4	272,000	17.78
Sugarbeets	2006	North Dakota	Cass	26,700	24,700	26.4	651,000	17.94
Sugarbeets	2006	North Dakota	Traill	29,200	26,900	27.1	730,000	17.58
Sugarbeets	2006	North Dakota	D60 Combined Counties	200	100	30.0	3,000	17.24
Sugarbeets	2006	North Dakota	D60 East Central	56,100	51,700	26.2	1,354,000	17.75
Sugarbeets	2006	North Dakota	Ransom	100	100	30.0	3,000	16.63
Sugarbeets	2006	North Dakota	Richland	31,300	30,800	25.4	753,000	16.99
Sugarbeets	2006	North Dakota	D90 Southeast	31,400	30,900	25.4	755,000	16.99
Sugarbeets	**2006**	**North Dakota**	**State Total**	**261,000**	**243,000**	**26.0**	**6,318,000**	**16.01**
Sugarbeets	2006	Oregon	Union	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	D30 Northeast	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	Malheur	10,800	10,800	31.3	337,700	16.09
Sugarbeets	2006	Oregon	D80 Southeast	10,800	10,800	31.3	337,700	16.09
Sugarbeets	**2006**	**Oregon**	**State Total**	**13,100**	**13,100**	**30.1**	**394,000**	**17.15**
Sugarbeets	2006	Washington	Benton	2,000	2,000	37.0	74,000	16.40
Sugarbeets	2006	Washington	D20 Central	2,000	2,000	37.0	74,000	16.40
Sugarbeets	**2006**	**Washington**	**State Total**	**2,000**	**2,000**	**37.0**	**74,000**	**16.40**
Sugarbeets	2006	Wyoming	Big Horn	12,400	11,300	18.0	203,600	17.00
Sugarbeets	2006	Wyoming	Fremont	2,900	2,200	18.7	41,200	17.13
Sugarbeets	2006	Wyoming	Park	12,700	12,600	22.2	280,000	17.10
Sugarbeets	2006	Wyoming	Washakie	9,400	9,100	19.6	178,000	17.23
Sugarbeets	2006	Wyoming	D10 Northwest	37,400	35,200	20.0	703,000	17.10
Sugarbeets	2006	Wyoming	Goshen	1,800	1,400	21.9	30,600	17.36
Sugarbeets	2006	Wyoming	Laramie	1,000	900	20.7	18,600	17.48
Sugarbeets	2006	Wyoming	Platte	2,800	2,600	17.6	45,800	15.27
Sugarbeets	2006	Wyoming	D60 Southeast	5,400	4,900	19.4	95,000	17.81
Sugarbeets	**2006**	**Wyoming**	**State Total**	**42,800**	**40,100**	**19.9**	**798,000**	**17.18**
Sugarbeets	2005	California	Fresno	11,000	10,700	36.6	390,000	14.72
Sugarbeets	2005	California	Kern	4,700	4,700	40.4	190,000	14.07
Sugarbeets	2005	California	Kings	800	800	28.8	23,000	15.22
Sugarbeets	2005	California	Merced	3,600	3,600	31.1	112,000	15.43
Sugarbeets	2005	California	D51 Combined Counties	900	900	31.1	28,000	14.96
Sugarbeets	2005	California	D51 San Joaquin Valley	21,000	20,700	35.4	733,000	14.68
Sugarbeets	2005	California	Imperial	23,400	23,400	38.6	903,000	16.68
Sugarbeets	2005	California	D80 Southern California	23,400	23,400	38.6	903,000	16.68
Sugarbeets	**2005**	**California**	**State Total**	**44,400**	**44,100**	**37.1**	**1,636,000**	**15.79**
Sugarbeets	2005	Colorado	Boulder	700	600	25.3	15,200	16.83
Sugarbeets	2005	Colorado	Larimer	2,700	2,700	21.5	58,100	16.88
Sugarbeets	2005	Colorado	Logan	4,500	4,300	21.9	94,200	15.08
Sugarbeets	2005	Colorado	Morgan	2,400	2,200	26.0	57,100	15.43
Sugarbeets	2005	Colorado	Sedgwick	1,900	1,800	21.9	39,400	16.01
Sugarbeets	2005	Colorado	Weld	13,700	13,300	25.3	338,000	16.13
Sugarbeets	2005	Colorado	D20 Northeast	25,900	24,900	24.1	600,000	15.98
Sugarbeets	2005	Colorado	Adams	400	400	21.5	8,600	16.51
Sugarbeets	2005	Colorado	Kit Carson	500	500	23.8	11,900	15.34
Sugarbeets	2005	Colorado	Phillips	2,800	2,800	25.0	69,900	15.77
Sugarbeets	2005	Colorado	Washington	1,400	1,300	22.8	29,600	15.38
Sugarbeets	2005	Colorado	Yuma	5,400	4,400	25.7	113,000	15.45
Sugarbeets	2005	Colorado	D60 East Central	10,500	9,400	24.8	233,000	15.57
Sugarbeets	**2005**	**Colorado**	**State Total**	**36,400**	**34,300**	**24.3**	**833,000**	**15.87**
Sugarbeets	2005	Idaho	Ada	2,900	2,200	30.0	64,000	16.46
Sugarbeets	2005	Idaho	Canyon	10,100	9,900	29.9	296,000	16.45
Sugarbeets	2005	Idaho	Elmore	7,700	7,600	25.8	196,000	17.43
Sugarbeets	2005	Idaho	Owyhee	5,200	4,800	29.2	140,000	16.68
Sugarbeets	2005	Idaho	Payette	1,400	1,300	28.5	37,000	16.23
Sugarbeets	2005	Idaho	Washington	1,500	1,400	30.7	43,000	16.32
Sugarbeets	2005	Idaho	D70 Combined Counties	200	200	20.0	4,000	16.26
Sugarbeets	2005	Idaho	D70 Southwest	29,000	28,000	28.6	800,000	16.72
Sugarbeets	2005	Idaho	Cassia	30,600	30,500	26.8	817,000	17.84
Sugarbeets	2005	Idaho	Gooding	2,000	2,000	24.0	48,000	17.10
Sugarbeets	2005	Idaho	Jerome	14,000	13,900	25.2	350,000	17.90
Sugarbeets	2005	Idaho	Lincoln	5,000	7,200	24.0	167,000	17.85
Sugarbeets	2005	Idaho	Minidoka	42,600	42,400	26.0	1,104,000	17.82
Sugarbeets	2005	Idaho	Twin Falls	10,400	10,400	26.3	274,000	17.49

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Michigan	Saginaw	17,000	16,900	22.4	378,000	17.80
Sugarbeets	2006	Michigan	Sanilac	20,200	20,100	24.8	498,000	17.30
Sugarbeets	2006	Michigan	Tuscola	21,100	21,000	24.5	514,000	16.20
Sugarbeets	2006	Michigan	D60 East Central	132,000	131,500	23.9	3,140,000	16.10
Sugarbeets	2006	Michigan	Clinton	1,500	1,500	18.7	28,000	16.30
Sugarbeets	2006	Michigan	Ionia	500	500	22.0	11,000	21.10
Sugarbeets	2006	Michigan	Shiawassee	800	800	20.0	16,000	17.60
Sugarbeets	2006	Michigan	D80 South Central	2,800	2,800	19.6	55,000	16.70
Sugarbeets	2006	Michigan	Lapeer	900	900	24.4	22,000	17.30
Sugarbeets	2006	Michigan	D90 Combined Counties	1,300	1,300	20.8	27,000	17.20
Sugarbeets	2006	Michigan	D90 Southeast	2,200	2,200	22.3	49,000	17.20
Sugarbeets	**2006**	**Michigan**	**State Total**	**155,000**	**154,000**	**23.2**	**3,573,000**	**16.10**
Sugarbeets	2006	Minnesota	Becker	10,400	9,200	27.2	250,500	16.40
Sugarbeets	2006	Minnesota	Clay	55,400	52,700	25.9	1,367,100	16.10
Sugarbeets	2006	Minnesota	Kittson	35,500	35,100	23.5	825,300	18.00
Sugarbeets	2006	Minnesota	Mahnomen	5,100	4,400	24.1	105,900	16.20
Sugarbeets	2006	Minnesota	Marshall	45,700	41,500	22.9	949,300	15.50
Sugarbeets	2006	Minnesota	Norman	46,200	42,100	26.3	1,108,200	17.80
Sugarbeets	2006	Minnesota	Polk	102,400	93,300	24.8	2,314,600	15.00
Sugarbeets	2006	Minnesota	Red Lake	1,900	1,700	22.8	38,700	17.70
Sugarbeets	2006	Minnesota	D10 Combined Counties	400	400	22.3	8,900	17.90
Sugarbeets	2006	Minnesota	D10 Northwest	307,000	281,000	24.8	6,992,500	16.20
Sugarbeets	2006	Minnesota	Chippewa	32,200	32,200	23.2	747,300	16.50
Sugarbeets	2006	Minnesota	Grant	11,600	11,500	23.4	269,400	16.80
Sugarbeets	2006	Minnesota	Otter Tail	4,400	4,300	27.4	118,000	16.80
Sugarbeets	2006	Minnesota	Pope	3,600	3,600	24.8	89,400	16.90
Sugarbeets	2006	Minnesota	Stevens	4,100	4,100	25.5	104,700	17.00
Sugarbeets	2006	Minnesota	Swift	5,900	5,900	23.8	140,700	16.80
Sugarbeets	2006	Minnesota	Traverse	9,600	9,500	24.6	234,000	16.90
Sugarbeets	2006	Minnesota	Wilkin	50,900	50,400	26.7	1,343,400	17.20
Sugarbeets	2006	Minnesota	Yellow Medicine	3,600	3,600	23.8	85,700	16.70
Sugarbeets	2006	Minnesota	D40 Combined Counties	1,100	1,100	23.8	26,200	16.90
Sugarbeets	2006	Minnesota	D40 West Central	127,000	126,200	25.0	3,158,500	16.90
Sugarbeets	2006	Minnesota	Kandiyohi	16,400	16,300	25.6	416,600	16.60
Sugarbeets	2006	Minnesota	McLeod	2,700	2,700	22.6	61,000	16.90
Sugarbeets	2006	Minnesota	Meeker	2,300	2,300	25.5	58,600	16.80
Sugarbeets	2006	Minnesota	Renville	39,400	39,300	24.8	975,400	16.70
Sugarbeets	2006	Minnesota	Sibley	2,300	2,300	25.4	58,500	16.80
Sugarbeets	2006	Minnesota	Stearns	2,100	2,100	26.2	55,000	16.30
Sugarbeets	2006	Minnesota	D50 Central	65,200	65,000	25.0	1,625,100	16.70
Sugarbeets	2006	Minnesota	Redwood	3,800	3,800	23.3	88,500	16.50
Sugarbeets	2006	Minnesota	D70 Combined Counties	600	600	24.2	14,500	17.10
Sugarbeets	2006	Minnesota	D70 Southwest	4,400	4,400	23.4	103,000	16.60
Sugarbeets	2006	Minnesota	D98 Combined Districts	400	400	18.3	7,300	17.20
Sugarbeets	**2006**	**Minnesota**	**State Total**	**504,000**	**477,000**	**24.9**	**11,877,000**	**17.60**
Sugarbeets	2006	Montana	Dawson	2,830	2,820	20.9	59,000	17.26
Sugarbeets	2006	Montana	Richland	15,630	15,460	25.0	387,000	17.58
Sugarbeets	2006	Montana	Roosevelt	2,180	2,160	26.4	57,000	17.67
Sugarbeets	2006	Montana	D30 Northeast	20,640	20,430	24.6	503,000	17.55
Sugarbeets	2006	Montana	Big Horn	8,860	7,900	31.0	245,000	15.51
Sugarbeets	2006	Montana	Carbon	4,560	4,490	24.9	112,000	16.29
Sugarbeets	2006	Montana	Treasure	3,680	3,090	31.4	97,000	15.70
Sugarbeets	2006	Montana	Yellowstone	9,420	7,830	28.2	220,500	15.61
Sugarbeets	2006	Montana	D80 Combined Counties	320	280	32.9	9,200	16.32
Sugarbeets	2006	Montana	D80 South Central	27,860	23,590	28.0	663,700	15.71
Sugarbeets	2006	Montana	Custer	1,160	1,010	27.1	27,400	16.64
Sugarbeets	2006	Montana	Prairie	1,600	1,570	21.8	34,300	17.78
Sugarbeets	2006	Montana	Rosebud	2,340	1,900	32.4	61,600	15.92
Sugarbeets	2006	Montana	D90 Southeast	5,100	4,480	27.5	123,300	16.66
Sugarbeets	**2006**	**Montana**	**State Total**	**53,600**	**48,500**	**27.0**	**1,310,000**	**16.50**
Sugarbeets	2006	Nebraska	Banner	800	700	16.4	11,500	17.76
Sugarbeets	2006	Nebraska	Box Butte	23,000	22,700	23.0	521,700	17.51
Sugarbeets	2006	Nebraska	Cheyenne	2,900	2,900	24.4	70,900	17.98
Sugarbeets	2006	Nebraska	Deuel	800	800	23.8	19,000	16.66
Sugarbeets	2006	Nebraska	Kimball	4,600	4,300	21.2	91,300	17.70
Sugarbeets	2006	Nebraska	Morrill	5,400	5,100	23.3	118,700	16.16
Sugarbeets	2006	Nebraska	Scotts Bluff	11,500	10,100	23.0	231,500	16.22
Sugarbeets	2006	Nebraska	Sheridan	3,700	3,000	22.4	67,100	17.08
Sugarbeets	2006	Nebraska	D10 Combined Counties	1,000	900	26.1	23,500	16.97
Sugarbeets	2006	Nebraska	D10 Northwest	53,700	50,500	22.9	1,155,500	17.11
Sugarbeets	2006	Nebraska	Chase	3,800	3,800	28.4	108,100	15.40
Sugarbeets	2006	Nebraska	Keith	1,900	1,600	23.6	37,700	16.76
Sugarbeets	2006	Nebraska	Perkins	1,900	1,900	24.1	45,700	16.40

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2006	Nebraska	D70 Southwest	7,600	7,300	26.2	191,500	15.91
Sugarbeets	**2006**	**Nebraska**	**State Total**	**61,300**	**57,800**	**23.3**	**1,347,000**	**16.94**
Sugarbeets	2006	North Dakota	Williams	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	D10 Northwest	4,500	4,500	23.8	107,000	17.99
Sugarbeets	2006	North Dakota	Grand Forks	32,900	30,400	27.0	822,000	17.65
Sugarbeets	2006	North Dakota	Pembina	79,700	73,200	26.3	1,923,000	15.59
Sugarbeets	2006	North Dakota	Walsh	45,600	41,600	25.3	1,054,000	16.44
Sugarbeets	2006	North Dakota	D30 Northeast	158,200	145,200	26.0	3,769,000	16.34
Sugarbeets	2006	North Dakota	McKenzie	10,800	10,700	25.4	272,000	17.78
Sugarbeets	2006	North Dakota	D40 West Central	10,800	10,700	25.4	272,000	17.78
Sugarbeets	2006	North Dakota	Cass	26,700	24,700	26.4	651,000	17.94
Sugarbeets	2006	North Dakota	Traill	29,200	26,900	27.1	730,000	17.58
Sugarbeets	2006	North Dakota	D60 Combined Counties	200	100	30.0	3,000	17.24
Sugarbeets	2006	North Dakota	D60 East Central	56,100	51,700	26.8	1,384,000	17.75
Sugarbeets	2006	North Dakota	Ransom	100	100	30.0	3,000	16.83
Sugarbeets	2006	North Dakota	Richland	31,300	30,200	25.4	763,000	16.99
Sugarbeets	2006	North Dakota	D90 Southeast	31,400	30,900	25.4	766,000	16.99
Sugarbeets	**2006**	**North Dakota**	**State Total**	**261,000**	**243,000**	**26.0**	**6,318,000**	**18.01**
Sugarbeets	2006	Oregon	Union	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	D30 Northeast	2,300	2,300	24.5	56,300	17.60
Sugarbeets	2006	Oregon	Malheur	10,800	10,800	31.3	337,700	16.09
Sugarbeets	2006	Oregon	D20 Southeast	10,800	10,200	31.3	337,700	16.09
Sugarbeets	**2006**	**Oregon**	**State Total**	**13,100**	**13,100**	**30.1**	**394,000**	**17.15**
Sugarbeets	2006	Washington	Benton	2,000	2,000	37.0	74,000	16.40
Sugarbeets	2006	Washington	D20 Central	2,000	2,000	37.0	74,000	16.40
Sugarbeets	**2006**	**Washington**	**State Total**	**2,000**	**2,000**	**37.0**	**74,000**	**16.40**
Sugarbeets	2006	Wyoming	Big Horn	12,400	11,300	18.0	203,500	17.00
Sugarbeets	2006	Wyoming	Fremont	2,900	2,200	18.7	41,200	17.13
Sugarbeets	2006	Wyoming	Park	12,700	12,600	22.2	280,000	17.10
Sugarbeets	2006	Wyoming	Washakie	9,400	9,100	19.6	178,000	17.23
Sugarbeets	2006	Wyoming	D10 Northwest	37,400	35,200	20.0	703,000	17.10
Sugarbeets	2006	Wyoming	Goshen	1,600	1,400	21.9	30,600	17.35
Sugarbeets	2006	Wyoming	Laramie	1,000	900	20.7	18,600	17.48
Sugarbeets	2006	Wyoming	Platte	2,800	2,600	17.6	45,800	16.27
Sugarbeets	2006	Wyoming	D80 Southeast	5,400	4,900	19.4	95,000	17.81
Sugarbeets	**2006**	**Wyoming**	**State Total**	**42,800**	**40,100**	**19.9**	**798,000**	**17.18**
Sugarbeets	2005	California	Fresno	11,000	10,700	36.6	392,000	14.72
Sugarbeets	2005	California	Kern	4,700	4,700	40.4	190,000	14.07
Sugarbeets	2005	California	Kings	800	800	28.8	23,000	15.22
Sugarbeets	2005	California	Merced	3,600	3,600	31.1	112,000	15.43
Sugarbeets	2005	California	D51 Combined Counties	900	900	31.1	28,000	14.95
Sugarbeets	2005	California	D51 San Joaquin Valley	21,000	20,700	35.4	733,000	14.66
Sugarbeets	2005	California	Imperial	23,400	23,400	38.6	903,000	16.66
Sugarbeets	2005	California	D80 Southern California	23,400	23,400	38.6	903,000	16.66
Sugarbeets	**2005**	**California**	**State Total**	**44,400**	**44,100**	**37.1**	**1,636,000**	**15.79**
Sugarbeets	2005	Colorado	Boulder	700	600	25.3	15,200	16.83
Sugarbeets	2005	Colorado	Larimer	2,700	2,700	21.5	58,100	16.86
Sugarbeets	2005	Colorado	Logan	4,500	4,300	21.9	94,200	15.08
Sugarbeets	2005	Colorado	Morgan	2,400	2,200	26.0	57,100	15.43
Sugarbeets	2005	Colorado	Sedgwick	1,900	1,800	21.9	39,400	16.01
Sugarbeets	2005	Colorado	Weld	13,700	13,300	25.3	336,000	16.13
Sugarbeets	2005	Colorado	D20 Northeast	25,900	24,900	24.1	600,000	15.98
Sugarbeets	2005	Colorado	Adams	400	400	21.5	8,600	16.51
Sugarbeets	2005	Colorado	Kit Carson	500	500	23.8	11,900	15.34
Sugarbeets	2005	Colorado	Phillips	2,800	2,800	25.0	69,900	15.77
Sugarbeets	2005	Colorado	Washington	1,400	1,300	22.8	29,600	15.39
Sugarbeets	2005	Colorado	Yuma	5,400	4,400	25.7	113,000	15.45
Sugarbeets	2005	Colorado	D60 East Central	10,500	9,400	24.8	233,000	15.57
Sugarbeets	**2005**	**Colorado**	**State Total**	**36,400**	**34,300**	**24.3**	**833,000**	**15.87**
Sugarbeets	2005	Idaho	Ada	2,900	2,800	30.0	84,000	16.48
Sugarbeets	2005	Idaho	Canyon	10,100	9,900	29.9	296,000	16.45
Sugarbeets	2005	Idaho	Elmore	7,700	7,600	25.8	196,000	17.43
Sugarbeets	2005	Idaho	Owyhee	5,200	4,800	29.2	140,000	16.68
Sugarbeets	2005	Idaho	Payette	1,400	1,300	28.5	37,000	16.23
Sugarbeets	2005	Idaho	Washington	1,500	1,400	30.7	43,000	16.32
Sugarbeets	2005	Idaho	D70 Combined Counties	200	200	20.0	4,000	16.26
Sugarbeets	2005	Idaho	D70 Southwest	29,000	28,000	28.6	800,000	16.72
Sugarbeets	2005	Idaho	Cassia	30,600	30,500	16.9	517,000	17.84
Sugarbeets	2005	Idaho	Gooding	2,000	2,000	24.0	48,000	17.10
Sugarbeets	2005	Idaho	Jerome	14,000	13,900	25.2	350,000	17.90
Sugarbeets	2005	Idaho	Lincoln	5,000	7,200	24.0	157,000	17.65
Sugarbeets	2005	Idaho	Minidoka	42,500	42,400	26.0	1,104,000	17.62
Sugarbeets	2005	Idaho	Twin Falls	10,400	10,400	26.3	274,000	17.49

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Idaho	D20 South Central	107,500	107,000	26.0	2,780,000	17.70
Sugarbeets	2005	Idaho	Bingham	19,200	18,200	28.2	541,000	17.60
Sugarbeets	2005	Idaho	Power	13,300	13,200	30.7	405,000	17.50
Sugarbeets	2005	Idaho	D90 East	32,500	32,000	29.6	946,000	17.65
Sugarbeets	**2005**	**Idaho**	**State Total**	**169,000**	**167,000**	**27.1**	**4,526,000**	**17.57**
Sugarbeets	2005	Michigan	D30 Combined Counties	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	D30 Northeast	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	Gladwin	1,000	1,000	23.0	23,000	17.20
Sugarbeets	2005	Michigan	Gratiot	11,000	10,800	20.4	220,000	17.10
Sugarbeets	2005	Michigan	Isabella	900	900	20.0	18,000	16.80
Sugarbeets	2005	Michigan	Midland	3,200	3,200	19.7	63,000	16.20
Sugarbeets	2005	Michigan	Montcalm	1,100	1,100	22.7	25,000	16.70
Sugarbeets	2005	Michigan	D50 Central	17,200	17,000	20.5	349,000	16.90
Sugarbeets	2005	Michigan	Arenac	3,700	3,700	23.5	87,000	17.20
Sugarbeets	2005	Michigan	Bay	14,500	14,000	19.1	268,000	16.50
Sugarbeets	2005	Michigan	Huron	54,500	54,000	22.6	1,220,000	17.10
Sugarbeets	2005	Michigan	Saginaw	16,300	16,200	20.1	326,000	16.80
Sugarbeets	2005	Michigan	Sanilac	20,000	19,800	22.0	436,000	16.80
Sugarbeets	2005	Michigan	Tuscola	21,000	20,600	20.5	423,000	16.90
Sugarbeets	2005	Michigan	D60 East Central	130,000	128,300	21.5	2,760,000	16.90
Sugarbeets	2005	Michigan	Clinton	1,800	1,800	19.4	35,000	17.50
Sugarbeets	2005	Michigan	Ionia	500	500	18.0	5,000	17.80
Sugarbeets	2005	Michigan	Shiawassee	1,000	900	20.0	18,000	17.30
Sugarbeets	2005	Michigan	D80 South Central	3,300	3,200	19.1	61,000	17.50
Sugarbeets	2005	Michigan	Genesee	700	700	20.0	14,000	13.40
Sugarbeets	2005	Michigan	Lapeer	1,000	1,000	20.0	20,000	17.00
Sugarbeets	2005	Michigan	St. Clair	1,200	1,200	17.5	21,000	17.30
Sugarbeets	2005	Michigan	D90 Southeast	2,900	2,900	19.0	55,000	16.20
Sugarbeets	**2005**	**Michigan**	**State Total**	**154,000**	**152,000**	**21.3**	**3,238,000**	**16.90**
Sugarbeets	2005	Minnesota	Becker	10,700	10,000	20.4	203,600	15.20
Sugarbeets	2005	Minnesota	Clay	57,000	56,100	19.8	1,113,000	17.50
Sugarbeets	2005	Minnesota	Kittson	36,800	18,300	11.8	216,300	15.50
Sugarbeets	2005	Minnesota	Mahnomen	5,800	5,600	22.5	125,900	15.10
Sugarbeets	2005	Minnesota	Marshall	47,400	42,900	15.4	659,500	15.10
Sugarbeets	2005	Minnesota	Norman	43,200	42,700	21.2	905,500	17.70
Sugarbeets	2005	Minnesota	Polk	99,100	97,900	20.2	1,974,400	17.80
Sugarbeets	2005	Minnesota	Red Lake	1,200	1,100	18.5	20,300	17.70
Sugarbeets	2005	Minnesota	D10 Combined Counties	400	400	18.5	7,400	17.60
Sugarbeets	2005	Minnesota	D10 Northwest	301,400	275,000	19.0	5,225,500	17.80
Sugarbeets	2005	Minnesota	Chippewa	34,300	34,200	25.0	856,000	15.80
Sugarbeets	2005	Minnesota	Grant	10,200	10,000	14.5	145,200	16.10
Sugarbeets	2005	Minnesota	Otter Tail	3,200	3,100	15.8	48,900	15.90
Sugarbeets	2005	Minnesota	Pope	2,300	2,200	24.7	54,300	16.40
Sugarbeets	2005	Minnesota	Stevens	3,900	3,800	23.5	89,400	16.20
Sugarbeets	2005	Minnesota	Swift	6,100	5,900	25.6	151,100	16.10
Sugarbeets	2005	Minnesota	Traverse	8,800	8,100	14.1	114,500	16.40
Sugarbeets	2005	Minnesota	Wilkin	47,100	45,400	18.3	829,700	16.60
Sugarbeets	2005	Minnesota	Yellow Medicine	2,800	2,700	27.9	75,200	16.00
Sugarbeets	2005	Minnesota	D40 Combined Counties	800	800	26.4	21,100	20.50
Sugarbeets	2005	Minnesota	D40 West Central	119,600	116,200	20.6	2,394,400	16.20
Sugarbeets	2005	Minnesota	Kandiyohi	13,200	13,100	26.3	345,000	15.90
Sugarbeets	2005	Minnesota	McLeod	1,500	1,400	23.0	32,200	15.50
Sugarbeets	2005	Minnesota	Meeker	1,900	1,800	24.8	44,700	15.60
Sugarbeets	2005	Minnesota	Renville	42,100	41,600	25.8	1,074,500	15.40
Sugarbeets	2005	Minnesota	Sibley	3,700	3,600	24.9	89,600	15.00
Sugarbeets	2005	Minnesota	Stearns	2,700	2,600	23.7	61,600	16.00
Sugarbeets	2005	Minnesota	D50 Central	65,100	64,100	25.7	1,647,600	15.50
Sugarbeets	2005	Minnesota	Redwood	3,400	3,300	27.3	90,100	15.40
Sugarbeets	2005	Minnesota	D70 Combined Counties	800	800	24.6	19,700	24.70
Sugarbeets	2005	Minnesota	D70 Southwest	4,200	4,100	26.8	109,800	15.50
Sugarbeets	2005	Minnesota	D98 Combined Districts	700	600	27.8	16,700	15.70
Sugarbeets	**2005**	**Minnesota**	**State Total**	**491,000**	**460,000**	**20.4**	**9,384,000**	**17.00**
Sugarbeets	2005	Montana	Dawson	2,990	2,230	20.7	46,200	16.01
Sugarbeets	2005	Montana	Richland	17,720	16,190	21.2	344,000	15.59
Sugarbeets	2005	Montana	Roosevelt	2,140	2,100	19.9	41,700	19.27
Sugarbeets	2005	Montana	D30 Northeast	22,850	20,520	21.0	431,900	15.59
Sugarbeets	2005	Montana	Big Horn	9,260	8,790	25.9	227,600	16.44
Sugarbeets	2005	Montana	Carbon	4,280	4,120	22.7	93,700	16.82
Sugarbeets	2005	Montana	Treasure	3,210	2,990	26.1	78,000	16.63
Sugarbeets	2005	Montana	Yellowstone	8,610	8,460	24.3	206,000	16.59
Sugarbeets	2005	Montana	D80 Combined Counties	200	200	30.0	6,000	16.43
Sugarbeets	2005	Montana	D80 South Central	25,560	24,560	24.9	611,300	16.56
Sugarbeets	2005	Montana	Custer	1,390	1,370	19.3	26,400	15.54

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Idaho	D20 South Central	107,500	107,000	26.0	2,780,000	17.79
Sugarbeets	2005	Idaho	Bingham	19,200	18,200	26.8	541,000	17.69
Sugarbeets	2005	Idaho	Power	13,300	13,200	30.7	405,000	17.59
Sugarbeets	2005	Idaho	D90 East	32,500	32,000	29.6	946,000	17.65
Sugarbeets	**2005**	**Idaho**	**State Total**	**169,000**	**167,000**	**27.1**	**4,526,000**	**17.57**
Sugarbeets	2005	Michigan	D30 Combined Counties	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	D30 Northeast	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	Gladwin	1,000	1,000	23.0	23,000	17.20
Sugarbeets	2005	Michigan	Gratiot	11,000	10,200	20.4	220,000	17.10
Sugarbeets	2005	Michigan	Isabella	900	900	20.0	18,000	16.80
Sugarbeets	2005	Michigan	Midland	3,200	3,200	19.7	63,000	16.20
Sugarbeets	2005	Michigan	Montcalm	1,100	1,100	22.7	25,000	16.70
Sugarbeets	2005	Michigan	D50 Central	17,200	17,000	20.5	349,000	16.90
Sugarbeets	2005	Michigan	Arenac	3,700	3,700	23.5	87,000	17.20
Sugarbeets	2005	Michigan	Bay	14,500	14,000	19.1	268,000	16.50
Sugarbeets	2005	Michigan	Huron	54,500	54,000	22.6	1,220,000	17.10
Sugarbeets	2005	Michigan	Saginaw	16,300	16,200	20.1	326,000	16.80
Sugarbeets	2005	Michigan	Sanilac	20,000	19,200	22.0	436,000	16.80
Sugarbeets	2005	Michigan	Tuscola	21,000	20,600	20.5	423,000	16.90
Sugarbeets	2005	Michigan	D60 East Central	130,000	125,300	21.5	2,760,000	16.90
Sugarbeets	2005	Michigan	Clinton	1,800	1,800	19.4	35,000	17.50
Sugarbeets	2005	Michigan	Ionia	500	500	16.0	8,000	17.90
Sugarbeets	2005	Michigan	Shiawassee	1,000	900	20.0	18,000	17.30
Sugarbeets	2005	Michigan	D80 South Central	3,300	3,200	19.1	61,000	17.50
Sugarbeets	2005	Michigan	Genesee	700	700	20.0	14,000	13.40
Sugarbeets	2005	Michigan	Lapeer	1,000	1,000	20.0	20,000	17.00
Sugarbeets	2005	Michigan	St. Clair	1,200	1,200	17.5	21,000	17.30
Sugarbeets	2005	Michigan	D90 Southeast	2,900	2,900	19.0	55,000	16.20
Sugarbeets	**2005**	**Michigan**	**State Total**	**154,000**	**152,000**	**21.3**	**3,238,000**	**16.90**
Sugarbeets	2005	Minnesota	Becker	10,700	10,000	20.4	203,600	15.20
Sugarbeets	2005	Minnesota	Clay	57,000	56,100	19.8	1,113,000	17.50
Sugarbeets	2005	Minnesota	Kittson	36,600	18,300	11.8	216,300	15.50
Sugarbeets	2005	Minnesota	Mahnomen	5,800	5,600	22.5	125,900	15.10
Sugarbeets	2005	Minnesota	Marshall	47,400	42,900	15.4	659,500	16.10
Sugarbeets	2005	Minnesota	Norman	43,200	42,700	21.2	905,600	17.70
Sugarbeets	2005	Minnesota	Polk	99,100	97,900	20.2	1,974,400	17.80
Sugarbeets	2005	Minnesota	Red Lake	1,200	1,100	18.5	20,300	17.70
Sugarbeets	2005	Minnesota	D10 Combined Counties	400	400	18.5	7,400	17.60
Sugarbeets	2005	Minnesota	D10 Northwest	301,400	275,000	19.0	5,225,500	17.80
Sugarbeets	2005	Minnesota	Chippewa	34,300	34,200	25.0	856,000	15.80
Sugarbeets	2005	Minnesota	Grant	10,200	10,000	14.5	145,200	16.10
Sugarbeets	2005	Minnesota	Otter Tail	3,200	3,100	15.8	48,900	15.90
Sugarbeets	2005	Minnesota	Pope	2,300	2,200	24.7	54,300	16.40
Sugarbeets	2005	Minnesota	Stevens	3,900	3,200	23.5	69,400	16.20
Sugarbeets	2005	Minnesota	Swift	6,100	5,900	25.6	151,100	16.10
Sugarbeets	2005	Minnesota	Traverse	8,800	8,100	14.1	114,500	16.40
Sugarbeets	2005	Minnesota	Wilkin	47,100	45,400	18.3	526,700	16.60
Sugarbeets	2005	Minnesota	Yellow Medicine	2,800	2,700	27.9	75,200	16.00
Sugarbeets	2005	Minnesota	D40 Combined Counties	900	800	26.4	21,100	20.50
Sugarbeets	2005	Minnesota	D40 West Central	119,600	116,200	20.5	2,384,400	16.20
Sugarbeets	2005	Minnesota	Kandiyohi	13,200	13,100	26.3	345,000	15.90
Sugarbeets	2005	Minnesota	McLeod	1,500	1,400	23.0	32,200	15.50
Sugarbeets	2005	Minnesota	Meeker	1,900	1,800	24.8	44,700	15.60
Sugarbeets	2005	Minnesota	Renville	42,100	41,600	25.8	1,074,500	15.40
Sugarbeets	2005	Minnesota	Sibley	3,700	3,600	24.9	89,600	15.00
Sugarbeets	2005	Minnesota	Stearns	2,700	2,600	23.7	61,600	16.00
Sugarbeets	2005	Minnesota	D50 Central	65,100	64,100	25.7	1,647,600	15.50
Sugarbeets	2005	Minnesota	Redwood	3,400	3,300	27.3	90,100	15.40
Sugarbeets	2005	Minnesota	D70 Combined Counties	800	800	24.6	19,700	24.70
Sugarbeets	2005	Minnesota	D70 Southwest	4,200	4,100	26.8	109,500	15.50
Sugarbeets	2005	Minnesota	D98 Combined Districts	700	600	27.8	16,700	15.70
Sugarbeets	**2005**	**Minnesota**	**State Total**	**491,000**	**460,000**	**20.4**	**9,384,000**	**17.00**
Sugarbeets	2005	Montana	Dawson	2,990	2,230	20.7	46,200	16.01
Sugarbeets	2005	Montana	Richland	17,720	16,190	21.2	344,000	15.59
Sugarbeets	2005	Montana	Roosevelt	2,140	2,100	19.9	41,700	19.27
Sugarbeets	2005	Montana	D30 Northeast	22,850	20,520	21.0	431,900	15.69
Sugarbeets	2005	Montana	Big Horn	9,260	8,790	25.9	227,600	16.44
Sugarbeets	2005	Montana	Carbon	4,280	4,120	22.7	93,700	16.62
Sugarbeets	2005	Montana	Treasure	3,210	2,990	26.1	78,000	16.63
Sugarbeets	2005	Montana	Yellowstone	8,610	8,460	24.3	206,000	16.59
Sugarbeets	2005	Montana	D20 Combined Counties	200	200	30.0	6,000	16.43
Sugarbeets	2005	Montana	D20 South Central	25,560	24,560	24.9	611,300	16.56
Sugarbeets	2005	Montana	Custer	1,390	1,370	19.3	26,400	15.54

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Idaho	D80 South Central	107,500	107,000	26.0	2,780,000	17.78
Sugarbeets	2005	Idaho	Bingham	19,200	18,800	28.8	541,000	17.69
Sugarbeets	2005	Idaho	Power	13,300	13,200	30.7	405,000	17.59
Sugarbeets	2005	Idaho	D80 East	32,500	32,000	29.6	946,000	17.65
Sugarbeets	**2005**	**Idaho**	**State Total**	**169,000**	**167,000**	**27.1**	**4,526,000**	**17.57**
Sugarbeets	2005	Michigan	D30 Combined Counties	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	D30 Northeast	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	Gladwin	1,000	1,000	23.0	23,000	17.20
Sugarbeets	2005	Michigan	Gratiot	11,000	10,800	20.4	220,000	17.10
Sugarbeets	2005	Michigan	Isabella	900	900	20.0	18,000	16.80
Sugarbeets	2005	Michigan	Midland	3,200	3,200	19.7	63,000	16.20
Sugarbeets	2005	Michigan	Montcalm	1,100	1,100	22.7	25,000	16.70
Sugarbeets	2005	Michigan	D50 Central	17,200	17,000	20.5	349,000	16.90
Sugarbeets	2005	Michigan	Arenac	3,700	3,700	23.5	87,000	17.20
Sugarbeets	2005	Michigan	Bay	14,500	14,000	19.1	268,000	16.50
Sugarbeets	2005	Michigan	Huron	54,500	54,000	22.6	1,220,000	17.10
Sugarbeets	2005	Michigan	Saginaw	16,300	16,200	20.1	326,000	16.80
Sugarbeets	2005	Michigan	Sanilac	20,000	19,800	22.0	436,000	16.60
Sugarbeets	2005	Michigan	Tuscola	21,000	20,600	20.5	423,000	16.90
Sugarbeets	2005	Michigan	D60 East Central	130,000	125,300	21.5	2,760,000	16.90
Sugarbeets	2005	Michigan	Clinton	1,800	1,800	19.4	35,000	17.50
Sugarbeets	2005	Michigan	Ionia	500	500	16.0	8,000	17.90
Sugarbeets	2005	Michigan	Shiawassee	1,000	900	20.0	18,000	17.30
Sugarbeets	2005	Michigan	D80 South Central	3,300	3,200	19.1	61,000	17.50
Sugarbeets	2005	Michigan	Genesee	700	700	20.0	14,000	13.40
Sugarbeets	2005	Michigan	Lapeer	1,000	1,000	20.0	20,000	17.00
Sugarbeets	2005	Michigan	St. Clair	1,200	1,200	17.5	21,000	17.30
Sugarbeets	2005	Michigan	D90 Southeast	2,900	2,900	19.0	55,000	16.20
Sugarbeets	**2005**	**Michigan**	**State Total**	**154,000**	**152,000**	**21.3**	**3,238,000**	**16.90**
Sugarbeets	2005	Minnesota	Becker	10,700	10,000	20.4	203,600	15.20
Sugarbeets	2005	Minnesota	Clay	57,000	56,100	19.8	1,113,000	17.50
Sugarbeets	2005	Minnesota	Kittson	36,600	18,300	11.8	216,300	15.50
Sugarbeets	2005	Minnesota	Mahnomen	5,800	5,600	22.5	125,900	15.10
Sugarbeets	2005	Minnesota	Marshall	47,400	42,900	15.4	659,500	15.10
Sugarbeets	2005	Minnesota	Norman	43,200	42,700	21.2	905,500	17.70
Sugarbeets	2005	Minnesota	Polk	99,100	97,900	20.2	1,974,400	17.80
Sugarbeets	2005	Minnesota	Red Lake	1,200	1,100	18.5	20,300	17.70
Sugarbeets	2005	Minnesota	D10 Combined Counties	400	400	18.5	7,400	17.60
Sugarbeets	2005	Minnesota	D10 Northwest	301,400	275,000	19.0	5,225,500	17.80
Sugarbeets	2005	Minnesota	Chippewa	34,300	34,200	25.0	856,000	15.80
Sugarbeets	2005	Minnesota	Grant	10,200	10,000	14.5	145,200	16.10
Sugarbeets	2005	Minnesota	Otter Tail	3,200	3,100	15.8	49,000	15.90
Sugarbeets	2005	Minnesota	Pope	2,300	2,200	24.7	54,300	16.40
Sugarbeets	2005	Minnesota	Stevens	3,900	3,800	23.5	89,400	16.20
Sugarbeets	2005	Minnesota	Swift	6,100	5,900	25.6	151,100	16.10
Sugarbeets	2005	Minnesota	Traverse	8,800	8,100	14.1	114,500	16.40
Sugarbeets	2005	Minnesota	Wilkin	47,100	45,400	18.3	829,700	16.60
Sugarbeets	2005	Minnesota	Yellow Medicine	2,800	2,700	27.9	75,200	16.00
Sugarbeets	2005	Minnesota	D40 Combined Counties	900	800	26.4	21,100	20.50
Sugarbeets	2005	Minnesota	D40 West Central	119,600	116,200	20.5	2,384,400	16.20
Sugarbeets	2005	Minnesota	Kandiyohi	13,200	13,100	26.3	345,000	15.90
Sugarbeets	2005	Minnesota	McLeod	1,500	1,400	23.0	32,200	15.50
Sugarbeets	2005	Minnesota	Meeker	1,900	1,800	24.8	44,700	15.60
Sugarbeets	2005	Minnesota	Renville	42,100	41,600	25.8	1,074,500	15.40
Sugarbeets	2005	Minnesota	Sibley	3,700	3,600	24.9	89,600	15.00
Sugarbeets	2005	Minnesota	Stearns	2,700	2,600	23.7	61,600	16.00
Sugarbeets	2005	Minnesota	D50 Central	65,100	64,100	25.7	1,647,600	15.50
Sugarbeets	2005	Minnesota	Redwood	3,400	3,300	27.3	90,100	15.40
Sugarbeets	2005	Minnesota	D70 Combined Counties	800	800	24.6	19,700	24.70
Sugarbeets	2005	Minnesota	D70 Southwest	4,200	4,100	26.8	109,500	15.50
Sugarbeets	2005	Minnesota	D98 Combined Districts	700	600	27.8	16,700	15.70
Sugarbeets	**2005**	**Minnesota**	**State Total**	**491,000**	**460,000**	**20.4**	**9,384,000**	**17.00**
Sugarbeets	2005	Montana	Dawson	2,990	2,230	20.7	46,200	15.01
Sugarbeets	2005	Montana	Richland	17,720	16,190	21.2	344,000	15.50
Sugarbeets	2005	Montana	Roosevelt	2,140	2,100	19.9	41,700	12.27
Sugarbeets	2005	Montana	D30 Northeast	22,850	20,520	21.0	431,900	15.59
Sugarbeets	2005	Montana	Big Horn	9,260	8,790	25.9	227,600	16.44
Sugarbeets	2005	Montana	Carbon	4,280	4,120	22.7	93,700	16.82
Sugarbeets	2005	Montana	Treasure	3,210	2,990	26.1	78,000	16.53
Sugarbeets	2005	Montana	Yellowstone	8,610	8,460	24.3	205,000	16.59
Sugarbeets	2005	Montana	D80 Combined Counties	200	200	30.0	6,000	16.43
Sugarbeets	2005	Montana	D80 South Central	25,560	24,560	24.9	611,300	16.56
Sugarbeets	2005	Montana	Custer	1,390	1,370	19.3	26,400	16.64

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Idaho	D20 South Central	107,600	107,000	26.0	2,790,000	17.79
Sugarbeets	2005	Idaho	Bingham	19,200	19,200	28.2	541,000	17.69
Sugarbeets	2005	Idaho	Power	13,300	13,200	30.7	405,000	17.59
Sugarbeets	2005	Idaho	D90 East	32,600	32,000	29.6	946,000	17.65
Sugarbeets	**2005**	**Idaho**	**State Total**	**169,000**	**167,000**	**27.1**	**4,526,000**	**17.57**
Sugarbeets	2005	Michigan	D30 Combined Counties	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	D30 Northeast	600	600	21.7	13,000	17.10
Sugarbeets	2005	Michigan	Gladwin	1,000	1,000	23.0	23,000	17.20
Sugarbeets	2005	Michigan	Gratiot	11,000	10,200	20.4	220,000	17.10
Sugarbeets	2005	Michigan	Isabella	900	900	20.0	18,000	16.80
Sugarbeets	2005	Michigan	Midland	3,200	3,200	19.7	63,000	16.20
Sugarbeets	2005	Michigan	Montcalm	1,100	1,100	22.7	25,000	16.70
Sugarbeets	2005	Michigan	D50 Central	17,200	17,000	20.5	349,000	16.90
Sugarbeets	2005	Michigan	Arenac	3,700	3,700	23.5	87,000	17.20
Sugarbeets	2005	Michigan	Bay	14,500	14,000	19.1	268,000	16.50
Sugarbeets	2005	Michigan	Huron	54,500	54,000	22.6	1,220,000	17.10
Sugarbeets	2005	Michigan	Saginaw	16,300	16,200	20.1	326,000	16.80
Sugarbeets	2005	Michigan	Sanilac	20,000	19,800	22.0	436,000	16.60
Sugarbeets	2005	Michigan	Tuscola	21,000	20,600	20.5	423,000	16.90
Sugarbeets	2005	Michigan	D60 East Central	130,000	128,300	21.5	2,760,000	16.90
Sugarbeets	2005	Michigan	Clinton	1,800	1,800	19.4	35,000	17.50
Sugarbeets	2005	Michigan	Ionia	500	500	16.0	8,000	17.90
Sugarbeets	2005	Michigan	Shiawassee	1,000	900	20.0	18,000	17.30
Sugarbeets	2005	Michigan	D80 South Central	3,300	3,200	19.1	61,000	17.50
Sugarbeets	2005	Michigan	Genesee	700	700	20.0	14,000	13.40
Sugarbeets	2005	Michigan	Lapeer	1,000	1,000	20.0	20,000	17.00
Sugarbeets	2005	Michigan	St. Clair	1,200	1,200	17.5	21,000	17.30
Sugarbeets	2005	Michigan	D90 Southeast	2,900	2,900	19.0	55,000	16.20
Sugarbeets	**2005**	**Michigan**	**State Total**	**154,000**	**152,000**	**21.3**	**3,238,000**	**16.90**
Sugarbeets	2005	Minnesota	Becker	10,700	10,000	20.4	203,600	15.20
Sugarbeets	2005	Minnesota	Clay	57,000	56,100	19.8	1,113,000	17.50
Sugarbeets	2005	Minnesota	Kittson	36,600	18,300	11.8	216,300	15.60
Sugarbeets	2005	Minnesota	Mahnomen	5,800	5,600	22.5	125,900	16.10
Sugarbeets	2005	Minnesota	Marshall	47,400	42,900	15.4	659,500	15.10
Sugarbeets	2005	Minnesota	Norman	43,200	42,700	21.2	905,500	17.70
Sugarbeets	2005	Minnesota	Polk	99,100	97,900	20.2	1,974,400	17.80
Sugarbeets	2005	Minnesota	Red Lake	1,200	1,100	18.5	20,300	17.70
Sugarbeets	2005	Minnesota	D10 Combined Counties	400	400	18.5	7,400	17.60
Sugarbeets	2005	Minnesota	D10 Northwest	301,400	275,000	19.0	5,225,500	17.80
Sugarbeets	2005	Minnesota	Chippewa	34,300	34,200	25.0	855,000	15.80
Sugarbeets	2005	Minnesota	Grant	10,200	10,000	14.5	145,200	16.10
Sugarbeets	2005	Minnesota	Otter Tail	3,200	3,100	15.8	48,900	15.90
Sugarbeets	2005	Minnesota	Pope	2,300	2,200	24.7	54,300	16.40
Sugarbeets	2005	Minnesota	Stevens	3,900	3,800	23.5	89,400	16.20
Sugarbeets	2005	Minnesota	Swift	6,100	5,900	25.6	151,100	16.10
Sugarbeets	2005	Minnesota	Traverse	8,800	8,100	14.1	114,500	16.40
Sugarbeets	2005	Minnesota	Wilkin	47,100	45,400	18.3	829,700	16.60
Sugarbeets	2005	Minnesota	Yellow Medicine	2,800	2,700	27.9	75,200	16.00
Sugarbeets	2005	Minnesota	D40 Combined Counties	800	800	26.4	21,100	20.60
Sugarbeets	2005	Minnesota	D40 West Central	119,600	116,200	20.5	2,354,400	16.20
Sugarbeets	2005	Minnesota	Kandiyohi	13,200	13,100	26.3	345,000	15.90
Sugarbeets	2005	Minnesota	McLeod	1,500	1,400	23.0	32,200	15.50
Sugarbeets	2005	Minnesota	Meeker	1,900	1,800	24.8	44,700	15.60
Sugarbeets	2005	Minnesota	Renville	42,100	41,600	25.8	1,074,500	15.40
Sugarbeets	2005	Minnesota	Sibley	3,700	3,600	24.9	89,600	15.00
Sugarbeets	2005	Minnesota	Stearns	2,700	2,600	23.7	61,600	16.00
Sugarbeets	2005	Minnesota	D50 Central	65,100	64,100	25.7	1,647,600	15.50
Sugarbeets	2005	Minnesota	Redwood	3,400	3,300	27.3	90,100	15.40
Sugarbeets	2005	Minnesota	D70 Combined Counties	800	800	24.6	19,700	24.70
Sugarbeets	2005	Minnesota	D70 Southwest	4,200	4,100	26.8	109,800	15.50
Sugarbeets	2005	Minnesota	D98 Combined Districts	700	600	27.8	16,700	15.70
Sugarbeets	**2005**	**Minnesota**	**State Total**	**491,000**	**460,000**	**20.4**	**9,384,000**	**17.00**
Sugarbeets	2005	Montana	Dawson	2,980	2,230	20.7	46,200	15.01
Sugarbeets	2005	Montana	Richland	17,720	16,190	21.2	344,000	15.59
Sugarbeets	2005	Montana	Roosevelt	2,140	2,100	19.9	41,700	19.27
Sugarbeets	2005	Montana	D30 Northeast	22,850	20,520	21.0	431,900	15.59
Sugarbeets	2005	Montana	Big Horn	9,260	8,790	25.9	227,600	16.44
Sugarbeets	2005	Montana	Carbon	4,280	4,120	22.7	93,700	16.82
Sugarbeets	2005	Montana	Treasure	3,210	2,990	26.1	78,000	16.53
Sugarbeets	2005	Montana	Yellowstone	8,610	8,460	24.3	206,000	16.59
Sugarbeets	2005	Montana	D80 Combined Counties	200	200	30.0	6,000	16.43
Sugarbeets	2005	Montana	D80 South Central	25,560	24,560	24.9	611,300	15.56
Sugarbeets	2005	Montana	Custer	1,390	1,370	19.3	26,400	15.54

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Montana	Prairie	1,770	1,530	15.2	23,300	16.34
Sugarbeets	2005	Montana	Rosebud	2,330	1,920	28.1	53,100	16.68
Sugarbeets	2005	Montana	D90 Southeast	5,480	4,820	20.7	99,800	17.56
Sugarbeets	**2005**	**Montana**	**State Total**	**53,900**	**49,900**	**22.9**	**1,143,000**	**17.41**
Sugarbeets	2005	Nebraska	Banner	800	800	16.9	13,500	16.70
Sugarbeets	2005	Nebraska	Box Butte	21,100	20,200	19.3	390,400	16.70
Sugarbeets	2005	Nebraska	Cheyenne	2,800	2,800	18.6	52,100	17.40
Sugarbeets	2005	Nebraska	Deuel	500	500	18.4	9,200	15.60
Sugarbeets	2005	Nebraska	Kimball	2,500	2,500	22.4	55,900	17.20
Sugarbeets	2005	Nebraska	Morrill	4,300	3,600	19.9	71,700	15.40
Sugarbeets	2005	Nebraska	Scotts Bluff	7,500	6,700	22.0	147,100	15.90
Sugarbeets	2005	Nebraska	Sheridan	2,400	2,400	23.1	55,400	16.80
Sugarbeets	2005	Nebraska	D10 Combined Counties	600	500	21.4	10,700	16.10
Sugarbeets	2005	Nebraska	D10 Northwest	42,500	40,000	20.2	805,000	16.50
Sugarbeets	2005	Nebraska	Chase	3,400	3,000	23.6	70,800	15.40
Sugarbeets	2005	Nebraska	Keith	1,100	1,000	23.5	23,500	16.50
Sugarbeets	2005	Nebraska	Perkins	1,400	1,300	18.2	23,700	15.10
Sugarbeets	2005	Nebraska	D70 Southwest	5,900	5,300	22.3	118,000	15.80
Sugarbeets	**2005**	**Nebraska**	**State Total**	**48,400**	**45,300**	**20.4**	**924,000**	**16.40**
Sugarbeets	2005	North Dakota	Williams	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	D10 Northwest	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	Cavalier	100	100	15.0	1,500	17.12
Sugarbeets	2005	North Dakota	Grand Forks	31,300	30,500	20.4	621,000	15.03
Sugarbeets	2005	North Dakota	Pembina	79,200	74,700	15.7	1,174,500	16.22
Sugarbeets	2005	North Dakota	Walsh	43,100	42,000	20.1	844,000	15.40
Sugarbeets	2005	North Dakota	D30 Northeast	153,700	147,300	17.9	2,641,000	16.23
Sugarbeets	2005	North Dakota	McKenzie	10,700	10,600	22.3	236,000	15.98
Sugarbeets	2005	North Dakota	D40 West Central	10,700	10,600	22.3	236,000	15.98
Sugarbeets	2005	North Dakota	Cass	24,500	23,000	20.9	480,000	16.00
Sugarbeets	2005	North Dakota	Steele	100	100	20.0	2,000	15.10
Sugarbeets	2005	North Dakota	Traill	29,100	28,400	20.9	593,000	17.81
Sugarbeets	2005	North Dakota	D60 East Central	53,700	51,500	20.9	1,075,000	17.90
Sugarbeets	2005	North Dakota	Richland	31,900	28,700	18.0	518,000	16.41
Sugarbeets	2005	North Dakota	D90 Southeast	31,900	28,700	18.0	518,000	16.41
Sugarbeets	**2005**	**North Dakota**	**State Total**	**255,000**	**243,000**	**18.8**	**4,568,000**	**18.00**
Sugarbeets	2005	Oregon	Union	2,000	2,000	25.8	51,500	16.30
Sugarbeets	2005	Oregon	D30 Northeast	2,000	2,000	25.8	51,500	16.30
Sugarbeets	2005	Oregon	Malheur	7,800	7,700	33.7	259,500	16.31
Sugarbeets	2005	Oregon	D80 Southeast	7,800	7,700	33.7	259,500	16.31
Sugarbeets	**2005**	**Oregon**	**State Total**	**9,800**	**9,700**	**32.1**	**311,000**	**16.71**
Sugarbeets	2005	Washington	Benton	1,700	1,700	40.6	69,000	16.75
Sugarbeets	2005	Washington	D20 Central	1,700	1,700	40.6	69,000	16.75
Sugarbeets	**2005**	**Washington**	**State Total**	**1,700**	**1,700**	**40.6**	**69,000**	**16.75**
Sugarbeets	2005	Wyoming	Big Horn	8,200	8,200	22.3	183,200	17.66
Sugarbeets	2005	Wyoming	Fremont	3,100	3,100	22.8	70,800	17.89
Sugarbeets	2005	Wyoming	Park	12,300	12,100	22.2	269,000	17.79
Sugarbeets	2005	Wyoming	Washakie	8,600	8,600	23.9	205,500	17.27
Sugarbeets	2005	Wyoming	D10 Northwest	32,200	32,000	22.8	728,500	17.63
Sugarbeets	2005	Wyoming	Goshen	1,200	1,200	16.0	19,200	16.23
Sugarbeets	2005	Wyoming	Laramie	700	600	20.5	12,300	17.22
Sugarbeets	2005	Wyoming	Platte	2,100	2,100	19.5	41,000	17.32
Sugarbeets	2005	Wyoming	D50 Southeast	4,000	3,900	18.6	72,500	17.01
Sugarbeets	**2005**	**Wyoming**	**State Total**	**36,200**	**35,900**	**22.3**	**801,000**	**17.57**

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Montana	Prairie	1,770	1,530	15.2	23,300	15.34
Sugarbeets	2005	Montana	Rosebud	2,330	1,920	26.1	50,100	16.66
Sugarbeets	2005	Montana	D90 Southeast	5,490	4,820	20.7	99,800	17.55
Sugarbeets	**2005**	**Montana**	**State Total**	**53,900**	**49,900**	**22.9**	**1,143,000**	**17.41**
Sugarbeets	2005	Nebraska	Banner	800	800	16.9	13,500	16.70
Sugarbeets	2005	Nebraska	Box Butte	21,100	20,200	19.3	390,400	16.70
Sugarbeets	2005	Nebraska	Cheyenne	2,800	2,200	18.6	50,100	17.40
Sugarbeets	2005	Nebraska	Deuel	500	500	18.4	9,200	15.60
Sugarbeets	2005	Nebraska	Kimball	2,500	2,500	22.4	55,900	17.20
Sugarbeets	2005	Nebraska	Morrill	4,300	3,600	19.9	71,700	15.40
Sugarbeets	2005	Nebraska	Scotts Bluff	7,500	6,700	22.0	147,100	15.90
Sugarbeets	2005	Nebraska	Sheridan	2,400	2,400	23.1	55,400	16.60
Sugarbeets	2005	Nebraska	D10 Combined Counties	600	500	21.4	10,700	16.10
Sugarbeets	2005	Nebraska	D10 Northwest	42,500	40,000	20.2	806,000	16.50
Sugarbeets	2005	Nebraska	Chase	3,400	3,000	23.6	70,800	15.40
Sugarbeets	2005	Nebraska	Keith	1,100	1,000	23.5	23,500	16.50
Sugarbeets	2005	Nebraska	Perkins	1,400	1,300	18.2	23,700	16.10
Sugarbeets	2005	Nebraska	D70 Southwest	5,900	5,300	22.3	118,000	15.80
Sugarbeets	**2005**	**Nebraska**	**State Total**	**48,400**	**45,300**	**20.4**	**924,000**	**16.40**
Sugarbeets	2005	North Dakota	Williams	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	D10 Northwest	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	Cavalier	100	100	15.0	1,500	17.12
Sugarbeets	2005	North Dakota	Grand Forks	31,300	30,500	20.4	621,000	15.03
Sugarbeets	2005	North Dakota	Pembina	79,200	74,700	15.7	1,174,500	15.22
Sugarbeets	2005	North Dakota	Walsh	43,100	42,000	20.1	844,000	15.40
Sugarbeets	2005	North Dakota	D30 Northeast	153,700	147,300	17.9	2,641,000	15.23
Sugarbeets	2005	North Dakota	McKenzie	10,700	10,600	22.3	236,000	15.88
Sugarbeets	2005	North Dakota	D40 West Central	10,700	10,600	22.3	236,000	15.88
Sugarbeets	2005	North Dakota	Cass	24,600	23,000	20.9	492,000	18.00
Sugarbeets	2005	North Dakota	Steele	100	100	20.0	2,000	15.10
Sugarbeets	2005	North Dakota	Traill	29,100	28,400	20.9	593,000	17.81
Sugarbeets	2005	North Dakota	D60 East Central	53,700	51,500	20.9	1,075,000	17.80
Sugarbeets	2005	North Dakota	Richland	31,900	28,700	18.0	518,000	16.41
Sugarbeets	2005	North Dakota	D90 Southeast	31,900	28,700	18.0	518,000	16.41
Sugarbeets	**2005**	**North Dakota**	**State Total**	**255,000**	**243,000**	**18.8**	**4,568,000**	**18.00**
Sugarbeets	2005	Oregon	Union	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	D30 Northeast	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	Malheur	7,800	7,700	33.7	259,500	16.31
Sugarbeets	2005	Oregon	D80 Southeast	7,800	7,700	33.7	259,500	16.31
Sugarbeets	**2005**	**Oregon**	**State Total**	**9,800**	**9,700**	**32.1**	**311,000**	**16.71**
Sugarbeets	2005	Washington	Benton	1,700	1,700	40.6	69,000	16.75
Sugarbeets	2005	Washington	D20 Central	1,700	1,700	40.6	69,000	16.75
Sugarbeets	**2005**	**Washington**	**State Total**	**1,700**	**1,700**	**40.6**	**69,000**	**16.75**
Sugarbeets	2005	Wyoming	Big Horn	8,200	8,200	22.3	183,200	17.66
Sugarbeets	2005	Wyoming	Fremont	3,100	3,100	22.8	70,800	17.99
Sugarbeets	2005	Wyoming	Park	12,300	12,100	22.2	269,000	17.79
Sugarbeets	2005	Wyoming	Washakie	8,600	8,600	23.9	205,500	17.27
Sugarbeets	2005	Wyoming	D10 Northwest	32,200	32,000	22.8	728,500	17.63
Sugarbeets	2005	Wyoming	Goshen	1,200	1,200	16.0	19,200	16.23
Sugarbeets	2005	Wyoming	Laramie	700	600	20.5	12,300	17.22
Sugarbeets	2005	Wyoming	Platte	2,100	2,100	19.5	41,000	17.32
Sugarbeets	2005	Wyoming	D80 Southeast	4,000	3,900	18.6	72,500	17.01
Sugarbeets	**2005**	**Wyoming**	**State Total**	**36,200**	**35,900**	**22.3**	**801,000**	**17.57**

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Montana	Prairie	1,770	1,530	15.2	23,300	15.34
Sugarbeets	2005	Montana	Rosebud	2,330	1,920	26.1	50,100	16.66
Sugarbeets	2005	Montana	D90 Southeast	5,490	4,820	20.7	99,800	17.55
Sugarbeets	**2005**	**Montana**	**State Total**	**53,900**	**49,900**	**22.9**	**1,143,000**	**17.41**
Sugarbeets	2005	Nebraska	Banner	800	800	16.9	13,500	16.70
Sugarbeets	2005	Nebraska	Box Butte	21,100	20,200	19.3	390,400	16.70
Sugarbeets	2005	Nebraska	Cheyenne	2,800	2,800	18.6	52,100	17.40
Sugarbeets	2005	Nebraska	Deuel	500	500	18.4	9,200	15.60
Sugarbeets	2005	Nebraska	Kimball	2,500	2,500	22.4	55,900	17.20
Sugarbeets	2005	Nebraska	Morrill	4,300	3,600	19.9	71,700	15.40
Sugarbeets	2005	Nebraska	Scotts Bluff	7,500	6,700	22.0	147,100	15.90
Sugarbeets	2005	Nebraska	Sheridan	2,400	2,400	23.1	55,400	16.80
Sugarbeets	2005	Nebraska	D10 Combined Counties	800	500	21.4	10,700	16.10
Sugarbeets	2005	Nebraska	D10 Northwest	42,500	40,000	20.2	808,000	16.50
Sugarbeets	2005	Nebraska	Chase	3,400	3,000	23.6	70,800	15.40
Sugarbeets	2005	Nebraska	Keith	1,100	1,000	23.5	23,500	16.60
Sugarbeets	2005	Nebraska	Perkins	1,400	1,300	18.2	23,700	16.10
Sugarbeets	2005	Nebraska	D70 Southwest	5,900	5,300	22.3	118,000	15.80
Sugarbeets	**2005**	**Nebraska**	**State Total**	**48,400**	**45,300**	**20.4**	**924,000**	**16.40**
Sugarbeets	2005	North Dakota	Williams	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	D10 Northwest	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	Cavalier	100	100	15.0	1,500	17.12
Sugarbeets	2005	North Dakota	Grand Forks	31,300	30,500	20.4	621,000	16.03
Sugarbeets	2005	North Dakota	Pembina	79,200	74,700	15.7	1,174,500	16.22
Sugarbeets	2005	North Dakota	Walsh	43,100	42,000	20.1	844,000	15.40
Sugarbeets	2005	North Dakota	D30 Northeast	153,700	147,300	17.9	2,641,000	16.23
Sugarbeets	2005	North Dakota	McKenzie	10,700	10,600	22.3	236,000	16.98
Sugarbeets	2005	North Dakota	D40 West Central	10,700	10,600	22.3	236,000	16.98
Sugarbeets	2005	North Dakota	Cass	24,500	23,000	20.9	480,000	16.00
Sugarbeets	2005	North Dakota	Steele	100	100	20.0	2,000	16.10
Sugarbeets	2005	North Dakota	Traill	29,100	28,400	20.9	593,000	17.81
Sugarbeets	2005	North Dakota	D60 East Central	53,700	51,500	20.9	1,075,000	17.90
Sugarbeets	2005	North Dakota	Richland	31,900	28,700	18.0	518,000	16.41
Sugarbeets	2005	North Dakota	D90 Southeast	31,900	28,700	18.0	518,000	16.41
Sugarbeets	**2005**	**North Dakota**	**State Total**	**255,000**	**243,000**	**18.8**	**4,568,000**	**18.00**
Sugarbeets	2005	Oregon	Union	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	D30 Northeast	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	Malheur	7,800	7,700	33.7	259,500	16.31
Sugarbeets	2005	Oregon	D80 Southeast	7,800	7,700	33.7	259,500	16.31
Sugarbeets	**2005**	**Oregon**	**State Total**	**9,800**	**9,700**	**32.1**	**311,000**	**16.71**
Sugarbeets	2005	Washington	Benton	1,700	1,700	40.6	69,000	16.75
Sugarbeets	2005	Washington	D20 Central	1,700	1,700	40.6	69,000	16.75
Sugarbeets	**2005**	**Washington**	**State Total**	**1,700**	**1,700**	**40.6**	**69,000**	**16.75**
Sugarbeets	2005	Wyoming	Big Horn	8,200	8,200	22.3	183,200	17.66
Sugarbeets	2005	Wyoming	Fremont	3,100	3,100	22.8	70,800	17.89
Sugarbeets	2005	Wyoming	Park	12,300	12,100	22.2	269,000	17.79
Sugarbeets	2005	Wyoming	Washakie	8,600	8,600	23.9	205,500	17.27
Sugarbeets	2005	Wyoming	D10 Northwest	32,200	32,000	22.8	728,500	17.63
Sugarbeets	2005	Wyoming	Goshen	1,200	1,200	16.0	19,200	16.23
Sugarbeets	2005	Wyoming	Laramie	700	600	20.5	12,300	17.22
Sugarbeets	2005	Wyoming	Platte	2,100	2,100	19.5	41,000	17.32
Sugarbeets	2005	Wyoming	D50 Southeast	4,000	3,900	18.6	72,600	17.01
Sugarbeets	**2005**	**Wyoming**	**State Total**	**36,200**	**35,900**	**22.3**	**801,000**	**17.57**

Commodity	Year	State	County	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Sucrose (Percent)
Sugarbeets	2005	Montana	Prairie	1,770	1,530	15.2	23,300	15.34
Sugarbeets	2005	Montana	Rosebud	2,330	1,920	28.1	53,100	16.66
Sugarbeets	2005	Montana	D90 Southeast	5,490	4,820	20.7	99,800	17.55
Sugarbeets	**2005**	**Montana**	**State Total**	**53,900**	**49,900**	**22.9**	**1,143,000**	**17.41**
Sugarbeets	2005	Nebraska	Banner	800	800	16.9	13,500	16.70
Sugarbeets	2005	Nebraska	Box Butte	21,100	20,200	19.3	390,400	16.70
Sugarbeets	2005	Nebraska	Cheyenne	2,800	2,800	18.6	52,100	17.40
Sugarbeets	2005	Nebraska	Deuel	500	500	18.4	9,200	15.60
Sugarbeets	2005	Nebraska	Kimball	2,500	2,500	22.4	55,900	17.20
Sugarbeets	2005	Nebraska	Morrill	4,300	3,600	19.9	71,700	15.40
Sugarbeets	2005	Nebraska	Scotts Bluff	7,500	6,700	22.0	147,100	15.90
Sugarbeets	2005	Nebraska	Sheridan	2,400	2,400	23.1	55,400	16.80
Sugarbeets	2005	Nebraska	D10 Combined Counties	600	500	21.4	10,700	16.10
Sugarbeets	2005	Nebraska	D10 Northwest	42,500	40,000	20.2	805,000	16.50
Sugarbeets	2005	Nebraska	Chase	3,400	3,000	23.6	70,800	15.40
Sugarbeets	2005	Nebraska	Keith	1,100	1,000	23.5	23,500	16.50
Sugarbeets	2005	Nebraska	Perkins	1,400	1,300	18.2	23,700	16.10
Sugarbeets	2005	Nebraska	D70 Southwest	5,900	5,300	22.3	118,000	15.60
Sugarbeets	**2005**	**Nebraska**	**State Total**	**46,400**	**45,300**	**20.4**	**924,000**	**16.40**
Sugarbeets	2005	North Dakota	Williams	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	D10 Northwest	5,000	4,900	20.0	98,000	19.14
Sugarbeets	2005	North Dakota	Cavalier	100	100	15.0	1,500	17.12
Sugarbeets	2005	North Dakota	Grand Forks	31,300	30,500	20.4	621,000	16.03
Sugarbeets	2005	North Dakota	Pembina	79,200	74,700	15.7	1,174,500	16.22
Sugarbeets	2005	North Dakota	Walsh	43,100	42,000	20.1	844,000	15.40
Sugarbeets	2005	North Dakota	D30 Northeast	153,700	147,300	17.9	2,641,000	15.23
Sugarbeets	2005	North Dakota	McKenzie	10,700	10,600	22.3	236,000	15.98
Sugarbeets	2005	North Dakota	D40 West Central	10,700	10,600	22.3	236,000	15.98
Sugarbeets	2005	North Dakota	Cass	24,500	23,000	20.9	480,000	15.00
Sugarbeets	2005	North Dakota	Steele	100	100	20.0	2,000	15.10
Sugarbeets	2005	North Dakota	Traill	29,100	28,400	20.9	593,000	17.81
Sugarbeets	2005	North Dakota	D60 East Central	53,700	51,500	20.9	1,075,000	17.80
Sugarbeets	2005	North Dakota	Richland	31,900	28,700	18.0	518,000	16.41
Sugarbeets	2005	North Dakota	D90 Southeast	31,900	28,700	18.0	518,000	16.41
Sugarbeets	**2005**	**North Dakota**	**State Total**	**255,000**	**243,000**	**18.8**	**4,568,000**	**18.00**
Sugarbeets	2005	Oregon	Union	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	D30 Northeast	2,000	2,000	25.8	51,500	15.30
Sugarbeets	2005	Oregon	Malheur	7,800	7,700	33.7	259,500	16.31
Sugarbeets	2005	Oregon	D80 Southeast	7,800	7,700	33.7	259,500	16.31
Sugarbeets	**2005**	**Oregon**	**State Total**	**9,800**	**9,700**	**32.1**	**311,000**	**16.71**
Sugarbeets	2005	Washington	Benton	1,700	1,700	40.6	69,000	16.75
Sugarbeets	2005	Washington	D20 Central	1,700	1,700	40.6	69,000	16.75
Sugarbeets	**2005**	**Washington**	**State Total**	**1,700**	**1,700**	**40.6**	**69,000**	**16.75**
Sugarbeets	2005	Wyoming	Big Horn	6,200	6,200	22.3	153,200	17.66
Sugarbeets	2005	Wyoming	Fremont	3,100	3,100	22.8	70,800	17.98
Sugarbeets	2005	Wyoming	Park	12,300	12,100	22.2	269,000	17.79
Sugarbeets	2005	Wyoming	Washakie	8,600	8,600	23.9	205,500	17.27
Sugarbeets	2005	Wyoming	D10 Northwest	32,200	32,000	22.8	728,500	17.63
Sugarbeets	2005	Wyoming	Goshen	1,200	1,200	16.0	19,200	16.23
Sugarbeets	2005	Wyoming	Laramie	700	600	20.5	12,300	17.22
Sugarbeets	2005	Wyoming	Platte	2,100	2,100	19.5	41,000	17.32
Sugarbeets	2005	Wyoming	D50 Southeast	4,000	3,900	18.6	72,500	17.01
Sugarbeets	**2005**	**Wyoming**	**State Total**	**36,200**	**35,900**	**22.3**	**801,000**	**17.57**

Commodity	Year	State	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Price per Unit (Dollars per Ton)	Value of production (Thousands of Dollars)
Sugarbeets	2010	California	25					
Sugarbeets	2010	Colorado	30					
Sugarbeets	2010	Idaho	169					
Sugarbeets	2010	Michigan	147					
Sugarbeets	2010	Minnesota	445					
Sugarbeets	2010	Montana	42					
Sugarbeets	2010	Nebraska	46					
Sugarbeets	2010	North Dakota	227					
Sugarbeets	2010	Oregon	11					
Sugarbeets	2010	United States	1,174					
Sugarbeets	2010	Wyoming	32					
Sugarbeets	2009	California	25	25	35.00	286		
Sugarbeets	2009	Colorado	36	35	27.50	963		
Sugarbeets	2009	Idaho	164	163	34.30	5,591		
Sugarbeets	2009	Michigan	138	136	24.40	3,315		
Sugarbeets	2009	Minnesota	464	449	23.70	10,641		
Sugarbeets	2009	Montana	38	34	29.80	1,001		
Sugarbeets	2009	Nebraska	53	53	24.60	1,284		
Sugarbeets	2009	North Dakota	225	215	22.00	4,785		
Sugarbeets	2009	Oregon	11	11	37.60	395		
Sugarbeets	2009	United States	1,186	1,149	25.70	29,563		
Sugarbeets	2009	Wyoming	32	26	26.50	675		
Sugarbeets	2008	California	26	25	41.60	1,052	$44.80	$47,130
Sugarbeets	2008	Colorado	34	29	26.50	756	$47.80	$36,232
Sugarbeets	2008	Idaho	131	116	31.20	3,619	$42.00	$151,995
Sugarbeets	2008	Michigan	137	136	25.70	3,903	$44.00	$171,732
Sugarbeets	2008	Minnesota	440	399	24.70	9,855	$49.90	$491,765
Sugarbeets	2008	Montana	32	31	26.80	823	$50.80	$41,806
Sugarbeets	2008	Nebraska	45	37	22.60	843	$50.80	$42,824
Sugarbeets	2008	North Dakota	208	197	25.90	5,102	$51.00	$260,202
Sugarbeets	2008	Oregon	7	6	33.10	195	$42.00	$6,190
Sugarbeets	2008	United States	1,091	1,005	26.80	26,881	$48.00	$1,289,821
Sugarbeets	2008	Washington	2	2	41.90	67	$42.00	$2,814
Sugarbeets	2008	Wyoming	30	27	24.50	664	$52.60	$34,926
Sugarbeets	2007	California	40	39	35.50	1,385	$43.80	$60,617
Sugarbeets	2007	Colorado	32	29	26.20	765	$36.00	$27,540
Sugarbeets	2007	Idaho	169	167	34.40	5,745	$36.90	$211,991
Sugarbeets	2007	Michigan	150	149	23.40	3,487	$36.00	$125,532
Sugarbeets	2007	Minnesota	486	451	23.80	11,445	$45.20	$517,460
Sugarbeets	2007	Montana	48	47	24.70	1,161	$39.10	$45,395
Sugarbeets	2007	Nebraska	48	44	23.50	1,041	$40.40	$42,056
Sugarbeets	2007	North Dakota	252	247	23.10	5,706	$46.30	$264,185
Sugarbeets	2007	Oregon	12	11	31.90	351	$36.90	$12,952
Sugarbeets	2007	United States	1,269	1,247	25.50	31,834	$42.00	$1,337,173
Sugarbeets	2007	Washington	2	2	42.00	84	$36.90	$3,100
Sugarbeets	2007	Wyoming	31	30	21.80	655	$40.20	$26,452
Sugarbeets	2006	California	43	43	36.10	1,556	$42.20	$65,663
Sugarbeets	2006	Colorado	42	38	23.40	889	$42.20	$37,516
Sugarbeets	2006	Idaho	188	187	31.70	5,928	$39.50	$234,156
Sugarbeets	2006	Michigan	155	154	23.20	3,573	$38.00	$135,774
Sugarbeets	2006	Minnesota	504	477	24.90	11,877	$46.70	$554,656
Sugarbeets	2006	Montana	54	49	27.00	1,310	$41.60	$54,496
Sugarbeets	2006	Nebraska	61	58	23.30	1,347	$44.50	$59,942
Sugarbeets	2006	North Dakota	261	243	26.00	6,316	$48.90	$305,950
Sugarbeets	2006	Oregon	13	13	30.10	394	$39.50	$15,563
Sugarbeets	2006	United States	1,366	1,304	26.10	34,064	$44.20	$1,506,965
Sugarbeets	2006	Washington	2	2	37.00	74	$39.50	$2,923
Sugarbeets	2006	Wyoming	43	40	19.90	795	$46.80	$37,346
Sugarbeets	2005	California	44	44	37.10	1,636	$41.80	$65,355
Sugarbeets	2005	Colorado	36	34	24.30	833	$40.70	$33,903
Sugarbeets	2005	Idaho	169	167	27.10	4,526	$44.40	$200,954
Sugarbeets	2005	Michigan	154	152	21.30	3,235	$34.40	$111,387
Sugarbeets	2005	Minnesota	491	460	20.40	9,364	$43.80	$411,019
Sugarbeets	2005	Montana	54	50	22.90	1,143	$45.30	$51,776
Sugarbeets	2005	Nebraska	48	45	20.40	924	$43.10	$39,824
Sugarbeets	2005	North Dakota	255	243	18.80	4,565	$49.20	$224,746
Sugarbeets	2005	Oregon	10	10	32.10	311	$44.40	$13,808
Sugarbeets	2005	United States	1,300	1,243	22.10	27,433	$43.50	$1,193,151
Sugarbeets	2005	Washington	2	2	40.60	69	$44.40	$3,064
Sugarbeets	2005	Wyoming	38	36	22.30	801	$42.80	$34,283

Commodity	Year	State	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Price per Unit (Dollars per Ton)	Value of production (Thousands of Dollars)
Sugarbeets	2010	California	25					
Sugarbeets	2010	Colorado	30					
Sugarbeets	2010	Idaho	169					
Sugarbeets	2010	Michigan	147					
Sugarbeets	2010	Minnesota	445					
Sugarbeets	2010	Montana	42					
Sugarbeets	2010	Nebraska	46					
Sugarbeets	2010	North Dakota	227					
Sugarbeets	2010	Oregon	11					
Sugarbeets	2010	United States	1,174					
Sugarbeets	2010	Wyoming	32					
Sugarbeets	2009	California	25	25	35.00	886		
Sugarbeets	2009	Colorado	35	35	27.50	963		
Sugarbeets	2009	Idaho	164	163	34.30	5,591		
Sugarbeets	2009	Michigan	138	136	24.40	3,315		
Sugarbeets	2009	Minnesota	464	449	23.70	10,641		
Sugarbeets	2009	Montana	38	34	29.80	1,001		
Sugarbeets	2009	Nebraska	53	53	24.60	1,294		
Sugarbeets	2009	North Dakota	225	215	22.00	4,706		
Sugarbeets	2009	Oregon	11	11	37.60	395		
Sugarbeets	2009	United States	1,186	1,149	25.70	29,563		
Sugarbeets	2009	Wyoming	32	26	26.50	675		
Sugarbeets	2008	California	26	25	41.60	1,052	$44.80	$47,130
Sugarbeets	2008	Colorado	34	29	26.50	755	$47.80	$36,232
Sugarbeets	2008	Idaho	131	116	31.20	3,619	$42.00	$151,995
Sugarbeets	2008	Michigan	137	136	28.70	3,903	$44.00	$171,732
Sugarbeets	2008	Minnesota	440	399	24.70	9,855	$49.90	$491,765
Sugarbeets	2008	Montana	32	31	26.80	823	$50.80	$41,805
Sugarbeets	2008	Nebraska	46	37	22.60	843	$50.80	$42,824
Sugarbeets	2008	North Dakota	208	197	25.90	5,102	$51.00	$260,202
Sugarbeets	2008	Oregon	7	6	33.10	195	$42.00	$6,190
Sugarbeets	2008	United States	1,091	1,005	26.80	26,881	$48.00	$1,289,621
Sugarbeets	2008	Washington	2	2	41.90	67	$42.00	$2,814
Sugarbeets	2008	Wyoming	30	27	24.50	664	$52.60	$34,926
Sugarbeets	2007	California	40	39	35.60	1,385	$43.60	$60,517
Sugarbeets	2007	Colorado	32	29	26.20	765	$36.00	$27,540
Sugarbeets	2007	Idaho	169	167	34.40	5,745	$36.90	$211,991
Sugarbeets	2007	Michigan	150	149	23.40	3,487	$36.00	$125,532
Sugarbeets	2007	Minnesota	486	451	23.80	11,445	$45.20	$517,450
Sugarbeets	2007	Montana	48	47	24.70	1,161	$39.10	$45,395
Sugarbeets	2007	Nebraska	48	44	23.60	1,041	$40.40	$42,056
Sugarbeets	2007	North Dakota	252	247	23.10	5,706	$46.30	$264,185
Sugarbeets	2007	Oregon	12	11	31.90	351	$36.90	$12,952
Sugarbeets	2007	United States	1,269	1,247	25.50	31,834	$42.00	$1,337,173
Sugarbeets	2007	Washington	2	2	42.00	84	$36.90	$3,100
Sugarbeets	2007	Wyoming	31	30	21.60	656	$40.20	$26,452
Sugarbeets	2006	California	43	43	36.10	1,556	$42.20	$65,663
Sugarbeets	2006	Colorado	42	35	23.40	889	$42.20	$37,516
Sugarbeets	2006	Idaho	188	157	31.70	5,926	$39.50	$234,155
Sugarbeets	2006	Michigan	155	154	23.20	3,573	$38.00	$135,774
Sugarbeets	2006	Minnesota	504	477	24.90	11,877	$46.70	$554,656
Sugarbeets	2006	Montana	54	49	27.00	1,310	$41.60	$54,496
Sugarbeets	2006	Nebraska	61	55	23.30	1,347	$44.50	$59,942
Sugarbeets	2006	North Dakota	261	243	26.00	6,316	$48.90	$306,950
Sugarbeets	2006	Oregon	13	13	30.10	394	$39.50	$15,563
Sugarbeets	2006	United States	1,366	1,304	26.10	34,064	$44.20	$1,506,985
Sugarbeets	2006	Washington	2	2	37.00	74	$39.50	$2,923
Sugarbeets	2006	Wyoming	43	40	19.90	795	$46.80	$37,346
Sugarbeets	2005	California	44	44	37.10	1,636	$41.80	$65,355
Sugarbeets	2005	Colorado	36	34	24.30	833	$40.70	$33,903
Sugarbeets	2005	Idaho	169	167	27.10	4,526	$44.40	$200,954
Sugarbeets	2005	Michigan	154	152	21.30	3,236	$34.40	$111,367
Sugarbeets	2005	Minnesota	491	460	20.40	9,384	$43.80	$411,019
Sugarbeets	2005	Montana	54	50	22.90	1,143	$45.30	$51,778
Sugarbeets	2005	Nebraska	48	45	20.40	924	$43.10	$39,824
Sugarbeets	2005	North Dakota	255	243	18.80	4,565	$49.20	$224,746
Sugarbeets	2005	Oregon	10	10	32.10	311	$44.40	$13,809
Sugarbeets	2005	United States	1,300	1,243	22.10	27,433	$43.50	$1,193,151
Sugarbeets	2005	Washington	2	2	40.60	69	$44.40	$3,064
Sugarbeets	2005	Wyoming	36	36	22.30	801	$42.20	$34,283

Commodity	Year	State	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Price per Unit (Dollars per Ton)	Value of production (Thousands of Dollars)
Sugarbeets	2010	California	25					
Sugarbeets	2010	Colorado	30					
Sugarbeets	2010	Idaho	169					
Sugarbeets	2010	Michigan	147					
Sugarbeets	2010	Minnesota	445					
Sugarbeets	2010	Montana	42					
Sugarbeets	2010	Nebraska	46					
Sugarbeets	2010	North Dakota	227					
Sugarbeets	2010	Oregon	11					
Sugarbeets	2010	United States	1,174					
Sugarbeets	2010	Wyoming	32					
Sugarbeets	2009	California	25	25	35.00	886		
Sugarbeets	2009	Colorado	35	35	27.50	963		
Sugarbeets	2009	Idaho	164	163	34.30	5,591		
Sugarbeets	2009	Michigan	138	136	24.40	3,319		
Sugarbeets	2009	Minnesota	464	449	23.70	10,641		
Sugarbeets	2009	Montana	38	34	29.60	1,001		
Sugarbeets	2009	Nebraska	53	53	24.60	1,294		
Sugarbeets	2009	North Dakota	225	215	22.00	4,786		
Sugarbeets	2009	Oregon	11	11	37.60	395		
Sugarbeets	2009	United States	1,186	1,149	25.70	29,563		
Sugarbeets	2009	Wyoming	32	26	26.50	675		
Sugarbeets	2008	California	26	25	41.60	1,052	$44.80	$47,130
Sugarbeets	2008	Colorado	34	29	26.50	765	$47.80	$36,232
Sugarbeets	2008	Idaho	131	116	31.20	3,619	$42.00	$151,998
Sugarbeets	2008	Michigan	137	136	28.70	3,903	$44.00	$171,732
Sugarbeets	2008	Minnesota	440	399	24.70	9,855	$49.90	$491,765
Sugarbeets	2008	Montana	32	31	26.60	823	$50.80	$41,808
Sugarbeets	2008	Nebraska	45	37	22.80	843	$50.80	$42,824
Sugarbeets	2008	North Dakota	208	197	25.90	5,102	$51.00	$260,202
Sugarbeets	2008	Oregon	7	6	33.10	195	$42.00	$8,190
Sugarbeets	2008	United States	1,091	1,005	26.60	26,881	$48.00	$1,289,621
Sugarbeets	2008	Washington	2	2	41.90	67	$42.00	$2,814
Sugarbeets	2008	Wyoming	30	27	24.60	664	$52.60	$34,926
Sugarbeets	2007	California	40	39	35.60	1,388	$43.60	$60,517
Sugarbeets	2007	Colorado	32	29	26.20	765	$36.00	$27,540
Sugarbeets	2007	Idaho	169	167	34.40	5,745	$36.90	$211,991
Sugarbeets	2007	Michigan	150	149	23.40	3,487	$36.00	$125,532
Sugarbeets	2007	Minnesota	486	481	23.80	11,448	$45.20	$517,450
Sugarbeets	2007	Montana	48	47	24.70	1,161	$39.10	$45,395
Sugarbeets	2007	Nebraska	48	44	23.60	1,041	$40.40	$42,056
Sugarbeets	2007	North Dakota	252	247	23.10	5,706	$46.30	$264,185
Sugarbeets	2007	Oregon	12	11	31.90	351	$36.90	$12,952
Sugarbeets	2007	United States	1,269	1,247	25.50	31,834	$42.00	$1,337,173
Sugarbeets	2007	Washington	2	2	42.00	84	$36.90	$3,100
Sugarbeets	2007	Wyoming	31	30	21.80	655	$40.20	$26,452
Sugarbeets	2006	California	43	43	36.10	1,556	$42.20	$65,663
Sugarbeets	2006	Colorado	42	38	23.40	889	$42.20	$37,516
Sugarbeets	2006	Idaho	188	187	31.70	5,928	$39.50	$234,156
Sugarbeets	2006	Michigan	155	154	23.20	3,573	$38.00	$135,774
Sugarbeets	2006	Minnesota	504	477	24.90	11,877	$46.70	$554,656
Sugarbeets	2006	Montana	54	49	27.00	1,310	$41.60	$54,496
Sugarbeets	2006	Nebraska	61	58	23.30	1,347	$44.50	$59,942
Sugarbeets	2006	North Dakota	261	243	26.00	6,318	$48.90	$308,950
Sugarbeets	2006	Oregon	13	13	30.10	394	$39.50	$15,563
Sugarbeets	2006	United States	1,366	1,304	26.10	34,064	$44.20	$1,506,985
Sugarbeets	2006	Washington	2	2	37.00	74	$39.50	$2,923
Sugarbeets	2006	Wyoming	43	40	19.90	795	$46.90	$37,346
Sugarbeets	2005	California	44	44	37.10	1,636	$41.80	$68,385
Sugarbeets	2005	Colorado	36	34	24.30	833	$40.70	$33,903
Sugarbeets	2005	Idaho	169	167	27.10	4,526	$44.40	$200,954
Sugarbeets	2005	Michigan	154	152	21.30	3,235	$34.40	$111,287
Sugarbeets	2005	Minnesota	491	460	20.40	9,384	$43.80	$411,019
Sugarbeets	2005	Montana	54	50	22.90	1,143	$45.30	$51,776
Sugarbeets	2005	Nebraska	48	45	20.40	924	$43.10	$39,824
Sugarbeets	2005	North Dakota	255	243	18.80	4,568	$49.20	$224,746
Sugarbeets	2005	Oregon	10	10	32.10	311	$44.40	$13,808
Sugarbeets	2005	United States	1,300	1,243	22.10	27,433	$43.50	$1,193,151
Sugarbeets	2005	Washington	2	2	40.60	69	$44.40	$3,064
Sugarbeets	2005	Wyoming	36	36	22.30	801	$42.80	$34,283

Commodity	Year	State	Planted All Purposes (Thousands of Acres)	Harvested (Thousands of Acres)	Yield (Tons)	Production (Thousands of Tons)	Price per Unit (Dollars per Ton)	Value of production (Thousands of Dollars)
Sugarbeets	2010	California	25					
Sugarbeets	2010	Colorado	30					
Sugarbeets	2010	Idaho	169					
Sugarbeets	2010	Michigan	147					
Sugarbeets	2010	Minnesota	446					
Sugarbeets	2010	Montana	42					
Sugarbeets	2010	Nebraska	46					
Sugarbeets	2010	North Dakota	227					
Sugarbeets	2010	Oregon	11					
Sugarbeets	2010	United States	1,174					
Sugarbeets	2010	Wyoming	32					
Sugarbeets	2009	California	26	25	35.00	886		
Sugarbeets	2009	Colorado	36	35	27.50	963		
Sugarbeets	2009	Idaho	164	163	34.30	5,591		
Sugarbeets	2009	Michigan	138	136	24.40	3,319		
Sugarbeets	2009	Minnesota	464	449	23.70	10,641		
Sugarbeets	2009	Montana	38	34	29.80	1,001		
Sugarbeets	2009	Nebraska	53	53	24.80	1,294		
Sugarbeets	2009	North Dakota	226	219	22.00	4,796		
Sugarbeets	2009	Oregon	11	11	37.60	395		
Sugarbeets	2009	United States	1,186	1,149	25.70	29,563		
Sugarbeets	2009	Wyoming	32	26	26.50	675		
Sugarbeets	2008	California	26	25	41.60	1,052	$44.80	$47,130
Sugarbeets	2008	Colorado	34	29	26.50	755	$47.80	$36,232
Sugarbeets	2008	Idaho	131	116	31.20	3,619	$42.00	$151,995
Sugarbeets	2008	Michigan	137	136	25.70	3,903	$44.00	$171,732
Sugarbeets	2008	Minnesota	440	399	24.70	9,855	$49.90	$491,765
Sugarbeets	2008	Montana	32	31	26.80	823	$50.80	$41,806
Sugarbeets	2008	Nebraska	46	37	22.60	843	$50.80	$42,824
Sugarbeets	2008	North Dakota	208	197	25.90	5,102	$51.00	$260,202
Sugarbeets	2008	Oregon	7	6	33.10	195	$42.00	$6,190
Sugarbeets	2008	United States	1,091	1,005	26.60	26,881	$48.00	$1,289,821
Sugarbeets	2008	Washington	2	2	41.90	67	$42.00	$2,814
Sugarbeets	2008	Wyoming	30	27	24.50	664	$52.60	$34,926
Sugarbeets	2007	California	40	39	35.50	1,365	$43.60	$60,517
Sugarbeets	2007	Colorado	32	29	26.20	765	$36.00	$27,540
Sugarbeets	2007	Idaho	169	167	34.40	5,745	$36.90	$211,991
Sugarbeets	2007	Michigan	150	149	23.40	3,487	$36.00	$125,532
Sugarbeets	2007	Minnesota	486	451	23.80	11,445	$45.20	$517,450
Sugarbeets	2007	Montana	48	47	24.70	1,161	$39.10	$45,395
Sugarbeets	2007	Nebraska	48	44	23.50	1,041	$40.40	$42,056
Sugarbeets	2007	North Dakota	252	247	23.10	5,706	$46.30	$264,185
Sugarbeets	2007	Oregon	12	11	31.90	351	$36.90	$12,952
Sugarbeets	2007	United States	1,269	1,247	25.60	31,234	$42.00	$1,337,173
Sugarbeets	2007	Washington	2	2	42.00	84	$36.90	$3,100
Sugarbeets	2007	Wyoming	31	30	21.80	659	$40.20	$26,452
Sugarbeets	2006	California	43	43	36.10	1,555	$42.20	$65,663
Sugarbeets	2006	Colorado	42	38	23.40	889	$42.20	$37,516
Sugarbeets	2006	Idaho	188	157	31.70	5,925	$39.50	$234,156
Sugarbeets	2006	Michigan	155	154	23.20	3,573	$38.00	$135,774
Sugarbeets	2006	Minnesota	504	477	24.90	11,877	$46.70	$554,656
Sugarbeets	2006	Montana	54	49	27.00	1,310	$41.60	$54,496
Sugarbeets	2006	Nebraska	61	55	23.30	1,347	$44.50	$59,942
Sugarbeets	2006	North Dakota	261	243	26.00	6,315	$48.90	$305,950
Sugarbeets	2006	Oregon	13	13	30.10	394	$39.50	$15,563
Sugarbeets	2006	United States	1,366	1,304	26.10	34,064	$44.20	$1,506,985
Sugarbeets	2006	Washington	2	2	37.00	74	$39.50	$2,923
Sugarbeets	2006	Wyoming	43	40	19.90	795	$46.80	$37,346
Sugarbeets	2005	California	44	44	37.10	1,636	$41.80	$65,355
Sugarbeets	2005	Colorado	36	34	24.30	833	$40.70	$33,903
Sugarbeets	2005	Idaho	169	167	27.10	4,526	$44.40	$200,954
Sugarbeets	2005	Michigan	154	152	21.30	3,235	$34.40	$111,367
Sugarbeets	2005	Minnesota	491	460	20.40	9,384	$43.80	$411,019
Sugarbeets	2005	Montana	54	50	22.90	1,143	$45.30	$51,778
Sugarbeets	2005	Nebraska	48	45	20.40	924	$43.10	$39,824
Sugarbeets	2005	North Dakota	255	243	15.60	4,565	$49.20	$224,746
Sugarbeets	2005	Oregon	10	10	32.10	311	$44.40	$13,806
Sugarbeets	2005	United States	1,300	1,243	22.10	27,433	$43.50	$1,193,151
Sugarbeets	2005	Washington	2	2	40.60	69	$44.40	$3,064
Sugarbeets	2005	Wyoming	38	36	22.30	801	$42.80	$34,283

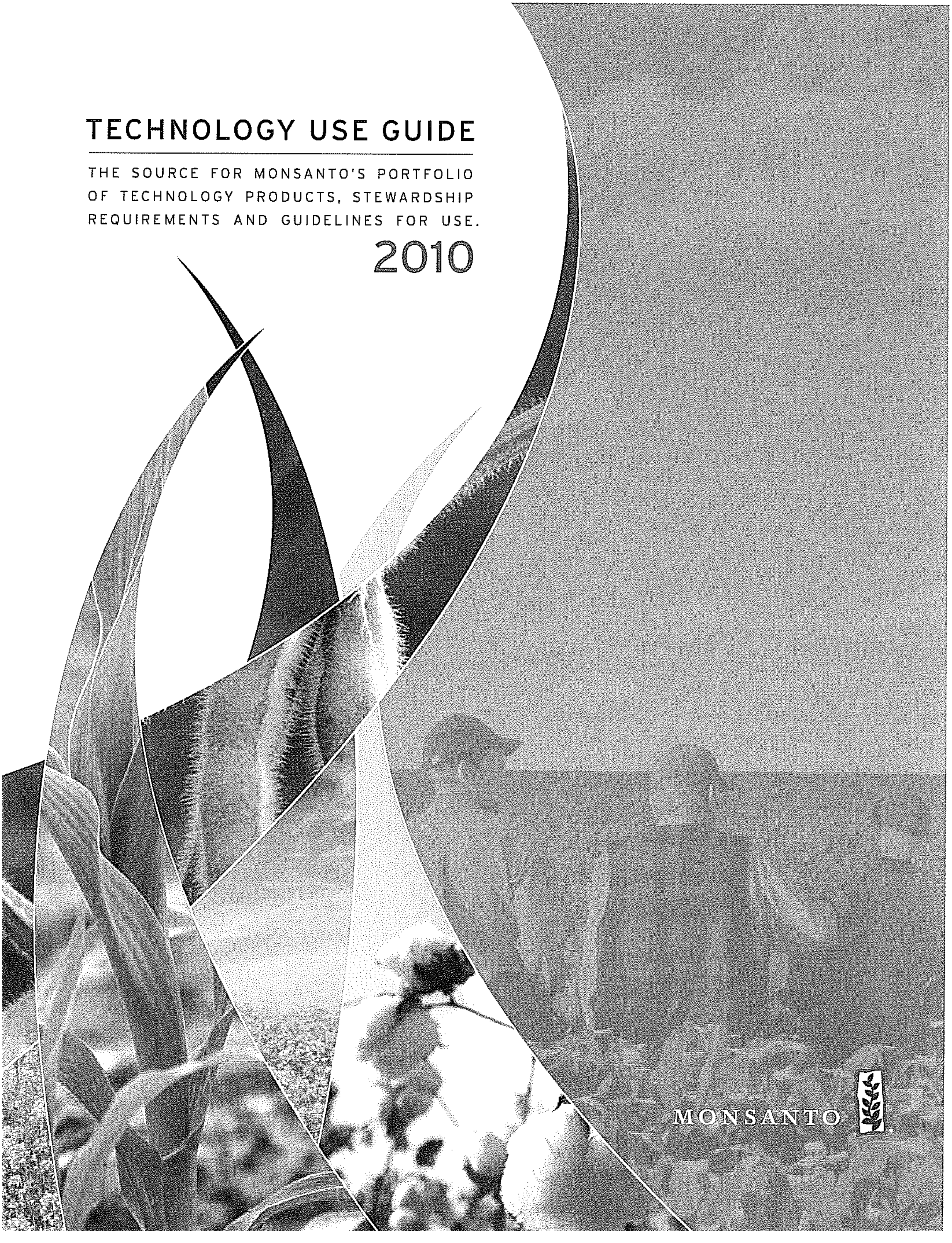
Appendix E

2010 Technology Use Guide

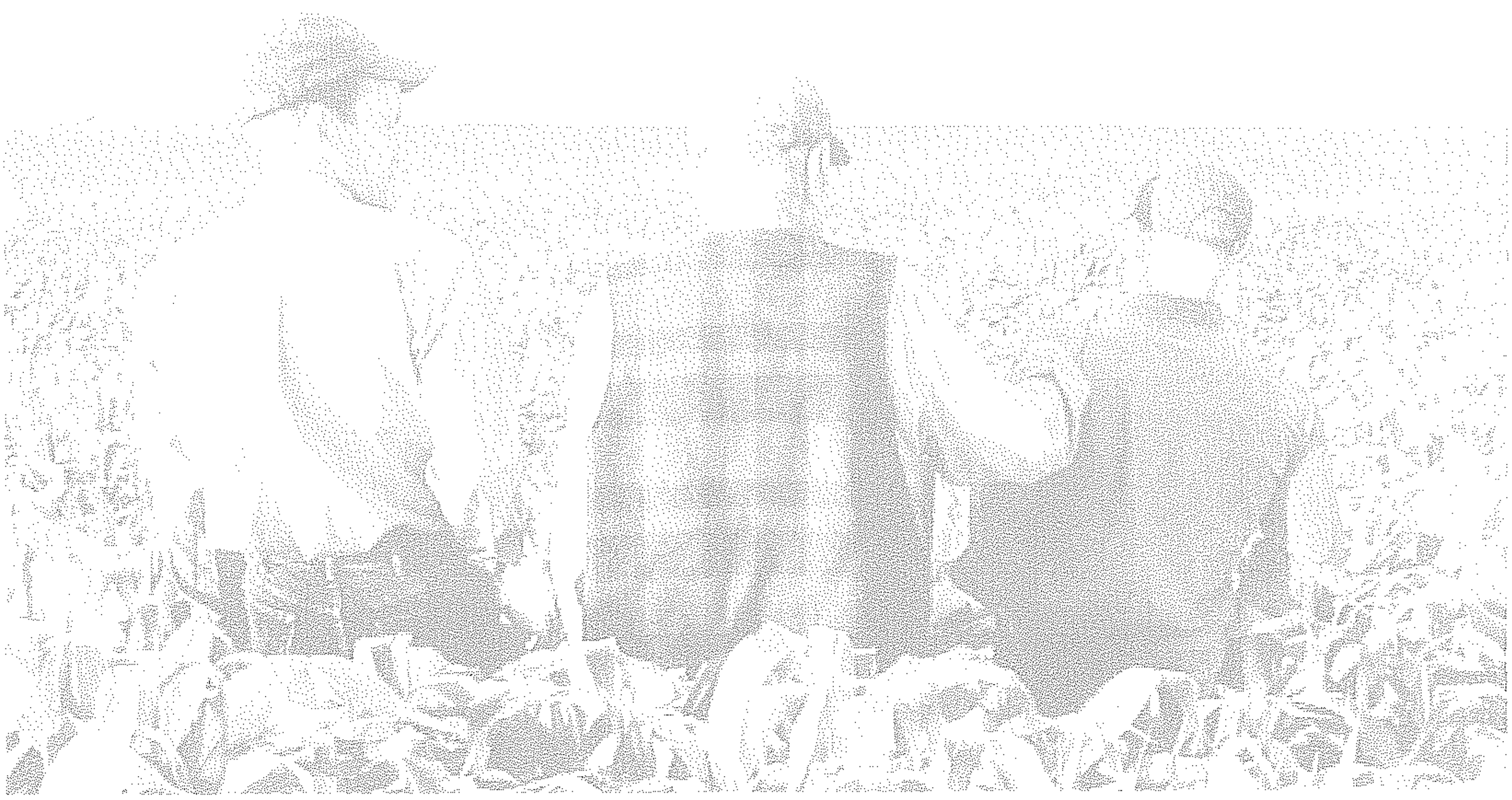
TECHNOLOGY USE GUIDE

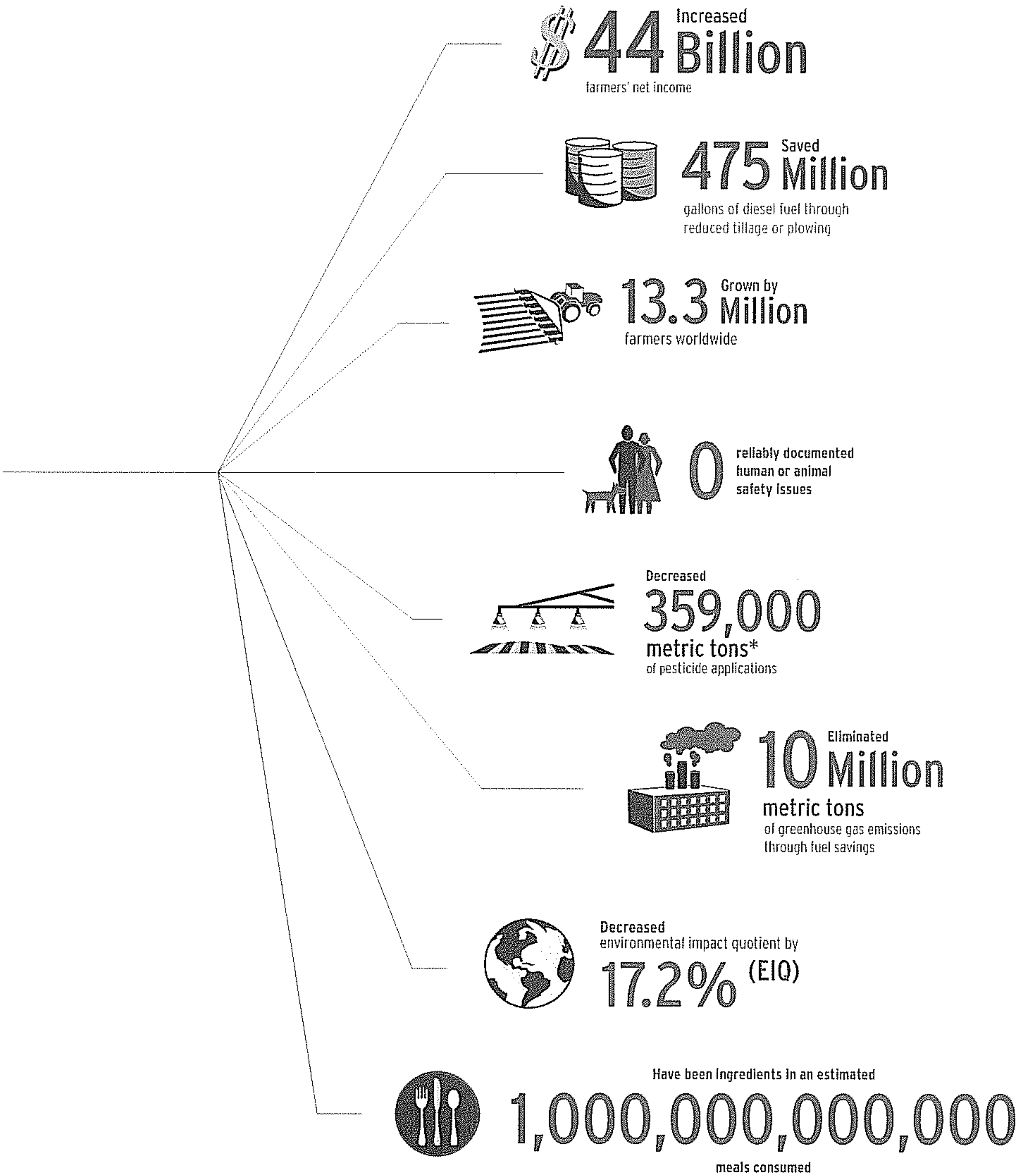
THE SOURCE FOR MONSANTO'S PORTFOLIO OF TECHNOLOGY PRODUCTS, STEWARDSHIP REQUIREMENTS AND GUIDELINES FOR USE.

2010



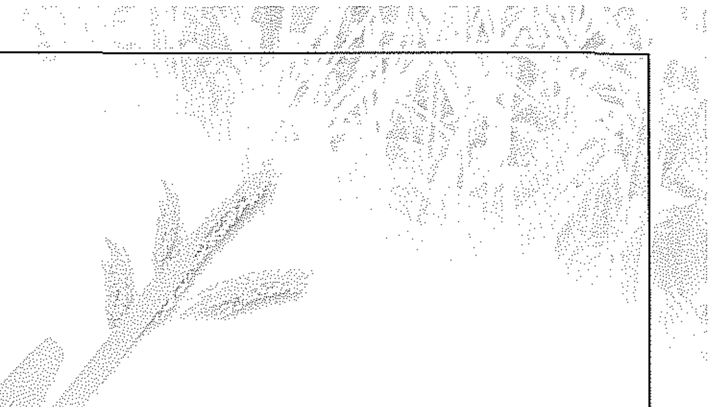
Since 1996, biotech crops have delivered environmental and economic benefits to both farmers and consumers.





Source: www.biotech-gmo.com

*Pesticides registered by the U.S. EPA will not cause unreasonable adverse effects to man or the environment when used in accordance with label directions.



RE:NEW

YOUR ABILITY TO ENHANCE YOUR CROPS TODAY!

It's time to ReNEW your license

If you haven't renewed your Monsanto Technology/Stewardship Agreement (MTSA) in the past nine months, **take care of it today!**

Signing the MTSA ensures you'll have access to current and next-wave technologies. These innovations will enhance plant drought tolerance, cold tolerance, nitrogen use efficiency, yield and much more!

CALL

1-800-768-6387, Option 3

You'll then have the option to complete the process online or through conventional mail.

Paper MTSA's will continue to be accepted.

Introduction

This 2010 Technology Use Guide (TUG) provides a concise source of technical information about Monsanto's current portfolio of technology products and sets forth requirements and guidelines for the use of these products. As a user of Monsanto Technology, it is important that you are familiar with and follow certain management practices. Please read all of the information pertaining to the technology you will be using, including stewardship and related information. Growers must read the Insect Resistance Management (IRM)/Grower Guide prior to planting for important information on planting and IRM.

This technical guide is not a pesticide product label. It is intended to provide additional information and to highlight approved uses from the product labeling. Read and follow all precautions and use instructions in the label booklet and separately published supplemental labeling for the Roundup® agricultural herbicide product you are using.

Included in this guide is information on the following:

If you have any questions, contact your Authorized Retailer or Monsanto at 1-800-768-6387.

A Message About Stewardship - SEED AND TRAITS

Monsanto Company is committed to enhancing farmer productivity and profitability through the introduction of new agricultural biotechnology traits. These new technologies bring enhanced value and benefits to farmers, and farmers assume new responsibilities for proper management of these traits. Farmers planting seed with biotech traits agree to implement good stewardship practices, including, but not limited to:

- Reading, signing and complying with the Monsanto Technology/Stewardship Agreement (MTSA) and reading all annual license terms updates before purchase or use of any seed containing a trait.
- Reading and following the directions for use on all product labels.
- Following applicable stewardship practices as outlined in this TUG.
- Reading and following the IRM/Grower Guide prior to planting.
- Observing regional planting restrictions mandated by the U.S. Environmental Protection Agency (EPA).
- Complying with any additional stewardship requirements, such as grain or feed use agreements or geographical planting restrictions, that Monsanto deems appropriate or necessary to implement for proper stewardship or regulatory compliance.
- Following the Weed Resistance Management Guidelines to minimize the risk of resistance development.
- Complying with the applicable IRM practices for specific biotech traits as *mandated* by the EPA and set forth in this TUG.
- Utilizing all seed with biotech traits only for planting a single crop.
- Selling crops or material containing biotech traits only to grain handlers that confirm their acceptance, or using those products on farm.
- Not moving material containing biotech traits across boundaries into nations where import is not permitted.
- Not selling, promoting and/or distributing within a state where the product is not yet registered.

CROP OR MATERIAL HANDLING STEWARDSHIP STATEMENT

Monsanto Company is a member of Excellence Through Stewardship® (ETS). Monsanto products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Monsanto's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. This product has been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Biotechnology Industry Organization.

WHY IS STEWARDSHIP IMPORTANT?

Each component of stewardship offers benefits to farmers:

- Signing the MTSA provides farmers access to Monsanto's biotech trait seed technology.
- Following IRM guidelines guards against insect resistance to *Bacillus thuringiensis (B.t.)* technology and therefore enables the long-term viability of this technology, and meets EPA requirements.
- Proper weed management maintains the long-term effectiveness of glyphosate-based weed control solutions.
- Utilizing biotech seed only for planting a single-commercial crop helps preserve the effectiveness of biotech traits, while allowing investment for future biotech innovations which further improves farming technology and productivity.

Practicing these stewardship activities will enable biotechnology's positive agricultural contributions to continue.

Farmers' attitudes and adoption of sound stewardship principles, coupled with biotechnology benefits, provide for the sustainability of our land resources, biotechnology and farming as a preferred way of life.

SEED PATENT INFRINGEMENT

If Monsanto reasonably believes that a farmer has planted saved seed containing a Monsanto biotech trait, Monsanto will request invoices and records to confirm that fields in question have been planted with newly purchased seed. If this information is not provided within 30 days, Monsanto may inspect and test all of the farmer's fields to determine if saved seed has been planted. Any inspections will be coordinated with the farmer and performed at a reasonable time to best accommodate the farmer's schedule.

If you have questions about seed stewardship or become aware of individuals utilizing biotech traits in a manner other than as noted above, please call 1-800-768-6387. Letters reporting unacceptable or unauthorized use of biotech traits may be sent to:

Monsanto Trait Stewardship
800 N. Lindbergh Boulevard NC3C
St. Louis, MO 63167

For more information on Monsanto's practices related to seed patent infringement, please visit: www.monsanto.com/seedpatentprotection.

Provide Anonymous or Confidential reports as follows:

"Anonymous" reporting results when a person reports information to Monsanto in such a way that the identity of the person reporting the information cannot be identified. This kind of reporting includes telephone calls requesting anonymity and unsigned letters.

"Confidential" reporting results when a person reports information to Monsanto in such a way that the reporting person's identity is known to Monsanto. Every effort will be made to protect a person's identity, but it is important to understand that a court may order Monsanto to reveal the identity of people who are "known" to have supplied relevant information.

You're buying more than just seed. You're getting value today and innovation for tomorrow.
COMMITMENT. INNOVATION. PERFORMANCE.

The Beyond the Seed Program was launched by the American Seed Trade Association (ASTA) to raise awareness and understanding of the value that goes beyond the seed. The future success of U.S. agriculture depends upon quality seed delivered by an industry commitment to bring innovation and performance through continued investment. For more information about seed technology, visit ASTA's Beyond the Seed Program at www.beyondtheseed.org.

Genuity™ Unites the Best Traits*

As a purchaser of Monsanto biotech trait products, your investment helps fuel the research and development engine that leads to the discovery and delivery of new technologies for agriculture. Current and future Genuity™ traits are designed to deliver high yield potential, maximize return on seed investments and consistently deliver future trait innovations.

CORN

Higher yields come from quality grain. Genuity™ VT Triple PRO™ was the next generation of corn technology available for the 2009 growing season. Genuity™ VT Triple PRO™ provides dual modes of action against above-ground pests such as corn earworm, European and southwestern corn borers, sugarcane borer, southern cornstalk borer and fall armyworm. Reduced kernel damage from corn earworm means the potential for reduced Aflatoxin contamination. Genuity™ VT Triple PRO™ dual modes-of-action also allows for a reduction in refuge acres required in southern cotton-growing regions while providing long-term effectiveness and consistency.

GENUITY™ SMARTSTAX™

Scheduled for launch in 2010, Genuity™ SmartStax™ is the most-advanced, all-in-one corn trait system that controls the broadest spectrum of above- and below-ground insects and weeds. Genuity™ SmartStax™ provides control of corn earworm, European corn borer, southwestern corn borer, sugarcane borer, fall armyworm, western bean cutworm, black cutworm, western corn rootworm, northern corn rootworm and Mexican corn rootworm. Genuity™ SmartStax™ contains Roundup Ready® 2 Technology and LibertyLink® herbicide tolerance. Genuity™ SmartStax™ also allows for a reduction in refuge acres in the corn belt from 20% down to 5% for above- and below-ground refuge. Genuity™ SmartStax™ is also approved for a 20% refuge in the cotton belt.

SOYBEAN

Genuity™ Roundup Ready 2 Yield® soybeans are taking yield to a higher level. They were developed to provide farmers with the same simple, dependable and flexible weed control and crop safety they've come to rely on with the first-generation Roundup Ready® soybean system, but with higher yield potential. This is possible because of advanced insertion and selection technologies.

COTTON

Genuity™ Roundup Ready® Flex and Genuity™ Bollgard II® offer the ultimate combination of peace of mind and flexibility. They contain unrivaled built-in worm control to stop the most leaf- and boll-feeding worm species, including bollworms, budworms, armyworms, loopers, saltmarsh caterpillars and cotton leaf perforators. Protecting just one additional boll per plant can result in significantly higher lint yield. The convenience and savings from fewer or no sprays for worms can make a big difference when it comes to the bottom line.

SPECIALTY

Genuity™ Roundup Ready® alfalfa: Bred from an innovative germplasm pool, it offers outstanding weed control, excellent crop safety and preservation of forage quality potential.

Genuity™ Roundup Ready® canola: Offers excellent control of broadleaf weeds and grasses, even in tough weather conditions. Also features excellent crop safety and broad application flexibility.

Genuity™ Roundup Ready® sugarbeets: Excellent in-plant tolerance to over-the-top applications of labeled Roundup agricultural herbicides. Offers outstanding weed control, excellent crop safety and preservation of yield potential.

*See pages 16 and 17 for additional traits.

NOTE: Farmers must read the IRM/Grower Guide prior to planting for information on planting and Insect Resistance Management.

Monsanto's New Generation of Technologies

As Monsanto continues to develop new generations of technologies, several of our newer technologies are migrating to the Genuity™ brand. These products and their new logos are presented below.

CORN

VT Triple PRO

SOYBEANS

Roundup Ready 2 Yield

COTTON

Roundup Ready Flex

Bollgard II

Bollgard II

Roundup Ready Flex

Bollgard II

SPECIALTY

Grow the Feed, Not the Weeds.

Roundup Ready

Insect Resistance Management
Planting Refuges, Preserving Technology

An **EFFECTIVE** IRM program is a vital part of responsible product stewardship for insect-protected biotech products. Monsanto is committed to implementing an effective IRM program for all of its insect-protected *B.t.* technologies in all countries where they are commercialized, including promoting farmer awareness of these IRM programs. Monsanto works to develop and implement IRM programs that strike a balance between available knowledge and practicality, with farmer acceptance and implementation of the plan as critical components.

The U.S. EPA requires that Monsanto implement, and farmers who purchase insect-protected products follow, an IRM plan.* IRM programs for *B.t.* traits are based upon an assessment of the biology of the major target pests, farmer needs and practices, and appropriate pest management practices. These **mandatory regulatory programs** have been developed and updated through broad cooperation with farmer and consultant organizations, including the National Corn Growers Association and the National Cotton Council, extension specialists, academic scientists, and regulatory agencies.

*In some areas, a natural refuge option is available for Bollgard II. See the current IRM/Grower Guide for details.

The IRM programs for planting seeds containing *B.t.* traits contain several important elements. One key component of an IRM plan is a refuge. A refuge is simply a portion of the relevant crop (corn or cotton) that does not contain a *B.t.* technology for the control of the insect pests which are controlled by the planted technology(ies). The lack of exposure to the *B.t.* proteins means that there will be susceptible insects nearby to mate with any rare resistant insects that may emerge from *B.t.* products. Susceptibility to *B.t.* products is then passed on to offspring, preserving the long-term effectiveness of the technology.

Farmers who purchase seeds containing *B.t.* traits must plant an appropriately designed refuge. Refuge size, configuration, and management is described in detail in the sections on those products in the 2010 IRM/Grower Guide.

Failure to follow IRM requirements and to plant a proper refuge may result in the loss of a farmer's access to Monsanto technologies. Monsanto is committed to the preservation of *B.t.* technologies. Please do your part to preserve *B.t.* technologies by implementing the correct IRM plan on your farm.

MONITORING PROGRAM

The U.S. EPA requires Monsanto to take corrective measures in response to a finding of IRM non-compliance. Monsanto or an approved agent of Monsanto must monitor refuge management practices. The MTSA signed by a farmer requires that upon request by Monsanto or its approved agent, a farmer must provide the location of all fields planted with Monsanto technologies and the locations of all associated refuge areas as **required**, to cooperate fully with any field inspections, and allow Monsanto to inspect all fields and refuge areas to ensure an approved insect resistance program has been followed. All inspections will be performed at a reasonable time and arranged in advance with the farmer so that the farmer can be present if desired.

IRM GUIDELINES

Farmers must read the current IRM/Grower Guide prior to planting for information on planting and IRM. If you do not have a copy of the current IRM/Grower Guide, you may downloaded it at **www.monsanto.com**, or you may call 1-800-768-6387 to request a copy by mail.

RESPECT THE REFUGE®

RESPECT THE REFUGE®

Monsanto considers product stewardship to be a fundamental component of customer service and responsible business practices. As leaders in the development and stewardship of Roundup® agricultural herbicides and other products, Monsanto invests significantly in research to continuously improve the proper uses and stewardship of our proprietary herbicide brands.

This research, done in conjunction with academic scientists, extension specialists and crop consultants, includes an evaluation of the factors that can contribute to the development of weed resistance and how to properly manage weeds to delay the selection for weed resistance. Visit **www.weedtool.com** for practical, best practices-based information on reducing the risk for development of glyphosate-resistant weeds. Developed in cooperation with academic experts, the website provides options for managing the risk on a field-by-field basis.

Glyphosate is a Group 9 herbicide based on the mode of action classification system of the Weed Science Society of America. Any weed population may contain plants naturally resistant to Group 9 herbicides. The following general recommendations help manage the risk of weed resistance occurring.

WEED RESISTANCE MANAGEMENT PRACTICES:

- Scout your fields before and after herbicide application
- Start with a clean field, using either a burndown herbicide application or tillage
- Control weeds early when they are small
- Add other herbicides (e.g. a selective in-crop and/or a residual herbicide) and cultural practices (e.g. tillage or crop rotation) as part of your Roundup Ready® cropping system where appropriate
- Rotation to other Roundup Ready crops will add opportunities for introduction of other modes of action
- Use the right herbicide product at the right rate and the right time
- Control weed escapes and prevent weeds from setting seeds
- Clean equipment before moving from field to field to minimize spread of weed seed
- Use new commercial seed that is as free from weed seed as possible

Monsanto is committed to the proper use and long-term effectiveness of its proprietary herbicide brands through a four-part stewardship program: developing appropriate weed control recommendations, continuing research to refine and update recommendations, education on the importance of good weed management practices and responding to repeated weed control inquiries through a product performance evaluation program.

GLYPHOSATE-RESISTANT WEEDS

Monsanto actively investigates and studies weed control complaints and claims of weed resistance. When glyphosate-resistant weed biotypes have been confirmed, Monsanto alerts farmers and develops and provides farmers with recommended control measures, which may include additional herbicides, tank-mixes or cultural practices. Monsanto actively communicates all of this information to farmers through multiple channels, including the herbicide label, **www.weedscience.org**, supplemental labeling, this TUG, media and written communications, Monsanto's website, **www.weedresistancemanagement.com**, and farmer meetings.

Farmers must be aware of, and proactively manage for, glyphosate-resistant weeds in planning their weed control program. When a weed is known to be resistant to glyphosate, then a resistant population of that weed is by definition no longer controlled with labeled rates of glyphosate. Roundup® agricultural herbicide warranties will not cover the failure to control glyphosate-resistant weed populations.

Report any incidence of repeated non-performance on a particular weed to your local Monsanto representative, retailer or county extension agent.

Note: Always read and follow all pesticide label requirements.

ROUNDUP BRAND AGRICULTURAL OVER-THE-TOP HERBICIDE PRODUCTS

Read and follow all product labeling before using Roundup agricultural herbicides over the top of products with Roundup Ready Technology.

You may use another glyphosate herbicide, but only if it has federally approved label instructions for use over that specific Roundup Ready crop, and the product and the use label for that Roundup Ready crop has been approved by your specific state. Contact the product manufacturers, the local retailers or the local extension agents for confirmation that the products carry EPA and state approved labeling for this use. **MONSANTO DOES NOT MAKE ANY REPRESENTATIONS, WARRANTIES OR RECOMMENDATIONS CONCERNING THE USE OF GLYPHOSATE PRODUCTS SUPPLIED BY OTHER COMPANIES WHICH ARE LABELED FOR USE OVER ROUNDUP READY CROPS. MONSANTO SPECIFICALLY DENIES ALL RESPONSIBILITY AND DISCLAIMS ANY LIABILITY FOR ANY DAMAGE FROM THE USE OF THESE PRODUCTS IN ROUNDUP READY CROPS. ALL QUESTIONS AND COMPLAINTS CAUSED BY THE USE OF GLYPHOSATE PRODUCTS SUPPLIED BY OTHER COMPANIES SHOULD BE DIRECTED TO THE SUPPLIER OF THE PRODUCT IN QUESTION.**

MONSANTO BRANDS OF SELECTIVE OVER-THE-TOP HERBICIDE PRODUCTS

Herbicide products sold by Monsanto for use over the top of Roundup Ready crops for the 2010 crop season are as follows:

Roundup WeatherMAX®

Roundup PowerMAX®

Read and follow all product labeling before using Roundup agricultural herbicides over the top of Roundup Ready traits. To learn more about applicable supplemental labels or fact sheets, call 1-800-768-6387.

Tank-mixtures of Roundup agricultural herbicides with insecticides, fungicides, micronutrients or foliar fertilizers are not recommended as they may result in reduced weed control, crop injury, reduced pest control or antagonism. Refer to the Roundup agricultural herbicide product label, supplemental labeling or fact sheets published separately by Monsanto for tank-mix recommendations.

Do not add additional surfactants and/or products containing surfactants to these Roundup agricultural herbicides unless otherwise directed by the label. Other glyphosate products labeled for use in Roundup Ready technologies may require the addition of surfactants, or other additives to optimize performance, that may increase the potential for crop injury. Monsanto will label and promote only fully tested brands that do not require surfactants and other additives for over-the-top applications to Roundup Ready Crops.

GLYPHOSATE ENDANGERED SPECIES INITIATIVE

Before making applications of glyphosate-based herbicide products, licensed farmers of crops containing Roundup Ready technology must access the website **www.pre-serve.org** to determine whether any mitigation requirements apply to the planned application to those crops, and must follow all applicable requirements. The mitigation measures described on the website are appropriate for all applications of glyphosate-based herbicides to all crop lands.

Farmers making only ground applications to crop land with a use rate of less than 3.5 lbs of glyphosate a.e./A are not required to access the website. If a farmer does not have web access, the seed dealer can access the website on behalf of the farmer to determine the applicable requirements, or the farmer can call 1-800-332-3111 for assistance.

RECOMMENDATIONS FOR MANAGING GLYPHOSATE-RESISTANT WEEDS IN ROUNDUP READY CROPS

In certain areas, populations of ryegrass, johnsongrass, marestail, common ragweed, giant ragweed, *Palmer Amaranth* and waterhemp are known to be resistant to glyphosate. For control recommendations for resistant biotypes of these weeds, refer to **www.weedresistancemanagement.com** or call 1-800-768-6387. When approved, supplemental labeling for specific herbicide products can also be viewed on **www.cdms.net** or **www.greenbook.net** or obtained by calling 1-800-768-6387.

COEXISTENCE AND IDENTITY PRESERVED PRODUCTION

Coexistence in agricultural production systems and supply chains is not new. Different agricultural systems have coexisted successfully for many years around the world. Standards and best practices were established decades ago and have continually evolved to deliver high purity seed and grain to support production, distribution and trade of products from different agricultural systems. For example, production of similar commodities such as field corn, sweet corn and popcorn has occurred successfully and in close proximity for many years. Another example is the successful coexistence of oilseed rape varieties with low erucic acid content for food use and high erucic acid content for industrial uses.

The introduction of biotech crops generated renewed discussion of coexistence focused on biotech production systems with conventional cropping systems and organic production. These discussions have primarily focused on the potential economic impact of the introduction of biotech products on other systems. The health and safety of biotech products are not an issue because their food, feed and environmental safety must be demonstrated before they enter the agricultural production system and supply chain.

The coexistence of conventional, organic and biotech crops has been the subject of several studies and reports. These reports conclude that coexistence among biotech and non-biotech crops is not only possible but is occurring. They recommend that coexistence strategies be developed on a case-by-case basis considering the diversity of products currently in the market and under development, the agronomic and biological differences in the crops themselves and variations in regional farming practices and infrastructures. Furthermore, coexistence strategies are driven by market needs and should be developed using current science-based industry standards and management practices. The strategies must be flexible, facilitating options and choice for the farmer and the food/feed supply chain, and must be capable of being modified as changes in markets and products warrant.

Successful coexistence of all agricultural systems is achievable and depends on cooperation, flexibility and mutual respect for each system. Agriculture has a history of innovation and change, and farmers have always adapted to new approaches or challenges by utilizing appropriate strategies, farm management practices and new technologies.

The responsibility for implementing practices to satisfy specific marketing standards or certification lies with that farmer who is growing a crop to satisfy a particular market. Only that farmer is instructed to employ the practices appropriate to assure the integrity of his/her crop. This is true whether the goal is high-oil corn, white/sweet corn or organically produced yellow corn for animal feed. In each case, the farmer is seeking to produce a crop that is supported by a market price and consequently that farmer assumes responsibility for satisfying reasonable market specifications. That said, the farmer needs to be aware of the planting intentions of his/her neighbor in order to gauge the need for management practices.

IDENTITY PRESERVED PRODUCTION

Some farmers may choose to preserve the identity of their crops to meet specific markets. Examples of Identity Preserved (I.P.) corn crops include production of seed corn, white, waxy or sweet corn, specialty oil or protein crops, food grade crops and any other crop that meets specialty needs, including organic and non-genetically enhanced specifications. Farmers of these crops assume the responsibility and receive the benefit for ensuring that their crop meets mutually agreed contract specifications.

Based on historical experience with a broad range of I.P. crops, the industry has developed generally accepted I.P. agricultural practices. These practices are intended to manage I.P. production to meet quality specifications, and are established for a broad range of I.P. needs. The accepted practice with I.P. crops is that each I.P. farmer has the responsibility to implement any necessary processes. These processes may include sourcing seed appropriate for I.P. specifications, field management practices such as adequate isolation distances, buffers between crops, border rows, planned differences in maturity between adjacent fields that might cross-pollinate and harvest and handling practices designed to prevent mixing and to maintain product quality. These extra steps associated with I.P. crop production are generally accompanied by incremental increases in cost of production and consequently of the goods sold.

General Instructions for Management of Pollen Flow and Mechanical Mixing

For all crop hybrids or varieties that they wish to identity preserve, or otherwise keep separated, farmers should take steps to prevent mechanical mixing. Farmers should make sure all seed storage areas, transportation vehicles and planter boxes are cleaned thoroughly both prior to and subsequent to the storage, transportation or planting of the crop. Farmers should also make sure all combines, harvesters and transportation vehicles used at harvest are cleaned thoroughly both prior to and subsequent to their use in connection with the harvest of the grain produced from the crop. Farmers should also make sure all harvested grain is stored in clean storage areas where the identity of the grain can be preserved.

Self-pollinated crops, such as soybeans, do not present a risk of mixing by cross-pollination. If the intent is to use or market the product of a self-pollinated crop separately from general commodity use, farmers should plant fields a sufficient distance away from other crops to prevent mechanical mixture.

Farmers planting cross-pollinated crops, such as corn or alfalfa, who desire to preserve the identity of these crops, or to minimize the potential for these crops to outcross with adjacent fields of the same crop kind, should use the same generally accepted practices to manage mixing that are used in any of the currently grown I.P. crops of similar crop kind.

It is generally recognized in the industry that a certain amount of incidental, trace level pollen movement occurs, and it is not possible to achieve 100% purity of seed or grain in any corn production system. A number of factors can influence the occurrence and extent of pollen movement. As stewards of technology, farmers are expected to consider these factors and talk with their neighbors about their cropping intentions.

Farmers should take into account the following factors that can affect the occurrence and extent of cross-pollination to or from other fields. Information that is more specific to the crop and region may be available from state extension offices.

- Cross-pollination is limited. Some plants, such as potatoes, are incapable of cross-pollinating, while others, like alfalfa, require cross-pollination to produce seed. Importantly, cross-pollination only occurs within the same crop kind, like corn to corn.
- The amount of pollen produced within the field can vary. The pollen produced by the crop within a given field, known as pollen load, is typically high enough to pollinate all of the plants in the field. Therefore, most of the pollen that may enter from other fields falls on plants that have already been pollinated with pollen that originated from plants within the field. In crops such as alfalfa, the hay cutting management schedule significantly limits or eliminates bloom, and thereby restricts the potential for pollen and/or viable seed formation.
- The existence and/or degree of overlap in the pollination period of crops in adjacent fields varies. This will vary depending on the maturity of crops, planting dates and the weather. For corn, the typical pollen shed period lasts from 5 to 10 days for a particular field. Therefore, viable pollen from neighboring fields must be present when silks are receptive in the recipient field during this brief period to produce any grain with traits introduced by the out-of-field pollen.
- Distance between fields of different varieties or hybrids of the same crop: The greater the distance between fields the less likely their pollen will remain viable and have an opportunity to mix and produce an outcross. For wind-pollinated crops, most cross-pollination occurs within the outermost few rows of the field. In fact, many white and waxy corn production contracts ask the farmer to remove the outer 12 rows (30 ft.) of the field in order to remove most of the impurities that could result from cross-pollination with nearby yellow dent corn. Furthermore, research has also shown that as fields become further separated, the incidence of wind-modulated cross-pollination drops rapidly. Essentially, the in-field pollen has an advantage over the pollen coming from other fields for receptive silks because of its volume and proximity to silks.
- The distance pollen moves. How far pollen can travel depends on many environmental factors, including weather during pollination, especially wind direction and velocity, temperature and humidity. For bee-pollinated crops, the farmer's choice of pollinator species and apiary management practice may reduce field-to-field pollination potential. All these factors will vary from season to season, and some factors from day to day and from location to location.
- For wind-pollinated crops, the orientation and width of the adjacent field in relation to the dominant wind direction. Fields oriented upwind during pollination will show dramatically lower cross-pollination for wind-pollinated crops, like corn, compared to fields located downwind.

Advanced breeding and biotechnology have had a major impact on farming production. From 1971 to 1995, average corn yields were increasing at a rate of 1.5 bushels per acre, per year. Since the advent of biotech in 1996, corn yields have increased at a rate of 2.6 bushels per acre, per year, for a total increase of 32 bushels per acre.*

Excellence Through Stewardship

Monsanto Company is a member of Excellence Through Stewardship® (ETS). Monsanto products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Monsanto's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. This product has been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Biotechnology Industry Organization.

IRM GUIDELINES

For specific refuge requirements for *B.t.* corn and cotton, see the current IRM/Grower Guide, sent with this TUG. If you have not received a copy of this Guide, it can be downloaded at **www.monsanto.com**, or call 1-800-768-6387 to request a copy be mailed to you.

RESPECT THE REFUGE®

Insect Resistance Management
Planting Refuges, Preserving Technology

Before opening a bag of seed, be sure to read and understand the stewardship requirements, **including applicable refuge requirements for insect resistance management**, for the biotechnology traits expressed in the seed as set forth in the Monsanto Technology Agreement that you sign. By opening and using a bag of seed, you are reaffirming your obligation to comply with those stewardship requirements.

* USDA Yields were calculated using 3 year rolling averages (32 Yield is 2.6 bu/ac *12 years). 2008 Yield is from Doane Ag Services forecast in April 8, 2008 Quarterly Crop Outlook.

Genuity™ Trait Products and YieldGard® Corn Technologies Product Descriptions

GENUITY™ SMARTSTAX™

Scheduled to launch in 2010, Genuity™ SmartStax™ is the most advanced, all-in-one corn trait system that controls the broadest spectrum of above- and below-ground insects and weeds. Genuity™ SmartStax™ hybrids will contain *B.t.* proteins that represent three separate modes of action for control of lepidopteron, above-ground insect pests, as well as combined modes of action for control of coleopteran, below-ground insect pests. Providing multiple *B.t.* proteins for control will dramatically decrease the probability that insects will become resistant to the traits, resulting in enhanced durability of transgenic insect control via *B.t.* genes. Based on this multiple gene approach, Genuity™ SmartStax™ is approved for reduced refuge in the corn belt from 20% down to 5% for both above- and below-ground pests. The cotton belt refuge for Genuity SmartStax™ is also reduced, from 50% down to 20%.

VT Triple PRO

GENUITY™ VT TRIPLE PRO™

(Formerly YieldGard VT Triple PRO™) — Genuity™ VT Triple PRO™ is available in selected southern corn- and cotton-growing areas. It includes broad-spectrum insect control against corn earworm, European and southwestern corn borers, sugarcane borer, southern cornstalk borer, fall armyworm, western corn rootworm, northern corn rootworm and Mexican corn rootworm. Its advanced control of ear pests can result in higher grain quality and higher-yielding crop potential. The dual mode-of-action of Genuity™ VT Triple PRO™ allows for lower corn borer refuge acres in southern cotton-growing areas compared to other registered *B.t.*-traited products. It includes the same Roundup Ready® 2 Technology as Monsanto's previous product, YieldGard VT Triple. Seed containing Genuity™ VT Triple PRO™ technology is treated with seed-applied insecticide.*

YIELDGARD VT TRIPLE®

YieldGard VT Triple technology combines YieldGard Corn Borer and YieldGard VT Rootworm/RR2® technology into a single plant. YieldGard VT Triple corn hybrids control European and south-western corn borer, sugarcane borer, southern cornstalk borer, western corn rootworm, northern corn rootworm and Mexican corn rootworm. YieldGard VT Triple technology suppresses corn earworm, fall armyworm and stalk borer. By providing in-plant protection against the above insect pests, the genetic yield potential of YieldGard VT Triple corn hybrids is preserved. YieldGard VT Triple corn hybrids also include Roundup Ready 2 Technology. This trait allows a farmer to experience the benefits of utilizing Roundup agricultural herbicides in a weed control system that provides the broadest weed control spectrum available, better application flexibility, and superior crop safety. Seed containing YieldGard VT Triple technology is treated with seed-applied insecticide.*

VT Double PRO

GENUITY™ VT DOUBLE PRO™

Genuity™ VT Double PRO™ is a new corn technology scheduled for launch in 2010. It includes broad-spectrum insect control against corn earworm, European and southwestern corn borers, sugarcane borer, southern cornstalk borer and fall armyworm. The dual mode-of-action of Genuity™ VT Double PRO™ allows for lower corn borer refuge acres compared to other registered *B.t.*-traited products. Seed containing Genuity™ VT Double PRO™ technology is treated with seed-applied insecticide.*

*A seed-applied insecticide can protect seed, roots and seedlings from insects such as black cutworm, wireworm, white grubs, seed corn maggots, chinch bug and early flea beetles.

YIELDGARD VT ROOTWORM/RR2®

YieldGard VT Rootworm/RR2 technology is the current YieldGard stacked-trait product for control of western corn rootworm, northern corn rootworm and Mexican corn rootworm. Protecting the root of the corn plant from feeding by corn rootworm larvae decreases lodging and protects the genetic yield potential of YieldGard VT Rootworm/RR2 corn hybrids. The Roundup Ready 2 Technology allows a farmer to experience the benefits of utilizing Roundup agricultural herbicides in a weed control system that provides the broadest weed control spectrum, better application flexibility and superior crop safety. Seed containing YieldGard VT Rootworm/RR2 technology is treated with seed-applied insecticide.*

YIELDGARD® CORN BORER

YieldGard Corn Borer corn hybrids contain an insecticidal protein from *B.t.* that protects corn plants from European corn borer, southwestern corn borer, sugarcane borer and southern cornstalk borer resulting in full yield potential.

Maximum Insect Protection

YIELDGARD PLUS

YieldGard Plus corn technology combines YieldGard Corn Borer and YieldGard Rootworm technology into a single plan.

YIELDGARD ROOTWORM

YieldGard Rootworm corn hybrids contain an insecticidal protein from *B.t.* that protects corn roots from larval feeding by western, northern and Mexican corn rootworm.

YIELDGARD® CORN BORER WITH ROUNDUP READY® CORN 2

YieldGard Corn Borer with Roundup Ready Corn 2 offers farmers all the benefits of both traits combined in one crop. These hybrids exhibit the same insect protection qualities as YieldGard Corn Borer and, like Roundup Ready Corn 2, are tolerant to over-the-top applications of Roundup® agricultural herbicides.

Maximum Insect Protection

YIELDGARD PLUS WITH ROUNDUP READY CORN 2

YieldGard Plus with Roundup Ready Corn 2 offers farmers all the benefits of all three traits combined in one crop. These hybrids exhibit the same insect protection qualities of YieldGard Corn Borer and YieldGard Rootworm and, like Roundup Ready Corn 2, are tolerant to over-the-top applications of Roundup® agricultural herbicides. Seed containing YieldGard Plus technology is treated with seed-applied insecticide.*

YIELDGARD ROOTWORM WITH ROUNDUP READY CORN 2

YieldGard Rootworm with Roundup Ready Corn 2 offers farmers all the same insect protection qualities as YieldGard Rootworm and, like Roundup Ready Corn 2, is tolerant to over-the-top applications of Roundup agricultural herbicides.

*A seed-applied insecticide can protect seed, roots and seedlings from insects such as black cutworm, wireworm, white grubs, seed corn maggots, chinch bug and early flea beetles.

ROUNDUP READY® Technology in Corn

WEED CONTROL RECOMMENDATIONS

Roundup Ready® Corn 2 (RR2) and corn with Roundup Ready® 2 Technology are equivalent in their tolerance to Roundup agricultural herbicides. Products with Roundup Ready Technology contain in-plant tolerance to Roundup agricultural herbicides.

The Roundup Ready® Technology system's flexibility, broad-spectrum weed control and proven crop safety offer farmers weed control programs that allow them to use the system in the way that provides the greatest benefit. Farmers can select the program that best fits the way they farm. Options include the use of a residual herbicide with a Roundup® agricultural herbicide, tank-mixing other herbicides with Roundup agricultural herbicides where appropriate and a total postemergence program.

AGRONOMIC PRINCIPLES

Corn yield is very sensitive to early-season weed competition. Weed control systems must provide farmers the opportunity to control weeds before they become competitive. The Roundup Ready Technology system provides a mechanism to control weeds at planting and once they emerge. Farmers are provided excellent crop safety and full yield potential, with applications made from planting through 48" of corn height. Drop nozzles must be used between 30" and 48" of corn height. Failure to control weeds with the right rate, at the right time and with the right product, can lead to increased weed competition, weed escapes and the potential for decreased yields. Use other approved herbicide products with Roundup agricultural herbicides if appropriate for the weed spectrum.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
For use where residual herbicides are typically used for early-season weed control: **Residual Herbicide Plus Roundup WeatherMAX®**	Use the proper Roundup Ready RATE™ of Bullet®, Degree®, Degree Xtra®, Harness®, Harness Xtra, Harness Xtra 5.6L, Micro-Tech™, or Lariat® (no post) as defined in the table below and the individual product labels, either pre or postemergence to the crop.** Follow with Roundup WeatherMAX at 16 to 22 oz/A post sequentially after preemergence application or tank-mixed in-crop with the residual. Applications should be made before weeds exceed 4" in height. **Roundup Ready RATEs***** Harness 1.5 Pints Degree 3.0 Pints Harness Xtra 1.2 Quarts Harness Xtra 5.6L 1.5 Quarts Degree Xtra 2.0 Quarts Micro-Tech 2.0 Quarts Lariat 2.0 Quarts Bullet 2.0 Quarts	Use full labeled rate of residual when application is 14 days or more prior to planting or when tough grasses are present, e.g., barnyardgrass, shattercane, seedling johnsongrass, sandbur. Use a minimum of 2.5 pt/A of Harness on woolly cupgrass and wild proso millet. Products containing atrazine will provide improved control of cocklebur, giant ragweed, *Palmer Amaranth* and morningglory. Tank-mix products such as 2,4-D, dicamba or Status® herbicide with Roundup WeatherMAX for control of glyphosate-resistant marestail (horseweed), *Palmer Amaranth* and other difficult-to-control weeds. Use 22 to 32 oz/A of Roundup WeatherMAX* when morningglory or perennial weeds are present or when broadleaf weeds are 4" in height or taller.
For use where total postemergence programs are effective and sustainable: **Roundup WeatherMAX Sequential**	Apply Roundup WeatherMAX at 16 to 22 oz/A before weeds exceed 4" in height and follow with a second application at 16 to 22 oz/A for an additional flush of weeds before they exceed 4" in height.	Use 22 to 32 oz/A of Roundup WeatherMAX when morningglory or perennial weeds are present. Tank-mix products such as 2,4-D, dicamba or Status herbicide with Roundup WeatherMAX for control of glyphosate-resistant marestail (horseweed), *Palmer Amaranth* and other difficult-to-control weeds.
Maximum Use Rates For Roundup WeatherMAX	**Products with Roundup Ready 2 Technology In-crop:** • 32 oz/A per single application • Total: 64 oz/A from emergence through 48" height of corn, drop nozzles must be used from 30" to 48" corn.	**Products with Roundup Ready 2 Technology Total Season:** The combined total of preplant, in-crop and preharvest applications of Roundup WeatherMAX can not exceed 5.3 qt/A. The combined total of in-crop and preharvest applications can not exceed 66 oz/A.

*If using another Roundup agricultural herbicide, you must refer to the label booklet or Roundup Ready Corn 2 Technology supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX®, application rates are the same as for Roundup WeatherMAX. If using another residual herbicide, follow the labeled use rate instructions applicable to Roundup Ready Corn 2. Follow all pesticide label requirements.

**Atrazine may also be used as a residual herbicide in the Roundup Ready Corn 2 System.

***You may apply up to the full residual herbicide labeled rate for corn.

WEED RESISTANCE MANAGEMENT FOR CORN WITH ROUNDUP READY TECHNOLOGY

Follow all pesticide label requirements and the guidelines below to minimize the risk of developing glyphosate-resistant weed populations in a Roundup Ready Technology system.

- Start clean with a burndown herbicide or tillage. Early-season weed control is critical to yield.
- Apply pre-emergence residual herbicides such as Harness Xtra, Degree Xtra or other residual herbicides at the recommended rate.
- Or apply a pre-emergence residual herbicide at the recommended rate tank-mixed with Roundup WeatherMAX® at a minimum of 22 oz/A in-crop before weeds exceed 4" in height.
- Follow with a postemergence in-crop application of Roundup WeatherMAX at a minimum of 22 oz/A for additional weed flushes before they exceed 4" in height.
- Roundup WeatherMAX may be tank-mixed with other herbicides for postemergence weed control.
- Report repeated non-performance to Monsanto or your local retailer.

RECOMMENDATIONS FOR MANAGING GLYPHOSATE-RESISTANT WEEDS IN PRODUCTS WITH ROUNDUP READY TECHNOLOGY

WEEDS	INSTRUCTIONS AND USE RATES*
Glyphosate-Resistant Marestail (Horseweed)	Start clean with a burndown program or tillage. -Tank-mix Roundup agricultural herbicides with 2,4-D, or dicamba, according to the label directions. In-crop, tank-mix 22 ounces per acre of Roundup WeatherMAX with Clarity® (8 to 16 fluid ounces per acre) or 2,4-D (0.5 to 1.0 lb active ingredient per acre) from corn emergence to the 5-leaf stage of corn growth (approximately 8" tall). Or tank-mix 22 ounces per acre of Roundup WeatherMAX with 5 ounces per acre of Status® herbicide when the corn is 4" to 36" tall (V2 to V10). Marestail should not exceed 6" in height at the time of in-crop application.
Glyphosate-Resistant *Amaranthus* Species - *Palmer Amaranth* - Waterhemp	Start clean with a burndown program or tillage. Use a residual herbicide such as Harness Xtra, Harness Xtra 5.6L, Degree Xtra or other residual herbicide either preemergence or in-crop for control of *Amaranthus* species. In-crop, tank-mix Roundup WeatherMAX with other herbicides such as 2,4-D, dicamba (Clarity or Banvel®) or Status herbicide to control emerged weeds. Applications of Status herbicide should be made when the corn is between 4" and 36" tall (V2 to V10). Follow all label directions. *Amaranthus* species should not exceed 3" in height at the time of in-crop application.
Glyphosate-Resistant *Ambrosia* Species - Giant Ragweed - Common Ragweed	Start clean with a burndown program or tillage. Use a residual herbicide such as Harness Xtra, Harness Xtra 5.6L, Degree Xtra or other residual herbicide either preemergence or in-crop for control of *Ambrosia* species. In-crop, tank-mix Roundup WeatherMAX with other herbicides such as 2,4-D, dicamba (Clarity or Banvel) or Status herbicide to control emerged weeds. Applications of Status herbicide should be made when the corn is between 4" and 36" tall (V2 to V10). Follow all label directions. *Ambrosia* species should not exceed 3" in height at the time of in-crop application.
Glyphosate-Resistant Johnsongrass	Start clean with a burndown program or tillage. Use a residual herbicide such as Harness Xtra, Harness Xtra 5.6L, Degree Xtra or other residual herbicide containing atrazine preemergence to reduce the competition from seedling johnsongrass prior to the emergence of corn. In-crop, tank-mix Roundup WeatherMAX with a herbicide such as Accent®, Equip™ or Option® for control of emerged weeds including seedling and rhizome johnsongrass. Follow all label directions of tank-mix partners, especially those related to weed size.

In certain areas, Italian ryegrass is known to be resistant to glyphosate. For control recommendations, refer to **www.weedresistancemanagement.com** or call 1-800-768-6387. When approved, supplemental labeling for specific herbicide products can also be viewed on **www.cdms.net** or **www.greenbook.net.**

*Follow all pesticide label requirements.

Genuity™ Bollgard II® and Bollgard® Cotton Descriptions

GENUITY™ BOLLGARD II® COTTON

Genuity™ Bollgard II® cotton contains two distinct insecticidal proteins from *Bacillus thuringiensis (B.t.)* that increase the efficacy and spectrum of control and reduce the chance that resistance will develop to the *B.t.* insecticidal proteins, relative to Bollgard® cotton. Genuity™ Bollgard II® cotton normally provides excellent, season-long control of tobacco budworm, pink bollworm and cotton bollworm. Genuity™ Bollgard II® cotton provides good protection against fall armyworm, beet armyworm, cabbage and soybean loopers and other secondary leaf- or fruit-feeding caterpillar pests of cotton. Applications of insecticides to control these insects are substantially reduced with Genuity™ Bollgard II® cotton.

BOLLGARD® COTTON

Bollgard cotton contains a single insecticidal protein from *B.t.* that provides good control against three major lepidopteran insect pests of cotton. Specifically, Bollgard cotton provides excellent, season-long control of tobacco budworm and pink bollworm, and suppression of cotton bollworm. When the above-mentioned insect larvae feed on Bollgard cotton plants, the *B.t.* protein protects the plants from damage by reducing larval survival. Under high infestation, application of insecticides may be necessary to protect Bollgard cotton.

BOLLGARD PHASE OUT

The U.S. Environmental Protection Agency has mandated the following terms and conditions:*

- Bollgard® cotton may be sold through September 30, 2009. After that date, all sales of Bollgard cotton are prohibited.
- All Bollgard cotton seed must be planted by midnight of July 1, 2010 (the expiration date of the Bollgard cotton registration). After July 1, 2010, planting of Bollgard cotton seed is prohibited. Any Bollgard cotton seed not planted on or before July 1, 2010, must be returned to either the retailer or to Monsanto. No refunds are to be issued on Bollgard cotton seeds bought for planting in 2010 and returned by growers.
- An adequate amount of refuge seed must be purchased for planting an appropriate refuge for Bollgard cotton. Purchase of refuge seed with the Bollgard cotton seed is mandatory, and such seed must be purchased by growers in advance of their receipt of Bollgard cotton seed. Any seed purchased for use as a refuge is non-refundable, unless the proportional amount of Bollgard cotton seed that the refuge seed would have supported is returned at the same time.
- Any order for replacement or additional Bollgard cotton seed for the 2010 planting season, that does not conform to the requirements stated above must be filled with Genuity™ Bollgard II® cotton seed (or other products with current registrations).
- On-farm IRM assessments will be conducted during the planting season.
- In 2010, Bollgard cotton may only be planted in: Alabama, Arkansas, Florida (North of Florida Route 60), Georgia, Kentucky, Louisiana, Maryland, Missouri, Mississippi, North Carolina, South Carolina, Tennessee, Texas (excluding the ten prohibited Texas panhandle counties of: Dallam, Sherman, Hansford, Ochiltree, Lipscomb, Hartley, Moore, Hutchinson, Roberts, and Carson) and Virginia.

*It is a violation of federal law to sell or distribute an unregistered pesticide.

NOTE: Sale or commercial planting of Bollgard® cotton is prohibited in certain states, including: Arizona, California, Colorado, Kansas, New Mexico and Oklahoma.

Sale or planting of Bollgard is prohibited in the Texas counties of: Carson, Dallam, Hansford, Hartley, Hutchison, Lipscomb, Moore, Ochiltree, Roberts, and Sherman.

Sale or commercial planting of both Genuity™ Bollgard II® and Bollgard is prohibited in Hawaii, Puerto Rico, the U.S. Virgin Islands, and in Florida south of Route 60 (near Tampa).

The *B.t. delta endotoxin* protein expressed in this cotton targets certain cotton insect pests. Routine applications of insecticides to control certain insects are usually unnecessary when cotton containing the *B.t. delta endotoxin* protein is planted. However, if insecticide applications are necessary to control certain cotton insect pests, follow all label requirements.

Genuity™ Bollgard II® and Bollgard® Cotton

INSECT RESISTANCE MANAGEMENT (IRM)

Lepidopteran cotton pests have demonstrated the ability to develop resistance to many chemical insecticides. As a pre-emptive measure, Genuity™ Bollgard II® and Bollgard® cotton must be managed in ways that will retard insect resistance development. These practices are designed to ensure that some lepidopteran populations are not exposed to the *B.t.* proteins so they can maintain susceptibility in select populations. In order to achieve this, refuge cotton that does not contain *B.t.* proteins must be planted.

GENUITY™ BOLLGARD II - DUAL EFFECTIVE DOSE

Resistance management is critical to the long-term viability of our technology and the benefits realized by our farmer customers. 2010 is a transition year for Monsanto *B.t.* cotton products as we shift all U.S. cotton acres toward the two-gene insect control product, Genuity™ Bollgard II® cotton. The move to multiple-gene products, including Genuity™ Bollgard II®, offers dual effective modes of action against target insect pests, increasing the longevity of the technology.

INTEGRATED PEST MANAGEMENT (IPM)

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information is used to manage pests in a manner that is least harmful to people, property and the environment.

Prevention

Using the best agronomic management practices in conjunction with the appropriate cotton varieties will yield the greatest benefits.

Use varieties, seeding rates and planting technologies appropriate for each specific geographical area. As much as possible, manage the crop to avoid plant stress.

- Employ appropriate scouting techniques and treatment decisions to preserve beneficial insects that can provide additional insect pest control.
- Manage for appropriate maturity and harvest schedules. destroy stalks immediately after harvest to avoid regrowth and minimize selection for resistance in late-season infestations.
- Use soil management practices that encourage destruction of over-wintering pupae.

Monitor and Identify

Fields should be carefully monitored for all pests, including cotton bollworms, to determine the need for remedial insecticide treatments. For target pests, scouting techniques and supplemental treatment decisions should take into account the fact that larvae must hatch and feed before they can be affected by the *B.t.* protein(s) in either Genuity™ Bollgard II® or Bollgard cotton. Fields should be scouted regularly, following periods of heavy or sustained egg lay, especially during bloom, to determine if significant larval survival has occurred. Scouting should include a modified whole-plant inspection, including terminals, squares, blooms, bloom tags and small bolls. Larvae larger than 1/4 inch (3- to 4-days old) are generally recognized as survivors that may not be controlled by Genuity™ Bollgard II® or Bollgard cotton.

Read the IRM/Grower Guide prior to planting for information on planting and Insect Resistance Management. If you do not have a copy of this Guide, you may download it at **www.monsanto.com**, or call **1-800-768-6387** to request a copy by mail.

Control

Monsanto recommends the use of appropriate remedial insecticide treatments to ensure desired levels of control if any cotton insect pest reaches locally established thresholds in Genuity™ Bollgard II® or Bollgard cotton.

Although Genuity™ Bollgard II® and Bollgard cotton will sustain less damage from some of the most troublesome lepidopteran pests, they will not provide protection against non-lepidopteran species. These insects should be monitored and treated with insecticides when necessary, using recommended thresholds. Whenever possible, select insecticides that are least harmful to beneficial insects.

NOTE: In 2010, sale or commercial planting of Bollgard® cotton is prohibited in the following states: Arizona, California, Colorado, Kansas, New Mexico and Oklahoma.

In 2010, sale or planting of Bollgard® is prohibited in the Texas counties of: Carson, Dallam, Hansford, Hartley, Hutchison, Lipscomb, Moore, Ochiltree, Roberts, and Sherman.

In 2010, sale or commercial planting of both Genuity™ Bollgard II® and Bollgard® is prohibited in Hawaii, Puerto Rico, and the U.S. Virgin Islands, or in Florida south of Route 60 (near Tampa).

Roundup Ready® Cotton, Genuity™ Bollgard II® with Roundup Ready® Cotton and Bollgard with Roundup Ready Cotton

Roundup Ready COTTON

genuity™ Bollgard II

Roundup Ready COTTON

Bollgard with Roundup Ready® Cotton

ROUNDUP READY COTTON

Roundup Ready® cotton varieties contain in-plant tolerance to Roundup® agricultural herbicides, enabling farmers to make in-crop applications of Roundup WeatherMAX® or Roundup PowerMAX® according to label requirements.

GENUITY™ BOLLGARD II WITH ROUNDUP READY COTTON AND BOLLGARD WITH ROUNDUP READY COTTON

Genuity™ Bollgard II® with Roundup Ready® cotton and Bollgard with Roundup Ready varieties offer farmers the benefits of both insect protection and glyphosate tolerance combined in one crop. These varieties exhibit the same insect protection qualities as Genuity™ Bollgard II® and Bollgard cotton and enable farmers to make in-crop applications of Roundup WeatherMAX or Roundup PowerMAX according to label requirements.

MARKET OPTIONS

Gin by-products of cotton containing Monsanto's biotech traits, including cottonseed for feed uses, are fully approved for export to Canada, Japan, Mexico and South Korea. Cottonseed containing Monsanto traits may not be exported for the purpose of planting without a license from Monsanto.

It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted.

RECOMMENDED MANAGEMENT PRACTICES

Managing Roundup Ready cotton, Bollgard with Roundup Ready cotton and Genuity™ Bollgard II® with Roundup Ready® cotton requires that a farmer follow the recommended management practices associated with cotton containing each individual trait. Farmers of Bollgard with Roundup Ready cotton and Genuity™ Bollgard II® with Roundup Ready® cotton varieties must follow the same guidelines for establishing required refuge options, practicing IRM and managing target and non-target pests as described for Bollgard and Genuity™ Bollgard II® cotton in the IRM/Grower Guide.

APPLICATION OF ROUNDUP WEATHERMAX® AND ROUNDUP POWERMAX®

Roundup Ready cotton is genetically improved to provide tolerance to glyphosate, the active ingredient in Roundup agricultural herbicides. Roundup Ready cotton can receive over-the-top applications of Roundup agricultural herbicides only through the four-leaf stage. With the introduction of Genuity™ Roundup Ready® Flex cotton, there is the potential for both Roundup Ready cotton and Genuity™ Roundup Ready® Flex cotton to be used on a farmer's farm. This creates concern for the crop safety of Roundup Ready cotton. Monsanto recommends that farmers:

TRACK IT. COUNT IT.
More than Four, Post-Direct.

- Maintain accurate records of which technologies have been planted and where they have been planted.
- Communicate the field plan with other members of their work force to ensure proper applications for each technology.
- Clearly mark fields to indicate which technology has been planted.

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow all pesticide label requirements and these guidelines to minimize the risk of developing glyphosate-resistant weed populations in a Roundup Ready cotton system:

- Scout fields before and after each burndown and in-crop application.
- Start clean with a burndown herbicide program or tillage.
- Use the right herbicide product at the right rate and right time.
- Add soil residual herbicide(s) and cultural practices as part of a Roundup Ready weed control program.
- In-crop, apply Roundup WeatherMAX at a minimum of 22 oz/A when weeds are less than 6" in height.
- Tank-mix other approved herbicides with Roundup WeatherMAX if necessary for postemergence weed control.
- Clean equipment before moving from field to field to minimize the spread of weed seed (as well as nematodes, insects and other cotton pests).
- Should repeated non-performance occur, report to Monsanto or your local retailer.

WEED CONTROL RECOMMENDATIONS

Weed control in cotton is essential to help maximize both fiber yield and quality potential. Cotton is very sensitive to early-season weed competition, which can result in unacceptable stands and/or reduced yield potential. The Roundup Ready® cotton system provides farmers with the right tools to control weeds before they become competitive.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Preplant Burndown	Always start clean by planting into a weed-free field using either tillage or a burndown application. In no-till and reduced-till systems, apply a preplant burndown application of Roundup WeatherMAX®** at 22 to 44 oz/A in a tank-mix with dicamba or 2,4-D. See the dicamba and 2,4-D product label for rates and time intervals required between application and cotton planting. State restrictions may apply.	Early-season weed competition can result in unacceptable stands and/or reduced yield potential. This tank-mix is recommended for control and management of glyphosate-resistant marestail (*Conyza sp.*) or other tough-to-control weeds. Burndown application should be made far enough in advance of planting to control existing weeds.
Residual Herbicides	Apply residual herbicide(s) as part of a Roundup Ready cotton weed control program. Use the recommended label rate and timing of the residual herbicide applied. Refer to individual product labels for list of residual herbicides that may be used.	The residual herbicide(s) may be applied as either a preemergence (including preplant incorporated), postemergence, and/or layby application as allowed on the label of the specific product being used.
Over-The-Top through Fourth Leaf	Apply Roundup WeatherMAX over the top from crop emergence through the fourth true-leaf (node) stage (until the fifth true leaf reaches the size of a quarter). Two applications can be made during this period at a maximum rate of 22 oz/A per application. Refer to the "Annual Weeds Rate Table" in the Roundup WeatherMAX label for rate recommendations for specific annual weeds.	In-crop over-the-top applications must be at least 10 days apart and the cotton must have at least two nodes of incremental growth between applications. Care should be taken to record growth stage at first application. In situations where the potential for weed infestations is high (including perennial weeds), make the first application early enough to allow a second application before cotton exceeds the fourth true-leaf stage. Over-the-top applications after the fourth true-leaf stage can result in boll loss, delayed maturity, and/or yield loss.
Selective Equipment	After the fourth true-leaf stage through layby, Roundup WeatherMAX may be applied using precision post-directed or hooded sprayers which direct the spray to the base of the cotton plant. Two post-directed applications can be made during this period at a maximum rate of 22 oz/A per application.	Place nozzles in a low horizontal position to permit spray pattern to overlap in the row while contact of spray solution with cotton leaves should be avoided to the maximum extent possible. Excessive foliar contact can result in boll loss, delayed maturity, and/or yield loss. There must be two nodes of growth and at least 10 days between applications.
Preharvest Over-The-Top Applications	Before harvest and after cotton reaches 20% boll-crack, if needed, apply up to 44 oz/A of Roundup WeatherMAX. This treatment is effective in controlling late-season perennial weeds and can improve harvest efficiency.	Applications must be made at least 7 days prior to harvest. Roundup agricultural herbicides are not effective for preharvest cotton regrowth in Roundup Ready cotton. Do not apply Roundup agricultural herbicides preharvest to crops grown for seed under contract at an authorized cotton seed company.

Roundup Ready cotton has excellent vegetative tolerance to Roundup WeatherMAX allowing early-season over-the-top applications. Incomplete reproductive tolerance requires that applications after the 4-leaf (node) stage be properly post-directed.

ATTENTION: Use of Roundup agricultural herbicides in accordance with label directions is expected to result in normal growth of Roundup Ready cotton, however, various environmental conditions, agronomic practices, and other factors make it impossible to eliminate all risks associated with the product, even when applications are made in conformance with the label specifications. In some cases, these factors can result in boll loss, delayed maturity, and/or yield loss.

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or Roundup Ready cotton supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX®, application rates are the same as for Roundup WeatherMAX.

RECOMMENDATIONS FOR MANAGING GLYPHOSATE-RESISTANT WEEDS

WEEDS	INSTRUCTIONS AND USE RATES*
Glyphosate-Resistant Marestail (Horseweed)	Start clean with a burndown herbicide program or tillage. -Tank-mix Roundup agricultural herbicides with dicamba or 2,4-D (consult label for plant back timing). If you have dense stands of marestail, use a preplant residual herbicide at the recommended rate and timing, such as diuron (Direx®) or flumioxazin (Valor®). Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. In-crop, if applying post-directed to glyphosate-resistant marestail, Roundup WeatherMAX can be tank-mixed with other herbicides, such as diuron or MSMA. Marestail should be less than 6" in height at the time of in-crop application.
Glyphosate-Resistant *Amaranthus* Species - *Palmer Amaranth* - Waterhemp	Start clean with a burndown herbicide program or tillage. Apply a preemergence residual herbicide such as pendimethalin (Prowl®) plus fluometuron or fomesafen (Reflex®) or flumioxazin (Valor) for control of *Amaranthus* species. In-crop, tank-mix Roundup WeatherMAX at 22 oz/A with metolachlor or other labeled chloracetamide herbicide before *Amaranthus* species emerges. Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. A post-directed application of Roundup WeatherMAX tank-mixed with MSMA and a residual such as diuron (Direx) or flumioxazin (Valor) should be made to control *Amaranthus* species 3" or smaller in height and prevent additional flushes.
Glyphosate-Resistant *Ambrosia* Species - Giant Ragweed - Common Ragweed	Start clean with a burndown herbicide program or tillage. Apply a preemergence residual herbicide such as pendimethalin (Prowl) plus fluometuron or fomesafen (Reflex)for control of *Ambrosia* species. In-crop, tank-mix Roundup WeatherMAX at 22 oz/A with metolachlor before *Ambrosia* species emerges. Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. A post-directed application of Roundup WeatherMAX tank-mixed with MSMA and a residual such as diuron (Direx) or flumioxazin (Valor) should be made to control *Ambrosia* species 3" or smaller in height and prevent additional flushes.
Glyphosate-Resistant Johnsongrass	Start clean with a burndown herbicide or tillage. Preplant incorporate a residual herbicide such as pendimethalin or trifluralin for control or suppression of seedling johnsongrass. Apply Roundup WeatherMAX in a tank-mix with herbicides such as SelectMAX®, Assure® II or Poast Plus for the control of emerged weeds including seedling and rhizome johnsongrass. Follow all label directions of tank-mix partners, especially those related to weed size.

In certain areas, Italian ryegrass is known to be resistant to glyphosate. For control recommendations, refer to **www.weedresistancemanagement.com** or call 1-800-768-6387. When approved, supplemental labeling for specific herbicide products can also be viewed on **www.cdms.net** or **www.greenbook.net.**

*Follow all pesticide label requirements.

Genuity™ Roundup Ready® Flex Cotton and Genuity™ Bollgard II® with Roundup Ready® Flex Cotton

Roundup Ready Flex

Roundup Ready Flex Bollgard II

GENUITY™ ROUNDUP READY® FLEX COTTON

Genuity™ Roundup Ready® Flex cotton varieties possess improved reproductive tolerance to Roundup® agricultural herbicides. This technology gives farmers the opportunity to make over-the-top broadcast applications of labeled Roundup agricultural herbicides from crop emergence up to seven (7) days prior to harvest.

GENUITY™ BOLLGARD II® WITH ROUNDUP READY® FLEX COTTON

Genuity™ Bollgard II® with Roundup Ready® Flex varieties offer farmers the benefits of both insect protection and glyphosate tolerance combined in one crop. These varieties exhibit the same insect protection qualities as Genuity™ Bollgard II® and are tolerant to over-the-top applications of Roundup WeatherMAX® and Roundup PowerMAX®.

MARKET OPTIONS

Genuity™ Roundup Ready® Flex cotton and Genuity™ Bollgard II® with Roundup Ready Flex cotton have regulatory clearance in the United States, but do not have import approval in all export markets. Processed fractions from these products, including linters, oil, meal, cottonseed and gin trash, must not be exported without all necessary approvals in the importing country. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted.

RECOMMENDED MANAGEMENT PRACTICES

Managing Genuity™ Roundup Ready® Flex cotton and Genuity™ Bollgard II® with Roundup Ready® Flex cotton requires a farmer to follow the recommended management practices associated with cotton containing each individual trait. Farmers of Genuity™ Bollgard II® with Roundup Ready® Flex cotton must follow the same guidelines for establishing required refuge options, practicing IRM and managing target and non-target pests as described for Genuity™ Bollgard II® cotton in the IRM/Grower Guide.

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow all label requirements and the guidelines below to minimize the risk of developing weed resistance in a Genuity™ Roundup Ready® Flex cotton system:

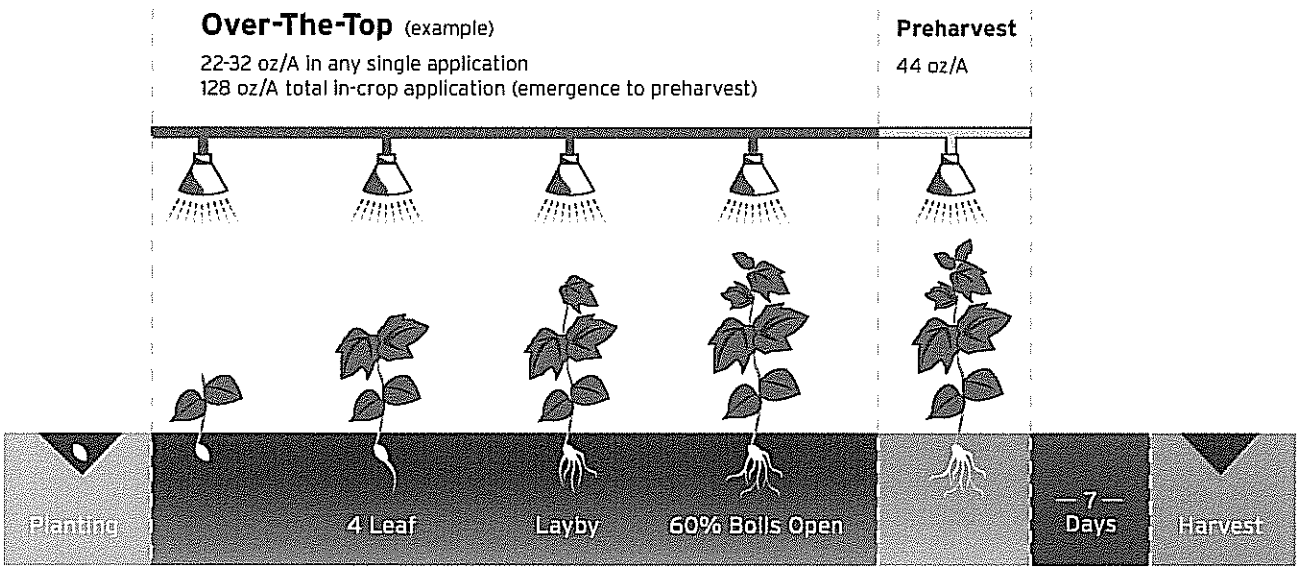
- Scout fields before and after each burndown and in-crop application.
- Start clean with a burndown herbicide program or tillage.
- Use the right herbicide product at the right rate and right time.
- Add soil residual herbicide(s) and cultural practices as part of a Genuity™ Roundup Ready® Flex cotton weed control program.
- In-crop, apply Roundup WeatherMAX at a minimum of 22 oz/A when weeds are 3" to 6" in height.
- Tank-mix other approved herbicides with Roundup WeatherMAX if necessary for postemergence weed control.
- Should repeated non-performance occur, report to Monsanto or your local retailer.
- Clean equipment before moving from field to field to minimize the spread of weed seed (as well as nematodes, insects and other cotton pests).

APPLICATION OF ROUNDUP WEATHERMAX® AND ROUNDUP POWERMAX®

- May be applied over-the-top and/or in-crop, from crop emergence up to 7 days prior to harvest.
- A maximum rate of 32 oz/A per application may be applied using ground application equipment while the maximum is 22 oz/A per application by air.
- There are no growth or timing restrictions for sequential applications.
- Four (4) quarts/A is the total in-crop volume allowed from emergence to 60% open bolls.
- A maximum total volume of 44 oz/A may be applied between layby and 60% open bolls.
- Post-directed equipment may be used to achieve more thorough spray coverage of weeds or if herbicides not labeled for over-the-top application will be tank-mixed with Roundup WeatherMAX or Roundup PowerMAX.

PREHARVEST APPLICATIONS

- Up to 44 oz/A may be applied after cotton reaches 60% open bolls and before harvest, if needed.
- Applications must be made at least 7 days prior to harvest.



CROP SAFETY OF OVER-THE-TOP GLYPHOSATE APPLICATIONS

Monsanto has determined that a combination of components in glyphosate formulations have the potential to cause leaf injury when applied during later stages of crop growth. Roundup WeatherMAX and Roundup PowerMAX are the only Roundup agricultural herbicides labeled and approved for new labeled uses over the top of Genuity™ Roundup Ready® Flex cotton.

Leaf injury may occur if the products are not used according to the product label, used at higher than recommended rates or if overlap of spray occurs in the field. **Farmers must confirm that any glyphosate formulation to be used on Genuity™ Roundup Ready® Flex cotton has been labeled for use on Genuity™ Roundup Ready® Flex cotton and should confirm that it has been tested to demonstrate crop safety.**

WEED CONTROL RECOMMENDATIONS

Weed control in cotton is essential to maximize both fiber yield and quality potential. Cotton is very sensitive to early-season weed competition, which can result in unacceptable stands and/or reduced yield potential. The Genuity™ Roundup Ready® Flex cotton system, with improved reproductive tolerance to Roundup® agricultural herbicides, provides farmers with the right tools to control weeds.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Preplant Burndown	Always start clean by planting into a weed-free field using either tillage or a burndown application. In no-till and reduced-till systems, apply a preplant burndown application of Roundup WeatherMAX®** at 22 to 44 oz/A in a tank-mix with dicamba or 2,4-D. See the dicamba and 2,4-D product label for rates and time intervals required between application and cotton planting. State restrictions may apply.	Early-season weed competition can result in unacceptable stands and/or reduced yield potential. This tank-mix is recommended for control and management of glyphosate-resistant marestail (*Conyza sp.*) or other tough-to-control weeds. Burndown application should be made far enough in advance of planting to control existing weeds.
Residual Herbicides	Apply approved residual herbicide(s) as part of a Genuity™ Roundup Ready® Flex cotton weed control program. Use the recommended label rate and timing of the residual herbicide applied. Refer to individual product labels for list of residual herbicides that may be used.	The residual herbicide(s) may be applied as either a preemergence (including preplant incorporated), postemergence, and/or layby application as allowed on the label of the specific product being used.
In-Crop Weed Control	Target the first application of Roundup WeatherMAX on 1-2 leaf cotton when weeds are small. Apply a minimum of 22 oz/A of Roundup WeatherMAX in-crop. The need for sequential applications of Roundup WeatherMAX will depend upon the occurrence of subsequent weed flushes. Refer to the "Annual Weeds Rate Table" in the Roundup WeatherMAX label booklet for rate recommendations for specific annual weeds.	Early-season weed competition can reduce yield potential in cotton. Select timing of application based on the most difficult to control weed species in your field. Post-direct or hooded sprayers can be used to achieve more thorough spray coverage on weeds.
Preharvest Over-The-Top Applications	Before harvest and after cotton reaches 60% open bolls, if needed, apply up to 44 oz/A of Roundup WeatherMAX. This treatment is effective in controlling late-season perennial weeds.	Applications must be made at least 7 days prior to harvest. Roundup agricultural herbicides are not effective for preharvest cotton regrowth in Genuity™ Roundup Ready® Flex cotton.

*Follow all pesticide label requirements.

**The maximum volume of Roundup WeatherMAX and Roundup PowerMAX® that may be used in a single season is 5.3 quarts per acre.

Roundup Ready Flex

Roundup Ready Flex Bollgard II

RECOMMENDATIONS FOR MANAGING GLYPHOSATE-RESISTANT WEEDS

WEEDS	INSTRUCTIONS AND USE RATES*
Glyphosate-Resistant Marestail (Horseweed)	Start clean with a burndown herbicide program or tillage. -Tank-mix Roundup agricultural herbicides with dicamba or 2,4-D (consult label for plant back timing). If you have dense stands of marestail, use a preplant residual herbicide at the recommended rate and timing, such as diuron (Direx®) or flumioxazin (Valor®). Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. In-crop, if applying post-directed to glyphosate-resistant marestail, Roundup WeatherMAX can be tank-mixed with other herbicides, such as diuron or MSMA. Marestail should not exceed 6" in height at the time of in-crop application.
Glyphosate-Resistant *Amaranthus* Species **- *Palmer Amaranth*** **- Waterhemp**	Start clean with a burndown herbicide program or tillage. Apply a preemergence residual herbicide such as pendimethalin (Prowl®) plus fluometuron or fomesafen (Reflex®) or flumioxazin (Valor) for control of *Amaranthus* species. In-crop, tank-mix Roundup WeatherMAX at 22 oz/A with metolachlor or other labeled chloracetamide herbicide before *Amaranthus* species emerges. Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. A post-directed application of Roundup WeatherMAX tank-mixed with MSMA and a residual such as diuron (Direx) or flumioxazin (Valor) should be made to control *Amaranthus* species 3" or smaller in height and prevent additional flushes.
Glyphosate-Resistant *Ambrosia* Species **- Giant Ragweed** **- Common Ragweed**	Start clean with a burndown herbicide program or tillage. Apply a preemergence residual herbicide such as pendimethalin (Prowl) plus fluometuron or fomesafen (Reflex) for control of *Ambrosia* species. In-crop, tank-mix Roundup WeatherMAX at 22 oz/A with metolachlor before *Ambrosia* species emerges. Use Roundup WeatherMAX in-crop, as needed, at a minimum of 22 oz/A to control other weeds. A post-directed application of Roundup WeatherMAX tank-mixed with MSMA and a residual such as diuron (Direx) or flumioxazin (Valor) should be made to control *Ambrosia* species 3" or smaller in height and prevent additional flushes.
Glyphosate-Resistant Johnsongrass	Start clean with a burndown herbicide or tillage. Preplant incorporate a residual herbicide such as pendimethalin or trifluralin for control or suppression of seedling johnsongrass. Apply Roundup WeatherMAX in a tank-mix with herbicides such as SelectMAX®, Assure® II or Poast Plus for the control of emerged weeds including seedling and rhizome johnsongrass. Follow all label directions of tank-mix partners, especially those related to weed size.

In certain areas, Italian ryegrass is known to be resistant to glyphosate. For control recommendations, refer to **www.weedresistancemanagement.com** or call 1-800-768-6387. When approved, supplemental labeling for specific herbicide products can also be viewed on **www.cdms.net** or **www.greenbook.net.**

*Follow all pesticide label requirements.

GENUITY™ ROUNDUP READY 2 YIELD® AND ROUNDUP READY® SOYBEANS

Genuity™ Roundup Ready 2 Yield® and Roundup Ready® soybean varieties contain in-plant tolerance to Roundup® agricultural herbicides. This means you can spray Roundup agricultural herbicides in-crop from emergence through flowering.

Spray labeled Roundup agricultural herbicides over the top from emergence (cracking) through flowering (R2 stage soybeans) for unsurpassed weed control, proven crop safety and maximum yield potential. R2 stage soybeans end when a pod 5 millimeters (3/16") long at one of the four uppermost nodes appears on the main stem along with a fully developed leaf (R3 stage).

WEED CONTROL RECOMMENDATIONS

Starting clean with a weed-free field, and making timely post-emergence in-crop applications, is critical to obtaining excellent weed control and maximum yield potential. The Roundup Ready soybean system provides the flexibility to use the herbicide tools necessary to control weeds at planting and in-crop. Failure to control weeds with the right rate, at the right time and with the right product, can lead to increased weed competition and the potential for decreased yield.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Preplant Burndown	To start clean in no-till systems, apply a burndown application of Roundup WeatherMAX®** at 22 to 44 oz/A before planting. See the label for appropriate rates by weed species. For control and management of glyphosate-resistant marestail (*Conyza sp.*) or other difficult-to-control weeds present at burndown, apply 22 oz/A of Roundup WeatherMAX in a tank-mix with 1 to 2 pt/A 2,4-D. Make applications 7 to 30 days before planting and before marestail reaches 6" in height.	Always start with a weed-free field. In no-till and reduced-till systems, apply a Roundup WeatherMAX* burndown application to control existing weeds before planting. Adding 2,4-D in the burndown can significantly reduce broadleaf weed pressure at post-emergence timing. Read the 2,4-D product label for time intervals required between application and soybean planting.
Residual Herbicide Plus Roundup WeatherMAX	Use the recommended label rate of a soil-applied residual herbicide applied preemergence to soybeans as defined in the individual product's labeling. The residual product may be tank-mixed with Roundup WeatherMAX at burndown. Refer to individual product labels for list of residual herbicides that may be used. Follow with 22 oz/A Roundup WeatherMAX in-crop when weeds are 2" to 8" tall. Refer to the "Annual Weeds Rate Table" in the Roundup WeatherMAX label for rate recommendations for specific annual weeds. Crop rotation following Genuity™ Roundup Ready 2 Yield® and Roundup Ready soybeans is strongly encouraged. Use of a residual herbicide is encouraged especially if the cropping system is a continuous Roundup Ready system.	A residual program is encouraged when agronomic conditions favor the practice. Reducing Roundup WeatherMAX rate when tank-mixing with a residual or use of premixes utilizing a reduced rate of glyphosate (such as Extreme®) is not recommended. If the in-crop application is delayed and weeds are larger, apply a higher rate of Roundup WeatherMAX.
Roundup WeatherMAX	Apply a minimum of 22 oz/A of Roundup WeatherMAX** in-crop when weeds are 2" to 8" tall. Refer to the "Annual Weeds Rate Table" in the Roundup WeatherMAX label for rate recommendations for specific annual weeds. Choose the rate to control the most difficult-to-control weed in your field. A sequential application of this product may be required to control new flushes of weeds in the Roundup Ready soybean crop. If a sequential application is necessary, apply 16 to 22 oz/A of Roundup WeatherMAX** when weeds are 3" to 6" tall.	In-crop application of Roundup WeatherMAX provides control of labeled weeds. For best results, apply 3 to 4 weeks after planting or when weeds are less than 8" tall. If initial application is delayed and weeds are larger, apply a higher labeled rate of Roundup WeatherMAX.

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or Genuity™ Roundup Ready 2 Yield® soybean or Roundup Ready soybean supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Glyphosate-Tolerant Volunteer Corn	Tank-mix Roundup WeatherMAX® with 6 to 12 oz/A of Select Max™ and apply to 4" to 36" glyphosate-tolerant volunteer corn.	Choose your Roundup WeatherMAX rate based on the weed species and size listed in the "Annual Weeds Rate Table" of the Roundup WeatherMAX Label.
Maximum Use Rates for Roundup WeatherMAX	**In-Crop:** • 44 oz/A per single application • 44 oz/A during flowering • 64 oz/A emergence through flowering (R2 stage soybeans) **Preharvest:** • 22 oz/A application	**Total Season:** The combined total of preplant, in-crop and preharvest applications of Roundup WeatherMAX can not exceed 5.3 qt/A. The combined total of in-crop and preharvest applications can not exceed 64 oz/A.

*Follow all pesticide label requirements.

Herbicide products sold by Monsanto for use over the top of soybeans with Genuity™ Roundup Ready 2 Yield® Technology for the 2010 crop season are as follows:

- Roundup WeatherMAX
- Roundup PowerMAX

WEED CONTROL RECOMMENDATIONS

KEY WEEDS	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Weeds that Tend to Have Multiple Emergence Events	Where dense stands of weed species such as common lambsquarters, tall and common waterhemp, *Palmer Amaranth*, redroot pigweed, common ragweed, and giant ragweed are expected, the following agronomic practices are recommended: • Start clean with tillage or burndown in no-till and reduced till systems. Include 2,4-D in the burndown. • Plant soybeans in narrow rows (<20"). • Use a pre-plant residual herbicide. • Use the right rate of Roundup WeatherMAX at the right time (proper weed size).	Weeds such as lambsquarters, waterhemp, pigweed, and giant ragweed tend to emerge throughout the season. Sequential Roundup WeatherMAX applications or the addition of a soil residual herbicide may be required for control of subsequent weed flushes.
Difficult-to-Control Weeds	Black nightshade, velvetleaf, waterhemp, morningglory, lambsquarters, Florida pusley, giant ragweed, Pennsylvania smartweed, groundcherry, hemp sesbania and spurred anoda are difficult-to-control weeds. Please refer to the Roundup agricultural herbicide label for specific rates and weed sizes for control of these weeds.	These weed species require special attention be paid to Roundup WeatherMAX rate and application timing (proper weed size) to obtain excellent weed control. A sequential application may be required if a new weed flush occurs, especially in soybeans planted in wide rows (>20").
Perennial Weeds	An in-crop application of 22 to 44 oz/A of Roundup WeatherMAX** will provide suppression and/or control of nutsedge and perennial weeds like Canada thistle, field bindweed, hemp dogbane, horsenettle, johnsongrass, milkweed, quackgrass, etc.	For additional information on perennial weeds, see the "Perennial Weeds Rate Table" in the label booklet for Roundup WeatherMAX. For best control, allow perennials to achieve at least 6" or more of growth before spraying.

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or Roundup Ready Soybean or Genuity™ Roundup Ready 2 Yield® Soybean supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow all pesticide label requirements and the guidelines below to minimize the risk of developing glyphosate-resistant weed populations in a Roundup Ready Soybean System:

- Crop rotation is strongly encouraged.
- Scout fields before and after each burndown and in-crop application.

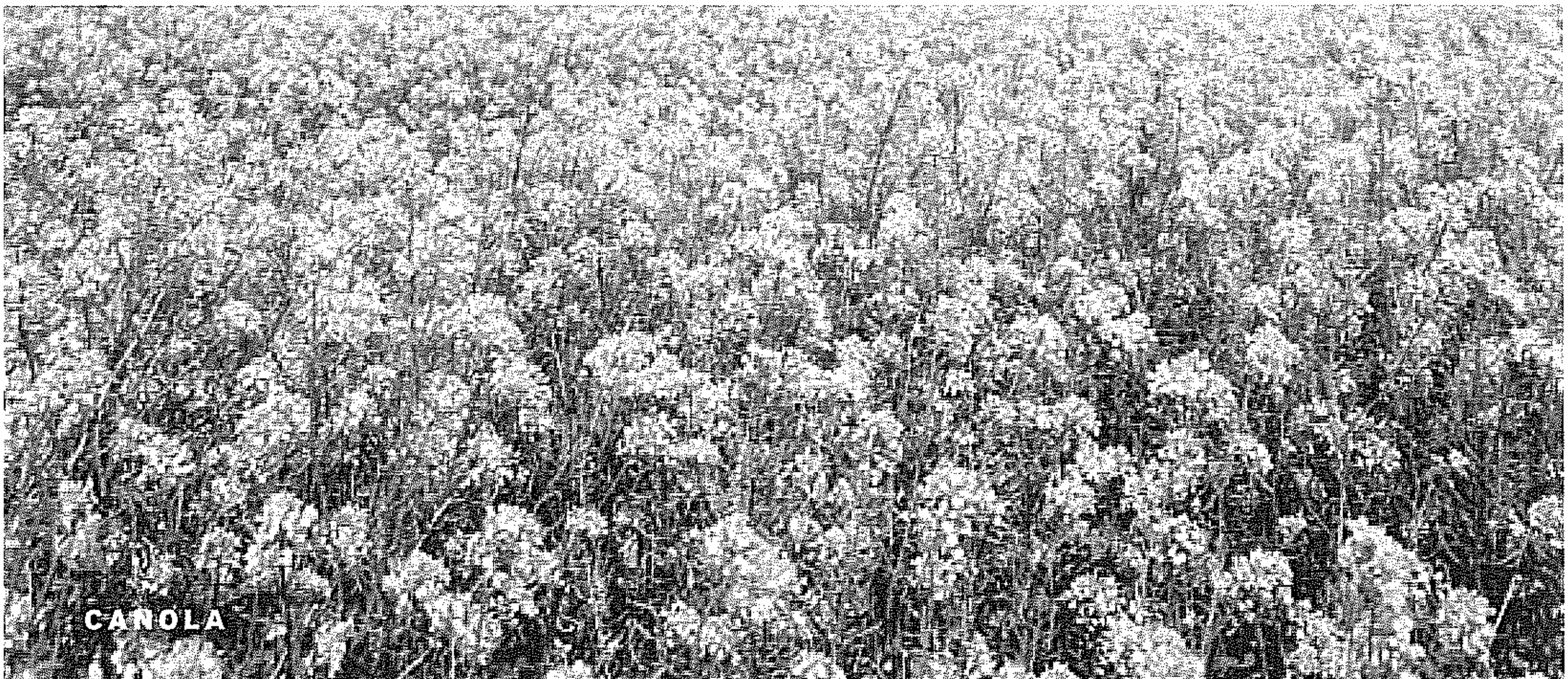
- Start clean with a burndown herbicide or tillage.
  - Tank-mix with 2,4-D to control glyphosate-resistant marestail or other tough-to-control broadleaf weeds.
- Use the recommended label rate of a soil-applied residual herbicide such as INTRRO®, Valor®, Valor XLT® or Gangster®.
- In-crop, apply Roundup WeatherMAX at a minimum of 22 oz/A before weeds exceed 8" in height.
- If an additional flush of weeds occurs, a sequential application of Roundup WeatherMAX at 22 oz/A may be needed before weeds exceed 6" in height.
- Refer to individual product labels for a list of recommended tank-mix partners.
- Clean equipment before moving from field to field to minimize the spread of weed seed.
- Report repeated non-performance to Monsanto or your local retailer.

RECOMMENDATIONS FOR MANAGING GLYPHOSATE-RESISTANT WEEDS

WEEDS	INSTRUCTIONS AND USE RATES*
Glyphosate-Resistant Marestail (Horseweed)	**Preplant:** Apply a tank-mixture of 22 oz/A Roundup WeatherMAX® with 1 pt/A 2,4-D before marestail exceeds 6" in height. See the 2,4-D product label for time intervals required between application and planting. **In-crop:** It is strongly encouraged that marestail should be controlled prior to planting using recommended preplant burndown treatments. In-crop, apply a tank-mixture of 22 oz/A Roundup WeatherMAX with 0.3 oz/A FirstRate®. This treatment should be used as a salvage treatment only for a marestail infestation that was not controlled preplant. Application should be made between full emergence of the first trifoliate leaf and 50% flowering stage of soybeans. At the time of treatment, marestail should not exceed 6" in height.
Glyphosate-Resistant *Amaranthus* Species **- *Palmer Amaranth*** **- Waterhemp**	**Preplant:** Apply a tank-mix of 22 oz/A Roundup WeatherMAX with a preemergence residual herbicide such as alachlor (INTRRO®), flumioxazin (Valor®) or another residual herbicide for preemergence control of *Amaranthus* species. 2,4-D may be added to the tank-mix to help control emerged *Amaranthus* species and other broadleaf weeds preplant only. Follow label instructions regarding application timing relative to soybean planting. **In-crop:** It is strongly encouraged that a preemergence residual product be used to control *Amaranthus* species prior to emergence. If there is emerged *Amaranthus* in-crop, apply a tank-mixture of 22 oz/A Roundup WeatherMAX with a postemergence product with activity on *Amaranthus* such as lactofen (Cobra®), fomesafen (Flexstar®) or cloransulam (FirstRate). Applications should be made on emerged *Amaranthus* that does not exceed 3" in height. Read and follow all product label instructions. It is likely that visual soybean injury will occur with these tank-mixtures.
Glyphosate-Resistant *Ambrosia* Species **- Giant Ragweed** **- Common Ragweed**	**Preplant:** Apply a tank-mix of 22 oz/A Roundup WeatherMAX with a preemergence residual herbicide such as cloransulam (FirstRate) or cloransulam + flumioxazin (Ganster®) or another residual herbicide for preemergence control of *Ambrosia* species. 2,4-D may be added to the tank-mix to help control emerged *Ambrosia* species and other broadleaf weeds preplant only. Follow label instructions regarding application timing relative to soybean planting. **In-crop:** It is strongly encouraged that a preemergence residual product be used to control *Ambrosia* species prior to emergence. If there is emerged *Ambrosia* in-crop, apply a tank-mixture of 22 oz/A Roundup WeatherMAX with a postemergence product with activity on *Ambrosia* such as lactofen (Cobra) or fomesafen (Flexstar). Applications should be made on emerged *Ambrosia* that does not exceed 3" in height. Read and follow all product label instructions. It is likely that visual soybean injury will occur with these tank-mixtures.
Glyphosate-Resistant Johnsongrass	Start clean with a burndown herbicide or tillage. Preplant incorporate a residual herbicide such as pendimethalin or trifluralin for control or suppression of seedling johnsongrass. Apply Roundup WeatherMAX in a tank-mix with herbicides such as SelectMAX®, Assure® II or Poast Plus for the control of emerged weeds including seedling and rhizome johnsongrass. Follow all label directions of tank-mix partners, especially those related to weed size.

In certain areas, Italian ryegrass is known to be resistant to glyphosate. For control recommendations, refer to **www.weedresistancemanagement.com** or call 1-800-768-6387. When approved, supplemental labeling for specific herbicide products can also be viewed on **www.cdms.net** or **www.greenbook.net.**

*Follow all pesticide label requirements.


CANOLA


ALFALFA


SUGARBEET

ATTENTION: Pursuant to a Court Order issued on May 3, 2007, Genuity™ Roundup Ready® alfalfa seed CAN NOT be commercially sold or planted until further administrative regulatory actions are completed. For more information, and the latest updates on Genuity™ Roundup Ready® alfalfa, go to www.roundupreadyalfalfa.com.

Genuity™ Roundup Ready® alfalfa varieties have in-plant tolerance to Roundup® agricultural herbicides, enabling farmers to apply labeled Roundup agricultural herbicides up to 5 days before cutting for unsurpassed weed control, excellent crop safety and preservation of forage quality potential.

Hay and Forage Management Practices

Genuity™ Roundup Ready® alfalfa must be managed for high quality hay/forage production, including timely cutting to promote high forage quality (i.e. before 10% bloom) and to prevent seed development. In geographies where conventional alfalfa seed production is intermingled with forage production and the agronomic conditions (climate and water/irrigation availability) are such that forage alfalfa is allowed to stand and flower late in the season, Genuity™ Roundup Ready® alfalfa must be harvested at or before 10% bloom to minimize potential pollen flow from hay to common or conventional alfalfa seed production. Farmers who are unwilling to or who can not make this commitment to stewardship should not continue to grow Genuity™ Roundup Ready® alfalfa.

Genuity™ Roundup Ready® alfalfa varieties have excellent tolerance to over-the-top applications of labeled Roundup agricultural herbicides. An in-crop weed control program using Roundup WeatherMAX® or Roundup PowerMAX® will provide excellent weed control in most situations. A residual herbicide labeled for use in alfalfa may also be applied postemergence in alfalfa. Contact a Monsanto Representative, local crop advisor or extension specialist to determine the best option for your situation.

Stand Takeout and Volunteer Management

Crop rotations can be divided into two main groups, alfalfa rotated to: 1) grass crops (e.g. corn and cereal crops); and 2) broadleaf crops. More herbicide alternatives exist for management of volunteer alfalfa in grass crops. The recommended steps for controlling volunteer Genuity™ Roundup Ready® alfalfa are:

- Diligent Stand Takeout
- Start Clean
- Plan for Success
- Timely Execution

DILIGENT STAND TAKEOUT

Use appropriate, commercially available herbicide treatments alone for reduced tillage systems or in combination with tillage to terminate the Genuity™ Roundup Ready® alfalfa stand. Refer to your regional technical bulletin for specific stand takeout recommendations. **NOTE:** Roundup® agricultural herbicides are **not** effective for terminating Genuity™ Roundup Ready® alfalfa stands.

START CLEAN

If necessary, utilize tillage and/or additional herbicide application(s) after stand takeout, and before planting of the subsequent rotational crop to manage any newly emerged or surviving alfalfa.

PLAN FOR SUCCESS

Rotate the crops with known and available mechanical or herbicidal methods for managing volunteer alfalfa, keeping in mind that Roundup agricultural herbicides will not terminate Genuity™ Roundup Ready® alfalfa stands.

- Rotations to certain broadleaf crops are not advisable if the farmer is not willing to implement recommended stand termination practices.
- In the event that no known mechanical or herbicidal methods are available to manage volunteer alfalfa in the desired rotational crop, it is suggested that a crop with established volunteer alfalfa management practices be introduced into the rotation.

TIMELY EXECUTION

Implement in-crop mechanical or herbicide treatments for managing alfalfa volunteers in a timely manner; that is, before the volunteers become too large to control or begin to compete with the rotational crop.

Planting Requirements

Genuity™ Roundup Ready® alfalfa is not permitted to be planted in any wildlife feed plots.

Stewardship

All Genuity™ Roundup Ready® alfalfa farmers shall sign the Monsanto Technology/Stewardship Agreement (MTSA) limited-use license application which provides the terms and conditions for the authorized use of the product. Due to special circumstances, alfalfa farmers in the Imperial Valley of California will also sign an Imperial Valley Use Agreement (IVUA) with specific stewardship commitments. The MTSA or IVUA must be completed before purchase or use of seed.

Both the MTSA or IVUA explicitly prohibit all forms of commercial seed harvest on the stand. Every alfalfa farmer producing seed of Genuity™ Roundup Ready® alfalfa must possess an additional, separate and distinct seed farmer contract to produce Genuity™ Roundup Ready® alfalfa seed. Genuity™ Roundup Ready® alfalfa seed may not be planted outside of the United States, or for the production of seed or sprouts.

Any product produced from a Genuity™ Roundup Ready® alfalfa crop or seed, including hay and hay products, must be labeled and may only be used, exported to, processed or sold in countries where regulatory approvals have been granted. It is a violation of national and international laws to move material containing biotech traits across boundaries into nations where import is not permitted.

Pursuant to a Court Order issued on May 3, 2007, Genuity™ Roundup Ready® alfalfa farmers must adhere to the requirements set out in the December 18, 2007 USDA Administrative Order **(http://www.aphis.usda.gov/brs/pdf/RRA_A8_final.pdf)** until the USDA completes its regulatory process.

These requirements include, but are not limited to:

- Pollinators shall not be added to Genuity™ Roundup Ready® alfalfa fields grown only for hay production.
- Farm equipment used in Genuity™ Roundup Ready® alfalfa production shall be properly cleaned after use.
- Genuity™ Roundup Ready® alfalfa shall be handled and clearly identified to minimize commingling after harvest.

For additional information visit the USDA website:
http://www.aphis.usda.gov/biotechnology/alfalfa_history.shtml

For more information and the latest updates on Genuity™ Roundup Ready® alfalfa, go to **http://www.roundupreadyalfalfa.com**

To meet sales reporting requirements, the seed supplier is required to identify and list all Genuity™ Roundup Ready® alfalfa field locations. Therefore, all farmers MUST PROVIDE their seed supplier with the GPS coordinates of all their Genuity™ Roundup Ready® alfalfa fields.

genuity™

Roundup Ready

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow all pesticide label requirements and the guidelines below to minimize the risk of developing glyphosate-resistant weed populations in a Genuity™ Roundup Ready® alfalfa system:

- Scout fields before and after each herbicide application.
- Use the right herbicide product at the right rate and at the right time.
- To control flushes of weeds in established alfalfa, make applications of Roundup WeatherMAX® or Roundup PowerMAX® herbicide at 22 to 44 oz/A before weeds exceed 6" in height, up to 5 days before cutting.
- Use other approved herbicide products tank-mixed or in sequence with Roundup agricultural herbicide if appropriate for the weed spectrum present as part of a Genuity™ Roundup Ready® alfalfa weed control program.
- Report repeated non-performance to Monsanto or your local retailer.

WEED CONTROL RECOMMENDATIONS

In established stands, to preserve the quality potential of forage and hay, applications should be made after weeds have emerged but before alfalfa re-growth interferes with application spray coverage of the target weeds.

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Established Stands	After the first harvest of a newly established stand, up to 44 oz/A of Roundup WeatherMAX®** herbicide per cutting may be applied up to 5 days before each subsequent cutting. The combined total per year for all in-crop applications in established stands must not exceed 132 oz/A (4.1 qt/A) of Roundup WeatherMAX.	Applications between cuttings may be applied as a single application or in multiple applications (e.g. 2 applications of 22 oz/A). Sequential applications should be at least 7 days apart.
Weeds Controlled	For specific application rates and instructions for control of various annual and perennial weeds, refer to the Roundup WeatherMAX** herbicide label booklet. Some weeds with multiple germination times or suppressed (stunted) weeds may require a second application of Roundup WeatherMAX** herbicide for complete control. For some perennial weeds, repeated applications may be required to eliminate crop competition throughout the growing season.	In addition to those weeds listed in the Roundup WeatherMAX* label booklets, this product will suppress or control the parasitic weed, dodder (*Cuscuta spp.*) in Genuity™ Roundup Ready® alfalfa. Repeat applications may be necessary for complete control. For tough-to-control weeds or weeds not controlled by Roundup® agricultural herbicides use labeled rates of other approved herbicides, alone or in tank-mixtures, with Roundup agricultural herbicides.
Maximum Use Rates	**In-Crop:** • 44 oz/A per single application. • Established Stand Total: 44 oz/A per cutting up to 5 days before harvest.	**Total Per Year:** The combined total per year for all in-crop applications in established stands must not exceed 132 oz/A (4.1 qt/A) of Roundup WeatherMAX.

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or separately published Genuity™ Roundup Ready® alfalfa supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

™ Genuity™ Roundup Ready® spring canola hybrids contain in-plant tolerance to Roundup agricultural herbicides, enabling farmers to apply Roundup® agricultural herbicides over the top of Genuity™ Roundup Ready® spring canola anytime from emergence through the 6-leaf stage of development.

Roundup Ready

The introduction of the Roundup Ready® trait into leading spring canola hybrids and varieties gives farmers the opportunity for unsurpassed weed control, proven crop safety and maximum profit potential. With Genuity™ Roundup Ready® spring canola, farmers have the weed management tool necessary to improve spring canola profitability, while providing a viable rotational crop to help break pest and disease cycles in cereal-growing areas.

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow all pesticide label requirements and the guidelines below to minimize the risk of developing glyphosate-resistant weed populations in a Genuity™ Roundup Ready® spring canola system:

- Scout fields before and after each burndown and in-crop application.
- Start clean with a burndown herbicide or tillage.
- In-crop, apply Roundup WeatherMAX® herbicide before weeds exceed 3" in height.
- A sequential application of Roundup WeatherMAX herbicide may be needed.
- Clean equipment before moving from field to field to minimize the spread of weed seed.
- Report repeated non-performance to Monsanto or your local retailer.

WEED CONTROL RECOMMENDATIONS (SPRING-SEEDED)

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Two-Pass Program– For Annual and Perennial Weed Control	For broad-spectrum control of annual and perennial weeds, use an initial application of 11 oz/A of Roundup WeatherMAX**, in 5 to 10 gal/A water volume. No surfactant is required. Make a second application of 11 oz/A of Roundup WeatherMAX** no less than 10 days after initial application up to the 6-leaf stage (prebolting). Do not exceed 11 oz/A per application.	Spray when canola is at the 0- to 6-leaf stage of growth. To maximize yield potential, spray Genuity™ Roundup Ready® spring canola at the 1- to 3-leaf stage to eliminate competing weeds. Short-term yellowing may occur with later applications, with little effect on crop growth, maturity, or yield. Wait a minimum of 10 days between applications. Two applications of Roundup WeatherMAX will: • Control late flushes of annual weeds such as foxtail, pigweed, and wild mustard. • Provide season-long suppression of Canada thistle, quackgrass, and perennial sow thistle. • Provide better yields by eliminating competition from both annuals and hard-to-control perennials.
Single Application– For Annual Weed Control	For broad-spectrum control of annual and easy-to-control perennial weeds, make a single application of 16 oz/A of Roundup WeatherMAX.**	For best results, spray Genuity™ Roundup Ready® spring canola at the 2- to 3-leaf stage. Can be applied up to 6-leaf stage; yellowing may occur with later application with little effect on crop growth, maturity, or yield. No additional over-the-top applications can be made.
Maximum Use Rate For Roundup WeatherMAX	Two over-the-top applications: Do not exceed 11 oz/A per application. Single over-the-top applications: Do not exceed 16 oz/A. No additional application can be made.	

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or separately published Genuity™ Roundup Ready® canola supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

Genuity™ Roundup Ready® winter canola varieties have been developed for seeding in the fall and harvesting the following spring/summer.

Genuity™ Roundup Ready® winter canola varieties contain in-plant tolerance to Roundup® agricultural herbicides, enabling farmers to apply Roundup agricultural herbicides over the top of Genuity™ Roundup Ready® winter canola from crop emergence to the pre-bolting stage. The introduction of the Roundup Ready trait into winter canola varieties gives farmers the opportunity of unsurpassed weed control, crop safety and maximum yield potential. Genuity™ Roundup Ready® winter canola offers farmers an important option as a rotational crop in traditional monoculture winter wheat production areas. Introducing crop rotation is an important factor in reducing pest cycles, including weed and disease problems.

WEED RESISTANCE MANAGEMENT GUIDELINES

Follow the same guidelines as stated for spring canola.

WEED CONTROL RECOMMENDATIONS (WINTER-SEEDED)

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Sequential Applications	The two-pass program gives the greatest flexibility in controlling late emerging weeds. For broad-spectrum weed control, apply 11 to 22 oz/A of Roundup WeatherMAX** herbicide to 2-leaf or larger Genuity™ Roundup Ready® winter canola in the fall. Use 5 to 10 gallons/A water volume. Do not add surfactants. Apply a second application of Roundup WeatherMAX** at 11 to 22 oz/A at a minimum interval of 60 days after the first application and before bolting in the spring. Do not exceed 22 oz/A per application.	Spray when Genuity™ Roundup Ready® winter canola is at the 2-3 leaf stage of growth. Early applications can eliminate competing weeds and improve yield potential. Two applications of Roundup WeatherMAX will provide control of early emerging annual weeds and winter emerging weeds such as downy brome, cheat and jointed goatgrass.
Single Application	For broad-spectrum control of annual and easy-to-control perennial weeds, make a single application of 16 to 22 oz/A of Roundup WeatherMAX**, preferably in the fall.	For best results, spray Genuity™ Roundup Ready® winter canola at the 2-3 leaf stage and when weeds are small and actively growing. Applications must be made prior to bolting. Use the higher rate in the range when weed densities are high, when weeds have over wintered or when weeds become large and well established.
Maximum Use Rate for Roundup WeatherMAX	Any single over-the-top application of Roundup WeatherMAX** should not exceed 22 oz/A. No more than two over-the-top applications may be made from crop emergence to canopy closure prior to bolting in the spring.	Applications of greater than 16 fluid ounces/A prior to the 6-leaf stage may result in temporary yellowing and/or growth reduction.

*Follow all pesticide label requirements.

**If using another Roundup brand herbicide, you must refer to the label booklet or Genuity™ Roundup Ready® winter canola supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

GRAZING

It is recommended that Genuity™ Roundup Ready® winter canola not be grazed. While Genuity™ Roundup Ready® winter canola may provide farmers additional opportunity as a forage for grazing livestock, at the present time insufficient information exists to allow safe and proper grazing recommendations. Preliminary data suggest that excessive grazing can significantly reduce yield, and that careful nitrate management is critical in managing Genuity™ Roundup Ready® winter canola as a forage to limit the risk of livestock nitrate poisoning. State universities are assessing the potential and the instructions for grazing Genuity™ Roundup Ready® winter canola and they will provide grazing management guidelines when their research is completed.

Genuity™ Roundup Ready® sugarbeet varieties have in-plant tolerance to Roundup® agricultural herbicides, enabling farmers to apply labeled Roundup agricultural herbicides from planting through 30 days prior to harvest for unsurpassed weed control, excellent crop safety and preservation of yield potential.

MANAGEMENT PRACTICES

Sugarbeets are extremely sensitive to weed competition for light, nutrients and soil moisture. Research on sugarbeet weed control suggests that sugarbeets need to be kept weed-free for the first eight weeks of growth to protect yield potential. Therefore, weeds must be controlled when they are small and before they compete with Genuity™ Roundup Ready® sugarbeets (exceed crop height), that is from less than 2" up to 4" in height, to preserve sugarbeet yield potential. *More than one in-crop herbicide application will be required* to control weed infestations to protect yield potential as Roundup agricultural herbicides have no soil residual activity. Bolting sugarbeets must be rogued or topped in Genuity™ Roundup Ready® sugarbeet fields.

Genuity™ Roundup Ready® sugarbeet varieties have excellent tolerance to over-the-top applications of labeled Roundup agricultural herbicides. A postemergence weed control program using Roundup WeatherMAX® or Roundup PowerMAX® will provide excellent weed control in most situations. A residual herbicide labeled for use in sugarbeets may also be applied preemergence, preplant or postemergence in Genuity™ Roundup Ready® sugarbeets. Contact a Monsanto Representative, local crop advisor or extension specialist to determine the best option for your situation.

WEED RESISTANCE MANAGEMENT FOR GENUITY™ ROUNDUP READY® SUGARBEETS

Follow all pesticide label requirements and the guidelines below to minimize the risk of developing glyphosate-resistant weed populations in a Genuity™ Roundup Ready® sugarbeet system:

- Start clean with tillage and follow-up with a burndown herbicide, such as Roundup WeatherMAX, if needed prior to planting.
- Early-season weed control is critical to protect sugarbeet yield potential. Apply the first in-crop application of Roundup WeatherMAX at a minimum of 22 oz/A while weeds are less than 2" in height.
- Follow with additional postemergence in-crop application of Roundup WeatherMAX at a minimum of 22 oz/A for additional weed flushes before weeds exceed 4" in height.
- Add spray grade ammonium sulfate at a rate of 17 lbs/100 gallons of spray solution with Roundup® agricultural herbicides to maximize product performance.
- Use mechanical weed control/cultivation and/or residual herbicides where appropriate in your Genuity™ Roundup Ready® sugarbeets.
- Use additional herbicide modes of action/residual herbicides and/or mechanical weed control in other Roundup Ready crops you rotate with Genuity™ Roundup Ready® sugarbeets.
- Report repeated non-performance of Roundup agricultural herbicides to Monsanto or your local retailer.

AGRONOMIC PRINCIPLES IN SUGARBEETS

Sugarbeets are very sensitive to early-season weed competition. It is important to select the appropriate herbicide product, application rate and timing to minimize weed competition to protect yields. The Genuity™ Roundup Ready® sugarbeet system provides a mechanism to control weeds at planting and once Genuity™ Roundup Ready® sugarbeets emerge. Failure to control weeds with the right rate, at the right time and with the right product, can lead to increased weed competition, weed escapes and the potential for decreased yields. Tank-mixtures of Roundup agricultural herbicides with fungicides, insecticides, micronutrients or foliar fertilizers are not recommended as they may result in crop injury and reduced pest control or antagonism.

PLANTING REQUIREMENTS

Genuity™ Roundup Ready® sugarbeets are not permitted to be planted in any wildlife feed plots.

STEWARDSHIP

All Genuity™ Roundup Ready® sugarbeet farmers shall sign the Monsanto Technology/Stewardship Agreement (MTSA) limited-use license application which provides the terms and conditions for the authorized use of the product. The MTSA must be signed and approved prior to purchase or use of seed.

WEED CONTROL RECOMMENDATIONS

PROGRAM	INSTRUCTIONS AND USE RATES*	ADDITIONAL INFORMATION
Preplant Burndown	After preplant tillage or bedding operations have been completed, a preplant burndown application of Roundup WeatherMAX®** at 22 to 44 oz/A may be applied to control weeds that have germinated after tillage and prior to planting. See the label for appropriate rates by weed species and weed size.	Always utilize tillage to start with a weed-free field.
Over-The-Top Applications up to eight-leaf Genuity™ Roundup Ready® Sugarbeets	Up to two applications of Roundup agricultural herbicides may be made prior to the 8-leaf stage of Genuity™ Roundup Ready® sugarbeets. The first application of 22 to 32 oz/A of Roundup WeatherMAX** should be made when weeds are less than 2" in height to protect yield potential. Make an additional application of 22 to 32 oz/A of Roundup WeatherMAX before weeds exceed 4" in height. Maximum in-crop Roundup WeatherMAX prior to 8-leaf stage must not exceed 56 oz/A.	Sugarbeets are sensitive to weed competition and can lose yield rapidly if weeds are not controlled early. More than one in-crop Roundup WeatherMAX application will be required to control weed infestations to protect yield potential as Roundup agricultural herbicides have no soil residual activity. Add ammonium sulfate at a rate of 17 lbs/100 gallons of spray solution with Roundup agricultural herbicides to maximize product performance. Tank-mixtures of Roundup agricultural herbicides with fungicides, insecticides, micronutrients or foliar fertilizers are not recommended. Sequential applications should be at least 10 days apart.
Over-The-Top Applications to greater than eight-leaf Genuity™ Roundup Ready® Sugarbeets	Up to two additional applications of 22 oz/A of Roundup WeatherMAX can be made after the eight-leaf stage up to 30 days prior to harvest. Maximum in-crop Roundup WeatherMAX from 8-leaf stage up until 30 days prior to harvest must not exceed 44 oz/A.	Add ammonium sulfate at a rate of 17 lbs/100 gallons of spray solution with Roundup agricultural herbicides to maximize product performance. Tank-mixtures of Roundup agricultural herbicides with fungicides, insecticides, micronutrients or foliar fertilizers are not recommended. Sequential applications should be at least 10 days apart.
Maximum Use Rates	**In-Crop:** • Two applications of Roundup WeatherMAX prior to the 8-leaf stage of Genuity™ Roundup Ready® sugarbeets - 32 oz/A per single application up to the 8-leaf stage. - Combined maximum of 56 oz/A in-crop prior to the 8-leaf stage • Two applications of Roundup WeatherMAX after the 8-leaf stage up to 30 days prior to harvest - 22 oz/A per single application after the 8-leaf stage. - Combined maximum of 44 oz/A in-crop after the 8-leaf stage until 30 days prior to harvest	**Total Per Year:** The combined total per year for all Roundup WeatherMAX applications including pre-plant must not exceed 5.3 qt/A. Total in-crop application must not exceed 3 qt/A. Add ammonium sulfate at a rate of 17 lbs/100 gallons of spray solution with Roundup agricultural herbicides to maximize product performance. Tank-mixtures of Roundup agricultural herbicides with fungicides, insecticides, micronutrients or foliar fertilizers are not recommended.

*Follow all pesticide label requirements.

**If using another Roundup agricultural herbicide, you must refer to the label booklet or separately published Genuity™ Roundup Ready® sugarbeets supplemental label for that brand to determine appropriate use rates. If using Roundup PowerMAX, application rates are the same as for Roundup WeatherMAX.

This guide was printed using Utopia II XG Cover and Text which contains 30% post-consumer waste. Savings derived from using 30% post-consumer fiber in lieu of 100% virgin fibers:

- Saves the equivalent of 585 mature trees
- Reduces solid waste by 35,308 pounds
- Reduces waste water by 213,390 gallons
- Reduces greenhouse gas emissions by 199,989.75 pounds

Before opening a bag of seed, be sure to read, understand and accept the stewardship requirements, **including applicable refuge requirements for insect resistance management**, for the biotechnology traits expressed in the seed as set forth in the Monsanto Technology Agreement that you sign. By opening and using a bag of seed, you are reaffirming your obligation to comply with the most recent stewardship requirements.

Roundup Ready® Alfalfa seed is currently not for sale or distribution. The movement and use of Roundup Ready® Alfalfa forage is subject to a USDA administrative Order available at http://www.aphis.usda.gov/brs/pdf/RRA_AB_final.pdf.

This stewardship statement applies to all products listed herein except Genuity™ VT Double PRO™, Genuity™ VT Triple PRO™ and Genuity™ SmartStax™. See restrictions related to Genuity™ Double PRO™, Genuity™ VT Triple PRO™ and Genuity™ SmartStax™ below:

Monsanto Company is a member of Excellence Through Stewardship® (ETS). Monsanto products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Monsanto's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. This product has been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Biotechnology Industry Organization.

IMPORTANT: Grain Marketing and Seed Availability: Genuity™ VT Double PRO™ has received the necessary approvals in the United States, however, as of October 22, 2009, approvals have not been received in certain major corn export markets. **Genuity™ VT Double PRO™** will not be launched and seed will not be available until after import approvals are received in appropriate major corn export markets. ***B.t.* products, including Genuity™ VT Double PRO™** may not yet be registered in all states. Check with your Monsanto representative for the registration status in your state.

IMPORTANT: Grain Marketing and Seed Availability: Genuity™ VT Triple PRO™ has received the necessary approvals in the United States however, as of October 22, 2009, approval has not been received in all major corn export markets. Monsanto anticipates that all such approvals will be in place for the 2010 growing season. If all approvals are not in place, **Genuity™ VT Triple PRO™** seed will only be available as part of a commercial demonstration program that includes grain marketing stewardship requirements. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Consult with your seed representative for current regulatory and stewardship information status.

IMPORTANT: Grain Marketing and Seed Availability: Genuity™ SmartStax™ has received the necessary approvals in the United States, however, as of October 22, 2009, approvals have not been received in certain major corn export markets. **Genuity™ SmartStax™** will not be launched and seed will not be available until after import approvals are received in appropriate major corn export markets. ***B.t.* products, including Genuity™ SmartStax™** may not yet be registered in all states. Check with your Monsanto representative for the registration status in your state.

Cottonseed containing Monsanto traits may not be exported for the purpose of planting without a license from Monsanto.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

Growers may utilize the natural refuge option for varieties containing the Bollgard II® trait in the following states: AL, AR, FL, GA, KS, KY, LA, MD, MS, MO, NC, OK, SC, TN, VA, and most of Texas (excluding the Texas counties of Brewster, Crane, Crockett, Culberson, El Paso, Hudspeth, Jeff Davis, Loving, Pecos, Presidio, Reeves, Terrell, Val Verde, Ward and Winkler). The natural refuge option does not apply to **Bollgard II** cotton grown in areas where pink bollworm is a pest, including CA, AZ, NM, and the above listed Texas counties. It also remains the case that **Bollgard®** and **Bollgard II** cotton cannot be planted south of Highway 60 in Florida, and that **Bollgard** cotton cannot be planted in certain other counties in the Texas panhandle. Refer to the Technology Use Guide and IRM/Grower Guide for additional information regarding Bollgard II, Bollgard, natural refuge and EPA-mandated geographical restrictions on the planting of *B.t.* cotton.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Roundup Ready® crops contain genes that confer tolerance to glyphosate, the active ingredient in Roundup® brand agricultural herbicides. Roundup® brand agricultural herbicides will kill crops that are not tolerant to glyphosate. Degree® and Harness® are not registered in all states. Degree® and Harness® may be subject to use restrictions in some states. Bullet®, Degree Xtra®, Harness®, INTRRO®, Lariat®, and Micro-Tech® are restricted use pesticides and are not registered in all states. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local Monsanto dealer or representative for the product registration status in your state.

Tank mixtures: The applicable labeling for each product must be in the possession of the user at the time of application. Follow applicable use instructions, including application rates, precautions and restrictions of each product used in the tank mixture. Monsanto has not tested all tank mix product formulations for compatibility or performance other than specifically listed by brand name. Always predetermine the compatibility of tank mixtures by mixing small proportional quantities in advance.