Appendix 1.

USDA Notifications and States Approved for Environmental Releases of MON 88701 Dicamba- and Glufosinate-Resistant Cotton and MON 87708 Dicamba-Resistant Soybean

Table 1-1. USDA Notifications, Permits and States Approved for MON 88701 Cotton

USDA No.	Date	State/Territory-Number of Releases
07-241-107n	9/28/2007	PR-2
08-042-109n	3/12/2008	TX-2, TN-1, NC-2, MS-3, GA-4
08-056-112n	3/26/2008	NM-2
08-056-117n	3/26/2008	TX-3, SC-2, NC-2, MS-2, LA-1, GA-4, AR-1
08-266-130n	10/19/2008	PR-3
09-058-104n	3/29/2009	CA-1
09-065-111n	4/5/2009	AZ-5, GA-1, MS-3, SC-2, TX-4
09-068-108n	4/8/2009	AL-1, AR-2, AZ-1, GA-1, IL-1, LA-1, MS-1, NC-4, NM-2, TX-1
09-072-103n	4/8/2009	AR-1, MS-2, SC-5, TN-2, TX-5
09-224-101n	9/21/2009	PR-2
10-054-134n	3/20/2010	TX-4
10-059-109n	3/28/2010	GA-2, NC-9, SC-3
10-061-102n	7/10/2010	MS-1, PR-7
10-064-101n	4/3/2010	CA-2, GA-1, LA-1, MO-1, OK-3, SC-1, AR-1
10-067-104n	4/7/2010	AZ-5, IL-1, MS-4, NM-2, PR-2, TX-10
10-071-101n	4/9/2010	AR-4, AZ-2, GA-2, KS-1, LA-1, NC-2, NM-1, SC-1, TX-2
10-071-102n	4/10/2010	AR-1, GA-1, LA-1, MS-1, NC-1, SC-1, TN-1, TX-2
10-242-102n	9/29/2010	PR-2
10-285-105n	11/11/2010	AR-1, GA-1, LA-1, NM-1
11-045-101n	3/16/2011	MS-1, PR-2
11-052-105n	3/23/2011	AL-1, FL-2, GA-9, MS-1, NC-6, SC-4
11-053-105n	3/25/2011	AR-3, LA-2, MO-2, MS-8, TN-5, TX-4
11-075-107n	4/15/2011	AL-1, AR-1, AZ-4, IL-1, LA-1, MO-1, MS-4, NC-1, SC-1, TX-9
11-068-103n	4/8/2011	AL-2, AR-2, AZ-1, CA-2. GA-2, LA-1, NC-1, NM-1, SC-1, TX-5
11-083-104n	4/23/2011	AL-1, MS-1
11-084-107n	4/24/2011	NC-1
11-091-102n	5/1/2011	TX-1

Table 1-1 (Continued). USDA Notifications, Permits and States for MON 88701 Cotton

USDA No.	Date	State/Territory-Number of Releases
11-094-101n	5/4/2011	AZ-1
11-111-104n	5/21/2011	FL-1
11-133-103n	6/12/2011	IL-1
11-153-101n	7/2/2011	MS-1, PR-2
11-152-101n	7/1/2011	GA-1
11-199-102n	8/17/2011	PR-1
11-290-101n	11/16/2011	MS-1, PR-3
12-018-101n	2/17/2012	AL-1, TX-2
12-053-110n	3/23/2012	AR-3, CA-1, GA-2, LA-2, MS-11, NC- 1, TN-1, TX-2
12-046-104n	3/16/2012	AL-1, AR-4, FL-1, GA-2, LA-1, NC-3, SC-1, TN-4, TX-2
12-051-106n	3/21/2012	AL-3, AR-3, FL-1, GA-3, MS-7, SC-1, TN-1, TX-5
12-051-105n	3/21/2012	GA-5, MS-4, NC-6, SC-2, TN-1, TX-5
12-046-109n	3/16/2012	AR-1, MO-5, TN-13,TX-2
12-055-101n	3/25/2012	AR-1, CA-1, SC-1, TX-1
12-068-101n	4/7/2012	CA-4
12-053-109n	3/23/2012	AL-1, NC-1, SC-1, TX-4
12-069-101n	4/8/2012	GA-9, TX-2
12-075-102n	4/14/2012	AL-1, AR-2, MS-1, NC-1, SC-1, TX-4
12-074-107n	4/13/2012	TX-1
12-081-101n	4/20/2012	AL-1, TX-2

Abbreviations:
AL = Alabama; AR = Arkansas; AZ = Arizona; CA = California; FL = Florida; GA = Georgia; LA = Louisiana; IL = Illinois; MO = Missouri; MS = Mississippi; NC = North Carolina; PR = Puerto Rico; SC = South Carolina; TN = Tennessee; TX = Texas

Table 1-2. USDA Notifications, Permits and States Approved for MON 87708 Soybean

USDA No.	Date	State/Territory-Number of Releases
05-269-02n	11/16/2005	PR-1
06-045-15n	5/18/2006	HI-5
06-045-17n	5/18/2006	PR-3
06-052-01n	3/20/2006	IL-7, KS-5
06-052-02n	4/24/2006	IA-7, IL-5, IN-2
06-052-09n	4/24/2006	IA-2, IL-6, IN-2
06-067-05n	4/24/2006	IL-2
06-090-03n	5/5/2006	IL-2
06-275-102n	11/14/2006	PR-1
06-345-101n	1/10/2007	PR-3
07-018-103n	2/17/2007	IL-10, IN-3, MO-1, PR-1
07-018-106n	2/17/2007	IA-7, KS-6
07-018-109n	2/17/2007	IA-1, IL-10, IN-3, MO-1
07-024-101n	3/18/2007	IA-7, KS-6
07-039-101n	3/18/2007	IA-4, IL-5, IN-3, KS-3
07-043-102n	4/10/2007	IA-1, IL-2, KS-1 MD-1, WI-1
07-050-107n	4/9/2007	IA-1, IL-2, IN-1, KS-1 KY-1, MN-1, NE-1, SD-1
07-057-109n	4/6/2007	AL-1, IA-3, IL-1 IN-1, LA-1, MN-1
07-094-104n	5/4/2007	MO-2, MS-1, NE-1 SD-1, TN, IA-1
07-094-116n	5/4/2007	MN-1
07-113-103n	6/4/2007	PR-2
07-241-103n	9/28/2007	PR-1
07-250-102n	10/7/2007	PR-2
07-261-101n	10/18/2007	PR-2
07-271-101n	10/28/2007	PR-2
07-312-101n	12/5/2007	PR-1

Table 1-2 (Continued). USDA Notifications, Permits and States for MON 87708 Soybean

USDA No.	Date	State/Territory-Number of Releases
07-352-101rm	3/26/2008	IA-8, IL-16, IN-4, KS-7, MO-1
08-030-103n	2/29/2008	PR-2
08-031-105n	3/13/2008	IA-5, IL-4, KS-5
08-031-106n	3/1/2008	IA-2, IL-5, IN-3
08-039-107n	3/9/2008	IA-5, IL-1, IN-3, KS-5, MO-1
08-043-107n	3/13/2008	IA-3, IL-10, IN-1, OH-1
08-049-101n	3/19/2008	IL-1, MD-1, WI-1
08-058-101n	3/28/2008	IA-3, IL-2, IN-1, MO-1, PA-1, WI-2
08-059-109n	3/29/2008	IA-1
08-059-110n	3/29/2008	IL-1
08-059-112n	3/29/2008	IN-1
08-060-103n	4/2/2008	MN-1
08-063-112n	4/2/2008	IA-4, IL-2, IN-1, MI-1 MO-1, NE-2
08-063-113n	4/4/2008	MN-2, ND-1, SD-5, WI-5
08-065-101n	4/4/2008	IL-2, IN-1
08-064-102n	4/3/2008	PA-1
08-064-103n	4/3/2008	IL-1
08-064-104n	4/3/2008	AR-1, GA-1, KS-5 LA-1, MO-1 SC-1
08-064-105n	4/3/2008	AR-1, IL-2, IN-1, KS-3, MD-1 MN-3, NC-1, SD-1, WI-1, ND-1
08-072-110n	4/25/2008	AR-1, IA-1, IN-3 KS-1, MI-1, MO-2
08-079-101n	4/17/2008	NE-1, IA-3
08-084-102n	4/24/2008	IA-1, NE-1
08-182-101n	8/1/2008	PR-2
08-219-101n	9/5/2008	PR-1
08-263-101n	10/19/2008	AR-1, IA-1, IL-1, MO-1
08-266-105n	10/22/2008	PR-1
08-323-101n	12/18/2008	PR-1
08-352-108n	1/26/2009	PR-1
08-357-101rm	3/17/2009	IA-8, IL-7, IN-3, KS-5, NE-1

Table 1-2 (Continued). USDA Notifications, Permits and States for MON 87708 Soybean

USDA No.	Date	State-Number of Releases
09-007-106n	2/25/2009	PR-1
09-036-103n	3/7/2009	IA-2, IL-2, IN-1, NE-1
09-042-103n	3/19/2009	MS-1
09-049-110n	3/20/2009	IA-1
09-050-136n	4/3/2009	IA-2, IL-2, IN-2,MD-1, MN-1, OH-1, PR-1
09-061-108n	4/1/2009	AR-1, IA-1, IL-3, KS-1, SD-1
09-061-117n	4/1/2009	IL-1, MO-2
09-068-111n	4/8/2009	IL-2, IN-2, MS-1 NE-2, OH-1
09-071-102n	4/11/2009	NE-1, SD-1, TN-2
09-082-103n	4/22/2009	IN-1
09-091-103n	5/1/2009	AR-1
09-093-120n	5/3/2009	AR-1
09-124-102n	6/3/2009	PR-1
09-124-105n	5/13/2009	IA-1
09-135-104n	6/14/2009	IL-1
09-162-105n	7/11/2009	PR-1
09-162-106n	7/11/2009	PR-1
09-222-101n	9/9/2009	PR-2
09-237-104n	9/24/2009	PR-1
09-247-101rm	11/17/2009	PR-1

Abbreviations:

AR = Arkansas; GA = Georgia; HI = Hawai'i; KS = Kansas; KY = Kentucky; LA = Louisiana; IA = Iowa; IL = Illinois; IN = Indiana; MD = Maryland; MI = Michigan; MN = Minnesota; MO = Missouri; MS = Mississippi; NC = North Carolina; ND = North Dakota; NE = Nebraska; OH = Ohio; PA = Pennsylvania; PR = Puerto Rico; SC = South Carolina; SD = South Dakota; TN = Tennessee; WI =Wisconsin

Appendix 2. Summary of Public Comments

Public Scoping Comments

Members of the public were invited to participate in the scoping process for this draft EIS through an announcement of a notice of intent (NOI) to prepare an environmental impact statement (EIS) in connection with making a determination on the status of Monsanto petitions 10-188-01p (designated as event MON 87708 soybean) and 12-185-01p (designated as event MON 88701 cotton). APHIS published an NOI to prepare an EIS for the two petitions and requested public comments for scoping the EIS in the Federal Register on May 16, 2013. The 60-day public comment period closed on July 17, 2013. The docket file was published at http://www.regulations.gov/#!docketDetail;D=APHIS-2013-0043.

In this NOI, APHIS asked for comments, data, and information regarding 18 broad, overlapping issues. APHIS also requested the public to provide suggestions for other issues to be discussed or alternatives to be analyzed in the draft EIS. During this comment period, APHIS received 64 comments (see summary in Table 2-1) with an additional 16 comments from the virtual public meetings (see summary in Table 2-2). Comments were made by interest groups, industry representatives, industry trade organizations, growers, private individuals, scientists, agronomists and crop specialists, and a Federal agency. Full text of the comments received during the open comment period is available online at www.regulations.gov.

In addition to posting written comments directly to the docket, members of the public were given opportunities to provide their comments directly to APHIS during public meetings held on June 26 and 27, 2013. Transcripts of the public meetings are available as follows:

For the June 26, 2013, virtual meeting:

http://www.aphis.usda.gov/biotechnology/downloads/VPM/062613/VPM_062613_transcript.pdf

For June 27, 2013, virtual meeting:

http://www.aphis.usda.gov/biotechnology/downloads/VPM/062713/VPM_062713_transcript.pdf

In all, a total of 80 public comments were received with 64 public comments submitted to the docket folder on the NOI for the preparation of an EIS on dicamba-resistant soybean and cotton and an additional 16 comments were given on the NOI during the virtual meetings.

APHIS used the public comments to identify issues to be considered in development of the Draft EIS. A number of commenters indicated they object to APHIS Notice of Intention to prepare an EIS, finding the level of analysis performed in the EAs scientifically sufficient. These commenters felt preparing an EIS unnecessarily keeps valuable traits and tools currently needed by growers battling herbicide-resistant weeds.

Commenters who were opposed to the deregulation of MON 87708 soybean and MON 88701 cotton generally were concerned about the potential increased use of dicamba by growers with adoption of the deregulated events. While APHIS recognizes these concerns, APHIS does not regulate pesticide use. EPA is reviewing and analyzing the information Monsanto has submitted in support of the registration of their dicamba formulation. This includes assessing the physical and chemical properties of, fate and transport of, and impacts to the environment and human health from the new formulation. APHIS has no input into the decision of permitting the use of the new dicamba uses; therefore, those issues are not analyzed in this EIS.

Table 2-1. EIS Public Scoping Comments Submitted Online

Comment #	Comment ID	Commenter	Comment Excerpt
1	APHIS-2013-0043-0002	Anna Fox	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • These crops may be resistant to the herbicides glufosinate but what about all the other organisms in the ecosystem?
2	APHIS-2013-0043-0003	Darryl Figueroa	• We need to stop using pesticides that are banned in Europe and killing our bees. • Stop using genetically engineered food without long term study RE the impact on our health. GE crops and seeds are creating super weeds and changing the bacteria in our stomachs and changing how we digest food. • We want and need labelling of all genetically engineered food and products using GE seeds and crops.
3	APHIS-2013-0043-0004	Arthur Tesla	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • Spraying these crops with dangerous herbicides makes these crops plant pests!.
4	APHIS-2013-0043-0006	Caitlyn Batche	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • Monsanto's "Roundup Ready" crops require about 4 times more water, and the application of several pesticides. Clean water is a diminishing resource because of exploitation and pollution. In Environmental Protection Agency's Numeric Nutrient Criteria, pesticides were a major problem in water systems. • GMO products should be labelled.
5	APHIS-2013-0043-0005	Philip Nelson, Illinois Farm Bureau (IFB)	• These traits have already gone through USDA's rigorous regulatory review protocol and there have been no scientific, findings to warrant additional EIS. On behalf of nearly 83,000 Illinois farmers, I write today to request-that, APHIS move expeditiously when completing this seemingly superfluous regulatory review.
			• Biotechnology has produced vast improvements in farm production practices, permitting farmers to do more with less. Herbicide-tolerant seeds are simply another tool for our producers to utilize towards helping feed the world's ever increasing population. These technologies will have a positive impact on farming and the food that we produce.
6	APHIS-2013-0043-0008	U.S. Department of Interior, National Park Service – Elaine Leslie	• The National Park Service supports the objective identified or development of science that addresses the Environmental Issues for Consideration identified on pages 28799 [of the Federal Register notice]. The NPS is

Comment #	Comment ID	Commenter	Comment Excerpt
			concerned about the indirect effects on the soil and water quality in NPS areas as a result of increased herbicide use. We believe the indirect effects on soil and water quality as a result of increased herbicide use of the products proposed to be de-regulated, be evaluated.
7	APHIS-2013-0043-0009	Jean Public	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • I do not believe the tests on these products are adequate. This is new stuff. It has not had rigorous long term testing.
8	APHIS-2013-0043-0010	None None	• No content
9	APHIS-2013-0043-0011	Sergio Benitez	• Wants labeling of GMOs
10	APHIS-2013-0043-0012	Kelli Lord	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton.
11	APHIS-2013-0043-0013	Omar Flores	• Two documents, one in English and the other in Spanish (by European Union and Greenpeace Mexico), show the negative health, economical and ecological consequences of having allowed Monsanto's GMO soybean RoundUp(tm) resistant in the Yucatan Peninsula and in Argentina. • An economical study by the Autonomous University of Yucatan shows that the economical costs of using GMO soybean, not even counting the environmental costs is 55 higher than the total benefit.
12	APHIS-2013-0043-0016	Carl Bausch	• Opposed to preparation on an EIS. • The statement of purpose and need is missing from the notices. To what need and for what purposes are *petitioners* responding in developing and commercializing their products? The answer to this question largely determines the range of reasonable alternatives the agency must consider in the NEPA process. • Granting (with or without conditions) or denying petitions does not constitute “alternatives” to be considered in NEPA’s environmental impact statement process; rather, they are decision options for the agency (see my earlier comment for explanation). Alternatives that must be considered under NEPA relate directly to the purposes of and need for proposed actions. • APHIS NEPA documents are not written in plain language, as required by the NEPA implementing procedures (40 C.F.R. § 1502.8). • Monitoring, which is an essential component of the NEPA process (40 C.F.R. § 1505.3), should be employed in biotechnology permitting to confirm assumptions made in NEPA documents and respond to many

Comment #	Comment ID	Commenter	Comment Excerpt
			unanswered, but oft-repeated questions. • APHIS has often claimed that, although individual farmers may be affected by releasing genetically engineered organisms in the area, when examined in total, none of the potential business losses is expected to be so severe as to amount to a significant impact. This determination fails to recognize that environmental "significance" exists at all levels—"society as a whole (human, national), the affected region, the affected interests, and the locality." 40 C.F.R. § 1508.27(a). • APHIS tends to rely on the United States Environmental Protection Agency's (EPA) consideration of environmental effects in the context of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) registration process, as well as FDA's determinations under its enabling legislation. The regulatory and review processes of EPA and FDA cannot be relied upon to relieve APHIS from considering in the context of the National Environmental Policy Act (NEPA) process any and all effects associated with release into the environmental of petitioners' products. • In the past, APHIS appears to have placed a great deal of reliance on petitioners in complying with NEPA. Agencies have a responsibility under NEPA to independently investigate and assess the environmental impacts of proposals under consideration (40 C.F.R. § 1506.5(a) and (b)). • There is considerable uncertainty regarding potential environmental effects of releasing genetically engineered organisms. Although an agency is not precluded from approving a particular proposal involving substantial uncertainty, it must disclose all areas of uncertainty. *Save Our Ecosystems v. Clark*, 747 F.2d 1240, 1246 (9th Cir. 1984). • The taxpayer and the agricultural biotechnology industry would be better served if APHIS announced it would no longer "regulate" agricultural biotechnology because there has not been a proven plant-pest risk associated with the technology in decades, perhaps ever.
13	APHIS-2013-0043-0014	Sally Smith-Weymouth	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • Please do not grant Monsanto's request for nonregulated status of herbicide resistant soybeans and cotton. Such herbicides are already wreaking havoc all over the world causing crop failures and super weeds, soil depletion, and a plethora of ailments afflicting humans the world over. • Wants labeling of GMOs
14	APHIS-2013-0043-0015	Sarah Stolar	• The raise in acceptable levels of glyphosphate on our foods are ridiculous and criminal. Round up is toxic to the environment, soil organisms, and

Comment #	Comment ID	Commenter	Comment Excerpt
			people.
15	APHIS-2013-0043-0017	Jessica Padgett	• Opposed to Monsanto receiving unregulated status for herbicide resistant soybeans and cotton. • One theory for the cause of the decrease in the bee population is because of the bacterial toxin, Bacill Thuringiensis (Bt), which was created by Monsanto for the GM corn seeds. According to the Health Wyze Report, “Bbacterial toxin Bacill Thuringiensis is known to provoke an immune response in humans and bees. An immune response in a bee prevents proper memory formation, and causes confusion. One of the symptoms of Colony Collapse Disorder is bees' decreased navigational ability [1].” The bees are unable to go back to their hives and end up dying. • According to the American Academy of Environmental Medicine (AAEM), “Several animal studies indicate serious health risks associated with GM food, including infertility, immune problems, accelerated aging, faulty insulin regulation, and changes in major organs and the gastrointestinal system [2].” • According to the Institute for Responsible Technology, “the only published human feeding experiment revealed that the genetic material inserted into GM soy transfers into bacteria living inside our intestines and continues to function. This means that long after we stop eating GM foods, we may still have their GM proteins produced continuously inside us [5].”
16	APHIS-2013-0043-0018	Gregg Langer	• This technology will be very valuable to our growers as a herbicide option of choice. It will broaden and increase our control options while limiting impact on environment. It will be an essential technology to prevent and control resistance in weed control.
17	APHIS-2013-0043-0019	Reid J. Smeda, Professor of Weed Science, University of Missouri	• Development of dicamba-tolerant soybean represents a novel solution to the postemergence control of glyphosate-resistant weeds. I would urge you to not limit a potentially significant management tool (dicamba) because of fears that past mistakes will be repeated. The path forward should be an integrated approach to weed management in soybean. • I believe that adoption of dicamba-tolerant soybean technology will be different than adoptive practices of glyphosate-resistant soybean, and the potential for selection for dicamba-resistant weeds will be lower than for glyphosate. Below are my reasons to support the previous statement: 1) In-crop, growers know that weed size is important for using dicamba. I believe this same mentality can be transferred to postemergence use of dicamba on tolerant soybean.

Comment #	Comment ID	Commenter	Comment Excerpt
			2) I believe that the current mind-set of soybean growers, especially in Missouri, is to apply labeled rates of residual herbicides in soybean, and clean up escape weeds with a timely postemergence herbicide. This is the pattern that was practiced before glyphosate-resistant soybeans were introduced, and I believe sets the stage for proper use of the dicamba-tolerant technology. 3) Current options for postemergence control of glyphosate-resistant weeds in soybean are limited. We have observed a dramatic increase in the use of PPO herbicides (lactofen, fomesafen, etc.). However, prior to the introduction of glyphosate-resistant soybean, a number of biotypes of waterhemp were found resistant to lactofen and fomesafen. Re-release of Liberty Link® soybean has resulted in effective control of glyphosate-resistant weeds in soybean. However, growers have few other options and my fear is that glufosinate-resistant weeds in soybean will occur. Now is the time to adopt the use of dicamba-tolerant soybean to preclude selection for weed resistance to glufosinate. 4) Dicamba use will be limited in amount (total applied per cropping year) and to specific weed sizes, which should reduce selection pressure for resistance. 5) I believe increased grower knowledge about Amaranthus species will improve decision-making with dicamba-tolerant soybean, which will lower the risk for selection of resistant Amaranthus species. 6) In my field trials, we have shown over time that dicamba can provide from 3-7 days of residual weed control. This can provide some short-term benefit to growers, but is not a substitute for adoption of preemergence herbicides. Therefore, dicamba is not a stand alone product. 7) Although reduction of production costs remains important, the higher commodity price for soybean has resulted in openness of the grower to adopt use of residual herbicides to protect soybean yield. Use of residual herbicides will be important for protecting the integrity of the dicamba-tolerant crop technology. 8) ….herbicide use cannot be reversed or abandoned for the majority of our soybean acres. Continued education on proper herbicide use is, in my opinion, the only path forward. Dicamba-tolerant soybeans provide crop producers with a highly effective tool, and integration of dicamba should be in the context of proper use of residual herbicides.
18	APHIS-2013-0043-0020	J. Christopher Hall, Professor, University of Guelp	Emphasize the following points in regards to de-regulation of dicamba-tolerant crops; specifically in terms of evolution of resistance to auxinic herbicides (e.g., dicamba and others) in weed species: • …the risk of evolution of week resistance to herbicides can be

Comment #	Comment ID	Commenter	Comment Excerpt
		Mithila Jugulam, Assistant Professor, Kansas State University	significantly mitigated through implementation of diversified weed management programs by farmers, that include: use of multiple herbicides with overlapping activity on target weeds and/or the inclusion of mechanical and/or cultural weed control practices. • Compared with other herbicides families, the incidence of resistance to auxinic herbicides is relatively low… • Information about fitness cost associated with auxin herbicides has been documented in a few species indicating that resistant plants are less fit in the absence of herbicide application. This could be a major reason for the limited occurrence of auxinic herbicide-resistant weeds. Additionally, this could explain why farmers continue to use and derive benefits from these products after resistant populations have been identified. • The recessive trait spreads much slower in a population than a dominant trait. Since the resistance to auxinic herbicides in some weeds is determined by recessive genes…, this may be one of the reasons for low occurrence of auxinic herbicide resistant weeds. • In many cases the use and, thus, selection pressure of these auxinic herbicides has exceeded that of other herbicides groups to which resistance is more common. • Definitive mechanisms of resistance to auxinic herbicides have yet to be defined….This suggests a relatively low probability for cross resistance to other herbicide groups and classes that could occur because of common metabolic resistance pathways. • The low probability in combination with stringent implementation with integrated weed management practices should reduce risks of evolution of resistance to there herbicides. Overall, the key is, educating the farmer of the negative consequences of continuous use of herbicides with the same mode of action and the positive consequences of implementing efficient weed-management practices such as herbicide rotations, use of multiple herbicides in mixtures and sequences, inclusion of tillage where necessary and other non-chemical-based weed management practices, which will help reduce the chances of evolution of herbicide-resistant weed populations. See attached review article: Mithila, J., J.C. Hall, W.G. Johnson, K.B. Kelley, and D.E. Riechers. 2011. Evolution of resistance to auxinic herbicides: Historical perspectives,

Comment #	Comment ID	Commenter	Comment Excerpt
			mechanisms of resistance, and implications for broadleaf weed management in agronomic crops. Weed Sci. 59: 445-457.
19	APHIS-2013-0043-0020	Fred Yoder, grower, Ohio Corn and Wheat Growers Association, and former president of the National Corn Growers Association	• Farmers should have the choice to use safe and valuable new agricultural technologies to help manage weeds, using multiple modes of action. • It is important to ensure the USDA regulatory review of new biotech traits does not fall further behind those of other major crop producing countries such as Brazil or Argentina, who are rapidly gaining a larger share of the global market. • Farmers have many years of experience using products like dicamba, and are very capable of preventing off-site movement through proper stewardship including application techniques, equipment settings, nozzle selection, and consideration of environmental conditions during application, such as wind speed.
20	APHIS-2013-0043-0032	Charles Hall, North Carolina Soybean Producers Association	• I support the full deregulation of event MON 87708 - dicamba-tolerant soybeans- so that soybean farmers will have full access to this technology which, combined with other currently available technologies, will expand options for weed management practices on the farm. Timely access to a safe, sustainable new technology will increase farmer options for cost-effective weed management. The beneficiaries will be the downstream users of soybean products, including human and livestock nutrition products. As demand increases worldwide for human and livestock nutrition, effective weed management will be vital to sustaining the soybean yield increases that will be demanded of U.S. soybean farmers. • The dicamba- tolerant soybeans and the same tolerance being developed in cotton expands the dicamba weed control window from the current preplant burndown use to allow in-crop applications of dicamba herbicide for the control of broadleaf weeds pre-emergence and post-emergence. When combined with Roundup Ready, it will allow a new mode of action for improved weed control and weed resistance management. Use of dicamba at planting in this system eliminates having to wait the three weeks required in non-dicamba tolerant crops. This translates into a three week gain on weed control. Additionally, dicamba provides potential residual benefit, depending on soil type and rainfall. • The dicamba product has a decades-long record of safety and effectiveness, and is highly effective at combating the major weed pests of soybeans. North Carolina soybean farmers have the knowledge and training to incorporate

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			dicamba-tolerant soybeans into on-farm stewardship practices. • I oppose USDA's proposal to conduct an Environmental Impact Statement (EIS), which is not necessary and would only serve to delay farmers' access and ability to use this new tool.
21	APHIS-2013-0043-0023	Steve Austin	• Wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
22	APHIS-2013-0043-0024	Victor Miller	• Herbicide use, possible selection for and the spread of weeds resistant to the herbicide and drift from applications of dicamba onto dicamba intolerant crops and other areas, seems to be the responsibility of EPA not USDA. All of these questions are under review at EPA, which is responsible for issues related to herbicides and their use. • This is a safe, widely used herbicide. Over the past 10 years it has been used very successfully on over 250 million acres, including corn, wheat, pasture and range land, as well as other crop land. • The equipment, the knowledge, and the desire to use the products in a responsible manner by the Agricultural Community already exists! • Glyphosate tolerant weeds are becoming a problem and we as producers need more modes of action to limit this problem. Dicamba is one of those additional modes of action and it becomes criminal to deny that tool to us as we then have less produce to serve to a hungry world.
23	APHIS-2013-	Kenneth Martin,	• We are a medium sized food processor and our business was built and

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	0043-0025	Director Ag Operations, Furmano Foods, Inc.	continues on specialty crops who are highly suspectable to Dicamba drift. Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors like us. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. Because of these drift issues a large portion of row crop growers have discontinued the use of this product. • I do not oppose advances in plant technology, however, the answer is not in accepting a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. I think that USDA should expand the scope of its inquiry to consider uses of its authority to help look for better ways to combat the resistant weed issue from the over use of certain chemicals. • Approving Dicamba tolerant crops seems very short sighted given the potential of drift damage that we know has happened in the past. There has to be better alternatives to work at this problem, lets find them.
24	APHIS-2013-0043-0026	Mark Jackson, president Iowa Soybean Association	• I write to reaffirm our strong support for full deregulation of dicamba-tolerant soybeans and cotton. Full deregulation of dicamba-tolerant soybeans will help Iowa growers increase yields in an environmentally-friendly manner and is consistent with the ISA's mission. • ISA understands USDA APHIS' reasons for conducting an Environmental Impact Statement (EIS) on dicamba-tolerant technologies, and how they appear to relate to potential impacts associated with herbicide use and resistance. However, matters relating to herbicide use are regulated under the authority of the Environmental Protection Agency (EPA). • growers need access to weed management technologies with proven efficacy over a broad spectrum of weeds - like dicamba tolerant soybeans (MON87708) and dicamba tolerant cotton (MON88701). As herbicide resistance becomes more prevalent, the arsenal of tools at our disposal to effectively control and manage resistance is limited. Weed scientists tell us that the best way to address herbicide resistance is to implement diversity in weed management practices, including the use of multiple herbicide modes of action. The dicamba-tolerant system will provide an additional mode of action, while expanding the dicamba weed control window, eliminating planting restrictions and permitting in-crop applications. • Access to a broad range of technologies will help us maintain healthy yields and ensure a stable supply of quality soybeans to the food and

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			feed processing industries. USDA's decision on dicamba-tolerant technologies will have broad implications for the entire soybean value chain in the U.S. and globally. • we believe that dicamba-tolerant technologies will enable growers to continue to be good stewards of the land. Compared to some weed control programs, this system may result in fewer herbicide applications. Glyphosate-tolerant crops enabled widespread adoption of conservation tillage practices. This has been a tremendous advance in sustainable farming practices thanks to the preservation of the topsoil, reduced fuel emissions and better water conservation. The use of dicamba as part of the Roundup Ready Xtend Crop system will help us preserve the value of existing pre- and post-emergent herbicides, which continue to bring significant value. • With regard to concerns about dicamba off-site movement, growers have experience with various cropping systems and are experienced and capable of applying dicamba in a manner that will minimize drift. With the use of an appropriate formulation, following label directions, training and communicating with neighbors, we are confident these concerns will be addressed. Newer dicamba formulations, along with best management practices make it possible for all types of growers to co-exist and prosper.
25	APHIS-2013-0043-0027	Wayne Keeling, Professor, Texas A&M University Darrin Dodds, Associate Extension Professor, Mississippi State University Dr. Stanley Culpepper, Professor, University of Georgia	• We believe that the ability to selectively use dicamba in cotton will provide a much needed tool for management of broadleaf weeds and in particular *Amaranthus spp.*, currently the most troublesome weed species in cotton. In particular additional postemergence options in cotton are needed for control of broadleaf weeds and dicamba will be such an option. However with the launch of any new herbicide in a cropping system we must understand how to use it in a sustainable way so to minimize the risk of resistance. • It is widely recognized that the way to mitigate resistance to herbicides is to use herbicides in diversified weed management systems. The WSSA has define this as using more than one herbicide mode of action that is effective on the targeted specie(s) in mixtures, sequences or in rotation and/or using herbicides in combination mechanical and/or cultural practices. Weed management is ultimately the responsibility of farmers and requires that the weed science community, including industry, academics, crop commodity groups and others reach out to farmers and communicate information on practices to best manage resistance as well as the benefits of implementing these practices. By so doing resistance to our

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			existing herbicide resources, as well as new options such as dicamba, will be minimized. • We believe that farmers will integrate dicamba into diversified management programs because they will see better overall weed control. • The risk of resistance for an herbicide is a function of the probability for resistance based upon genetic and biological factors and the probability that farmers will implement recommended best management practices. In the case of dicamba's use in dicamba and glufosinate tolerant cotton we believe that the risk of evolution of resistance is relatively low. If one balances risk of resistance with benefits of use, the benefits greatly outweigh the risk in this case.
26	APHIS-2013-0043-0028	Dale Moore Executive Director Public Policy, American Farm Bureau Federation	• Farm Bureau respectfully asks APHIS to abide by the Ninth Circuit's interpretation of its legal obligations under the PPA and NEPA and reconsider its decision to prepare EISs for the herbicide tolerant crops identified in the Notices. Farm Bureau asks APHIS to act expeditiously to finalize the deregulation process for these crops in keeping with the Ninth Circuit's recent RRA decision and the APHIS regulations governing deregulation petitions.
27	APHIS-2013-0043-0029	Dennis M. Dixon, Hartung Brothers, Incorporated	• Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
28	APHIS-2013-0043-0030	Kimberly Iott, Iott Ranch & Orchard	• Iott Ranch & Orchard, Inc wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors.

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			Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
29	APHIS-2013-0043-0031	Kevin Wilson	• I'm a tomato grower from Indiana,and also a corn and soybean producer as well. What I am asking for is a reasonable ruling that will let me protect my crop as well as use these products as well. The agreement that was worked between DOW agriscience and the SOCC accomplishes this. Monsanto has chosen to ignore the SOCC's request to work out an agreement similar to DOW. The current label that Monsanto is trying to get approval does not address several issues that I feel have potential events that can cause losses of my crops.
30	APHIS-2013-0043-0032	Thomas Parker, H & T Parker Farms	• H & T Parker Farms wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant

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			damage these crops pose.
31	APHIS-2013-0043-0033	A. Stanley Culpepper - University of Georgia, Weed Scientist, and grower	• Cotton weed management programs in Georgia have undergone, and are continuing to undergo, significant changes. Currently recommended programs are complex, costly, and challenging to implement in a timely fashion. Growers are desperately in need of new technologies to improve control of Palmer amaranth, reduce the potential for further herbicide resistance development to currently used tools, and to reduce the economic burden that Palmer amaranth is placing on the agricultural industry. • We admire and respect the desire of USDA and EPA to be certain that no agriculture technology will negatively impact the consumer, the user, or the environment in which we and our children live. Our request is simple, if deemed safe please assist in the movement of all new technologies to our growers as rapidly as feasible. • Herbicide-resistance has significantly changed agriculture forever in the Southeast; especially for cotton growers. To combat this pest, growers have relied heavily on herbicides, tillage, and hand weeding. Herbicide use in cotton has increased sharply with 2.5-times more herbicide active ingredient applied to cotton following the confirmation of glyphosate resistance in Palmer amaranth as compared to before documented resistance. Although grower herbicide input costs have more than doubled following the evolution and spread of glyphosate resistance, Palmer amaranth control is still not adequate. Thus, 92% of Georgia cotton growers hand-weed 52% of the crop with an average cost of $23 per hand-weeded acre, which is an increase of at least 475% as compared to hand weeding costs prior to resistance. In addition to increased herbicide use and hand weeding, growers in Georgia have indicated that they are using mechanical, in-crop cultivation (44% of acres), tillage for the incorporation of preplant herbicides (20% of the acres), and deep turning (19% of the acres every three years) to aid in Palmer amaranth control. Current weed management systems are extremely diverse, complex, less environmentally friendly, and costly when compared to those systems employed only a decade ago. Growers are in desperate need of new technologies that will aid in the management of glyphosate-resistant Palmer amaranth, and other problematic weeds, for long term sustainability.
31	APHIS-2013-0043-0033	A. Stanley Culpepper - University of Georgia, Weed Scientist, and grower	**Benefits of 2,4-D or Dicamba Technologies For the Georgia Cotton Grower:** ***1.*** ***Improved Weed Control:*** Neither dicamba nor 2,4-D are consistently effective in controlling Palmer amaranth larger than 4 inches when applied alone (Culpepper et al. 2010; Culpepper et al. 2011; Merchant et al. 2011);

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			however, weed management systems including these herbicides are more consistently effective than current standards (Braxton et al. 2010; Beckie 2011; Merchant et al. 2013; Richburg et al. 2012; Shaw and Arnold 2012). Weed management programs including 2,4-D or dicamba would improve a grower's ability to manage this problematic weed in the following ways: 1) improved consistency in weed control especially on dryland production acres where residual herbicides often are not activated with rainfall at planting time, 2) more flexibility with herbicide application timings because glufosinate plus dicamba or 2,4-D will consistently control Palmer amaranth up to 6 inches in height (at least 2 inches larger than todays standards), 3) less herbicide carryover to subsequent crops because growers would be less dependent on long lasting residual herbicides, and 4) less yield loss from Palmer amaranth crop competition for light, nutrients, and water (Coetzer et al. 2002; Culpepper et al. 2010; Merchant et. al 2013; MacRae et al. 2013). ***2. Prevention of Additional Herbicide Resistance Development:*** USDA has voiced concerns that growers may adopt 2,4-D or dicamba technologies and rely too heavily on these herbicides thereby developing an even greater weed resistance scenario. Science has clearly shown that there is risk of resistance development to all herbicides; dicamba and 2,4-D are no exception. In fact, weeds have developed resistance to nearly all forms of weed management including herbicides, tillage, mowing and even hand weeding. Our data and surveys contrast the assumption that rapid development of resistance to 2,4-D or dicamba would occur in Georgia cotton. First, our data notes that since these auxin herbicides control only very small Palmer amaranth then they must be applied in tank mixtures with other herbicides such as glufosinate. Second, even mixtures of glufosinate plus 2,4-D or dicamba will only control Palmer amaranth less than six inches in height and since Palmer amaranth can grow as much as two inches per day selective residual herbicides must be used throughout the season. Simply put, data throughout the belt supports the fact that over-use and/or over-dependence of 2,4-D or dicamba in cotton would equal poor weed control and eventual crop failure which is a practice no grower would follow. Dicamba and 2,4-D would be an additional tool to include in the weed management program. The greatest risk for developing herbicide resistance is actually occurring at this moment with the PPO herbicides and glufosinate. These products are being over used as growers have no other effective herbicidal options. New technologies such as dicamba or 2,4-D could be used to delay resistance

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			development to the PPO herbicides and glufosinate and, in turn, systems could be developed using the PPO herbicides, glufosinate, 2,4-D, and dicamba extending the life of each of these chemistries. It is also critical to stress that, at least in Georgia, no weed management program relies exclusively on herbicides. The University of Georgia Weed Science Extension Team stresses to growers at more than 50 meetings each year that herbicides are only one part of the weed management program. Sustainability is only possible with the adoption and implementation of diverse management programs and Georgia growers have accepted this message as fact (Sosnoskie and Culpepper 2013). Growers are using programs that are complex and diverse integrating herbicides, hand weeding, and tillage or cover crops. Neither dicamba nor 2,4-D would change this approach but would simply be an additional tool to add into these management systems. ***3. Reduction in Herbicide Use:*** Glyphosate-resistant Palmer amaranth has increased herbicide pounds of active ingredient applied in Georgia cotton by a factor of 2.5 when compared to herbicide use prior to resistance (Sonoskie and Culpepper 2013). Programs developed by the University of Georgia for 2,4-D or dicamba technologies suggest the pounds of herbicide active ingredient may be able to be reduced by at least 30% while actually providing better weed control; similar results are also noted in other areas across the cotton belt (Edwards et al. 2013; Merchant et al. 2013; Smith and Hagood 2013; Steckel et al. 2013). ***4. Reduction in Tillage, Wind Erosion, and Soil Erosion:*** As the spread of glyphosate-resistant Palmer amaranth occurred, the adoption of tillage including deep turning of the land with moldboard plows has become common (Sosnoskie and Culpepper 2013). The return of conventional tillage has led to increased wind and water erosion. Neither 2,4-D nor dicamba technologies would eliminate tillage, but they would greatly reduce the need for deep tillage allowing many growers to return to more reduced tillage production systems. This opportunity to return to reduced tillage systems would be in response to a more consistently effective management program.
31	APHIS-2013-0043-0033	A. Stanley Culpepper - University of Georgia, Weed Scientist, and grower	**Concerns With 2,4-D- or Dicamba-Resistant Technologies:** *1.* ***Off-Target Movement:*** Off target movement of 2,4-D and dicamba pose the greatest limitation to the adoption of either auxin technology. Although it is currently unknown what restrictions will be in place to minimize off-target movement by herbicide labels, an enormous amount of research by the registrants

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			and other scientists across the world is being conducted to develop methods to minimize the potential for off-target movement. These efforts include 1) improving herbicide formulations, thereby reducing volatility and/or drift, 2) improving application equipment techniques and application methods, thereby reducing drift, and 3) developing educational materials to assist growers in reducing off target movement when making pesticide applications (Bagley 2013, Huff et al. 2013; Kendig et al. 2013; Magidow et al. 2013; Newsom et al. 2013; Reynolds et al. 2013, Sandbrink et al. 2013). Benefits from these efforts will be monumental in minimizing off-target movement of ALL pesticides, not just 2,4-D and dicamba, and will greatly improve the ability of a grower to apply pesticides that stay in the targeted area. In Georgia, the University of Georgia and the Georgia Department of Agriculture are currently developing additional methods to further minimize off-target movement of auxin herbicides and other pesticides. Also, a cooperative effort between The University of Georgia, Georgia Department of Ag, Agronomic Industry leaders, and Horticultural Industry leaders is underway to further define methods to minimize off-target movement.
32	APHIS-2013-0043-0034	Richard Minor, Past President and current Board Member of The Georgia Fruit and Vegetable Growers Association.	• I support full and timely deregulation of dicamba- and glufosinate- tolerant cotton and dicamba tolerant soybeans, an essential weed management tool that is badly needed by growers. Over the past several years, the pressure from glyphosate resistant weeds has become stronger and harder to manage, despite diligent stewardship. Our growers need multiple-mode-of-action options at their disposal to manage and prevent weed resistance. Farmers in this part of the country have no choice but to manage multiple chemistries to fight and control weeds. The dicamba tolerant traits will provide farmers with a cotton and soybean product that have increased yield opportunity and tolerance to multiple herbicides with different modes of action for weed control making dicamba tolerant cotton and soybeans an important weed management tool. • I believe Monsanto has convinced a majority of these growers that proper training and support will be available to combat any problems which might have concerned our growers concerning off target applications. In addition, Monsanto has demonstrated new spray technology which has further convinced our specialty crop growers that we will be able to adapt these new technologies. We recognize the complexity that can exist from off-site movement of certain herbicides and impact on vegetable crops. We would point out, however, that through proper application requirements and stewardship, much of the off-site movement and, thus, potential damage may be managed and allow fruit and vegetable crops to be grown in proximity to

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			traditional row crops. This crop diversity is well know to Georgia growers and on behalf of my members, wanted to express our organization's view that dicamba applications can and have successfully been made, provided care is taken in the type of equipment that is used, applications are not made in strong winds toward a sensitive crop and tank clean out is properly addressed. • Dicamba has been a safe and reliable resource in modern agriculture, used by growers in over 25 countries including the USA and Canada. In the U.S., dicamba has been used on more than 237 million acres over the past 10 years. Growers have experience and a long track record of using dicamba according to label specifications. • Dicamba has the potential to protect and may also increase the current acres under conservation tillage. Once approved, dicamba tolerance will allow growers to use dicamba in burn down without plant-back restrictions while providing effective control of hard to control and glyphosate resistant weeds including pigweed and marestail. More complete burn down has the ability to further enhance conservation tillage. • This system may lead to fewer herbicide applications, which may result is better soil and water conservation and a reduction in greenhouse gas emissions because of fewer trips across the field. Maintaining reduced tillage practices will enable our growers to preserve the value of their land. • In addition to helping growers maintain productivity thanks to improved weed management, dicamba tolerant traits will offer efficiencies and convenience to growers and improve their quality of life.
33	APHIS-2013-0043-0035	Mike Schulte	• As a vegetable farmer, I am quite concerned about the drift possibility of dicamba. Please reconsider the regulations on these types of chemicals as they could well cause hundreds of thousands of dollars of damage to a vegetable crop.
34	APHIS-2013-0043-0036	Scott Bretthauer, Extension Specialist in Pesticide Application Technology, University of Illinois	• I have conducted research investigating the use of drift reduction technologies for making applications of glyphosate and dicamba. These technologies have included drift reduction nozzles, drift reduction adjuvants, and combinations of the two. The results of this research, and research I've seen conducted by colleagues, indicates that applications of dicamba can be made both effectively and safely. • Applications of dicamba can be made safely by understanding two key components of drift reduction: droplet size and weather. • I believe the major drift risk for dicamba applications is particle drift, not vapor drift. This is positive because it means that application technology and understanding weather impacts can be used to reduce the

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			risk of drift…. research on the new formulation of dicamba, which shows volatility is virtually a non-issue…many off-target incidents blamed on volatility and vapor drift were in fact caused by particle drift of very small spray droplets that moved off target during an inversion….I have seen many reports from insurance companies, and in many cases the cause of drift was because applications were made during an inversion. Symptoms can be similar to vapor drift because the exposure is very minimal, damage will not show up for sometime after the application, and the pattern does not look like normal particle drift. • The label for a Monsanto registered pre-mix of glyphosate and dicamba has specific requirements that extend beyond current requirements for dicamba applications and will help ensure the risk of particle drift is minimized. Proper selection of nozzles and adjuvants has shown that the driftable fraction of the spray volume can be reduced to less than 1 percent in many cases, and one combination of nozzle and adjuvant completely eliminated all droplets of the size considered to be at risk of drift. • I believe that applicators can safely and effectively apply dicamba through the use of a combination of drift reduction technologies, including nozzles and adjuvants, operating those correctly through the use of other technologies such as pulse width modulation and auto boom height controllers, and making applications in suitable weather conditions with appropriate downwind buffers zones. • it is important to consider successful applications are both possible and being made today. U.S. farmers need access to new technologies to help control weeds and provide options in their operations. Spray applications can and will be managed to maximize both efficacy and safety.
35	APHIS-2013-0043-0037	Jerry Bambauer, Ohio Soybean Association	• OSA urges USDA to reconsider the need for the EIS since USDA's basis for conducting the EIS all relate to herbicide uses. The dicamba uses in question are currently being reviewed by the EPA, and as such EPA will review and mandate the conditions in which it may be used. Conducting a time-consuming analysis already within the responsibilities of other federal agencies will cause a significant delay in bringing needed technologies to growers. • Soybean farmers need new technologies such as dicamba-tolerant soybeans to increase yields, manage weed resistance and keep their farming operations profitable. • Soybean farmers need new technologies such as dicamba-tolerant soybeans to increase yields, manage weed resistance and keep their farming operations profitable. In light of the recent ruling by the Ninth Circuit Court

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			of Appeals on the Roundup Ready alfalfa case -- which confirmed that issues relating to the use of herbicides are the responsibility of the Environmental Protection Agency (EPA), not USDA – OSA urges USDA to reconsider the need for the EIS since USDA's basis for conducting the EIS all relate to herbicide uses. The dicamba uses in question are currently being reviewed by the EPA, and as such EPA will review and mandate the conditions in which it may be used. Conducting a time-consuming analysis already within the responsibilities of other federal agencies will cause a significant delay in bringing needed technologies to growers. • U.S. growers should have the choice to use safe and valuable new agricultural technologies to increase yields and keep their farms profitable. Farmers today need multiple mode-of-action weed management tools. Dicamba tolerance would be a valuable addition to the existing soybean weed control options to maximize yield potential. Dicamba has been used in crops for many decades in the U.S. and continues to be effective on major broad leaf weeds. Farmers have proven they are able to use different application techniques and equipment for different types of pesticides to ensure proper performance of the product as well as on-target application. OSA understands that newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products. The petitioner has also addressed the potential for off-site movement by prohibiting aerial applications and implementing specific environmental and equipment application requirements on the dicamba label, including a wind-directional buffer when sensitive areas are present, and use of low volatility dicamba formulations. • The U.S. soybean processing and feed industries, along with the growing U.S. soybean export markets, are very healthy segments of our economy. The availability of these new effective soybean production tools is vital to maintaining that health. Weed resistance pressures underscore the need for timely regulatory approval of multiple mode-of-action technologies that can help manage resistant weeds and keep U.S. agriculture productive, sustainable and globally competitive. It is important that USDA follow through on its commitment to U.S. farmers by expediting the science-based regulatory review process and put a stop analyses that are duplicative and outside the scope of its authority.
36	APHIS-2013-0043-0038	Bill Wykes, Chair, Illinois Soybean Association	• ISA requests USDA to not conduct an EIS on dicamba tolerant soybean and cotton and move quickly to approve these new weed fighting tools so our farmers may have access to them and incorporate them as they see a fit in

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			their operations and remain able to control weeds for the future. • The proposed EIS is seen as an inherent conflict. Given that the proposed subject of the EIS is to assess impacts on weed resistance and off-site movement of dicamba which can be attributed to the herbicide application, the subject of the EIS would appear to fall under the EPA jurisdiction and not that of USDA. • We urge the USDA to move quickly to approve new weed management tools, such as dicamba tolerant soybeans and dicamba tolerant cotton, referred to as MON87708 and MON88701, respectively. When both the trait and chemistry are used together, farmers will be able to realize several benefits from utilizing the proposed dicamba weed management systems. These benefits include: – Effective and sustainable management of glyphosate-resistant weed species including Palmer amaranth, waterhemp, giant ragweed, and marestail – Provides an additional mode of action and reduces the dependence on ALS and PPO herbicides helping to preserve these herbicide tools – Improved and more consistent control of hard-to-control broadleaf weed species – Crop safety to dicamba and glyphosate herbicides to maximize yield potential – Application flexibility in the event of challenging weather conditions especially in the spring – Proactive program for weed resistance management – Preservation of conservation tillage benefits • U.S. farmers are capable and experienced at making herbicide applications and effectively managing off-site movement. Just as with other herbicides, off-site movement of dicamba can be prevented through proper stewardship including application techniques, equipment settings, nozzle selection, and consideration of environmental conditions during application. Equipment and hand held applications facilitate access to weather data, field plot maps and other on board information. The technology and capability exists and is at work on the farm fields across America today. Additionally, newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products to which much of the folklore is attributed.
37	APHIS-2013-0043-0039	Andrew LaVigne - American Seed Trade Association	The Notices of Intent published on May 16 identify two issues that led APHIS to conclude that EISs were required by NEPA – the development of herbicide-resistant weeds (i.e., weed resistance) and increased herbicide use. Both of these issues relate

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			solely to the herbicides, such as 2,4-D and Dicamba, that would be available for use in conjunction with the crops modified to tolerate their application. As such, these issues are subject to the exclusive jurisdiction of the U.S. Environmental Protection Agency ("EPA") under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") and are decidedly *not* subject to APHIS's jurisdiction under the Plant Protection Act ("PPA").
38	APHIS-2013-0043-0040	Steve Verett, Executive Vice President, Plains Cotton Growers, Inc.	• Urge APHIS to make a recommendation to fully deregulate dicamba-tolerant technologies for cotton and soybeans. • An EIS on dicamba and glufosinate-tolerant cotton is not warranted from a legal standpoint. • The competitiveness of the U.S. cotton industry depends on the ability of growers to access new, cost-effective and sustainable technologies to manage production pressures, such as weed control. Weeds reduce cotton yields by an average of 30 percent. Herbicide resistant weeds are becoming a persistent problem that could affect the productivity of cotton production across the cotton belt. Texas growers currently experience fewer issues with resistant weeds, but they recognize the need to proactively manage weeds with multiple modes-of-action to prevent or delay future resistance issues. The dicamba and glufosinate-tolerant trait will be stacked with the Genuity® Roundup Ready Flex providing farmers with a cotton product that has increased yield opportunity and tolerance to three herbicides with three different modes-of-action for weed control, making dicamba and glufosinate-tolerant cotton an important weed management tool. The impact of dicamba and glufosinate-tolerant cotton is that it will provide growers with two additional herbicide modes-of-action for the control of broadleaf weeds in cotton, including hard-to-control and herbicide-resistant broadleaf weeds. Weed resistance pressures underscore the need for timely regulatory approval of multiple mode of-action technologies that can help manage resistant weeds.
39	APHIS-2013-0043-0041	Josh Carey, Carey Farms	The widespread use of the dicamba chemistry will endanger many non-resistant crops through the volatility of the chemical. Specialty crop growers like myself will have significant crop damage and loss due the use of this chemical.
40	APHIS-2013-0043-0042	Michael Forche, M Forche Farms Inc.	• Michael A. Forche wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage.

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			• We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
41	APHIS-2013-0043-0043	Robert Wolf, Wolf Consulting & Research LLC, Retired Professor Emeritus and Extension Specialist in Application Technology in the Biological and Agricultural Engineering Department, Kansas State University	• Particle drift is controllable through equipment selection and conditions of use, such as formulation, spray tips and other technologies, wind speed and direction at application, sprayer speed and boom height. In some of my most recent research, selecting the proper nozzle type alone can be shown to reduce spray drift from 13.5% down to 0.5% and in some cases the inclusion of drift control additives can reduce that drift amount even more. • Newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products. The research is supporting this and through further research, education and training this point will be stressed. • Tank contamination will be of concern when switching between tolerant and non-tolerant crops. This will be addressed through proper tank clean out procedures that adequately clean out herbicide residues from the lining of the tank, boom and inner workings of the sprayer, including all hoses and filters, crevices and drain lines. Newer spray systems are being engineered to improve cleanout. • Monsanto has addressed one concern of the potential for offsite movement by prohibiting aerial applications and other concerns by implementing specific environmental and equipment application requirements on the draft dicamba label, including a wind-directional buffer when sensitive areas are present, and the use of low volatility dicamba formulations. • It is my opinion that US farmers and commercial applicators are capable and experienced at preventing off-site movement. Like any other herbicides, off-site movement of dicamba can be prevented through proper stewardship including application techniques, equipment settings, nozzle selection, and consideration of environmental conditions during application. • Equipment and hand held tools such as smart phone apps that support applications to facilitate access to weather data, field plot maps, nozzle details, and other on board information now exists. This technology and capability is at

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			work on the farm fields across America today. • When recommended label practices are followed, growers of various crops can co-exist and prosper. I believe that in combination with approved best management practices, including the use of the proper nozzle type(s), applications using dicamba will have potential to reduce the amount of off-target drift.
42	APHIS-2013-0043-0044	Bruce Rohwer, President, Iowa Corn Growers Association	• New technologies are needed to ensure agricultural productivity meets growing demand for food. We believe US farmers should have the choice to use safe and valuable agricultural technologies, such as herbicide tolerant soybeans, to help manage weeds. With the growing glyphosate resistance threat to soil conservation and the limited postemergence options for control of Palmer pigweed, waterhemp, and marestail, farmers need new technology solutions. Without effective weed management practices, herbicide resistance can decrease farm productivity and increase the complexity of crop production. Tillage may increase in order to control weeds, which increases the risk of erosion. • Farmers need new tools to manage weed resistance in order to preserve the value of their land. Dicamba tolerant technology is a sustainable solution that gives farmers additional choice and helps them to be good stewards of the land. Compared to some weed control programs, this system can equate to fewer herbicide applications, resulting in fewer trips across the field, reduced greenhouse gas emissions, reduced soil erosion, reduced soil compaction and enhanced water conservation. • The deregulation of MON 87708 helps sustain the long-term agronomic, environmental, and economic benefits of glyphosate as a weed control tool in soybeans. Growers should be able to access new agricultural technologies to keep agricultural productivity on pace to meet demands for food. In order for farmers to remain competitive, it is critical that the USDA regulatory review of new biotech traits does not fall further behind those of other major crop producing countries such as Brazil or Argentina.
43	APHIS-2013-0043-0045	Steve Smith, Save Our Crops Coalition	• Requests APHIS consider a range of possible alternatives beyond out-right denial or approval of these crops, and requests that APHIS specifically address the problem of non-target drift damage caused by the increased use of dicamba on dicamba tolerant crops. • SOCC requests that APHIS expand the scope of its EIS inquiry to address non-target drift damage impacts cause by the use of dicamba on dicamba tolerant crops, especially in sensitive areas. Dicamba tolerant crops heighten the drift and volatilization concerns associated with dicamba. The introduction of

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			dicamba tolerant crops is anticipated to increase the use of dicamba in cotton-producing regions. These regions also produce substantial acreages of broadleaf crops that are sensitive to dicamba. Thus, any drift or volatilization from dicamba could be expected to have significant impacts on non-target crops grown in proximity. • If APHIS considers spray drift and volatilization impacts but determines on balance that the environmental effect is positive, and therefore does not anticipate adverse effects within its conclusion, this level of consideration is insufficient. If spray drift and volatility impacts are significant effects, the regulations require APHIS consider and explain them within an EIS. Upon consideration of the "context" factor, APHIS would find the proposed action to be "significant" in multiple contexts. Upon consideration of the "intensity" factor, APHIS would find the proposed action to have "severe" impacts. Thus, upon consideration of the "context" and "intensity" factors, APHIS would find the proposed action raises substantial questions about whether it may have a significant effect on the environment. Therefore, APHIS should prepare an EIS addressing dicamba spray drift and volatilization impacts associated with Dicamba Tolerant Soybeans and Cotton. • The use of dicamba has declined precipitously from its peak 1994 level. Monsanto's petitions do not indicate the rate of change in dicamba use from current use levels. This omission was particularly glaring given the intensity of the rate of change. The latest figures place the amount of dicamba applied at about 2.7 million pounds annually. Monsanto's projected use pattern would represent an approximately 925% increase in pounds applied over current levels, an almost 250% increase in the total acreage treated, and a 5660% increase in soybean acreage treated. Such an increase would represent a dramatic shift in the utilization of an herbicide both in terms of total pounds applied and areas in which the herbicide would be used. Even the increase in the use of glyphosate upon the introduction glyphosate tolerant crops, an increase of almost 600% in pounds applied, would be eclipsed by this shift in use. • Dicamba has substantial harmful effects on unmodified broadleaf crops even at very low applications rates, and because dicamba tolerant crops will be grown in such close proximity to unmodified broadleaf crops like soybeans and tomatoes, the potential for non-target plant damage caused by drift and volatilization is great. • We suggest that APHIS and EPA work together to find solutions that protect against non- target drift damage caused by the increased use of dicamba on dicamba tolerant crops. Because SOCC cannot be certain that EPA will

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			adequately evaluate the potential for environmental harms, at this time, SOCC requests that APHIS withhold a grant of the petition until such time as effective measures are in place to protect against non-target plant damage, whether imposed by it, or in conjunction with other agencies.
44	APHIS-2013-0043-0046	Wenonah Hauter – Food & Water Watch	Food & Water Watch urges the USDA to consider the following risks in its upcoming Environmental Impact Statement for dicamba-tolerant soybeans and cotton: • Dicamba-resistant cotton and soybeans will lead to an increase in dicamba use, which will spur the evolution of dicamba resistant weeds and the abandonment of conservation tillage practices; • Higher volumes of dicamba will lead to pollution of surface water, which will impact non-target plants and animals, including endangered species; • The volatility of dicamba will result in more occurrences of pesticide drift into neighboring fields, affecting plant health and the livelihoods of nearby farmers; • Dicamba-tolerant crops will cost farmers more through higher seed prices, the loss of export markets due to contamination of non-genetically engineered (GE) or organic seed and through the presence of dicamba---resistant weeds; and • Dicamba is dangerous to human health and its continued use will endanger agricultural workers and the general public. The USDA's Environmental Impact Statement must include, at a minimum: • An analysis on how dicamba-tolerant soybeans and cotton will facilitate increased use of dicamba, leading to the evolution of dicamba-resistant weeds and the abandonment of conservation tillage practices; • Data on the potential carcinogenicity and long-term risks to human health that dicamba would pose at new application levels and the cumulative effects of its interaction with other herbicides on human health and the environment; • Studies on the effects of increased application of dicamba on surface water quality and impacts on non-target plants and animals, including endangered species; • A detailed evaluation of the volatility of dicamba, including a map of potentially affected specialty crop growing regions that would be in the proximity of dicamba-tolerant cotton and soybean growing areas. The USDA must look at the impacts of pesticide drift onto neighboring conventional specialty crop and organic fields, including its effects on plant health and farmer costs; • Research on how the ingestion of foods manufactured from this crop would affect human health and how the continued use of the herbicide in agriculture could

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			endanger agricultural workers and the public; and • A detailed examination of the cumulative effects of stacking dicamba-tolerant corn with other herbicide tolerances, including the costs of contamination to non-GE farmers and the costs that dicamba and glyphosate resistant weeds would impose on these growers.
45	APHIS-2013-0043-0047	Cory Rosenbaum, Rosenbaum Farms	• Rosenbaum Farms wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request the USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
46	APHIS-2013-0043-0048	Curt Utterback, Secretary, Utterback Farms, Inc.	Utterback Farms, Inc. wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America’s most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective

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			measures to protect against the threat of non-target plant damage these crops pose.
47	APHIS-2013-0043-0049	E. Keith Menchey, Manager, Science & Environmental Issues, National Cotton Council	• With regard to the proposed EIS on dicamba-tolerant cotton, the NCC believes this activity is not warranted from a legal standpoint and will unnecessarily delay a needed technology for cotton farmers. • The competitiveness of the U.S. cotton industry depends on the ability of growers to access new, cost-effective, and sustainable technologies to manage production pressures such as weed control. • The availability of dicamba- and glufosinate-tolerant cotton will help the sustainability of related industries (including gins, cottonseed processors, livestock operations, food processors, and textile mills) who could potentially face higher input costs if cotton supplies decrease due to weed resistance pressures. The loss of cotton acreage could result in the inability to reach “critical mass” of production to support gins and other related infrastructure. • The use of dicamba- and glufosinate-tolerant cotton provides a new weed control system that should provide for fewer herbicide applications resulting in less trips across the field, reduced greenhouse gas emissions, reduced soil erosion, reduced soil compaction, and enhanced water conservation. In fact, the use of dicamba- and glufosinate-tolerant cotton has the potential to protect and may also increase the current acres under conservation tillage. Once approved, dicamba tolerance will allow growers to use dicamba in burn down without planting restrictions, while providing effective control of herbicide resistant weeds. More complete burn down should further enhance conservation tillage. Most importantly, dicamba and glufosinate tolerance will offer a robust weed management program, incorporating multiple herbicide modes of action, to combat weed resistance. • Cotton farmers are good stewards of the land and have extensive experience in preventing off-site movement. Like any other herbicides, off-site movement of dicamba can be prevented through proper stewardship including application techniques, equipment settings, nozzle selection, and consideration of environmental conditions during application, such as wind speed. Moreover, newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products. Today, growers of different crops have access to information, resources, equipment, and best management and application practices necessary to enable responsible usage of dicamba, with benefits to all parties.
48	APHIS-2013-	Adam Hartley, grower	Dicambia has a long history of volitization after it has been sprayed. You can

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	0043-0050		spray this active ingredient on days when the wind is calm and then a few days later it will get up and move onto adjacent crops that are not resistant to it. This will cause a huge liability on row crop producers that have speciality crops raised in the same area. Just this year I have had an issue where the railroad sprayed the track and the product got up and moved onto my soybeans on both sides of the railroad. This was caused by volitization and not drift since it was on both sides of the track. Please consider requiring similar limitations and restrictions on the use of dicamba similar to what Dow Agro Sciences supported with their agreement with the SOCC. Those were reasonable and proper and recognizes the need for weed control alternatives but works to protect sensitive crops.
49	APHIS-2013-0043-0051	Leon Corzine, LPC Farms, former President of Illinois Corn Growers Association and the National Corn Growers Association	• Opposes preparation of an EIS. • Supports full deregulation of dicamba-tolerant soybeans and dicamba- and glufosinate-tolerant cotton. • Technologies like these give farmers choices so we can continue to improve our farms and remain competitive in the global marketplace, pass on reasonable prices to processors and, ultimately, end consumers who buy high-protein soybean-containing products in the form of food and feed. • Soybeans resistant to both glyphosate and dicamba will add a new mode of action to the system, allowing for better weed control and harvested soybeans with less foreign material from weed seeds, a valuable characteristic for processors. • Dicamba-tolerant soy and cotton are not only likely to help us manage weed resistance, but will enable us to continue to be good stewards of • the land. Compared to some weed control programs, this system may result in fewer herbicide applications, less tillage, reduced greenhouse gas emissions, and soil conservation. Dicamba tolerance will allow growers to use dicamba in burn down without plant-back restrictions while providing effective control of hard to control and resistant weeds, further enhancing conservation tillage. • Growers follow label instructions closely, go through training and and invest heavily in equipment that prevents and minimizes drift. In addition, the new formulations of dicamba have lower volatility than previous generations of the product. Today, growers of different crops have access to information, resources, tools and best management and application practices necessary to enable responsible usage of dicamba, with benefits to all parties.
50	APHIS-2013-0043-0052	TJ Idlewin, grower	I am concerned and do not want to be held liable due to volatilization and drift from dicamba herbicide spray. I not only have specialty crops neighboring my commercial grain crops but will also have some neighbor's crops that are not dicamba tolerant. I have great concern with drift and volatilization when spraying next to homeowner's properties and grandmas backyard gardens.

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51	APHIS-2013-0043-0053	Pam Johnson - National Corn Growers Association	• Opposed to preparation of an EIS. USDA should immediately convey nonregulated status on these traits and make them available to U.S. growers. • Growers need new tools for weed management. Growers need new tools for weed management. With additional modes of action, growers will be able to more effectively manage glyphosate-resistant and conventional weeds.
52	APHIS-2013-0043-0054	Dallas Peterson, Professor and Extension Weed Specialist, Kansas State University	• Support the deregulation of dicamba tolerant soybeans, which could provide benefits for control of problematic weeds and provide a needed management tool for herbicide resistance management. New technologies such as dicamba tolerant soybeans would provide an additional tool that could be incorporated into an integrated weed management program to improve overall weed management, including glyphosate resistant weeds. • The introduction of dicamba tolerant soybean would likely increase the potential for developing dicamba resistant weeds, but I feel the potential benefits of helping to control existing herbicide resistant weeds far outweighs the risk of developing dicamba resistant weeds. I also believe the risk of developing dicamba resistant weeds if this technology is introduced is much lower than what has occurred with glyphosate in recent years. • Many problematic weeds, especially waterhemp and Palmer amaranth germinate over an extended period of time, so later flushes of weeds will not be controlled by short residual herbicides like glyphosate and dicamba. Consequently, weed management will be much more successful if glyphosate plus dicamba is used in conjunction with preemergence residual herbicides that can provide extended control. The use of preemergence herbicides as part of an integrated approach has increased in recent years due to the difficulties of controlling glyphosate resistant weeds and because of the improved commodity prices. Although growers were successful with multiple postemergence applications of glyphosate before the development of glyphosate resistant weeds, I think farmers now realize the many benefits of using a preemergence herbicide in conjunction with a postemergence treatment. This approach helps minimize potential for early season weed competition and provides more flexibility and better efficacy with the postemergence treatment. The other huge benefit is that by utilizing multiple herbicide modes of action, the risk of developing herbicide resistant weeds is greatly diminished. • Finally, I think farmers and crop advisers now realize that relying simply on a single technology such as glyphosate in Roundup Ready crops is not a sustainable practice and will eventually lead to the development of herbicide resistant weeds and the loss of an effective tool for weed management.
53	APHIS-2013-0043-0055	Cathleen Enright - Biotechnology Industry	• Opposes the preparation of an EIS. • BIO and its members are also concerned that the decision to prepare EISs for

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		Organization (BIO)	the crops identified by APHIS will unnecessarily delay Issuance of determinations of nonregulated status, causing significant harm to American farmers and the developers of the crops without any additional environmental benefit. • The delay that will result from preparation of the EISs will deny American farmers the new tools they need to prevent and combat herbicide-resistant weeds and maximize yields. BIO members have submitted applications to EPA that would authorize use of their herbicides on the associated herbicide tolerant crops identified In the APHIS Notices. These herbicides have differing modes of action, enhancing the ability of growers to address weed problems and supporting the continued use of environmentally sustainable practices such as no-till farming. • Delays inherent in the EIS process will also put U.S. corn, soybean and cotton growers at a particular disadvantage in relation to their counterparts in other nations that are now completing their review processes for GE crops on a far more timely basis than the United States. In addition, the developers of these crops will suffer further delay in commercializing and offering valuable new products for sale and other developers of Innovative products may reconsider whether to invest in the U.S. market. Because the APHIS Notices failed to provide a satisfactory legal or scientific justification for opting to prepare an EIS for the subject products, developers of future products also lack predictability as to whether APHIS will opt to prepare an EA or an EIS, which significantly affects the deregulation timeline and product development decisions.
54	APHIS-2013-0043-0056	Rachel Lattimore, Senior Vice President, General Counsel, Secretary - CropLife America	• Opposed the preparation of an EIS. • We strongly urge you to reconsider the need for EISs for these technologies. The proposed EISs would introduce unnecessary regulatory redundancy and potential regulatory confusion by analyzing the proposed use of herbicides that are under active review by EPA and outside the jurisdictional purview of APHIS.
55	APHIS-2013-0043-0057	- Agricultural Retailers Association - American Farm Bureau Federation - American Seed Trade Association - American Soybean Association	• Oppose the preparation of an EIS. • Our members, who produce the vast majority of commodity crops in America, must be able to utilize the very best available methods to combat weed resistance problems. Weed resistance is a well understood scientific phenomenon that is not unique to biotechnology or any other form of agriculture. Different herbicides attack weeds by different methods or “modes of action.” • The delay that will result from preparation of the EISs as proposed by APHIS will deny growers the tools they need to prevent and combat weed

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		- American Sugarbeet Growers Association - Biotechnology Industry Organization - National Association of Wheat Growers - National Corn Growers Association - National Cotton Council	resistance and maximize yields through the use of herbicides that have been shown to operate with differing modes of action. The proposed use of these herbicides in conjunction with the associated herbicide tolerant plants also supports the continued use of environmentally sustainable practices such as no-till and low-till farming. • The delays inherent in the EIS process proposed by APHIS will put American growers at a further disadvantage to corn, soybean and cotton growers in other nations that are now completing their review processes for biotechnology-derived crops on a far more timely basis than the United States.
56	APHIS-2013-0043-0058	Michael Owen, Extension Weed Scientist, Iowa State University	• I support the deregulation of the new technologies as they will be helpful in managing weeds with evolved resistance to glyphosate and other herbicides and giving farmers a choice to use tools to maximize yield potential and meet growing global demand for their product. • I believe that if growers use these technologies in compliance with the stewardship programs developed by the companies, the potential issues will be minimal.
57	APHIS-2013-0043-0059	David Cleavinger, grower, past president of the National Association of Wheat Growers	• American farmers count on USDA to be timely and scientific in the review of beneficial new biotech crop technologies. Growing delays in this process have a real cost to farmers who need these tools. In the case of dicamba-tolerant crops, we are in dire need of new weed management tools that allow us to diversify weed management and thereby address weeds developing resistance to other herbicides. Several already have, and more will if USDA continues to delay such an important technology. • USDA’s delays have already resulted in the US falling behind other countries that have more reliable, science-based regulatory processes. Canada, for example has already approved the dicamba-tolerant soybean trait and South American governments are poised to approve it.
58	APHIS-2013-0043-0060	Robert Savage, Director of Risk Management, Red Gold, Inc.	Wishes to join the concerns expressed by the Save Our Crops Coalition in its comment to this docket. • Non-target plant damage associated with herbicide spray drift and volatilization is a major concern for specialty crop growers and processors. Credible estimates project significant increases in the amount of dicamba that

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			will be applied upon the introduction of dicamba tolerant crops. Dicamba, because of its potential to drift and volatilize, has proven to be one of America's most dangerous herbicides for non-target plant damage. • We do not oppose advances in plant technology, however, we will not accept a range of alternatives that includes only wholesale deregulation or wholesale prohibition of these crops. We request that USDA expand the scope of its inquiry to consider uses of its authority to address a range of issues our membership faces. • We request that USDA strictly analyze changes to agronomic practices, including herbicide use, that will result from deregulation of these crops, and consider where USDA and EPA may be able to jointly develop effective measures to protect against the threat of non-target plant damage these crops pose.
59	APHIS-2013-0043-0061	Phillip Miller, Vice President, Global Regulatory Sciences & Affairs, Monsanto Company	• Opposed to the preparation of an EIS. • Because EPA, not USDA, regulates herbicides under FIFRA and according to the Coordinated Framework, and because herbicide resistance is not a proper factor for USDA to consider in making its plant pest risk determination under the PPA, herbicide resistance alone (or any other alleged herbicide impacts) cannot justify the preparation of a full EIS in this instance. • The vitality of the agricultural economy in the United States depends upon the development of new technologies like those GE crops under review. These products will provide important benefits to farmers, and growers should not be required to wait for USDA to perform duplicative and time consuming analyses already within the regulatory responsibilities of another federal agency. As numerous growers, grower groups and agronomy professors have previously commented in 2012 for DT soybean and 2013 for DT cotton, such products are needed *now* and should be approved promptly.
60	APHIS-2013-0043-0062	Danny Murphy - American Soybean Association	• Soybean farmers need new technologies such as dicamba-tolerant soybeans to increase yields, manage weed resistance and maintain profitability. As stated in ASA's comment on MON87708, we strongly support biotechnology and believe the development of biotechnology-enhanced soybean varieties and products can benefit farmers, consumers, and the environment. • ASA strongly urges USDA to reconsider the need for the EIS. The delay that will result from preparation of the EISs as proposed by APHIS will deny growers the tools they need to prevent and combat weed resistance and maximize yields through the use of herbicides that have been shown to operate with differing modes of action. • The proposed use of these herbicides in conjunction with the associated

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			herbicide tolerant plants also supports the continued use of environmentally sustainable practices such as no-till and low-till farming. • The introduction of soybeans tolerant to both glyphosate and dicamba will allow an additional mode of action to be used in the system, allowing for better weed control and harvested soybeans with less foreign material from weed seeds, a valuable characteristic for processors. • To meet growing global demand and maintain the United States as the largest producer of soybeans globally, growers need access to new and effective technologies such as MON 87708 to increase yield potential and keep soybean prices stable. U.S. soybeans rely on exports and the EIS would need to take into consideration any implications for international trade. • While ASA appreciates concerns about off-target movement of dicamba, we are confident that farmers have a long history of successfully using proper equipment and application procedures to avoid and minimize off-target movement of herbicides. Similarly to other herbicide products, off-site movement of dicamba can be prevented through proper stewardship, application techniques, equipment settings and consideration of environmental conditions during application, such as wind speed. ASA is pleased that newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products. We are also pleased that the petitioner has addressed the potential for off-site movement by prohibiting aerial applications and implementing specific environmental and equipment application requirements on the dicamba label, including a wind-directional buffer when sensitive areas are present, and the use of low volatility dicamba formulations. ASA believes that when recommended label practices are followed, farmers of various crops can co-exist and prosper.
61	APHIS-2013-0043-0063	Joyce Dillard	We request that more thorough studies occur on bees and colony collapse, birds and the watershed ecosystems as well as viruses that spread through migration related to watershed ecosystem connectivity. Water contamination is a problem in a watershed not necessarily in the vicinity of the crops, so all avenues need to be studied. The liabilities of the Clean Water Act should not be placed on other watershed systems.
62	APHIS-2013-0043-0064	Lee Van Wychen, Director Science Policy - WSSA	Science has clearly shown that there is a risk of resistance development to all herbicides, and 2,4-D and dicamba are no exception. In fact weeds have evolved resistance to nearly all forms of weed control including herbicides, tillage, mowing and hand weeding. Some of our members have voiced concerns that growers may adopt 2,4-D and dicamba technologies and rely too heavily on these herbicides thereby developing an even greater weed resistance situation. However, the majority

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			of our member scientists view 2,4-D and dicamba resistant crops as an additional weed management tool to include in an integrated weed management program. The greatest risk for developing herbicide resistance is actually occurring right now with the PPO herbicides and glufosinate. These products are being over-used in certain cropping systems as farmers have no other effective herbicide options. The 2,4-D and dicamba resistant crops could be used to delay resistance development to the PPO herbicides and glufosinate and, in turn, weed management systems could be developed using the PPO herbicides, glufosinate, 2,4-D and dicamba, extending the life of each of these chemistries.
			Weed management is ultimately the responsibility of farmers and farm advisors. However, the weed science community, including industry, academics, crop commodity groups and others who reach out to farmers, must recommend robust and effective stewardship programs espousing the basic principles of good weed management and encourage adoption of these practices. By doing so, evolution of resistance to our herbicide resources and new options such as 2,4-D and dicamba resistant crops will be minimized.
			Research indicates that 2,4-D and dicamba will fit best in a fully diversified program and such a program is particularly important when glyphosate resistant palmer pigweed and waterhemp are the targets.
			Resistance to 2,4-D and dicamba represents no more a threat to agricultural production than resistance to other critical herbicides and the likelihood that it will be used in a manner consistent with best management practices is good.
			Stacking 2,4-D and dicamba tolerance with that of glyphosate, glufosinate, and other herbicide tolerant traits will further facilitate the use of these herbicides in a diversified program. Stacking herbicide traits does not in itself promote the evolution of resistance to more than one herbicide since, just as for individual herbicides, the evolution of resistance is a function of how the herbicides are used rather than a function of the selectivity of the crop to multiple herbicides.
			The ability of farmers to use 2,4-D and dicamba in diversified weed management programs in soybeans, corn, and cotton is not expected to significantly change current farming practices. These herbicide tolerant crops will, however, provide valuable new postemergence options that will allow farmers to most effectively manage their weeds when practicing conservation tillage even in the presence of glyphosate resistant populations. Farmers have clearly shown a preference for postemergence weed control in conservation tillage systems and 2,4-D and dicamba can be an important part of this system. As the spread of glyphosate-resistant weeds occurred, the adoption of tillage, including deep tillage with a moldboard plow has once again become more common.

Comment #	Comment ID	Commenter	Comment Excerpt
			The return of conventional tillage has led to increased wind and water erosion. Neither 2,4-D nor dicamba technologies would eliminate tillage, but they would greatly reduce the need for deep tillage allowing many farmers to return to more reduced tillage production systems.
			New and expanded uses of existing herbicides are needed for integrated weed management programs in order to mitigate weed resistance and meet our current and future crop production needs.
			Off target movement of 2,4-D and dicamba pose the greatest limitation to the adoption of either auxin technology. An enormous amount of research by the registrants and other weed scientists around the world has been conducted to develop methods to minimize the potential for off-target movement. These efforts include 1) improving herbicide formulations, thereby reducing volatility and/or drift, 2) improving application equipment techniques and application methods, thereby reducing drift, and 3) developing educational materials to assist growers in reducing off target movement when making pesticide applications. There is no question these research efforts will greatly minimize off-target movement of all pesticides, not just 2,4-D and dicamba, and will greatly improve the ability of a grower to apply pesticides that stay in the targeted area.
63	APHIS-2013-0043-0065	Center for Food Safety	**2,4-D-resistant crops must be viewed as weed control systems** APHIS must assess dicamba-resistant soybeans and cotton as crop systems comprising the herbicide-resistant crop itself and associated use of dicamba. Monsanto describes its Roundup Ready (RR) crops as RR crop systems, and will also treat its dicamba-resistant crops in the same manner.
			Impacts of dicamba-resistant crop systems on herbicide use APHIS must assess the shift in dicamba use patterns to be expected in various DR crop adoption scenarios. APHIS should assess both the change in amount applied, per acre per crop, and the shift in use pattern (i.e. amount used pre-emergence vs. post-emergence). APHIS should also assess the impact of DR crops on overall herbicide use, keeping in mind that dicamba would likely displace little if any glyphosate, which has a broader spectrum of activity, including (unlike 2,4-D) activity on grass family weeds. We refer APHIS to our comments, where CFS makes such projections.
			Features of HR crop systems that promote HR weeds As discussed in our comments, HR crop systems promote not only (near-) exclusive reliance on the associated herbicide(s), but also more frequent use over a broader application window that extends much further into the crop season than would otherwise be possible. Resistant weeds with Roundup Ready crops are too often treated superficially as simply the result of excessive glyphosate use, but as Paul Neve has pointed out, the post-emergence use pattern of glyphosate with RR crops is

Comment #	Comment ID	Commenter	Comment Excerpt
			another, independent factor promoting weed resistance, beyond exclusivity and frequency of glyphosate use. In other words, the timing as well as the exclusivity and frequency of herbicide use is a factor in promoting weed resistance. In practice, applications are often made late post-emergence to larger weeds, increasing resistance risks still more. Additional evidence comes from weed resistance to ALS inhibitor herbicides, many of which were and are used post-emergence. ALS inhibitor-resistant weeds arose in 1987 just five years after the first ALS inhibitor herbicide was introduced, and became extremely prevalent in less than a decade; in fact, by undermining the efficacy of widely used ALS inhibitors (especially in soybeans), resistant weeds provided much of the impetus for adoption of RR crops (as a means to kill ALS inhibitor-resistant weeds), just as glyphosate-resistant weeds have become the rationale for 2,4-D-resistant crop systems. We emphasize that while a post-emergence herbicide use pattern is certainly not a necessary condition for weed resistance to evolve (e.g. atrazine used primarily pre-emergence and early post-emergence in corn led to substantial weed resistance), it does appear to be a facilitating factor where present. APHIS must assess the post-emergence weed control paradigm that is a central feature of HR crop systems for its resistance-promoting potential in the case of 2,4-D-resistant crops and weeds, in addition to the more obvious factors of exclusivity and frequency of use.
			Socioeconomic factors associated with HR crops and HR weeds As discussed in our comments, pricing strategies influence farmer weed management decisions in such a way as to contribute to evolution of weed resistance. Companies charge fees for HR traits that are substantial enough to create a strong incentive for the farmer to make full use of the trait(s) through total reliance on the associated herbicide(s). APHIS should find or develop studies that explore the extent to which pricing strategies for HR crop systems (e.g. high-priced seed, low-cost herbicide) reinforce herbicide use patterns that foster resistance in the case of 2,4-D-resistant corn and soybeans. RR crops' major and closely intertwined "benefits" are reduced labor needs for weed management (at least until resistant weeds emerge) and the simplicity of glyphosate-only weed control. In addition, glyphosate's superior ability to control large weeds relative to other herbicides broadens the application window for acceptable weed control. These factors together facilitate increased farm size, since more land can be managed for weeds with the same labor, and labor needs for weed control are a major limiting factor on farm size. One can expect 2,4-D- resistant crops to have similar impacts. APHIS should assess the socioeconomic consequences of 2,4-D-resistant corn and soybeans, in terms of increased land and rental prices from increased competition for land, increased average size of farms, and accelerated exit of small- to medium-size farmers from agriculture.

Comment #	Comment ID	Commenter	Comment Excerpt
			HR crops and drift damage HR crop systems entail a pronounced shift in herbicide use to much later in the season when neighboring crops have leafed out and are more vulnerable to drift damage (from early season herbicide use when drift poses much less risk). Glyphosate has become a leading cause of drift damage in the era of Roundup Ready crops, despite the fact that it is not a volatile or drift-prone herbicide. This is not merely because its use has increased so dramatically, but also because its use has shifted heavily to later in the season. 2,4-D is much more volatile than glyphosate, and is particularly prone to vapor drift. APHIS must comprehensively assess the increased drift damage that would occur with various 2,4-D-resistant corn and soybean adoption scenarios, both in terms of lost yield and income, broken down by major crop (e.g. soybeans, cotton) or crop category (e.g. vegetables). APHIS should further assess the extent to which 2,4-D-resistant crop adoption would reduce plantings of susceptible crops (e.g. vegetables, grapes) and/or shift acreage to 2,4-D-tolerant crops that could withstand drift level doses (e.g. corn). In conducting this assessment, APHIS must account for the inevitable use of more drift-prone 2,4-D formulations (e.g. because likely to be cheaper than the choline salt), and not presume an ideal world scenario where only potentially less drift-prone formulations are used.
			Crop volunteers resistant to 2,4-D, ACCase inhibitors, glyphosate, glufosinate, etc. as weeds RR crop volunteers have been repeatedly noted as problematic weeds, particularly corn, but also cotton and soybeans; and particularly where RR crops are rotated (see comments). SmartStax corn is even more problematic, since glufosinate as well as glyphosate are eliminated as control options. APHIS must assess the increased weediness of volunteers of corn and soybeans resistant to 2,4-D, ACCase inhibitors, glyphosate, and/or glufosinate. Further, since cross-pollination with other prospective herbicide-resistant cultivars will be possible (e.g. dicamba-resistant corn), APHIS should consider scenarios with volunteers that have stacked resistance. The assessment should include increased costs of control, increased use of herbicides, increased weed resistance risks from a narrowing of herbicidal control options and increased reliance on those (few) herbicides still effective.
			Interplay between HR traits and Bt resistant pests 2,4-D-resistant corn will be offered mainly in stacks with Bt traits. Research described in the 2,4-D comments shows that HR corn volunteers produce lower levels of Bt toxin and thereby promote Bt resistance in corn rootworm; the more HR traits in the corn volunteers, the less likely they will be managed adequately, and hence the more likely they will contribute to Bt resistance. See discussion in 2,4-D-comments.

Comment #	Comment ID	Commenter	Comment Excerpt
			Cross-resistance between 2,4-D, dicamba and other synthetic auxin herbicides In our comments, we discuss evidence that certain weeds resistant to 2,4-D (e.g. waterhemp) also exhibit increased tolerance to dicamba; and that dicamba-resistant crops have increased tolerance to chlorophenoxy herbicides like 2,4-D. In view of their common mechanism of action, these findings strongly suggest the potential for evolution of cross-resistance in weeds to dicamba and phenoxy herbicides. Most weed biotypes resistant to either dicamba or 2,4-D have not been tested for resistance to the other. APHIS must assess the potential for 2,4-D crop systems to foster resistance, not only to 2,4-D, but also to dicamba, and the impacts such cross-resistant weeds (against a background of resistance to glyphosate, ALS inhibitors and/or other herbicides), would have on weed control in soybeans, corn and other crops. Known weed biotypes with resistance to either 2,4-D or dicamba should be tested for tolerance to the other, to help establish the potential for such cross-resistance.
			Non-target effects of 2,4-D-resistant crops Roundup Ready crop systems have dramatically increased use of one of the most effective plant-killing compounds ever developed. Glyphosate is particularly noted for its efficacy against perennial weeds, which most other herbicides have difficulty controlling. Glyphosate use with Roundup Ready crops is a major factor in the dramatic decline in Monarch butterfly populations over the past two decades (see 2,4-D-resistant soybean comments to USDA). Glyphosate has decimated milkweed populations in Midwest corn and soybean fields; and milkweed in such fields is the major breeding ground for migratory Monarchs that overwinter in Mexico. APHIS must project the impact of 2,4-D-resistant corn and soybean systems (with additional resistance to glyphosate and/or glufosinate) in further reducing populations of milkweed in agricultural fields and thus exacerbating the decline in Monarch populations.
			Many glyphosate formulations are extremely toxic to various species of frogs. Massive glyphosate use accompanying Roundup Ready crops has been posited as a likely factor in the global decline of amphibian populations. APHIS must assess the impacts of 2,4-D-resistant corn and soybean systems (with additional resistance to glyphosate and/or glufosinate) on amphibian populations.
			Impact of HR crop systems on sustainable weed control Please assess the impact that Roundup Ready crop systems have had on efforts to advance adoption of sustainable weed management techniques (e.g. crop rotation, cover crops); and based on this analysis, similarly project the impacts that 2,4-D-resistant crops (with additional resistance to ACCase inhibitors, glyphosate and/or glufosinate) would have on the same.
			Health impacts of increased 2,4-D use with 2,4-D-resistant crop systems

Comment #	Comment ID	Commenter	Comment Excerpt
			Medical scientists have found 2,4-D use associated with increased risk of non-Hodgkin's lymphoma and other adverse human health impacts (for discussion see human health section of 2,4-D comments to EPA). Dioxins continue to contaminate 2,4-D, and EPA has failed to collect comprehensive, independent data on the dioxin content of the many 2,4-D formulation used by farmers. CFS projects a many-fold increase in use of 2,4-D with introduction of either or both 2,4-D crop systems, and thus a further increase in exposure to and disease from this toxic herbicide. APHIS and EPA must assess the increased incidence of disease to be expected with the substantial increase in 2,4-D use accompanying introduction of these crop systems.
			2,4-D-resistant crops and tillage Roundup Ready crops have not, as popularly imagined, fostered increased use of conservation tillage. The major gains in conservation tillage adoption came in the 1980s and early 1990s, in consequence of 1985 and 1990 Farm Bill provisions that tied subsidies to use of soil-conserving practices. In fact, adoption of conservation tillage actually stagnated in the decade of Roundup Ready crop adoption. Instead, the glyphosate-resistant weeds generated by RR crop systems have led to increased tillage for weed control and hence greater soil erosion. CFS has presented a detailed analysis to support these conclusions in the 2,4-D-resistant soybean comments. APHIS must assess the potential for 2,4-D crop systems to further increase soil erosion through increased use of tillage to control the 2,4-D-resistant weeds that will be generated by these crop systems.
			APHIS should also require the applicants to supply information necessary for meaningful risk assessments that is not in their petitions, or better yet undertake appropriate research to fill in the gaps. For example, the following information should be available for review by APHIS and the public: • Proposed herbicide application regime: how much herbicide, how often, window of application. • Degree of resistance conferred by the transgene in different plant parts and stages of development. • Expression of the transgene in pollen, nectar; levels of herbicide residues and metabolites in pollen, nectar. • Herbicide residues and metabolites in plant tissues from the time of application through post-harvest.
			APHIS needs to analyze the following areas: • Agricultural production impacts, including and not limited to burden on organic and non-transgenic agricultural production and potential harms to non---target crops from the adoption of the HR crop system. • Environmental impacts, including but not limited to: - Herbicide use and changes in herbicide use patterns;

Comment #	Comment ID	Commenter	Comment Excerpt
			- Gene flow from 2,4-D-resistant corn and soybeans to compatible varieties and the resulting increased weediness; - Agricultural practices, including herbicide use, effects on tillage; and - Weed resistance and volunteers. • Socioeconomic impacts, such as: - Transgenic contamination and their effects on both domestic and export markets, as well as, consumers and farmers' right of choice - Changes in seed industry market concentration and their impacts, - Effects on the methods and costs of weed control • Human health impacts, such as: - Herbicide use, including impacts on farm workers; and - Safety of food products • Livestock health, such as: - Herbicide use; and - Safety of animal feed. • Threatened and endangered species, such as: - Herbicide use; and - Quality of crop tissues as food sources. • Disease and pest impacts stemming from 2,4-D-resistant soybeans and corn and the associated herbicide use.
63	APHIS-2013-0043-0065	Center for Food Safety	Comments to USDA APHIS on Environmental Assessment for the Determination of Nonregulated Status of Herbicide-Tolerant DAS-40278-9 Corn, *Zea mays*, Event DAS-40278-9 - Center for Food Safety, Science Comments II See Comment Summary for DEA for DAS-40278-9 Corn
64	APHIS-2013-0043-0066	Center for Food Safety	Comments to USDA APHIS on Draft Environmental Assessment and Draft Plant Pest Risk Assessment for Dupont-Pioneer's Petition (11-244-01p) for Determination of Nonregulated Status of Insect-Resistant and Herbicide-Resistant Pioneer 4414 Maize: Event DP-004114-3

Table 2-2. Public Scoping Comments Submitted During Virtual Public Meeting

Commenter	Affiliation	Concern/Issue
June 26, 2013		
Victor Miller	grower and past chairman U.S. Grains Council	As USDA surveys the topics to be considered in the development of the draft EIS, I would first offer that USDA should take a hard look at the question is an EIS even warranted. USDA's and APHIS' reasons for conducting the EIS all appear to relate to potential impacts associated with herbicide use, possible selection for, and spread of weed resistance to herbicides…from applications of dicamba on the dicamba intolerant crop and other areas.
		Use of dicamba is nothing new. According to industry estimates, dicamba has been used successfully on more than 250 million acres over the past 10 years. In 2012, it was the fifth most widely used herbicide in the U.S. in terms of acres treated, used on over 32 million acres of farmland across the range of crops, including 12 million acres of corn, 6 million acres of wheat, 4 million acres of other crops, and 10 million acres of fallow for (indiscernible). Additionally, any homeowner who has gone to their local Weed-B-Gon herbicide product has used dicamba without certification or licensing. The equipment, the know-how, and the ability to successfully apply dicamba as part of the new dicamba tolerant soybean and cotton weed control system under review exists today. I have purchased upgrades through my current system to accommodate the new requirements, and I'm confident that I and other producers will do this successfully.
		The ability to choose dicamba within my soybean acres will allow me to have a badly needed additional mode of action to control weeds such as waterhemp and lambsquarters that are a problem on my farm. Without it, I am left with few viable alternatives to control weeds in my field, resulting in poor yields, which means I produce less on these acres. This means I get paid less for my crop, I deliver fewer beans to my local elevator, and this cascade of impact carries on down the line, as the elevator adds (indiscernible) fewer beans and more weed seed to foreign material that end up at the local crushing plants. The crush plant profitability is hurt, and so is bean quality that is made into animal feed, soybean oil, biodiesel, food ingredients, and ultimately either used domestically in many applications or sold to foreign buyers

Commenter	Affiliation	Concern/Issue
		for their use in international markets. Now, not only has my income been impacted, but very possibly, hungry people in foreign markets have less to eat.
		Looking on the bright side, incorporating dicamba tolerant soybeans into my weed management program allows me to reduce dependence on ALS and PPO herbicides and would offer a proactive program for weed resistance management and preserve the value of glyphosate, an herbicide that still controls most of the weeds on my farm.
		Lastly, I adopted no till, also called conservation tillage, because of the great environmental benefits that it creates: reduced soil erosion, increased moisture and benefit to top soil. Here, I use Roundup to remove the weeds in my field before I plant instead of tilling them under. With dicamba tolerant soybeans, I have another tool to assist me in my conservation tillage efforts and potentially help me and other farmers to expand this practice. Without dicamba tolerant beans, I may be forced to till my fields if and when weed pressure dictates, which could lead to soil erosion, impaction, and unsatisfactory weed control.
		In closing, restricting the use or denying access to these new technologies would have a negative effect on U.S. farmers' operations, reduced weed control capability, increasing costs, reducing farm returns, and impacting the producer's ability to meet foreign market demand. And also, it stands a very great chance of reducing conservation tillage options. Ultimately, this has a very negative impact on the food supply of not only the U.S. but the world as well. I urge you to complete your report and remove promptly so that other farmers may have access to this knowledge.
Ray Gaesser	grower and First Vice President of the American Soybean Association	Those traits (indiscernible) are much needed. They will allow us, on our farm at least, to continue to no till. If we don't have those products, we may have to go back to tillage to deal with some of the weeds that we have. So I would really urge you to move forward with the approval of both the dicamba and the 2,4-D for our soybeans and our corn…
		We use them [2,4-D and dicamba] on our farms. I've been farming 25 years now, and I've had experience using both of those products in a different formulation for all that time. And, really, I've never had any problems with it, (static - call interference) response to our own crop or our neighbor's. As the previous

Commenter	Affiliation	Concern/Issue
		speaker said, we are tested in Iowa. As is required of all of our applicators that come from the co-ops and from the industry, are tested, and understand the need and the right way to apply herbicides.
		We used to use a lot of those products, and now with glyphosate, we use less in order to address the issues of weed resistance in particular, and the real need for multiple modes of actions. All of our universities are saying that we need multiple modes (indiscernible) of action to avoid weed resistance. So I would urge you to move forward with both of these applications.
David Shaw	Past President, Weed Science Society of America (WSSA)	Biotechnology has allowed us to maximize yields in economics, to be able to mitigate the potential development of herbicide resistance, and to be able to effectively gain tremendously with the development of conservation tillage practices in the United States.
		Herbicide resistance has developed substantially over the last few years, but is not a new phenomenon. In fact, it has been recorded and noted for over 40 years now.
		One of the primary practices that we scientists recommend in managing proactively herbicide resistance is the ability to use a wide diversity of mechanisms of actions with different herbicides that affect plants in different ways. We need more herbicide options to be able to manage these and to be able to preserve the utility of those that we already have. The ability to effectively use dicamba and 2,4-D in soybean and cotton will help fill this critical need. We have seen the development of herbicide resistant plants most notably in the last few years with glyphosate resistance in (indiscernible) crops. This problem has become widespread, in several of our major commodities. And dicamba and 2,4-D, also the ability to use a different mechanism of action than what is currently available in these crops to be able to more effectively and proactively mitigate and delay the evolution of herbicide resistance.
		There are a number of factors that come into play in the evolution of herbicide resistant weeds and crops. However, we scientists understand that this is a function of managing the practices and the herbicides that are available for weed management. It is as such not a plant biotechnology issue. It is a use of the technology and

Commenter	Affiliation	Concern/Issue
		the rotation and a development of an overall plan using various management practices that have been identified. Weed management is ultimately the responsibility of farmers and farm advisors that requires the entire community of weed scientists, industry, academia, crop commodity, and others to be able to effectively steward herbicide resistance management. By using the development of resisted crops that have the tolerance to dicamba and 2,4-D, this represents no greater threat than the development of any herbicide technology that has hurt in the past.
		Dicamba best fits in a fully diversified program that utilizes many different mechanisms of action of herbicides, and is therefore a tool that can be used either in stacked (indiscernible) or as stand alone to be able to offer the growers options that 16 they currently do not have. It is also noted that one of the major challenges that we have with the development of herbicide resistance is the losses that we are now experiencing in conservation tillage acres. Dicamba and 2,4-D tolerance will certainly allow us to help preserve these valuable gains and the preservation of our soils in the United States.
		We urge the USDA to expedite the necessary review process that will lead to final approval of dicamba and 2,4-D tolerant crops, and we appreciate the opportunity to provide this comment.
Victor Miller	grower and past chairman U.S. Grains Council	I would like to make an additional comment on the fact or the idea that we as private applicators applying herbicides to our crops, the amount of time that we spend in reading and understanding and following the label is of paramount importance to us. And as we look at this, there are many reasons for doing it, but the two that stick out the most are the fact that if we do not follow those label requirements, we risk unsatisfactory control. And worse yet, we risk crop injury, which is at the ultimate end a reduction in our incomes. And so, I think it's very important for USDA to understand that we spend a great deal of time doing exactly what is on that label.
Ray Gaesser	grower and First Vice President of the American Soybean Association	I'd like to talk from my heart, and I really don't understand the fear of these products, because on our farms -- and I have 25 years in this experience -- we've been using these products for all that time, for a decade now, and we haven't had a problem. And they've been used all over the world for a decade. And you have all the data and

Commenter	Affiliation	Concern/Issue
		the experience that I would think you need. I can't understand why there is a need for an environmental impact assessment. I just really struggle with that. It's going to delay my ability and my fellow farmers here in the United States to use these products in a new way that allows us to (indiscernible) of this issue; that let's us use multiple modes of action to avoid these resistances in the first place and let's us farm the way we really need to run our land so that we can continue, and not have to use facilities to incorporate some of the other herbicides that can work okay, but it's not very good for my part of the country where we're having (indiscernible). So I would really encourage you to move forward to deregulate these products, to not do the EIS. You have all the data in the world. You have all the data you need to move forward with these two products, and I would encourage you to do that.
Michael McCarty	grower	We've been fighting this [resistant weeds] for probably the last five or six years. We have glyphosate tolerant cotton, soybeans, all that was great. We followed the stewardship requirements, followed everything that was presented to us, all that by the book. And now we've come upon a resistant, amaranth, pigweed. And it is totally destroying the infrastructure on our cotton industry. We've gone from a 2800-acre cotton farm down to 1500 acres. And trying to maintain, it's a battle we just can't fight. We don't have enough tools in our arsenal. There aren't enough -- it's enough technology for us to overcome this problem, so we're just totally out of the cotton industry now. We have zero acres of cotton. And I've got a $600,000 cotton picker that's sitting under the shed -- it's decreased in value, probably now cut in half because there's nobody interested in buying it so they can plant cotton. My problem is, I know that there's technology out there, and why haven't we been able to use it? It's out there for us. I've been to two fields, test spots, looked at different things, read different articles about it. And my main concern is we're getting ready to totally lose it. And I'm just voicing a concern from the field standpoint. I read all these -- these people in Austin and California and all these different places that are trying to tell us what we need to be doing and how we need to do it. I'm telling you from the field level, we need the technology, and we need it quick. These other countries

Commenter	Affiliation	Concern/Issue
		are already using it, and we're at a disadvantage to them. I know some of the problems are worried about drift management, whether or not we can control it. We've got the John Deere, the green release, all technologies, everything in our arsenal to keep drift down, (indiscernible), GPS equipment, stuff that doesn't have any overlap. We've got sprayers that will cut off to keep from overlapping. It's an amazing amount of technology that's out there to keep out drift control down. I know that was one of the problems that I read about. It was a concern. Farmers are some of the most responsible people because we get back from the earth whatever we put in it. If we destroy our ground, we overlay chemicals, then we don't get anything back. That's how we make a living. We're not going to do that. We're not going to abuse anything, nothing like that. No farmer that's still in business has ever abused a chemical because simply there's EPA regulations; there's everything that can toss us out. And it's just not going to happen. My deal is -- my main concern is let's get this technology. You've been going over this for three years, and steady having meetings, talking about them. Come back with another set of meetings. You can only meet so long. You can only have so many (indiscernible) to do this for, so let's open it up. Let's give us the technology we need so we can start using them.
June 27, 2013		
Genna Reed	Food and Water Watch	Our previously submitted comments outline issues that must be considered carefully in (indiscernible). Environmental Impact Statement. The Food and Water Watch analysis of USDA data revealed that for every 1 million acres of dicamba tolerant soybean plant, there could be an additional 2 millions of dicamba applied to crop. Even if just a million dicamba tolerant soybean acres are planted, that would be 17 times the current dicamba volume used on soybeans. If 2,4-D corn were adopted as quickly a Roundup Ready corn, about 1 million acres a year between 1997 and 2001, 2,4-D application on corn is easily increased by nearly three

Commenter	Affiliation	Concern/Issue
		(indiscernible), from 3.5 million pounds to 5.5 million pounds in two years 21 of 2,4-D tolerant corn introduction. USDA must look at the economic cost to development of 2,4-D and dicamba tolerant weeds could have on (indiscernible). Farmers face significant costs from (indiscernible).and increased production costs. These costs can range from $12 to $50 an acre, or as much as $12,000 for an average bag of corn or soybean farm, or $28,000 for an average cotton farm. Since U.S. farmers have found herbicide-resistant weeds in their fields, they've changed farming methods to control them, resulting in higher weed control costs and even tillage and hand tilling. Additionally, USDA must also look at the impacts that these resistant and multiple herbicides could have on farmers and agriculture. Second, increased applications of 2,4-D and dicamba will lead to elevated surface water pollution, which will not only affect the quality of water near agriculture, but will impact plants and animals, including endangered species. USDA must consider the biological opinion of the National Marine Fishery Service regarding 2,4-D registration and specific (indiscernible), and look carefully at the individual and synergistic effects of increased volumes that of these chemicals on non-target organisms, threatened and endangered species.
Robert Wolf	retired professor emeritus, application technology in the biological and agricultural engineering department, and extension specialist, Kansas State University	My main responsibility while at Kansas State was to conduct an extension and research program in our chemical pesticide application with a particular emphasis on novel technology. My research focus was and continues to evaluating novel types for improved pest control efficacy while minimizing the straight drift. In retirement, I have formed a consulting company, Wolf Consulting and Research and continued working with the application industry as a researcher and a trainer. As a part of my consulting work, I have had the opportunity to work with Monsanto's dicamba tolerant soybean train team and trained Monsanto employees and others on the topic of spray technology basics, including the focus on selecting and using

Commenter	Affiliation	Concern/Issue
		proper novels for the application with dicamba as a part of a prescribed weed control system as it relates to the introduction of these dicamba tolerant crops. For the past four years, the focus of this reach has involved conducting commercial size sprayer oriented research trials involving spray nozzles and drip- producing (indiscernible) to support this training, with the most recent efforts used in resistant weed plots (ph). As the USDA considers areas of study for the plant environmental impact statement, I would like to offer some thoughts and consideration, as well as my perspective on the new weed control tool. Current spray technologies for residual off-site movement and the application practices available to make herbicide applications accessible. Some forces of concern include off-site movement caused by particle drift, volatility, contamination due to improper clean out and making applications in unfavorable environmental conditions. Here are some of my key points. Particle drift is controllable through equipment selection and conditions of use, such as formulation, spray tips, and other technologies, wind speed and direction of application considerations and sprayers feed and (indiscernible). In some of my most recent research, selecting a proper nozzle type alone was shown to reduce (indiscernible) as much as 13 and a half percent, down to as low as half a percent. And in some cases, with the inclusion of drip control additives reducing drip even more. Newer dicamba formulations have been developed to substantially reduce volatility compared to earlier generations of dicamba products. The research is supporting this and to further research, education and training at this point will be stress, and contamination will be a major concern when switching between tolerant and non-tolerant crops. This will be addressed through proper cleanout procedures that adequately clean out herbicide residues from the lining tank and inner workings of the sprayer,

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		including all (indiscernible) 45 builders, crevices, drain lines, et cetera. Newer spray systems are being engineered to improve this cleanout process. Monsanto has addressed one concern of the potential for off-site movement by prohibiting aerial applications and other concerns by implementing specific environmental and equipment applications comments on the draft dicamba label, including wind directional buffer when sensitive areas are present and the use of low volatility dicamba formulations. In my opinion, the U.S. farmers and applicators are capable and experienced after many on-site movement. Like any other herbicides off-site movement of dicamba can be prevented through proper stewardship, including application techniques, equipment settings, nozzle selection, and consideration of the environmental conditions during the application. Equipment and other hand-held tools, such as Smartphone apps that support applications to facilitate access to weather data, field crop mass, nozzle details and other information now exist in this technology, and its capabilities are being used in fields across America today. Correct label practices are followed and growers of various crops will co-exist and prosper. I believe that in combination with approved best management practices, including the use of proper novel type, or types, applications using dicamba will have the potential to reduce the amount of off-target drift. In closing, the use of dicamba does not (indiscernible) at 2012 pictures indicating its use in over 32 million acres of farmland in the U.S. The equipment know-how and ability to successfully apply dicamba as a part of the new dicamba tolerant soybean and cotton weed control systems exist today. Putting these application details on a label is an effective means of communicating and requiring these strategies to be followed. Restricting the use or denying access to these new technologies, based on concerns for off-site movement because it may not be controlled or labeled formulations may not be successfully applied (indiscernible)

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		exaggeration are a huge disservice to the farmers who I understand the USDA is representing.
Jim Broten	Grower and past chairman, U.S. Grains Council	I just want to comment that in spite of the, problems with weeds (indiscernible), including (indiscernible). These weeds compete with our crops for (indiscernible), water, and (indiscernible), and they hurt our fields. If left without effective control, these weeds can decrease our (indiscernible).
Bill Bridgeforth	Grower and chairman, National Black Growers Council	…we produce cotton and soybeans on our farm. And the pigweed problem has become a very serious issue for us. This year, pigweed threatens our profitability. It could take the whole farm, just that one weed alone. We do have -- each year, we'll have some areas of our farm where the technologies that we're using now and the chemicals we're using, they just do not work. And we'll have to abandon those crops. It's not a large percentage of the acres, but we do have it. It does happen. Without another mode of action on the pigweed, we're going to see more and more of this -- we're just going to have to start -- we're going to start seeing more acres that will have to be amended because the pigweed is just taking over. And so I believe that the dicamba technology in cotton and soybeans on our farm is going to be very important. We're already using all the technology and precision. All the tools out there that can help us be better farmers, we're using them. And we just think that the approval of dicamba cotton and soybeans will keep us on track to being good farmers with a high level of productivity.
Michael Owen	extension weed scientist and professor (weed management), Iowa State University	I would like to suggest a couple of things. First of all, that as the previous speaker indicated, growers not just in the south or the Delta, or in the Midwest, need as many tools to manage weeds as possible. Weeds represent the most important, most prolific and most consistent pest complex that causes reductions in yields and profitability throughout the world. And having new tools to help manage those pests are incredibly important. A comment was made earlier that the de-registration or deregulation of these traits -- and I am speaking both to Docket 42 and to Docket 43. The statement was made that there will be an

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		increased use of these two herbicides, dicamba and 2,4-D. I would look back not that far in history where 2,4-D/dicamba was the most prevalent herbicide treatment used in corn production across the United States. And thus, I do not see that this change in the technology is going to dramatically change how over the history these two herbicides have been used. Importantly, I would also point out that the concern for the EIS reflects the concern for evolved resistance to these herbicides. The fact is that these herbicides represent no more greater risk than any other herbicide in whether or not they will select for herbicide resistant weed biotype. It is the decision on how those herbicides are used and the management practices that dictate the level of selection pressure and the likelihood of herbicide resistant weeds. The truth is that there are already some leaves that evolve resistance to dicamba and some leaves that evolve resistant to 2,4D. The manner by which the companies are prescribing the use of these new technologies and the concomitant use of these herbicides to such that selection pressure by their rules will be reduced significantly; and thus in my opinion, reduce the probability that new leaves will indeed be selected and have the training for resistance to either 2,4-D or dicamba. The other point is that we talk about these concerns about volatilization. And again, the new formulations of the 2,4-D and of the dicamba are such that volatization potential is minimized. It's not eliminated but if you significantly minimize – and once again, it is the decision as to how these herbicides are applied, as Dr. Wolf explained, will determine the risk of all target movement, based on the stewardship programs that the companies are placing in effect in anticipation of deregulation. My sense is that the potential for off- target movement of these herbicides has been managed very effectively. he other comment that was made is that if these trades were deregulated, that we will lose opportunities for conservation tillage. The fact remains that these products specifically do support the success of conservation tillage in all row crops that

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		form the soybean and the cotton, where these new genetically-engineered traits will be sold and these herbicides will be used. The final point that I want to make is that it was suggested that. But the final point that I want to make is that it was suggested that herbicides are now a major problem with regard to how widely they are used and how other alternative strategies have been compromised as a result of the ubiquitous use of herbicides. This is not new. This has been an agricultural fact over 40 years. And so, I do not see where the deregulation of the corn, cotton and soybeans, with traits for either 2,4-D or dicamba is dramatically going to change. The amount of herbicides or the acres of herbicides treated crops, will occur. I think that in fact, the industry has learned from their historical efforts with developing products and having them cause selection pressure resulting in herbicide resistance. There's historical knowledge, and they're putting this into practice with the stewardship programs that they now are beginning to up into place. I think this will change grower behavior. And by changing grower behavior the potential negative consequences of these new genetically engineered crops or the use of either 2,4-D or dicamba will be minimized.
Kip Tom	grower, Tom Farms	This is nothing new to us. We've experienced a lot of -- in Argentina as well, so we're not surprised we're seeing some of it here. And when I say that, I'm talking about the (indiscernible). Well, I've got to tell you that on May 10th of this year, USDA took an action-oriented step by delaying the regulatory approval of the dicamba tolerant technologies for corn and soybeans and the 2,4-D tolerant technologies for soybeans and corn from Dow, requiring an environmental impact statement. This move threaten, though, severe delays to the Farmers Act, that's multiple weed control technology across three major U.S. crops: corn, cotton, and soybeans. These technologies have been under USDA for approximately three years, a timeline that is already much longer than expected. And now the USDA is initiating a process that's taken as long as four years, when I think

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		about Roundup Ready alfalfa in the past. Unacceptable. USDA's stated purposes for the EIS revolves around stewardship of chemistry herbicide-resistant weed and (indiscernible), which is EPA's goal as determined by Congress decades ago and upheld in federal courts as recent as last month, the Ninth Circuit Court of Appeals ruling on Roundup Ready alfalfa. USDA has no legal authority to regulate these matters, and it's hurting farmers with delays, while it takes this overreaching step. These traits already have been approved by the Canadian government for the Canadian soybean farmer. This is bad enough, but further delays may result in Argentina and South American governments also close to approving these technologies. If it delays another three years, it's going to put the U.S. way behind most other countries and access to these technologies to address an issue that we have today. Continued delays and lack of predictability in USDA's process hinders innovation and creates insurmountable barriers to entry for a variety of new tools and competitive product choices that would benefit all of us in U.S. agriculture and our consumers globally. The impact of U.S. delays are potentially not deregulating these technologies on our farm and our communities, and the U.S. farmer's ability to compete for supplies and growing global markets. We all know the numbers. Today we're feeding 7 billion people, and we're on the pathway to feed 9 billion people by the year 2050, a big job to do, especially when we have to face some of the challenges we do in these regulatory processes. This technology is critical to allow successful over-the-top control broadleaf weeds, crops and soybeans, cotton and corn. Several broadleaf weed species, such as palmer amaranth, waterhemp, and (indiscernible) must be controlled with a limited set of tools, including tillage and other less effective chemistries that also face the same resistant issues, and (indiscernible), and farmers are forced to (indiscernible).

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		The weeds are only on USA (indiscernible), but will continue to get worse as a great cost to farmers and consumers who benefit from the productivity. Failure to deploy multiple tools for the sake of diversifying management by farmers result in the development of resistance to one herbicides at a time, which can lead to multiple herbicide resistance evolving. When a new tool finally gets approved, all the pressure's on it. If major global competitors have access to this technology and U.S. farmers do not, it will hurt global competitors, exports, and economic value. This is very important in all American agriculture to see if this gets moved forward. If U.S. gives up leadership in these important technologies, it will be a major setback in reaching the critical goal of growing production to meet the demand of a growing and hungry population on planet earth. U.S. farmers already manage these tools and many others responsibly. Although it is EPA's job to regulate matters related to chemistry, USDA should know that farmers use herbicides responsibly and understand the risk of careless misuse. Farmers and applicators who use these tools are highly sophisticated. These have to be in order to stay in business. Awareness and compliance with labels is higher than ever as the applicator training and experience. The sophistication of application equipment, safety features, and GIS systems is far beyond what most of the public, including regulators, ever experienced in their vehicles, offices, or Smartphone apps. As it relates to herbicide resistance, farmers have rapidly adopted diverse weed management programs that put more weight on multiple herbicides, tillage and cultural practices and one herbicide. This has been the (indiscernible) neglect of safe resistance. These new tools are critical of broadleaf control that do not provide the full strength and control of (indiscernible) or even the same timing flexibility, not effective in all tall weeds. It is impossible for a farmer to rely exclusively on them the way glyphosate (indiscernible) was often used for many years, which leads to resistant weeds. After decades of use on hundreds of

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		millions of acres over time, there are very few weed resistance to these chemistries. As it relates to drip and off-site movement, these chemistries are very familiar to farmers who have used them over the last several decades. In 2012, over 30 million acres of U.S. crop (indiscernible) was treated with dicamba. A large crop market was done. Farmers and applicators are eager to use the new formulation and technologies to reduce any drip on off-site movement. This is motivated by a good neighbor stewardship, inherent to agriculture as well as financial motives that (indiscernible) costly damage. In conclusion, many farmers who grow sensitive crops and specialty crops also grow row crops, and benefit from the use of herbicide tolerant technologies. This is more mutual need to understanding and stewardship than (indiscernible) between different crop types, as most farmers produce a variety of crops for economic and agronomic reasons. This is not about a soybean farmer and a vegetable farmer, or a cotton farmer and a soybean farmer. It's about farmers and farmers. I hope that my comments paint a clear picture for our needs here in rural agriculture. But we need this technology today because the problem is becoming more evident each and every year we wait.
Danny Murphy	Current president, American Soybean Association	As I've traveled around the country speaking to the soybean farmers this year, I continually hear the story of farmers having to deal with resistance to mainly palmer amaranth, and their frustration and desire for these new chemicals to be able to help combat that resistance. Many of those farmers have adopted no-till practices. They're comfortable with those, but their only alternative at this point is for many years to go back to tillage, which results in soil erosion and more expensive reduction costs. So it was really disappointing to see the additional delay in both the dicamba and 2,4-D products. I really feel like the farmers really need these tools to be able to combat this resistance. I think it's critical for us -- for USDA and APHIS to move these products

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		alone and give farmers the opportunity to use them. Both of these products have been used, probably 2,4-D over 50 years and dicamba over 40 years, that they've used. So farmers are familiar with those products, and I think they understand how to use them. They understand the labels that we operate under today, and they're used to dealing with off-target movement and drift and understand what they need to do to correct that. I also would like to respond as a farmer in Mississippi that grows cotton and corn and soybeans. I'm fortunate in this area that I do not have resistant palmer amaranth today. My field's more isolated, but I'm really concerned that the next time I spray, that it may show up. So these tools, both dicamba and 2,4-D, would really provide me an alternative to an alternate chemistry to make sure that I don't develop resistant palmer, or glyphosate resistant palmer. And it would really be a great benefit to me if I was able to insert one of those products in my application and be able to make sure that I don't develop that resistance in the future. I've begun to adopt no-till (indiscernible) farming just as those farmers across the nation have, and super savings in soil erosion and reduced reduction cost, reduced inputs for diesel and labor and equipment. We really need to be able to continue to use these practices. I can say that we really need the availability of the best technology. And to delay the vote for 2,4-D and the dicamba -- and there are a number of products that are coming down the line as that will also be available and help to combat this resistance. So I think it's critical for U.S. agriculture and U.S. farmers that we have these products available.
Barron Brown	Grower	This technology is really made for the (indiscernible). I am fortunate enough that I was in the -- been a part of the Roundup Ready (indiscernible). And I had several acres of the dicamba resistant soybeans. (Comments are indiscernible.) Soybeans are not always important. From my logic, they're also important to crop in the United States. They're found on over more than 55 million acres. We've got to have this technology. That's

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		basically all I really have to say.
Bryan Young	Professor of wheat science, Southern Illinois University	Ultimately, the responsibility that I have with the university is to develop solid recommendations for growers to implement in their field, primary corn and soybeans, as well as some wheat, to be successful and profitable in managing weeds and productivity. So in terms of experience with herbicide-resistant crops, obviously, I've been involved with the use of herbicide-resistant crops with both corn and soybean to date, and I have been involved with testing both the dicamba tolerant soybean system, as well as the 2,4-D tolerant soybean system, the Roundup Ready, and then corn and beans (indiscernible). I think I first want to comment on what brought you to this point. So there's a need for the technology because we have seen a rapid decline in recent years in the robust weed control that we can achieve with glyphosate in some geographies because of resistance. But it's not just resistance to glyphosate, it's resistance to the other herbicides that we have used in the past, such as the inhibiting herbicides, the triazine herbicides, the PTO-inhibiting herbicides. And so, it's been a culmination that's been building for years were you selected for herbicides as to weed biotypes that have been extremely problematic, and now it's represented within the (indiscernible) complex, as well as amaranth and pigweed family, both waterhemp and palmer amaranth. And so, there's a definite need. I'll just share that on Friday, I had a phone call from somebody who is involved with the industry giving recommendations to growers. And they wanted me to provide them, what criteria do I give to the grower to determine if they just dig up the entire soybean field and try again because they applied all available herbicides to date this year, and they still have waterhemp that they were not able to control. And so they obviously need additional tools. So we've gotten to this point where the previous herbicides that

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		we've utilized are not working out, (indiscernible) herbicides resistance, and we need additional tools, and in some cases more herbicides, which sounds like more fuel on the fire, but I would contend that is probably the best solution we have to date until another alternative presents itself. But none have as of yet. So we've gotten to this point in some ways because of our efforts to be more sustainable in crop productivity and crop production. I was part of an analysis looking at the sustainability of U.S. soybean production. That was a publication by CAS (ph), Council for Cultural Science and Technology (ph), and I was the author for the part of weed management side. And that publication spoke towards the greatest component, at least towards sustainability, of soybean production in the U.S., its conservation tillage practices. And because we are reducing the amount of tillage that we use pre-plant or in the fall, or even row cultivation, that means we rely more heavily on herbicides today that we ever have. And so, it would be logical to expect that an outcome of that would be greater selection pressure for herbicide-resistant weeds. So it's not a surprise that in our efforts to be more sustainable in soil conservation practices, that we have greater challenges in how we utilize our herbicides. Now, how do these two technologies fit, the 2,4-D and dicamba technology? Well, actually we've used these herbicides for decades. That has been mentioned by some of the growers as well as Mike Owen and Bob Wolf, who participated thus far. So we're really expanding their use window, so it allows greater flexibility utilizing the herbicides to provide a greater benefit in overall weed management, and I would say the sustainability or stability, if you will, of our weed management practices. So I think they're a key component, and right now they're the only component that we have available because the discovery of new herbicides active ingredients, like that have come in the past 50 years, that pipeline of new active ingredients has dried up temporarily possibly. But we don't have any alternatives, so we're going back to the older herbicides that growers have decided that didn't provide as much benefit. And so these two technologies,

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		2,4-D and dicamba, provide another -- some other options that I would suggest might be favored than some of the other alternatives that we might be considering, especially when it comes to conservation practices and some of the deep tillage that might be occurring in some areas because of these resisting weeds. So the other thing I want to comment about is I have tested both the technologies that have been listed on ready to extend, and in the program, if you will, the herbicide program concept. Now, how we achieve weed control with these technologies in the future, as stated before, it's not just a 2,4-D or a dicamba, and that's all you need like we did with squat (indiscernible), and soon won't develop resistance. I think in most cases I've seen residual herbicides, which represent different herbicide modes of action that are utilized prior to planting and then after planting. And then other herbicides, that all provide solar (ph) activity. It might be glufosinate or glyphosates, around the liberty involved in the mixtures as well. So what I have tested in my research on glyphosate-resistant waterhemp (indiscernible) and glyphosate-resistant marestail, with these technologies has been multiple herbicide modes of action to develop a more sustainable weed management program. So it's not just based on a single herbicide active ingredient. It's more robust, so I think that it is a more sustainable approach to achieving a well-rounded IPM approach for how we manage our weeds. And those are the things I think are important because, as stated before, 2,4-D or dicamba will not control all of our weeds. It's going to be required to involve other herbicides. And I think that is the part that's different than where we went through with the Roundup Ready system back in 1996 when it was released. So moving forward over the next ten years, obviously weed management is going to get a lot more difficult because if we don't have other alternatives to glyphosate that are viable or another older herbicide like the PPO-inhibiting herbicides, we're going to continue to use those herbicides, and we're going to continue to

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		get more resistance to those herbicides and create an even larger problems than what we have today. So it's going to be a challenge to manage these until we get these tools that tell us as scientists be more -- that are able to develop these solutions. And as growers or crop consultants to devise a program on a field-by-field basis to be sustainable as much as possible, as well as being effective and profitable in wheat management and crop production.
Jim Broten	Grower and past chairman, U.S. Grains Council	As you can see, the farmers across the nation all emphasize the importance of our needed to use both 2,4-D and dicamba. And to use it with glyphosate tolerance would just be fantastic. We are in a world market. We need it to feed the world, but we also need to be competitive. And we need all the advantages that we can have, and we need to encourage USDA to pass this quickly as they can.

Appendix 3. Weed Management and Herbicide Use

Weed Management and Herbicide Use

Weed control programs are important aspects of soybean and cotton production intended to prevent the establishment of plants other than the intended crop. In crop production systems, these plants, identified as weeds, are controlled using a number of tactics to maximize the production of food, fiber, and fuel (Green and Martin, 1996). The goal of weed management is to reduce weed populations, allowing for more efficient use of herbicides and other cultural practices to control weeds.

Each field has a finite amount of resources, i.e., light, nutrients, and moisture, available for the growth and development of crops. Weeds allowed to compete with crops can ultimately result in crop yield loss. Once the critical period of weed control (CPWC) has been reached, if weed control is delayed, the yield loss can increase fairly rapidly. Knezevic concluded that delaying the time of weed removal after the starting point of CPWC will cost soybean producers an average of 2% in yield loss per every leaf stage of delay (Knezevic *et al.*, 2003). According to Iowa State University research, uncontrolled weeds of 3-4 inches in corn at the V-3 to V-4 growth stage have been shown to decrease yields by about 3 bushels per acre per day (Rosenberg, 2013). For cotton, if weed control is implemented later than 30 days after crop emergence, it will result in a crop loss yield of greater than 1 % (Schutte *et al.*, 2010).

Weeds species present varying degrees of competitiveness. Table 3-1 shows the potential yield losses associated with specific weed species present at two different densities. The impacts to yield are based on normal weather conditions and adequate soil moisture and assume that the weeds emerged with the crop. Crops under drought conditions or other stresses may have higher yield losses. According to the data, at higher densities annual broadleaf weeds impact yields more than annual grasses (Ontario Ministry of Agriculture and Food, 2009).

The degree of yield loss for a crop can be related to:

- Environmental conditions (e.g., temperature, moisture, etc.),
- The distribution of weed species within a given field;
- Weed density; and
- The timing of weed emergence (i.e., weed height) relative to the crop growth stage (Knezevic, 2007).

Therefore, weed management programs should not only focus on minimizing weed density and yield reductions, they should also include approaches to minimize weed seed banks. Eliminating weeds before seed production diminishes contributions to the weed seed bank and provides the best assurance for improving future weed management.

Weed control programs vary by crop, weed problem, geography, and cropping system (e.g., no-till, conventional-till, etc.). Many growers use a combination of weed control techniques, including cultural, mechanical, and chemical. Practices that establish a dense, vigorous crop canopy quickly (e.g., higher seeding rates, optimum soil fertility, proper seedbed preparation, seeding depth) provide competition to smother weeds.

The keys components to successful weed management are:

- Knowing the exact identity of all weeds in the field;
- Treating (if necessary) while the weeds are small;
- Tailoring control measures to the type of weed and its size (Linker *et al.*).

Although weed control typically involves an integrated approach that includes herbicide use, crop rotation, weed surveillance, and weed monitoring (Farnham, 2001; IPM, 2004; 2007; Hartzler, 2008; University of California, 2009), currently, herbicides are the most common and efficient tactic to manage weeds within agroecosystems (Gianessi and Reigner, 2007). Various strategies utilized for weed management are discussed in the following sections.

<u>Chemical Control - Herbicides</u>

Herbicides are chemicals that move into a plant and disrupt vital biological process. Herbicides have been the primary tactic used to manage weed communities in cotton and soybean since the mid-1960s and will continue to be an important feature of row crop weed management for the foreseeable future. One study, which examined aggregated data on crop yield losses and herbicide use, estimated that even if additional tillage and hand weeding labor replaced the use of herbicides, U.S. crop production would decline by 20 percent with a $16 billion loss in value if herbicides were not used (Gianessi and Reigner, 2007). Herbicide use is not regulated by APHIS but rather by EPA under FIFRA and its amendments.

Before selecting a herbicide program, growers should know what weeds are present or expected to appear, the soil texture and organic matter content, capabilities and limitations of the various herbicides, and how to best apply the herbicides (York and Culpepper, 2000). Additionally, when selecting an herbicide, a grower must consider, among other factors, whether an herbicide can be used on the crop (herbicides are registered by EPA for specific uses and crops), potential adverse effects on the crop, residual effects that can limit crops that can be grown in rotation, effectiveness on expected weeds, and cost.

To be effective, herbicides must (1) adequately contact plants, (2) be absorbed by plants, (3) move within the plants to the site of action without being deactivated, and (4) reach toxic levels at the site of action (Penn State Extention, 2013).

Herbicides are classified according to their effects on plants as either selective or nonselective. Selective herbicides will kill weeds without significant damage to desirable plants. Nonselective herbicides kill or injure all when applied at an adequate rate (Penn State Extention, 2013). Herbicide action is either contact or systemic. Contact herbicides kill only plant tissue contacted by the chemical. Systemic herbicides are absorbed from the point of application, either the roots or foliage, and move within the plant to other plant parts. Systemic herbicides may be effective against both annual and perennial weeds, but are particularly effective for control of established perennial weeds. However, systemic movement of an herbicide in perennial weeds can vary seasonally (NC State University, 1998).

Applications of herbicides to a crop or weed are described according to when they are applied:

- Pre-plant (i.e., burndown): applied to soil before the crop is planted. In burndown situations, there is no crop present requiring post-emergence selectivity if soil-residual herbicide is a component of the burndown application. Burndown applications in both cotton and soybean often incorporate glyphosate, dicamba, and 2,4-D and may include paraquat or glufosinate to control weeds prior to planting the crop.

- Pre-plant incorporated (PPI): for PPI, herbicides are applied to soil and mechanically incorporated into the top 2 to 3 inches of soil before the crop is planted.
- Pre-emergence: applied after the crop is planted, but prior to emergence of the crop. Pre-emergent herbicides are generally not effective after weeds have established.
- Post-emergence: applied after the weeds and crop emerges. Early post emergence application occurs when the crop has just emerged and the weeds are small. Post-emergent herbicides selectively target weeds relative to the crop. The post materials have activity when applied to leaves and can be used over the top of crops if the crop is resistant to the active ingredient.

Most herbicides used as pre-plant and pre-emergent applications are residuals, herbicides that remain active for several weeks and theoretically work continuously after application. These types of herbicides are finding increasing use in the management of glyphosate-resistant weeds. (See Appendix 4, Herbicide Use Trends, for more details). Examples include acetochlor, trifluralin, metolachlor, metolachlor-S, pendimethalin, atrazine and alachlor. These herbicides work by controlling weeds before they germinate or emerge. Usually residual herbicides need to be activated by water (Hager and McGlamery, 1997). In rainfed crops, residual herbicides may fail to become activated during drought. The foliar product controls emerged weeds while the residual material controls weeds prior to germination or emergence.

When herbicides are applied, biochemical pathways that control the growth and development of plants are interrupted and plant death and injury occurs (Sosnoskie and Hanson). These biochemical pathways control the growth and development of plants; when herbicides are applied, these processes are constrained and plant injury and death will occur. Most herbicides bind to, and thereby block the action of, a specific enzyme. Herbicides 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. The Weed Science Society of America (WSSA) has classified herbicides by group number, based on their mode of action. Brief descriptions of these groups are provided (Sosnoskie and Hanson) :

Group 1: herbicides inhibit the action of acetyl CoA carboxylase (ACCase) needed for the synthesis of lipids. Grasses, but not broadleaf weeds, are affected.

Group 2: herbicides inhibit the action of acetolactate synthase (ALS) needed for the synthesis of three amino acids (isoleucine, leucine, and valine).

Group 3: herbicides inhibit cell division (mitosis inhibitors).

Group 4: herbicides are growth regulators. At low concentrations, they mimic the plant growth hormone auxin and are referred to as synthetic auxins. At high concentration they produce distinctive symptoms on broadleaf weeds; twisted and curled stems, malformed flowers, thickened or stunted roots, and cupped, strapped or otherwise deformed leaves. Grasses are usually resistant.

Group 5, 6, and 7: herbicides inhibit photosynthesis leading to a buildup of highly reactive free radicals that damage chlorophyll and cell membranes.

Group 8: herbicides inhibit fatty acid and lipid biosynthesis but not ACCase (Group 1).

Group 9: herbicides inhibit the action of the enzyme enolpyruvyl shikimate-3-phosphate synthase (EPSPS) needed for the synthesis of three aromatic amino acids (tryptophan, phenylalanine, and tyrosine) that are produced through the shikimate pathway.

Group 10: herbicides inhibit glutamine synthetase. These herbicides stop the conversion of glutamate and ammonia to glutamine which causes ammonia to accumulate in the plant, inhibiting photosynthesis and destroying plant cells.

Group 12: herbicides inhibit carotenoid biosynthesis. Lack of carotenoids results in destruction of chlorophyll, which is needed for plant photosynthesis.

Group 14: herbicides inhibit protopophyrinogen oxidase (PPO). PPO inhibitors block the production of chlorophyll and cause reactive molecules to form in the cell, resulting in the destruction of existing chlorophyll molecules, carotenoids and cell membranes.

Group 15: herbicides block mitosis by inhibiting the synthesis of very long chain fatty acids.

Group 20, 21, 29: herbicides inhibit the synthesis of cellulose needed for the synthesis of cell walls.

Group 22: herbicides inhibit photosystem I (PSI) forming reactive molecules that destroy lipids, eventually breaking down plant cell membranes.

Group 27: herbicides inhibit 4-hydroxyphenyl-pyruvate-dioxygenase needed for the synthesis of carotenoids.

Herbicides with a common chemistry are grouped into "families." Also, two or more families may have the same site of action, and thus can be grouped into "classes." Table 3-1 provides WSSA herbicide groups with information on modes of action, chemical families, and example active ingredients and herbicides.

Table 3-1. Herbicide Groups with Example Active Ingredients and Herbicides

	Site of Action Group (WSSA Group)	Site of Action	Number of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient	Herbicide
Lipid Synthesis Inhibitors	1	ACCase Inhibitors (acetyl CoA carboxylase)	15	Aryloxyphenoxy propionate ("FOPs")	fenoxaprop	Puma
					diclofop	Hoelon
					fluazifop	Fusilade
					quizalofop	Assure II

	Site of Action Group (WSSA Group)	Site of Action	Number of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient	Herbicide
				Cyclohexanedione ("DIMs")	clethodim	Select
					sethoxydim	Poast
				Phenylpyrazoline ("DENs")	pinoxaden	Axial XL
Amino Acid Synthesis Inhibitors	2	ALS Inhibitors (acetolactate synthase)	44	Sulfonylurea ("SUs")	chlorimuron	Classic
					foramsulfuron	Option
					halosulfuron	Permit
					iodosulfuron	Autumn
					nicosulfuron	Accent
					primisulfuron	Beacon
					prosulfuron	Peak
					rimsulfuron	Resolve
					thifensulfuron	Harmony
					tribenuron	Express
					metsulfuron	Ally
					triasulfuron	Amber
					chlorsulfuron	Glean
					sulfofsulfuron	Maverick
					mesosulfuron	Osprey
				Imidazolinone ("IMIs")	imazamox	Beyond
					imazaquin	Scepter
					imazapic	Cadre
					imazethapyr	Pursuit
				Triazoloyrmidine	flumetsulam	Python
					chloransulam-methyl	FirstRate
					pyroxysulfam	PowerFlex
					diclosulam	Strongarm
				Triazolinones	thiencarbazone	Component of Caperno
				Pyrimidinyl(thio) benzoate	pyrithiobac	Staple
				Sulfonylaminocar bonyl-triazilonones	flucarbazone	Everest
					propoxycarbazone	Olympus
	9	EPSP Synthase Inhibitor	13		glyphosate	RoundUp
Growth Regulators (Synthetic Auxins)	4	Specific Site Unknown	10	Phenoxy	2,4-D	
					2,4-DB	Butyrac
					MCPA	
				Benzoic acid	dicamba	Banvel
				Carboxylic acid	chlopyralid	Stinger
					fluroxypr	Starane
					picloram	Tordon
	19	Auxin Transport	0	Semicarbazone	diflufenzopyr	Component of Status
Photosynthesis	5	Photosynthesis	24	Triazine	prometryn	Caparol

	Site of Action Group (WSSA Group)	Site of Action	Number of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient	Herbicide
Inhibitors		II Inhibitors (binding sites other than 6 and 7)			atrazine	Aatrex
					simazine	Princep
				Triazinone	hexazinone	Velpar
					metribuzin	Sencor
	6	Photosynthesis II Inhibitors (binding sites other than 5 and 7)	1	Nitrile	bromoxynil	Buctril
				Benzodiazole	bentazon	Basagran
	7	Photosynthesis II Inhibitors (binding sites other than 5 and 6)	7	Ureas		Lorox
Nitrogen Metabolism	10	Glutamine Synthesis Inhibitor		Phosphonic Acid	glufosinate	Liberty
Pigment Inhibitors	13	Diterpene Synthesis Inhibitors	1	Isoxazolidinone	clomazone	Command
	27	HPPD Inhibitors	1	Isoxazole	isoxaflutole	Balance
				Pyrazolone	topramezone	Impact
				Triketone	mesotrione	Callisto
					tembotrione	Laudis
Cell Membrane Disruptors	14	PPO Inhibitors	2	Diphenylether	acifluoron	Blazer
					fomasefen	Reflex
					lactofen	Cobra
					oxyfluorfen	Goal
				N-Phenylphthalamide	flumiclorac	Resource
					flumioxazin	Valor
				Aryl triazinone	sulfentrazone	Spartan
					carfentrazone	Aim
					fluthiacet-ethyl	Cadet
	27	Photosystem I Electron Diverter	5	Bipyridium	paraquat	Gramoxone Inteon
					diquat	Reglone
Seedling Root Growth Inhibitors	3	Microtubule Inhibitors	6	Dinitroaniline	ethalfluralin	Sonalan
					pendamethalin	Prowl
					trifluralin	Treflan
Seedling Shoot Growth	8	Lipid Synthesis	8	Thiocarbamate	butylate	Sutan +
					EPTC	Eradicane

	Site of Action Group (WSSA Group)	Site of Action	Number of Resistant Weed Species in U.S.	Chemical Family	Active Ingredient	Herbicide
Inhibitors		Inhibitors				
	15	Long-chain Fatty Acid Inhibitors	1	Chloroacetamide	acetochlor	Harness
					alachlor	Intrro
					metalochlor	Dual
					dimethanamid	Outlook
				Oxyacetamide	flufanacet	Define
				Pyrazole	pyroxasulfone	Zidua

Sources: (Armstrong, 2009; Glyphosate Stewardship Working Group, 2012).

Mechanical Weed Control – Tillage

Prior to planting, the soil must be stripped of weeds that would otherwise compete with the crop for space, water, and nutrients. Tillage is used to prepare a seedbed, address soil compaction, incorporate fertilizers and herbicides, manage water movement both within and out of a production field, and control weeds (Heatherly *et al.*, 2009). Soil cultivation or tillage can be very valuable in many situations and should be considered as an alternate weed control practice where appropriate:

- Tillage serves as another way to control weeds and break certain weed patterns
- Tillage reduces complete reliance on herbicides
- Periodic tillage is a reliable cultural practice that also provides the benefits of removing trash build-up on the soil surface and levels ruts or rough spots in fields.

Some form of conservation tillage is utilized by the majority of cotton and soybean growers. Tillage can supplement chemical control (i.e., herbicides) and, in the case of light weed infestations, could provide sufficient control if used alone. Cultivation should be shallow to reduce crop root damage and to avoid breaking through any residual herbicide layer and bringing up untreated soil and weed seed. Use of tillage is optimized when weeds are small and should not be practiced for a week prior or after post-emergence herbicide application (York and Culpepper, 2000).

Tillage can be a useful weed control method in some situations but may not be appropriate for all producers or areas. For example, tillage is not a good practice where soils are susceptible to erosion. Also, no-till soybean production is less successful in heavier, cooler soils more typical of northern latitudes (Kok *et al.*, 1997; NRC, 2010).

Although tillage may control weeds, fuel costs and machine maintenance may represent substantial farm expenditures (NRC, 2010). This fact and the availability of herbicide technology have driven producers to increasingly adopt chemical management strategies. For example, in 2012, 98 percent of soybean acreage was treated with synthetic herbicides (USDA-NASS, 2013).

Cultural Weed Control

The successive planting of different crops on the same land is known as crop rotation. In contrast, the planting of the same crop on the same field in successive years is known as continuous crop production. Crop rotations are used to optimize soil nutrition and fertility, reduce pathogen loads, control volunteers (carry over in successive years), and limit the potential for weeds to develop resistance to herbicides (IPM, 2004; 2007; USDA-ERS, 2010).

Crop rotation is also a key element of successful weed control as it often reduces the populations of weeds that closely mimic the appearance of the young crop or are tolerant to herbicides often used in these crops. Crop rotation should be an integral component of a weed management program. Crop rotation generally leads to healthier crops that are more competitive with weeds. Moreover, certain weeds are more easily or more economically managed in one crop than in another. Additionally, crop rotation allows use of different herbicide chemistries on the same field in different years. This can prevent weed population shifts (changes in the species composition), avoid selection of herbicide resistant weeds, and help to keep the overall weed population at lower levels.

Weed control in cotton is essential to maximize both yield and quality of cotton fiber. The slow early growth of cotton does not permit the crop to aggressively compete against weed species that often grow more rapidly and utilize the available water, nutrients, light, and other resources for growth (Smith and Cothren, 1999). Cotton yields can be reduced substantially if weeds are uncontrolled. Palmer amaranth has been reported to cause yield losses as high as 54 percent (Morgan *et al.*, 2001) and johnsongrass and barnyardgrass have been reported to reduce yields by 90 percent and 98 percent, respectively (Vargas *et al.*, 1996). Based on 2005 data, not using herbicides in cotton would result in an increased production cost of approximately $2.3 billion annually and an estimated yield loss of 27 percent (Gianessi and Reigner, 2006).

Weed-crop competition studies have demonstrated that the control of weeds during the first four to eight weeks after cotton planting is critical as weeds compete against the crop for water, nutrients, light and other resources necessary for growth (Smith and Cothren, 1999). The primary weed competition factors affecting yield loss potential are the weed species, weed density, and the timing/duration of weed competition. Cotton emergence and above ground growth is relatively slow during the first few weeks after planting, and does not permit the crop to aggressively compete against often more rapidly developing weed species (Smith and Cothren, 1999). In addition, cotton is primarily planted using wide row spacing which delays crop canopy closure until layby stage of cotton and extends the window of weed-crop competition.

Crop rotation is a common practice on U.S. soybean fields, with approximately 95 percent of the soybean acreage planted in some form of a crop rotation system since 1991 (USDA-ERS, 2013). A variety of crops may be rotated with soybean. In terms of acreage however, corn is the most commonly rotated crop. In a survey of major corn/soybean production states, corn and soybean were alternated on 72 to 80 percent of acreage, other rotations were grown on 16 to 20 percent of acreage, and soybean was grown continuously on 5 to 12 percent of acreage between 1996-2002 (Sandretto and Payne, 2006). Other crops that may be rotated with soybean include wheat, cotton, rice, sorghum, barley, oats, and dry beans.

The mitigation of pest cycles on an agricultural field is one of the primary benefits of crop rotation. The rotation of other crops following soybean production may disrupt pest life cycles that are more adapted to soybean field cultivation than other crops (Poole, 2004) through the creation of a relatively unstable agroecosystem (Weller *et al.*, 2010). For example, crop rotation may encourage the use of alternative herbicides to further control broadleaf weeds in the same field in successive years that would not otherwise be used if continuous soybean was grown (Gunsolus, 2012).

Planting high-quality, weed-free crop seed is another cultural practice that keeps weed infestations low and easier to manage. One of the most effective means of reducing weed competition is to establish a highly competitive crop. This is best accomplished by planting good quality seed into a well-prepared seedbed with good fertility and soil moisture. Higher seeding rates can help establish a competitive crop and for some weed species delaying planting will allow for destruction of early flushes of weeds via tillage or non-selective herbicide application.

Integrated Weed Management

To reduce or mitigate against the selective pressures associated with the use of a single weed management practice, agronomists have recommended that growers adopt a diverse weed management strategy, also known as integrated weed management (IWM) (Norsworthy, 2012; HRAC, 2013). Effective IWM in crops usually involves a combination of cultural, mechanical, and chemical methods. Thus, IWM does not exclude any one management technique. IWM integrates practices such as crop rotation, cover crops, competitive crop cultivars, the judicious use of tillage, and targeted herbicide application to reduce weed populations and selection pressures toward the development of herbicide resistant weeds (Mortensen *et al.*, 2012).

Resistance management begins with good agronomic practices, including the implementation of IWM to incorporate diverse weed control practices to reduce the frequency of herbicide applications and decrease selection pressure for herbicide resistant weed populations (Norsworthy, 2012). IWM programs that use herbicides from different groups, vary cropping systems, rotate crops, and use mechanical as well as chemical weed control methods will prevent the selection of herbicide-resistant weed populations (Powles, 2008; Green and Owen, 2011; Sellers *et al.*, 2011; Gunsolus, 2012; HRAC, 2013).

The Herbicide Resistance Action Committee, an industry-based group, has developed the following general principles of weed resistance management:

- Apply integrated weed management practices. Use multiple herbicide sites-of-action with overlapping weed spectrums in rotation, sequences, or mixtures;
- Use the full recommended herbicide rate and proper application timing for the hardest to control weed species present in the field;
- Scout fields after herbicide application to ensure control has been achieved. Avoid allowing weeds to reproduce by seed or to proliferate vegetatively; and
- Monitor site and clean equipment between sites.

For annual cropping situations, the following recommendations of the Herbicide Resistance Action Committee (HRAC, 2013) are provided:

- Start with a clean field and control weeds early by using a burndown treatment or tillage in combination with a pre-emergence residual herbicide as appropriate;
- Use cultural practices such as cultivation and crop rotation, where appropriate; and
- Use good agronomic principles that enhance crop competitiveness.

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Appendix 4. Herbicide Use Trends and Predicted Dicamba Use on Dicamba-Resistant Soybean and Cotton

Herbicide Use Trends

The following information was presented in Monsanto's *Petitioner's Environmental Report for Dicamba-Tolerant Soybean MON 87708 and Dicamba- and Glufosinate-Tolerant Cotton MON 88701* (ER) (Monsanto, 2013). Additional information can be obtained in the ER, which will be posted by USDA as supplementary information to the Federal Register docket for this EIS:

http://www.regulations.gov/#!docketDetail;D=APHIS-2013-0043

Herbicide Use – Soybean

The use of herbicides has become an important part of managing weeds in soybean. Approximately 98 percent of the soybean acreage received an herbicide application in 2012 (USDA-NASS, 2012b). The availability of herbicide-tolerant soybean products is an important aspect of weed management in U.S. soybean production. Herbicide-tolerant soybean was introduced to provide growers with additional options by improving crop safety (no herbicide damage to the crop) and improving weed control. In 2013, 93% of the U.S. soybean crop was herbicide-tolerant (USDA-ERS, 2013); almost all is glyphosate-tolerant. As a result and as shown by the 2012 use data shown in Table 4-1 (ER Appendix A, Table A-8 (Monsanto, 2013)), glyphosate is the most widely used herbicide, being applied on 98 percent of the soybean acreage in 2012, including for pre-plant burndown and post-emergence in crop applications (USDA-NASS, 2012b). In 2012, dicamba-treated acres in soybean accounted for only 87 thousand acres, or 0.07% of the total pre-emergent treated acres (USDA-NASS, 2012b). This is primarily because dicamba is phytotoxic to current soybean varieties and is therefore currently only labeled for application at timings that avoid contact with the growing plant, such as pre-plant treatments prior to planting, depending on rate and rainfall.

Over 35 different herbicide active ingredients are registered and available for use by soybean growers to control weeds. The ten most widely used alternative herbicides in soybean are listed in Table 4-2 (ER Table II.B-6 (Monsanto, 2013)). Alternative soybean herbicide use has almost doubled between 2009 and 2012. Integration of DT soybean into the glyphosate-tolerant soybean system and the subsequent use of dicamba will result in the displacement of some currently used, or foreseeable future use, non-glyphosate herbicides. Some non-glyphosate alternative herbicides have less benign human health and environmental characteristics as compared to dicamba, and reduced agronomic flexibility due to soybean planting restrictions, rotational crop planting restrictions, the need for adequate soil moisture for activation, or the need to apply prior to planting to minimize crop injury.[1] The properties of these alternative herbicides are summarized in Appendices A and C (see ER (Monsanto, 2013)) to provide a baseline for comparison to dicamba use on DT soybean.

[1] In order to approve a new use of a herbicide EPA must conclude that the herbicide, when used according to the label, does not pose an unreasonable adverse effect to humans or the environment, and, in order to establish a tolerance for the use of a herbicide on a food or feed crop, find there is a reasonable certainty of no harm to human health from non-occupational (food, water and residential/recreational) exposures to the herbicide. Therefore, all alternative herbicides used in soybean production can be used safely, and do not pose an unreasonable risk to humans or the environment.

Table 4-1. Herbicide Applications Registered for Use in Soybean in 2012[1]

Herbicide	Chemical Family	Mode-of-Action (MOA)	Percent-Treated Acres	Total Area Applied (Percent/MOA)	Quantity Applied (1000 lb)	Total Quantity Applied (1000 lb/MOA)
Glyphosate Sulfosate	glycine glycine	EPSPS inhibitor	98 3	100	109,336 1,253	110,589
Pendimethalin Trifluralin	dinitroanaline dinitroanaline	Tubulin inhibitor	2 2	4	1,559 1,306	2,865
Metribuzin Sulfentrazone	triazinone triazolinone	PSII inhibitor	3 8	11	675 1,078	1,753
Chlorimuron-ethyl Cloransulam-methyl Flumetsulam Imazamox Imazaquin Imazethapyr Rimsulfuron Thifensulfuron Tribenuron-methyl	sulfonylurea triazolopyrimidine triazolopyrimidine imidazolinone imidazolinone imidazolinone Imidazolinone sulfonylurea sulfonylurea	ALS inhibitor	11 4 * * * 5 * 5 1	26	187 83 14 6 34 221 4 31 10	590
Acetochlor Metolachlor Dimethenamid	chloroacetamide chloroacetamide chloroacetamide	Cell division inhibitor	1 7 1	9	635 5,683 235	6,553
Paraquat	bipyridilium	PSI disruption	3	3	813	813

Table 4-1 (continued). Herbicide Use in Soybean in the U.S. in 2012[1]

Herbicide	Chemical Family	Mode-of-Action (MOA)	Percent-Treated Acres	Total Area Applied (Percent/MOA)	Quantity Applied (1000 lb)	Total Quantity Applied (1000 lb/MOA)
Clethodim	cyclohexenone	ACCase inhibitor	9	14	524	907
Fenoxaprop	aryloxyphenoxy propionate		*		7	
Fluazifop-P-butyl	aryloxyphenoxy propionate		3		195	
Quizalofop-P-ethyl	aryloxyphenoxy propionate		2		118	
Sethoxydim	cyclohexenone		*		63	
Acifluorfen	diphenylether	PPO inhibitor	1	29	210	2,477
Carfentrazone-ethyl	triazolinones		*		1	
Fluthiacet	thiadiazole		2		10	
Flumiclorac-pentyl	N-phenylphthalimide		1		35	
Flumioxazin	N-phenylphthalimide		11		602	
Fomesafen	diphenylether		8		1,347	
Lactofen	diphenylether		2		192	
Saflufenacil	pyrimidinedione		4		80	
2,4-D	phenoxy	Synthetic auxin	15	15	6,021	6,108
Dicamba	benzoic acid		*		87	
					Total	**132,979**

* Area receiving application is less than 0.5 percent.

[1] Data derived from (USDA-NASS, 2013). Planted acreage for the nineteen primary soybean production states was 72.9 million acres, which represented 96.5% of total planted acres.

Source: Appendix A, Table A-8 (Monsanto, 2013)

Herbicide weed control programs in conventional soybean consist of pre-emergence herbicides used alone or in mixtures. Mixtures of two pre-emergence herbicides are used to broaden the spectrum of control to both grasses and broadleaf weed species. Preemergence herbicides are followed by postemergence applications to control weeds that emerge later in the crop. Total postemergence weed control programs were seldom used in conventional soybean prior to 1995 when glyphosate-tolerant soybean was first introduced. Prior to glyphosate-tolerant soybean, soybean planted in a no-till system would receive a preplant burndown herbicide application for broad-spectrum control of existing weeds at time of planting, followed by different soil residual herbicides at planting and possibly still other herbicides applied postemergence to the crop and the weeds. In conventional soybeans, the typical herbicide program consisted of multiple soil residual herbicides applied preemergence to the crop and weeds and, possibly, other herbicides applied postemergence to the crop and weeds. Therefore, multiple herbicides and/or multiple applications were generally used in conventional and no-till non-glyphosate-tolerant soybean. The average number of herbicide applications per acre in soybean rose from 1.5 in 1990 to 1.7 applications in 1995, reflecting the use of at-plant and postemergence applications or two postemergence applications (Gianessi *et al.*, 2002).

Table 4-2. Ten Most Widely Used Alternative Herbicides in U.S. Soybean Production in 2012

Herbicide	Treated Acres (millions)[1]	Pounds Applied (millions)[1]
2,4-D (acid, salts, and esters,	11.58	6.02
Flumioxazin	8.49	1.56
Imazethapyr	3.86	1.35
cloransulam-methyl	3.09	0.60
chlorimuron-ethyl	8.49	0.52
Fomesafen	6.18	0.22
Clethodim	6.95	0.19
pendimethalin	1.54	0.08
Tribenuron	0.77	0.04
flumiclorac-pentyl	0.77	0.01

[1] (USDA-NASS, 2012b)
Source: Table II.B-6 (Monsanto, 2013)

Selective herbicides are designed to kill specific types of plants, usually grasses or broadleaf weeds, and have proven effective to reduce in-crop tillage or cultivation to control weeds in soybean production. The development of selective herbicides has progressed since the introduction of the first herbicide (2,4-D) for weed control in corn in early 1940s. Although the primary purpose of tillage is for seedbed preparation, tillage still is used to supplement weed control with selective herbicides in soybean production. Refer to Appendix A (see (Monsanto, 2013)) for details on alternative herbicides used in soybean production.

In glyphosate-tolerant soybean, a total of 53 different non-glyphosate herbicides had been used in the preemergence (PRE) timing, while 37 different non-glyphosate herbicides had been used in the postemergence (POST) timing Table 4-3 (ER Table A-9 (Monsanto, 2013)).

Table 4-3. Non-Glyphosate Herbicides Used in Glyphosate-Tolerant Soybeans from 2002 to 2011[a]

Preemergence (PRE) Active Ingredients			Postemergence (POST) Active Ingredients	
2,4-D	Iodosulfuron		2,4-D	Paraquat
2,4-DB	Lactofen		2,4-DB	Pelargonic acid
Acifluorfen	Linuron		Acetochlor	Pendimethalin
Alachlor	MCPA		Acifluorfen	Pyraflufen ethyl
Bentazone	Metolachlor		Alachlor	Quizalofop
Carfentrazone-ethyl	Metolachlor-S		Bentazone	Sethoxydim
Chlorimuron	Metribuzin		Carfentrazone-ethyl	Sulfosate
Chlorsulfuron	Metsulfuron		Chlorimuron	Thifensulfuron
Clethodim	MSMA		Clethodim	Tribenuron methyl
Clomazone	Nicosulfuron		Cloransulam-methyl	
Cloransulam-methyl	Norflurazon		Dicamba	
Dicamba	Paraquat		Dimethenamid	
Diflufenzopyr	Pelargonic acid		Dimethenamid-P	
Dimethenamid	Pendimethalin		Fenoxaprop	
Dimethenamid-P	Pyraflufen ethyl		Fluazifop	
Ethalfluralin	Quizalofop		Flumetsulam	
Fenoxaprop	Rimsulfuron		Flumiclorac	
Fluazifop	Saflufenacil		Flumioxazin	
Flufenacet	Sethoxydim		Fluthiacet-methyl	
Flumetsulam	Simazine		Fomesafen	
Flumiclorac	Sulfentrazone		Imazamox	
Flumioxazin	Sulfosate		Imazaquin	
Fluthiacet-methyl	Thifensulfuron		Imazethapyr	
Fomesafen	Tribenuron methyl		Lactofen	
Glufosinate	Trifluralin		Linuron	
Imazamox			Metolachlor	
Imazaquin			Metolachlor-S	
Imazethapyr			Naptalam	

[a] Unpublished market research data (Monsanto, 2012b)
Source: Table A-9 (Monsanto, 2013).

Herbicide Use – Cotton

Herbicides are used on essentially all (>99%) cotton acres, and in 2011 approximately 39 million pounds of herbicides were applied pre- or postemergence in cotton production (Brookes and Barfoot, 2012; Monsanto, 2012b). According to 2010 market data[2], there were approximately 46.3 million herbicide-treated cotton acres. Herbicides were applied to 21.8 million acres prior to the planting or emergence of cotton (preemergent) and to 24.5 million acres after the emergence of cotton (postemergent). For clarification, the market survey data counts one treated acre as the application of one active ingredient (a.i.) one time to an acre. If the same a.i. is applied a second time to that same acre or if two a.i.s are applied, it counts as two treated acres. USDA reports that 11.0 million acres of cotton were planted in 2010,[3] so that the 46.3 million herbicide-treated cotton acres means that on average each planted

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2 Monsanto Company. 2011. Farmer Survey Data. St. Louis, MO.

3 USDA Statistics for crops and geographic regions are available at http://www.nass.usda.gov/index.asp.

acre received at least 4 herbicide treatments. Cotton acres also received on average four treatments with herbicides during the 2011 growing season (USDA-ERS, 2012).

Herbicide-tolerant cotton is planted on the majority of U.S. cotton acres (73% in 2011), which allows for the postemergence in-crop use of glyphosate for control a broad spectrum of weeds. Glyphosate is the most widely-used herbicide in cotton, applied on 91% of cotton acres with an average of 2.4 applications per growing season (Monsanto, 2012b). In 2010, between 49 and 76% of the growers who plant glyphosate-tolerant (GT) cotton applied non-glyphosate herbicides prior to planting, at planting, or postemergence. Percentages varied among cropping systems, with 76% of GT cotton in a rotation system with GT soybean receiving non-glyphosate herbicide applications, whereas non-glyphosate herbicides were only applied 49% of the time in continuous cotton cropping systems (Prince *et al.*, 2011a).

Over 30 different herbicide active ingredients are registered and available for use by cotton growers to control weeds. Table 4-4 (ER Table A-33 (Monsanto, 2013)) provides a summary of the herbicide applications registered for use in cotton in 2011, demonstrating that herbicides are used on essentially all (>99%) cotton acres in the U.S (Brookes and Barfoot, 2012; Monsanto, 2012b). Approximately 39 million pounds of herbicide active ingredient were applied to cotton in 2011.

Of these treatments, 50% (23.3 million acres) were made with glyphosate herbicides, and the remaining 50% of treatments were made with more than 25 other active ingredients. The number of glyphosate applications on an average cotton acre was between 2 and 3 applications per year at an average rate of 2.0 pounds acid equivalent (a.e.) of glyphosate active ingredient per acre per crop year.

Approximately 53% to 64% of growers used a non-glyphosate herbicide in addition to glyphosate in the glyphosate-tolerant cotton systems in 2005 (Givens *et al.*, 2009a). In 2007, approximately 39% of the growers often or always used herbicides with different modes-of-action in the glyphosate-tolerant cotton systems (Frisvold et al., 2009).

Non-glyphosate herbicides with different modes-of-action are also frequently used to provide residual weed control, improve control on certain weed species, and extend weed control or control resistant weed species (Prince *et al.*, 2011a). The non-glyphosate herbicides applied on cotton in 2011, included ALS inhibitors (trifloxysulfuron, pyrithiobac), longchain fatty acid inhibitors (acetochlor, metolachlor), microtubule inhibitors (pendimethalin, trifluralin), PSII inhibitors (prometryn, fluometuron, diuron), PPO inhibitors (flumioxazin, fomesafen), synthetic auxins (2,4-D, dicamba), glufosinate, MSMA and paraquat (Monsanto, 2012b).

Table 4-4. Herbicide Applications Registered for Use in Cotton in 2011[1]

Herbicide	Herbicide Family	Mode-of-Action (MOA)	Cotton Acres Treated (%)	Cotton Acres Treated per MOA	Quantity Applied (1000 lb a.i. [2])	Total Quantity Applied/MOA (1000 lb a.i.[2])
Glyphosate	Glycine	EPSPS inhibitor	73	73	20,015	20,015
Pendimethalin	Dinitroanaline	Microtubule inhibitor	16	40	1,964	5,043
Trifluralin	Dinitroanaline		24		3,079	
Diuron	Urea	PSII inhibitor	15	34	1,727	3,737
Prometyrn	Triazine		10		1,102	
Fluometuron	Urea		8		870	
Linuron	Urea		<1		38	
Acifluorfen	Diphenylether	PPO inhibitor	<1	38	1	856
Carfentrazone	Triazolinone		<1		<1	
Flumiclorac	N-phenylphthalimide		<1		<1	
Flumioxazin	N-phenylphthalimide		19		192	
Fomesafen	Diphenylether		17		626	
Oxyfluorfen	Diphenylether		1		36	
Pyraflufen	Phenylpyrazole		<1		<1	
2,4-D	Phenoxy	Synthetic Auxin	17	27	1,659	2,023
Dicamba	Benzoic acid		10		364	
Pyrithiobac	Benzoate	ALS inhibitor	14	21	113	120

Table 4-4. (continued). Herbicide Applications Registered for Use in Cotton in 2011[1]

Herbicide	Herbicide Family	Mode-of-Action (MOA)	Cotton Acres Treated (%)	Cotton Acres Treated per MOA (%)	Quantity Applied (1000 lb a.i. [2])	Total Quantity Applied/MOA (1000 lb a.i.[2])
Thifensulfuron	Sulfonylurea		<1		<1	
Thibenuron	Sulfonylurea		<1		<1	
Trifloxysulfuron	Sulfonylurea		6		6	
Acetochlor	Chloroacetamide	Long-chain fatty acid inhibitor	8	25	1,502	4,587
Metolachlor	Chloroacetamide		17		3,085	
Norflurazon	Pyridazinone	Inhibition of carotenoid	<1	<1	2	2
Paraquat	Bipyridylium	Photosystem-I-electron	10	10	735	735
Glufosinate-ammonium	Phosphinic acid	Glutamine synthesis	10	10	800	800
MSMA	Organoarsenical	Cell membrane	6	6	1,066	1,066
Clethodim	Cyclohexanedione	ACCase inhibitor	<1	<1	3	3
Fluazifop	Aryloxphenoxy propionate		<1		<1	
Diflufenzopyr	Semicarbazone	Auxin transport	<1	<1	3	3
Clomazone	Isoxazolidinone	Diterpene synthesis	<1	<1	<1	<1
Total				99.4		38,992

[1] Updated version of Table VIII-9 of petition 12-185-01p_a1 (Monsanto, 2012a) with 2011 data (Monsanto, 2012b).
[2]lb a.i.= pounds active ingredient.

Source: Table A-33 (Monsanto, 2013).

Dicamba is currently labeled for use in cotton although its use is limited to preplant applications due to cotton's susceptibility to dicamba. Consequently, the average application rate preplant in cotton is 0.26 pounds of dicamba per acre with one application per season. Dicamba preplant use in cotton has been on the rise in recent years, increasing from 140,000 acres in 2004, to 590,000 acres in 2008, and 1.4 million acres, or 9.6% of U.S. cotton acres, in 2011 (Monsanto, 2012b). This is primarily because it is a leading recommended herbicide for control of glyphosate-resistant marestail and Palmer amaranth in the Southeast and Midsouth region (McClelland *et al.*, 2006; AgWatch, 2011; University of Georgia, 2012)

The ten most widely used alternative herbicides in cotton in 2010 are listed in Table 4-5 (ER Table B-18 (Monsanto, 2013)), compared to 2007 use.

Table 4-5. Ten Most Widely Used Alternative Herbicides in U.S. Cotton Production

Herbicide	2007 Applications (million lb)[1]	2010 Applications (million lb)[1]
Trifluralin	2.8	3.1
Diuron	1.3	1.3
Pendimenthalin	1.3	1.2
S-metolachlor	0.6	1.1
Prometryn	0.6	0.4
2,4-D, dimethylamine salt	0.3	0.4
Fluormeturon	0.3	0.4
MSMA	0.4	0.3
Fomesafen	0.05	0.2
2,4-D, ethylhexyl ester	0.1	0.1

1 (USDA-NASS, 2014)
Source: Table B-18 (Monsanto, 2013)

Soil residual herbicides play an important role in cotton weed management by providing control of a number of weeds species that continuously germinate in cotton prior to canopy closure (Wilcut *et al.*, 2003). Soil residual herbicides, such as pendimethalin, trifluralin, diuron, fluometuron, acetochlor, and metolachlor, are applied to more than 40% of the current cotton acres (Monsanto, 2012b). In addition, many of the soil residual herbicides are limited by application restrictions, plant-back restrictions, the need for adequate soil moisture for activation, and the need to apply prior to planting or with hooded sprayers in-crop to minimize crop injury. Approximately 20% of growers applied a fall residual herbicide to control weeds prior to planting the following spring, and 60% (continuous cotton system) to 75% (GR cotton/GR soybean rotation) applied a mixture of glyphosate and a synthetic auxin herbicide (2,4-D or dicamba) as a spring burndown application (Prince *et al.*, 2011a). Post emergent residual herbicides, such as metolachlor and acetochlor, were applied on over 25% of cotton acres in 2010 (Monsanto, 2012b).

In glyphosate-tolerant cotton, a total of 38 different non-glyphosate herbicides had been used in the PRE timing while 40 non-glyphosate herbicides had been used at the POST timing (Table 4-6) (ER Table A-34 (Monsanto, 2013)).

Table 4-6. Non-Glyphosate Herbicides Used in Cotton from 2002-2011

Preplant/preemergence Active Ingredients	Postemergence Active Ingredients
2,4-D	2,4-D
2,4-DB	Acetochlor
Alachlor	Acifluorfen
Bromoxynil	Alachlor
Carfentrazone-Ethyl	Bromoxynil
Clethodim	Carfentrazone-Ethyl
Clomazone	Clethodim
Cyanazine	Cyanazine
Dicamba	Dicamba
Diflufenzopyr	Dimethipin
Diuron	Diuron
Fluazifop	DSMA
Flumiclorac	Fenoxaprop
Flumioxazin	Fluazifop
Fluometuron	Flumiclorac
Fomesafen	Flumioxazin
Glufosinate	Fluometuron
Lactofen	Fomesafen
Linuron	Glufosinate
Metolachlor	Hexazinone
Metolachlor-S	Lactofen
MSMA	Linuron
Norflurazon	Metolachlor
Oxyfluorfen	Metolachlor-S
Paraquat	Metsulfuron
Pendimethalin	MSMA
Prometryn	Oxyfluorfen
Pyraflufen Ethyl	Paraquat
Pyrithiobac-Sodium	Pelargonic Acid
Quizalofop	Pendimethalin
Rimsulfuron	Prometryn
Saflufenacil	Pyraflufen Ethyl
Sethoxydim	Pyrithiobac-Sodium
Sulfosate	Quizalofop
Thifensulfuron	Rimsulfuron
Tribenuron Methyl	Sethoxydim
Trifloxysulfuron	Sulfosate
Trifluralin	Trifloxysulfuron
	Trifluralin
Total 38	**40**

Source: Table A-34 (Monsanto, 2013).

Further details on the use of non-glyphosate herbicides in cotton producing states can be found in Prince et al. (2011a; 2011b), where it is reported that approximately 50% of surveyed growers who did not have glyphosate-resistant weeds on their farm used a non-glyphosate residual and/or postemergence herbicide in the 2009 growing season. For growers who have on-farm herbicide-resistant weed populations, the percentage of growers was higher, with 72% to 75% reporting the use of non-glyphosate herbicides. Older studies report that approximately 40 to 50% of the growers utilizing glyphosate-tolerant crops indicate that applying herbicides with different modes-of-action in sequence, rotating herbicides with different modes-of-action across the season, or tank mixing glyphosate with other herbicide modes-of-action are effective management practices to minimize the evolution and/or development of glyphosate resistance (Powles *et al.*, 1996; Diggle *et al.*, 2003; Beckie, 2006; Beckie and Reboud, 2009). The use of non-glyphosate herbicides in cotton production is expected to continue to increase as more growers adopt more diversified weed management strategies. Refer to Appendix A (see ER (Monsanto, 2013)) for details on alternative herbicides used in cotton production.

Volume Projections for Proposed New Uses of Dicamba

The following sections of Appendix 4 present Monsanto's projections of the increases in dicamba usage volumes based on the proposed new dicamba application rates for DT soybean and cotton. Monsanto has submitted an application to EPA to amend current registrations of DGA salt formulation for new uses of dicamba on dicamba-resistant soybean and cotton. The application is currently being evaluated by the U.S. Environmental Protection Agency (EPA).

Details on and supporting information for Monsanto's calculations can be found in the Environmental Report prepared by Monsanto (Monsanto, 2013) and posted by USDA as supplementary information to the Federal Register docket for this EIS:

http://www.regulations.gov/#!docketDetail;D=APHIS-2013-0043

Impact of DT Soybean Deregulation on Dicamba Usage

Use of Low-Volatility DGA Salt of Dicamba – Proposed Changes in Dicamba Registration: Monsanto has submitted to EPA an application to amend EPA Reg. No. 524-582 to register a new use pattern for dicamba on DT soybean. The current and proposed uses are summarized in Table 4-7 (ER Table IV.A-1 (Monsanto, 2013)).

Table 4-7. Summary of Dicamba Uses on Soybean

Application Timing	Current Approved Uses		Proposed Uses on DT soybean	
	Maximum Single Application Rate (lb a.e./acre)	Maximum Annual Application Rate (lb a.e./acre)	Maximum Single Application Rate (lb a.e./acre)	Maximum Annual Application Rate (lb a.e./acre)
Pre-emergence	0.50[1]	2.0	1.0[2]	2.0
Post-emergence	Not labeled		**0.50** (V3) + **0.50** (R1/R2)[3]	
Pre-harvest (7 days prior to harvest)	1.0		Not labeled	

[1] 14-28 day planting interval based on product application rate
[2] No planting interval
[3] In-crop application through V3 with a sequential application through R1/R2 growth stage as needed. Total of all in-crop applications from emergence up to R1/R2 is 1.0 lb a.e./acre.
Source: Table IV.A-1 (Monsanto, 2013).

In the pending application to EPA, Monsanto requested approval only for the low volatility DGA salt formulation of dicamba (U.S. EPA Reg. No. 524-582) for use on DT soybean, and has proposed that dicamba applications be limited to ground applications only (*i.e.*, no aerial spraying), as well as proposing additional enforceable directions for use. Monsanto has also requested the establishment of a tolerance for soybean forage and hay; no other revisions to the dicamba residue tolerances are necessary, including animal products such as meat and milk.

Combination with Glyphosate-Tolerant Soybean. DT soybean is intended to be combined with glyphosate-tolerant soybean utilizing traditional breeding techniques. Soybean containing both DT soybean and glyphosate tolerance will allow the use of glyphosate and dicamba herbicides in a diversified weed management program, which includes the use of residual herbicides or other cultural practices, to control a broad spectrum of grasses and broadleaf weed species, and to sustain and complement the benefits and value of the glyphosate use in the glyphosate-tolerant systems. The combined system will support long-term sustainability of weed management in soybean and, in turn, support sustained, economic soybean production.

Inclusion of Potential Impacts from Herbicide Use: As discussed above, it is EPA's regulatory authority under FIFRA to register pesticide products for their intended uses. EPA has sole authority to regulate the use of any herbicide. Nonetheless, for the reasons discussed above, this environmental report evaluates potential impacts of dicamba use associated with DT soybean on the human environment.

Anticipated Weed Management Recommendations for DT Soybean: Monsanto's weed management system recommendations are shown in Table 4-8 (ER Table IV.A-2 (Monsanto, 2013)). The recommended use patterns for dicamba on DT soybean will vary across U.S. soybean growing regions based on differences in growth habits and competitiveness of certain glyphosate-resistant weed species. Option 1 would be recommended for more aggressive glyphosate-resistant weed species, such as Palmer amaranth (*Amaranthus palmeri*) and waterhemp (*Amaranthus rudis*). These weed species are very fast growing, highly competitive with crops, high seed producers, very densely populated, and germinate and emerge throughout the growing season (Keeley *et al.*, 1987; Nordby *et al.*, 2007; Fast *et al.*, 2009; Sprague, 2012). Two sequential postemergence applications will generally be required to control late-season emergence of these weed species. However, low rainfall conditions and/or early crop canopy closure that can be associated with narrow row spacing of soybean can reduce late-season weed emergence and potentially reduce the number of dicamba postemergence applications. Option 2 would be used for less aggressive glyphosate resistant weed species, such as horseweed (*Conyza canadensis*), common ragweed (*Ambrosia artemisiifolia*) and giant ragweed (*Ambrosia trifida*).

These weed management system recommendations represent a high-end proposal for dicamba use associated with DT soybean when combined with glyphosate-tolerant soybean. The actual number of applications and timing of applications of dicamba or glyphosate that the grower will make will vary depending on the specific weed spectrum, weed infestation levels, and the agronomic situation of the individual soybean field. Applying a residual herbicide preemergence in sequence with glyphosate plus dicamba postemergence, or tank mixing a residual herbicide with glyphosate plus dicamba postemergence could be considered as an alternative to two postemergence applications of glyphosate plus dicamba for season long weed control.

Table 4-8. Proposed Weed Management System Recommendations for DT Soybean Combined with Glyphosate-Tolerant Soybean

Application Timing	Conventional Tillage[1]			Conservation Tillage (No-till or reduced till)[1]		
	No GR Weeds	GR Weeds or Suspected GR Weeds[2]		No GR Weeds	GR Weeds or Suspected GR Weeds[2]	
		Option 1[4]	Option 2[5]		Option 1[4]	Option 2[5]
Pre-emergence/ Pre-plant Burndown[3]	Residual	Residual	Residual	Residual plus Glyphosate plus Dicamba	Residual plus Glyphosate plus Dicamba	Residual plus Glyphosate plus Dicamba
Post-emergence 1 (V1-V3)	Glyphosate plus Dicamba	Glyphosate plus Dicamba	Glyphosate plus Dicamba	Glyphosate plus Dicamba	Glyphosate plus Dicamba	Glyphosate plus Dicamba
Post-emergence 2 (V4-R1)	---	Glyphosate plus Dicamba	---	---	Glyphosate plus Dicamba	---

[1] Anticipated average rate for dicamba is 0.38 pound a.e. per acre except for fields with glyphosate resistant (GR) species where a 0.5 pound a.e. per acre postemergence application rate will be recommended in most situations. See Appendix A (Monsanto ER (Monsanto, 2013)).
[2] GR indicates glyphosate-resistant
[3] Monsanto and academics recommend the use of soil residuals as part of a comprehensive weed resistance management program to ensure that at least two effective herbicide modes-of-action are used in soybean and to provide protection against additional resistance development to existing herbicides used in soybean production. When a residual plus glyphosate plus dicamba is recommended the residual may be applied separately or in tank mixture with glyphosate plus dicamba.
[4] Option 1 would be used for more aggressive glyphosate resistant weed species, such as *Amaranthus spp*.
[5] Option 2 would be used for less aggressive glyphosate resistant weed species, such as horseweed.
Source: Table IV.A-2 (Monsanto, 2013).

Potential Additional Dicamba Use. It is impossible to determine the exact amount of acreage on which DT soybean may be grown if deregulated. Projections on the annual application of dicamba used on DT soybean are based on market adoption rates and the dicamba use pattern on DT soybean. The maximum possible annual application of dicamba on DT soybean, based on 100% adoption of across all U.S. soybean acreage (75 million acres) and applications of dicamba at the maximum labeled rates (proposed at 2.0 lbs a.e. per acre per year), would be 150 million pounds dicamba (as acid equivalent or a.e.). However, as discussed below, the actual total anticipated application will be much lower.

For the purposes of this assessment, it is assumed that DT soybean will occupy 40% of the U.S. soybean acreage at peak penetration. This estimate is based on a number of factors: 1) the percentage of non-glyphosate herbicides currently used in glyphosate-tolerant soybean, 2) current and historical use of dicamba in corn, 3) the development of glyphosate-resistant weeds in soybean cultivation areas, 4) the effectiveness of other non-glyphosate herbicides used in glyphosate-tolerant soybean, s; and 5) the foreseeable future introduction of new competitive biotechnology-derived traits in soybean.

Similarly the anticipated use patterns for dicamba on DT soybean will vary across U.S. soybean growing regions. This variability is dictated by growth habits and competitiveness of certain glyphosate-resistant weed species. As discussed above in *Anticipated Weed Management Recommendations for DT Soybean*, weed management recommendations will vary based on cultivation practices (i.e., tillage) and spectrum of glyphosate-resistant weeds present in the field. Based on weed management trials conducted across regions and weed spectrum a single early season in-crop application per year of dicamba at 0.38 lb a.e. per acre is expected on the majority of DT soybean acres. However, in no-till or conservation tillage soybean systems, an additional preplant application at 0.50 lb a.e. per acre could also be common practice, and in areas where glyphosate resistant weeds, especially *Ambrosia and Amaranthus* species, are present two in-crop applications at 0.5 lb a.e. each may be needed in some situations. See Appendix A (of Monsanto's ER: (Monsanto, 2013)) for additional information supporting these anticipated use patterns.

Based on the anticipate dicamba application and use rate analysis summarized above, use of DT soybean on 40% of U.S. soybean acres would result in approximately 20.5 million lbs a.e. of dicamba applied to DT soybean annually (including preplant, preemergence and in-crop applications), see Table 4-9 (ER Table IV.A-3 (Monsanto, 2013)). Currently 233,000 lbs a.e. of dicamba are applied preplant to commercially available soybean (Monsanto, 2012b).

The potential increase in dicamba usage associated with DT soybean production is expected to displace, in part, some of the current herbicides used in soybean today. Dicamba offers a relative reduction of risk potential in comparison to some of the alternative non-glyphosate herbicides currently available to soybean growers (see Appendices E and F (Monsanto, 2013)). Dicamba could be expected to conservatively replace approximately 21% of the projected total acres treated (TAT)[4] for all non-glyphosate herbicides used in preplant/preemergence application timing and 56% of the projected TAT for all non-glyphosate herbicides used in postemergence application timing at peak dicamba use based on a projection that 40% of total planted soybean acres may be treated with dicamba following the introduction of DT soybean. At projected peak penetration of dicamba use in DT soybean, an increase in both total soybean acres treated and total pounds of non-glyphosate herbicides applied to soybean is projected, however estimated increases are 12% or less of the total herbicide use projections if DT soybean is not commercialized.

[4] The use of TAT provides a way to look at herbicide use that is independent of the various use rates of herbicides. If a herbicide is used more than once on an acre the TAT will reflect this multiple use, and consequently the TAT may exceed the number of crop acres planted. This provides a more complete view of herbicide use.

Table 4-9. Projected Dicamba Use on DT Soybean

Use Scenario	Dicamba Treated DT Soybean Acres (x1,000,000)	# PRE applications	PRE application rate (lb/acre a.e.)	# POST applications (V3 or V3 & R1)	POST application rate (lb/acre a.e.)	Total lb of Dicamba (000,000)[a]	Total Annual lb of Dicamba
Maximum labeled use pattern, 100% adoption							
	75	1	1.0	2	0.50	150	**150**
Anticipated use pattern, 100% adoption							
no-till acres [b]	30	1	0.5	1	0.38	26.4	
conventional tillage acres[c]	45			1	0.38	17.1	
Total							**44**
Anticipated use pattern, anticipated peak adoption of dicamba-treated DT soybean acres							
no-till acres [b]	12[d]	1	0.5	1	0.38	10.6	
conventional tillage acres[c]	18[d]			1	0.38	6.8	
Resistant *Amaranthus spp.* acres [e]	5			2	0.31[f]	3.1	
Total							**20.5**[g]

[a] Total lbs dicamba is calculated combining the lbs of dicamba PRE and POST, where the lbs dicamba used either PRE or POST is calculated by multiplying the number of applications by the application rate for the respective application timing.

[b] No-tillage is practiced on 40% of the U.S. soybean acres (CTIC, 2007).

[c] Conventional tillage acres also includes acres where reduced or minimum tillage is practiced and where it is assumed that a preemergent application of dicamba will be needed for weed control.

[d] Monsanto projects dicamba to be used on 40% of U.S. soybean acres (i.e., 30 million acres).

[e] These acres are a subset of the no-till and conventional tillage acres.

[f] Monsanto anticipates that two POST applications at 0.5 lb/acre a.e. each will be needed on acres resistant with A*maranthus spp*. Since these acres are a subset of the no-till and conventional tillage acres where a single POST application at 0.38 lb/acre dicamba a.e. has already been accounted for, the POST application rate is adjusted to avoid double counting of dicamba use on this subset of acres (i.e., adjusted POST application rate = 0.5 lb/acre – (0.38÷2) lb/acre).

[g] This figure is slightly less than the estimate of 22 million pounds described in Section VIII.H of the petition because it subtracts out the single 0.38 lb/acre a.e. application already accounted for in the no-till and conventional tillage calculations.

Impact of DGT Cotton Deregulation on Dicamba Usage

The deregulation and commercialization of DGT cotton will expand dicamba use to in-crop postemergence applications to address hard-to-control and herbicide-resistant broadleaf weeds found in U.S. cotton production. The impact that DGT cotton will have on overall dicamba use will depend on the level of DGT cotton adoption by growers. Therefore, the extent of DGT cotton acreage following the deregulation of DGT cotton is difficult to forecast. Monsanto estimates that dicamba-treated acres could ultimately reach 50% of the total U.S. cotton acres. This estimate is based on a number of factors, including: (1) the percentage of non-glyphosate herbicides currently used in glyphosate-tolerant cotton; (2) the development of glyphosate-resistant weeds; (3) the effectiveness of other non-glyphosate herbicides used in the glyphosate-tolerant cotton weed control systems; (4) the perceived risk of offsite movement onto dicamba-sensitive crops; and (5) the foreseeable future introduction of new competitive GE-derived traits in cotton.

Approximately 53% to 64% of growers used a non-glyphosate herbicide in addition to glyphosate in the glyphosate-tolerant cotton systems in 2005 (Givens *et al.*, 2009a). In 2007, approximately 39% of the growers often or always used herbicides with different modes-of-action in the glyphosate-tolerant cotton systems (Frisvold *et al.*, 2009). Regardless of the availability of DGT cotton, the future use of non-glyphosate herbicides is expected to increase in order to support the management of glyphosate-resistant weeds. Additionally, grower educational programs on weed resistance management conducted by industry and universities encourage the use of non-glyphosate herbicides with alternative modes-of-action in glyphosate-tolerant cropping systems as a proactive measure to minimize the potential for development of glyphosate-resistant weeds (Powles, 2008; Beckie *et al.*, 2011). These programs will likely drive a further increase in non-glyphosate herbicides applied in cotton production.

A second factor impacting dicamba-treated cotton acreage is the current and future need for control of glyphosate-resistant weeds. Glyphosate-resistant weeds have been identified in multiple states (Heap, 2014). When a glyphosate-resistant weed biotype has been confirmed to be present in a geographical area, growers in that area are advised proactively to implement glyphosate-resistant weed management programs to ensure effective control of the resistant weed biotype regardless of whether the weed species has been confirmed to be resistant on a grower's farm. Therefore, the acreage in an area where responsive weed resistance management practices are implemented is potentially greater than the actual acres known to be impacted by glyphosate-resistant weeds. University weed scientists recommend that growers implement best management practices, including a non-glyphosate herbicide with a second mode-of-action, in their cropping systems to minimize the development and potential spread of glyphosate-resistant weeds in the future (Hurley *et al.*, 2009; Owen *et al.*, 2011; Norsworthy, 2012; University of Georgia, 2012; Culpepper *et al.*, 2013).

It is anticipated that even in locations where glyphosate-resistant weeds are present, glyphosate will continue to be the base herbicide applied to DGT cotton as a combined trait product with glyphosate-tolerant cotton. Table 4-4 (ER Table A-33 (Monsanto, 2013)) provides a summary of the herbicide applications registered for use in cotton in 2011, demonstrating that herbicides are used on essentially all (>99%) cotton acres in the U.S (Brookes and Barfoot, 2012; Monsanto, 2012b). Approximately 39 million pounds of herbicide active ingredient were applied to cotton in 2011. These alternative herbicides will compete with dicamba and are expected to reduce the potential dicamba use on DGT cotton integrated into the glyphosate-tolerant cotton systems and in future combined trait products containing DGT cotton.

Another factor influencing the number of dicamba-treated cotton acres in the future will be the introduction of competing herbicide-tolerant traits in cotton. Currently, there are numerous herbicide-tolerant cotton products that are under regulatory review or have recently been authorized. This includes several products that have tolerance to multiple herbicides with different modes-of-action. These new GE-derived herbicide-tolerant cotton products are anticipated to be introduced in future years and will compete with Monsanto's DGT cotton and glyphosate-tolerant cotton products, thereby further reducing the potential dicamba use in cotton.

Taking into consideration the above assessment, the potential acreage of DGT cotton treated with dicamba is estimated to be 50% of the U.S. cotton acres, and would result in approximately 5.2 million pounds a.e. of dicamba applied to DGT cotton annually (including preplant, preemergence, and in-crop applications). Currently, 364,000 pounds of dicamba are applied preplant to commercially available cotton (see Table 4-4) (ER Table A-33 (Monsanto, 2013)). It is anticipated that dicamba applications will continue for all other currently labeled crops at the current annual level of approximately 3.8 million pounds (see Table 4-4) (ER Table A-33 (Monsanto, 2013)). Therefore, the addition of the estimated 5.2 million pounds of dicamba that would be applied to DGT cotton would result in a total U.S. dicamba use of approximately 9 million pounds annually.

Use of Low-Volatility DGA Salt of Dicamba – Proposed Changes in Dicamba Registration: Monsanto has requested a registration from U.S. EPA for the expanded use of a low volatility diglycolamine (DGA) salt of dicamba on DGT cotton, limited dicamba application to ground application equipment, as well as proposing additional stewardship measures. Monsanto plans to further address the use of dicamba on DGT cotton with U.S. EPA to evaluate whether any additional measures may be appropriate to further address potential drift and offsite movement. Monsanto has also requested an increase in the dicamba residue tolerance for cottonseed, the establishment of a tolerance for cotton gin by-products, and the inclusion of DCSA in the residue definitions for both cottonseed and gin by-products.

Monsanto submitted an application to EPA to amend Registration number 524-582, a low-volatility DGA salt formulation, to remove all existing preemergence planting restrictions (application intervals, rainfall, and geographic) and to allow in-crop postemergence dicamba applications to DGT cotton containing varieties[5]. Before any application of dicamba can be made onto commercially cultivated DGT cotton, the EPA must first approve a label describing the conditions of use of the herbicide on DGT cotton – including the appropriate application rates and timing, and other measures necessary to address potential impacts of dicamba drift and offsite movement. Dicamba can currently be applied to cotton in the U.S. as a preplant application, at least 21 days prior to planting. Following EPA approval of the dicamba label amendment, growers would be authorized to apply dicamba alone or in mixtures with glyphosate, glufosinate, or other registered herbicides for preplant or postemergence in-crop applications on DGT cotton. If the proposed label is approved by EPA, dicamba would be authorized to be applied up to 1.0 lb a.e.

[5] The current dicamba label approved by EPA prohibits dicamba preplant application on cotton west of the Rockies due to the potential for direct crop injury caused by dicamba in conjunction with the environmental conditions in this area. This restriction will not be included on the amended label for application of dicamba on DGT cotton since DGT cotton is tolerant to dicamba.

per acre any time prior to cotton emergence, and postemergence in-crop up to 0.5 lbs a.e. per acre per application up through seven days prior to harvest. Maximum application amounts for dicamba would be 1.0 lb a.e. per acre for preplant/preemergence applications and 0.5 lb a.e. per acre per in-crop application with the combined total not to exceed 2.0 lbs a.e. dicamba per year for all applications. The proposed application rates on DGT cotton would be less than or equivalent to rates for dicamba established for other uses in the dicamba RED including the 2.0 lbs a.e. dicamba per year for all applications (U.S. EPA, 2009). Based on Monsanto's proposed dicamba label, aerial applications of dicamba will not be allowed on DGT cotton, thereby reducing spray drift potential (BASF, 2008). Monsanto has requested a registration from U.S. EPA for the expanded use of dicamba on DGT cotton, an increase in the dicamba residue tolerance from 0.2 ppm to 3 ppm for cottonseed, the establishment of a tolerance of 70 ppm for cotton gin by-products, and the inclusion of DCSA in the residue definitions for cottonseed and gin by-products. No other revisions to the dicamba residue tolerances are necessary, including animal products such as meat and milk. Furthermore, the use of dicamba on DGT cotton does not present any new environmental exposure scenarios not previously evaluated in the RED and deemed acceptable by EPA.

Use of Glufosinate – No Changes in Registration: The PAT(*bar*) protein acetylates the free amino group of glufosinate to produce non-herbicidal N-acetyl glufosinate, a known metabolite in glufosinate-tolerant plants (OECD, 2002). The use pattern and rate of glufosinate application on DGT cotton will follow the existing glufosinate-tolerant cotton uses outlined on the existing glufosinate herbicide label (Bayer Crop Science, 2007) and Monsanto has confirmed that glufosinate residues on DGT cotton treated with commercial glufosinate rates are below the established pesticide residue tolerances established by U.S. EPA for both cottonseed and gin by-products (40 CFR 180.473). Consequently, Monsanto has not and will not pursue any changes in the glufosinate label or the established tolerances for its use on DGT cotton. Because there will be no changes in the use pattern and rate of glufosinate on DGT cotton from the current baseline, these aspects related to the associated use of glufosinate on DGT cotton are not discussed in detail in this analysis.

Combination with Glyphosate-Tolerant Cotton. DGT cotton is intended to be combined with glyphosate-tolerant cotton utilizing traditional breeding techniques. Cotton containing both DGT cotton and glyphosate tolerance will allow the use of glyphosate, dicamba, and glufosinate herbicides in a diversified weed management program, which includes the use of residual herbicides or other cultural practices, to control a broad spectrum of grasses and broadleaf weed species, and to sustain and complement the benefits and value of the glyphosate use in the glyphosate-tolerant systems. The combined system will support long term sustainability of weed management in cotton and, in turn, support sustained, economic cotton production.

Use of Multiple Herbicide-Tolerant Traits. In recent years, the development, in certain areas of the U.S., of glyphosate-resistant weeds, as well as shifts in broadleaf weed populations to species that are inherently more tolerant to glyphosate, have increased the use of non-glyphosate herbicides that work through different modes-of-action to achieve an acceptable level of weed control. As a result, multiple herbicide-tolerant traits are and have been developed to provide cotton growers with additional weed control options that will compete with DGT cotton. These herbicides and traits will be available at the time DGT cotton is introduced to the marketplace; thus, DGT cotton will compete for market share with approved herbicide tolerance traits, including

LibertyLink®, GlyTol®, and TwinLink® combined-trait products, and new herbicide-tolerance traits that will be available in the foreseeable future. Growers will ultimately select weed control systems that fit the needs for their individual farming operation, such that some proportion of growers will choose to use DGT cotton-containing varieties integrated into glyphosate-tolerant cotton systems.

Anticipated Weed Management Recommendations for DGT Cotton: The expected use patterns for dicamba and glufosinate on DGT cotton will vary across U.S. cotton growing regions. This variability is dictated by the environment and weed spectrum variations across these regions. Monsanto's recommendations for the Midsouth and Southeast regions are shown in Table 4-10 (ER Table IV.A-4 (Monsanto, 2013)). In these regions, conventional tillage planted acres are expected to receive a single in-crop application per season of dicamba at 0.5 lbs a.e. per acre and conservation tillage or no-tillage acres are expected to receive two applications (one preplant application at 0.375 lbs a.e. per acre and one in-crop application at 0.50 lbs a.e. per acre). All acres in this region where glyphosate-resistant weeds are present, regardless of tillage, are expected to receive a single in-crop application of glufosinate as 0.53 lbs a.i. per acre. For the remaining acres where glyphosate-resistant weeds are not present, glyphosate will likely be used for control of late-emerging weeds. Dicamba and glufosinate use in eastern Texas and California is expected to be similar to that described for the Midsouth and Southeast regions.

In western Texas, New Mexico, Kansas, Oklahoma, and Arizona, dicamba is expected to be utilized more extensively than glufosinate for management of hard-to-control and/or glyphosate-resistant weeds in DGT cotton. Glufosinate is considered less effective on the weed spectrum under the high temperature and low humidity environmental conditions in these regions (Bayer CropScience, 2011). The recommendations for these cotton growing areas are shown in Table 4-11 (ER Table IV.A-5 (Monsanto, 2013)). All acres are expected to receive one preplant application of dicamba (0.375 lbs a.e. per acre). Areas with glyphosate-resistant weeds are also expected to receive two in-crop applications of dicamba (0.50 lbs a.e./acre) per season, whereas areas without glyphosate-resistant weeds will only receive one in-crop application of dicamba (0.50 lbs a.e./acre).

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Table 4-10. Anticipated Weed Management Recommendations for DGT Cotton Combined with Glyphosate-Tolerant Cotton Systems for MO, AR, TN, AL, FL, GA, NC, SC, VA, LA, MS, eastern TX and CA[1,2]

Application Timing	Conventional Tillage	Conservation Tillage (No-till or reduced till)
Preplant burndown and/or Preemergence	Residual	Dicamba + Glyphosate + Residual
Postemergence 1	Dicamba + Glyphosate + Residual[3]	Dicamba + Glyphosate + Residual
Postemergence 2	Glyphosate OR Glufosinate[4,5]	Glyphosate OR Glufosinate + Residual[5,6]

[1] Recommendations modified from those presented in Petition 12-185-01p_a1.
[2] Monsanto and academics recommend the use of soil residuals as part of a comprehensive weed resistance management program to ensure that two effective herbicide modes-of-action are used in cotton and to provide protections against additional resistance development to existing herbicides used in cotton production.
[3] Residual recommended if GR weeds present.
[4] Glyphosate recommended if no GR weeds present, glufosinate recommended in the presence of GR weeds.
[5] Tank mixes of glyphosate and glufosinate will not be recommended, because reduced weed control has been observed with the glyphosate and glufosinate tank mix as compared to each individual herbicide (Dotray *et al.*, 2011; Reed *et al.*, 2011; Reed *et al.*, 2012).
[6] Glyphosate only if no GR weeds present, glufosinate and residual recommended in the presence of GR weeds.
Source: Table IV.A-4 (Monsanto, 2013).

Table 4-11. Anticipated Weed Management Recommendations for DGT Cotton Combined with Glyphosate-Tolerant Cotton Systems for Western TX, NM, KS, OK, and AZ [1,2]

Application Timing	Conventional Tillage	Conservation Tillage (No-till or reduced till)
Pre-plant burndown and/or Pre-emergence	Dicamba + Glyphosate + Residual	Dicamba + Glyphosate + Residual
Post-emergence 1	Dicamba + Glyphosate	Dicamba + Glyphosate
Post-emergence 2	Glyphosate ± Dicamba[3]	Glyphosate ± Dicamba[3]

[1] Recommendations modified from those presented in Petition 12-185-01p_a1.
[2] Monsanto and academics recommend the use of soil residuals as part of a comprehensive weed resistance management program to ensure that two effective herbicide modes-of-action are used in cotton and to provide protections against additional resistance development to existing herbicides used in cotton production.
[3] Dicamba recommended when GR weeds present.
Source: Table IV.A-5 (Monsanto, 2013).

Inclusion of Potential Impacts from Herbicide Use: As discussed above, it is EPA's regulatory authority under FIFRA to register pesticide products for their intended uses. EPA has sole authority to regulate the use of any herbicide. Nonetheless, for the reasons discussed above, this environmental report evaluates potential impacts of dicamba use associated with DGT cotton on the human environment. Glufosinate will not be discussed in detail because glufosinate use on DGT cotton is equivalent to currently deregulated glufosinate-tolerant cotton and will be considered baseline.

Potential Additional Dicamba Use: The maximum possible annual application of dicamba on cotton, with 100% adoption of DGT cotton across all U.S. upland cotton acreage (14.8 million acres)[6] and applications of dicamba at the maximum labeled rates (proposed at 2.0 lbs a.e. per acre per year), would be 29.6 million pounds a.e. However, as discussed below, the actual total anticipated application will be much lower and will not likely be additive with the current application of herbicides currently used on cotton, as dicamba will displace some of the current herbicide usage in cotton.

As discussed above, in the Midsouth, and Southeast regions, conventional tillage-planted acres are expected to receive a single in-crop application per season of dicamba at 0.5 lbs a.e. per acre and conservation tillage or no-tillage acres are expected to receive two applications (one preplant application at 0.375 lbs a.e. per acre and one in-crop application at 0.50 lbs a.e. per acre). Dicamba use in East Texas and California is expected to be similar to that described for the Midsouth and Southeast regions. In West Texas, Kansas, Oklahoma, New Mexico, and Arizona dicamba is expected to be utilized more extensively than glufosinate for management of troublesome and/or glyphosate-resistant weeds. Glufosinate is considered less effective on the weed spectrum under the high temperature and low humidity environmental conditions in these regions (Bayer CropScience, 2011). In western Texas, Kansas, Oklahoma, New Mexico, and Arizona, all acreage is expected to receive one preemergence application of dicamba (0.375 lbs a.e. per acre), and one postemergence in-crop application of dicamba (0.5 lb/acre a.e.). Areas with GR weeds are also expected to receive an additional postemergence in-crop application of dicamba (0.50 lbs a.e./acre) per season). Assuming these anticipated applications and use rates of dicamba, and using the assumption that DGT cotton has 100% adoption across all U.S. cotton acres and conservation tillage systems are used on approximately 21% of the U.S. cotton acres (CTIC, 2008), dicamba use on DGT cotton would total approximately 10.5 million pounds.

It is impossible to determine the exact amount of acreage on which DGT cotton may be grown if deregulated. A 100% adoption rate of DGT cotton among cotton growers is unrealistic. Monsanto estimates dicamba-treated acres could eventually reach 50% of the total U.S. cotton acres. Growers will ultimately select weed control systems that fit the needs for their individual farming operations such that some proportion of growers will choose to use DGT cotton integrated into the glyphosate-tolerant cotton systems. As discussed in ER Section II.B.2.d (See ER (Monsanto, 2013)), growers produced herbicide-tolerant cotton on approximately 73% of U.S. cotton acres in 2011, with almost all of this cotton being glyphosate-tolerant and approximately 3% being glufosinate tolerant. Growers currently producing herbicide-tolerant cotton are the growers most

6 Based on approximately 14.8 million acres planted to cotton in 2011, see ER **Error! Reference source not found.** Monsanto (2013).

likely to adopt DGT cotton. Some of these growers may continue to grow the currently-available types of herbicide-tolerant cotton, and use other herbicides for hard-to-control weeds. For example, approximately 53 to 64% of growers of glyphosate-tolerant cotton used a non-glyphosate herbicide in addition to glyphosate in their cotton crops in 2005 (Givens *et al.*, 2009b). An additional factor influencing the number of dicamba-treated cotton acres in the future will be the introduction of competing herbicide-tolerant traits in cotton.

Based on the dicamba application and use rate analysis summarized above, use of DGT cotton on 50% of U.S. cotton acres would result in approximately 5.2 million lbs a.e. of dicamba applied to DGT cotton annually (including preplant, preemergence and in-crop applications). Currently 364,000 lbs a.e. of dicamba are applied preplant to commercially available cotton (Monsanto, 2012b).

It is anticipated that dicamba applications will continue for all other currently labeled crops at the current annual level of approximately 3.8 million pounds (Monsanto, 2012b). Therefore, the addition of the estimated 5.2 million pounds of dicamba that would be applied to DGT cotton would result in a total estimated U.S. dicamba use of approximately 9.0 million pounds annually. This does not include the additional amount from DT soybean (ER Section IV.A.1 (Monsanto, 2013)).

The potential increase in dicamba usage associated with DGT cotton production is expected to displace a number of the current herbicides used in cotton today, particularly applications of fluometuron, fomesafen, MSMA, and paraquat. Dicamba offers a relative reduction of risk potential in comparison to some of the alternative non-glyphosate herbicides currently available to cotton growers (see Appendices E and F. Dicamba could be expected to conservatively replace approximately 34% of the projected total acres treated (TAT)[7] for all non-glyphosate herbicides used in preplant/preemergence application timing and 37% of the projected TAT for all non-glyphosate herbicides used in postemergence application timing at peak dicamba use based on a projection that 50% of total planted cotton acres may be treated with dicamba following the introduction of DGT cotton. At projected peak penetration of dicamba use in DGT cotton an increase in both total cotton acres treated and total pounds of non-glyphosate herbicide active ingredient applied to cotton is projected, however estimated increases are 16% or less of the total herbicide use projections (16% for TAT and 12% of total pounds of active ingredient) if DGT cotton is not commercialized.

Projected Dicamba Use (Total Pounds) on DGT Cotton: Based upon anticipated use patterns for dicamba on DGT cotton, projections on the number of dicamba TAT and total pounds of dicamba used on DGT cotton were determined for the combined PRE and POST application timing. The anticipated use projections represent a high-end estimate of the incremental dicamba use. Projected dicamba use at peak penetration is 10.8 million TAT (see ER Table A-40) and 5.2 million pounds active ingredient Table 4-12 (Table A-41) (Monsanto, 2013).

7 The use of TAT provides a way to look at herbicide use that is independent of the various use rates of herbicides. If a herbicide is used more than once on an acre the TAT will reflect this multiple use, and consequently the TAT may exceed the number of crop acres planted. This provides a more complete view of herbicide use.

Table 4-12. Estimated Dicamba Total lbs a.i. at Peak Dicamba Use on DGT Cotton

Cotton Growing Region	Tillage system	2011 planted acres (000) available for dicamba use[1]	Planted acres at Peak (*i.e.* 15% reduction)	Planted conventional till acres (000) at Peak	Planted no till acres (000) at Peak	Conventional Tillage: # dicamba in-crop applications	Conservation tillage: # dicamba apps in crop[2]	Conservation Tillage: # dicamba application preplant	Conventional Tillage: Dicamba rate in-crop	Conservation tillage: Dicamba Rate Preplant	Total lbs dicamba ai (000)
SE, Delta, E.TX	Conventional			2,310		1			0.5		1,155
	Conservation				614		1	1	0.5	0.375	537
	Total	**3,441**	**2,924**								**1,693**
CA	Conventional			214		1			0.5		107
	Conservation				57		1	1	0.5	0.375	50
	Total	**319**	**271**								**157**
W.TX, AZ, OK, NM, KS	Conventional			2,472		2			0.5		2,472
	Conservation				657		2	1	0.5	0.375	904
	Total	**3,682**	**3,129**								**3,376**
US Total											**5,225**

[1] Acres from (USDA-NASS, 2012a). Note: Total planted acres for 2011 varies between USDA-NASS and the grower survey data used in previous tables. USDA-NASS was used to calculate dicamba TAT in the different cotton growing areas because only USDA-NASS planted acres is broken out by state.

[2] Based on 21% of cotton acres being no till.

Source: ER Table A-41(Monsanto, 2013).

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Appendix 5. Common Weeds in Cotton and Soybean

Common Weeds in Cotton and Soybean

Weeds are simply plants growing in areas where their presence is undesired by humans (Baucom and Holt, 2009). Plants that colonize frequently disturbed environments have evolved with characteristics or mechanisms that allow them to survive conditions in agricultural environments. Weedy plants typically exhibit early germination and rapid growth from seedling to sexual maturity, have the ability to reproduce sexually and asexually, and therefore are well adapted to agricultural fields (Baucom and Holt, 2009).

The presence of weeds in cotton and soybean fields is a primary detriment to productivity. Weeds are the most important pest complex in agriculture, impacting yields by competing with crops for light, nutrients, and moisture. In addition to taking valuable resources from crops, weeds can introduce weed seed or plant material to a crop, thereby reducing the market grade of the crop.

Additionally, weeds can harbor insects and diseases; weeds also can interfere with harvest, clogging and causing extra wear on harvest equipment (Loux *et al.*, 2008). For example, some winter annuals have been found to serve as alternative hosts for the soybean cyst nematode, a pest that affects soybean yields in the U.S.

Effective weed management involves an understanding of weed biology and of weed management strategies. This section provides an overview of weed types, the weed seed bank, and the timing and occurrence of weeds. Also described are the types of weeds that occur in corn and soybean. Weed management is discussed in Appendix 3.

Weed Classification

Weeds are classified according to their life cycle, as annuals, biennials or perennials. Weeds are also classified as broadleaf (dicots) or grass (monocots). Weeds can reproduce by seed, rhizome (underground creeping stems), or other underground part (e.g., buds, bulbs).

An annual is a plant that completes its lifecycle in one year or season and reproduces only by seed. Annuals can be further differentiated into summer or winter annuals. Summer annuals appear in the spring or early summer and die prior to or by the first frost, producing seeds within the same growing season. These weeds grow rapidly, strongly competing with crops for resources, and can outgrow and shade slower-growing crops.

Summer annuals can be further categorized into three groups: small-seeded summer annual broadleaf weeds, large-seeded summer annual broadleaf weeds, and summer annual grass weeds (Schonbeck, 2010). Some small-seeded summer annual broadleaf weeds include pigweeds, common lambsquarters, common purslane, galinsoga, and smartweeds. Commonly found large-seeded summer annual broadleaf weeds include velvetleaf, common cocklebur, and morningglory. Summer annual grass weeds have small to medium sized seeds and include foxtail, crabgrass, and goosegrass.

Winter annuals typically emerge in late summer or early fall, but can also germinate as late as early spring. Usually these weeds over-winter as small seedlings and set seed in the spring. These weeds have little effect on warm season crops. Common winter annuals include purple deadnettle, henbit, field pennycress, shepherd's-purse, and chickweed (Schonbeck, 2010; Mock *et al.*, 2011).

Biennials have a life cycle of two years or seasons. After persisting as low-growing vegetation during their first season, biennial weeds overwinter, then flower and produce seeds in their second growing season. Examples of biennial weeds are burdock, bull thistle, poison hemlock, and wild carrot.

Perennials are plants that live for more than two years and are typically categorized as simple or creeping or invasive perennials. Canada thistle, bermudagrass, common milkweed, common pokeweed, dandelion, Johnsongrass are examples of perennial weeds (Penn State University, 2009; Mock *et al.*, 2011).

<u>Weed Seed Bank</u>

An important concept in weed control is the seed bank which is the reservoir of seeds that are on the soil surface and scattered at different depths in the soil. The soil weed seedbank determines the size and species composition of the weed community within a growing season (Norsworthy, 2012). Under favorable conditions, these seeds have the potential to germinate and emerge, creating weed pressure (i.e., competition) in crops. The weed seed bank contains recently dropped seeds, older seeds mixed into the soil, tubers, bulbs, rhizomes, and other vegetative structures. Climate, soil characteristics, shifts in agricultural management practices, such as tillage, crop selection, and weed management practices, affect the density and species composition of the seed bank within a given field (Davis *et al.*, 2005; May and Wilson, 2006; Buhler *et al.*, 2008).

The majority of seeds in the weed seed bank come from the weeds that have grown and set seed in the field. Wind, water, animals, and birds can carry seeds, adding to the weed seeds already present. Also, manure or other material (e.g., mulch, feed, soil) transported by humans or farm equipment from other locations can be indirect sources of weed seed (Renner, 2000).

Agricultural soils can contain thousands of weed seeds and a dozen or more vegetative weed propagules per square foot (Menalled and Schonbeck, 2013). Annual weeds produce large numbers of seeds. For example, a pigweed plant can shed at least 100,000 mature seeds and one lambsquarters plant can produce more than 50,000 seeds (Renner, 2000). If left untended and without crop competition, giant ragweed can produce approximately 10,000 seeds, common waterhemp 70,000 seeds, and waterhemp 100,000 seeds, or more, per plant. Larger-seeded broadleaf weeds are not as prolific in comparison to small-seeded summer broadleaf weeds, but seed production is still high, with a few hundred to a few thousand per plant (Schonbeck, 2010). It has been observed that weeds in agricultural fields produce less seeds as a result of competition from the crop, damage from herbicides, and other factors, although these weed still produce high numbers of seeds that can affect production (Buhler *et al.*, 1997). Effective weed control is required to limit the number of weed seeds entering the soil seed bank that will contribute to sustained competition with the crops into subsequent growing seasons.

Although seedbanks are made up of numerous weed species, generally only a few species will comprise 70 to 90 percent of the total seed bank (Wilson, 1988; Buhler *et al.*, 1997; Renner, 2000). For example, common lambsquarters (*Chenopodium album*) is the dominant weed seed in many field soils in the north central region of the U.S. (Michigan) (Renner, 2000). A second smaller group of weed species may represent 10 to 20 percent of the seed bank (Buhler *et al.*, 1997).

Additionally, only a fraction of the seeds in a weed seed bank germinate and grow each year. Birds, rodents, insects, and other animals typically will consume available weed seeds found on the soil surface. Some seeds may decay or become unviable in the soil; other seeds may germinate but will die. Some seeds can remain dormant in the soil for long periods of time. When changes in the cropping system change, creating conditions that are suitable for germination and development of a particular weed species, that species can respond rapidly, becoming non-dormant and establish itself in the cropping system (Renner, 2000; Durgan and Gunsolus, 2003; May and Wilson, 2006; Steckel *et al.*, 2007). It is estimated that less than 10% of the weed seeds in the soil are non-dormant and able to germinate within a season. The remaining dormant seeds thereby serve to extend the longevity of the seed bank (Renner, 2000; PhysicalWeeding, 2009). For example, summer annuals can remain viable for years, even if buried deeper in the soil, while the larger broadleaf seeds can remain viable for decades (Schonbeck, 2010).

The majority of weeds grow from seeds in the top two inches of soil with the most significant numbers emerging from only the top one inch of soil (PhysicalWeeding, 2009). In general, most small-seeded weeds (e.g., foxtail, pigweed) germinate and emerge within the upper half inch of the soil surface. The large-seeded summer annual broadleaf weeds are usually found in soils below the surface layer (about 0.5 to 2 inches below the surface) and can germinate from soil depths of 1.5 inches or more. Summer annual grass weeds germinate predominantly from the top inch of soil. Generally, tillage brings these seeds to the surface, where they rapidly grow in response to light. The effects of different forms of tillage on the prevalence of weed species are discussed further, below.

Weed populations change in response to agricultural management decisions. Collectively, management decisions will impart selection pressures[1] on the present weed community, resulting in weed shifts on a local level (i.e., field level). These weed shifts occur regardless of what the selection pressure may be and may result in changes in weed density or weed diversity (Reddy and Norsworthy, 2010; Weller *et al.*, 2010). Weed shifts are generally most dramatic when a single or small group of weeds increases in abundance at the expense of other weed populations, potentially dictating the primary management efforts of the grower.

The vertical distribution of weed seeds in the soil is primarily influenced by the tillage system used.[2] These resulting changes in the distribution of the weed seeds in the weed seedbank will

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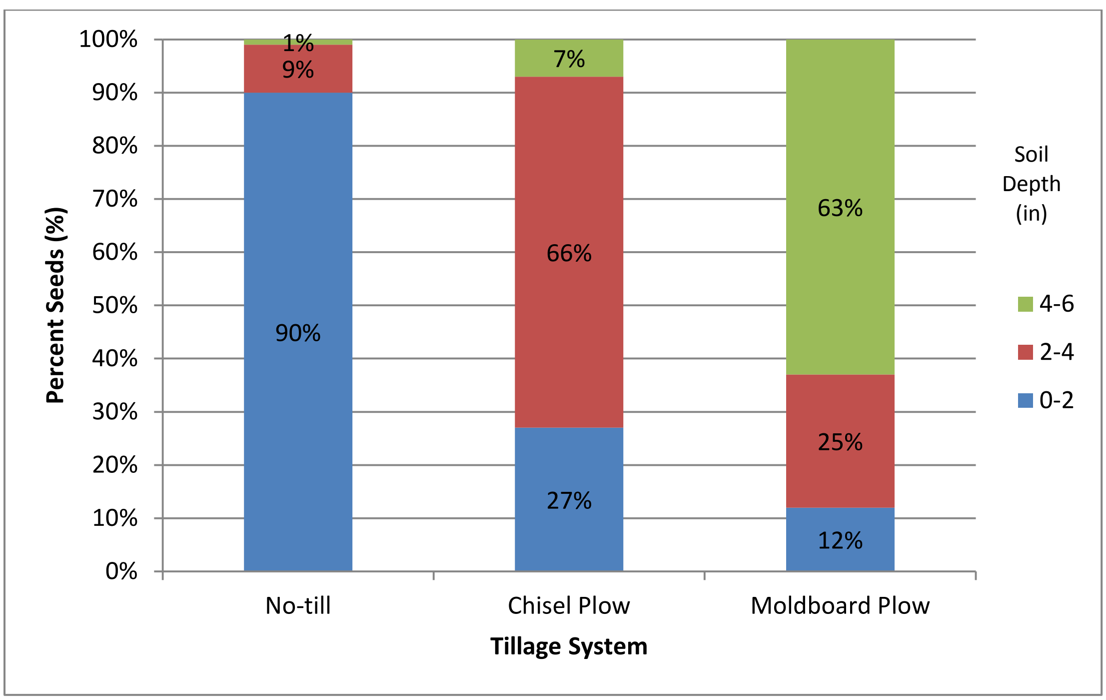
[1] Selection pressure may be defined as any event or activity that reduces the reproductive likelihood of an individual in proportion to the rest of the population of that one individual. In agriculture, selection pressure may be imparted by any facet of management in the production of a crop, including the type of crop cultivated, strategy of pest management, or when and how a crop is planted or harvested.

[2]Tillage represents a mechanical means of weed control and is generally characterized by the amount of remaining in-field residue and may be classified as conservation ($\geq$30 percent), reduced (15-30 percent), or intensive (0-15 percent) CTIC (2008)

impact weed emergence and the resulting weed population in farm fields (Renner, 2000). As shown in Figure 5-1, the practice of no-till results in a majority of the weed seeds remaining at or near the soil surface where they have been deposited (Renner, 2000; Shrestha *et al.*, 2006; Menalled and Schonbeck, 2013). In no-till fields with more seeds at the surface, a greater diversity of annual and perennial weeds species may occur (Baucom and Holt, 2009). Winter annuals thrive in soil that is undisturbed from late summer or fall through early summer the following year which is best provided by no-till systems. Similarly, biennial weeds are prevalent in fields that have been no-till for several years, as they need undisturbed soil for two consecutive growing seasons.

Under reduced tillage systems (such as chisel plowing), approximately 80 to 90 percent of the weed seeds are distributed in the top four inches, with the majority found at depths ranging from two to four inches. Summer annual grass weeds germinate predominantly from the top inch of soil with prevalence in shallow and reduced tilled fields (Curran *et al.*, 2009). With recent increased rates of conservation tillage, there has been an observed decrease in large-seeded broadleaf weeds and an increase in perennial, biennial, and shallow-emerging annual grasses, small-seeded broadleaves, and winter annual weed species in those fields (Green and Martin, 1996; Durgan and Gunsolus, 2003; Norsworthy, 2012). The growth and spread of some perennial species that reproduce by spread of underground structures (e.g., rhizomes) may be encouraged by no-till or conservation tillage system which allows these structures to remain undisturbed (Buhler *et al.*, 2008; Baucom and Holt, 2009; Curran *et al.*, 2009).



Source: (Shrestha *et al.*, 2006)

Figure 5-1. Vertical Distribution of Weed Seeds in the Soil Profile at Depths of 0 to 2 inches, 2 to 4 inches, and 4 to 6 inches Affected by Different Tillage Regimes

Weed seeds become buried approximately four to six inches below the surface as a result of increasing tillage (Menalled and Schonbeck, 2013). As fewer weeds can germinate when buried, weed diversity tends to decline and annual large-seeded broadleaves are more prominent (Norsworthy, 2012).

These shifts in weed species necessitate changes in weed management strategies. Tillage practices must be regularly changed, in a manner similar to that of other agricultural production practices, to prevent buildup of any particular species or group of weeds in the soil seedbank.

Weed Emergence/Timing

In addition to weed density, the timing of weed emergence affects how they compete with the cotton or soybean crop and influences the level of crop yield loss. The critical period of weed control (CPWC) is the time during which weeds must be controlled to prevent yields losses. The key components defining CPWC are 1) knowing when weeds need to be removed and 2) when the crop becomes dominant (Boerboom, 2000). Weeds emerging before the CPWC may not impact crop yields if those weeds are controlled by the start of the CPWC. Weed competition occurring after the end of the CPWC will not affect yield (Boerboom, 2000; Knezevic, 2007). In particular, early in the growing season, the critical period of weed competition is most affected by: 1) how competitive the different weed species are, 2) the density of weeds, and 3) the relative time of weed emergence (Boerboom, 2000).

In contrast to other crops, including corn and soybean, cotton emergence and above ground growth is relatively slow during the first few weeks after planting. The slow early growth of cotton does not permit the crop to aggressively compete against weed species that often grow more rapidly (Smith and Cothren, 1999). Weeds in cotton are controlled through the diversified use of various cultural, mechanical, and chemical methods (Hake *et al.*, 1996). Historically, mechanical tillage and hand-weeding were the most important tools in cotton weed control due to the limited application window afforded to most chemical applications. Today with the advent of GE cotton, approximately 38% of the total cotton acres are post-plant cultivated. In fields classified as employing conventional tillage systems, over 50% cotton acres are cultivated for weed control (USDA-ERS, 2012).

Due to the biology and planting practices of cotton, in the U.S., whereby complete crop canopy closure is at times never achieved, herbicides are used at multiple intervals throughout the entire growing season on essentially all (>99%) the cotton acres in the U.S. (Brookes and Barfoot, 2012; Monsanto, 2012).

In soybean, the later that weeds emerge, the less impact they will have on yield, although weeds emerging later can have a negative influence on seed quality and harvest efficiency (Prostko, 2013). Soybean plants withstand early season weed competition longer than corn because the soybean canopy closes earlier (Boerboom, 2000). The extent of canopy closure restricts the light available for weeds and other plants growing below the soybean. In addition, canopy closure occurs more quickly when soybean is drilled or planted in narrow rows (Boerboom, 2000; Bradley, 2006); however, in some studies it has also been observed that, depending on factors such as weed species, environmental conditions (i.e., rainfall amounts) and soybean cultivar, soybeans are able to compete with weeds with no resulting yield reduction (Krausz *et al.*, 2001).

Place et al. have determined that larger soybean seeds produce a larger canopy more quickly and are, therefore, more successful at outcompeting weeds (Place *et al.*, 2011). Full-season soybean planting is preferable during the drier late spring conditions; however, summer annual weed emergence often occurs at this same time, resulting in a high level of weed interference with soybean emergence and establishment (DeVore *et al.*, 2013).

Common Weeds in Cotton and Soybean

Weed species emerge in a particular order throughout the year with each species having one or more periods of high emergence. The initial emergence date can vary from year to year, but the order stays relatively constant. Figure 5-2 shows the relative emergence of common weed species found in summer annual crops such as soybean and cotton. Weed emergence timing can dictate which weeds will be the most problematic for or be more easily controlled by a specific crop production or weed management practice (Buhler *et al.*, 2008). Weed management is discussed in Appendix 3.

Table 5-1. Summary of Problem Weeds Affecting Cotton and Soybean

Broadleaf Weeds			Grass Weeds		
Cotton + Soybean	Cotton	Soybean	Cotton + Soybean	Cotton	Soybean
Browntop millet	Bindweed	Wild buckwheat	Barnyard grass	Bermuda grass	Fall Panicum
Cutleaf primrose	Black nightshade	Burcucumber	Crabgrass	Crowfoot grass	Quackgrass
Florida beggerweed	Common cocklebur	Canada thistle	Cupgrass	Large crabgrass	
Florida pusley	Common lambsquarter	Chickweed	Johnsongrass		
Foxtail	Common purslane	Cockeburr	Goose grass		
Ground Cherry	Common ragweed	Copperleaf hophorn	Broadleaf signal grass		
Hemp sesbania	Devil's claw	Dandelion			
Henbit	Hairy Nightshade	Honeyvine milkweed			
Horseweed	Junglerice	Eastern black nightshade			
Jimson weed	Palmer amaranth	Hairy nightshade			
Kochia	Red Sprangletop	Wild oats			
Lambsquarter	Russian thistle	Common pokeweed			
Morning Glory	Shepardspurse	Wild proso millet			
Mustard	Smellmelon	Common ragweed			
Nutsedge	Sprangletop	Giant ragweed			
Palmer pigweed	Spurred anoda	Field sandbur			
Prickly sida	Texas blueweed	Shattercane			
Pigweed	Volunteer peanut	Venice mallow			
Sicklepod	Volunteer corn	Volunteer cereal			
Smart weed	Field bindweed	Waterhemp			
Spurge	Horse purslane	Tropic croton			
Sunflower	Woolyleaf bursage				
Texas millet	Silverleaf nightshade				
Velvet leaf					
Volunteer Corn					

Source: (Monsanto, 2013)

Notes:

Green: Weeds managed in both corn and soybean

Yellow: Weeds primarily managed in corn

Blue: Weeds primarily managed in soybean

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Appendix 6. Herbicide Resistance

Herbicide Resistance

Not unlike other agronomic practices, herbicide use may impart selection pressures on weed communities, resulting in shifts in the weed community that favor those weeds that do not respond to the herbicide used (Owen, 2008). Herbicide resistance is described by the Weed Science Society of America as the "inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type" (WSSA, 2011b). The shift to herbicide resistance in plants is largely a function of the natural selection of herbicide-resistant traits and is strongly related to the repeated use of one or a limited number of herbicides (Durgan and Gunsolus, 2003; Duke, 2005).

Individual plants within a species can exhibit different responses to the same herbicide rate. Initially, herbicide rates are set to work effectively on the majority of the weed population under normal growing conditions. Genetic variability, including herbicide resistance, is exhibited naturally in normal weed populations, although at very low frequencies. When only one herbicide is used year after year as the primary means of weed control, the number of weeds resistant to that herbicide compared to those susceptible to the herbicide may change as the surviving resistant weeds reproduce. With no change in weed control strategies, in time, the weed population may be composed of more and more resistant weeds.

Both the increased selection pressure from the extensive use of glyphosate associated with glyphosate-tolerant crops along with the subsequent reduction in the use of other herbicides and changes in weed management practices (i.e., conservation tillage or no-till) have resulted in weed population shifts and increasing glyphosate resistance among some weed populations (Owen, 2008; Duke and Powles, 2009). Glyphosate-resistant crops themselves do not influence weeds any more than non-transgenic crops. It is the weed control tactics chosen by growers that create selection pressure that ultimately over time changes these weed communities and may result in the selection of herbicide-resistant weeds (Owen, 2008).

History of Weed Resistance to Herbicides and its Development

One of the earliest selective chemical herbicides to be used in agriculture was 2,4-D, a synthetic auxin, whose commercial use began in 1945 (Burnisde, 1996). Use of 2,4-D in corn was successful in controlling broadleaf weeds such that in the mid-1950s 2,4-D was applied to nearly one-half of all U.S. corn acres (Knake, 1996). Within 12 years, the first herbicide resistance to 2,4-D was reported in spreading dayflower in a Hawaiian sugarcane field (*Commelina diffusa*) in 1957 (see report in (Sellers *et al.*, 2011; Isaac *et al.*, 2013)).

Simazine was the first triazine to be used commercially in 1956. In 1958, the herbicide atrazine was first registered for weed control in corn in the U.S. Similar to what had occurred with 2,4-D, triazines were used extensively in the 1960s and common groundsel resistant to triazine herbicides was discovered in Washington in 1970 (Buhler, unknown). Regardless of the occurrence of resistant weeds, atrazine was, and still is, an extremely effective herbicide due to its broad spectrum, low cost, and flexible timing of applications (CropLife International, 2012).

ALS inhibitors or Group 2 herbicides were introduced in the mid-1980s and became extensively used in soybeans. With its broad-spectrum weed control, residual activity, and flexibility in application timing, the Group 2 herbicides became popular in the late 1980s and early 1990s. For example, by the early-1990s, Pursuit™, containing the ALS herbicide imazethapyr, was used on more than 75 percent of the soybeans in Iowa (Tranel and Wright, 2002). The widespread use of Group 2 herbicides resulted in the rapid selection of ALS-resistant waterhemp. By the mid-1990s, Group 2 resistant waterhemp was so widespread that the industry essentially stopped recommending Group 2 herbicides for this weed (Hartzler, 2013).

Sales of glyphosate began in 1974 and it became one of the most commercially successful and dominant herbicides in the U.S. (Duke and Powles, 2008). There are several reasons for the success of glyphosate in the market and the corresponding market sector penetration of glyphosate-tolerant crops since their introduction in the mid-late 1990s. Glyphosate: 1) works non-selectively on a wide range of plant species; 2) is a relatively low-cost herbicide; 3) enhances no-till farming practices; and 4) has minimal animal toxicological and environmental impact (Duke and Powles, 2008; Owen, 2008; Duke and Powles, 2009).

The widespread adoption of glyphosate-tolerant soybean, in combination with an increased reliance on glyphosate, has been related to the adoption of no-till cultivation which depends on controlling weeds without tillage. Glyphosate tolerant soybean also led to a simplification in weed control compared to past practices, reduced input and labor costs associated with the cultivar and glyphosate use, and increased flexibility in herbicide application timing (Lorenz *et al.*, 2006).

Most instructive are the events leading to the development of glyphosate resistance in weeds in the U.S. The previous history of glyphosate use for 20 years did not result the selection of herbicide-resistant weeds. As a result, industry promoted the view that widespread glyphosate use was unlikely to result in the selection of glyphosate resistant weeds (Bradshaw *et al.*, 1997), despite the fact that resistance to other herbicides, such as 2,4-D were being reported (see history in (Mithila *et al.*, 2011)). The first case reported, glyphosate resistant rigid ryegrass, was documented and confirmed in Australia in 1996 (Powles *et al.*, 1998), over twenty years after glyphosate first began to be used in agriculture.

Herbicide-resistant crops were introduced in 1996 with glyphosate-resistant soybean rapidly adopted by growers. As glyphosate went off patent in 2000, increased usage of glyphosate-resistant crops was facilitated by the low price of the herbicide. Tank mixes for separate activity against grasses and broad-leaf weeds were not needed when glyphosate could be used for weed control. In the mid-1990s, 51% of growers were using three, four or more herbicides for soybean weed control (cited in Gianessi et al. (2008)) or about three overall in 1995 (USDA-ERS, 1997). With the availability of glyphosate and glyphosate-resistant crops, herbicide applications could be reduced in many situations.

The efficacy of post-applications of glyphosate became clear, with weed control often not requiring a pre-application for good control (Reddy, 2001). If a grower needed additional weed control for effectiveness or flexibility, a pre-application of glyphosate and a post-glyphosate application were as effective and cost less than a pre-application with a non-glyphosate residual herbicide followed by post-application of glyphosate (Reddy, 2001). Increasing glyphosate applications resulted in a decline of the sales and use of most other herbicides. The earliest U.S. glyphosate resistance in a GE crop was found in horseweed, *Conyza canadensis*, in Delaware soybean in 2000 (Heap, 2013). Increasing exposure of weeds to glyphosate in other herbicide resistant crops such as corn and cotton soon began to expand the numbers and populations of resistant weeds in the U.S.

The intense use of glyphosate compared to sparing use of other herbicides on field crops is apparent in overall herbicide use trends over the last decade, and surveys of grower usage, such as that of Prince et al. (2012), provide specific details. These surveys give evidence of the prevalent practices employed by growers in which glyphosate was nearly the only herbicide used with the subsequent overexposure of crops and weeds to glyphosate.

It was reported by Young (Young, 2006) that there was a dramatic increase in the use of glyphosate in soybean and cotton production. In 2005, surveyed growers in multiple states rotating soybean and cotton indicated they chose glyphosate 51 % of the time for spring burndown, versus 21% for other herbicides (Table 6-1). For continuous soybean, growers chose glyphosate 46% of the time and 22% another herbicide (Table 6-1) (Prince *et al.*, 2012). Overall, 74% of the continuous soybean growers used glyphosate two or more times during a growing season (Table 6-2). When growers used non-glyphosate herbicides, continuous soybean growers used these herbicides in post-emergence applications 67% of the time, and cotton/soybean growers applied the herbicides on soybean post-emergence 76 % of the time (Table 6-2). Growers of GR cotton more frequently resorted applying glyphosate three or more times unless the GR cotton was rotated with GR corn (Prince *et al.*, 2012).

Table 6-1. Frequency of Spring Pre-plant Application of Glyphosate Among Surveyed Growers (2005)

	Herbicide Application	
Crop	**Glyphosate**	**Non-glyphosate**
Continuous soybean	46%	22%
Soybean in soybean/cotton rotation	51%	21%

Source: (Prince *et al.*, 2012)

Table 6-2. Frequency of Glyphosate Application to Crop by Surveyed Growers (2005)

	Herbicide Application					
	Glyphosate			**Non-glyphosate**		
Frequency	1X	2X	3X	1X	2X	3X
Crop						
Continuous soybean	23	62	12	27	7	67
Soybean in soybean/cotton rotation	26	53	13	24	---	76

Source: (Prince *et al.*, 2012)

It is clear that when herbicides are applied, selection for those weeds with adaptive mechanisms to escape elimination will survive. If the herbicide is repetitively used in crop production in the absence of diversified weed control practices, the surviving weeds will be further selected, and dominant genes as well as multi-component resistance mechanisms will be selected. While many practices can be used to manage weeds, the recent history of glyphosate use shows that when the collective knowledge of resistance development is either neglected or practices are not sufficiently integrated with mechanical and cultural controls, or with more robust herbicidal strategies, resistant weeds will arise. As noted earlier, it is not so much herbicide resistant crops that are a cause of herbicide resistant weeds, rather it is the failure to apply best management practices in the production of herbicide resistant crops.

Mechanisms of Herbicide Resistance in Weeds and Relationship to Selective Pressure

Two types of weed resistance may arise following inadvertent weed selection and both confer complex management concerns for growers. The first is target site-specific resistance (TSR), and the second, non-target site-specific resistance (NTSR). The first results in an alteration of the target site of the herbicide so the target is no longer inhibited. The second type of resistance is more general and may confer resistance to a wide range of chemistries. For example, NTSR resistance may provide protection by reduced penetration of the herbicide, altered translocation, overproduction of targets, target mutation, or neutralization of cytoplasmic toxins (Délye *et al.*, 2013). TSR confers resistance usually to a single herbicide, and NTSR may confer resistance to as many as nine different modes of action (e.g., *Lolium rigidum*) and 16 herbicides (Beckie, 2011). In the case of NTSR, the use of herbicides on weeds with unknown NTSRs may provide a substantial risk for development of weed resistance (Délye *et al.*, 2013).

The target site alterations leading to TSR are often produced by dominant or semidominant nuclear mutations and can be found in herbicide Groups 1, 2, 3, 23, 14, and 9, while triazine herbicides (Group 5) result from dominant cytoplasmic mutations (Délye *et al.*, 2013). This resistance arises following a single mutation, which because of its beneficial nature promotes immediate survival and is positively and rapidly selected within the agricultural environment. Glyphosate resistance that is TSR is a consequence of one amino acid change at position 106 of the chloroplast EPSPS protein. Worldwide, 14 of these populations have been identified (Beckie, 2011).

Natural Tolerance

Natural tolerance to certain herbicides may be apparent when weeds are first exposed to a herbicide, or with selection, existing genes may be selected and then accumulated to produce varying levels of tolerance (likely by NTSR). Field morning glory (*Convolvulus arvensis L.*) has such tolerance to glyphosate and has been assessed in detail (Westwood and Weller, 1997). Glyphosate tolerance in Convolvulus was also found in historical populations which predated glyphosate resistant crop introductions (Baucon and Mauricio, 2010). The pre exposure NTSR to glyphosate was at about the same level as that which is currently observed. Morning glory can also be shown to have pre-existing resistance (that is, by TSR) but which is not as high as that expressed by plants now collected (Baucon and Mauricio, 2010). Both types of resistance can exist in the species, but independently, with resource allocation costs apparent for the plant's tolerance mechanisms for the herbicide (Baucon and Mauricio, 2008). At least some populations of 16 species have been alleged as not controllable by recommended field rates of glyphosate, presumably by natural tolerance mechanisms (Duke and Powles, 2008).

Weeds Resistant to Multiple Herbicides

Direct resistance of a weed species to an herbicide is an unwelcome consequence of weed selection, but cross resistance to other herbicides in the same class or to other classes of herbicides provides an even greater consequence to those who manage weeds, since a grower's choice of herbicide site of action (SOA) will be restricted in the present season's crop and potentially also in the rotation crop. When resistance is based on non-target site mechanisms, which may include increased metabolism and reduced translocation to target sites, the weed may be capable of resistance to multiple herbicide modes of action (Beckie and Tardif, 2012). NTSR appears to arise from a weed's accretion of variants of several genes which may originally have been subsets of stress-tolerance genes (see review in Délye (2013)). Délye (2013) attributes much of the recently discovered weed resistance to this mechanism, and it is particularly important in Groups 9 (glyphosate) and 1 (acetyl-CoA carboxylase inhibitors), as well as grasses and probably broadleaf weeds (Group 2: acetohydroxyacid synthase inhibitors). In the case of glyphosate, Beckie (2011) lists 15 instances worldwide of glyphosate NTSR.

Weed Selection for Resistance to Herbicides by Overuse

The intense use of glyphosate on field crops compared to decreased use of other herbicides is a trend within the last decade, but how growers use glyphosate in field situations makes the situation clearer in grower surveys such as that of Prince (2012). These surveys give evidence of the prevalent practices employed by growers in which glyphosate is sometimes the only herbicide used, allowing the overexposure of crops and weeds to glyphosate. Growers were choosing glyphosate frequently for pre-plant burndown, but also post-planting with high frequency, so that repeated exposure of weeds to glyphosate during crop production was common within the same season. Because the most common rotation crop for corn is soybean, exposure of weeds to selecting doses of glyphosate occurs in consecutive seasons as well.

Because conservation tillage systems are inherently more dependent upon weed management using herbicides, selective pressure on weeds is greater than that on fields using conventional tillage with its greater options for pre-plant primary tillage and post plant secondary tillage (Vencill *et al.*, 2012). In a survey conducted in 2007, growers that planted 87% of their crops to glyphosate resistant corn, soy or cotton varied the SOA used on their crops 'always' or 'mostly' just 39% of the time, with the remaining 61% affirming they did so 'seldom' or 'never' (Frisvold *et al.*, 2009). Thus, when conservation tillage and HR crops define the production system, growers are likely to use the same herbicide (i.e., glyphosate) frequently. Some other options also may be foreclosed by conservation till (especially no-till), such as soil incorporation of residual herbicides, although some residuals can also be soil applied (Penn State Extention, 2013).

Considering the recommendations for success in reducing resistant weed development (Vencill *et al.*, 2012), unsuccessful herbicide strategies that have encouraged resistant weeds can include:

1. Herbicide use of mostly one or a few modes of action (Norsworthy, 2012) and infrequent use of herbicide tank mixes, sequences and diversity across seasons (WSSA, 2011a);

2. Incorrect timing of herbicide application (Norsworthy, 2012);

3. Failure to consider the likelihood that a weed already has non-target site resistance mechanisms (Délye *et al.*, 2013) against specific herbicides (including metabolic potential, ability to prevent translocation, or ability to sequester the herbicide);

4. Applying low doses of herbicide thereby allowing weeds to be exposed to low rates herbicide which encourages sequential escapes and accumulating resistance genes (WSSA, 2011b);

5. Not establishing fields devoid of active weeds at planting or good weed control at canopy closure (for soybean) because not all available tools and herbicides were used (Monsanto, 2013); resulting in poorer crop establishment and more weed initiation.

Weed Resistance from Undervaluing a Balance of Residual and Contact Herbicides

The decrease in use of soil applied residual herbicides and a focus instead on mainly foliar-applied contact herbicides may be another basic and strategic misapplication of technology by field crop producers and these resulted in resistant weed development. In the era before introduction of HR soybean and cotton, and afterwards, production changes by growers were noted in the use of herbicides in the transition to greater HR crop acreage. For soybeans, in 1996, 70% of growers used pre-emergent herbicides, but by 2002 they did so less than 20% of the time (Livingston and Osteen, 2012). Likewise, Prince (2012) concluded that soybean growers were less likely than corn or cotton growers to use a residual herbicide (often pre-emergent) in their multistate survey of herbicide use in 2005 and 2010. Growers thus lost value from an herbicide by not deploying a residual (soil applied residual in no-till production) herbicide that has a different SOA than glyphosate, and relying on post-emergence control using glyphosate or another foliar active herbicide. Perhaps as a consequence of awareness of weed herbicide resistance or in an effort to combat glyphosate resistant crops, use of residual herbicides has increased modestly between 2005 and 2009 from 15% to 27% of soybean acreage (Owen *et al.*, 2011).

Related to the issue of reductions in residual pesticide use is that of reductions in total numbers of herbicides used in soybean and cotton. An USDA Agricultural Resources and Environmental Indicators (AREI) survey showed that soybean growers reached a high point of rotating pesticides to slow resistance evolution in1998, but this declined steadily to low single digits in 2010 (USDA-ERS, 2010).

Herbicide-Resistant Weeds

It is important to distinguish herbicide resistance from herbicide tolerance. A herbicide-resistant weed is one in which there is an inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type (WSSA, 2012). A herbicide-tolerant weed species is one that is naturally tolerant to a herbicide; for example, a grass species is not killed by the application of a broadleaf herbicide (WSSA, 2012). Furthermore, certain weed species, while neither resistant nor tolerant, are inherently difficult to control with a particular herbicide, requiring more careful herbicide use and weed management practices (Monsanto, 2013).

Weeds have evolved resistance to 22 of the 25 known herbicide sites of action and to 154 different herbicides (Heap, 2014b). The first herbicide-resistant biotypes were described in the 1950s, but the number of weeds resistant to herbicides increased dramatically in the 1980s and 1990s (Heap, 2014b). Herbicide-resistant weeds have been reported in 81 crops in 65 countries (Heap, 2014b).

As of April 2014, 429 herbicide-resistant weed biotypes have been reported to be resistant to 22 different herbicide modes-of-action worldwide (Heap, 2014b). Glyphosate-resistant weeds, which occur in certain areas of the United States, account for approximately 7% of the herbicide-resistant biotypes, while weeds resistant to herbicides that inhibit acetolactate synthase (ALS) account for 34% of the herbicide-resistant biotypes. Synthetic auxin-resistant and glufosinate-resistant weeds account for 7% and 0.5% of resistant biotypes, respectively (Heap, 2014b; Heap, 2014a). The 429 unique cases of herbicide-resistant weeds identified globally are found in 234 species (138 dicots and 96 monocots). While there are hundreds of cases of herbicide-resistant weeds, most of these weeds are not actively managed in cotton and soybean.

The relative occurrence of herbicide-resistant weeds varies between the different sub-groups of auxinic herbicides. Considering that auxin herbicides have been widely used in agriculture for more than 60 years, weed resistance to this class is relatively low (31 species, to date, worldwide) and its development has been slow, especially when compared to the speed of appearance of resistance to ALS inhibitors (144 species) or triazine-resistant populations (72 species) (Heap, 2014a). The relatively low incidence of auxinic herbicide resistance is believed to be attributable to the fact that there are multiple target sites for these herbicides (Gressel and Segel, 1982; Morrison and Devine, 1993; Monsanto, 2012).

<u>Herbicide-Resistant Weeds in Soybean Production</u>

Glyphosate-resistant weed biotypes that can be found in soybean fields include Palmer amaranth (*Amaranthus palmeri*), spiny amaranth (*Amaranthus spinosus*), tall waterhemp (*Amaranthus tuberculatus*), common ragweed (*Ambrosia artemisiifolia*), giant ragweed (*Ambrosia trifida*), horseweed (*Conyza canadensis*), kochia (*Kochia scoparia*), goosegrass (*Eleusine indica*), Italian ryegrass (*Lolium multifloru*), and Johnsongrass (*Sorghum halepe*) (Heap, 2014c).

In certain areas of the United States, resistance to the ALS group of herbicides is present in most of the major broadleaf weed species commonly found in soybeans. For common ragweed and waterhemp, there is known resistance to at least one member for several of the major soybean herbicide chemistry classes. While there are effective options for managing common ragweed, waterhemp, Palmer amaranth and other key broadleaf weeds, the availability of additional herbicide modes-of-action will help combat future resistance in soybeans and manage existing herbicide-resistant weed populations in areas of the United States where such populations exist. Similarly, there has been an increase in the detection of weed populations with multiple resistance (i.e., resistance to multiple herbicide modes-of-action) in some weed species, for example, *Amaranthus* spp. (Tranel *et al.*, 2010). The emergence of these resistant biotypes in certain areas of the U.S. and continued need to utilize diversified weed management practices supports the need for additional herbicide modes-of-action in major crops, such as soybean.

<u>Herbicide-Resistant Weeds in Cotton Production</u>

Glyphosate-resistant weed biotypes found in cotton fields in certain areas of the United States may include Palmer amaranth (*Amaranthus palmeri*), spiny amaranth (*Amaranthus spinosus*), tall waterhemp (*Amaranthus tuberculatus*), common ragweed (*Ambrosia artemisiifolia*), giant ragweed (*Ambrosia trifida*), horseweed (*Conyza canadensis*), junglerice (*Echinochloa colona*), kochia (*Kochia scoparia*), goosegrass (*Eleusine indica*), and Italian ryegrass (*Lolium multifloru*) (Heap, 2014c). The emergence and growth of herbicide-resistant weeds (including glyphosate-resistant weed biotypes) in certain areas of the United States over the past decade, has required growers to adapt and implement improved weed management strategies.

The occurrence of weed-resistant biotypes varies across the cotton-growing regions, with more resistance issues observed in certain areas of the Southeast and Midsouth cotton-growing regions. *Amaranthus* spp., in particular Palmer amaranth, are problematic weeds in the mid-south and southeastern U.S. Palmer amaranth is considered to be one of the most competitive and aggressive of the *Amaranthus* spp. because of its rapid growth and prolific seed production. In addition, it has developed resistance to multiple herbicide classes (glycines, ALS, and dinitroanilines) (Culpepper *et al.*, 2011; Heap, 2014b). Managing herbicide-resistant Palmer amaranth has proven to be challenging due to the biology of this particular weed, including its dioecious nature (the male and female flowers occur on separate plants), which leads to greater genetic diversity in the plant population and increases the potential for spreading herbicide resistance (Sosnoskie *et al.*, 2011).

Resistance to the ALS group of herbicides is present in most of the major broadleaf weed species commonly found in cotton. For *Amaranthus* spp. and *Ambrosia* spp., there is known resistance to at least one member for several of the major herbicide chemistry classes. In an effort to manage glyphosate-resistant Palmer amaranth in certain areas of the U.S., certain non-glyphosate cotton herbicides are being used in conditions and practices that can result in increased selection of resistant biotypes to those herbicides, and as a result some key agricultural herbicides in some major herbicide classes, such as glufosinate and PPO inhibitors, are at further risk (Nichols *et al.*, 2010; Prostko, 2011b; Prostko, 2011a). While there are effective options for managing *Ambrosia* spp., and *Amaranthus* spp., including Palmer amaranth and other key broadleaf weeds, the availability of additional herbicide modes-of-action will help combat potential future resistance of the key herbicides needed for weed management in cotton. In addition, there has been an increase in the detection of multiple resistances (*i.e.*, resistance to multiple herbicide modes-of-action) in some weed species, for example, *Amaranthus* spp. (Tranel *et al.*, 2010). The emergence of these resistant biotypes in certain areas of the U.S. highlights the continuing need to utilize diversified weed management practices and the ongoing need for additional herbicide modes-of-action that are effective in major crops.

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Appendix 7. Off-Target Pesticide Movement

Off-Target Pesticide Movement

Once applied, pesticides (which include herbicides) remaining on the application site that are not taken up by targeted plants that have been harvested will persist, degrade, or move in the environment. The potential environmental fate of an herbicide is shown in Figure 7-1. Degradation occurs by hydrolysis, photolysis, or microbial dissipation resulting in the herbicide being broken down and eventually losing its herbicidal activity. Herbicides can be transported from their original application site by spray drift, runoff, leaching, volatility, wind erosion, or crop removal. Off-site movement of herbicides have the potential to impact non-target plant and animal communities living in proximity to fields in which herbicides are used, as well as human populations.

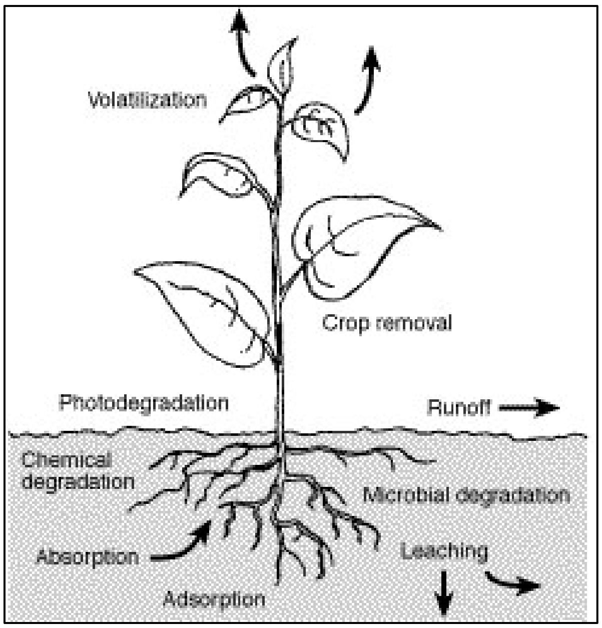

Figure 7-1. Environmental fate of herbicides in the environment
Source: (Wright *et al.*, 1996).

The length of persistence of herbicides in the environment depends on the concentration and rate of degradation by biotic and abiotic processes (Carpenter *et al.*, 2002). Persistence is measured by the half-life or dissipation time (DT_{50}), which equates to the length of time needed for the herbicide to degrade to half of its original concentration.

Use of herbicides for field crop production may introduce these chemicals to water through spray drift, cleaning of pesticide application equipment, soil erosion, or filtration through soil to groundwater. Irrigation and rainfall occurring the first few days after herbicide application can influence herbicide loss through leaching and runoff. However, it has been estimated that even after heavy rains, herbicide losses to runoff generally do not exceed 5 to 10 percent of the total applied (USDA-NRCS, 2000; Tu *et al.*, 2001). Planted vegetation, such as grass buffer strips, or crop residues can effectively reduce runoff (Fishel, 1997; USDA-NRCS, 2000).

Pesticides applied to crops may volatilize, thereby introducing chemicals to the air. Volatilization typically occurs during application, but herbicide deposited on plants or soil can also volatilize.

Volatilization occurs when pesticide surface residues change from a solid or liquid to a gas or vapor after application. Volatilization refers to the transformation of a liquid or solid pesticide into a gas. The extent of volatilization is dependent on properties of the chemical and herbicide formulation, and environmental factors such as air temperature, wind speed, and relative humidity. Volatilized pesticides can be carried by air currents potentially leading to off-target exposure. Once airborne, volatilized pesticides may be carried long distances from the treatment location by air currents. The higher the vapor pressure of a chemical, the more volatility it exhibits. In addition, other physical and chemical pesticide properties, agricultural practices, meteorological conditions, persistence of a pesticide on plant surfaces, and soil properties influence the extent of volatilization (University of Missouri, 1997; US-EPA, 2012). It is also important to note that once volatilized, pesticides may undergo transformation in the atmosphere or physical removal in precipitation. Most of the herbicides considered highly volatile are no longer used (Tu *et al.*, 2001).

Drift is the physical movement of spray droplets moving off-site as a chemical application is made. Under certain conditions, the potential for physical drift from an application site to adjacent non-target environments is possible for all types of pesticide spray applications. This is an application-related phenomenon independent of the chemical pesticide, which may be influenced by the formulation ingredients and spray mix additives. Spray drift is a concern for non-target susceptible plants growing adjacent to fields when herbicides are used in the production of any crop. This potential impact relates to exposure of non-target susceptible plants to the off-target herbicide drift (Jordan *et al.*, 2009). Damage from spray drift typically occurs at field edges or at shelterbelts (i.e., windbreaks), but highly volatile herbicides may drift further into a field. The risk of off-target herbicide drift is recognized by EPA, which has incorporated both equipment and management restrictions to address drift on EPA-approved herbicide labels. These EPA label restrictions include requirements that the grower manage droplet size, control spray boom height above the crop canopy, restrict applications under certain wind speeds and environmental conditions, and use drift control agents (Jordan *et al.*, 2009).

The amount of drift varies widely and is influenced by a range of factors, including weather conditions, topography, the crop or area being sprayed, application equipment and methods, and practices followed by the applicator (US-EPA, 2000). EPA's Office of Pesticide Programs (OPP), which regulates the use of pesticides and herbicides in the U.S., encourages pesticide applicators to use all feasible means available to minimize off-target drift. EPA-OPP has introduced several initiatives to help address and prevent the problems associated with drift. EPA-OPP is evaluating new guidance for pesticide drift labeling and the identification of BMPs to control such drift (US-EPA, 2009a) as well as identifying scientific issues surrounding field volatility of conventional pesticides (US-EPA, 2010). Additionally, EPA-OPP and its Office of Research and Development are developing a new voluntary program, the Drift Reduction Technology (DRT) Program, which encourages the development, marketing, and use of application technologies verified to significantly reduce spray drift (US-EPA, 2009a).

EPA's core pesticide risk assessment and regulatory processes ensure that protections are in place for all populations of non-target species potentially exposed to pesticides, including humans. These assessments provide EPA with information needed to develop label use restrictions for the pesticide. Growers are required to use pesticides, such as dicamba and glyphosate, consistent with the application instructions provided on the EPA-approved pesticide label. Labels can include restrictions related to minimizing drift or exclusion distances from bodies of water when necessary. These label restrictions carry the weight of law and are enforced by EPA and the states (FIFRA 7 USC 136j (a)(2)(G) Unlawful Acts).

Pesticide Regulation & Registration (Monsanto, 2013)

APHIS does not have any statutory authority to regulate herbicide uses in agriculture. Instead the use of a pesticide is regulated by the U.S. Environmental Protection Agency (EPA) under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA).[1]

EPA considers possible effects from offsite movement as part of the pesticide registration process under FIFRA. Additionally, pesticide registrants must report drift incidents to EPA as an adverse effect in order to ensure the pesticide continues to meet FIFRA requirements for registration. 40 C.F.R. § 159.195(a)(2). Before any registered herbicide can be applied to any new use site (including any deregulated GE-derived crop), EPA must approve a label amendment setting out the use pattern and specific application requirements for that new use site. Specifically, in order to approve a new use of a pesticide, EPA must conclude that no unreasonable adverse effects on the environment will result from the new use when applied according to label directions, which includes potential offsite movement. Offsite impacts are diminished when herbicides are applied in accordance with label instructions. Registered herbicides, including dicamba and glufosinate, are assessed by EPA for potential risks to non-target plants. A detailed discussion of the use of dicamba and glufosinate in the U.S. can be found in Appendix 4.

Use of Dicamba on DT soybean and DGT Cotton (Monsanto, 2013)

Dicamba (3,6-dichloro-2-methoxybenzoic acid) is a broad-spectrum, selective, post-emergence systemic herbicide with activity on a wide range of annual and perennial broadleaf plants. It was first registered in the United States in 1967 and is widely used in agricultural, industrial and residential settings. Dicamba controls annual, biennial and perennial broadleaf weeds in monocotyledonous crops and grasslands, and it is used to control brush and bracken in pastures. Because of the sensitivity of broadleaf plants to dicamba, the uses of dicamba in broadleaf crops until now have been limited to early pre-emergence and pre-harvest applications. DT soybean and DGT cotton have been developed to exhibit tolerance to dicamba herbicide applications by the insertion of a demethylase gene from *Stenotrophomonas maltophilia*. As a result DT soybean and DGT cotton express the dicamba mono-oxygenase (DMO) protein that rapidly demethylates dicamba to form the herbicidally inactive metabolite DCSA.

The use of dicamba is projected to increase if DT soybean and DGT cotton are deregulated. Please see Appendix A to this Environmental Report for a detailed discussion of the projections for increased use of dicamba in this scenario.

Offsite movement of herbicide to sensitive crops and plants during application is a concern during the growing season (Jordan *et al.,* 2009). The potential for effects to off-target crops from offsite movement due to spray drift is generally greatest with a postemergence application

[1] 7 U.S.C. §136 et seq.

because the treatment is made directly to the crop and requires the spray equipment to be higher above the ground, which results in more spray drift potential. In addition, postemergence herbicides typically have foliar activity, thereby increasing the potential of foliar effects or visual symptoms on desirable plants. The presence of dicamba can cause visible morphological effects to trees and certain sensitive crops, particularly beans (e.g., dry and snap beans), cotton, flowers, fruit trees, grapes, ornamentals, peas, potatoes, soybean, sunflower, tobacco, tomatoes, and other broadleaf plants when contacting their roots, stems or foliage (BASF, 2008; Jordan *et al.*, 2009). These plants are most sensitive to dicamba during their development or growing stage (BASF, 2008).

Spray Drift (Monsanto, 2013)

Spray drift of herbicides is a familiar and well-studied phenomenon, notably by the Spray Drift Task Force, of which Monsanto is a member. EPA defines drift as “the movement of pesticide through air at the time of application or soon thereafter, to any site other than that intended for application” (US-EPA, 2000). Factors affecting the occurrence of spray drift include application equipment and method, weather conditions, topography, and the type of crop being sprayed (US-EPA, 2000). Aerial application is associated with an increased drift potential compared to ground spray application because the herbicide is released at a greater distance above the crop canopy. In addition to the method of application, spray drift potential is also impacted by equipment type (e.g., nozzle types and ratings), settings (e.g., spray pressure, application speed, and application volume), equipment maintenance, environmental conditions (wind speed, temperature inversion), applicator behavior and distance from the edge of the application area (SDTF, 1997; Felsot *et al.*, 2010).

Prevention of Spray Drift (Monsanto, 2013)

Growers and commercial herbicide applicators have been applying dicamba to agricultural row crops for over 40 years. This experience has provided valuable knowledge and learning on the proper application of dicamba for effective weed control and also for minimizing offsite movement to sensitive crops. Spray drift can be reduced during application by using industry standard procedures for minimizing spray drift. Depending upon the herbicide being used, factors for managing the potential for spray drift include the selectivity and sensitivity of the herbicide, local weather conditions at the time of application (wind, temperature, humidity, inversion potential), droplet size distribution, application volume, boom height (height of the application equipment above the crop canopy), sprayer speed, and distance from the edge of the application area (SDTF, 1997; Felsot *et al.*, 2010). The minimization of droplets less than 150 microns is important in reducing any potential for spray drift. Droplet size can be increased by requiring the use of certain nozzle types, reducing spray pressure, increasing volume per minute spray rates, and by specifying an application volume per acre rate of at least 10 gallons (SDTF, 1997; TeeJet Technologies, 2011). Arvidsson *et al.* (2011) investigated meteorological and technical factors affecting total spray drift and determined that boom height and wind speed were the primary factors affecting the potential for spray drift among those tested, followed by air temperature, driving speed and vapor pressure deficit. Arvidsson *et al.* (2011) demonstrated that drift increased with driving speed. This increase was attributed to either air flows associated with the forward movement of the sprayer or to increased vertical boom movement.

EPA's Office of Pesticide Programs (OPP), which regulates the use of pesticides in the U.S., encourages pesticide applicators to use all feasible means available to them to minimize off-target drift. The Agency has introduced several initiatives to help address and prevent issues associated with drift. EPA is evaluating new regulations for pesticide drift labeling and the identification of best management practices to control such drift (US-EPA, 2009a), as well as identifying scientific issues surrounding field volatility of conventional pesticides (US-EPA, 2010). Additionally, OPP and EPA's Office of Research and Development are developing a new voluntary program, the Drift Reduction Technology (DRT) Program, which encourages the development, marketing and use of application technologies verified to significantly reduce spray drift (US-EPA, 2009a).

When herbicides are applied according to the FIFRA label application instructions, offsite impacts can be avoided. EPA concluded in the dicamba Registration Eligibility Decision (RED) (US-EPA, 2006; 2009b) that existing label language to mitigate offsite movement was sufficient to reduce the potential risk of damage to adjacent vegetation. Because the proposed application rates for dicamba on DT soybean and DGT cotton are less than or equivalent to rates for dicamba established for other uses in the dicamba RED, and because these uses were evaluated by EPA as part of the RED and the proposed label contains the offsite movement mitigation language, it is reasonable to conclude that the use of dicamba on DT soybean and DGT cotton also meets the FIFRA no unreasonable adverse effects on the environment standard for drift and offsite movement (US-EPA, 2006; 2009b).

Growers and commercial applicators follow label directions and restrictions, and are educated by university specialists and industry representatives on the proper application equipment, equipment setup, and climatic conditions to maximize herbicide performance and minimize offsite movement of herbicides. Equipment manufacturers have developed spray nozzles that provide uniform coverage for effective weed control while applying larger spray droplets to reduce the potential for particle drift.

Monsanto's Proposed Label Instructions (Monsanto, 2013)

Monsanto is proposing a multi-faceted approach to address potential for off-site movement of dicamba used on DT soybean and DGT cotton. Monsanto has proposed a range of application restrictions on its dicamba label. Collectively, these restrictions (which are currently pending before EPA) would go far beyond any other currently applicable limitations on dicamba application—indeed go beyond any label restrictions ever imposed on dicamba in the nearly half century that dicamba has been on the market.[2] Monsanto proposes to EPA that the supplemental labels for M1691 Herbicide use on DT soybean and DGT cotton contain application requirements that would minimize dicamba offsite movement, summarized as follows:

- No aerial application of M1691 Herbicide.

[2] For example, Monsanto's proposed limits are far more restrictive than those for Dicamba Max 4, which allows aerial applications and does not require the use of drift-reducing additives. *See* Dicamba Max 4 Label, *http://www.kellysolutions.com/erenewals/documentsubmit/KellyData/ND/pesticide/Product%20Label/83222/83222-14/83222-14_DICAMBA_MAX_4_3_10_2009_6_06_42_PM.pdf*.

- Use only spray nozzles that produce extremely coarse to ultra-coarse spray droplets and minimal amounts of fine spray droplets as defined by the American Society of Agricultural and Biological Engineers (ASABE S-572.1) and follow nozzle manufacturer's recommendations to deliver desired droplet size.

- Apply using a minimum of 10 gallons of spray solution per acre.

- Select a ground speed under 15 mph that will deliver the desired spray volume while maintaining the desired spray pressure.

- Spray at the appropriate boom height based on nozzle selection and nozzle spacing (not more than 24 inches above target pest or crop canopy). Set boom to lowest effective height over the target pest or crop canopy based on equipment manufacturer's directions.

- When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation.

- Do not apply during a temperature inversion.

- Survey the application site for neighboring sensitive areas prior to application. A potential way of locating sensitive areas is through the use of sensitive crop registries.[3]

- Do not apply when the wind is blowing in the direction of a sensitive area at a wind speed greater than 10 mph. Sensitive areas include known habitat for threatened or endangered species, non-target sensitive crops, residential areas, and greenhouses.

- Implement a spray buffer (to be determined by EPA) between the last treated row and the closest downwind edge of any sensitive area when the wind is blowing in the direction of a sensitive area at a speed of 10 mph or less.

- Do not apply if wind speed is greater than 15 mph.

- Do not use crop oil concentrate or methylated seed oil as adjuvants when applied with glyphosate-based agricultural products. Do not add acidifying buffering agents.

- Clean equipment immediately after using this product using the procedures outlined in the label.

These proposed label instructions and/ or any measures imposed by EPA will limit the offsite movement of dicamba via spray drift and inadvertent spray application for the reasons described in more detail in the following paragraphs.

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[3] For example, www.driftwatch.org

Reduction of Small Droplets (Monsanto, 2013)

Monsanto has taken a variety of measures to reduce offsite spray drift, including proposing label requirements to minimize the factors that result in small droplet generation, suspension, and movement into non-target areas. The factors that affect spray drift and associated impacts to adjacent areas can be divided into three main categories: a) droplet size and number, b) droplet transport, and c) the physical location of the spray. Droplet size and number is controlled by the nozzle type, application volume, spray pressure, and additives in the tank. Droplet transport is affected by wind speed, boom height, air temperature, vapor pressure deficit[4], and application speed. The third factor includes the proximity to sensitive non-target species which can be controlled through a mandate that applicators be aware of sensitive areas - including areas where threatened or endangered species may be present - that could be impacted from a dicamba application and implement a no-spray buffer as specified on the label.

Droplet Size and Number (Monsanto, 2013)

The minimization of droplets less than 150 microns is important in reducing any potential for spray drift. Nozzles used for application of agricultural products do not produce droplets of one uniform size, but rather produce a spectrum of droplet sizes (TeeJet Technologies, 2011). Nozzles are generally classified as very fine, fine, medium, coarse, very coarse, extremely coarse, or ultra-coarse by comparison of a nozzle's droplet size distribution when spraying water to that of a set of standard nozzles. ASABE has established a nozzle classification system in its published standard, ASABE S-572.1 (ASABE, 2009; Wilson, 2011b), which is the U.S. industry standard for agricultural spray drop size classification. Nozzles classified as Extremely Coarse to Ultra Coarse have a small percentage of the spray volume in droplets with diameters less than 150 microns.

Nozzle orifice size and operating pressure also affect the droplet size spectrum for a given nozzle type (SDTF, 1997). The relationship between orifice size, operating pressure, spray volume delivered, and droplet size classification can be found in the nozzle manufacturers' catalogs. The use of a larger orifice size allows the application to be made at a higher volume per minute rate without increasing the operating pressure, and consequently reducing the droplet size classification (TeeJet Technologies, 2011). Additionally, a higher volume per minute rate allows the spray volume per acre to be higher at a given operating speed. Specifying an application volume per acre of at least 10 gallons may result in the use of larger orifice nozzles for some equipment to reduce the percentage of small droplets with the higher potential to drift.

The proposed label instructions direct the applicator to employ all of the relevant practices – including nozzle type, operating pressure, and application volume – to ensure that the droplet size distribution can be classified as extremely coarse to ultra-coarse – which limits the percentage of spray droplets in the size category that has the potential to move offsite.

[4] Vapor pressure deficit is the difference between the amount of water vapor in the air and the amount of water vapor in the air at saturation. Evaporation reduces droplet size, and the greater the vapor pressure deficit the more rapid the evaporation and the greater the potential for drift.

Reduction of the Transport of Small Droplets (Monsanto, 2013)

Arvidsson *et al.* (2011) investigated meteorological and technical factors affecting total spray drift and determined that boom height and wind speed were the primary factors affecting the potential for spray drift among those tested, followed by air temperature, driving speed and vapor pressure deficit. Establishing a maximum wind speed (15 mph, or 10 mph if sensitive areas are downwind) limits the distance that fine droplets will travel before settling. A temperature inversion[5] can result when wind speeds are less than 3 mph, and can cause the suspension of the small spray droplets for extended periods of time. Prohibiting application during inversion conditions avoids the potential for suspension and farther transport of fine spray droplets (Wilson, 2011a).

Boom height is also restricted in the proposed application use instructions for dicamba to the minimum height required to get a uniform spray pattern in order to minimize the amount of time that spray droplets are suspended before settling to the ground (Wilson, 2011b). As shown in the Spray Drift Task Force information booklet on Ground Applications (SDTF, 1997), a difference in boom height between 20 and 50 inches can impact the extent to which spray volume may move offsite by allowing additional time for the droplets to be blown offsite before settling. Prohibiting aerial application and limiting the boom height for ground applications to 24 inches above the target pest or crop canopy will minimize the amount of time that spray droplets are suspended and available to move offsite.

Arvidsson *et al.* (2011) demonstrated that drift increased with driving speed. This increase was attributed to either air flows associated with the forward movement of the sprayer or to increased vertical boom movement. Limiting driving speed to 15 mph or less will minimize this potential contributing factor.

Physical Location of the Spray and Use of Wind Buffers (Monsanto, 2013)

Awareness of the presence of sensitive areas and whether the wind direction at the time of application may move any suspended spray droplets toward a sensitive area are important considerations at the time of application. Since the implementation of the DriftWatch™ [6] program in Indiana, drift incidents onto sensitive crops have been significantly reduced (Hahn *et al.*, 2011). This program has now been expanded to several states across the major Midwest soybean growing area and to some Great Plains states as well (IL, IN, MI, MN, MO, WI, CO, MT, and NE). Under some circumstances, a buffer may be needed to provide further protection to a sensitive area. This method is highly effective when used.

[5] A temperature inversion occurs when the air at the soil surface is cooler than the air above. Since cool air sinks, the surface air layer does not mix with upper layers of air. Under this condition, spray droplets are trapped near the surface and may stay suspended for increased periods of time.

[6] Driftwatch is a voluntary program that allows growers to reports locations of fields in which sensitive crops are being grown (and also identified other types of sensitive areas such as organic fields). The sensitive crop information is presented on a website in a map format which can then be utilized by pesticide applicators prior to application.

For these reasons, the proposed FIFRA product labels state that applicators should consult with available sensitive crop registries prior to making dicamba applications to DT soybean or DGT cotton. Many state lead agriculture agencies (IA, IL, IN, KS, MI, MN, MO, NE, OK, WI) have developed tools and resources to assist the applicator in the location of sensitive areas, such as vegetable or organic production fields, in an effort to minimize commercial impacts associated with pesticide offsite movement. Furthermore, prior to commercialization of DT soybeans and DGT cotton, Monsanto will implement an endangered species mitigation system for dicamba. The implemented system will either be an EPA-specific system and/or a web-based system, similar to that currently available for glyphosate at PreServe.org. This will facilitate applicator and grower implementation of use restrictions for protection of threatened and endangered non-monocotyledonous terrestrial plant species.

Determination of Proper Buffer Distances (Monsanto, 2013)

Monsanto has submitted information to the EPA that summarizes studies conducted at eight field locations to assess the buffer distance required to be protective of survival, growth, and reproduction of plant species that are very sensitive to dicamba (Orr *et al.*, 2012). These studies utilized nozzles that fit the droplet size classification requirements, the minimum application volume and the maximum boom height requirements specified above.

Justification for use of soybean plant height as the endpoint for risk assessment

Soybean was selected as the test species since it has been shown to be a highly sensitive indicator species for post-emergence dicamba effects. In the vegetative vigor study conducted in a greenhouse with the DGA salt of dicamba, soybean had the lowest endpoint of the ten species tested (Porch *et al.*, 2009). Comparable sensitivity for soybean to that observed in the greenhouse has also been displayed in field studies (Wax *et al.*, 1969; Auch and Arnold, 1978; Weidenhamer *et al.*, 1989; Al-Khatib and Peterson, 1999; Kelley *et al.*, 2005). See Table 7-1 for a summary of endpoints from these studies.

Higher Dicamba rates are needed to cause effects on soybean yield than are needed to cause effects on soybean plant height at early growth stages

Effects of dicamba on plant growth have been evaluated by considering effects on plant height at very sensitive early growth stages. Effects of dicamba on plant reproduction can be evaluated by assessing the effect of dicamba on plant species seed or fruit yields. A number of the field studies (Wax *et al.*, 1969; Auch and Arnold, 1978; Weidenhamer *et al.*, 1989; Al-Khatib and Peterson, 1999; Kelley *et al.*, 2005; Wright, 2012) indicate that soybean yield is no more sensitive, and is generally less sensitive, to dicamba treatment than is soybean plant height at the early growth stages at which studies to estimate buffer distances have been conducted. Additionally, results of these studies demonstrate that significant morphological effects in soybeans such as plant height reduction do not always result in yield reduction, but yield reduction in soybeans occurs at rates greater than that affecting soybean plant height at the early vegetative stages which were used in studies for buffer distance estimation. See Table 7-2 for a summary of the results of these studies.

Dicamba effects on yields of other crops occur at rates greater than or equal to rates affecting soybean plant height

The effects of dicamba on crop yield have been reported by a number of investigators in at least eleven other crops besides soybean. Monsanto has submitted field data on soybean to EPA and conducted an extensive review of relevant literature for use by EPA in establishing an appropriate buffer distance from potentially sensitive plant communities. The field data was generated across multiple growing seasons with diverse geographic and climatic conditions. The literature review included results from studies testing 12 possible sensitive crops, with many crops tested across multiple growing seasons and/or geographies and/or growth stages. The potential sensitive crops included in these studies were soybean, tomato, cantaloupe, cotton, pea, peanut, pepper, potato, sugarbeet, sunflower, tobacco, and watermelon.

These studies also indicate that the dicamba no effect rate for soybean plant height at vegetative growth stages is a lower value (approximately 0.3 g a.e./ha) than the dicamba no effect rates for plant yield in these other species that have been tested. See Table 7-3 for a summary of endpoints from these studies.

Because soybean plant height measured at vegetative growth stages is a more sensitive endpoint for dicamba effects than soybean yield or yield of eleven other plant species in five additional plant families, the use of the soybean plant height endpoint is appropriate to assess potential dicamba effects on survival, growth, and reproduction of sensitive species.

Monsanto's application management practices, including buffer distances that have been determined to not result in soybean plant height reduction after dicamba applications, can therefore be considered effective measures for mitigation of potential effects of dicamba on non-target plants.

Table 7-1. Soybean Field Studies with Dicamba

Growth Stage & Other Treatment Information	Dicamba Salt [a]	Time of Measurement	Plant Height No Effect Rate (g a.e./ha)[b]	Reference
2-3 trifoliate 1997	Not Specified	60 DAT	<5.6	(Al-Khatib and Peterson, 1999)
2-3 trifoliate 1998	Not Specified	60 DAT	5.6	(Al-Khatib and Peterson, 1999)
1-2 trifoliate - 1974	DMA	At maturity	56	(Auch and Arnold, 1978)
3-4 trifoliate - 1974	DMA	At maturity	1	(Auch and Arnold, 1978)
6-7 trifoliate - 1974	DMA	At maturity	1	(Auch and Arnold, 1978)
V3	DMA	At maturity	< 1.1	(Wax *et al.*, 1969)
Williams - prebloom 1980 (41 DAP)	DMA	At maturity	0.32[c]	(Weidenhamer *et al.*, 1989)
Elf - prebloom 1980 (41 DAP)	DMA	At maturity	1.3[c]	(Weidenhamer *et al.*, 1989)
V3	DGA	Full height before leaf senescence	< 0.56	(Kelley *et al.*, 2005)
V7	DGA	Full height before leaf senescence	< 0.56	(Kelley *et al.*, 2005)

[a] DMA – dimethylamine; DGA – diglycolamine

[b] For conversion of g a.e./ha to lb a.e./A divide the g a.e./ha value by 1120. Application rates expressed as oz/A were assumed to be of a 4 lb a.e./gal formulation and were converted to g a.e./ha

[c] Highest rate at which less than 10% effect on height was observed based on Table 2 of the publication

Table 7-2. Comparison of No Effect Rates for Plant Height and Yield from Dicamba Application to Soybeans

Growth Stage & Other Treatment Information	No Effect Rate (g a.e./ha)[a]		Reference
	Plant Height	Yield	
Williams - prebloom 1980	0.32[b,c]	20[b]	(Weidenhamer *et al.*, 1989)
Elf - prebloom 1980	1.3[b,c]	10[b]	(Weidenhamer *et al.*, 1989)
8-12 inches, 3 WAE[d], RM1 2009	--	11	(Johnson *et al.*, 2012)
8-12 inches, 3 WAE, RM2 2009	--	41	(Johnson *et al.*, 2012)
8-12 inches, 3 WAE, RM1 2010	--	3	(Johnson *et al.*, 2012)
8-12 inches, 3 WAE, RM2 2010	--	3	(Johnson *et al.*, 2012)
2-3 trifoliate 1997	5.6[e]	17	(Al-Khatib and Peterson, 1999)
2-3 trifoliate 1998	<5.6[e]	17	(Al-Khatib and Peterson, 1999)
V3[f] - SE Farm	--	< 5.6	(Andersen *et al.*, 2004)
V3 - Brookings Farm	--	< 5.6	(Andersen *et al.*, 2004)
V3	< 1[c]	1	(Wax *et al.*, 1969)
V3	< 0.56[c]	< 0.56[g]	(Kelley *et al.*, 2005)
1-2 trifoliate - 1974	56[c]	56	(Auch and Arnold, 1978)
3-4 trifoliate - 1974	1[c]	56	(Auch and Arnold, 1978)
6-7 trifoliate - 1974	1[c]	56	(Auch and Arnold, 1978)
V7[h]	< 0.56[c]	0.56	(Kelley *et al.*, 2005)
Early bloom - 1974	1[c]	11	(Auch and Arnold, 1978)
Early bloom - 1975	1[c,i]	1	(Auch and Arnold, 1978)
Early bloom - 1976	< 11[c]	< 11	(Auch and Arnold, 1978)
R2[j]	NA[k]	< 1	(Wax *et al.*, 1969)
R2	NA	0.56	(Kelley *et al.*, 2005)
Elf - midbloom 1980	NA	40[b]	(Weidenhamer *et al.*, 1989)
Mid-bloom - 1976	NA	28	(Auch and Arnold, 1978)
Williams - midbloom 1980	NA	10[b]	(Weidenhamer *et al.*, 1989)
Williams - midbloom 1981	NA	7.4[b]	(Weidenhamer *et al.*, 1989)
Early-pod - 1975	NA	11	(Auch and Arnold, 1978)
Early pod - 1976	NA	11	(Auch and Arnold, 1978)
Late pod - 1976	NA	28	(Auch and Arnold, 1978)

[a] For conversion of g a.e./ha to lb a.e./A divide the g a.e./ha value by 1120. Application rates expressed as oz/A were assumed to be of a 4 lb a.e./gal formulation and were converted to g a.e./ha

[b] Highest rate at which less than 10% and 20% effect on height and yield, respectively, were observed based on Table 2 & Table 3 of the publication

[c] Height at maturity

[d] WAE – weeks after emergence
[e] Assessed at 60 days after treatment
[f] At V3 growth stage the third trifoliate leaf is unfolded (http://extension.agron.iastate.edu/soybean/production_growthstages.html)
[g] Yield reduction was statistically significant but not considered biologically significant at rates of 0.56 and 5.6 g a.e./ha because a ten-fold increase in rate did not cause an increase in the yield reduction, and the percent reduction is small compared to the untreated control (i.e., less than 10% yield reduction).
[h] At V7 growth stage the seventh trifoliate leaf is unfolded.
[i] A height reduction of 18% was observed at rates above 1 g a.e./ha, but this reduction was not statistically significant
[j] R2 growth stage is when there is an open flower at one of the two uppermost nodes (http://extension.agron.iastate.edu/soybean/production_growthstages.html)
[k] Rates at which no effect on plant height are provided in the literature references, but are not provided here since yield values are being compared to rates causing plant height effects at earlier time points.

Table 7-3. Effect of Dicamba on Yield in Plant Species Other than Soybean

Crop	Growth Stage & Other Treatment Information	Effect	No Effect Rate (g a.e./ha)[a]	Reference
Soybean	pre-bloom	Plant Height	0.32[b]	(Weidenhamer *et al.*, 1989)
Cantaloupe	3 Weeks after transplanting	Total Harvest	560	(Hynes and Weller, 2010)
Cantaloupe	3 Weeks after transplanting	Total Harvest	11.2	(Hynes *et al.*, 2011)
Cotton	Cot – 2 Leaf	Lint Yield	140	(Everitt and Keeling, 2009)
Cotton	4-5 Leaf Pinhead Square First Bloom	Lint Yield	14	(Everitt and Keeling, 2009)
Cotton	20-30 cm tall RM 2009 LW 2009 LW 2010	Yield	140	(Johnson *et al.*, 2012)
Cotton	20-30 cm tall RM 2010	Yield	11	(Johnson *et al.*, 2012)
Cotton	6-8 Leaf	Lint Yield	2.8	(Marple *et al.*, 2007)
Cotton	3-4 Leaf 8-node 14-node 18-node	Lint Yield	2.8	(Marple *et al.*, 2007)
Pea	Flower buds formed	Yield	6.25 [c]	(Al-Khatib and Tamhane, 1999)
Pea	Vegetative & Flowering	Seed dry weight	5.63	(Olszyk *et al.*, 2009)
Peanut	15-20 cm width RM 2010	Yield	140	(Johnson *et al.*, 2012)
Peanut	15-20 cm width RM 2009 LW 2010	Yield	41	(Johnson *et al.*, 2012)
Peanut	15-20 cm width LW 2009	Yield	11	(Johnson *et al.*, 2012)
Pepper	3 Weeks after transplanting	Total harvest	11.2	(Hynes and Weller, 2010)
Pepper	3 Weeks after transplanting	Total harvest	560	(Hynes and Weller, 2010)
Pepper	3 Weeks after transplanting	Total harvest	560	(Hynes *et al.*, 2011)
Potato	11-15 Days after emergence	Tuber fresh weight	5.58	(Olszyk *et al.*, 2010)

Crop	Growth Stage & Other Treatment Information	Effect	No Effect Rate (g a.e./ha)[a]	Reference
Potato	15% flowering	Tuber Yield	11.2	(Leino and Haderlie, 1985)
Sugarbeet	10-15 leaf	Extractable sucrose	70	(Schroeder *et al.*, 1983)
Sugarbeet	10-15 leaf	Root yield	>140	(Schroeder *et al.*, 1983)
Sunflower	2-4 leaf	Yield	1.6	(Derksen, 1989)
Tomato	Full bloom - 1972	Total Yield	1	(Jordan and Romanowski, 1974)
Tomato	Green fruit stage 1971	Total Yield	20	(Jordan and Romanowski, 1974)
Tomato	Green fruit stage 1972	Total Yield	100	(Jordan and Romanowski, 1974)
Tomato	3 Weeks after transplanting	Total Yield Fruit weight	11.2 5.6	(Hynes and Weller, 2010)
Tomato	3 Weeks after transplanting	Total Yield	560	(Hynes *et al.*, 2011)
Tomato	15 cm tall Early vegetative	Marketable Fruit	0.9[d]	(Kruger *et al.*, 2012)
Tomato	25 cm tall Early bloom	Marketable Fruit	0.5[d]	(Kruger *et al.*, 2012)
Watermelon	3 Weeks after transplanting	Total Harvest	11.2	(Hynes and Weller, 2010)
Watermelon	3 Weeks after transplanting	Total Harvest	560	(Hynes *et al.*, 2011)

[a] For conversion of g a.e./ha to lb a.e./A divide the g a.e./ha value by 1120. Application rates expressed as oz/A were assumed to be of a 4 lb a.e./gal formulation and were converted to g a.e./ha

[b] Lowest rate from

[c] Next rate below rate with greater than a 25% effect on yield (lowest such rate of 5 sites). 25% effect on yield was chosen due to high variability.

[d] Value from dose response curve estimated to result in 1% fruit loss

Applicator Education and Awareness (Monsanto, 2013)

As mentioned above, growers and commercial applicators are aware of the sensitivity of certain crops to dicamba and the extra precautions that should be taken in making dicamba applications when these crops are nearby. In addition, growers and commercial applicators follow label directions and restrictions, and growers are educated by university specialists and industry representatives on the proper application equipment, equipment setup, and climatic conditions to maximize herbicide performance and minimize offsite movement of herbicides. To provide growers with specific information for dicamba applications to dicamba-tolerant crops, Monsanto is implementing a robust stewardship program that will include a strong emphasis on grower and applicator training. In addition, U.S. EPA and state agencies have enforcement authority over the use of any registered pesticide in a manner inconsistent with its labeling.

Equipment manufacturers developed spray nozzles that provide uniform coverage for effective weed control while applying larger spray droplets to reduce the potential for particle drift. Similarly, offsite movement of dicamba has been managed with the knowledge of the proper spray equipment and equipment setup, climatic conditions for accurate, on-target applications, and based on the requirements for applying dicamba at an appropriate distance from sensitive crops and plants (Jordan *et al.*, 2009).

<u>Volatilization (Monsanto, 2013)</u>

Volatilization of fertilizers and pesticides from soil and plant surfaces also introduces certain chemicals to the air and can cause offsite movement. A substance is volatile if it is likely to vaporize at atmospheric pressure. The USDA Agricultural Research Service (ARS) is conducting a long-term study to identify factors that affect pesticide levels in the Chesapeake Bay region airshed (USDA-ARS, 2011). This study has determined that volatilization is highly dependent upon exposure of disturbed unconsolidated soils, and that variability in measured compound levels is correlated with temperature and wind conditions. Another ARS study of volatilization of certain herbicides after application to fields has found moisture in dew and soils in higher temperature regimes significantly increases volatilization rates (USDA-ARS, 2011).

Physicochemical characteristics of the individual chemical have been shown to have little impact on spray drift. However, unlike spray drift, the potential for post-application volatilization is primarily a function of the physicochemical properties of the chemical, (e.g., vapor pressure, Henry’s Law constant, etc.), method of application (e.g., soil-incorporated or not), and the local environmental conditions (e.g., temperature, humidity, wind speed). Due to this complexity, the potential for post-application vapor loss is often measured experimentally.

In EFED’s Chapter in the Dicamba RED, laboratory volatility data have been summarized for potassium and dimethylamine (DMA) salts of dicamba from a moist soil. Monsanto has also submitted information to the EPA that summarizes a field study that was conducted to measure the volatilization rate of a dicamba DGA salt formulation from foliage.

<u>DGA Salts Reduce Volatilization (Monsanto, 2013)</u>

Monsanto seeks to minimize volatile loss from treated soybean and cotton fields by labeling optimal formulations and salt forms of dicamba. The DGA salt formulation of dicamba, which is proposed for use on DT soybean and DGT cotton, has low volatility. Side-by-side field experiments have indicated that a formulation of the diglycolamine (DGA) salt of dicamba dramatically reduced volatilization of dicamba compared to a similar formulation of the DMA salt form and that volatility is not a significant component of offsite movement for the DGA salt of dicamba (Egan and Mortensen, 2012). The use of formulations of, or similar to, the DGA salt of dicamba will help to limit non-target plant risk due to post-application vapor loss. In the publication, the authors state, “Our data demonstrate that the diglycolamine formulation has a dramatic effect on reducing dicamba vapor drift. Estimates of total gram acid equivalent vapor drift outside of the treated area were reduced 94% relative to the dimethylamine formulation, and the dose-distance curves indicate that predicted mean exposures drop close to zero only short distances away from the treated area." Additionally, measured air concentrations when using the DGA salt were at least 70-fold lower than those in the potassium and DMA salt laboratory studies EFED evaluated, even though the application rate was twice that of DMA (Mueller *et al.*, 2013).

Monsanto has requested the use of dicamba on DT soybean and DGT cotton only for low-volatility salts, including the DGA salt formulation (U.S. EPA Reg. No. 524-582). Specific application requirements on the proposed FIFRA product label (currently pending before EPA), and/or any other measures imposed, by EPA will minimize dicamba offsite movement. Monsanto plans to continue to invest in research and development of new dicamba formulations for use with DT soybean and DGT cotton. Monsanto and BASF have submitted separate applications to EPA seeking the approval of novel dicamba formulations (EPA File Symbols 7969-GUL, 524-ANO and 524-ARN). EPA will review relevant data and information as a part of its registration process and confirm that the product when used according to the approved label directions meets the FIFRA standard before granting a registration including the use on DT soybean or DGT cotton. Furthermore, Monsanto has indicated that it does not plan to allow growers to use dimethylamine salt (DMA) of dicamba and/or dicamba acid on DT soybean or DGT cotton.

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Appendix 8. EPA Assessment of Herbicides Used on MON 87708 Soybean and MON 88701 Cotton

EPA Regulation of Pesticides
The use of pesticides is regulated by EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The purpose of the Agency's review is to ensure that the pesticide, "when used in accordance with widespread and commonly recognized practice," will not cause "unreasonable adverse effects on the environment" FIFRA 3(c)(5)(D).

If the pesticide may be used on food or feed crops, EPA ensures the safety of the food supply by establishing the amount of each pesticide that may safely remain in or on foods. These maximum pesticide residue levels (called "tolerances") limit the amount of the pesticide residue that can legally remain in or on foods. EPA undertakes this analysis under the authority of the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended by the Food Quality Protection Act of 1996 (FQPA), and must conclude that such tolerances will be safe, meaning that there is a reasonable certainty that no harm will result from aggregate (food, water and non-occupational residential/recreational) exposure to the pesticide residues (US-EPA, 2013b). In addition, when multiple pesticides affect the same target organs through the same toxicological mode- of-action, EPA considers the cumulative effect of those pesticides. In addition, the FDA and the USDA monitor foods for pesticide residues and work with the EPA to enforce these tolerances (USDA-AMS, 2013).

The use of registered pesticides is further governed by labels, which are legally enforceable and define maximum application rates, total annual application limits, methods of application, and other use restrictions.

To register a new pesticide product, EPA evaluates potential risks to humans and the environment, and typically requires applicants to submit more than 100 different scientific studies conducted according to EPA's harmonized test guidelines. The data required by EPA are used to evaluate whether a pesticide has the potential to cause adverse effects on humans (including acute, chronic, reproductive, and carcinogenic risk), wildlife, fish, and plants (including endangered species and other non-target organisms, *i.e.*, organisms against which the pesticide is not intended to act). FIFRA was amended in 1988 to require the reregistration of products with active ingredients registered prior to November 1, 1984. In 1996, FIFRA was amended by the FQPA to require reevaluation of all pesticide active ingredient at fifteen year (or shorter) intervals thereafter (a process called Registration Review). The amendments called for the development and submission of data to support the continued registration of the active ingredient, as well as a review of all data submitted to the EPA. During the reregistration and registration review processes, EPA thoroughly reviews the scientific database since a pesticide's original registration.

EPA has responsibility to regulate the use of pesticides (including herbicides) that may be used on feed crops, and must establish pesticide tolerances (maximum pesticide residue levels) for the amount of pesticide residue that can legally remain in or on the feed crop. EPA undertakes this analysis under the authority of the FFDCA, and must conclude that such tolerances will be safe, meaning that there is a "reasonable certainty that no harm" to human health will result from the use of the pesticide. This finding of reasonable certainty of no harm is obligated under the FFDCA, as amended by the FQPA of 1996. Similar to the establishment of pesticide tolerances for food, the EPA will consider the toxicity of the pesticide and its break-down products, pesticide use rate and frequency of application; and how much of the pesticide (i.e., the residue) remains in or on food by the time is it marketed and prepared in its establishment of tolerance for animal feed (US-EPA, 2013b).

MON 87708 Soybean and MON 88701 Cotton

Two petitions were submitted by Monsanto to APHIS seeking determinations of nonregulated status for GE soybean and cotton cultivars engineered for resistance to herbicides.

APHIS Petition 10-188-01p is for GE soybean (*Glycine max*), designated as event MON 87708 soybean. It contains a demethylase gene from *Stenotrophomonas maltophilia* that expresses a dicamba mono-oxygenase (DMO) protein to confer resistance to the broadleaf herbicide dicamba. DMO protein rapidly demethylates dicamba to the inactive metabolite 3,6-dichlorosalicylic acid (DCSA), a known metabolite of dicamba in non-GE cotton, soybean, livestock and soil.

APHIS Petition 12-185-01p is for GE cotton (*Gossypium* spp.), designated as event MON 88701 cotton, that is also resistant to dicamba as a result of the expression of the DMO protein. MON 88701 cotton also contains a bialaphos resistance (*bar*) gene from *Streptomyces hygroscopicus* that expresses the phosphinothricin N-acetyltransferase [PAT (*bar*)] protein to confer tolerance to the herbicide glufosinate. The PAT (*bar*) protein acetylates the free amino group of glufosinate to produce non-herbicidal N-acetyl glufosinate, a known metabolite in glufosinate-tolerant plants (OECD, 2002).

As with any other GE crop deregulated by APHIS, deregulated status of these two events would include dicamba-resistant soybean, dicamba- and glufosinate-resistant cotton, any progeny derived from crosses between MON 87708 soybean and conventional or other previously deregulated GE soybean varieties, and any progeny derived from crosses between MON 88701 cotton and conventional or other previously deregulated GE cotton varieties. Monsanto has indicated that both MON 87708 soybean and MON 88701 cotton will be combined with glyphosate-resistance traits utilizing traditional breeding techniques.

Monsanto has submitted pesticide registration petitions to EPA requesting Section 3 registration for the use of dicamba on dicamba-resistant soybean and cotton. For these petitions, Monsanto is requesting to establish new tolerances for dicamba-resistant soybean forage at 45 ppm and for dicamba tolerant soybean hay at 70 ppm. Monsanto is also requesting to amend the cotton un-delinted seed tolerance from 0.2 ppm to 3.0 ppm and establish a new tolerance for cotton gin byproducts at 70.0 ppm.

A brief overview of the three herbicides (dicamba, glufosinate, and glyphosate) that are intended to be used on the two Monsanto events are presented in the following sections. Additionally, the proposed uses of these herbicides on MON 87708 soybean and MON 88701 cotton and any EPA assessments performed assessing the potential effects from the new uses are summarized.

Dicamba

Background and Current Uses

Dicamba (benzoic acid, 3,6-dichloro-2-methoxy-, aka 3,6-dichloro-*o*-anisic acid) is a selective systemic herbicide belonging to the benzoic acid chemical family. Dicamba is a broadleaf selective herbicide that was approved by the EPA for agricultural application uses in 1967 (US-

EPA, 2006; 2009c). Dicamba is registered for use on agricultural crops and for use as spot and broadcast treatments on turf, in addition to residential uses. Dicamba is currently labeled for weed control in corn, soybean, cotton, sorghum, wheat, barley, oats, millet, pasture, rangeland, asparagus, sugarcane, turf, grass grown for seed, conservation reserve programs, and fallow croplands. The herbicide is currently registered for use on both soybeans and cotton as pre-plant applications and not as post emergence applications because crop injury could occur if dicamba were to come in contact with roots, stems, or foliage.

Dicamba belongs to the auxin class of herbicides, which is the oldest class of known synthetic herbicides. This class includes 2,4-D, 2,4-DB, mecoprop, MCPA, clopyralid, and several other active ingredients, and is WSSA Herbicide Group Number 4 (HRAC, 2009).[1] On the basis of their structural and chemical properties, auxinic herbicides have been classified into several sub-groups, viz., phenoxyalkanoic acids (e.g., 2,4-D, MCPA), benzoic acids (e.g., dicamba, chloramben), pyridines (e.g., picloram, clopyralid), and quinolinecarboxylic acids (e.g., quinclorac, quinmerac). Generally, auxinic herbicides are effective against broadleaf (dicotyledonous) plant species, allowing them to often be used in production of narrow leaf (monocotyledonous) crops.

Various salt formulations of dicamba are formulated as standalone herbicide products and marketed by several companies under various trade names such as Banvel®, Clarity®, Diablo®, Rifle®, Sterling®, and Vision®. These dicamba products can also be tank-mixed with one or more active ingredients depending on the crop to be treated. For example, Clarity® can be tank mixed with over 75 herbicide products in labeled crops. Additionally, dicamba is currently formulated as a premix product with one or more other herbicide active ingredients, including glyphosate, 2,4-D, diflufenzopyr, atrazine, nicosulfuron, metsulfuron, primsulfuron, triazulfuron, rimsulfuron, and halosulfuron.

Dicamba-treated acreage has ranged from 17.4 to 36.3 million acres between 1990 and 2011. Usage of dicamba peaked during the period of 1994 through 1997, where 1994 was the peak year when 36 million crop acres were treated with 9.4 million pounds of dicamba. The use of dicamba steadily declined to 17.4 million treated acres with 2.7 million pounds applied in 2006. The reduction in dicamba use has been attributed to the competitive market introductions of sulfonylurea herbicides (chlorsulfuron, metsulfuron-methyl, and thifensulfuron-methyl) in wheat, new broadleaf herbicide active ingredients in corn, and introduction of glyphosate-tolerant corn. More recently, however, dicamba-treated acres have been on the rise and have increased by as much as 7.9 million acres between 2006 to 2011. Most of this increase has occurred in fallow, pastureland, sorghum, and cotton (pre-plant) (Monsanto, 2012). Dicamba-treated acres have increased in cotton, in particular, because it is a common pre-plant herbicide recommendation for glyphosate-resistant marestail (horseweed) and Palmer amaranth in the Midsouth region (McClelland *et al.*, 2006). Figure 8-1 shows the changes in dicamba use by year and crop from 1992 through 2011.

[1] There are several systems of herbicide mode-of action classification. Among the most widely used are those of the Herbicide Resistance Action Committee (HRAC) and the Weed Science Society of America.

Approximately 25.3 million acres of crops were treated with dicamba in 2011 (see Table 8-1 for a summary of the dicamba-treated acres by crop in 2011). Figure 8-2 shows a map reflecting the estimated agricultural use for dicamba in 2011. Heavy dicamba usage occurred in the Mid-West and states along the Mississippi River. Dicamba is currently labeled for use in conventional or glyphosate-resistant soybean, although dicamba use is extremely limited because applications are restricted to very early preplant and/or preharvest applications due to soybean (crop) injury concerns. The dicamba-treated acreage in 2011 soybean production was approximately 872,000 acres, representing 1.2 % of the total soybean acreage (Table 8-1) (Monsanto, 2012). Dicamba can currently be applied to cotton in the U.S. as a pre-plant application, at least 21 days prior to planting.

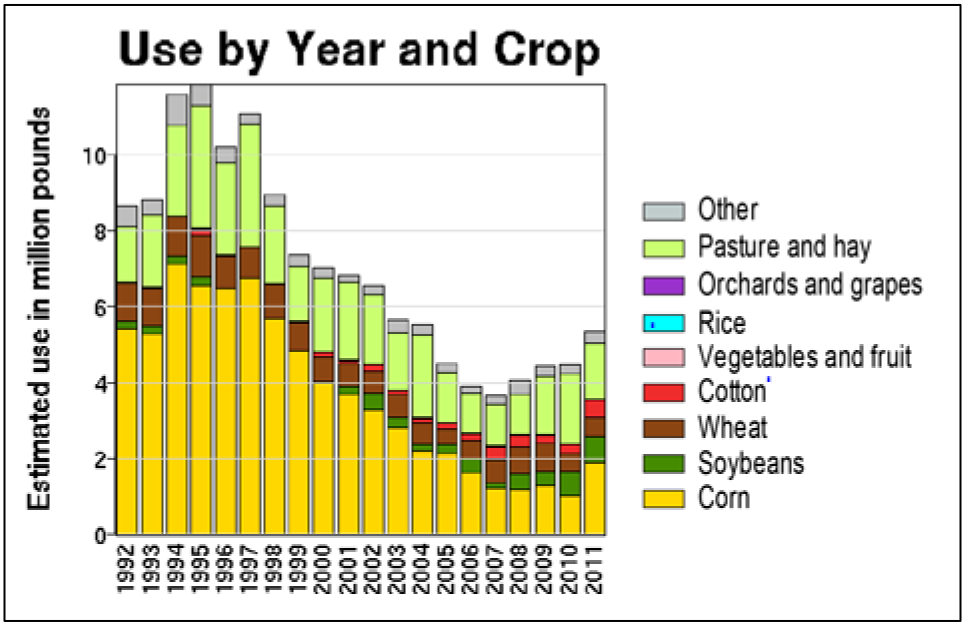

Figure 8-1. Dicamba Use by Year and Crop, 1992-2011
Source: (USGS, 2013a)

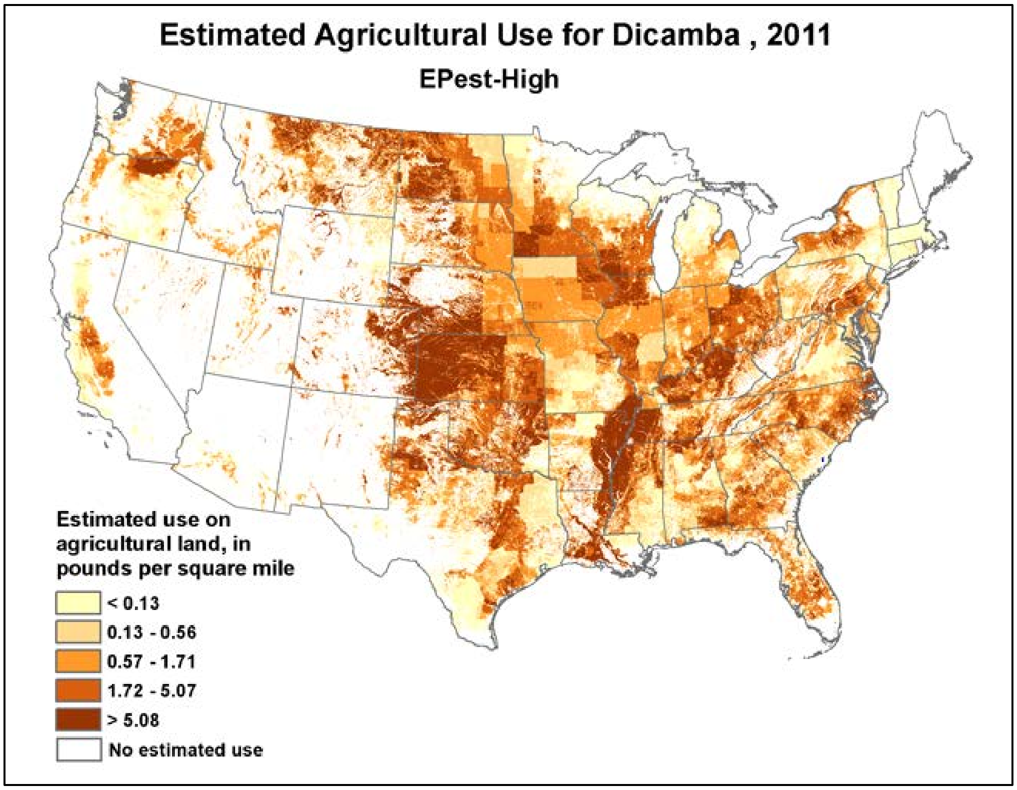

Figure 8-2. Estimated Agricultural Use for Dicamba, 2011
Source: (USGS, 2013a).

Table 8-1. Dicamba-Treated Acres and Amounts Applied for Labeled Crops, 2011

Crop	Total Crop Acres (x1,000)	Dicamba-Treated Acres (000)	% U.S. Dicamba-Treated Acres[2]	% Crop Acres Treated with Dicamba[3]	Dicamba (a.e.) (x1,000 lb)
Asparagus	29	2	0.01	NA	<1
Barley	2,460	80	0.3	3.2	6
Corn	92,146	10,880	43.0	10.3	1,531
Cotton	14,533	1,416	5.6	9.6	364
Fallow	14,899	3,966	15.7	18.7	597
Pastureland	95,532	2,009	7.9	2.0	438
Sorghum	5,315	1,316	5.2	18.1	206
Soybean	74,835	872	3.4	1.2	233
Sugarcane	825	163	0.6	15.6	36
Wheat, all	53,223	4,532	17.9	7.4	418
All other uses	NA	65	0.3	NA	9
Total		**25,301**	**100.0**		**3,837**

Definitions: a.e. = acid equivalent; lbs = pounds; NA = not applicable.
[1] Source: (Monsanto, 2012; 2013).
[2] The percentage of the total dicamba-treated acres for all labeled crops and uses.
[3] Percentages calculated from crop acres treated with dicamba (data not shown).

Based on USDA-NASS (USDA-NASS, 2005; 2007; 2010; 2011; 2012) statistics, dicamba application rates ranged from 0.07 to 0.24 pounds per acre with the average number of applications ranging from 1 to 1.9 applications per cropping season. Dicamba rates are lowest in barley, wheat and oats, where typically more than one application is made in these crops per cropping season (see Table 8-2) (Monsanto, 2012).

Table 8-2. Dicamba Applications – Average Number and Rates to Labeled Crops[1]

Crop	# of Dicamba Applications	Rate of Dicamba per Application	Rate of Dicamba per Crop Year
Corn	1.2	0.209	0.249
Cotton	1.0	0.244	0.244
Sorghum	1.9	0.159	0.298
Soybean	1.0	0.223	0.223
Barley	1.0	0.112	0.112
Wheat, spring	-	0.110	0.113
Wheat, winter	1.7	0.149	0.247
Oats	1.00	0.066	0.066

[1]Source: (USDA-NASS, 2005)(oats), (USDA-NASS, 2007)(cotton), (USDA-NASS, 2010)(corn), (USDA-NASS, 2011)(barley & sorghum), (USDA-NASS, 2012)(soybean & wheat); (Monsanto, 2013).

EPA has evaluated dicamba and has concluded that it has a complete and comprehensive regulatory database (toxicity, environmental fate, and ecological toxicity). EPA completed the reregistration process for dicamba and a Registration Eligibility Decision (RED) was issued in 2006 and subsequently amended in 2008 and 2009 (US-EPA, 2006; 2009c). EPA concluded there is a reasonable certainty that no harm will result to the general population, or to infants and children, as a result of aggregate (combined) exposure to dicamba residues; and that the available data submitted for dicamba are complete and adequate to support the continued registration of dicamba products and uses including current uses on commercial cotton and soybean. Part of EPA's risk assessment included exposure to drinking water using a conservative modelled scenario that assumed that essentially all (87%) crop acres within the watershed were treated with dicamba (US-EPA, 2006; 2009c; 2011).

EPA reassessed all dicamba pesticide food and feed tolerances as part of the dicamba RED, including the 10 ppm soybean seed tolerance supporting the existing use in conventional soybean (US-EPA, 2006; 2009c). A complete listing of dicamba feed tolerances can be found at 40 CFR § 180.227. Permanent tolerances are established under 40 CFR §180.227(a)(1) for dicamba and its 3,6-dichloro-5-hydroxybenzoic acid (5-hydroxydicamba) metabolite. Additional tolerances are established under 40 CFR §180.227(a)(2) for dicamba and its 3,6-dichloro-2-hydroxybenzoic acid (aka 3,6-diclorosalicyclic acid or DCSA) metabolite, as well as under 40 CFR §180.227(a)(3) for dicamba, 5-hydroxydicamba, and the DCSA metabolite. Before establishing a pesticide tolerance, the EPA is required to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the FQPA. Table 8-3 lists the current tolerances established for commodities of cotton and soybean.

Table 8-3. Tolerances for Residues of Dicamba

Commodity	Tolerance (parts per million)
Cotton, undelinted seed	0.2
Soybean, hulls[1]	30.0
Soybean, seed[1]	10.0

Source: 40 CFR §180.227 Dicamba; tolerances for residues.

[1] Tolerance established for residues of the herbicide dicamba, 3,6-dichloro-o-anisic acid, including its metabolites and degradates, in or on the commodities. Compliance with the tolerance levels is to be determined by measuring only the residues of dicamba, 3,6-dichloro-o-anisic acid, and its metabolites, 3,6-dichloro-5-hydroxy-*o*-anisic acid, and 3,6-dichloro-2-hydroxybenzoic acid, calculated as the stoichiometric equivalent of dicamba.

EPA Assessments of Proposed Section 3 New Uses on Dicamba-resistant Soybean and Cotton

Before any application of dicamba can be made onto commercially cultivated dicamba-resistant soybean or cotton, the EPA must first approve a label describing the conditions of use of the herbicide in connection with dicamba-resistant soybean and cotton – including the appropriate application rates and timing, and other measures necessary to address potential impacts of dicamba offsite movement.

The dicamba product used for treating dicamba-tolerant soybean and cotton proposed for registration is the M1691 Herbicide (EPA Reg. No. 524-582) which is a soluble (flowable) concentrate formulation. This end–use product contains 56.8% active ingredient in the form of the diglycolamine salt (DGA) of dicamba (equivalent to 4.0 lb ae/gal). A summary of the proposed directions for use taken directly from the supplemental M1691 herbicide label provided by the registrant are presented below in Table 8-4.

Monsanto has submitted an application to U.S. EPA to amend Registration Number 524-582, a low volatility DGA salt formulation, to remove all preemergence planting restrictions (intervals and rainfall) and to allow in-crop postemergence dicamba applications to MON 87708 soybean through the R1/R2 growth stage. Once approved, growers would be authorized to apply dicamba alone or in mixtures with glyphosate or other herbicides for preplant or in-crop postemergence applications on MON 87708 soybean. Dicamba would be authorized to be applied preemergence up to crop emergence as a single application or split applications up to a total of 1.0 lb a.e. per acre, and up to two postemergence applications up to 0.5 lb a.e. per acre each through the R1/R2 growth stage of soybean. The maximum annual application rate of dicamba on MON 87708 soybean is 2.0 lb dicamba a.e. per acre. The proposed dicamba use on soybean is summarized in Table 8-4.

If the proposed label is approved by EPA, dicamba would be authorized to be applied up to 1.0 lb a.e. per acre any time prior to cotton emergence, and postemergence in-crop up to 0.5 lbs a.e.

per acre per application up through seven days prior to harvest. Maximum application amounts for dicamba would be 1.0 lb a.e. per acre for preplant/preemergence applications and 0.5 lb a.e. per acre per in-crop application with the combined total not to exceed 2.0 lbs a.e. dicamba per year for all applications. The proposed application rates on MON 88701 cotton would be less than or equivalent to rates for dicamba established for other uses in the dicamba RED including the 2.0 lbs a.e. dicamba per year for all applications (US-EPA, 2006; 2009c). The proposed dicamba use on soybean is summarized in Table 8-4.

Following EPA approval of the dicamba label amendment, growers would be authorized to apply dicamba alone or in mixtures with glyphosate, glufosinate, or other registered herbicides for pre-plant or post-emergence in-crop applications on MON 87708 soybean and MON 88701 cotton.

Dicamba residue levels in soybean seed harvested from dicamba tolerant (DT) soybean treated with dicamba at more than twice the anticipated commercial in-crop application rate were less than 0.1 ppm, which is well below the established 10 ppm pesticide residue tolerance supporting dicamba use on commercial soybean. Soybean forage and hay, which can be feed to livestock, have no established tolerance, for that reason Monsanto is also petitioning (Pesticide Petition # 0F7725) the agency for the establishment of new tolerances on forage (45 ppm) and hay (70 ppm).

Monsanto has requested a registration of an expanded use of a low-volatility DGA dicamba formulation on DT soybean, and petitioned (Pesticide Petition # 0F7725) the EPA to establish new feed tolerances on soybean forage (45 ppm) and soybean hay (70 ppm). Tolerances for soybean forage and hay for current dicamba uses in conventional soybean were not previously established because the current preharvest application is made past the stage where the crop would be useful as forage or hay. No other revisions to dicamba pesticide residue tolerances are needed including animal products such as meat or milk.

Monsanto has petitioned (Pesticide Petition # 0F7725) EPA to establish new feed tolerances on soybean forage (45 ppm) and soybean hay (70 ppm). Tolerances for soybean forage and hay for current dicamba uses in conventional soybean were not previously established because the current preharvest application is made past the stage where the crop would be useful as forage or hay. No other revisions to dicamba pesticide residue tolerances are needed including animal products such as meat or milk.

Dicamba residue levels in cottonseed harvested from dicamba-glufosinate tolerant (DGT) cotton treated with dicamba at the anticipated commercial in-crop application rate, and were 0.54 ppm, which is greater than the established 0.2 ppm pesticide residue tolerance supporting dicamba use on commercial cotton (40 CFR § 180.227) which is for the combined residues of parent dicamba and its metabolite 5-hydroxy dicamba. Cotton gin by-products, which serve as a ruminant feed supplement, have no established dicamba tolerance PP 2F8067 for the expanded use of dicamba on MON 88701, an increase in the dicamba residue tolerance from 0.2 ppm to 3 ppm for cottonseed, the establishment of a tolerance of 70 ppm for cotton gin by-products, and the inclusion of DCSA in the residue definitions for cottonseed and gin by-products.

Based on the studies submitted on the DGA salt formulation of dicamba by Monsanto, EPA has conducted draft assessments on the potential environmental fate, ecological effects, and human health effects of the proposed new uses of dicamba DGA salt. The conclusions from those assessments are summarized in this section. EPA will be publishing these complete draft analyses in the Federal Register for public comment.

Table 8-4. Summary of Directions for Proposed Uses of Dicamba on MON 87708 Soybean and MON 88701 Cotton

Formulation [EPA Reg. No.]	Applic. Timing, Type, and Equip.	Max. Applic. Rate (lb ae/A)	Max. No. Application per Season	Max. Seasonal Application Rate (lb ae/A)	Combined Max. Seasonal Application Rate (lb ae/A)	RTI[1] (days)	PHI[2] (days)	Use Directions and Limitations[3]
MON 87708 Soybean								
M1691 4.0 lb ae/gal SL [524-582]	Pre-emergence Broadcast (20 gal/A)	1.0	NS[4]	1.0	2.0	7	7	The maximum rate for any single, in-crop (post-emergence) application must not exceed 0.5 lb dicamba a.e. per acre. A second post-emergence application may follow up to the R1 reproductive stage
	Post-emergence, Broadcast (20 gal/A)	0.5	NS	2.0				
MON 88701 Cotton								
M1691 4.0 lb ae/gal SL [524-582]	Pre-emergence Broadcast (20 gal/A)	1.0	NS[4]	1.0	2.0	7	7	Use of a COC or MSO is not recommended with Roundup branded herbicides. These adjuvants are only used when other products require them. For best results apply at min spray rate of 10 GPA.
	Post-emergence, Broadcast (20 gal/A)	0.5	NS	2.0				

[1] RTI = Re-Treatment Interval
[2] PHI = Pre-Harvest Interval
[3] COC = Crop Oil Concentrate; MSO = Methylated Seed Oil.
[4] NS = Not Specified

Human Health Risk Assessment

The EPA Health Effects Division (HED) of the Office of Pesticide Programs (OPP) is charged with estimating the risk to human health from exposure to pesticides. HED evaluated hazard and exposure data and conducted dietary, residential (non-occupational), aggregate, and occupational exposure assessments to estimate the risk to human health that will result from the proposed new use of the DGA salt formulation of dicamba on dicamba-resistant soybean and cotton. Based on information contained in Monsanto's pesticide petition and the label conditions HED has concluded that the request for a registration for the use of the DGA salt formulation of dicamba on dicamba-resistant soybean and cotton would pose a reasonable certainty of no harm to humans. A summary of the results of the assessment are provided, below. The draft assessment will be published by EPA in the Federal Register for public review and comment.

> "Monsanto has submitted new metabolism studies for dicamba-tolerant soybean and cotton, which show that dicamba generally follows the same metabolic pathway to other plants. Dicamba applied to dicamba-tolerant soybean and cotton is converted to the non-herbicide metabolite 3,6-dichlorosalicylic acid (DCSA) and its glycosidic conjugates, which are the main metabolites formed. In a minor metabolic pathway, DCSA is hydroxylated at the 5-position, to form 2,5-dichloro-3,6-dihydroxybenzoic acid (DCGA) and its glycosidic conjugates, which are found in amounts less than 10% of the total radioactive residue (TRR). The dicamba metabolite 5-hydroxydicamba was not identified in the TRR of dicamba-tolerant soybean and cotton.
>
> The nature of residues for dicamba-tolerant soybean and cotton is understood. The residues of concern (ROC) for monitoring the tolerance under 40 CFR §180.227(a)(3) for soybean includes parent dicamba, and the metabolites 5-hydroxydicamba, and DCSA remains appropriate. Data from the newly submitted metabolism and field trial studies support including residues of DCSA to the tolerance expression for cotton to fall under 40 CFR §180.227(a)(3). These data also necessitate including DCGA to the ROCs for the risk assessment of soybean which include the residues established for tolerance expression (parent, 5-hydroxydicamba, and DCSA).
>
> The nature of dicamba residues in animals and in rotational crops were previously determined based on acceptable studies. The establishment of a tolerance on soybean forage and hay, as well as on cotton gin byproducts will not increase livestock dietary burden; therefore, no new revised tolerances on livestock commodities are required to support this petition.
>
> The residue values obtained from the field trial studies were evaluated using the Organization for Economic Cooperation and Development (OECD) calculation procedures for estimating tolerances/Maximum Residue Limits (MRLs). Using the OECD calculation procedures, and inputting the total residue, which includes the sum of the parent compound, and its metabolites 5-OH dicamba, and DCSA, expressed as parent equivalents, tolerances of 60 ppm for soybean forage and 100 ppm for soybean hay are recommended. The current tolerances of 10 ppm in soybean seed and 30 ppm in soybean hull are adequate. For cotton, the OECD calculation procedures determined that the recommended tolerances of 3.0 ppm for cotton undelinted seed and 70.0 ppm for cotton

gin byproducts are appropriate. The US EPA and PMRA (Canada) established a harmonized tolerance (MRL) for soybean on seed at 10 ppm.

There are currently no Mexican, Canadian or Codex MRLs established for soybean forage and hay as well as in cotton gin byproducts. There are MRLs of 0.2 ppm in Mexico and 0.04 ppm established by Codex on cotton seed currently established. Since the registrant has requested a late season use of dicamba on dicamba-tolerant cotton, the currently established international tolerances are inadequate to cover residues likely from the newly proposed use in the U.S. In addition, the dicamba residues of concern for dicamba-tolerant cotton also include the DCSA metabolite which is not found nor regulated in the other common varieties of cotton. Therefore, harmonization is not possible at this time for cotton seed. Since there are no international tolerances on cotton gin byproducts, there is no issue of international harmonization relevant to that tolerance.

There are no proposed residential uses at this time; however, there are existing residential uses that have been reassessed in this document to reflect updates to HED's 2012 Residential Standard Operating Procedures (SOPs). The residential handler and post-application risk estimates are not of concern for dicamba for all scenarios and all routes of exposure.

The label-required personal protective equipment (PPE) include that mixers, loaders, applicators and other handlers wear a long-sleeved shirt and long pants, socks, shoes, and chemical-resistant gloves (except for applicators using ground boom equipment, pilots or flaggers). The restricted entry interval (REI) on the proposed label is 24 hours. The occupational handler and post-application risk estimates are not of concern for dicamba for all scenarios and all routes of exposure for the use on herbicide-tolerant cotton and soybean."

Environmental Fate and Ecological Risks

The Environmental Fate and Effects Division (EFED) has completed a review of the new use request for the herbicide dicamba [M1691 Herbicide, EPA Reg. No. 524-582 diglycolamine salt of dicamba (DGA); PC code 128931)] for use on dicamba-tolerant soybeans (MON 87708). Dicamba is currently registered for use on soybeans at applications rates similar to those proposed for the new use. The use of dicamba on soybeans was assessed by the Environmental Fate and Effects Division (EFED) in 2005 (USEPA, 2005, D317696). The primary difference between the proposed new use on soybeans and the previous soybean use assessed is the timing of the applications. The current registration for dicamba use on soybeans is limited to pre-emergence applications; however, for the proposed new use on dicamba-tolerant soybeans, dicamba could be applied pre-emergence and/or post-emergence. Therefore, an abbreviated ecological risk assessment is provided.

The draft assessment will be published by EPA in the Federal Register for public review and comment. The results are summarized as follows:

"Based on the proposed maximum application rates, there is a potential for direct adverse effects to listed and non-listed birds (acute exposure), listed and non-listed mammals (chronic exposure), listed vascular aquatic plants, and listed and non-listed terrestrial dicots from the proposed new use. This assessment uses new submitted information on the toxicity of diglycolamine salt of dicamba (DGA) to terrestrial plants. Although for monocots toxicity of the DGA salt formuation is decreased compared to TGAI dicamba acid, the vegetative vigor data indicate that toxicity in the DGA salt formulation is enhanced for dicots. It is unclear if the enhanced toxicity to dicots is due to synergistic effects with surfactants and adjuvants in the formulation used (Clarity Herbicide, EPA Reg No. 7969-137, 56.8% DGA salt) or due to the DGA salt itself. The study with TGAI dicamba acid did not use surfactants or adjuvants. Although levels of concern were not exceeded for listed and non-listed species of monocots, exceedances for monocots would occur if toxicity data for dicamba acid was used in place of the data for the DGA salt. Risks to aquatic animals from chronic exposure to dicamba could not be assessed at this time because of a lack of data; therefore, since risk to these taxa cannot be precluded, it is assumed.

At this time, no federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed new use of dicamba, since there is a potential for indirect effects to taxa that might rely on plants, birds, aquatic animals, and/or mammals for some stage of their life-cycle. A complete co-occurrence analysis could not be completed for listed species at this time, since the specific use site associated with the proposed new use of dicamba (dicambatolerant soybeans) is not available for analysis in LOCATES. Therefore, without further refinement, no species currently listed as federally threatened or endangered can be excluded from the potential for adverse effects from the proposed new use of dicamba.

Although the risks, based on standard risk assessment methods used by the Environmental Fate and Effects Division (EFED), are not expected to differ from the previous assessment done for dicamba use on soybeans (because the rates are similar to those already assessed), there is potential for other ecological concerns that would not normally be captured using our standard risk assessment methods. These concerns are related to a potential increase in usage of dicamba products and the proposed changes in the timing of applications. In general, there is also a potential for increased susceptibility of late season plants to direct impact from off-site transport. Thus, unlike previous assessments of dicamba the risk conclusions in this assessment have increased uncertainty."

Glufosinate Ammonium

Glufosinate is a nonselective herbicide that is registered for preplant and post-emergent applications to control broadleaf weeds in a variety of crop and non-crop areas. Additionally, it is also used as a defoliant and as a means of conducting chemical burndown.

Since it is a nonselective herbicide it injures or kills crop plants that it contacts. Glufosinate is a contact herbicide which is taken up by the plant primarily through the leaves. There is no uptake from the soil through the roots, presumably because of the rapid degradation of glufosinate by soil microorganisms. There is limited translocation of glufosinate within the plant.

Glufosinate herbicides contain the active ingredient phosphinothricin and are in the phosphinic acid family of herbicides. The herbicide acts by blocking the plant enzyme glutamine synthetase, which is responsible for nitrogen metabolism and for detoxifying ammonia, a by-product of plant metabolism. The exposed plant dies by the over-accumulation of ammonia (US-EPA, 2008).

First registered with EPA in 1993, initial glufosinate end-use products were designed for home owners; light industrial, non-food users; and farmstead, weed-control users (OSTP, 2001). Glufosinate is registered for use on apples, berries, canola, citrus, corn, cotton, currants, grapes, grass grown for seed, olives, pome fruit, potatoes, rice, soybeans, stone fruit, sugar beets, and tree nuts. Registrations for noncrop areas include golf course turf, residential lawns, ornamentals, and a variety of industrial and public areas.

Application rates of glufosinate range significantly by use pattern, with the highest rate allowed for broadcast (ground) spray applications, at 1.5 lb a.i./A, on orchard nuts and fruits, grapes, grasses grown for seed, and golf course turf. On the low end of application rates, labeled uses of glufosinate on turf and patio are at 0.03 lb a.i./A. Multiple applications are allowed by most labels, although the interval is not generally specified (US-EPA, 2008).

Based on its proprietary data for the period from 2007–2011, EPA estimated that the highest annual agricultural uses of glufosinate are in corn (1.3 million lb), almonds (200,000 lb), cotton (200,000 lb), grapes (200,000 lb), canola (100,000 lb) and soybeans (100,000 lb) (Table 8-5) (US-EPA, 2012a). Almonds, cotton, and grapes are also appreciable uses reported in the BEAD analysis. Uses which have not been calculated do not imply zero use, though they are likely low in comparison to those uses that are quantified in Table 8-5. Stone fruits, such as peaches, cherries, and plums/prunes, are new uses which were approved in 2012. Registered non-agricultural uses, such as fallow fields, lawns and gardens, conifer tree areas, and non-crop areas (*e.g.*, farmstead building foundations, shelter belts, along fences, *etc.*) are not captured in the above data. These data do not include non-agricultural uses (US-EPA, 2013a).

The map in Figure 8-3 shows the use of glufosinate from 2011, with most use of glufosinate concentrated in the Midwest (USGS, 2013b). Figure 8-4 shows the increasing use of glufosinate in crops (USGS, 2013b).

Table 8-5. Estimates of Agricultural Usage of Glufosinate, 2007-2011

Crop	Lbs. ai	Percent Crop Treated		Average Single App. Rate (lbs ai/A)	Average Number of Apps.
		Average (%)	Maximum (%)		
Almonds	200,000	15	40	0.96	NR
Apples	4,000	<1	<2.5	0.82	NR
Blueberries	10,000	5	15	NR	NR
Canola	100,000	25	35	0.37	1.0
Cherries	1,000	<1	<2.5	NR	NR
Corn	1,300,000	5	10	0.38	1.0
Cotton	200,000	5	10	0.40	1.4
Fallow	<500	<1	<2.5	NR	NR
Grapes	200,000	15	30	0.91 – 1.05	NR
Hazelnuts	6,000	10	25	0.71	NR
Peaches	2,000	<2.5	10	0.79	NR
Peanuts	1,000	<1	<2.5	NR	NR
Pecans	1,000	<1	<2.5	NR	NR
Pistachios	50,000	20	45	1.01	NR
Plums/Prunes	2,000	<2.5	10	0.55	NR
Potatoes	30,000	10	20	0.36	1.1
Rice	5,000	<1	<2.5	NR	NR
Soybeans	100,000	<1	<2.5	0.43	1.2
Sweet Corn	<500	<1	<2.5	NR	NR
Walnuts	30,000	10	20	0.87	NR

All numbers rounded. App(s).: Application(s). NC: Not calculated. NR: Not reported.
Data sources: Screening Level Usage Analysis (SLUA), OPP/BEAD, 19 March 2012; EPA Proprietary Data: 2007-2011, C. Doucoure, OPP/BEAD; any proprietary data have been obscured from their source(s).

Source: (US-EPA, 2012a; 2013a).

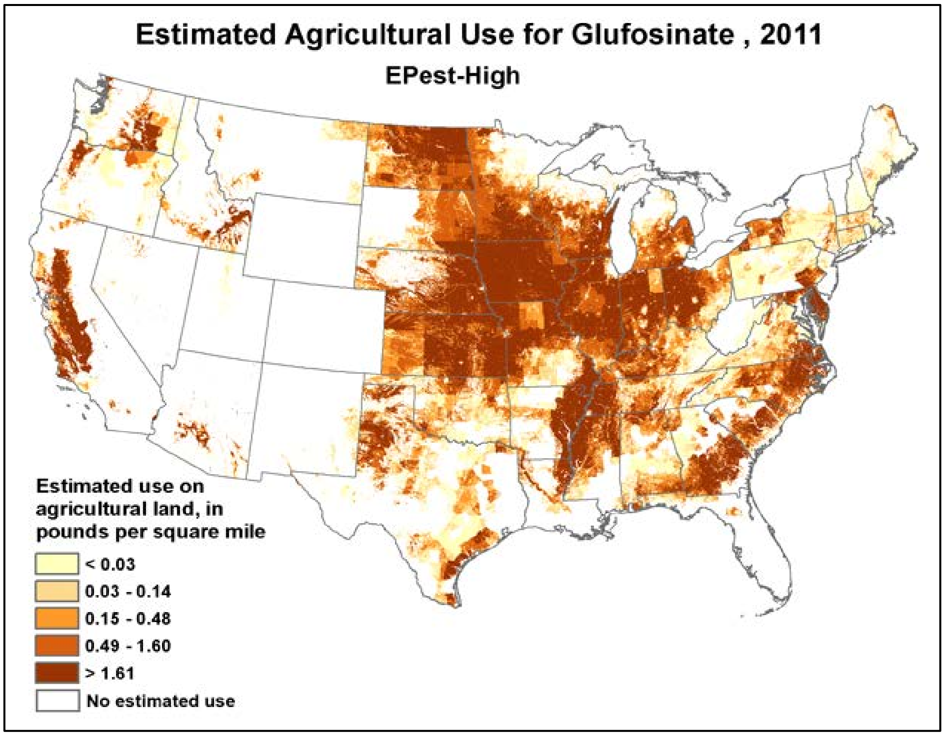

Figure 8-3. Estimated Annual Agricultural Use of Glufosinate in the U.S.
Source: (USGS, 2013b).

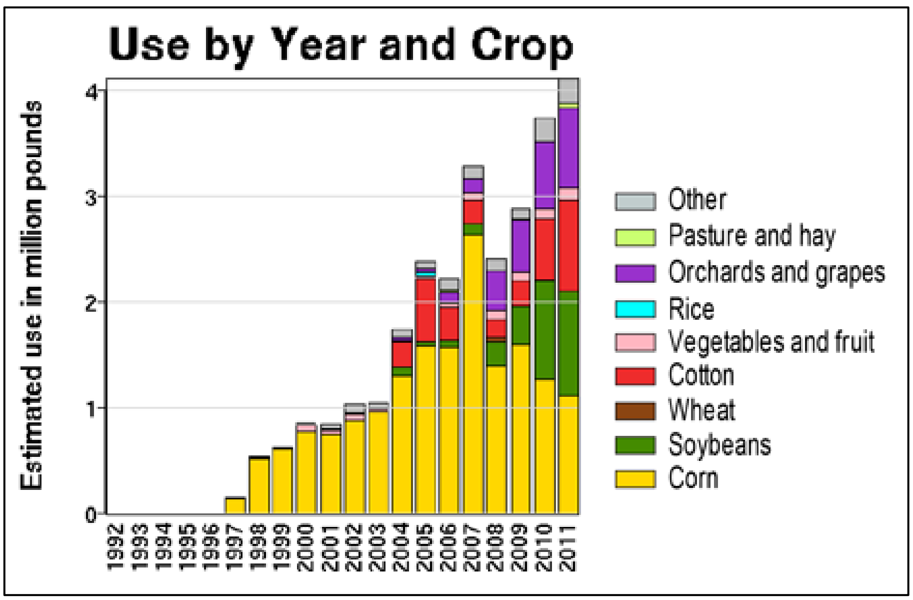

Figure 8-4. Glufosinate Use by Year and Crop, 1992 to 2011
Source: (USGS, 2013b).

Both aerial and ground spray is allowed for most uses, although some applications are limited to methods using hand wands and backpack sprayers. As glufosinate is designed primarily to control broadleaf weeds, applications are normally ground applications, to prevent damage to crops. Aerial application is considered a viable option for genetically modified crops (e.g., canola, corn, cotton, rice, sugarbeets, and soybeans) that are resistant to glufosinate's herbicidal properties, and for burndown applications.

Several crop plants have been modified by inserting a gene that produces an enzyme which detoxifies glufosinate by converting the herbicide into a non-active form. The PAT (*bar*) protein acetylates the free amino group of glufosinate to produce non-herbicidal N-acetyl glufosinate, a known metabolite in glufosinate-tolerant plants (OECD, 2002). Bayer Crop Science has registered glufosinate for use on glufosinate-resistant crops, including corn, soybean, and cotton. Ignite 280 SL Herbicide (EPA Reg. No. 264-829) is a commercially available glufosinate containing herbicide with directions for use on glufosinate-resistant crops. Glufosinate is currently labeled for in-crop application with glufosinate-tolerant cotton from emergence through early bloom growth stage (Bayer CropScience, 2011) (Table 8-6).

Table 8-6. Current Labeled Application Rates for Glufosinate-resistant Cotton

Use Pattern	1st Application (Burndown)	2nd Application	3rd Application	Season Maximum
Cotton Use Pattern 1	22-29 fl oz/A	22-29 fl oz/A	22-29 fl oz/A	87 fl oz/A
Cotton Use Pattern 2	30-43 fl oz/A	22-29 fl oz/A	None	72 fl oz/A

Source: (Bayer CropScience, 2011).

Due to its nonselective activity, glufosinate has a weed management spectrum similar to glyphosate and its use has grown, particularly in areas with glyphosate-resistant weeds (Southeast Farm Press, 2012). In the southeast in 2011, glufosinate was the ninth most frequently used herbicide on soybean. Glufosinate use is likely to continue to follow the recent trend of increased use associated with the adoption of glufosinate-resistant crops.

Although glufosinate provides an additional means of weed control, it is not as versatile as glyphosate. For example, glufosinate needs to be applied to smaller weeds with finer droplet sizes and larger carrier volumes to achieve adequate control. This is in part because, unlike glyphosate which translocates readily throughout the plant, glufosinate has limited mobility and thus requires better coverage for control (hence the larger carrier volumes and smaller droplet sizes) (Monsanto, 2013).

Products include Derringer® (Reg. No.432-1228), Derringer® F Herbicide (Reg. No. 432-960), Finale® Super Concentrate (Reg. No.432-954), Finale® Ready-to-Use (Reg. No. 432-955), Finale® Concentrate (Reg. No. 432-956), Finale® Herbicide (Reg. No. 432-1229), Glufosinate 280 (Reg. No. 88685-2), Liberty® (Reg. No. 264-660), Liberty® ATZ (Reg. No. 264-668), Liberty 280® (Reg. No. 264-829), Rely® (Reg. No. 264-652), and Remove® (Reg. No. 264-663). The EPA-established glufosinate residue tolerances are 4.0 ppm and 15.0 ppm for cottonseed and gin by-products, respectively (40 CFR 180.473). Both of these tolerances include the combined residues of parent glufosinate and its metabolites N-acetyl glufosinate and 3-methylphosphinico-propionic acid.

Currently glufosinate is undergoing Registration Review at EPA with a decision expected by the end of 2013 (US-EPA, 2008). Before establishing a pesticide tolerance, the EPA is required to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the FQPA. It is expected that EPA will affirm the safety and efficacy of glufosinate and approve its continued use in the marketplace upon completion of the registration process.

Glufosinate Use on MON 88701 Cotton

Glufosinate use on MON 88701 cotton will be equivalent to currently deregulated glufosinate-resistant cotton. The use pattern and rate of glufosinate application on MON 88701 cotton will follow the existing glufosinate-resistant cotton uses outlined on the existing glufosinate herbicide label (Bayer Crop Science, 2007). Like commercially available glufosinate-resistant cotton, MON 88701 cotton enables application of up to 0.53 lb a.i. per acre per application of glufosinate from emergence through early bloom growth stage. Monsanto has confirmed that glufosinate residues on MON 88701 cotton treated with commercial glufosinate rates are below the established pesticide residue tolerances established by EPA for both cottonseed and gin by-products (40 CFR 180.473). Consequently, Monsanto is not pursuing any changes in the glufosinate label or the established tolerances for its use on MON 88701 cotton (Monsanto, 2013).

Glyphosate

Glyphosate acid is a broad spectrum, nonselective systemic herbicide widely used to control most annual and perennial grass and broadleaf weeds in agricultural crops and non-agricultural sites. The herbicide is registered for pre- and post-emergence application on a variety of fruit, vegetable, and field crops, as well as for aquatic and terrestrial uses. Labeled uses of glyphosate include over 100 terrestrial food crops as well as other non-food sites including forestry, greenhouse, non-crop, and residential. Glyphosate can also be used as a plant growth regulator and accelerate fruit ripening. Additionally, glyphosate is registered for use on GE glyphosate-resistant crops, including canola, corn, cotton, soybeans, alfalfa, and sugar beets. Glyphosate is the most widely used herbicide on U.S. corn, soybean, and cotton.

Glyphosate was first introduced under the trade name of Roundup™ by Monsanto in 1974. Glyphosate salts serve as the source of the active ingredient (a.i.) *N*-(phosphonomethyl) glycine and improve handling, performance, and concentration of the glyphosate acid. Glyphosate is distributed in several forms, including technical grade glyphosate, isoproplyamine salt, monoammonium salt, diammonium salt, N-methylmethanamine salt , trimethylsulfonium salt, or potassium salt (US-EPA, 2009b). Isopropylamine salt is the most typically used form in formulated products (Henderson, 2010).

Glyphosate acid is a nonselective Group 9 herbicide and kills plants by inhibiting the 5-enolpyruvylshikimate-3-phosphate synthase (ESPS) enzyme. This enzyme is essential for the biosynthesis of aromatic amino acids (e.g., tyrosine, tryptophan, and phenylalanine) and other aromatic compounds in algae, higher plants, bacteria and fungi. By creating a deficiency in EPSP enzyme and aromatic amino acids production, glyphosate affects protein synthesis and plant growth (US-EPA, 2009b). Glyphosate is absorbed across the leaves and stems of plants and moves throughout the plant, concentrating in the meristem tissue (Henderson, 2010).

Glyphosate use is concentrated heavily in the Midwest, along the Mississippi River, the Southeast seaboard, and the Central Valley of California, as depicted in Figure 8-5.

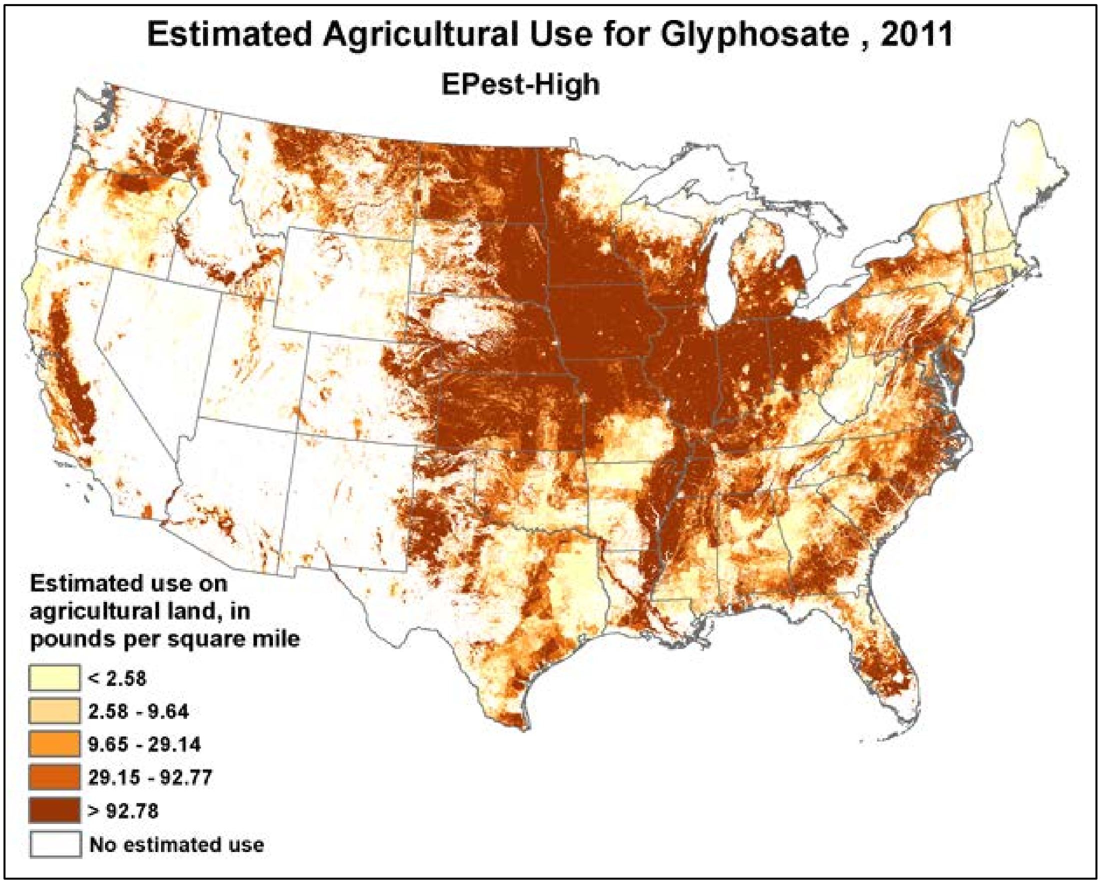

Figure 8-5. Estimated Agricultural Use for Glyphosate, 2011
Source: (USGS, 2013c).

Based on pesticide usage data from USDA-NASS, private pesticide market research, and California Department of Pesticide Regulation (DPR), EPA estimated glyphosate usage from 2004 through 2011. The crops with the highest glyphosate uses (based on average treated fraction of acreage) were: almond (85%), apples (55%), apricots (55%), asparagus (55%), avocados (45%), barley (20%), blueberries (20%), canola (65%), cherries (65%), corn (60%), cotton (85%), cucumbers (20%), dates (20%), dry beans/peas (25%), fallow (55%), figs (40%), grapefruit (80%), grapes (70%), hazelnuts (70%), kiwifruit (30%), lemons (70%), nectarines (45%), olives (45%), onions (30%), oranges (90%), peaches (55%), peanuts (20%), pears (65%), pecans (35%), peppers (20%), plums (65%), pumpkins (20%), rice (25%), sorghum (40%), soybeans (95%), squash (20%), sugar beets (50%), sugarcane (45%), sunflowers (55%), tangelos (55%), tangerines (65%), tomatoes (35%), walnuts (75%), and wheat (25%). All other treated crops averaged 15% or less of the total acreage grown (US-EPA, 2012b). Figure 8-6 shows the glyphosate use on crops from 1992 to 2011.

The current approved maximum pre-emergence application of glyphosate on glyphosate-resistant corn or soybeans is 3.7 lb a.e./acre. A glyphosate post-emergence application from 0.75 to 1.5 lb a.e./acre (total 2.25 lb/acre/season post-emergence) and an additional pre-harvest application of

0.77 lb a.e./acre are permitted. The current maximum total seasonal use rate for glyphosate on glyphosate-resistant corn and soybean is 6 lb a.e./acre.

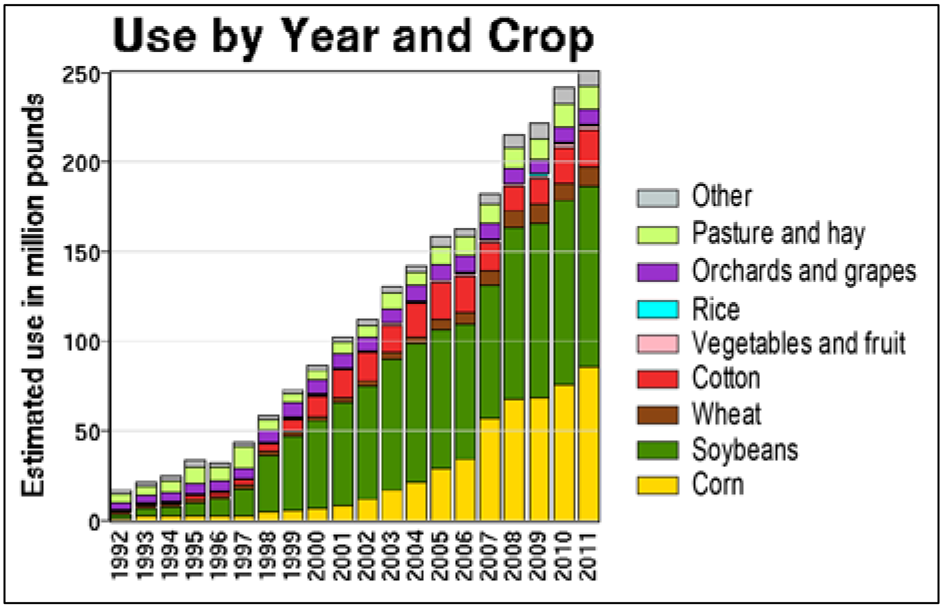

Figure 8-6. Glyphosate Use by Year and Crop, 1992 to 2011
Source: (USGS, 2013c).

Pesticide residue tolerances for glyphosate are listed in 40 CFR Part 180.364, representing combined residues of glyphosate, N-(phosphonomethyl)glycine and its metabolite N-acetyl-glyphosate (expressed as glyphosate) (US-EPA, 2010). Before establishing a pesticide tolerance, the EPA is required to reach a safety determination based on a finding of reasonable certainty of no harm under the FFDCA, as amended by the FQPA. Table 8-7 shows the current tolerances for residues of glyphosate established for corn and soybean commodities.

Table 8-7. Glyphosate Tolerances for Corn and Soybean Commodities

Commodity	Residue (parts per million)
Cotton, gin byproducts	210
Soybean, forage	100
Soybean, hay	200
Soybean, hulls	120
Soybean, seed	20

Source: 40 CFR 180.364

EPA is currently conducting a registration review of glyphosate which was begun in 2009 and is currently scheduled to be completed in 2015 (US-EPA, 2009a). According to EPA, as part of their review, “the Agency plans to require a number of ecological fate and effects studies, an acute and subchronic neurotoxicity study, and an immunotoxicity study through a data call-in, which is expected to be issued in 2010. The new information will be used to conduct a comprehensive ecological risk assessment, including an endangered species assessment, as well as a revised occupational human health risk assessment, for all glyphosate pesticidal uses (US-EPA, 2009a).”

All documents related to the glyphosate registration review can be viewed at the registration review docket:

http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2009-0361

MON 87708 soybean and MON 88701 cotton are intended to be combined with glyphosate-resistant varieties utilizing traditional breeding techniques. The combined system will support long term sustainability of weed management in soybean and cotton and, in turn, support sustained, economic cotton production.

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Appendix 9. Monsanto Tillage Report

[*This document has been submitted by Monsanto Company for use by USDA APHIS in support of a request for nonregulated status for Xtend soybean and cotton crops. USDA APHIS has chosen to include this section in its entirety because it is the most recent and comprehensive regional analysis of agricultural tillage.]*

Introduction

Recently there have been speculation and in some cases, reports, that the growth of conservation tillage acres and, in particular, no-till acres has slowed or is reversing in some parts of the country. Accordingly, Monsanto undertook an analysis of grower market research information from an independent market research company and follow up consultation with leading conservation tillage experts to understand more precisely current tillage trends and reasons for these trends in key soybean, corn and cotton growing areas.

Multiple factors could influence conservation tillage practices. Growth in the spread of glyphosate-resistant weed populations has been speculated or reported to be one such factor, because of the need for some farmers to incorporate more tillage into their farming operations in order to control some difficult to control weed species, such as Palmer amaranth. For example, where populations of glyphosate-resistant Palmer amaranth have grown large in areas such as Georgia, western Tennessee, and Arkansas, weed control experts recommend deep pre-plant tillage as one way to reduce the population before other weed control measures are applied (Culpepper, et al. 2013; Culpepper, et al. 2011; Price, et al. 2011). However, growers and leading conservation experts themselves report a range of factors other than weed management that can and do influence farmer practices relative to conservation tillage practices.

Materials and Methods

This analysis used market research data from an unpublished national grower survey conducted by a third party market research company. The data retrieved from this database included the number of crop acres planted conventionally, in a no-till system, or in a reduced tillage system. No-till acres are defined as those in which the farmer does not till the ground after the harvest of the last crop and before planting a new crop. Reduced tillage (reduced-till) is defined as situations where the farmer practices various types of reduced tillage after harvest of the last crop and before planting the new crop where significant crop residues (~15%-30%) are left on the soil surface. Examples of reduced tillage practices include ridge-till (planting row crops on permanent ridges), strip-till (planting crops directly in narrow strips that had been tilled), and mulch-till (any reduced tillage system that leaves at least 1/3 of soil surface covered with crop residue). Conventional tillage (conventional) is defined as situations where the farmer conducts several tillage operations such that the new crop is planted into soil with little to no surface residue.

The farmer market research data was sorted by crop (soybeans, cotton, and corn) and state. Selected states were combined into growing regions (East, Midwest, Southeast, Mid-South, and West, as indicated in Table 1). Data was retrieved for the period from 1998 through 2013 for soybeans and corn, and through 2012 for cotton (Note: 2013 cotton data from the market research company is not currently available). The estimated acreage of each tillage type for each crop and growing region was converted to percent of total crop planted acreage and submitted for statistical regression analysis over the designated time period. The data was analyzed to fit a linear or quadratic regression model at the 5% level of significance. Details of the statistical analysis are provided in the statistical report found in Appendix A [of the Environmental Report (ER)].

To understand possible reasons for some of the changes observed in this data set, Monsanto worked with CTIC (Conservation Tillage Information Center, www.ctic.org) to conduct a survey of leading conservation tillage experts in select Midwest, Southeastern and Mid-South. (Note: experts from these areas were surveyed because they represent the major regions for the production of soybean, corn and cotton, and because they represent the areas with the highest levels of herbicide resistant weeds). In this survey, the experts were asked to indicate the level of importance of 11 different factors to farmers as they make decisions as to which tillage system and in general how much tillage they will use on their farm(s). Examples of factors included "manage excess crop residue," "manage existing weeds," "manage disease," "economics," and "prevent weed resistance." To rank the factors, a number from 1 to 4 was assigned to each response category, with 1 assigned to "not important or not mentioned" and 4 assigned to "extremely important". The experts were not limited in the number of factors to which they could assign an individual ranking. (i.e., the experts could rank all – or none – of the 11 factors as "extremely important"). The assigned number was multiplied by the number of responses from the experts and then added together for each factor. The factors with the 5 highest numerical sums are listed in Table 3 for each crop and region. The detailed results of this survey for corn, soybeans and cotton can be found in Appendix B [of the ER] .

Table 1. States in each Geographic Region

Region	Crop Focus	States
East	Corn, soybean	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
Southeast	Corn, cotton, soybean	Alabama, Georgia, S. Carolina, N. Carolina, Virginia, Florida
Mid-South	Corn, cotton, soybean	Mississippi, Louisiana, Arkansas, Tennessee
Midwest	Corn, cotton, soybean	Ohio, Michigan, Indiana, Illinois, Wisconsin, Missouri, Minnesota, Iowa, Kentucky, Kansas, Nebraska, N. Dakota, S. Dakota
West	Corn, cotton, soybean	Arizona, California, New Mexico, Oklahoma, Texas, Colorado, Idaho, Montana, Nevada, Utah, Washington, Wyoming

Results and Discussion

A summary of the results of the grower market research data analysis on tillage trends can be found in Table 2. Key points are as follows:

- From 1998 to 2007, the conventional tillage acreage decreased and no-till acres increased across all crops and geographic areas. Likewise, reduced tillage acres generally increased during this time period, although for some areas and crops, no significant relationship between the tillage practice and time could be detected. The growth in no-till and reduced tillage acres coincides with, and was facilitated by, the growth in glyphosate-tolerant corn, soybean and cotton acres (Givens, et al. 2009a; Givens, et al. 2009b; McClelland, et al. 2000; Osteen and Fernandez-Cornejo 2013; Sankula 2006; Towery and Werblow 2010).

- Since 2007, however, some crops in some geographic areas have continued to see growth in no-till acreage, while other crops in other geographic areas have seen decreases in no-till acreage, accompanied by an increase in conventional and/or reduced tillage acreage. A more detailed, crop-by-crop discussion is presented below.

- **Corn:** From 1998 to 2007, the conventional tillage acreage decreased and no-till acres increased across all geographic areas. From 2007 through 2013, the trends varied across regions:
    - In the West and East, conventional tilled corn acres continued to decrease, and no-till acreage continued to increase. Reduced tillage acres also increased in the West, but there was no clear trend in the East.
    - In the Midwest, conventional tilled corn acres continued to decrease but there appeared to be a shift from strict no-till practices to reduced tillage acres where some tillage is practiced but significant (15% -30%) crop residues remain on the surface at planting.
    - In the Southeast, conventional tillage acres planted to corn tended to level off or increase while no-till acres tended to decrease.
    - In the Mid-South, there were no significant trends in conventional or no-till acreage, but reduced till acres increased throughout the time period.
- **Soybean:** From 1998 to 2007, the conventional tillage acreage decreased and no-till acres increased across all geographic areas. From 2007-2013, the trends varied across region:
    - In the West, conventional tilled soybean acres continued to decrease, and no-till acreage continued to increase. There was no significant trend for reduced tillage acres.
    - In the East, Midwest, Southeast and Mid-South regions, conventional tilled soybean acres were flat or increasing, while no-till acres were flat or decreasing. Reduced tillage acres in the Midwest increased during the same time period, but there was no clear relationship between time and reduced tillage plantings in the

East, Southeast or Mid-South regions (not significant at the 95% confidence interval). Thus, in the Midwest, the reduction in no-till acres appears in large part to be offset by an increase in reduced tillage acres, but similar offsetting does not appear to be occurring in other regions.

- **Cotton:** From 1998 to 2007, the conventional tillage acreage decreased and no-till acres increased across all geographic areas. From 2007-2012, the trends varied across regions:
    - In the West, conventional tilled soybean acres continued to decrease, and no-till acreage continued to increase. Reduced tillage acres also continued to increase.
    - In the Midwest, Southeast and Mid-South, conventionally-tilled cotton acres tended to be flat or increase, while a clear increase was found in the Mid-South region. Reduced tillage acres increased in the Midwest and Southeast during this period, but both no-till and reduced tillage acreages decreased in the Mid-South region. Thus, in the Midwest and Southeast, the reduction in no-till acres appears in large part to be offset by an increase in reduced tillage acres, but similar offsetting does not appear to be occurring in the Mid-South.

Overall, changes in tillage practices from 2007 to 2012 (cotton)/2013 (soybean and corn) varied by crop and region relative to changes seen in the earlier period from 1998 to 2006 where consistent trends were observed across all the regions (i.e., increase in no-till and reduced tillage with a decrease in conventional tillage systems).

In order to understand the reasons growers adopt specific tillage practices, a survey was conducted of top conservation tillage experts across the Midwest (for corn and soybeans), Southeast and Mid-South regions (combined, for corn, soybeans, and cotton). In Table 3, the top 5 factors, according to conservation tillage experts, governing farmer decisions relative to which tillage practice they adopt for their farm are provided by crop and region of the country. Key findings included:

- Economics (i.e., the importance of cost of production and/or commodity prices), and managing soil moisture (i.e., less tillage conserves soil moisture) were top-5 factors across all the crops and regions.
- Seed bed preparation was a top-5 factor in 4 out of 5 crop x region segments.
- Managing excessive crop residue (i.e., excessive prior crop residue may require more tillage) and managing weeds (existing weeds or preventing weed resistance) were important factors in 3 out of 5 crop x region segments.
- Managing weeds was an important factor across all soybean and cotton regional segments, but was not a top 5 factor for corn in either regional segment. The difference between corn and the other crops is likely because growers have a broad range of herbicide options (including atrazine, dicamba and 2,4-D) that are effective against species that are difficult to control in soybeans and cotton, i.e., glyphosate resistant Palmer amaranth and waterhemp.

This survey of conservation tillage experts highlights that farmers consider multiple factors when making decisions as to what type tillage system to employ.

Conclusions

From 1998-2007, no-till acreage increased steadily across all crops and all regions, with an accompanying decrease in conventional tillage. A more complicated picture emerged after 2007, with some crops and regions continuing to experience increases in no-till and decreases in conventional tillage, while other crops and regions experienced decreases in no-till acreage, either accompanied by increases in reduced tillage acreage and/or in conventional tillage.

Based upon information provided by conservation tillage experts regarding the most important factors governing farmer's decisions with respect to tillage practices, no one factor is driving these changes. Managing existing herbicide resistance and/or mitigating the potential for resistance to develop is a factor is some regions. For example, academics have been recommending more pre-plant tillage in parts of the Southeast and Mid-South (AR, western TN, and MS) in order to better manage glyphosate-resistant Palmer amaranth. But weed resistance management/mitigation does not appear to be a driver for other crops and regions. Indeed, the survey results indicate that higher corn and soybean grain prices, along with more focus on seed bed preparation, is likely to be a reason for some of switch to conventional tillage since a better stand (and thus higher potential yields) can usually be achieved in conventional tillage systems. Moreover, newer corn varieties can produce excessive crop residue, which may also be causing a move to more tillage and may be needed to optimize crop stands in this period of high grain prices.

Based upon the tillage trends seen over the last 5-6 years and with the information on the factors most influencing farmers' decision on tillage practices, more study, appropriately directed research, education, and new technology from a weed management and crop production standpoint are needed to maintain and further grow conservation tillage practices. In some areas and for some crops, managing existing herbicide resistance and/or mitigating the potential for resistance to develop has been reported as an important factor in influencing farmer tillage decisions. DT soybean and DGT cotton are two new herbicide technologies that have the characteristics that can significantly assist in reversing stagnated and downward trends and promote new growth in conservation tillage acres. Weed management has always been a limiting factor for many farmers in determining whether to adopt no-till production practices because farmers had to rely primarily on soil residual herbicides. Glyphosate, in glyphosate-tolerant crops, with its broad spectrum post-emergence control provided a way to achieve consistent weed control in these situations and facilitated an increase in adoption of no-till and, in general, conservation tillage practices (Fawcett and Towry, 2002). The effectiveness of dicamba to provide post-emergent control of broadleaf weeds, suggests that it too will promote adoption of no-till and conservation tillage practices. Additionally, dicamba's ability to control glyphosate resistant broadleaf weeds and its compatibility with glyphosate are characteristics that will facilitate the promotion of conservation tillage practices.

Table 2. Trends in Tillage Practices in Soybean, Corn and Cotton

Crop	Geography	Tillage system	Trend	
			1998-2007	2007-2012/13
Corn	West	Conventional	Dec	Dec
		No-till	Inc	Inc
		Reduced-till	Inc	Inc
	Midwest	Conventional	Dec	Dec
		No-till	Inc	Flat/Dec[1]
		Reduced-till	Dec	Inc
	Southeast	Conventional	Dec	Flat/Inc[1]
		No-till	Inc	Dec
		Reduced-till	NS	NS
	Mid-South	Conventional	NS	NS
		No-till	NS	NS
		Reduced-till	Inc	Inc
	East	Conventional	Dec	Dec
		No-till	Inc	Inc
		Reduced-till	NS	NS
Soybeans	West	Conventional	Dec	Dec
		No-till	Inc	Inc
		Reduced-till	NS	NS
	Midwest	Conventional	Dec	Flat/Inc[1]
		No-till	Inc	Dec
		Reduced-till	Dec	Inc
	Southeast	Conventional	Dec	Flat
		No-till	Inc	Flat
		Reduced-till	NS	NS
	Mid-South	Conventional	Dec	Inc
		No-till	Inc	Dec
		Reduced-till	NS	NS
	East	Conventional	Dec	Flat/Inc[1]
		No-till	Inc	Flat/Dec[1]
		Reduced-till	NS	NS

Table 2 (continued). Trends in Tillage Practices in Soybean, Corn and Cotton

Crop	Geography	Tillage system	Trend	
			1998-2007	2007-2012/13
Cotton	West	Conventional	Dec	Dec
		No-till	Inc	Inc
		Reduced-till	Inc	Inc
	Southeast	Conventional	Dec	Flat/Inc[1]
		No-till	Inc	Dec
		Reduced-till	Inc	Inc
	Midwest	Conventional	Dec	Flat/Inc[1]
		No-till	Inc	Dec
		Reduced-till	Inc	Inc
	Mid-South	Conventional	Dec	Inc
		No-till	Inc	Dec
		Reduced-till	Inc	Dec
NS=no significant trend at 5% Confidence Interval Inc= Increase Dec=decrease Flat=no change				

Source of data is propriety grower market research data (Monsanto, 2013).

[1]Where the trend is indicated as two phases (i.e. Flat/Dec), this means that statistically the trend is for no change over the designated time period but the slope over the last two years of the time period tended to be either reflective of an increase or a decrease.

Table 3. Top 5 Factors Governing Farmer's Tillage Practice Decisions

Factor	Midwest Corn (14 Experts)	Midwest Soybeans (13 Experts)	South Corn (6 Experts)	South Soybeans (6 Experts)	South Cotton (6 Experts)
1	Managing soil moisture	Excessive crop residue	Economics	Economics	Economics
2	Seed bed preparation	Seed bed preparation	Seed bed preparation	Managing existing weeds	Managing existing weeds
3	Economics	Economics	Excessive crop residue	Seed bed preparation	Availability of Labor
4	Excessive crop residue	Managing existing weeds	Improving water penetration	Managing soil moisture	Managing soil moisture
5	Managing soil temperature	Managing soil moisture	Managing soil moisture	Preventing weed resistance	Use of strip till / vertical tillage tools

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Appendix A: Statistical Analysis of Tillage Market Research Data

Summary of Statistical Analysis of Tillage Data

Purpose

Assess if tillage practices have significantly changed between 1998 and 2007, and between 2007 and 2013 (or 2012, for cotton).

Data Description

For the analysis PROC MEANS in SAS was used to calculate the acres that utilized each tillage type and total acres for each crop, region and year. The percent of total acres was calculated by dividing acres that utilized each tillage type by total acres.

Statistical Methods and Results

A quadratic regression model of the following form was fit for each crop, region and tillage type combination:

$$\text{Percent of total acres} = \beta_0 + \beta_1\text{*Year} + \beta_2\text{*Year* Year} + \varepsilon \qquad (1)$$

in which β_0 is the intercept, β_1 is the linear slope, β_2 is the quadratic slope and ε is the residual error. PROC MIXED in SAS was used to fit model (1) separately for each crop, region and tillage type combination. Tests were performed to determine if the quadratic slopes of the regression lines were significantly different from zero. These tests are displayed in Table 1. Twenty of the 42 tests observed quadratic slopes that were significantly different from zero at the 5% level of significance.

In the 20 cases where the quadratic slopes were significant, a quadratic regression model was deemed appropriate. For the 22 cases where the quadratic slopes were not significant, a linear regression model of the following form was fit for each crop, region and tillage type combination:

$$\text{Percent of total acres} = \beta_0 + \beta_1\text{*Year} + \varepsilon \qquad (2)$$

in which β_0 is the intercept, β_1 is the linear slope and ε is the residual error. PROC MIXED in SAS was used to fit model (2) separately for each crop, region and tillage type combination. Tests were performed to determine if the linear slopes of the regression lines were significantly different from zero. These tests are displayed in Table 2. Fourteen of the 22 tests observed linear slopes that were significantly different from zero at the 5% level of significance.

In the 14 cases where the linear slopes were significant, a linear regression model was deemed appropriate. For the 8 cases where the linear slopes were not significant, there was no significant change in tillage practices over time.

Conclusions

In 8 of the 42 crop, region and tillage type combinations there was no significant change over time.

In 14 of the 42 crop, region and tillage type combinations the change over time can be described using a linear regression model.

In 20 of the 42 crop, region and tillage type combinations the change over time can be described using a quadratic regression model.

The regression parameter estimates for the crop and region combinations with a significant the change over time, are displayed in Table 3.

Plots of the percent total acres data and model fit are displayed in the Appendix.

Table A-1. Tests to Determine if the Quadratic Slopes of the Regression Lines Were Significantly Different From Zero

Crop	Region	Tillage_Type	P-value	
Corn	East	Conservation	0.1381	
Corn	East	Conventional	0.6663	
Corn	East	No-Till	0.1161	
Corn	MidSouth	Conservation	0.5547	
Corn	MidSouth	Conventional	0.1925	
Corn	MidSouth	No-Till	0.0582	
Corn	MidWest	Conservation	0.0218	*
Corn	MidWest	Conventional	0.5444	
Corn	MidWest	No-Till	0.0015	*
Corn	Southeast	Conservation	0.1322	
Corn	Southeast	Conventional	0.0038	*
Corn	Southeast	No-Till	0.0018	*
Corn	West	Conservation	0.9108	
Corn	West	Conventional	0.2174	
Corn	West	No-Till	0.1183	
Cotton	MidSouth	Conservation	0.0018	*
Cotton	MidSouth	Conventional	<.0001	*
Cotton	MidSouth	No-Till	<.0001	*
Cotton	MidWest	Conservation	0.2096	
Cotton	MidWest	Conventional	0.0017	*
Cotton	MidWest	No-Till	<.0001	*
Cotton	Southeast	Conservation	0.7367	
Cotton	Southeast	Conventional	0.0002	*
Cotton	Southeast	No-Till	<.0001	*
Cotton	West	Conservation	0.0539	
Cotton	West	Conventional	0.0582	
Cotton	West	No-Till	0.8615	
Soybeans	East	Conservation	0.4610	
Soybeans	East	Conventional	0.0051	*

Table A-1 (continued). Tests to Determine if the Quadratic Slopes of the Regression Lines Were Significantly Different From Zero

Crop	Region	Tillage_Type	P-value	
Soybeans	East	No-Till	0.0017	*
Soybeans	MidSouth	Conservation	0.5038	
Soybeans	MidSouth	Conventional	0.0003	*
Soybeans	MidSouth	No-Till	0.0013	*
Soybeans	MidWest	Conservation	0.0006	*
Soybeans	MidWest	Conventional	0.0056	*
Soybeans	MidWest	No-Till	0.0002	*
Soybeans	Southeast	Conservation	0.3208	
Soybeans	Southeast	Conventional	0.0495	*
Soybeans	Southeast	No-Till	0.0447	*
Soybeans	West	Conservation	0.1184	
Soybeans	West	Conventional	0.0921	
Soybeans	West	No-Till	0.7472	

Note: Twenty of the 42 tests observed quadratic slopes that were significantly different from zero at the 5% level of significance. The tests that were significant at the 5% level are marked with an '*'.

Table A-2. Tests to Determine if the Linear Slopes of the Regression Lines Were Significantly Different From Zero

Crop	Region	Tillage_Type	P-value	
Corn	East	Conservation	0.2078	
Corn	East	Conventional	<.0001	*
Corn	East	No-Till	<.0001	*
Corn	MidSouth	Conservation	0.0195	*
Corn	MidSouth	Conventional	0.4904	
Corn	MidSouth	No-Till	0.3690	
Corn	MidWest	Conventional	0.0011	*
Corn	Southeast	Conservation	0.0835	
Corn	West	Conservation	0.0011	*
Corn	West	Conventional	<.0001	*
Corn	West	No-Till	0.0114	*
Cotton	MidWest	Conservation	0.0210	*
Cotton	Southeast	Conservation	<.0001	*
Cotton	West	Conservation	<.0001	*
Cotton	West	Conventional	<.0001	*
Cotton	West	No-Till	0.0001	*
Soybeans	East	Conservation	0.1917	
Soybeans	MidSouth	Conservation	0.1896	
Soybeans	Southeast	Conservation	0.6675	
Soybeans	West	Conservation	0.1233	
Soybeans	West	Conventional	0.0067	*
Soybeans	West	No-Till	0.0002	*

Note: Fourteen of the 22 tests observed linear slopes that were significantly different from zero at the 5% level of significance. The tests that were significant at the 5% level are marked with an '*'.

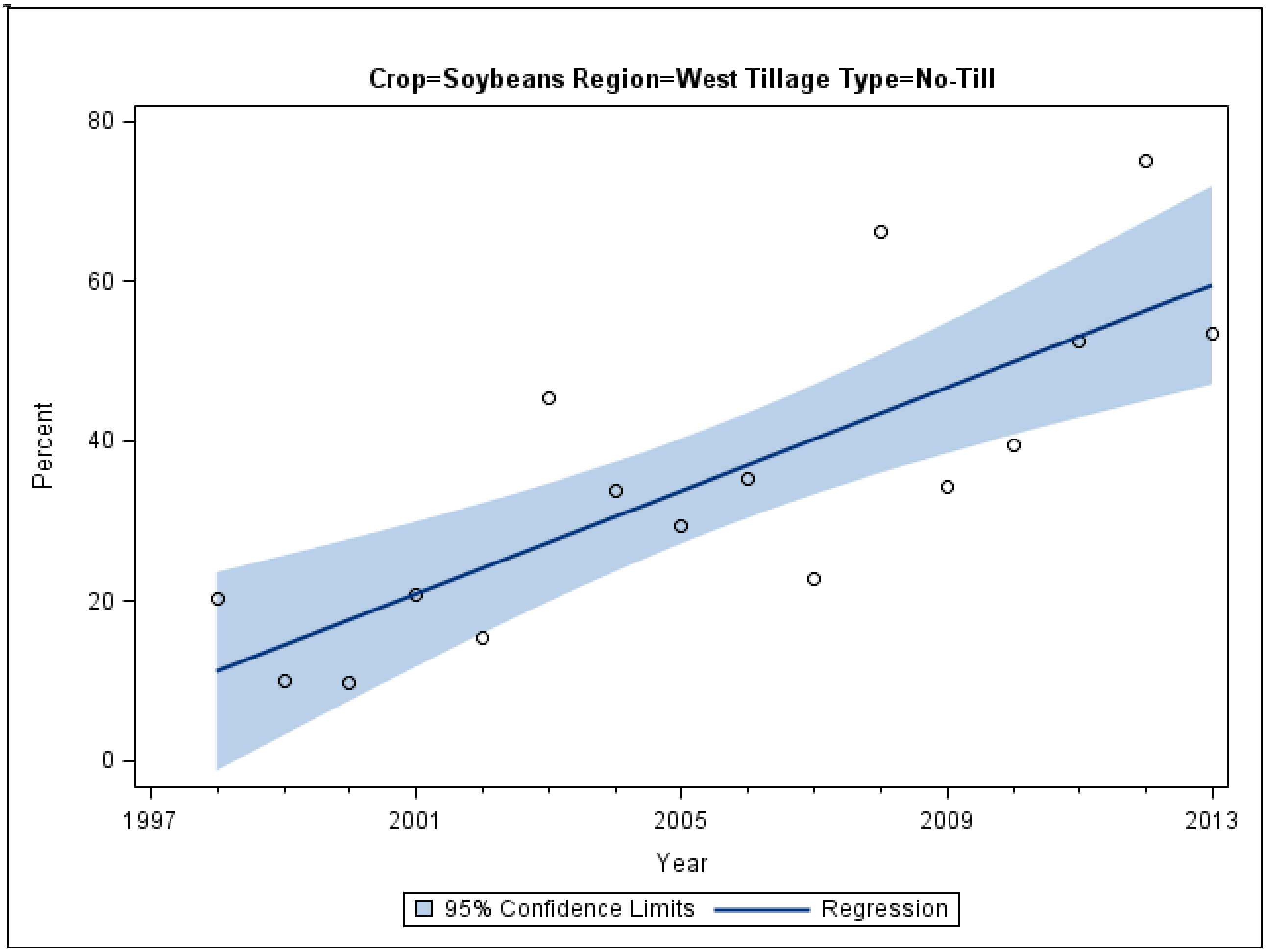
Table A-3. Regression Parameter Estimates for the Crop and Region Combinations with a Significant the Change in Tillage Over Time

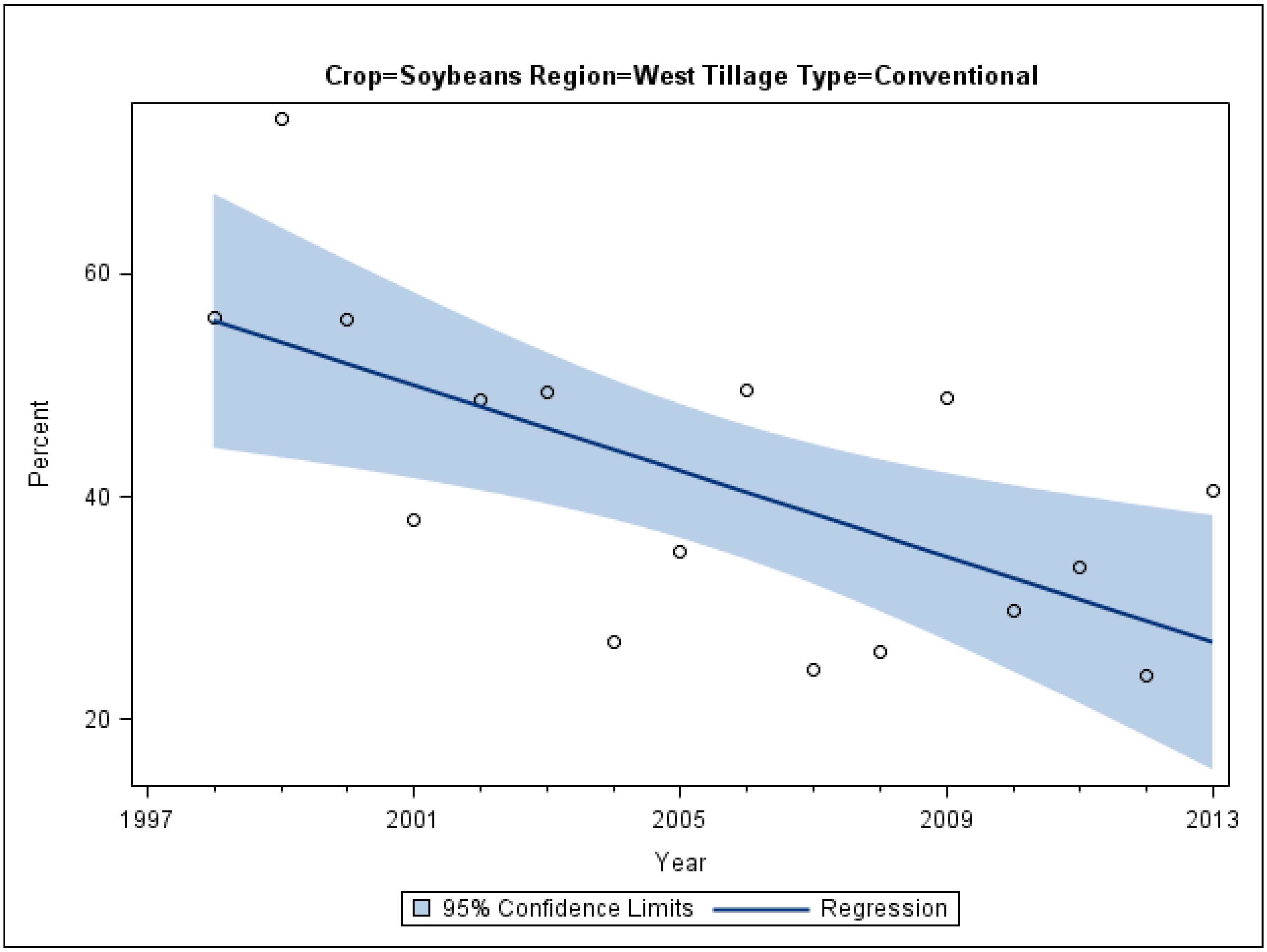
Crop	Region	Tillage Type	Intercept	Year	Year*Year
Corn	East	Conventional	3466.72	-1.7079	.
Corn	East	No-Till	-3039.87	1.5340	.
Corn	MidSouth	Conservation	-1769.03	0.8933	.
Corn	MidWest	Conservation	300587	-299.62	0.07467
Corn	MidWest	Conventional	1114.90	-0.5355	.
Corn	MidWest	No-Till	-383597	381.93	-0.09506
Corn	Southeast	Conventional	766604	-763.20	0.1900
Corn	Southeast	No-Till	-1202619	1198.66	-0.2987
Corn	West	Conservation	-2375.58	1.1991	.
Corn	West	Conventional	3782.79	-1.8592	.
Corn	West	No-Till	-1307.20	0.6601	.
Cotton	MidSouth	Conservation	-1044452	1041.04	-0.2594
Cotton	MidSouth	Conventional	2648507	-2639.72	0.6577
Cotton	MidSouth	No-Till	-1603955	1598.68	-0.3983
Cotton	MidWest	Conservation	-2277.83	1.1529	.
Cotton	MidWest	Conventional	1707629	-1701.22	0.4237
Cotton	MidWest	No-Till	-2295716	2289.07	-0.5706
Cotton	Southeast	Conservation	-3534.42	1.7786	.
Cotton	Southeast	Conventional	1405216	-1399.58	0.3485
Cotton	Southeast	No-Till	-1304016	1300.48	-0.3242
Cotton	West	Conservation	-2656.63	1.3372	.
Cotton	West	Conventional	4244.03	-2.0828	.
Cotton	West	No-Till	-1487.40	0.7456	.
Soybeans	East	Conventional	902937	-899.02	0.2238
Soybeans	East	No-Till	-1061879	1057.33	-0.2632
Soybeans	MidSouth	Conventional	1373279	-1368.84	0.3411
Soybeans	MidSouth	No-Till	-1208347	1204.77	-0.3003
Soybeans	MidWest	Conservation	387479	-386.03	0.09615
Soybeans	MidWest	Conventional	311116	-309.83	0.07714

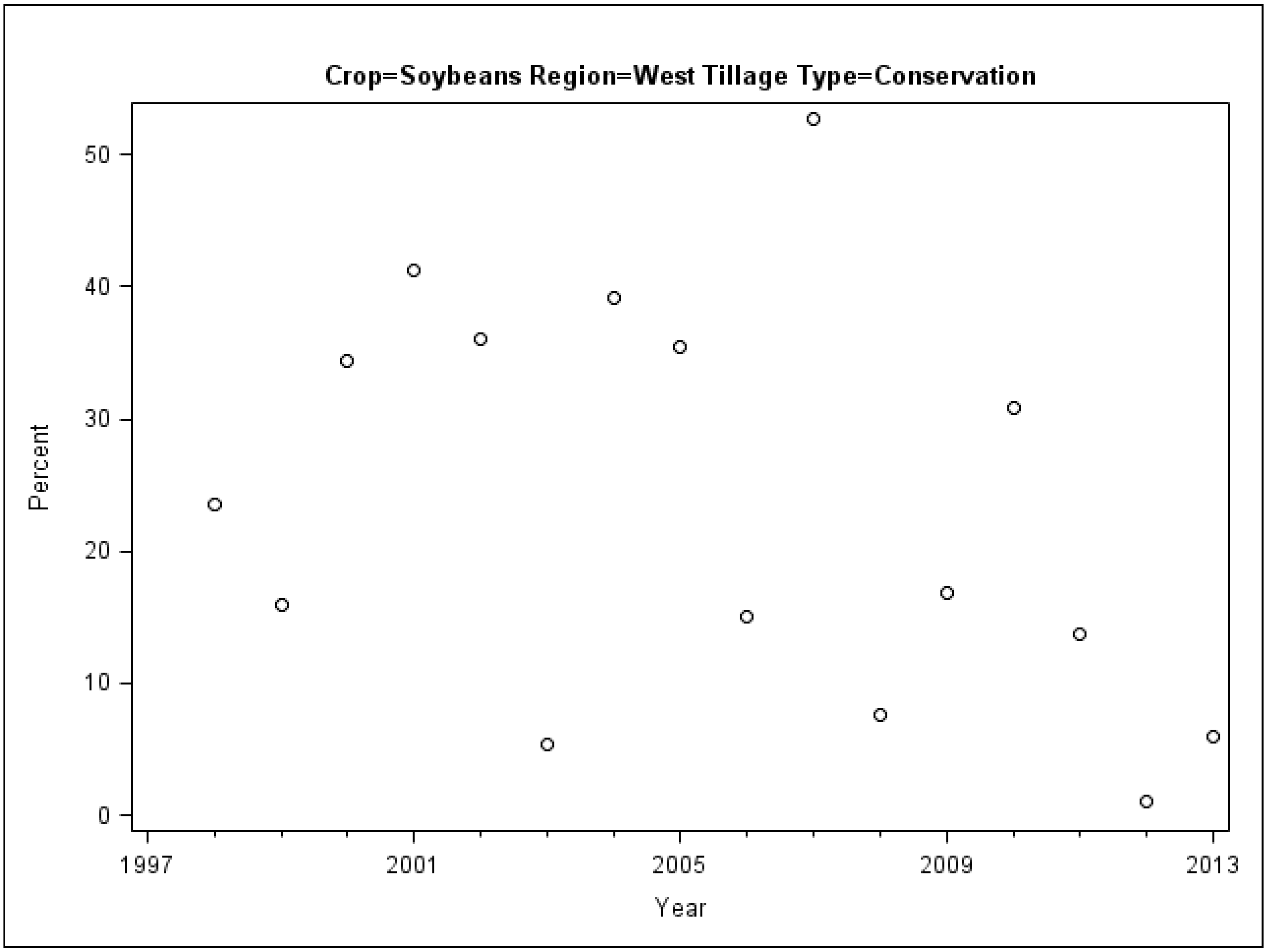
Table A-3 (continued). Regression Parameter Estimates for the Crop and Region Combinations with a Significant the Change in Tillage Over Time

Crop	Region	Tillage Type	Intercept	Year	Year*Year
Soybeans	MidWest	No-Till	-698495	695.85	-0.1733
Soybeans	Southeast	Conventional	600500	-597.28	0.1485
Soybeans	Southeast	No-Till	-768636	765.12	-0.1904
Soybeans	West	Conventional	3901.95	-1.9250	.
Soybeans	West	No-Till	-6423.22	3.2204	.

Appendix A Figures




Crop=Soybeans Region=West Tillage Type=Conventional
Percent
60
40
20
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression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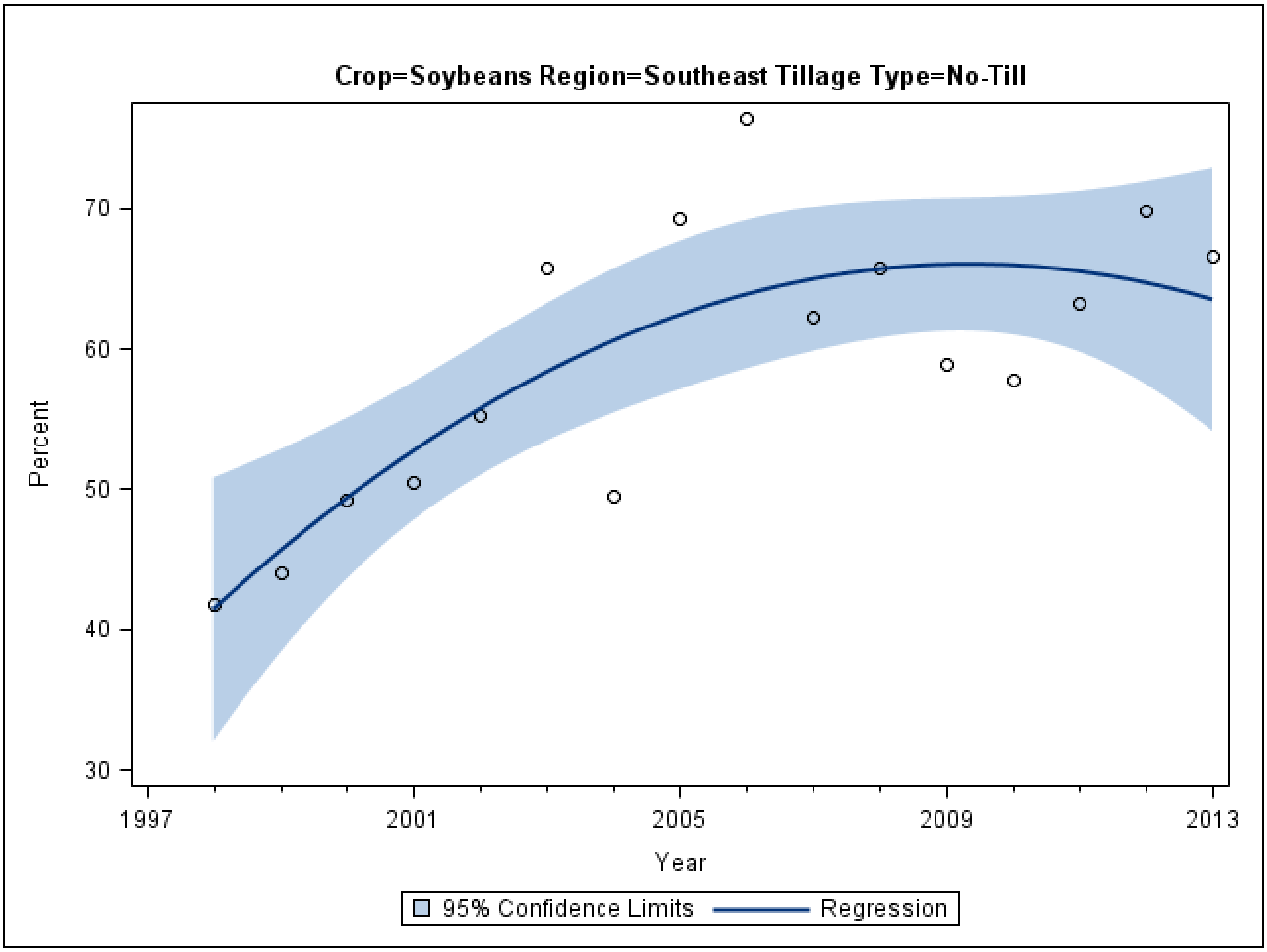
50
40
30
20
10
0
Percent
1997
2001
2005
2009
2013
Year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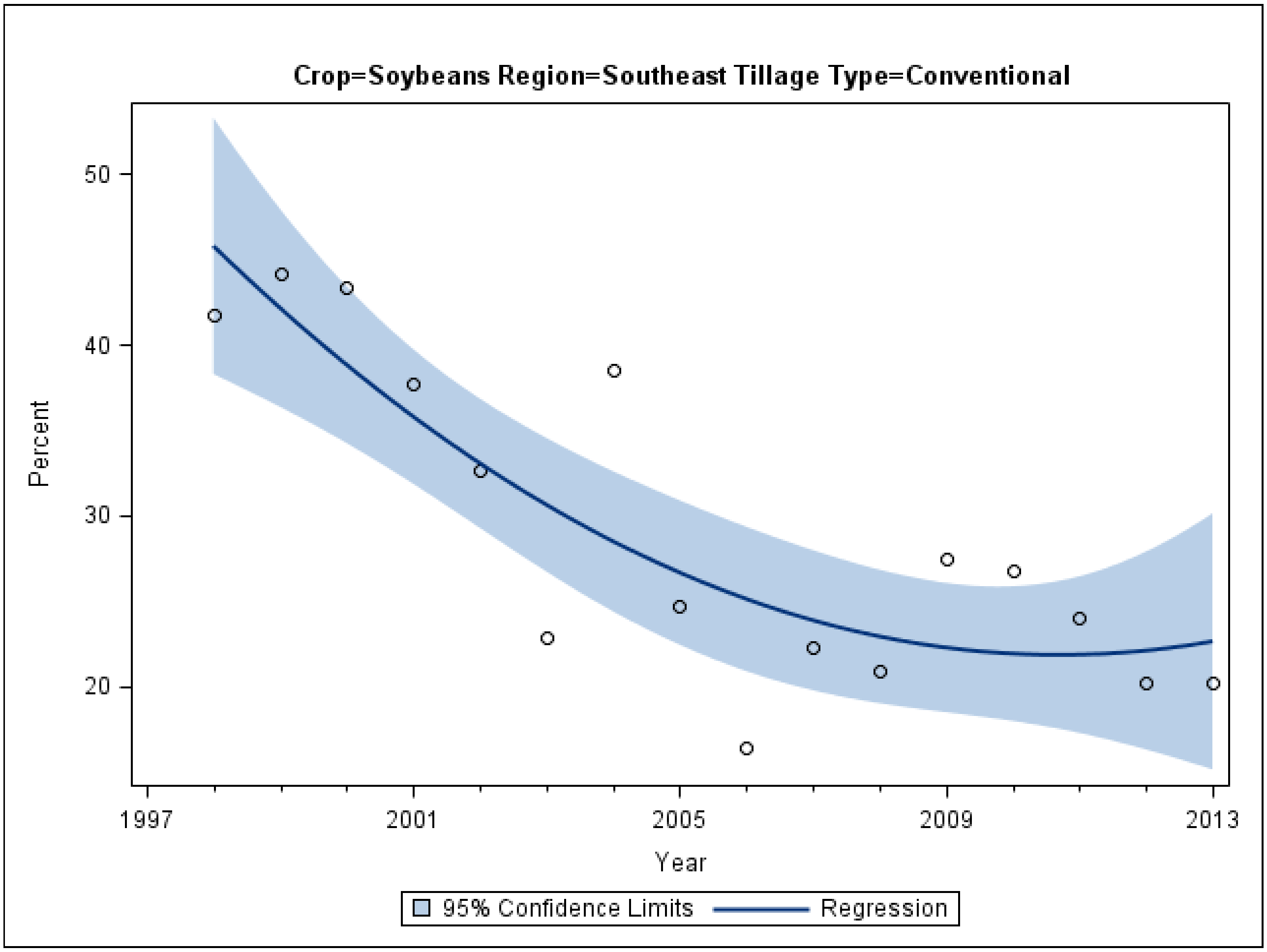
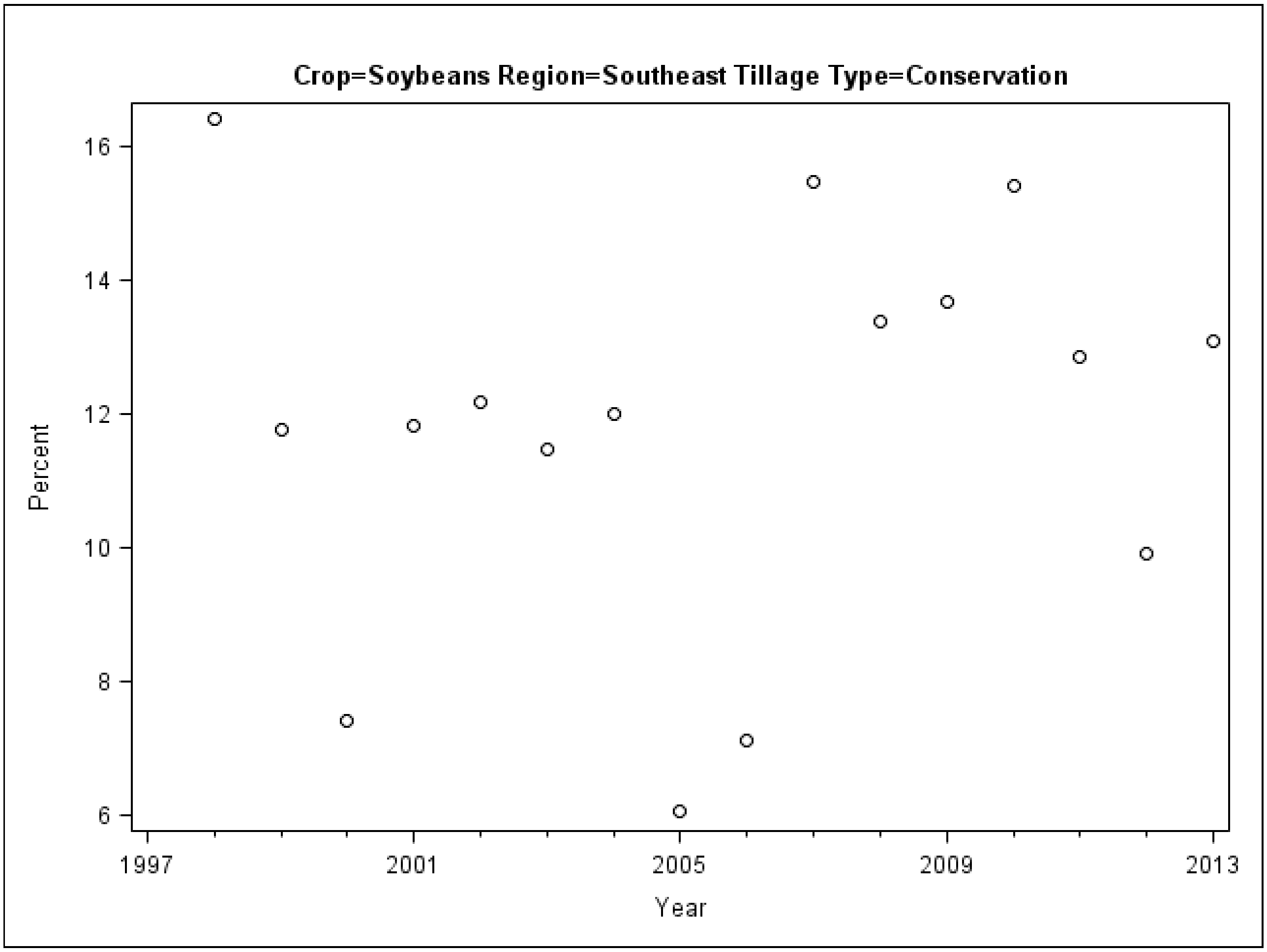
60
50
40
30
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression



Crop=Soybeans Region=Southeast Tillage Type=Conventional
50
40
30
20
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression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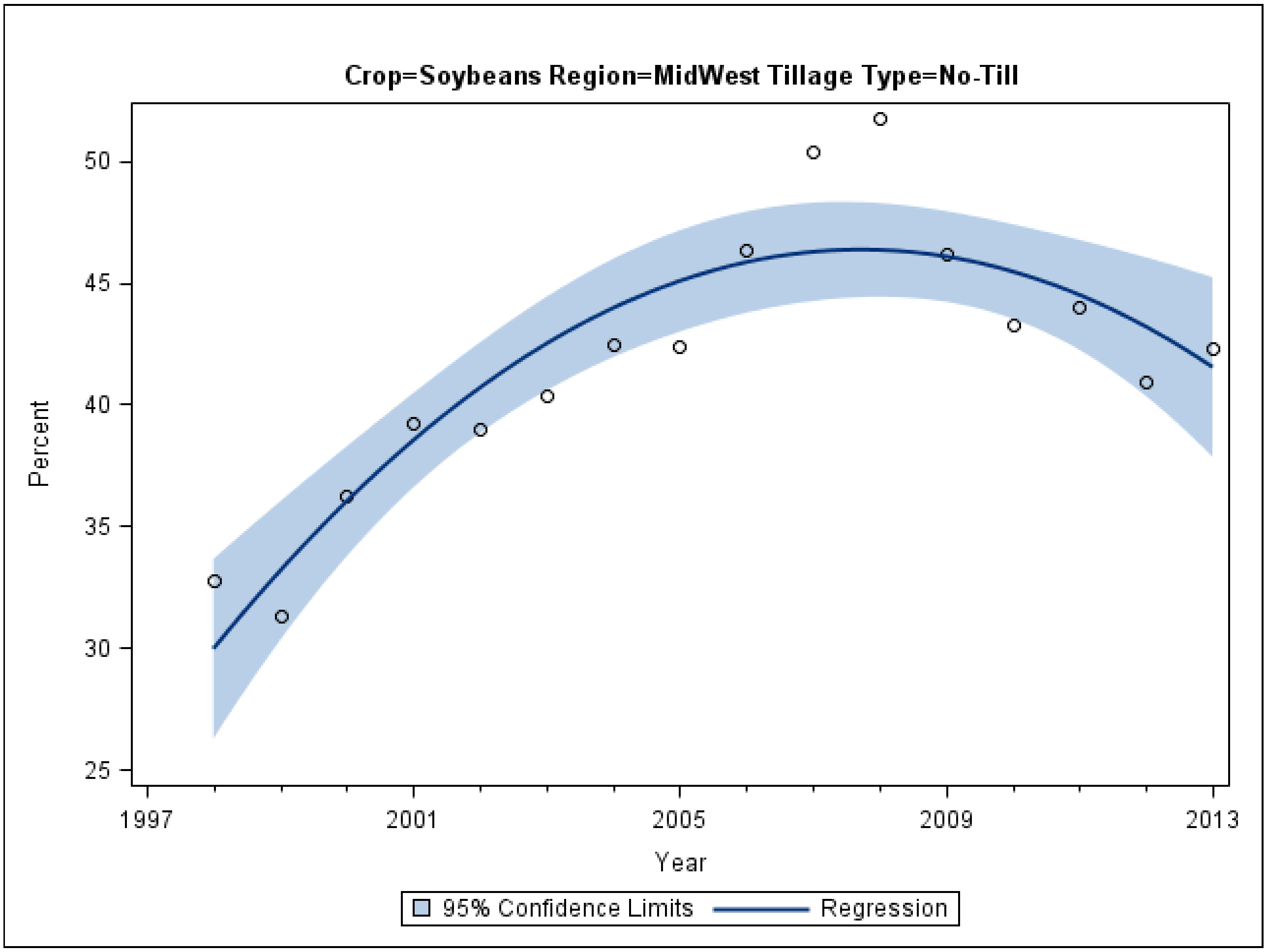
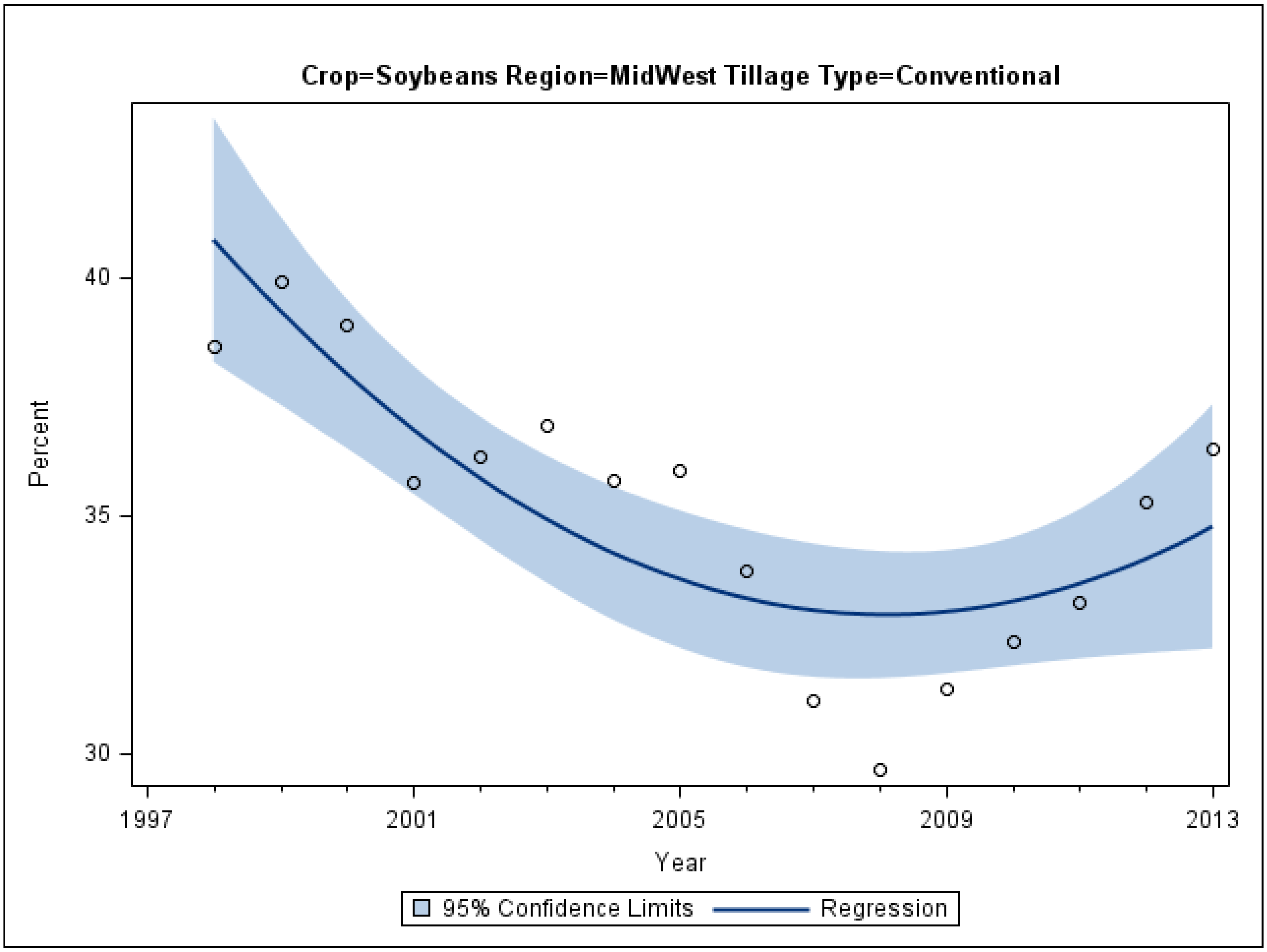
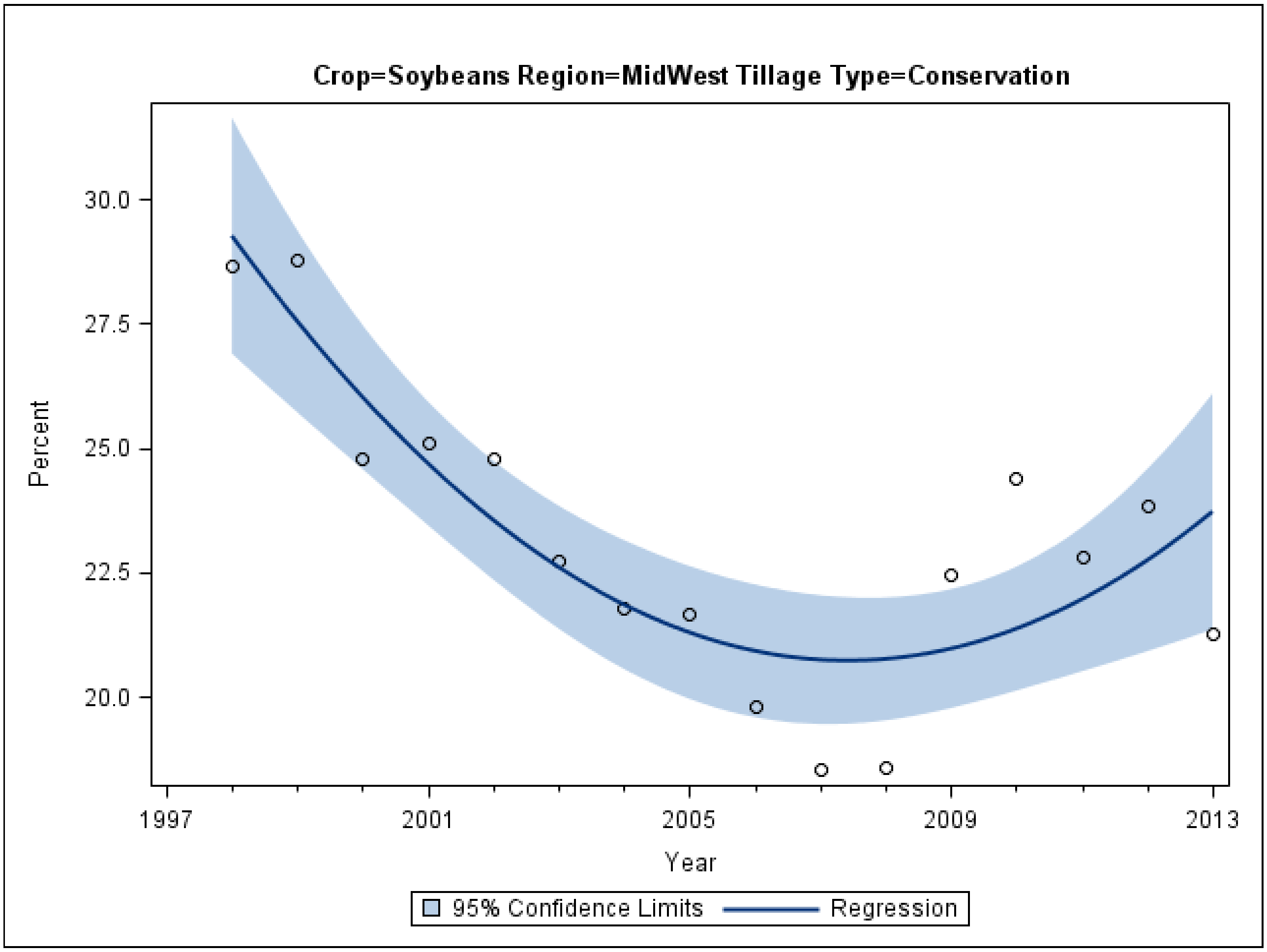
Percent
16
14
12
10
8
6
1997
2001
2005
2009
2013
Year



Crop=Soybeans Region=MidWest Tillage Type=No-Till
Percent
50
45
40
35
30
25
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Soybeans Region=MidWest Tillage Type=Conventional
Percent
40
35
30
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression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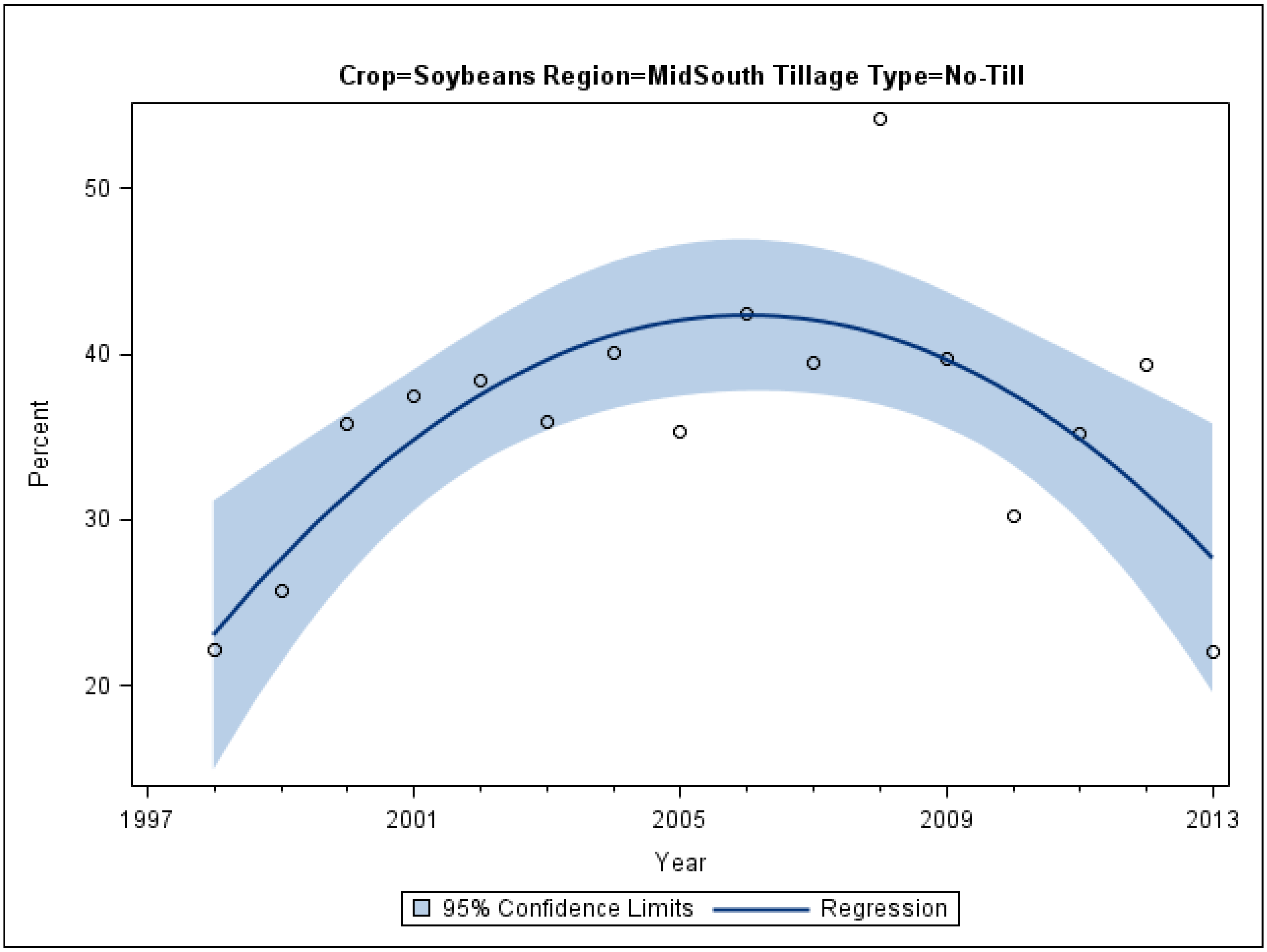
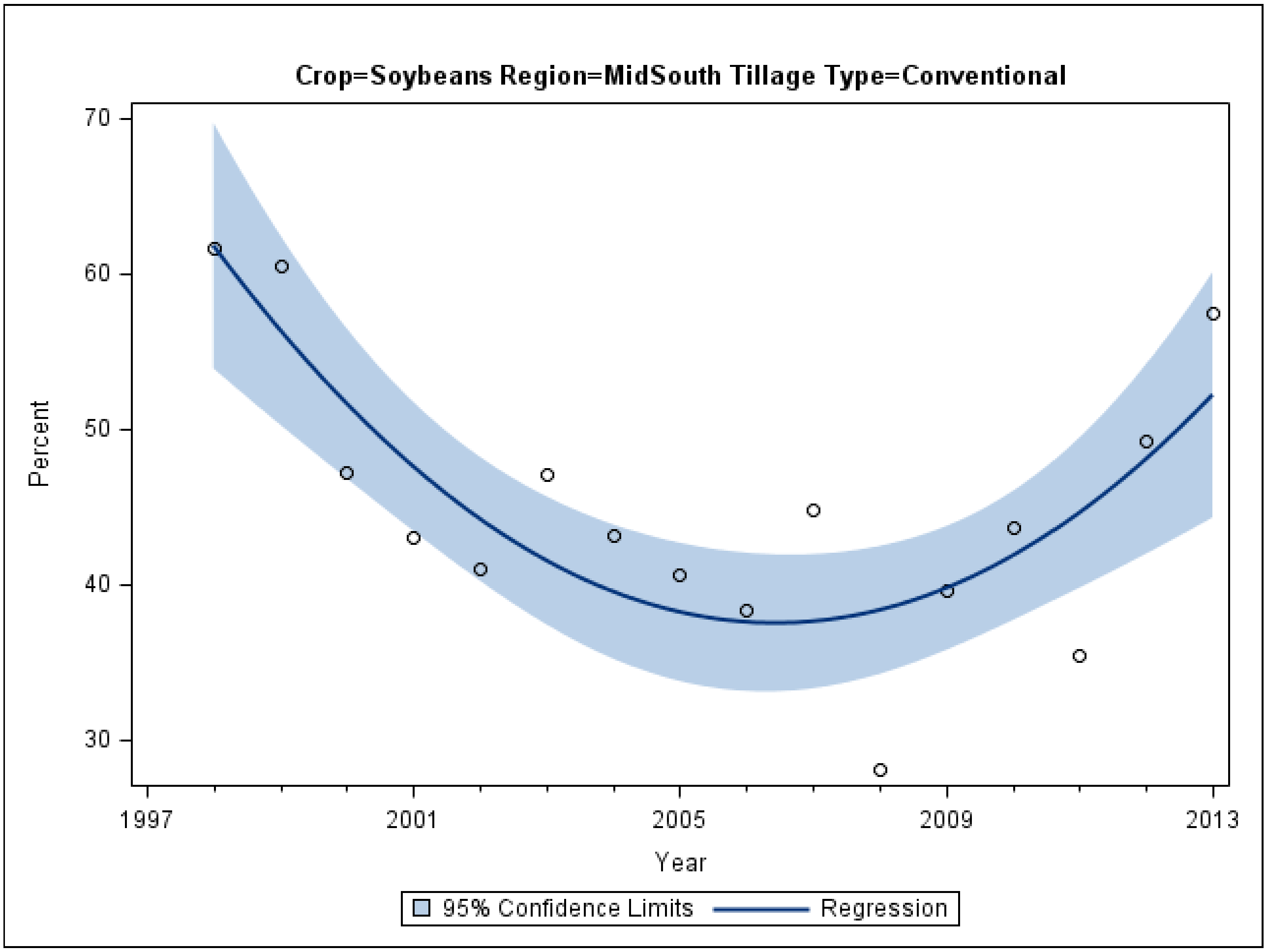
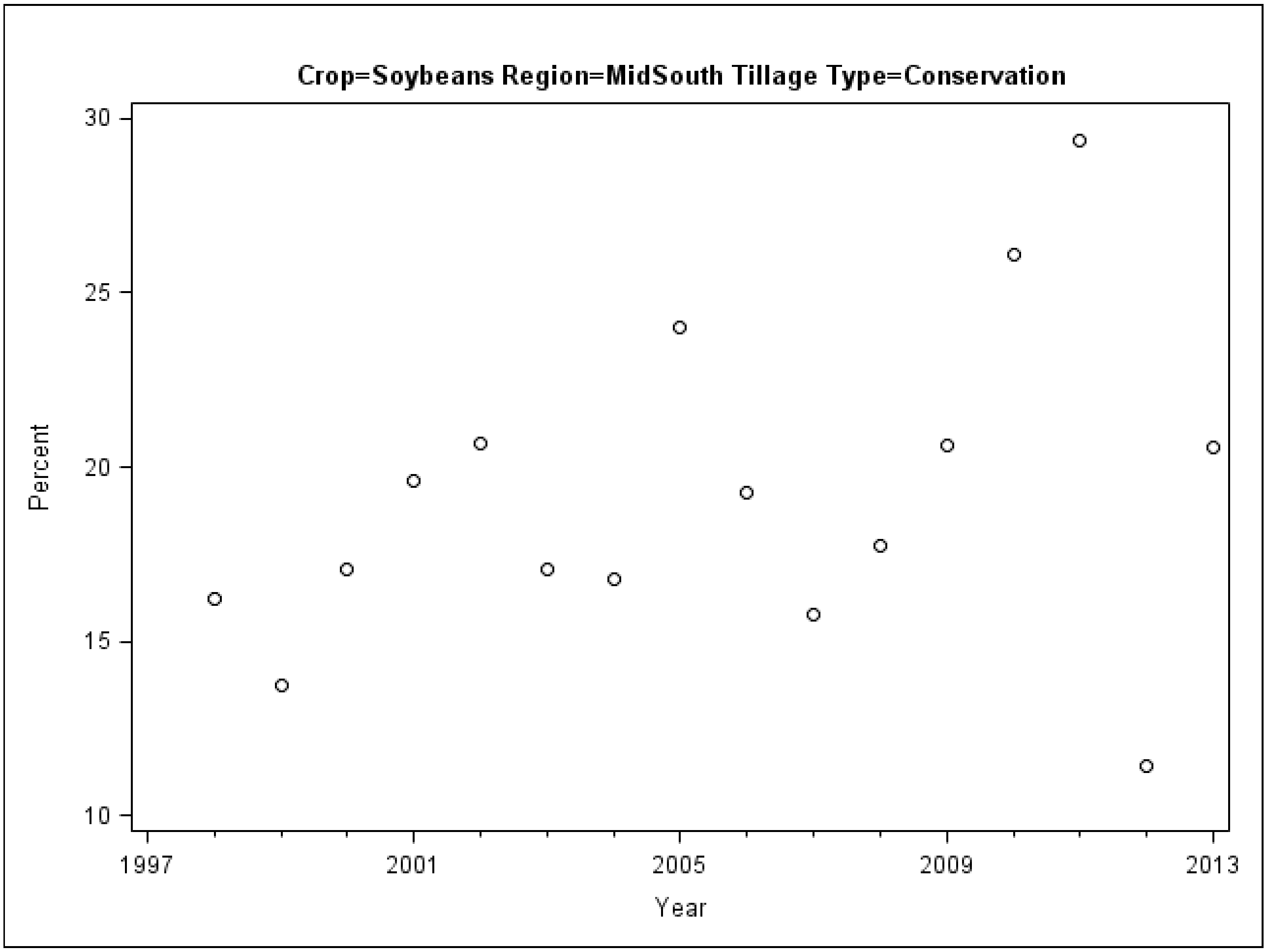
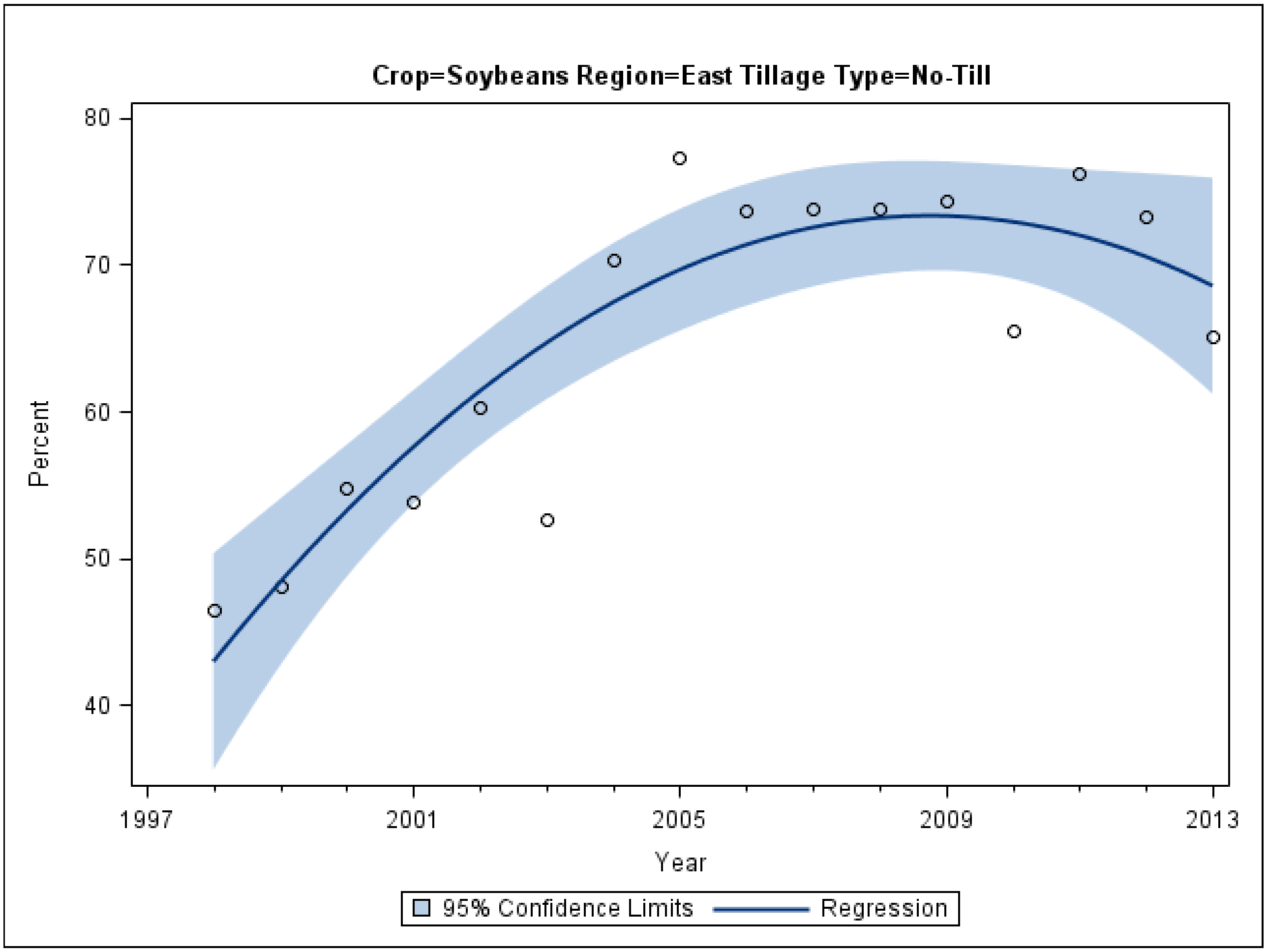
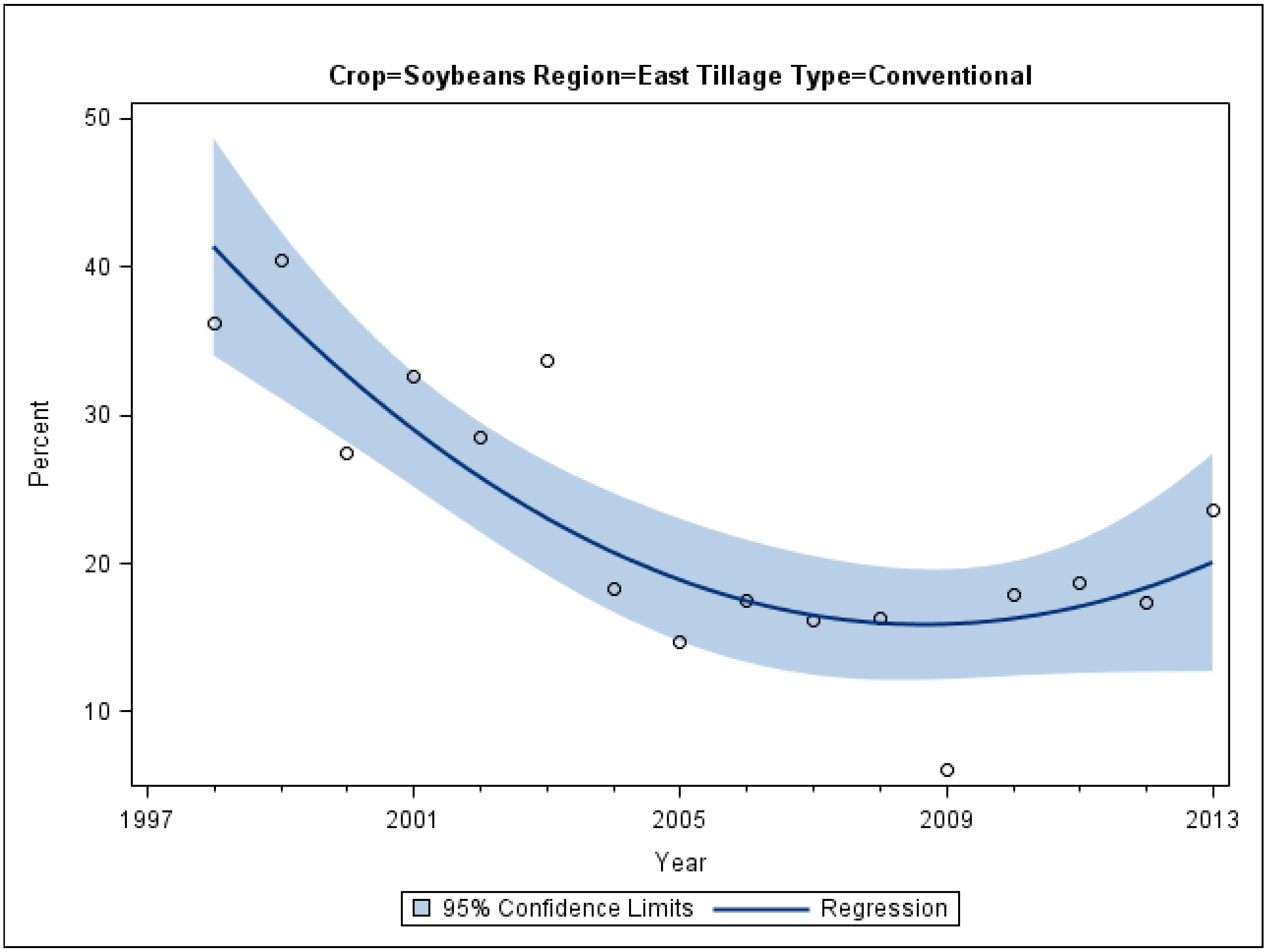
Percent
30.0
27.5
25.0
22.5
20.0
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Soybeans Region=MidSouth Tillage Type=No-Till
50
40
30
20
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

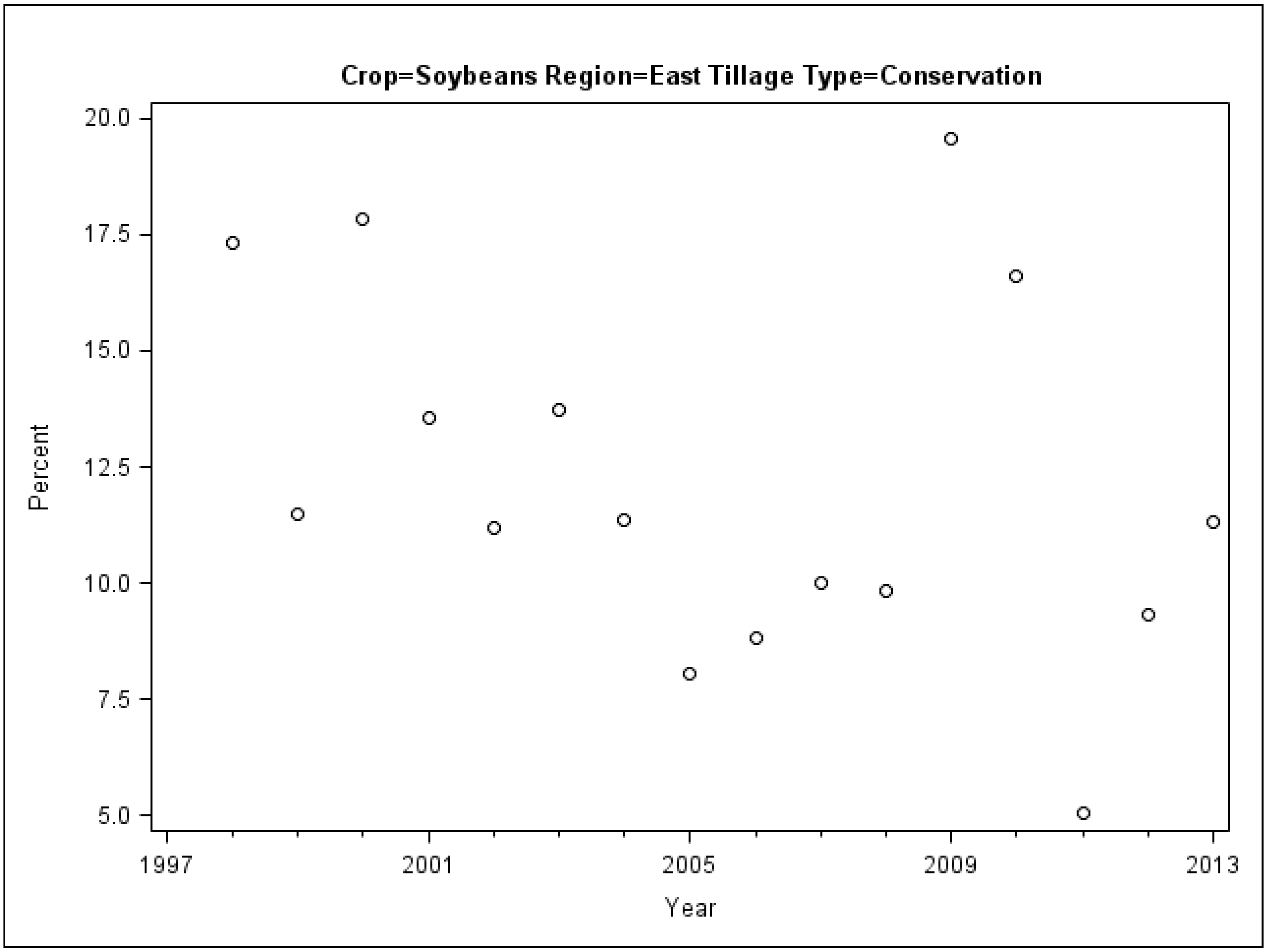

Crop=Soybeans Region=MidSouth Tillage Type=Conventional
Percent
70
60
50
40
30
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

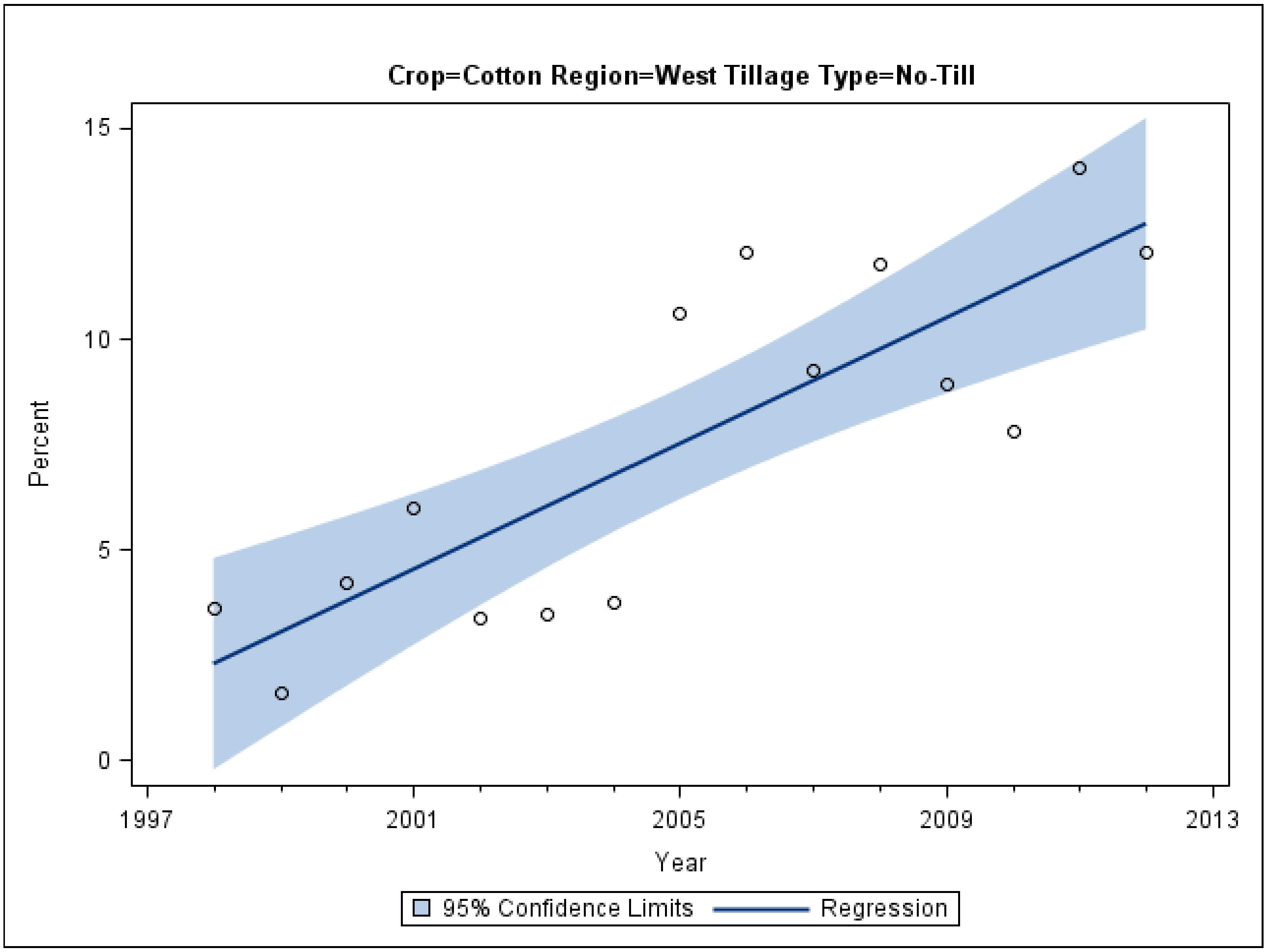

Crop=Soybeans Region=MidSouth Tillage Type=Conservation
Percent
30
25
20
15
10
1997
2001
2005
2009
2013
Year

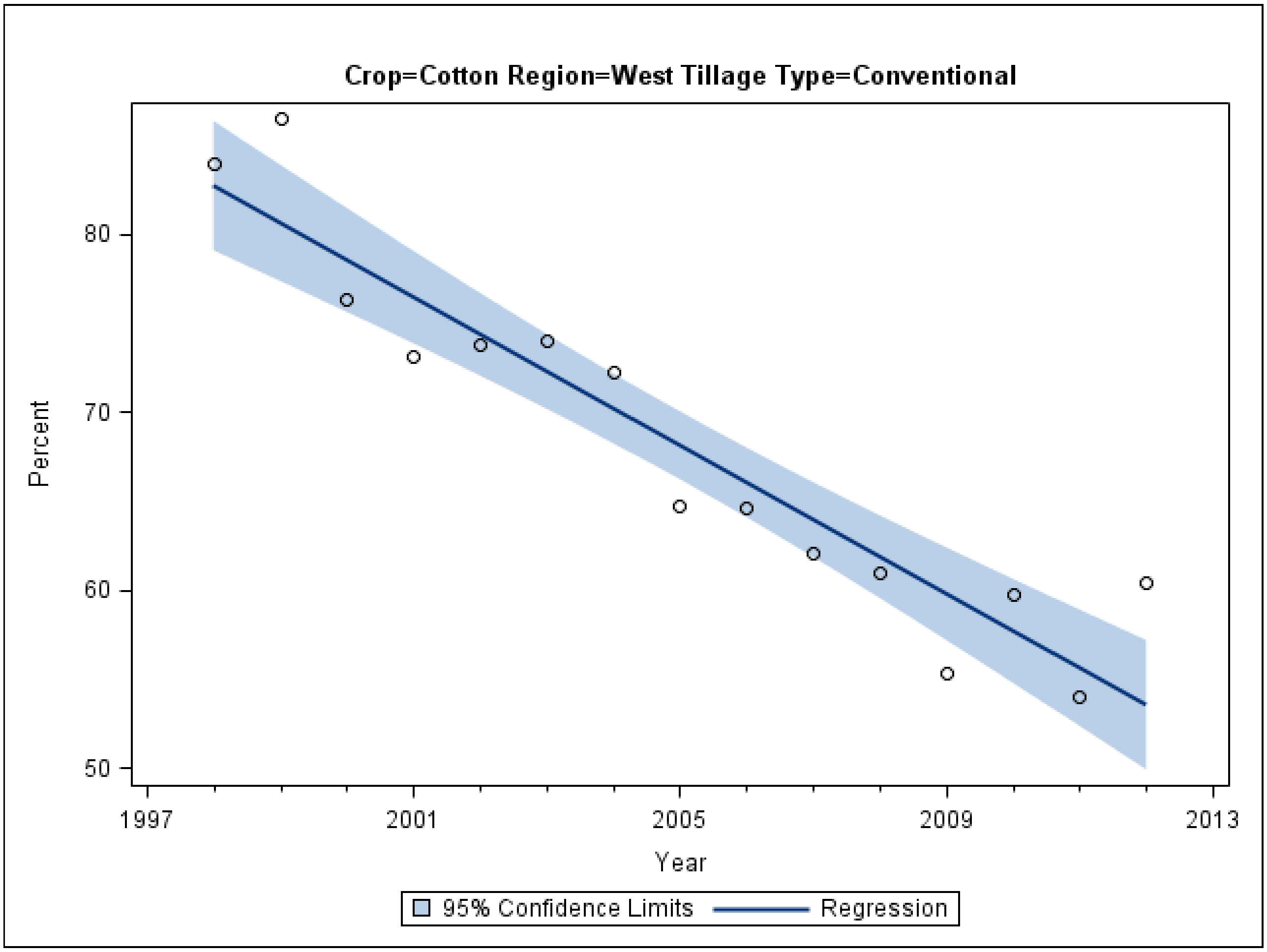

Crop=Soybeans Region=East Tillage Type=No-Till
80
70
60
50
40
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

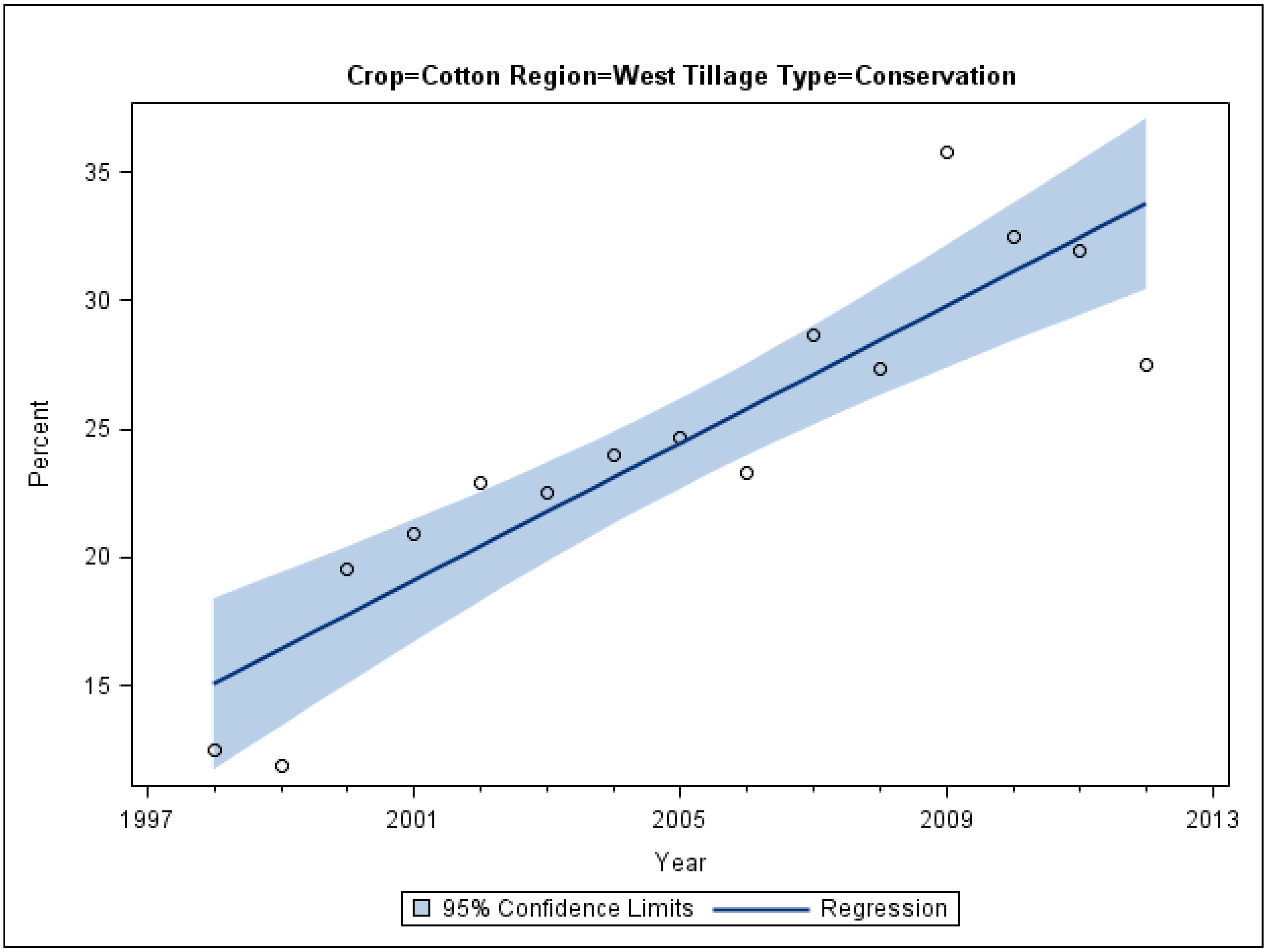


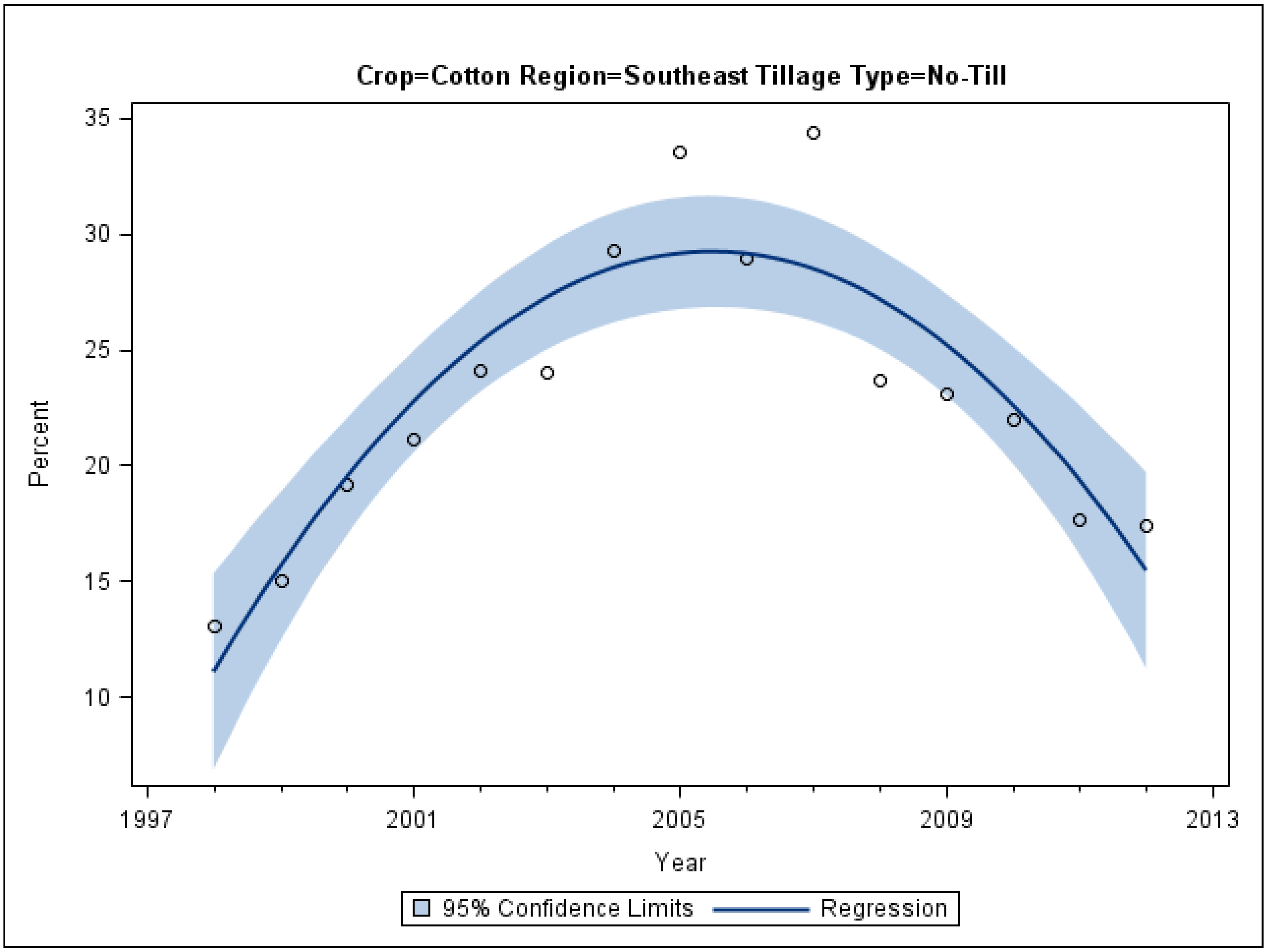
Crop=Soybeans Region=East Tillage Type=Conventional
50
40
30
20
10
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Soybeans Region=East Tillage Type=Conservation
20.0
17.5
15.0
12.5
10.0
7.5
5.0
Percent
1997
2001
2005
2009
2013
Year

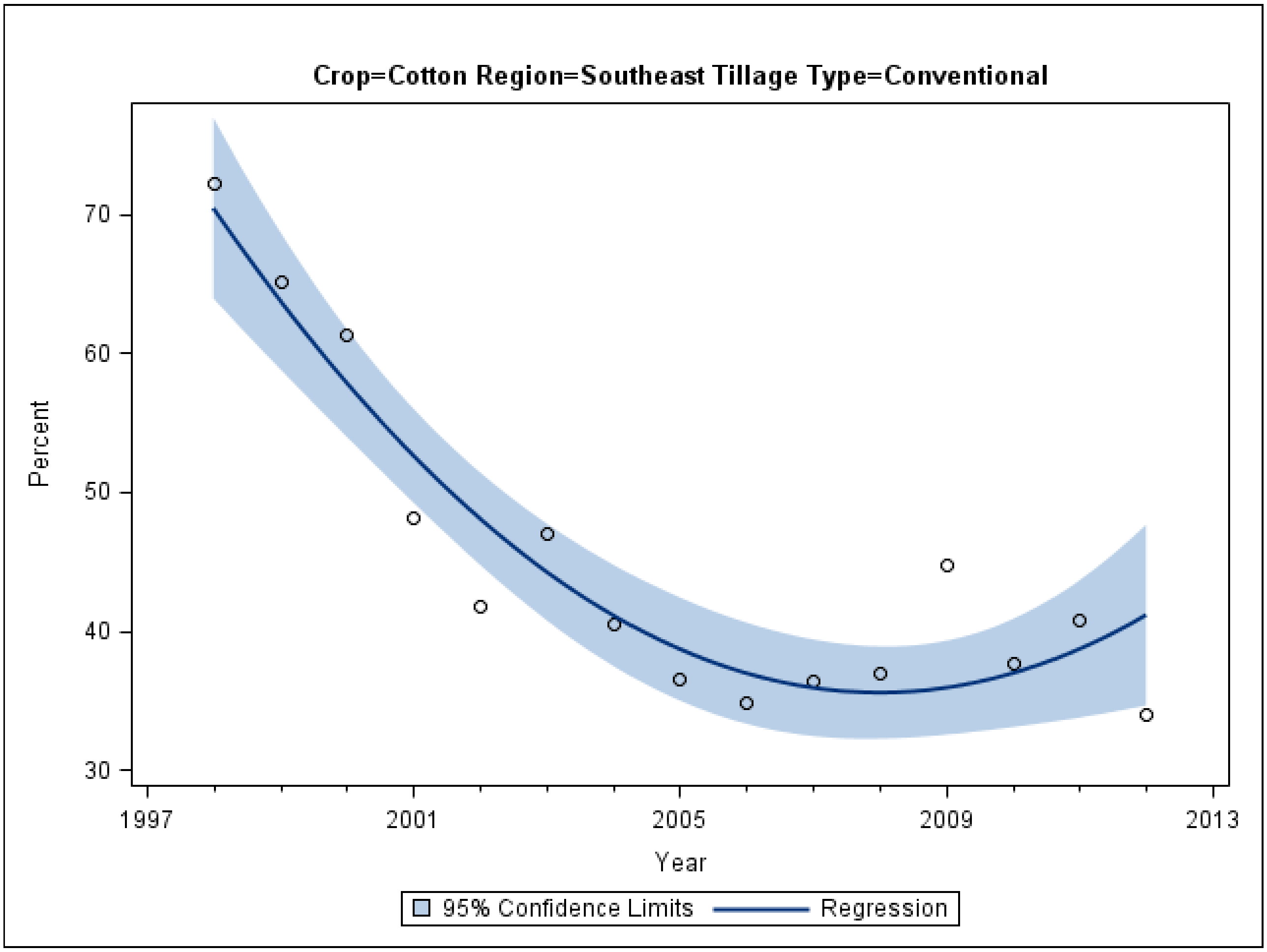

Crop=Cotton Region=West Tillage Type=No-Till
15
10
5
0
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

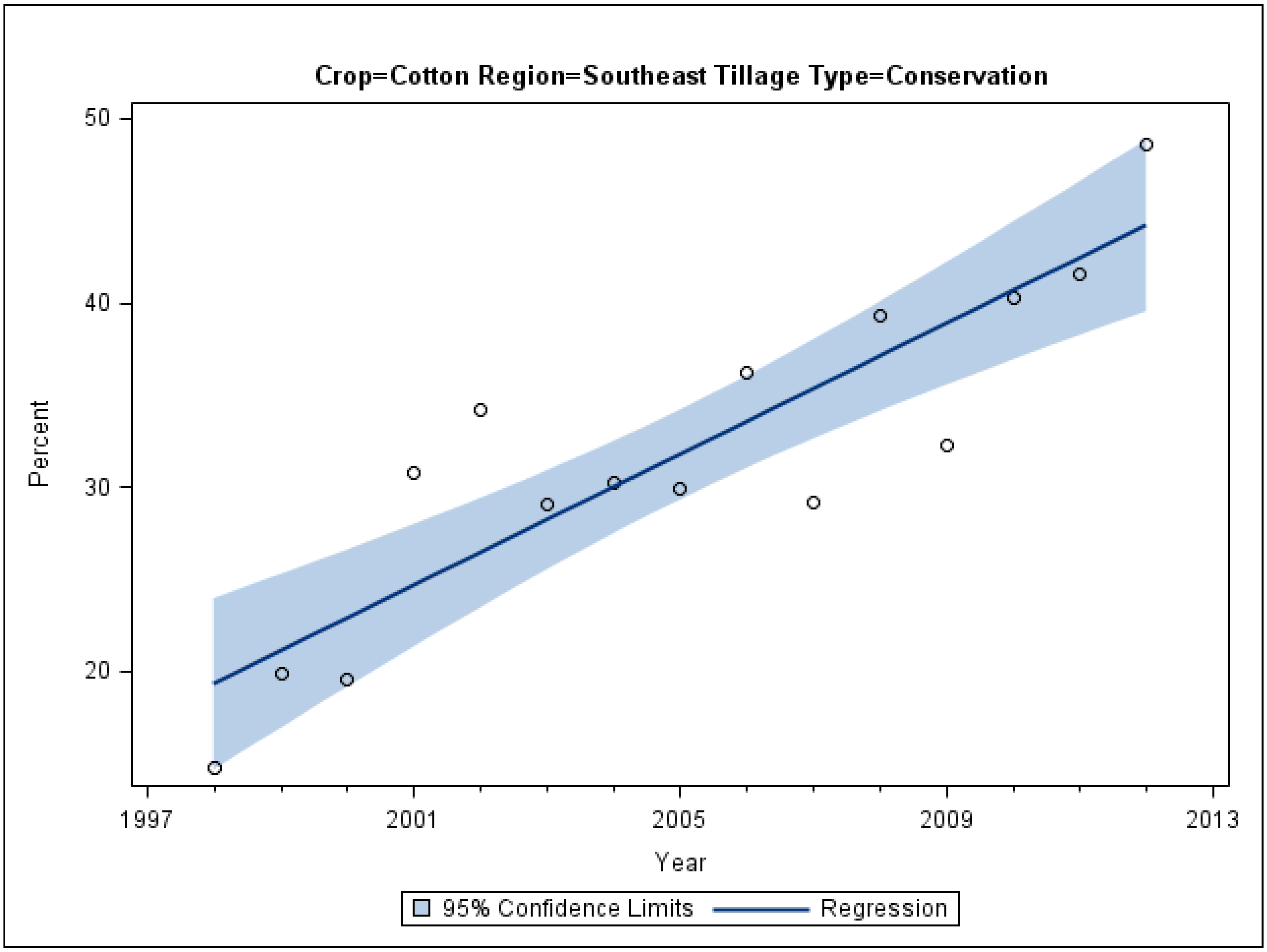

Crop=Cotton Region=West Tillage Type=Conventional
Percent
80
70
60
50
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

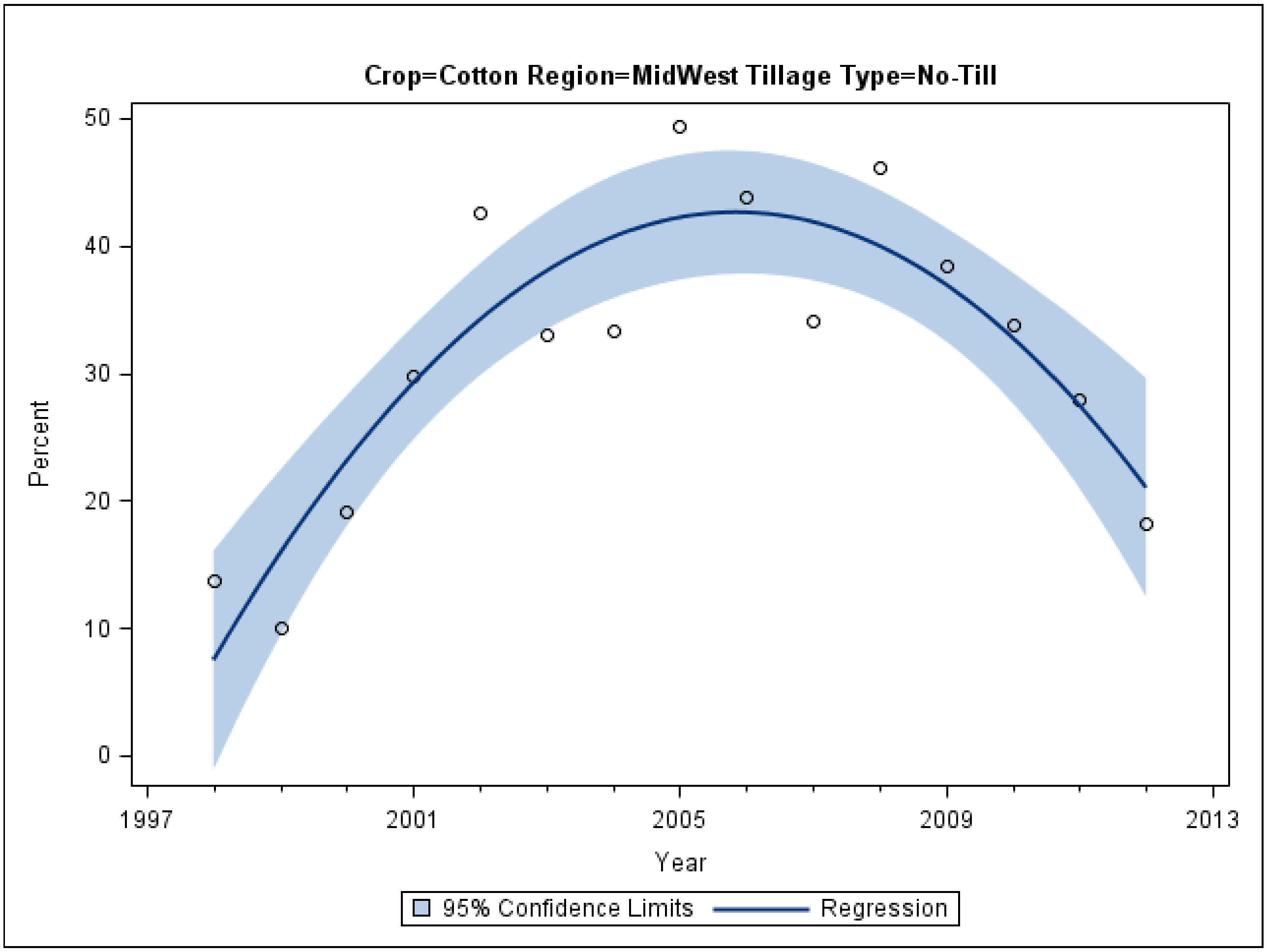

Crop=Cotton Region=West Tillage Type=Conservation
Percent
35
30
25
20
15
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

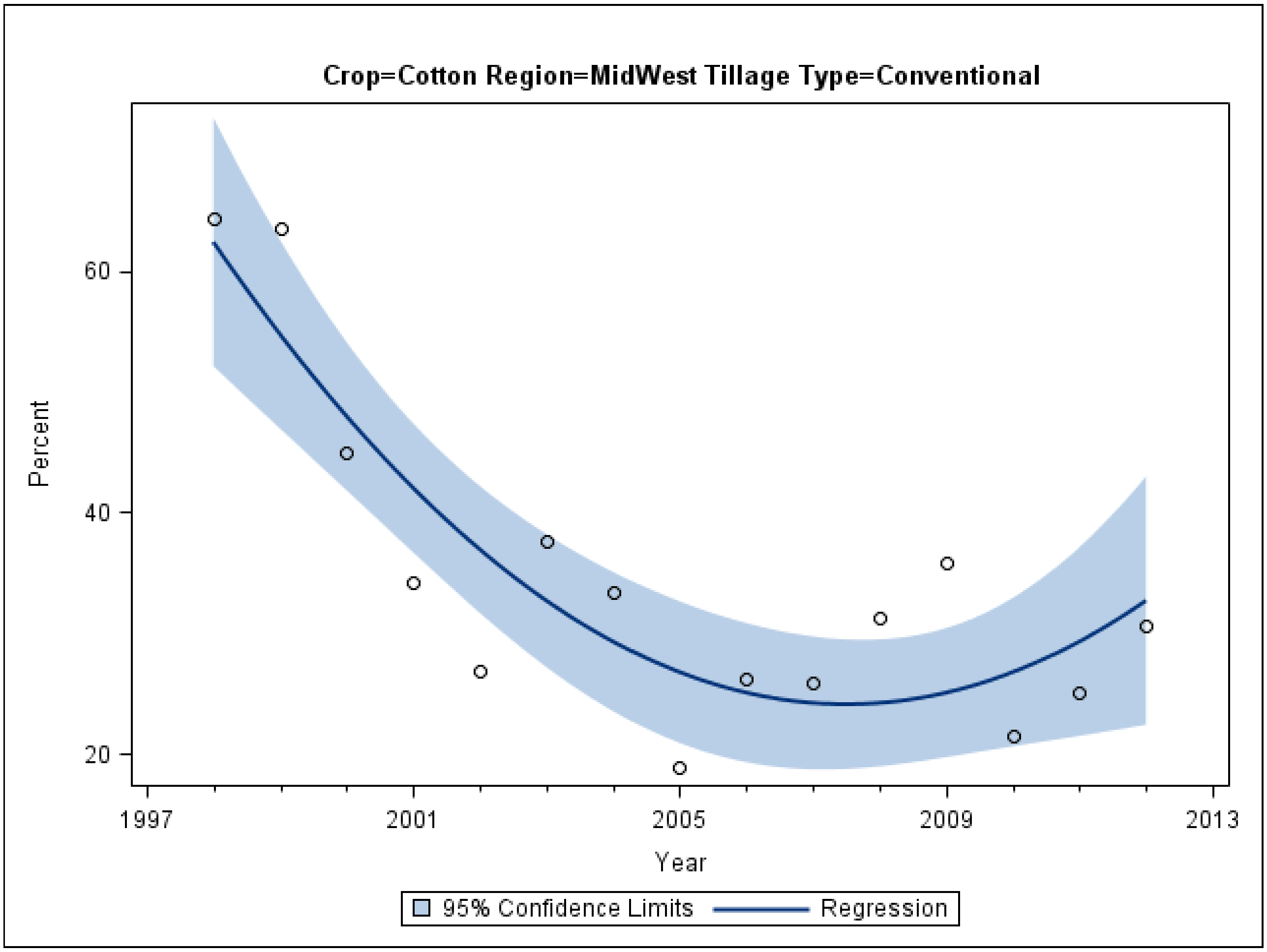


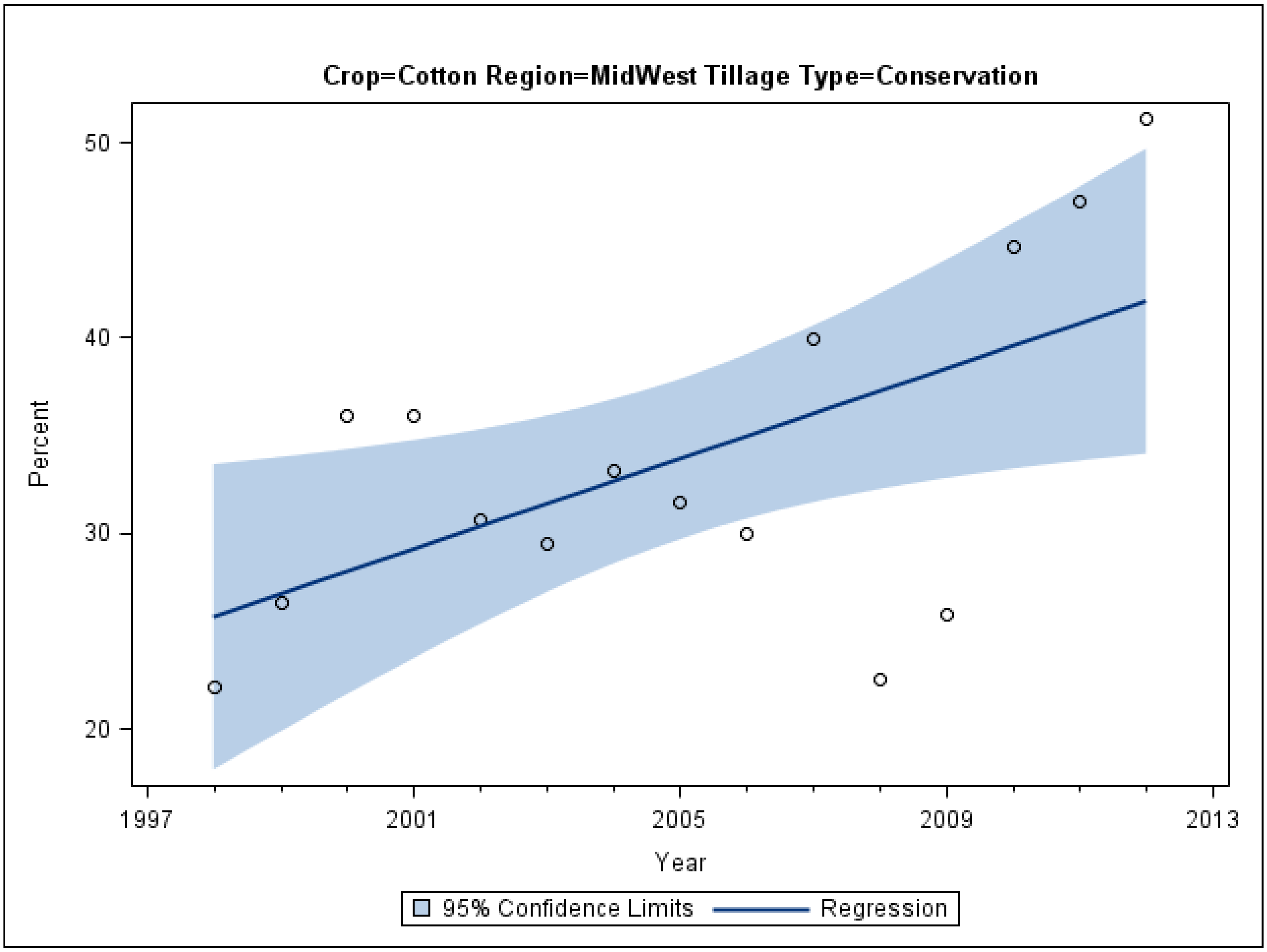
Crop=Cotton Region=Southeast Tillage Type=No-Till
35
30
25
20
15
10
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

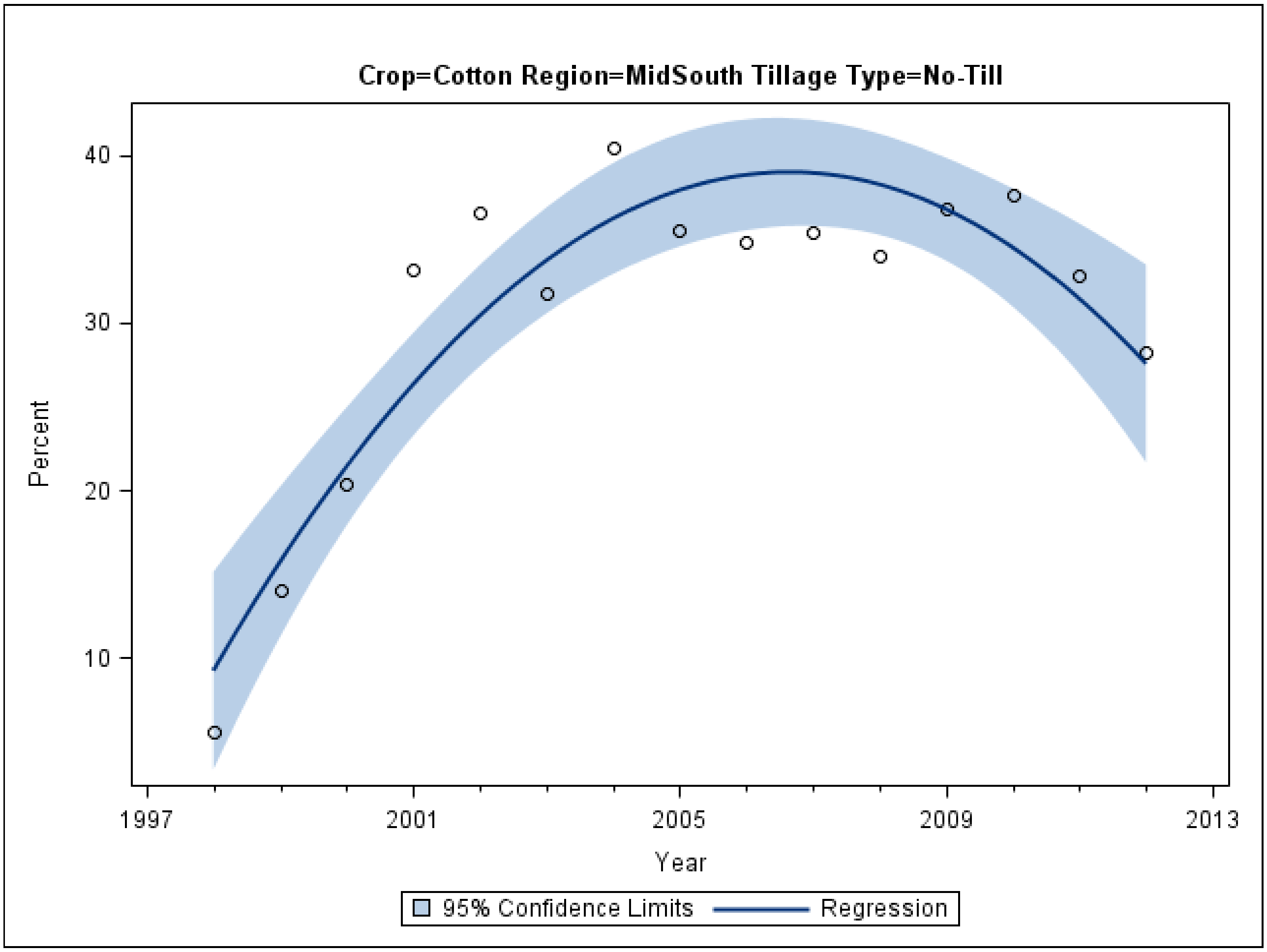

Crop=Cotton Region=Southeast Tillage Type=Conventional
Percent
70
60
50
40
30
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Cotton Region=Southeast Tillage Type=Conservation
Percent
50
40
30
20
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

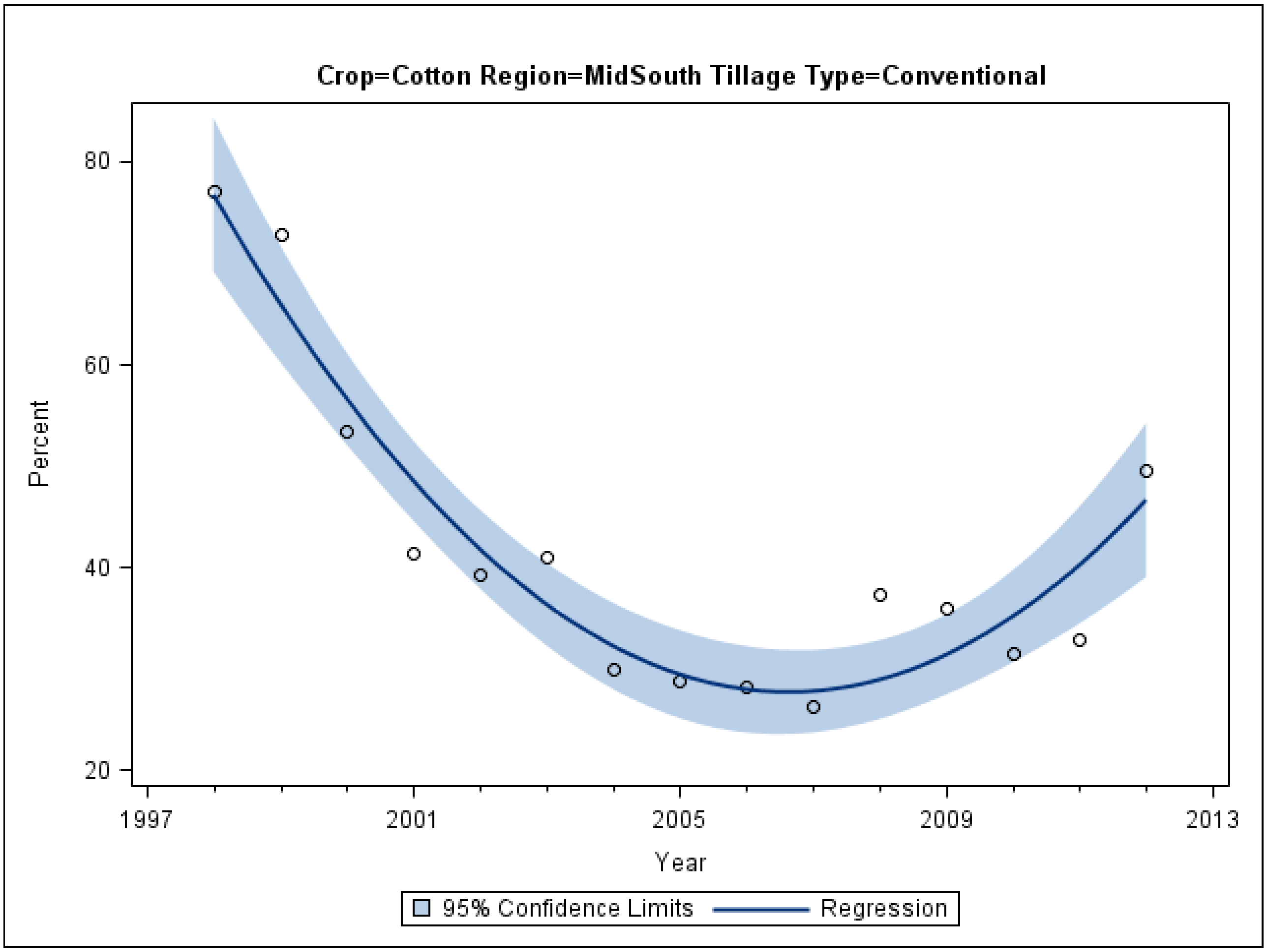

Crop=Cotton Region=MidWest Tillage Type=No-Till
Percent
50
40
30
20
10
0
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

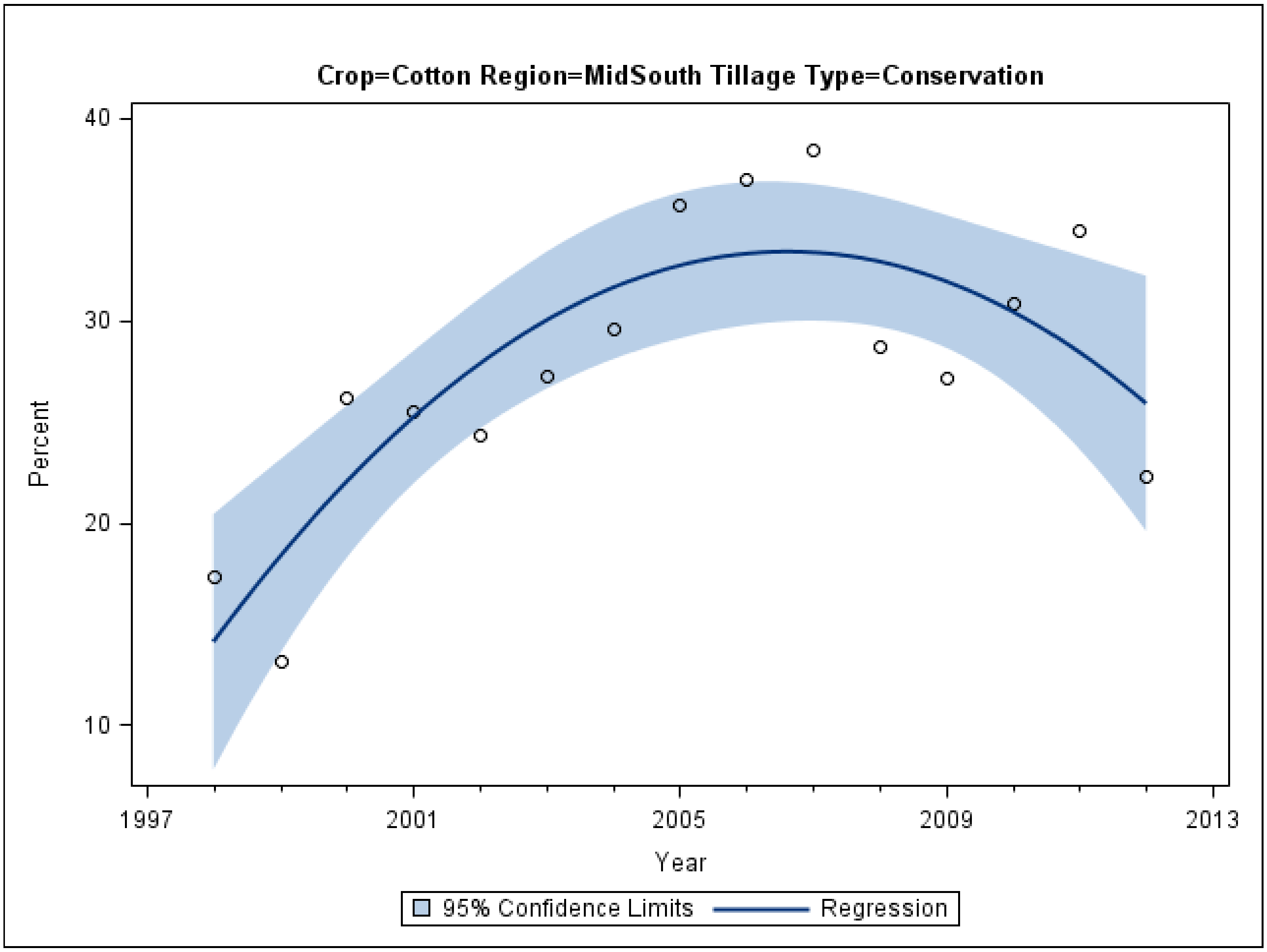

Crop=Cotton Region=MidWest Tillage Type=Conventional
Percent
60
40
20
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Cotton Region=MidWest Tillage Type=Conservation
50
40
30
20
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

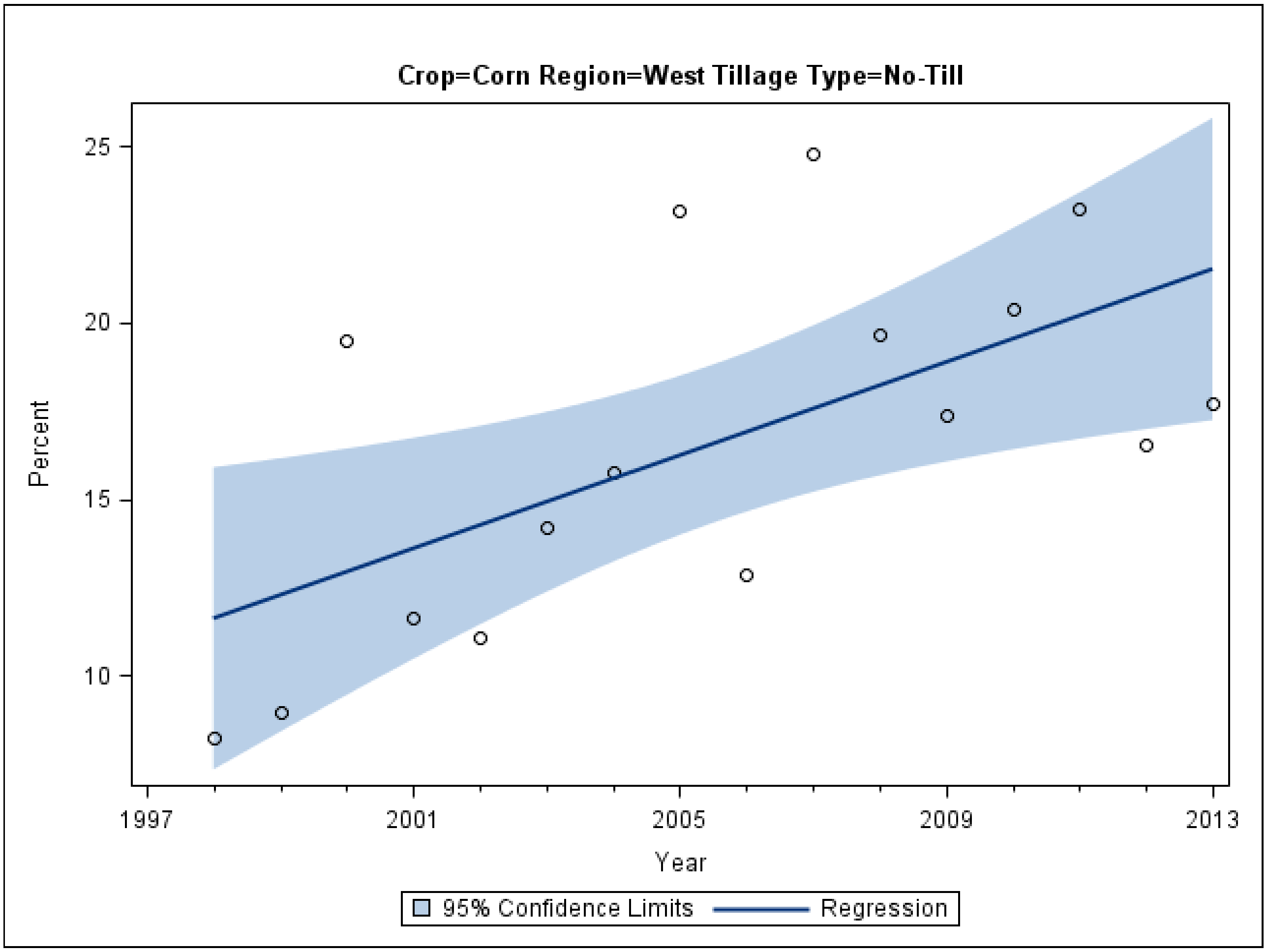


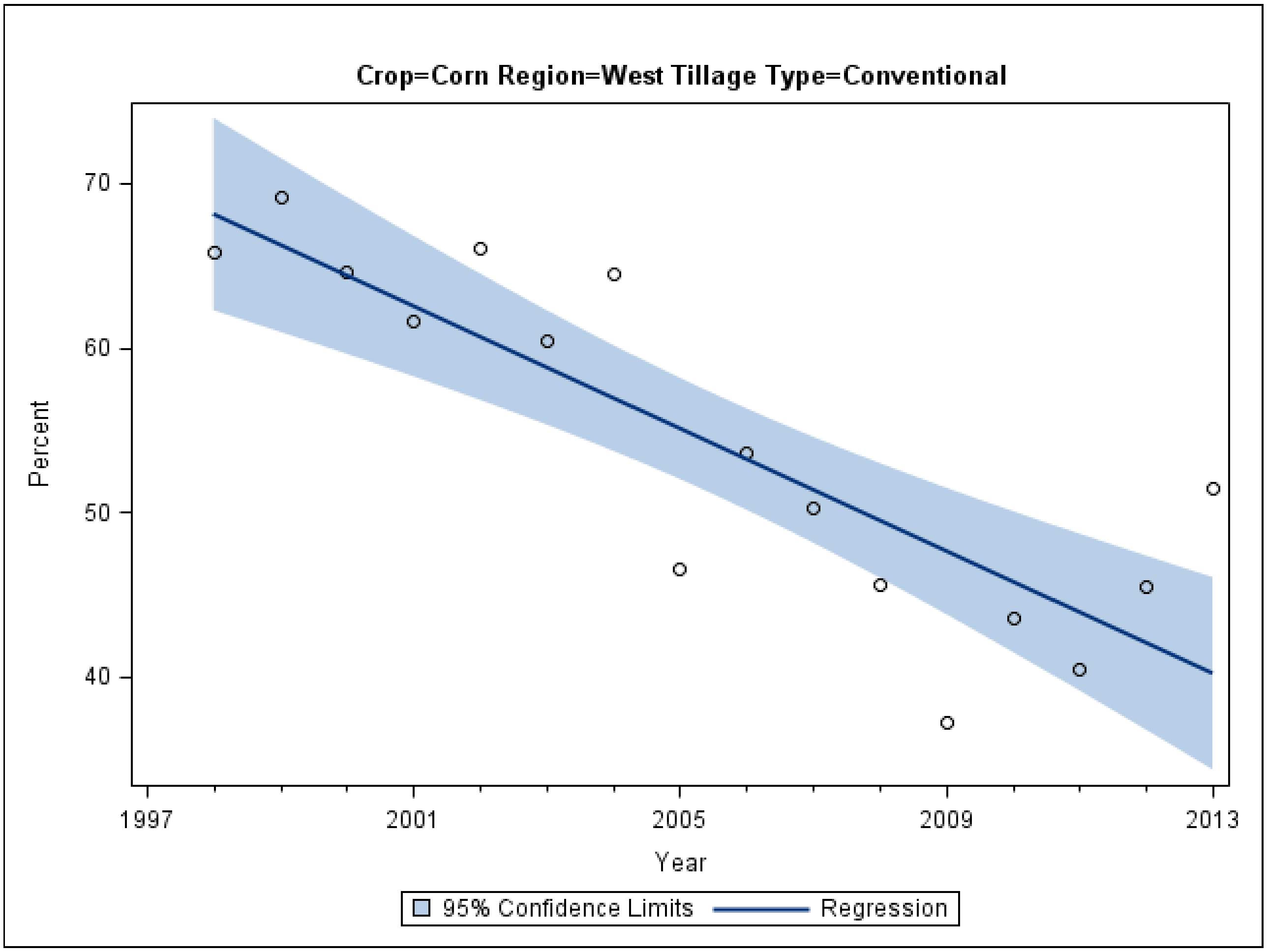
Crop=Cotton Region=MidSouth Tillage Type=No-Till
Percent
40
30
20
10
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

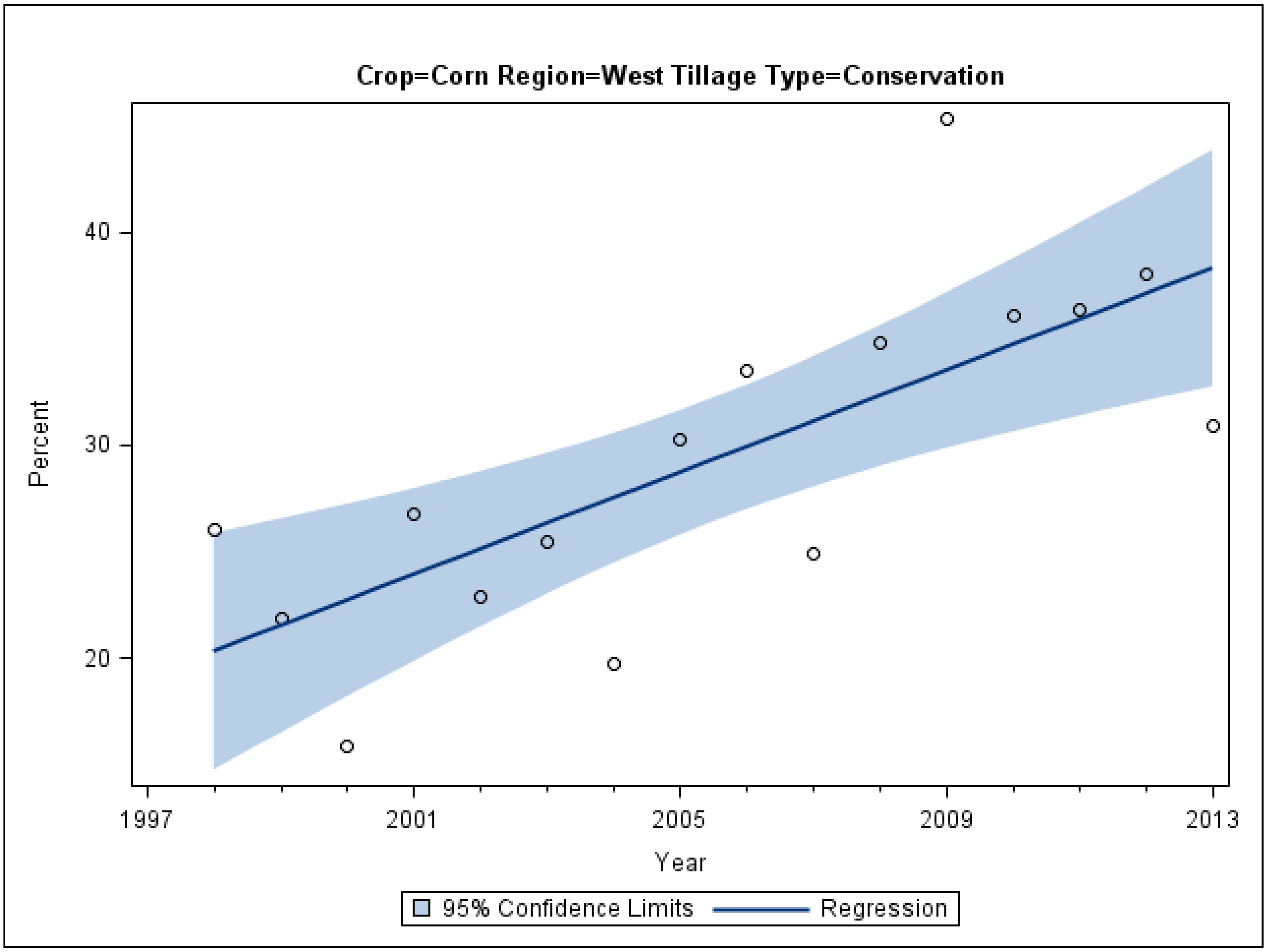

Crop=Cotton Region=MidSouth Tillage Type=Conventional
80
60
40
20
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression



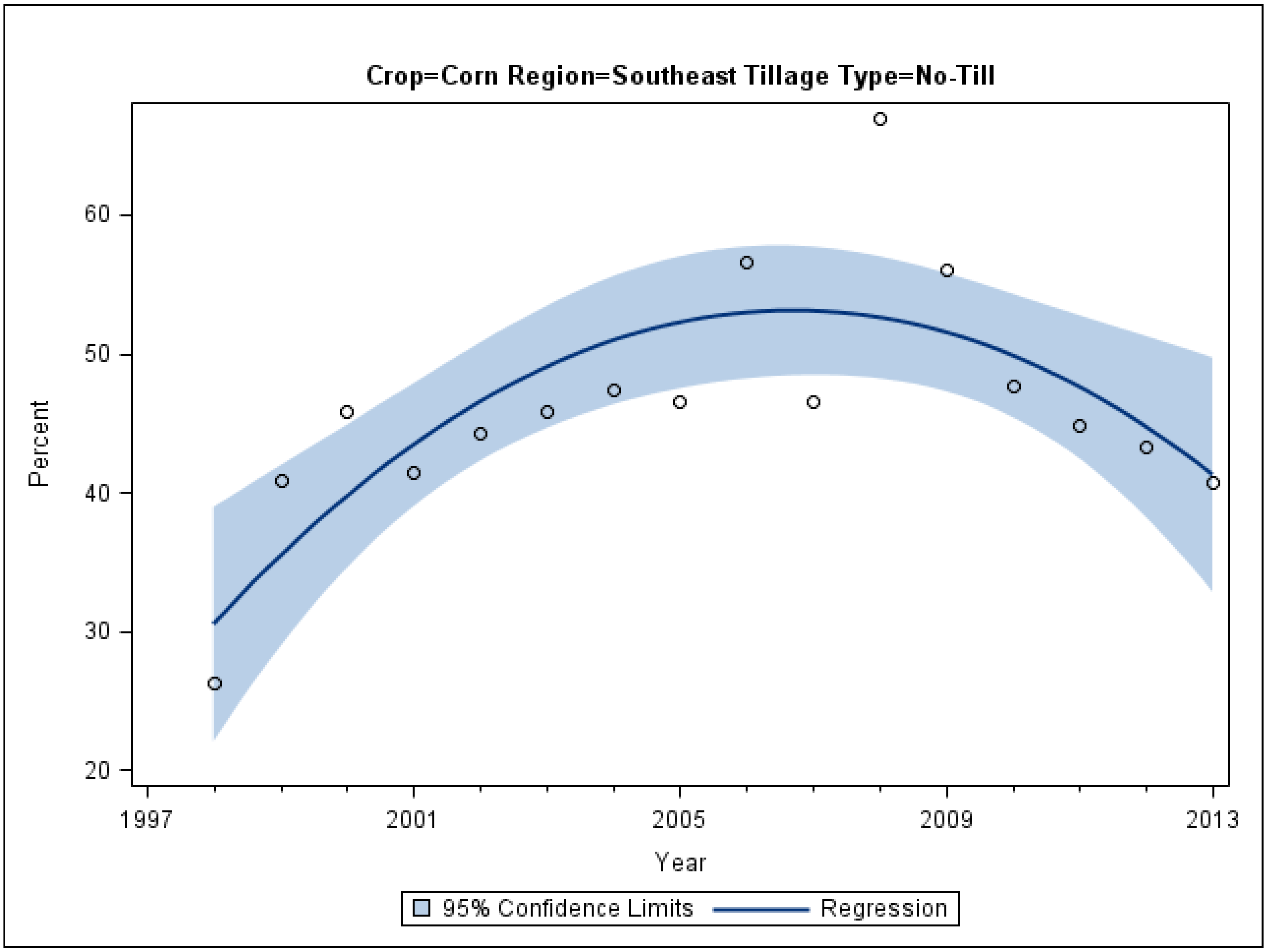
Crop=Cotton Region=MidSouth Tillage Type=Conservation
40
30
20
10
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

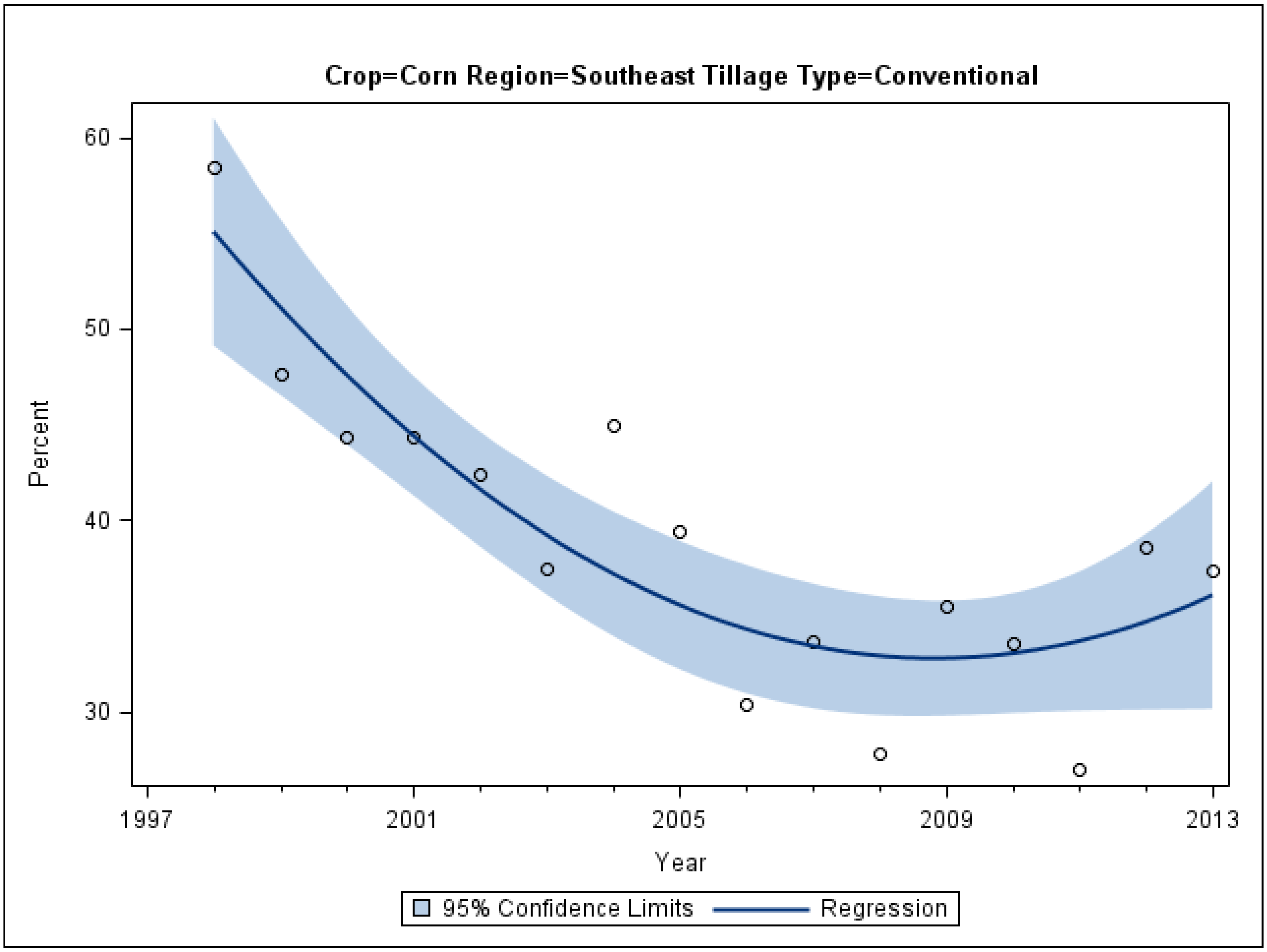

Crop=Corn Region=West Tillage Type=No-Till
Percent
25
20
15
10
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

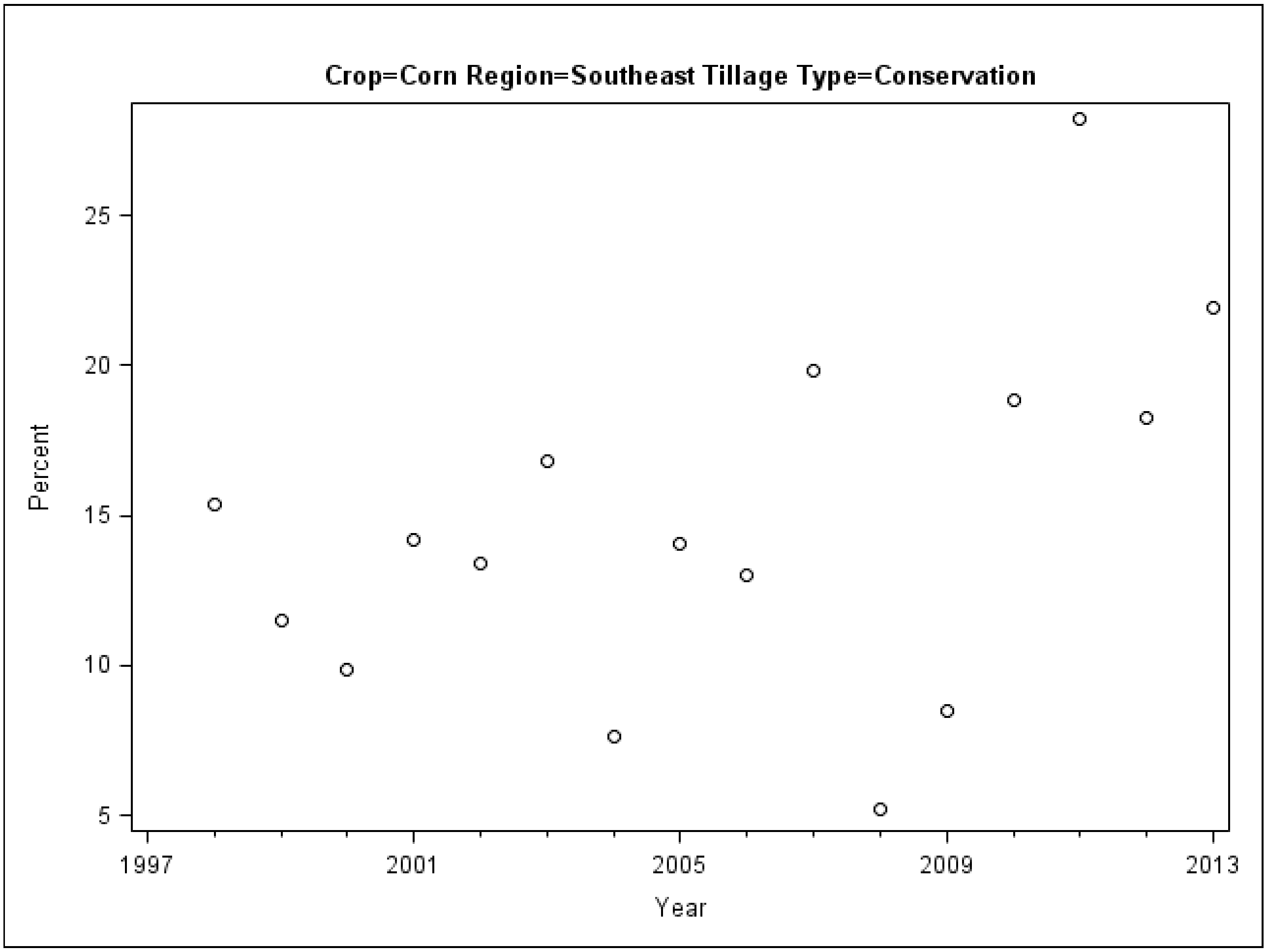

Crop=Corn Region=West Tillage Type=Conventional
Percent
70
60
50
40
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

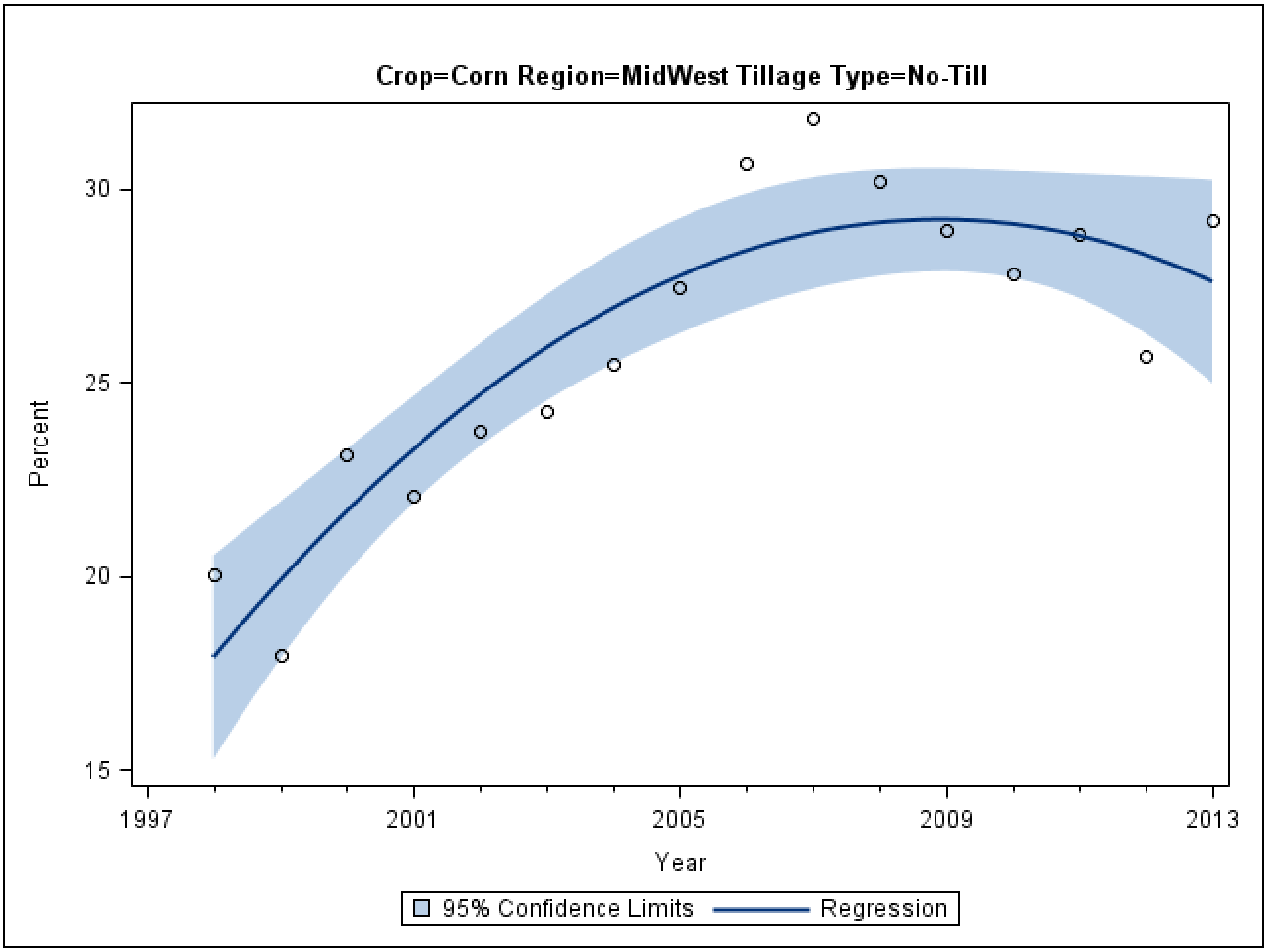


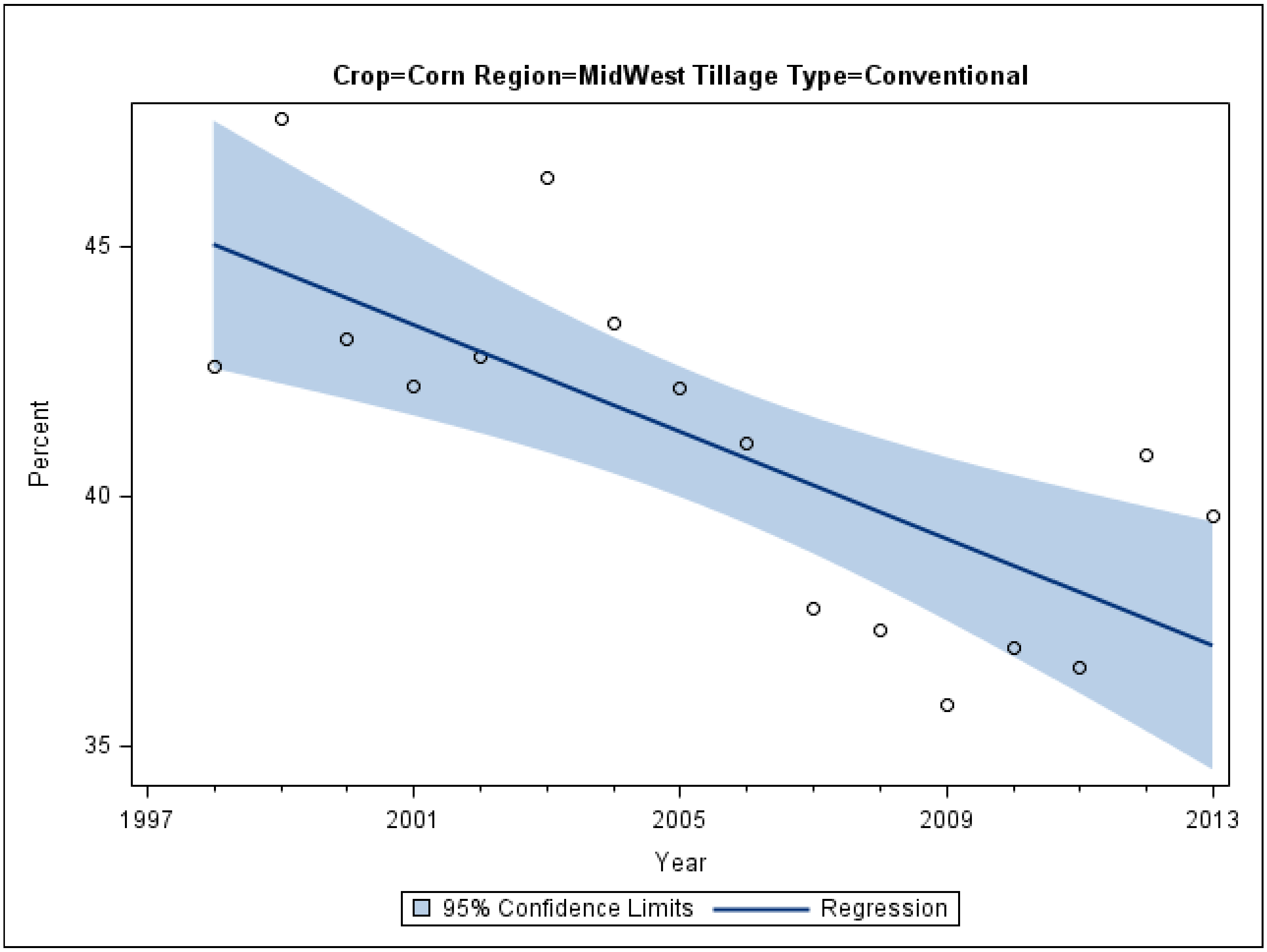
Crop=Corn Region=West Tillage Type=Conservation
Percent
40
30
20
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

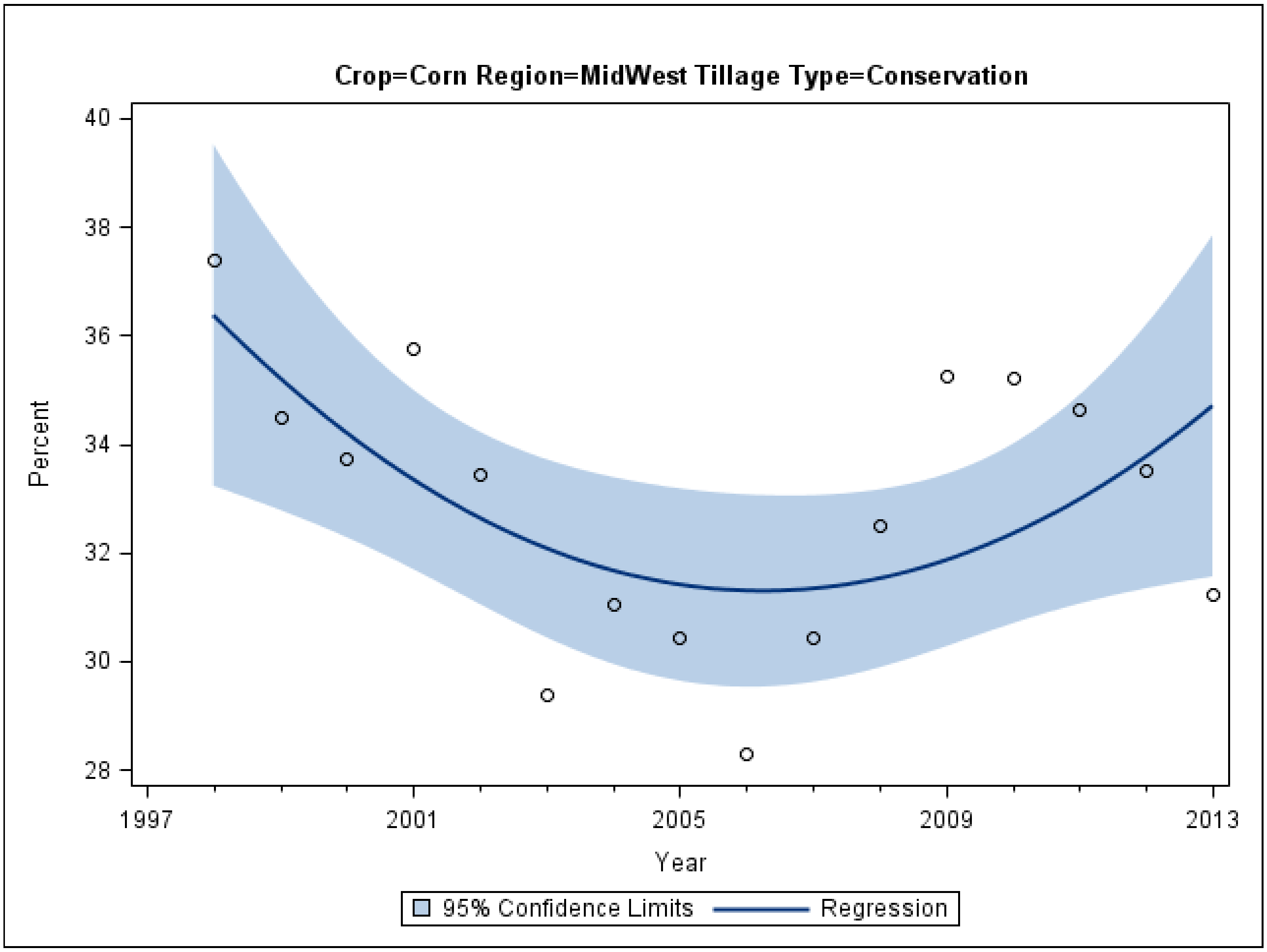

Crop=Corn Region=Southeast Tillage Type=No-Till
Percent
60
50
40
30
20
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

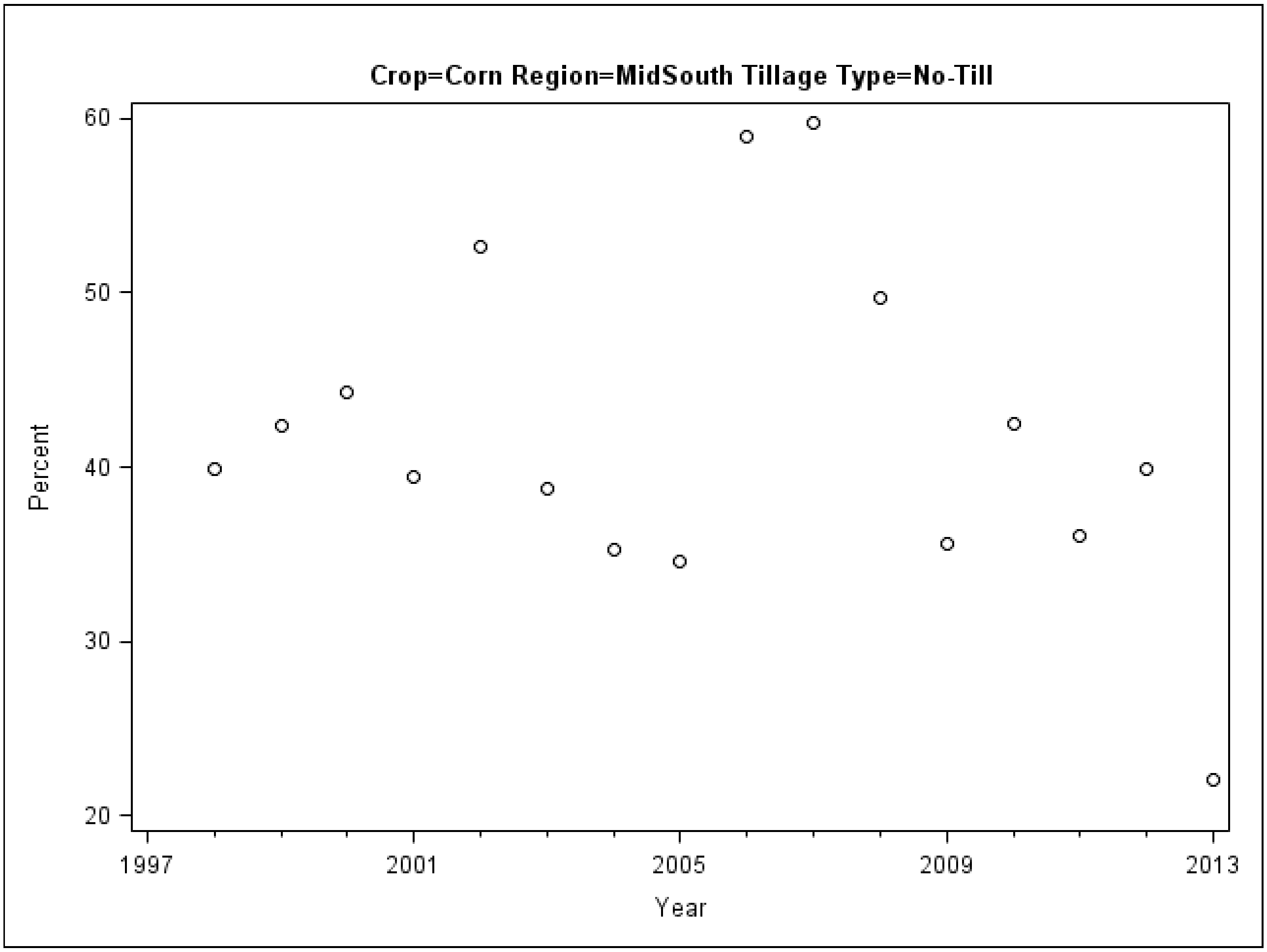

Crop=Corn Region=Southeast Tillage Type=Conventional
60
50
40
30
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Corn Region=Southeast Tillage Type=Conservation
Percent
25
20
15
10
5
1997
2001
2005
2009
2013
Year

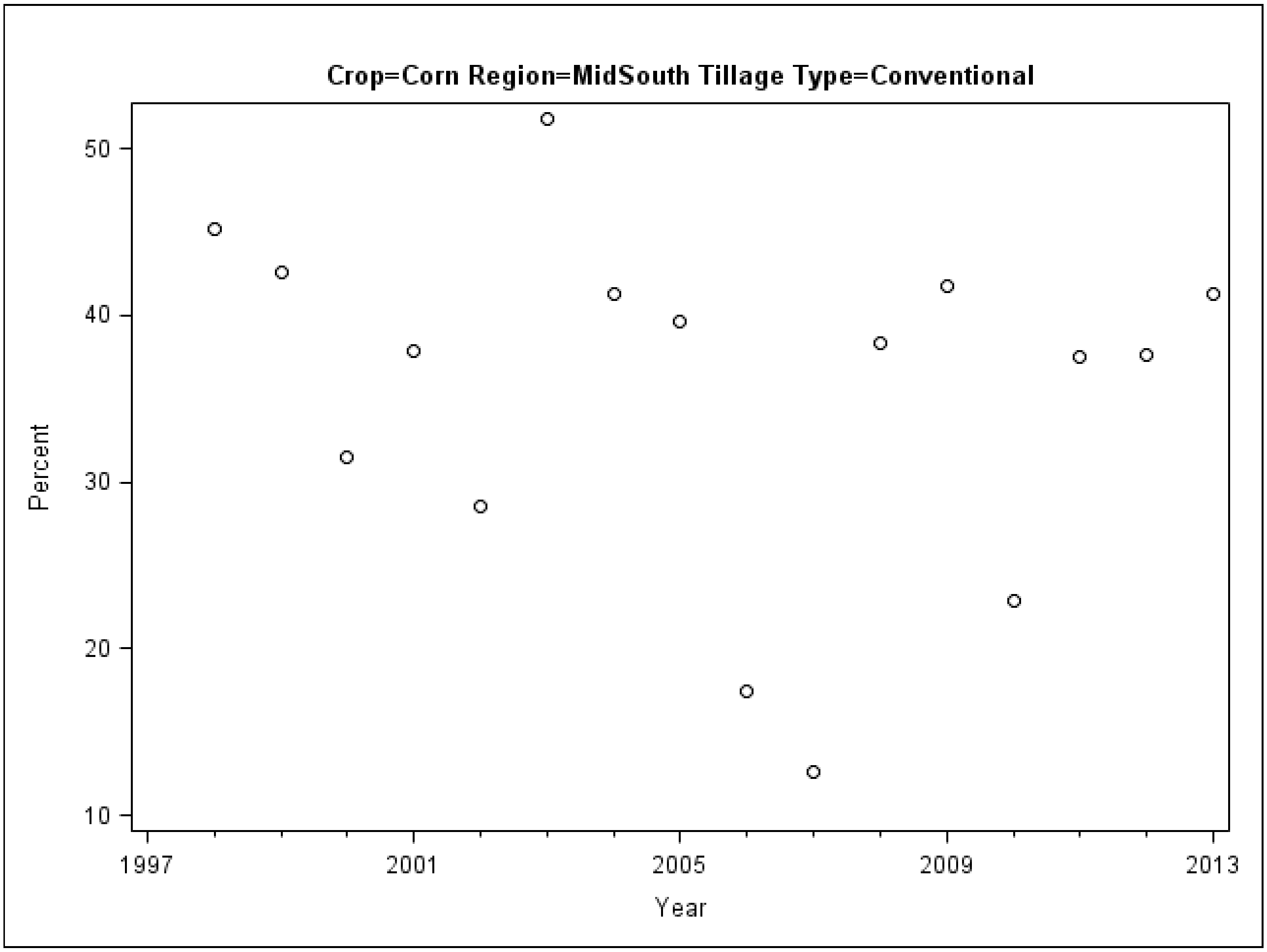

Crop=Corn Region=MidWest Tillage Type=No-Till
30
25
20
15
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

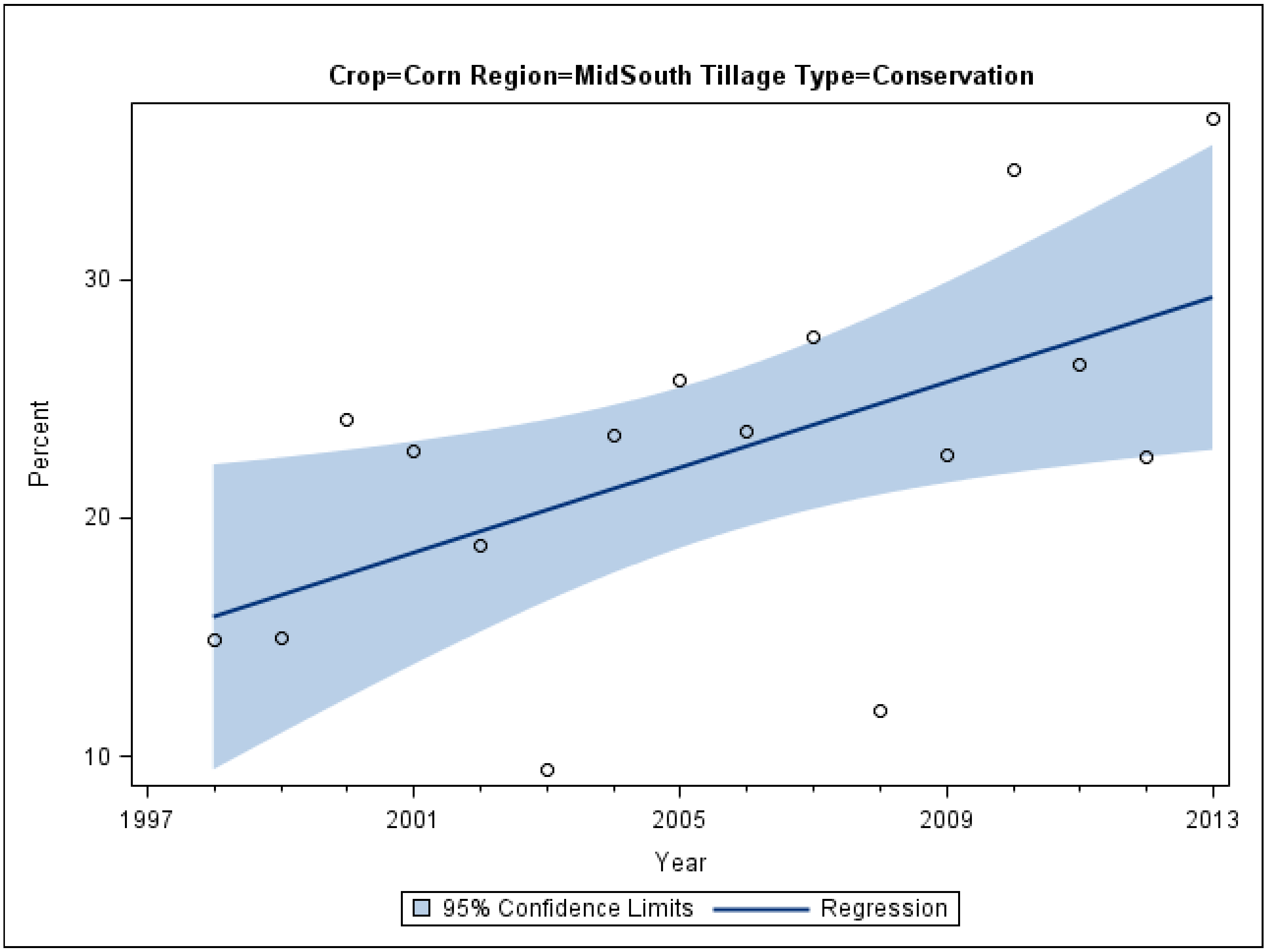

Crop=Corn Region=MidWest Tillage Type=Conventional
Percent
45
40
35
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Corn Region=MidWest Tillage Type=Conservation
40
38
36
34
32
30
28
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression

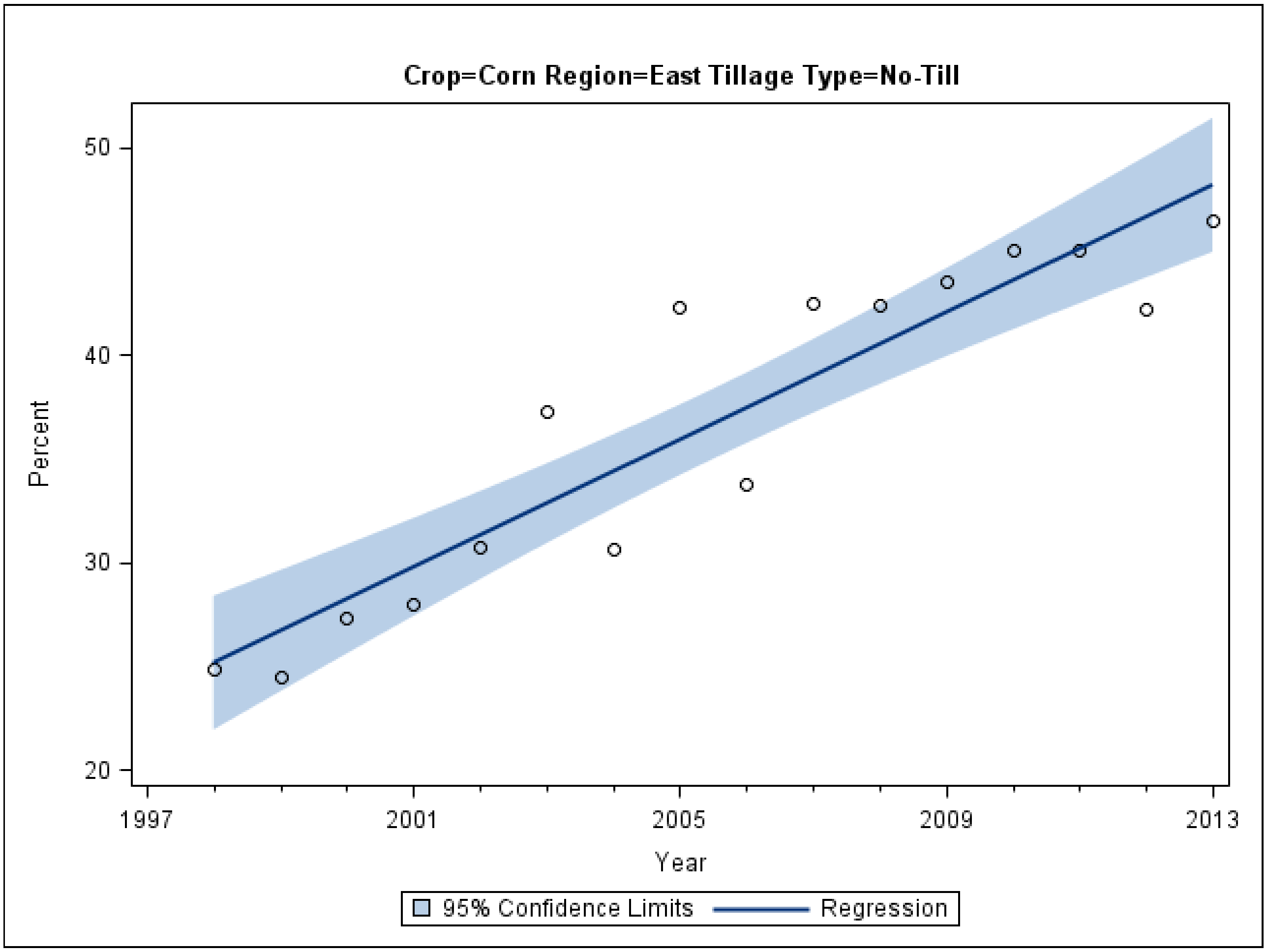


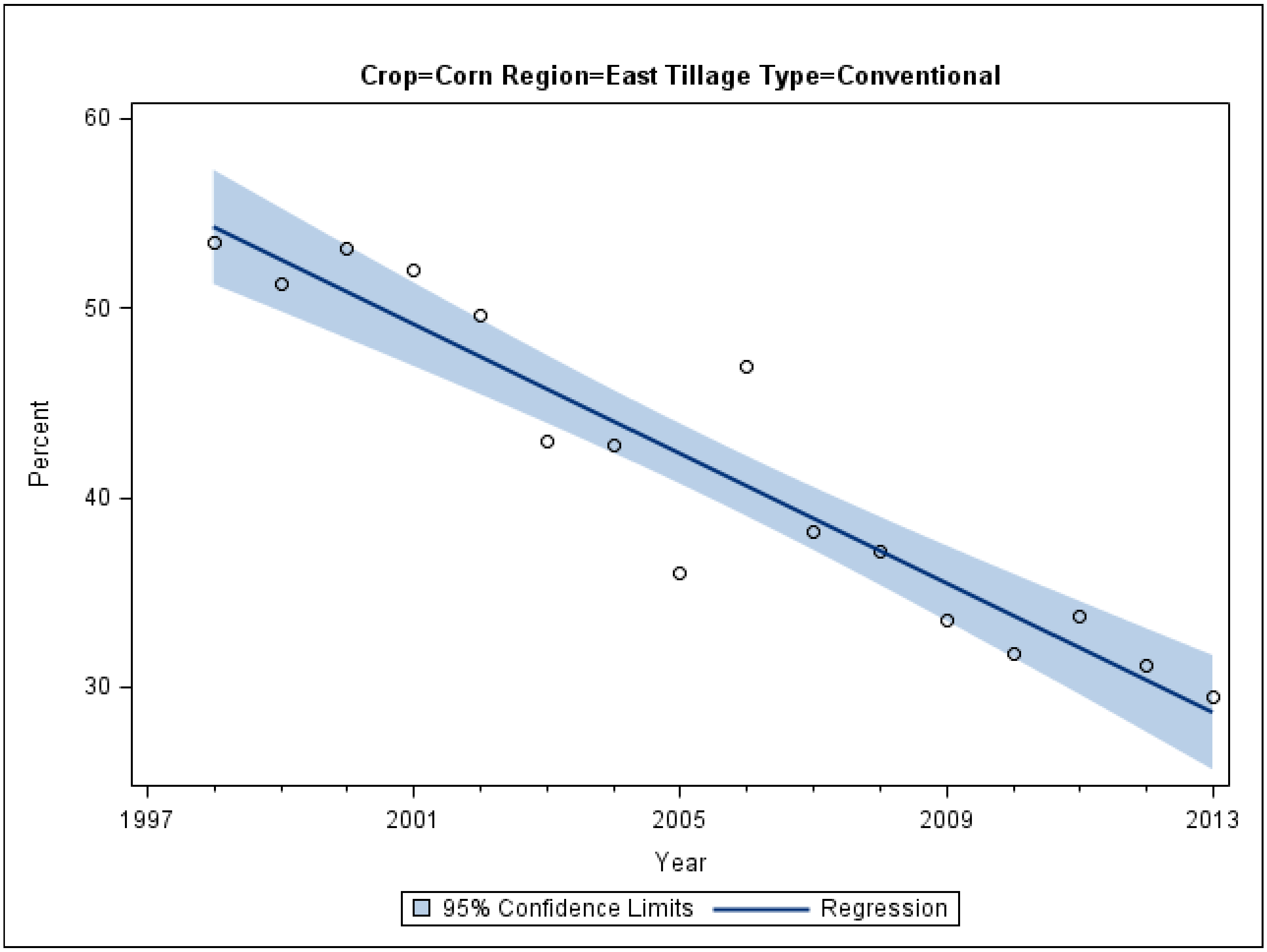
Crop=Corn Region=MidSouth Tillage Type=No-Till
60
50
40
30
20
Percent
1997
2001
2005
2009
2013
Year

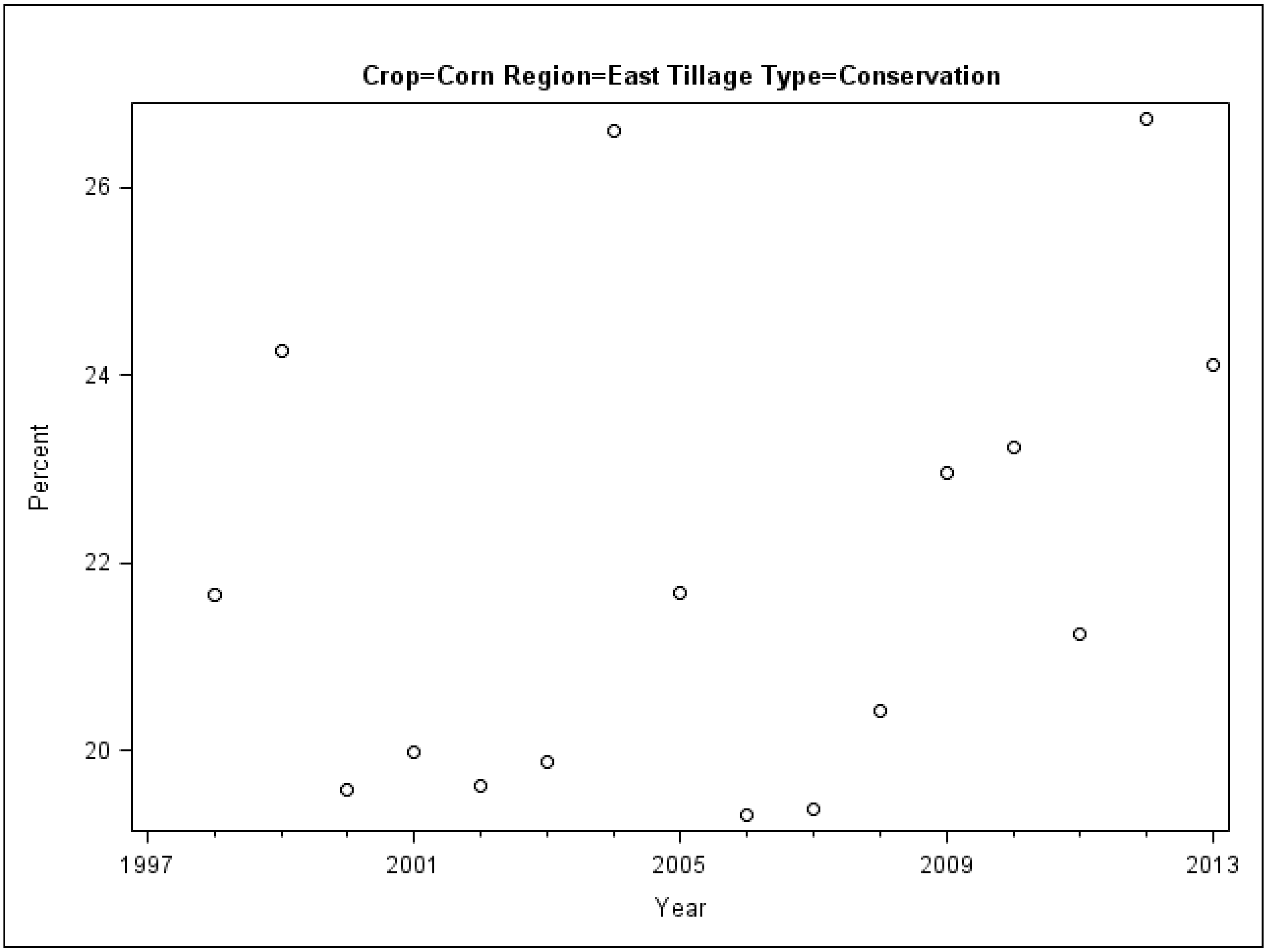

Crop=Corn Region=MidSouth Tillage Type=Conventional
Percent
50
40
30
20
10
1997
2001
2005
2009
2013
Year



Crop=Corn Region=MidSouth Tillage Type=Conservation
Percent
30
20
10
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Corn Region=East Tillage Type=No-Till
50
40
30
20
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression


Crop=Corn Region=East Tillage Type=Conventional
60
50
40
30
Percent
1997
2001
2005
2009
2013
Year
95% Confidence Limits
Regression



Crop=Corn Region=East Tillage Type=Conservation
Percent
26
24
22
20
1997
2001
2005
2009
2013
Year

Appendix B: CTIC Survey Results of Leading Conservation Tillage Experts

The following pages summarize the results of the CTIC (Conservation Tillage Information Center) survey of 21 total (14 in Midwest and 7 in South) leading conservation tillage experts across the key agronomic regions of the U.S. for soybean, corn and cotton production. These experts were asked to rate the importance of 11 factors that could influence tillage practices of growers in their region. Responses the the question below are summarized on the following pages.

Question: In general, how important are the following factors to the majority of the farmers in your region as they determine the total amount of tillage done to produce corn, regardless of whether the tillage is done prior to planting or done during the growing season? Choose the rating below that best reflects the importance of each factor in determining the amount of tillage being used.

Table B-1. Midwest Corn (14 total Experts)

	Number of Experts Responding										
	Manage excess crop residue	**Manage existing weeds**	**Manage disease**	**Manage soil moisture**	**Manage soil temperature**	**Prevent weed resistance**	**Seed bed preparation**	**Use of strip till / vertical tillage tools**	**Economics**	**Availability of labor**	**Water penetration**
Not important / Not mentioned	4	6	4	4	4	8	4	6	6	8	6
Sometimes important	4	3	5	3	3	2	2	3	1	2	4
Quite important	2	2	4	5	5	2	3	2		3	2
Extremely important	4	3	1	2	2	2	5	3	7	1	2
Ranking Sum[1]	34	30	30	33	33	26	37	30	36	25	28

[1]Ranking Sum was calculated as follows, a number from 1 to 4 was assigned to each response category, with 1 assigned to 'not important or not mentioned' and 4 assigned to 'extremely important'. The assigned number was multiplied by the number of responses from the experts and then added together for each factor.

Table B-2. Midwest Soybean (13 total Experts)

	Number of Experts Responding										
	Manage excess crop residue	**Manage existing weeds**	**Manage disease**	**Manage soil moisture**	**Manage soil temperature**	**Prevent weed resistance**	**Seed bed preparation**	**Use of strip till / vertical tillage tools**	**Economics**	**Availability of labor**	**Water penetration**
Not important / Not mentioned	6	4	7	3	5	6	4	10	4	2	4
Sometimes important	0	4	2	6	4	3	2	1	3	6	5
Quite important	1	2	2	2	1	2	3	0	2	3	2
Extremely important	6	3	2	2	3	2	4	2	4	1	1
Ranking Sum[1]	33	30	25	29	28	26	33	20	32	27	24

[1]Ranking Sum was calculated as follows, a number from 1 to 4 was assigned to each response category, with 1 assigned to ‘not important or not mentioned’ and 4 assigned to ‘extremely important’. The assigned number was multiplied by the number of responses from the experts and then added together for each factor.

Table B-3. South Corn (6 total Experts)

	Number of Experts Responding										
	Manage excess crop residue	Manage existing weeds	Manage disease	Manage soil moisture	Manage soil temperature	Prevent weed resistance	Seed bed preparation	Use of strip till / vertical tillage tools	Economics	Availability of labor	Water penetration
Not important / Not mentioned	2	2	3		1	2		2		1	2
Sometimes important	1	1	2	4	5	2	1	2	1	3	1
Quite important	3	1	1	2		1	4	2	2	1	1
Extremely important		1				1	1		3	1	2
Ranking Sum[1]	13	11	10	14	11	13	18	12	20	14	15

[1]Ranking Sum was calculated as follows, a number from 1 to 4 was assigned to each response category, with 1 assigned to 'not important or not mentioned' and 4 assigned to 'extremely important'. The assigned number was multiplied by the number of responses from the experts and then added together for each factor.

Table B-4. South- Soybean (6 total Experts)

	Number of Experts Responding										
	Manage excess crop residue	**Manage existing weeds**	**Manage disease**	**Manage soil moisture**	**Manage soil temperature**	**Prevent weed resistance**	**Seed bed preparation**	**Use of strip till / vertical tillage tools**	**Economics**	**Availability of labor**	**Water penetration**
Not important / Not mentioned	3		4		2			1		1	1
Sometimes important	2	2	1	3	4	1	2	3	1	2	3
Quite important	1	3	1	2		4	3	2	3	1	1
Extremely important		1		1		1	1		2	1	1
Ranking Sum[1]	10	17	9	16	10	18	17	13	19	12	14

[1]Ranking Sum was calculated as follows, a number from 1 to 4 was assigned to each response category, with 1 assigned to ‘not important or not mentioned’ and 4 assigned to ‘extremely important’. The assigned number was multiplied by the number of responses from the experts and then added together for each factor.

Table B-5. South- Cotton (6 total Experts)

	Number of Experts Responding										
	Manage excess crop residue	**Manage existing weeds**	**Manage disease**	**Manage soil moisture**	**Manage soil temperature**	**Prevent weed resistance**	**Seed bed preparation**	**Use of strip till / vertical tillage tools**	**Economics**	**Availability of labor**	**Water penetration**
Not important / Not mentioned			3		2		1				2
Sometimes important	4	3	2	2	3	4	1	3		2	1
Quite important	1	1	1	3	1	1	3	2	4	3	2
Extremely important	1	2		1		1	1	1	2	1	1
Ranking Sum[1]	15	17	10	17	11	18	16	16	20	17	14

[1]Ranking Sum was calculated as follows, a number from 1 to 4 was assigned to each response category, with 1 assigned to 'not important or not mentioned' and 4 assigned to 'extremely important'. The assigned number was multiplied by the number of responses from the experts and then added together for each factor.

Appendix 10. EPA Resistance Management Requirements for Registration of Dow Agrosciences Enlist Duo™

The following text in this appendix contains excerpts regarding the weed resistance management requirements specified in the U.S. EPA's Proposed Registration of Enlist Duo™ Herbicide. EPA may require similar requirements be added to the proposed registration of Monsanto's dicamba formulation, ExtendiMax.

IV. Resistance Management

The emergence of herbicide resistant weeds is an increasing problem that has become a significant economic issue to growers. This has led to a concern that the use of 2,4-D on GE crops may result in more resistant weeds. In an effort to address this issue going forward, EPA is requiring that DAS develop a stewardship program that will aggressively promote resistance management efforts.

The overall goal of the stewardship plan is to assist and support responsible use of the product. With regard to weed resistance management, the plan mandates that DAS must immediately investigate any claims of non-performance. The initial mechanism users can use for communicating directly with DAS is a toll-free number to get advice on how to resolve any uncontrolled weeds.

Academia, growers, USDA, and other leaders involved with pest management acknowledge the importance of field scouting. For this reason, the Enlist Duo™ label includes a requirement to scout treated fields. Field scouting before application will be essential to determining the weed species present as well as their stage of growth. Scouting 7-21 days after herbicide application will be used to assess the performance of weed control. In the event that a user encounters a non-performance issue, the toll-free number could be used to initiate an intervention against that weed population.

The DAS response to reports of non-performance must be immediate and must ensure that possible incidents of resistance are promptly investigated and resolved. EPA proposes that when a non-performance issue is identified , DAS or its representative will conduct a site visit and evaluate the issue using decision criteria identified by leading weed science experts (Norsworthy, et al.), in order to determine if "likely herbicide resistance" is present. This is distinct from, and more broad than, the term "likely herbicide resistance," as explained below. For purposes of this decision, a report of non-performance to DAS will be the trigger for a site visit.

Non-performance refers to any cause that results in inadequate weed control after an herbicide application. "Lack of herbicide efficacy" refers to inadequate weed control with various possible causes, including but not limited to: application rate, stage of growth, environmental conditions, herbicide resistance, plugged nozzle, boom shut off, tank dilution, post-application weed flush, unexpected rainfall event, weed misidentification, etc. EPA recognizes that it can be challenging to determine emerging weed resistance at an early stage. Therefore, EPA is selecting criteria that it feels will be helpful to DAS and to users in identifying when instances of "lack of herbicide efficacy" in fact constitute "likely herbicide resistance." These "likely herbicide resistance" criteria are: (1) failure to control a weed species normally controlled by the herbicide at the dose applied, especially if control is achieved on adjacent weeds; (2) a spreading patch of uncontrolled plants of a particular weed species; and (3) surviving plants mixed with controlled individuals of the same species (Norsworthy, et al., 2012).

When DAS or its representative applies the Norsworthy, et al., criteria cited above and likely herbicide resistance is identified, then DAS must take immediate action to eradicate likely resistant weeds in the infested area. This may be accomplished by re-treating with an herbicide or using mechanical control methods. If herbicide re-treatment is used to eliminate the likely resistant weed(s), follow-up scouting will be required to confirm that the lack of herbicide efficacy has been resolved. DAS must also notify EPA that likely herbicide resistance has been identified and report this on a monthly basis. In addition, samples of the likely herbicide resistant weeds and/or seeds must be taken, and prior to the next growing season laboratory or greenhouse testing must be initiated in order to determine whether resistance is the reason for the lack of herbicide efficacy. DAS must also work to develop a laboratory diagnostic test to quickly identify herbicide resistance, and report to EPA its progress toward developing such a diagnostic test.

In addition to reporting incidents of likely resistance, on or before October 15 of each year, DAS will submit annual summary reports to EPA. These reports must include a summary of the number of instances of likely and confirmed resistance to Enlist Duo™ by weed species, crop, county and state. They will also summarize the status of laboratory or greenhouse testing for resistance, as well as the status of the development of a laboratory test. The annual reports will also address the disposition of incidents of likely or confirmed resistance reported in previous years.

Users and other stakeholders must be informed of reports of likely and confirmed herbicide resistance to Enlist Duo™, if any. The information will include details of weed species and crop. To accomplish this, EPA expects that DAS will establish a website to facilitate delivery of resistance information.

Several management practices that are designed to help users avoid initial occurrences of weed resistance will appear on the product labeling under the Resistance Management heading of the label. These practices are discussed in Section VII.B.3 of this document.

Refer to Section VII.C below for EPA's delineation of necessary terms of registration to address the issue of weed resistance.

VII. Proposed Registration Decision

B. Labeling Requirements

3. Resistance Management

a. Herbicide Selection:

- Apply full rates of GF-2726 for the most difficult to control weed in the field at the specified time (correct weed size) to minimize weed escapes.
- Rotate the use of this product with non-Group 4 and non-Group 9 herbicides.

- Utilize sequential applications of herbicides with alternative modes of action.
- Avoid using more than two applications of GF-2726 and any other Group 4 or Group 9 herbicide within a single growing season unless mixed with another mode of action herbicide with overlapping weed spectrum.
- Use a broad spectrum soil applied herbicide with other modes of action as a foundation in a weed control program.

b. Crop Selection and Cultural Practices:

- Incorporate additional weed control practices whenever possible, such as mechanical cultivation, crop rotation, and weed-free crop seeds, as part of an integrated weed control program.
- Do not allow weed escapes to produce seeds, roots or tubers.
- Thoroughly clean plant residues from equipment before leaving fields suspected to contain resistant weeds.
- Scout fields before application to ensure herbicides and rates will be appropriate for the weed species and weed sizes present.
- Scout fields between 7 and 21 days after application to detect weed escapes or shifts in weed species.
- If resistance is suspected, treat weed escapes with an alternate mode of action or use nonchemical methods to remove escapes.
- User report any incidence of non-performance of this product against a particular weed species to the DAS representative.

C. Registration Terms

EPA has determined that certain registration terms are needed to ensure that likely weed resistance as discussed in section IV can be adequately addressed. EPA believes that it is important to address likely weed resistance and not wait until confirmation of resistance has been found. EPA is basing the registration terms on a list of criteria, presented in the peer-reviewed publication, Norsworthy, et al., “Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations,” *Weed Science* 2012 Special Issue: 31–62 (Norsworthy criteria).

1. Stewardship Program

EPA has determined that the registration must contain a term that requires DAS to have a stewardship program for Enlist Duo™. DAS has begun developing its program which it states is focused on educating and training retailers, farmers and applicators on the appropriate use of the Enlist™ technology. EPA has determined that the stewardship program must include the following measures (also to be included as terms on the registration) that would minimize the potential for off-target movement and avoid the development of weed resistance.

a. Investigation

EPA has determined that the registration must contain a term that requires DAS or its representative to investigate reports of non-performance as reported by users following required “scouting” (in accordance with labeling requirements). When investigating these reports, DAS or its representative would be required to conduct site visits.

b. Reporting of the Incidence of Likely Herbicide Resistance

EPA has determined that the registration must contain a term that requires DAS to use the Norsworthy criteria for determining likely herbicide resistance and inform EPA if likely resistance has been identified. This information must be submitted to the Agency on a monthly basis.

c. Remediation

EPA has determined that the registration must contain a term that requires DAS to take immediate action to eradicate likely resistant weeds in the infested area as well as requiring DAS to collect material for further testing.

d. Annual Reporting of Herbicide Resistance to EPA

EPA has determined that the registration must contain a term that requires DAS to submit annual summary reports to EPA that include a summary of the number of instances of likely and confirmed weed resistance by weed species, crop, county and state. The annual reports must include summaries of the status of laboratory or greenhouse testing for resistance. The annual reports would also address the disposition of incidents of likely or confirmed resistance reported in previous years. These reports would not replace or supplement adverse effects reporting required under FIFRA 6(a)(2).

e. Reporting of Likely Resistance to other Interested Parties

EPA has determined that the registration must contain a term that requires DAS to inform growers and other stakeholders of likely and confirmed resistance to Enlist Duo™. The information will include details of weed species and crop. EPA understands that DAS already plans to provide this information though a devoted website.

f. Reporting on the development of diagnostic tests

EPA has determined that the registration must contain a term that requires that DAS would inform EPA of DAS’s progress toward diagnostic testing for evaluating resistant weed species.

g. Monitoring the use of Enlist DuoTM on Enlist™ Seed

EPA believes it is important to require DAS to monitor whether Enlist Duo™ is being used on the Enlist™ seed purchased from DAS. EPA has determined that the registration must contain a term that requires DAS to provide EPA with a protocol to survey whether Enlist Duo™ is being used on Enlist™ seed purchased from DAS and not the non-choline 2,4-D products that are not registered for these application windows. EPA expects that a protocol would be agreed upon quickly so that monitoring the use of Enlist Duo™ can begin shortly thereafter.

h. Training and Education

EPA has determined that the registration must contain a term that requires DAS to provide training on the use of Enlist Duo™ when it provides training on the Enlist™ Seed technology. The training would focus on proper use of the technology to avoid off-target movement as well as avoid weed resistance.

2. EPA's Continued Control over the Registration

Because the issue of weed resistance is an extremely important issue to keep under control and can be very fast moving, EPA has determined that the registration must contain terms that ensure that EPA retains control to easily and quickly modify or cancel the registration if necessary.

References:

Jason K. Norsworthy, Sarah M. Ward, David R. Shaw, Rick S. Llewellyn, Robert L. Nichols, Theodore M. Webster, Kevin W. Bradley, George Frisvold, Stephen B. Powles, Nilda R. Burgos, William W. Witt, and Michael Barrett, Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations, *Weed Science* 2012 60 (sp1), 31-62.

Appendix 11. Response to Comments on the DEIS

Table of Contents

Summary

The draft environmental impact statement (DEIS) for petitions for nonregulated status of MON 87708 soybean (Petition 10-188-01p) and MON 88701 cotton (Petition 12-185-01p) was made available for public comment for 45 days from August 11 through September 25, 2014; the comment period was further extended to October 10, 2014. APHIS received 4,693 submissions to the EIS docket (APHIS 2013-0043). Of these comments, 935 opposed and 3,708 supported determinations of nonregulated status for MON 87708 soybean and MON 88701 cotton.

Some of the submissions in support or opposition were petitions with signatures, letters with multiple signatures, or batches of nearly identical form letters. (For each comment, the docket comment number is listed in parentheses (i.e., APHIS-2013-0043-XXXX)).

The form letters or signatures submitted included:

- Friends of the Earth (APHIS-2013-0043-4704): 32,551 form letters and unique comments opposing deregulation, submitted to the docket in 66 file attachments (note: the set of comments was posted twice to the docket);
- Center for Food Safety: petition with 26,707 signatures opposing deregulation (APHIS-2013-0043-4707); and
- Monsanto: submitted 2,731 individually signed form letters. Most letters were individually submitted to the docket (i.e., each of these has a unique docket comment number), while some were submitted grouped together in batches as part of one docket comment.

Organizations that submitted comments opposing the MON 87708 soybean and MON 88701 cotton petitions included:

- California Certified Organic Farmers (APHIS-2013-0043-4722);
- Center for Food Safety (APHIS-2013-0043-4702, -4706, -4709, -4713);
- Food & Water Watch (APHIS-2013-0043-3345);
- National Family Farm Coalition (APHIS-2013-0043-4757);
- Pesticide Action Network (APHIS-2013-0043-4360);
- Pollinator Partnership (APHIS-2013-0043-4719);
- Pollinator Stewardship Council (APHIS-2013-0043-4718); and
- Save Our Crops Coalition.

The following states submitted letters in support of the MON 87708 soybean and MON 88701 cotton petitions:

- Alabama (APHIS-2013-0043-3255);
- Illinois (APHIS-2013-0043-3216);
- Iowa (APHIS-2013-0043-3041);

- Maryland (APHIS-2013-0043-4564);
- Michigan (APHIS-2013-0043-3172);
- Nebraska (APHIS-2013-0043-2169); and
- Pennsylvania (APHIS-2013-0043-3273).

Trade and agribusiness groups that submitted letters in support of the MON 87708 soybean and MON 88701 cotton petitions included:

- Agribusiness Association of Iowa (APHIS-2013-0043-4720)
- Agricultural Council of Arkansas (APHIS-2013-0043-1482)
- Agricultural Alliance of North Carolina (APHIS-2013-0043-0058)
- Alabama Agribusiness Council (APHIS-2013-0043-0983)
- American Seed Trade Association (APHIS-2013-0043-3224)
- American Soybean Association (APHIS-2013-0043-2928)
- Arizona Cotton Growers Association (APHIS-2013-0043-2877)
- Biotechnology Industry Organization (APHIS-2013-0043-4764)
- Corn Producers Association of Texas (APHIS-2013-0043-3039)
- CropLife America (APHIS-2013-0043-4726)
- Delaware-Maryland Agribusiness Association (APHIS-2013-0043-0666)
- Delta Council (APHIS-2013-0043-3252)
- Georgia Agribusiness Council (APHIS-2013-0043-0781)
- Georgia Cotton Commission (APHIS-2013-0043-1628)
- Indiana Corn Growers Association (APHIS-2013-0043-3343)
- Indiana Soybean Alliance (APHIS-2013-0043-3344)
- Illinois Biotechnology Industry Organization (APHIS-2013-0043-0851)
- Illinois Fertilizer & Chemical Association (APHIS-2013-0043-3342)
- Illinois Soybean Association (APHIS-2013-0043-3256)
- Iowa Biotechnology Association (APHIS-2013-0043-0680)
- Iowa Corn Growers Association (APHIS-2013-0043-2830)
- Iowa Seed Association (APHIS-2013-0043-2923)
- Iowa Soybean Association (APHIS-2013-0043-2878)
- Kansas Agribusiness Retailers Association (APHIS-2013-0043-0795)
- Louisiana Cotton and Grain Association (APHIS-2013-0043-2675)
- Michigan Agri-Business Association (APHIS-2013-0043-0644)
- Michigan Bean Shippers (APHIS-2013-0043-0645)
- Minnesota Agri-Growth Association (APHIS-2013-0043-2802)
- Missouri Agribusiness Association (APHIS-2013-0043-3114)
- Missouri Soybean Association (APHIS-2013-0043-3215)
- National Association of Wheat Growers (APHIS-2013-0043-4753)

- National Corn Growers Association (APHIS-2013-0043-4763)
- National Cotton Council (APHIS-2013-0043-2963)
- Nebraska Corn Board (APHIS-2013-0043-0900)
- Nebraska Soybean Association (APHIS-2013-0043-3190)
- New York State Agribusiness Association (APHIS-2013-0043-2434)
- North Carolina Cotton Producers Association (APHIS-2013-0043-0619)
- North Carolina Soybean Producers Association (APHIS-2013-0043-1036)
- Northeast Agribusiness and Feed Alliance (APHIS-2013-0043-4552)
- Ohio AgriBusiness Association (APHIS-2013-0043-0896)
- Ohio Corn & Wheat Growers Association (APHIS-2013-0043-2127)
- Ohio Soybean Association (APHIS-2013-0043-3258, 3262)
- PennAg Industries Association (APHIS-2013-0043-1292)
- Plains Cotton Growers (APHIS-2013-0043-4729)
- Rolling Plains Cotton Growers (APHIS-2013-0043-4723)
- Southern Cotton Growers (APHIS-2013-0043-2356)
- South Dakota Corn Growers Association (APHIS-2013-0043-3346)
- South Texas Cotton & Grain Association (APHIS-2013-0043-1921)
- Texas Soybean Association (APHIS-2013-0043-3265)
- U.S. Soybean Export Council (APHIS-2013-0043-2936)
- Wisconsin Business Council (APHIS-2013-0043-3321)

Additionally, a letter was submitted, signed by the following trade and agribusiness groups, in support of the MON 87708 soybean and MON 88701 cotton petitions:

- Agricultural Retailers Association
- American Farm Bureau Federation
- American Seed Trade Association
- American Soybean Association
- American Sugarbeet Growers Association
- Biotechnology Industry Organization
- National Association of Wheat Growers
- National Corn Growers Association
- National Cotton Council

The American Farm Bureau Federation (APHIS-2013-0043-1681) and the following member groups submitted letters in support of the MON 87708 soybean and MON 88701 cotton petitions:

- Alabama Farmers Federation (APHIS-2013-0043-3810)
- Delta Farm Bureau (APHIS-2013-0043-3634)

- Georgia Farm Bureau Federation (APHIS-2013-0043-1885)
- Kansas Farm Bureau (APHIS-2013-0043-2181)
- Louisiana Farm Bureau (APHIS-2013-0043-3300)
- Illinois Farm Bureau (APHIS-2013-0043-1978)
- Iowa Farm Bureau (APHIS-2013-0043-2992)
- Maryland Farm Bureau (APHIS-2013-0043-0665)
- Minnesota Farm Bureau Federation (APHIS-2013-0043-0684)
- Mississippi Farm Bureau Federation (APHIS-2013-0043-0897)
- Missouri Farm Bureau (APHIS-2013-0043-4761)
- Nebraska Farm Bureau (APHIS-2013-0043-3266)
- New York Farm Bureau (APHIS-2013-0043-2030)
- Oklahoma Farm Bureau (APHIS-2013-0043-2115)
- Pennsylvania Farm Bureau (APHIS-2013-0043-3249)
- Tennessee Bureau (APHIS-2013-0043-3347)
- Texas Farm Bureau (APHIS-2013-0043-0167)
- Virginia Farm Bureau (APHIS-2013-0043-4082).

APHIS held a virtual public meeting September 11, 2014, where 16 participants provided verbal comments. APHIS received 11 comments supportive of deregulation, all from farmers, including one from a representative of the American Soybean Association (ASA) and another from the ASA president. Supporters cited the need for additional weed management tools. Among those (five) opposed, one was from a farmer and nutritionist, and four were from NGOs: Save Our Crops Coalition (submitted two), Food and Water Watch, and Pesticide Action Network. Those opposed to deregulation cited herbicide drift potential, persistence of dicamba in the environment, toxicity, herbicide misapplication, and risks to organic crop certifications as concerns.

Comments and Responses

The Response to Comments is organized by sections corresponding to the EIS. We have attempted to compile related comments by issue and correlated to the EIS sections. Verbatim comments have been posted for unique comments. In cases where many similar comments were received, we have selected a representative comment and posted that comment, below. For each comment, the docket comment number assigned from regulations.gov is indicated in parentheses (i.e., APHIS-2013-0043-XXXX). APHIS' response follows the comment.

Purpose and Need for Agency Action

APHIS Authority

1. **Comment (APHIS-2013-0043-4702)**: "APHIS makes two fundamental errors in applying its PPA authority in this action. First, the agency winnows its application of its plant pest risk authority in order to avoid addressing and regulating the proposed crops based on the significant harms they will cause. Second, APHIS refuses to apply the rest of its broad PPA authority, namely its oversight over noxious weed harms."

   Response: First, APHIS disagrees with the commenter's implication that the agency impermissibly interprets its plant pest risk authority in order to avoid regulating harmful crops. Second, the commenter misinterprets the regulatory structure of the PPA. The PPA provides APHIS with the authority to regulate both plant pests and noxious weeds under two distinct mechanisms and procedures. Section 7711 of the PPA covers plant pests and prohibits any unauthorized movement (e.g., importing, exporting, moving interstate, mailing, shipping, and releasing into the environment) of plant pests without regulatory permission under general or specific permits, unless APHIS determines that no permit is necessary. Section 7712 of the PPA covers noxious weeds, plants, plant products, and biological control organisms and provides APHIS with the authority to prohibit or restrict their movement. Section 7712(f)(1) specifically allows APHIS to publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or subject to restrictions on interstate movement.

   Pursuant to these different PPA authorities, APHIS has promulgated specific and distinct regulations for plant pests and noxious weeds. While there are numerous APHIS regulations concerning plant pests, GE organisms that are plant pests, or for which there is reason to believe are plant pests, are specifically regulated by 7 CFR part 340. APHIS' regulation of GE organisms under 7 CFR part 340 derives from Section 7711 of the PPA. APHIS does not regulate noxious weeds under 7 CFR part 340; rather, APHIS regulates noxious weeds under 7 CFR part 360. APHIS' authority to regulate noxious weeds under 7 CFR part 360 derives from section 7112(f) of the PPA. In accordance with those regulations, a party may petition APHIS to designate a plant or plant product as a noxious weed.

   Pursuant to 7 CFR part 340, petitions for nonregulated status for MON 87708 soybean and MON 88701 cotton were submitted to APHIS; the developer of MON 87708 soybean and MON 88701 cotton based the petition on the claim that MON 87708 soybean and

MON 88701 cotton do not pose a plant pest risk. Therefore, APHIS must evaluate MON 87708 soybean and MON 88701 cotton and determine whether they should be granted nonregulated status based on their potential plant pest risk. APHIS conducts a thorough plant pest risk assessment (PPRA) in order to make its determination.

If a petition to list a plant as a noxious weed under Part 360 is received, APHIS will evaluate the plant using the noxious weed regulatory framework set forth in those regulations.

PPA-Plant Pest Authority

2. **Comment (APHIS-2013-0043-4360)**: "In its draft EIS, USDA restricts its decision-making authority on the regulation of GE seeds to answering the question of whether or not a seed poses a plant pest risk. We reject this outdated, circumscribed definition.

   According to the 2000 version of the Plant Protection Act (PPA), USDA has much broader authority to regulate GE crops than it appears willing to admit. Under the noxious weed provision of the PPA, for example, USDA can evaluate and regulate GE seeds according to a broad range of direct and indirect harms, including economic harm to farmers or the public. The spread of dicamba-resistant weeds and dicamba-resistant cotton and soybean in fields intended for other crops is but one example of economic harm resulting from establishment of noxious weeds.

   We are deeply disappointed to observe throughout the draft EIS a great dedication to carefully circumscribing the agency's responsibility to as narrow a realm as possible (consideration of the "plant pest risk"), so as to evade the agency's broader mandate and responsibility to protect and support the public interest and the long-term viability and sustainability of our food and farming system."

   Response: APHIS disagrees with commenter's characterization of the scope of the APHIS regulation of GE organisms under the PPA. In accordance with the Coordinated Framework, APHIS regulates GE organisms under the plant pest authority of the PPA. The noxious weed authority of the PPA is promulgated under a separate regulation (i.e., 7 CFR part 360). Thus, APHIS must respond to the petition for a determination of nonregulated status in accordance with 7 CFR part 340.6.

3. **Comment (APHIS-2013-0043-4702):** "The agency's position flatly conflicts with the Supreme Court's Monsanto v. Geertson Seed Farms decision, in which the Court held APHIS had ample authority under the PPA to impose restrictions to minimize transgenic contamination and weed resistance risks."

   Response: APHIS disagrees with commenter's characterization of the scope of APHIS' authority under the PPA and disagrees that APHIS' interpretation of its conflicts with the Supreme Court's decision in *Geertson*.

Plant Protection Act - Noxious Weed Authority

4. **Comment (APHIS-2013-0043-4713)**: "Appendix G (pp. 22-28) provides a documented discussion of how auxin-resistant crops (Dow's Enlist corn and soybeans) threaten to transform troublesome weeds into noxious ones, and exacerbate the noxious character of weeds – such as those discussed above – whose impacts already merit the designation of noxious. Very similar considerations apply to Monsanto's dicamba-resistant soybeans and cotton. APHIS should expeditiously apply its noxious weed authority under the Plant Protection Act to properly regulate Xtend crops to forestall the noxious weed threats they pose."

   Response: APHIS disagrees with the commenter's characterization of Appendix G. The PPA provides APHIS with the authority to regulate both plant pests and noxious weeds under two distinct mechanisms and procedures. Section 7711 of the PPA covers plant pests and prohibits any unauthorized movement (e.g., importing, exporting, moving interstate, mailing, shipping, and releasing into the environment) of plant pests without regulatory permission under general or specific permits, unless APHIS determines that no permit is necessary. Section 7712 of the PPA covers noxious weeds, plants, plant products, and biological control organisms and provides APHIS with the authority to prohibit or restrict their movement. Section 7712(f)(1) specifically allows APHIS to publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or subject to restrictions on interstate movement.

   Pursuant to these different PPA authorities, APHIS has promulgated specific and distinct regulations for plant pests and noxious weeds. While there are numerous APHIS regulations concerning plant pests, GE organisms that are plant pests, or for which there is reason to believe are plant pests, are specifically regulated by 7 CFR part 340. APHIS' regulation of GE organisms under 7 CFR part 340 derives from Section 7711 of the PPA. APHIS does not regulate noxious weeds under 7 CFR part 340; rather, APHIS regulates noxious weeds under 7 CFR part 360. APHIS' authority to regulate noxious weeds under 7 CFR part 360 derives from section 7112(f) of the PPA. In accordance with those regulations, a party may petition APHIS to designate a plant or plant product as a noxious weed.

   Pursuant to 7 CFR part 340, petitions for nonregulated status for MON 87708 soybean and MON 88701 cotton were submitted to APHIS, and the developer of MON 87708 soybean and MON 88701 cotton based the petition on the claim that MON 87708 soybean and MON 88701 cotton are unlikely to pose a plant pest risk. Therefore, APHIS must evaluate MON 87708 soybean and MON 88701 cotton and determine whether they should be granted nonregulated status based on their potential plant pest risk. APHIS conducts a thorough plant pest risk assessment (PPRA) in order to make its determination.

   If a petition to list a plant as a noxious weed under Part 360 is received, APHIS will evaluate the plant using the noxious weed regulatory framework set forth in those regulations.

5. **Comment (APHIS-2013-0043-4702)**: "APHIS's now-outdated implementing regulations concerning transgenic plants, 7 CFR Part 340, were promulgated pursuant to its previous, narrower Plant Pest Act authority and therefore refer to only plant pest harms. APHIS misleadingly claims that its regulatory authority over GE crops is "limited to those with the potential to be plant pests or to increase plant pest risks." DEIS at 2, but this is contrary to the statute's plain language and completely ignores that the PPA of 2000 significantly expanded APHIS's authority, including over noxious weeds, providing the agency new tools with which to carry out its mandate. The PPA also provides "a much wider and more flexible set of criteria for identifying and regulating noxious weeds."

   Elsewhere APHIS admits that it has authority over noxious weed harms as well as plant pest harms, DEIS at v, (stating PPA grants APHIS authority to "the regulation of plant pests and noxious weeds), but then immediately claims its regulations require that "[APHIS] can only consider plant pest risks," in making a deregulation determination, *id*. The current GE crop regulations do not, however, purport to limit APHIS to addressing only plant pest harms in deregulation determinations; in fact, since 2008 APHIS has proposed revised regulations that "make it clear" that its GE crop regulations implement its broader authority under the PPA, expressly also including its authority to prevent noxious weed harms:

   > "The PPA grants the Secretary authority to regulate . . . noxious weeds
   >
   > . . .In order to best evaluate the risks associated with these GE organisms and regulate them when necessary, APHIS needs to exercise its authorities regarding noxious weeds and biological control organisms, in addition to its authority regarding plant pests.
   >
   > . . .We are proposing to revise the scope of the regulations in § 340.0 to make it clear that decisions regarding which organisms are regulated remain science-based and take both plant pest and noxious weed risks into account."

   The proposed rules' import is their acknowledgement of APHIS's statutory discretion (and its "need[] to exercise" it). APHIS cannot negate its authority simply by delaying updated regulations that "make it clear." The agency's failure to amend its regulations to expressly require compliance with the statute does not allow it to ignore a statutory directive in the meantime. Nor do the Part 340 GE crop regulations anywhere purport to preclude application of APHIS's noxious weed authority. In any event, APHIS's regulations do not, and could not, deny its noxious authority. Statutes are not limited by regulations that do not implement full statutory mandates, and APHIS may not repudiate the authority granted to it. The statutory mandate applies even without up-to-date regulations "making clear" that obligation, and APHIS's failure to consider this important factor in any way was arbitrary, capricious, and contrary to law."

   Response: Revising 7 CFR Part 340 to include noxious weed authority is outside the scope of the EIS. Further, the commenter misinterprets the regulatory structure of the PPA (see response to comment #1).

6. **Comment (APHIS-2013-0043-4702):** "APHIS has elsewhere argued that in order to apply this authority it must be petitioned by an outside party. However, APHIS's authority to prevent noxious weed risks by restricting "any plant" does not depend on inclusion in a list; the listing process is permissive. Nothing in the PPA suggests that the agency is barred from restricting a plant that threatens agronomic and environmental damage if APHIS has not included the plant on a published list. Rather, APHIS has the authority to "prohibit or restrict…any plant" if the agency "determines that the prohibition or restriction is necessary." In fact, APHIS regularly acts to prevent noxious weed risks without regard to listing.

   Regardless, CFS hereby submits these comments and its previous comments simultaneously as a noxious weed petition to APHIS, to apply its noxious weed authority, as part of this process, to the proposed dicamba-resistant crops, as the pathway for multiple herbicide, dicamba-resistant noxious weeds. As the proposed new rules make clear, this should be a holistic, inclusive noxious weed harms-plant pest harms process, not a separate bifurcated process. Accordingly, APHIS must broaden the scope of its analysis to this action, and properly apply all its statutory authority. It cannot claim that it "must" approve the proposed crops, because it lacks plant pest authority due to its overly narrow, contradictory and arbitrary interpretation of that authority (see *infra*). Instead, it now must apply its broader authority over noxious weed harms, which can cover "any plant." APHIS therefore must make this assessment anew, beginning with a new EIS, which meaningfully considers alternatives and analyses impacts it has thus far refused to analyze, and issue a new PPA decision applying its fulsome PPA authority."

   Response: As explained in the response to Comment 1, APHIS regulates plant pests and noxious weeds under two separate and distinct regulatory frameworks. Plant pest risks are evaluated upon receipt of a petition under 7 CFR 340. Noxious weeds are evaluated upon receipt of a petition under 7 CFR 360. For purposes of this FEIS, APHIS received petitions to evaluate the plant pest risks of dicamba-resistant crops under 7 CFR 340. The commenter acknowledges the separate framework by submitting comments to the DEIS as a noxious weed petition. APHIS has accepted the commenter's comments as a noxious weed petition and they will be evaluated separately from this EIS under 7 CFR 360. A letter has been sent to the commenter accepting those comments as a noxious weed petition. These, however, remain outside the scope of this FEIS; they are being evaluated by APHIS under the appropriate regulatory framework.

7. **Comment (APHIS-2013-0043-4702):** "APHIS concedes that Monsanto's Xtend crop systems would foster emergence of weeds with resistance to dicamba, but fails to assess the cumulative impacts of multiple resistance. Additional dicamba resistance would transform already troublesome HR weeds into noxious ones, and exacerbate the noxious character of already noxious weeds such as resistant Palmer amaranth by making them still more recalcitrant to control. Because HR weeds spread, the negative impacts of the Xtend crop system would not be confined to Xtend crop fields, but would rather become widespread. Because these crops will result in, and are the pathways for, these herbicide-resistant noxious weeds, APHIS plainly has the statutory authority to regulate them."

Response: APHIS discusses the likelihood of multiple resistance in the cumulative impacts section and Appendix 6. APHIS acknowledges that multiple resistance may occur and the benefits of dicamba use on MON 88701 cotton and MON 87708 soybean may diminish if weeds become resistant to both glyphosate and dicamba. In that case, the environmental impacts will increase to that expected to occur under the No Action Alternative, namely an increase in aggressive tillage and additional costs associated with weed control. APHIS disagrees with the characterization that dicamba resistance will transform a troublesome HR weed into a noxious one. Under the No Action Alternative, certain herbicide-resistant weeds are now more difficult to control with herbicides and will be less so under the Preferred Alternative. According to the commenter's logic, these troublesome weeds under the Preferred Alternative have become noxious weeds under the No Action Alternative. A more accurate description is that they are less effectively controlled by herbicide under the No Action Alternative, not more noxious, and will require control by non-chemical alternatives.

8. **Comment (APHIS-2013-0043-4702):** The PPA and Part 340 regulations by their plain language provide APHIS with ample discretion to address dicamba-resistant crops' harms as plant pest risks. The PPA's plant pest harm definition includes "any living stage" of organisms that can "directly or indirectly injure, cause damage to, or cause disease in any plant or plant product." The PPA places no restriction on how such damage may occur. CFS has previously explained how Monsanto's dicamba-resistant crops "directly or indirectly injure" and "cause damage to plant[s] and plant product[s]," namely, to conventional and organic corn and soy (in the case of transgenic contamination), and to wild and endangered plants and cultivated crops (in the case of resistant superweeds and the herbicide application integral to the dicamba-resistant crop system). These are significant harms to agriculture, the environment, and the economy, the protection of which is the PPA's overarching purpose. APHIS's "plant pest risk assessment" (PPRA), the only document upon which the agency is unlawfully basing its NEPA decision, turning NEPA into an empty exercise, *see infra*, completely fails to analyze these harms or explain that failure.

   Response: APHIS disagrees with the commenter's suggestion that the agency's actions are unlawful and that the agency fails to analyze plant pest harms noted by the commenter, i.e., transgenic contamination, the impacts of herbicide-resistant weeds, and the environmental impacts of herbicide use. As described in the EIS, impacts from commingling of GE cotton and soybean and non-GE cotton and soybean are not expected to change under any of the alternatives because currently more than 90% of cotton and soybean are transgenic and are likely to remain at this level under any of the alternatives. If some of the currently grown GE soybean and cotton are to be replaced by MON 88701 cotton and MON 87708 soybean, no differences in the amount of commingling would be expected.

   The EIS covers the impacts of herbicide-resistant weeds (Chapter 5 and Appendix 6).

   The alleged harms to wild and threatened species from "resistant superweeds" are not due to the MON 87708 soybean and MON 88701 cotton themselves, but rather attributed to the use of the herbicides on the MON 87708 soybean and MON 88701 cotton. APHIS does not have statutory authority to regulate the use of herbicides. That authority has been given to the EPA under FIFRA. EPA is currently reviewing the use of dicamba on MON 88701 cotton and MON 87708 soybean to determine whether the herbicide would cause any unreasonable environmental risks if it were applied in accordance with its labeling instructions. APHIS defers to the expertise of the EPA. (See EIS Chapter 5 and Appendix 6). Overall, the PPA does not regulate the types of harms the commenter complains of in this comment.

9. **Comment (APHIS-2013-0043-4702):** APHIS's arbitrary interpretation of its plant pest authority is also belied by the agronomic facts of Monsanto's dicamba-resistant crops. Under APHIS's regulations, GE plants are presumed to create plant pest risks—and thus regulated articles under the PPA—until APHIS determines otherwise. The agency retains control over these regulated articles, prescribing how they may be introduced into the environment and forbidding their release or movement in interstate commerce absent explicit approval. APHIS may grant permission to conduct experimental field trials of a regulated article subject to protective restrictions, after receiving sufficient data. Developers who want to commercialize a transgenic plant based on field trial data must petition USDA for deregulation, which APHIS can grant "in whole or in part." In most cases, GE crops are engineered with an *agrobacterium*, a listed plant pest under the Part 340 regulations. The existence of this plant pest in every cell of the plant makes it resistant to herbicides that the crop's manufacturers sell as part of their herbicide-resistant crop system. The use of the plant pest raises the question of how that plant pest will affect the crop, and how the plant pest-engineered crop will affect the environment. Such crops then begin as regulated articles that APHIS must approve before commercial sale.

   Response: APHIS disagrees with the commenter's assertion that GE plants are presumed to create plant pest risks. 7 CFR Part 340 defines regulated articles in part as any organisms which have been altered or produced through genetic engineering, if the donor organism, vector or vector agent belongs to certain taxa and meets the definition of a plant pest. If the organisms do not meet the definition of a plant pest, they are not regulated articles. Some manufacturers may produce organisms through genetic engineering that are not created using plant pest sequences and do not trigger our regulatory authority.

10. **Comment (APHIS-2013-0043-4702):** "As explained *supra*, the PPA requires that APHIS's decision to deregulate or approve such crops for commercial sale be "based on sound science."

    "Sound science" instructs that "plant pest risk" is a flexible construct, as it must be to adapt a 1957 statute, enacted for the primary purpose of controlling pathogenic microbes, to permit regulation of plants—organisms from a different phylogenetic kingdom—and to accommodate profound scientific uncertainties about the impacts of a new technology, genetic engineering. That the regulation is based on a comparative risk standard ("unlikely to pose a greater plant pest risk than" its conventional counterpart), rather than an absolute biological one, illustrates this further. It is plain that APHIS must simply apply the statutory definition, which broadly includes any direct or indirect harm to other plants or plant products. Neither the PPA nor its regulations limit the form or type this "injury, damage, or disease to plants and plant products," DEIS at i, can take.

APHIS's interpretation is also belied by the regulation's data requirements.30 A deregulation petitioner must present a wide array of information, including weediness, impacts on agricultural practices, indirect impacts on agricultural products, and effects on non-target organisms, which encompass these crops' contamination, superweeds, consequent herbicide application, and endangered species impacts, but data that would be superfluous if APHIS needed merely to determine whether the crop poses any plant pest risks, which the agency has limitedly framed as the likelihood of the GE organism "to cause plant disease or damage." DEIS at i.

Moreover, APHIS is internally contradictory in the DEIS, at some places attempting to limit "plant pest risk" to "plant disease or damage." See, e.g., DEIS at i; DEIS at iv (purpose only to protect "plant health"). This is contrary to the plain language of the PPA, which broadly defines "harm" as to "directly or indirectly injure, cause damage to, or cause disease in any plant or plant product." In the DEIS, APHIS also contradicts statements it has made elsewhere. Indeed, APHIS has acknowledged since its first GE crop approval in 1994 (and in many approvals thereafter) that its GE crop review is "considerably broader" than its review of "traditional" plant pests, belying its present arguments:

> "A certification that an organism does not present a plant pest risk means that there is a reasonable certainty that the organism cannot directly or indirectly cause disease, injury, or damage either when grown in the field, or when stored, sold, or processed. This approach is considerably broader than the narrow definition of plant pest risk arising from microbial or animal pathogens, including insect pests. Other traits, such as increased weediness, and harmful effects on beneficial organisms, such as earthworms and bees, are clearly subsumed within what is meant by direct or indirect plant pest risk."

And again:

> "APHIS views this [plant pest] definition very broadly. The definition covers direct or indirect injury, disease, or damage not just to agricultural crops, but also to plants in general, for example, native species, as well as to organisms that may be beneficial to plants, for example, honeybees, rhizobia, etc."

APHIS's application of its plant pest authority here is contrary to this past precedent, as well as sound science. The agency refuses to address the true harms of Monsanto's proposed dicamba-resistant crops, thus failing to consider all important factors. Further, the agency's decision is contrary to the plain language of the PPA, which gives APHIS authority over broadly defined harms, including those of the proposed dicamba-resistant crops."

Response: APHIS disagrees with the commenter's assertion that APHIS's application of its plant pest authority here is contrary to past precedent as well as sound science. APHIS has never considered the harms raised by the commenter to be harms covered under 7 CFR Part 340 (transgenic contamination and impacts from herbicide use, whether direct effects on non-target organisms or selection of herbicide resistant weeds). Furthermore, herbicide use falls under the regulatory oversight of the EPA under FIFRA and the Clean Water Act. Transgenic contamination from deregulated crops is not a regulatory issue under part 340.

Purpose of These Products

11. **Comment (APHIS-2013-0043-4713)**: "APHIS's assessment is filled with internal contradictions. To take just one example, APHIS acknowledges that "[t]he primary purpose of MON 87708 soybean and MON 88701 cotton is to provide growers with an additional in-crop weed management option to manage GR [glyphosate-resistant] broadleaf weeds" (DEIS, p. iii), but then warns that "use of Xtend crops in areas with such glyphosate-resistant weeds is inadvisable" because it would hasten the evolution of weed resistance to dicamba (DEIS, p. 181). APHIS never resolves the contradiction of the "inadvisability" of using Xtend crops for their 'primary purpose.'"

    Response: APIHS disagrees with the commenter's assessment of the EIS. However, APHIS acknowledges its misstatement in this instance and APHIS has clarified the text in the EIS.

Alternatives

12. **Comment (APHIS-2013-0043-4360):** "Rather than offering farmers a sustainable solution to the problem of resistant weeds (such as is available through integrated weed management approaches that do not rely heavily on chemical herbicides), USDA's "preferred alternative" will drive up herbicide use, exacerbate the weed problem, and push many farmers who are already struggling out of business.

    USDA's draft EIS also fails to consider perhaps the most important alternative, one in which dicamba-resistant seeds are not deregulated and in which USDA devotes significant research and extension support to farmers in integrated and organic weed management practices that minimize or eliminate reliance on chemical herbicides, keep tillage to a minimum, and still obtain comparable production levels (measured by unit area production of a range of crops over multiple years) and profit."

    Response: The alternative discussed by this commenter is outside of the regulatory authority of APHIS, and is thus outside the scope of this EIS. Growers, however, are free to choose to use cover cropping, organic methods, complex crop rotations, or any other ingenious methods of non-chemical weed control under any of the alternatives.

13. **Comment (APHIS-2013-0043-4702): "**Section 102(2)(E) of NEPA requires all agencies to "[s]tudy, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4331(2)(E). Regardless of whether

an EA or EIS is prepared, NEPA "requires that alternatives be given full and meaningful consideration."

The DEIS's alternatives analysis is legally deficient. The DEIS purports to have considered four alternatives: (1)the No Action Alternative – deny the petition request for unconditional deregulation; (2) Preferred Alternative – approve the petitions for nonregulated status for both dicamba-resistant cotton and soybean; (3) approve the petition for nonregulated status only for dicamba-resistant cotton; and (4) approve the petition for nonregulated status only for dicamba-resistant soybean. DEIS at 12-23. However, in reality, APHIS has only considered two alternatives: (1) the No Action Alternative, under which APHIS would deny commercialization and introduction of the dicamba-resistant crop system, and (2) the Preferred Alternative, under which APHIS will approve commercialization of Monsanto's dicamba-resistant crop system.

The only alternative to approval that APHIS has actually "evaluated" is that of no action, i.e., denying Monsanto's petitions. Yet even this analysis is defective. In dismissing the no action option, APHIS again states that it is forced to approve Monsanto's dicamba-resistant crops based on its earlier "plant pest risk assessments." *See supra; see* DEIS at 12 ("Following the conclusion of the plant pest risk analysis process, APHIS considered possible alternatives and selected those appropriate for further evaluation in this DEIS."). NEPA requires that the agency must rigorously explore and objectively evaluate all reasonable alternatives, including the no action alternative. Where an agency has statutory authority to address environmental impacts, efforts to limit itself through regulations or otherwise will not allow it to circumvent NEPA compliance.75 Yet, in the DEIS, rather than assessing the impacts of continuing dicamba-resistant cotton and soybean's status as regulated articles, APHIS dismissed the no action alternative "Based on its PPRAs…, APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] will not result in new plant pest risks…." DEIS at 12. Contrary to APHIS's flawed reasoning, APHIS is bound by NEPA to refrain from approving this action—regardless of the agency's findings in any separate, plant pest risk assessment—until the agency has completed the requisite comprehensive environmental analysis of all potentially significant environmental and ecological risks that approval presents.

Under the same flawed reasoning, APHIS listed, but rejected out of hand several reasonable alternatives, including: (1) an alternative that would prohibit the release of dicamba-resistant cotton and soybean entirely; (2) an alternative that would approve the petitions in part; (3) an alternative that would impose isolation distances and/or geographical restrictions on the production of dicamba-resistant cotton and soybean; and (4) an alternative that would require mandatory testing for transgenic contamination. See DEIS at 14-16. *Id*. APHIS rejected these alternatives without "studying, developing, and describing" them, once again stating that the agency's conclusion in the PPRAs precluded the agency from considering any of the alternatives. See DEIS at 14 ("APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] are unlikely to pose a plant pest risk. Therefore, there is no basis in science for prohibiting the release of these varieties…."); *id.* (repeating same language in refusing to consider granting the petitions in part); *id.* at 15 (relying entirely on APHIS's plant pest risk assessments to claim that there is “no basis in science” for imposing isolation distances and/or geographic restrictions on the production of dicamba-resistant cotton and soybean); *id.* ([Because] APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] are not likely to pose new plant pest risks nor increase existing ones…, testing requirements are inconsistent with … the PPA, [part 340 regulations], and … the Coordinated Framework.”).

The illusory nature of APHIS's alternatives analysis is made further by APHIS's failure to mention, let alone consider, several other reasonable alternatives:

- A partial deregulation alternative with mandatory pest management requirements to reduce the development of weed resistance (including resistance to glyphosate, glufosinate, and dicamba, as well as other synthetic auxin herbicides such as 2,4-D), such as the use of agroecological weed control methods instead of herbicides or intensive tillage (e.g. complex rotations, cover cropping. Limited tillage, changes in timing of planting, and other management options) and ways to promote use of such agroecological weed control methods;
- A partial deregulation alternative with mandatory mapping or geographic restrictions on the production of dicamba-resistant crops and the recently approved 2,4-D-resistant crops to prevent or isolate harms to agriculture through the development of cross-resistance between dicamba, 2,4-D and other synthetic auxin herbicides;
- A partial deregulation alternative with mandatory restrictions to prevent or mitigate substantial harms to agriculture through crop injury from herbicide drift to neighboring farms that is a reasonably foreseeable consequence of unrestricted deregulation of dicamba-resistant cotton and soybean; or
- A partial deregulation alternative with mandatory restrictions on the concessive planting of dicamba-resistant crops or the recently-approved 2,4-D-resistant crops on the same plots to reduce weed resistance and address the problems of volunteer dicamba-resistant or 2,4-D-resistant crops.

APHIS's failure to consider these alternatives violates NEPA because the DEIS repeatedly acknowledged, and in fact identified as the main reason for considering the deregulation of dicamba-resistant cotton and soybean, the epidemic of superweeds resistant to glyphosate resulting from the commercialization of GE, glyphosate-resistant (GR) “crop systems.” See DEIS at iii (“The primary purpose of [Monsanto's dicamba-resistant cotton and soybean] is to…manage GR broadleaf weed species.”); 4-5. The DEIS further admitted that the proposed dicamba-resistant cotton and soybean, once deregulated, will be “stacked” with other herbicide-resistance traits—with dicamba-resistant soybean also resistant to the applications of glyphosate, and dicamba-resistant cotton also resistant to the applications of both glyphosate and glufosinate—to create stacked GE soybean and cotton varieties that will be resistant to multiple herbicide modes of action. See, e.g., DEIS at 127. The demonstrated trend of glyphosate-resistant weeds emerging and spreading after the deregulation of glyphosate-resistant GE crop system makes the development of rapid evolution of weeds resistant to the synthetic auxin herbicides (including 2,4-D and dicamba) a “reasonably foreseeable” consequence that must be analyzed in the DEIS, especially since APHIS has recently approved and deregulated another class of synthetic auxin-resistant crop system—Dow's 2,4-D resistant corn and soybean.77 Nonetheless, APHIS failed to consider a deregulation alternative that would impose methods to reduce the development of herbicide-resistant weeds (including weeds resistant to 2,4-D, dicamba, glufosinate, or glyphosate).

Similarly, the DEIS recognized that herbicide drift is a concern under the Preferred Alternative of deregulation of dicamba-resistant crops, which would enable dicamba use for a longer period throughout the growing season. DEIS at 151-52. Nonetheless, APHIS did not consider the imposition of isolation distances, buffer zones, or other limitations that may reduce or eliminate the risk of harm to other crops from the drift of herbicide sprayed on dicamba-resistant cotton and soybean.

APHIS's failure to consider reasonable alternatives is contrary to law and inconsistent with the agency's approach to regulating other GE, herbicide-resistant crops. In the DEIS, APHIS acknowledges that it has the authority to "approve the petition in whole or in part." DEIS at 14 (citing 7 C.F.R. § 340.6(d)(3)(i)). Nonetheless, APHIS claims that the agency's determinations in the PPRAs prohibit the agency from considering approving the petition in part. *Id*. There is no basis in the statute or regulations for this extremely limited interpretation of the agency's authority.

"An agency's consideration of alternatives 'must be more than a pro forma [ ] ritual. Considering environmental costs means seriously considering alternative actions to avoid them.'" The unconditional deregulation of dicamba-resistant cotton and soybean pose significant risks to the quality of the human environment. The potential for APHIS to reduce these significant impacts by adopting one or more of these "rejected" or "never considered" alternatives must be fully analyzed as an alternative. In light of the significant harms the deregulation of dicamba-resistant crops to agriculture, finalizing the current draft without fully analyzing reasonable alternatives would be arbitrary and capricious and contrary to law and required procedure. APHIS should have included analyses fully exploring these alternatives. Specifically, the alternatives considered by APHIS must include a "range of reasonable actions which might meet the goals of the agency by using different approaches which may reduce the environmental impacts of the agency's action."

APHIS's alternatives analysis is fundamentally flawed because it is, like the rest of the DEIS, far too limited in scope. An agency's alternatives analysis should be a function of the purpose and need of the action under review. However, "an agency may not define the objectives of its actions in such unreasonably narrow terms as to make consideration of alternatives a mere formality." But APHIS does exactly that here. On page 1 of the DEIS, when explaining its "purpose and need," APHIS starts by correctly noting its very broad mission "to protect the health and value of American agriculture and natural resources." APHIS also correctly states that it must comply with NEPA and explains that in considering the petitions for deregulating Monsanto's dicamba-resistant crops, the agency found that the proposed deregulation may have significant impacts requiring the preparation of an EIS. DEIS at 7. As the agency recognizes, an EIS provides "[a]gency decisionmakers APHIS with a mechanism for examining the broad and cumulative impacts on the quality of the human environment that may result" from approval of

Monsanto's dicamba-resistant crops. *Id*. As an EIS is action-forcing procedure and analysis, APHIS's language parrots the correct role the agency's NEPA analysis should play: to analyze the potential impacts of a decision before it is made, and to meaningfully consider alternatives before deciding on an action.

Yet, in its actual process, APHIS first severely limits the scope of such review to only what it currently considers to be "plant pest risks" or, stated alternatively other places, whether the GE crop itself is going to become a "plant pest." Then, in two separate non-NEPA documents—neither of which are available for separate public comments—discussing the agency's self-determined subset of risks, APHIS cherry-picks what it does or does not consider to be such a "plant pest" risk (e.g., none of the harms caused by GE crops such as dicamba-resistant cotton and soybean are included). Then, because the agency has not found plant pest risks or risk that the GE crop itself will become a plant pest, APHIS declares itself without authority to disapprove commercial use of the GE crop. *See, e.g.,* DEIS at 9 ("If the Agency determines that a regulated article is unlikely to be a plant pest risk, a GE organism is no longer subject to the regulatory provisions of the PPA or the regulations of 7 CFR part 340."); DEIS at i-ii ("If APHIS concludes that the GE organism does not pose plant pest risk, APHIS must then issue a regulatory decision of non-regulated status…."). That is, according to APHIS, even before a NEPA analysis, it has no option other than full, unmitigated approval.

There are numerous problems with APHIS's approach, as discussed *supra*, but in sum, the limitations APHIS proclaims regarding its authority have no statutory or scientific basis. Rather, under the PPA, APHIS has authority over broadly defined harms, harms that fit the harms that the GE crops proposed here. APHIS admits that it has the ability to partially deregulate GE crops, but wrongly claims that it cannot use that authority here. Contrary to APHIS's overly constricted view, there is no list of factors to which APHIS is limited in determining whether to grant or deny a deregulation petition, or to deregulate "in part." Rather, APHIS may consider any risks encompassed by the statutory definitions of "plant pest" harms and "noxious weed" harms, which are very broad.

The upshot for alternatives purposes is that APHIS cannot meaningful comply with NEPA's alternatives mandates by pretending to consider other options, while simultaneously claiming to have no such options. APHIS therefore violated NEPA when it defined the purpose and need in this DEIS so narrowly as to preclude the agency from meaningfully considering any alternatives to the course of action it selected. APHIS wants the façade of alternatives, not actual alternatives. However, NEPA unequivocally requires that APHIS meaningfully consider reasonable alternatives. In contrast, by declaring that it had no authority to select other alternative, APHIS relegated the NEPA process to a pointless exercise. APHIS's process attempts to turn the NEPA review process into a charade, subverting the requirement that "[e]nvironmental impact statements shall serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made." "NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action." APHIS violates the statute's fundamental goal if it erroneously concludes that it need not or could not take into account what its NEPA analysis reveals.

Finally, in considering alternatives, APHIS impermissibly relies on Monsanto's biased representations of its own products. In so narrowly defining the purported purpose and need to make the proposed approval a foregone conclusion, APHIS ignores that "NEPA requires an agency to 'exercise a degree of skepticism in dealing with self-serving statements from a prime beneficiary of the project and to look at the general goal of the project rather than only those alternatives by which a particular applicant can reach its own specific goals." Monsanto's goal is to commercialize its dicamba-resistant GE crops; thus, commercialization cannot be APHIS's goal as well. In contrast, by law, the agency must consider the "general goals" of its purview and statutory mandate under the PPA: to protect agriculture and the environment from a broadly defined array of harms, including those of GE crops.

In so doing, APHIS must consider alternatives that are reasonable, meaning feasible from a technical, practical, and common sense perspective. As CEQ has instructed:

> "In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out the particular alternative. Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant."

APHIS must therefore consider CFS's proposed reasonable alternatives regarding limiting approval and requiring mandatory measures to protect against transgenic contamination, herbicide-resistant weeds, and herbicide application harms from dicamba-resistant crops.

With regards to the herbicide-resistant weed epidemic, APHIS plainly admits that the entire purpose of Monsanto's dicamba-resistant crops is as the purported "solution" to the crisis of glyphosate-resistant weeds. *See, e.g.*, DEIS at iii. ("[T]he nearly exclusive reliance on glyphosate during the past 20 years has contributed to the selection of glyphosate-resistant weeds."); *id*. ("In cropland where GR weeds are widespread, the benefits of the RoundupReady system are diminishing and weed management has become more costly."); *id*. ("The primary purpose of MON 87708 soybean and MON 88701 cotton is to provide growers with an additional in-crop weed management option to manage GR broadleaf weed species."). In APHIS's view, the superweeds epidemic caused by GE crop systems has necessitated Monsanto's new GE crop system proposal.

However, as the agency has recognized, Monsanto's dicamba-resistant crops will themselves create new weed resistance problems (i.e., a new superweeds epidemic), in the form of dicamba-resistant (and other synthetic auxin-resistant) superweeds. In fact, APHIS correctly identified weed resistance impacts from dicamba-resistant crops as a "potential environmental impact," yet attempts to diminish the impact by describing it as "a cumulative impact" that "would only result if APHIS approves [dicamba-resistant cotton and soybean] and EPA allows registration of the proposed new uses." DEIS at v. Curiously, in the final EIS for Dow's 2,4-D-resistant corn and soybean, prepared by the same APHIS personnel and consultant team and released months prior to the present DEIS, APHIS found the same threat of possible HR weeds associated with the adoption of the 2,4-D-resistant crop to be a "potentially significant environmental impact." APHIS fails to explain how the reasonably foreseeable development of weeds resistant to dicamba, which shares 2,4-D's mode of action as a synthetic auxin herbicide, is less significant than the development of 2,4-D resistant weeds. As explained supra, the effects that must be rigorously analyzed in an EIS include the cumulative impacts of the proposed action. APHIS cannot escape its legal duty to rigorously examine the reasonably foreseeable development of dicamba-resistant weeds by calling it a cumulative impact or by simply deleting the word "significant" from the agency's description.

Thus, given the breadth and significance of the herbicide-resistant weed issue that Dow and APHIS give as the fundamental need and purpose for dicamba-resistant crops, which APHIS believes is significant enough as to warrant an EIS, <u>NEPA requires APHIS to, at a minimum, consider and evaluate a wide range of alternatives capable of addressing the same problem</u>.

An agency may not formulate an action's objectives arbitrarily or to mandate one particular outcome. However, in the DEIS, APHIS does precisely this, again and again claiming the limitations of its current, outdated regulations. The agency's purported scope argument is wrong, see supra, but even if it was correct, APHIS's purpose and need must be guided by the purpose of the statute (i.e., the PPA) under which the agency is taking action, not the agency's own regulations: "[T]he statutory objectives of the project serve as a guide by which to determine the reasonableness of objectives outlined in an EIS."

The fundamental objectives of the PPA are the "protection of the agriculture, environment, and economy of the United States." 7 U.S.C. § 7701(1). Further, as discussed, CFS is submitting its comments also as a noxious weed listing petition, triggering APHIS's broader statutory duties and oversight. In this DEIS, APHIS said nothing about these statutory goals in its purpose and need statement, instead focusing exclusively on its outdated plant pest regulations and declaring that those regulations dictate but one result: unrestricted approval. Unrestricted approval may serve the financial interests of Dow, but "[p]erhaps more importantly [than the need to take private interests into account], an agency should always consider the views of Congress, expressed, to the extent that the agency can determine them, in the agency's statutory authorization to act, as well as in other congressional directives." The Ninth Circuit has recognized "that 'NEPA's legislative history reflects Congress's concern that agencies might attempt to avoid any compliance with NEPA by narrowly construing other statutory directives to create a conflict with NEPA. Section 102(2) of NEPA therefore requires government agencies to comply 'to the fullest extent possible.'"

Finally, it is unlawful for APHIS to refuse to consider reasonable alternatives that the agency believes (rightly or wrongly) fall within another agency's jurisdiction. NEPA regulations require alternatives analyses to "include reasonable alternatives not within the jurisdiction of the lead agency." Thus APHIS's repeated reliance on and deferral to EPA when convenient, discussed infra, is not lawful NEPA compliance. As CFS has explained in great detail in our prior and concurrent comments, there are significant environmental impacts due to the massive herbicide use these proposed new crops will cause. APHIS violated NEPA in failing to analyze them. The agency also violated NEPA in failing to consider alternatives to restrict and prevent such pesticide harms, even if it believes EPA also has such authority. APHIS could for example, as a condition for its action, introduce a regulatory requirement that conditions any approval to EPA similarly reviewing the crops and preventing herbicide drift and harm to non-target species. Courts have 'repeatedly recognized that if the agency fails to consider a viable or reasonable alternative, the [NEPA analysis] is inadequate.'"

Response: APHIS disagrees with the commenter's characterization of the scope of APHIS' authority under the PPA and its interpretation of the scope of the regulations contained at 7 CFR part 340, including when it would be appropriate for the Agency to consider partial deregulation. APHIS disagrees with the comment and with the commenter's characterization of the requirements of NEPA under the circumstances presented here. In this instance, the agency focused on four reasonable alternatives and the reasons for choosing these particular alternatives were given in the Notice of Intent to prepare an EIS. APHIS preliminarily concluded as part of its plant pest risk assessment process that these varieties are unlikely to pose plant pest risks. Therefore, selecting other alternatives would be inconsistent with the scientific evidence before the agency regarding plant pest risk and with the purpose and need of the plant pest provisions of the PPA, and the regulations codified in 7 CFR part 340. Alternatives three and four were initially included because corn and soybean are often grown as rotation crops and the two additional alternatives could compare the potential impacts of approving petitions for one rotation crop without the other. These comparisons were made throughout the DEIS. In the end however, alternatives three and four, along with the No Action alternative, were not considered to be the Preferred Alternatives, as these alternatives were found not to meet the ultimate purpose and need of the agency's action. The purpose and need for the agency's action is consistent with its jurisdiction over plant pests pursuant to its statutory and regulatory authority.

APHIS also disagrees with the comment's assertion that APHIS must consider alternatives that mitigate against risks which the comment refers to as transgenic contamination, development of herbicide resistant weeds and herbicide drift. These enumerated risks are not plant pest risks. Despite arguments to the contrary made by the comment, APHIS does not have statutory or regulatory authority to address the risks enumerated by the comment. Thus, APHIS is not required to analyze alternatives to unconditional deregulation absent any jurisdiction to adopt them.

The fact that the agency was constrained to make the full deregulation alternative its preferred alternative in light of its current regulatory authority for genetically engineered organisms does not render the other alternatives cursory or illusory. The analysis presented for each of the four alternatives provides the agency decisionmaker and the public with as full a picture as practicable of the effects of it determination. The agency believes the analysis of the four alternatives in this document provides the decisionmaker and public with the impacts of each of these alternatives and differences in environmental impacts that would result. Even so, in the end, the analysis contained in this document does not expand the agency's authority or impose a duty to select what some view as the most environmentally friendly result.

Also, APHIS also disagrees with the commenter's assertion that the two PPRAs prepared by APHIS were not "available for separate public comments." Both PPRAs were provided for public review and comment along with the draft EIS. Comments regarding the PPRA can be submitted to the APHIS docket on regulations.gov in the same manner comments are submitted on the petitions, the EIS, or any supporting documents.

14. **Comment (APHIS-2013-0043-4702): "**Section 102(2)(E) of NEPA requires all agencies to "[s]tudy, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4331(2)(E). Regardless of whether an EA or EIS is prepared, NEPA "requires that alternatives be given full and meaningful consideration."

    The DEIS's alternatives analysis is legally deficient. The DEIS purports to have considered four alternatives: (1)the No Action Alternative – deny the petition request for unconditional deregulation; (2) Preferred Alternative – approve the petitions for nonregulated status for both dicamba-resistant cotton and soybean; (3) approve the petition for nonregulated status only for dicamba-resistant cotton; and (4) approve the petition for nonregulated status only for dicamba-resistant soybean. DEIS at 12-23. However, in reality, APHIS has only considered two alternatives: (1) the No Action Alternative, under which APHIS would deny commercialization and introduction of the dicamba-resistant crop system, and (2) the Preferred Alternative, under which APHIS will approve commercialization of Monsanto's dicamba-resistant crop system.

    The only alternative to approval that APHIS has actually "evaluated" is that of no action, i.e., denying Monsanto's petitions. Yet even this analysis is defective. In dismissing the no action option, APHIS again states that it is forced to approve Monsanto's dicamba-resistant crops based on its earlier "plant pest risk assessments." *See supra; see* DEIS at 12 ("Following the conclusion of the plant pest risk analysis process, APHIS considered possible alternatives and selected those appropriate for further evaluation in this DEIS."). NEPA requires that the agency must rigorously explore and objectively evaluate all reasonable alternatives, including the no action alternative. Where an agency has statutory authority to address environmental impacts, efforts to limit itself through regulations or otherwise will not allow it to circumvent NEPA compliance.75 Yet, in the DEIS, rather than assessing the impacts of continuing dicamba-resistant cotton and soybean's status as regulated articles, APHIS dismissed the no action alternative "Based on its PPRAs…, APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] will not result in new plant pest risks…." DEIS at 12. Contrary to APHIS's flawed reasoning, APHIS is bound by NEPA to refrain from approving this action—regardless of the agency's findings in any separate, plant pest risk assessment—until the agency has completed the requisite comprehensive environmental analysis of all potentially significant environmental and ecological risks that approval presents.

Under the same flawed reasoning, APHIS listed, but rejected out of hand several reasonable alternatives, including: (1) an alternative that would prohibit the release of dicamba-resistant cotton and soybean entirely; (2) an alternative that would approve the petitions in part; (3) an alternative that would impose isolation distances and/or geographical restrictions on the production of dicamba-resistant cotton and soybean; and (4) an alternative that would require mandatory testing for transgenic contamination. See DEIS at 14-16. *Id*. APHIS rejected these alternatives without "studying, developing, and describing" them, once again stating that the agency's conclusion in the PPRAs precluded the agency from considering any of the alternatives. See DEIS at 14 ("APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] are unlikely to pose a plant pest risk. Therefore, there is no basis in science for prohibiting the release of these varieties…."); *id.* (repeating same language in refusing to consider granting the petitions in part); *id.* at 15 (relying entirely on APHIS's plant pest risk assessments to claim that there is "no basis in science" for imposing isolation distances and/or geographic restrictions on the production of dicamba-resistant cotton and soybean); *id.* ([Because] APHIS has preliminarily concluded that [dicamba-resistant cotton and soybean] are not likely to pose new plant pest risks nor increase existing ones…, testing requirements are inconsistent with … the PPA, [part 340 regulations], and … the Coordinated Framework.").

The illusory nature of APHIS's alternatives analysis is made further by APHIS's failure to mention, let alone consider, several other reasonable alternatives:

- A partial deregulation alternative with mandatory pest management requirements to reduce the development of weed resistance (including resistance to glyphosate, glufosinate, and dicamba, as well as other synthetic auxin herbicides such as 2,4-D), such as the use of agroecological weed control methods instead of herbicides or intensive tillage (e.g. complex rotations, cover cropping. Limited tillage, changes in timing of planting, and other management options) and ways to promote use of such agroecological weed control methods;
- A partial deregulation alternative with mandatory mapping or geographic restrictions on the production of dicamba-resistant crops and the recently approved 2,4-D-resistant crops to prevent or isolate harms to agriculture through the development of cross-resistance between dicamba, 2,4-D and other synthetic auxin herbicides;
- A partial deregulation alternative with mandatory restrictions to prevent or mitigate substantial harms to agriculture through crop injury from herbicide drift to neighboring farms that is a reasonably foreseeable consequence of unrestricted deregulation of dicamba-resistant cotton and soybean; or
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> crops on the same plots to reduce weed resistance and address the problems of volunteer dicamba-resistant or 2,4-D-resistant crops.

APHIS's failure to consider these alternatives violates NEPA because the DEIS repeatedly acknowledged, and in fact identified as the main reason for considering the deregulation of dicamba-resistant cotton and soybean, the epidemic of superweeds resistant to glyphosate resulting from the commercialization of GE, glyphosate-resistant (GR) "crop systems." See DEIS at iii ("The primary purpose of [Monsanto's dicamba-resistant cotton and soybean] is to…manage GR broadleaf weed species."); 4-5. The DEIS further admitted that the proposed dicamba-resistant cotton and soybean, once deregulated, will be "stacked" with other herbicide-resistance traits—with dicamba-resistant soybean also resistant to the applications of glyphosate, and dicamba-resistant cotton also resistant to the applications of both glyphosate and glufosinate—to create stacked GE soybean and cotton varieties that will be resistant to multiple herbicide modes of action. See, e.g., DEIS at 127. The demonstrated trend of glyphosate-resistant weeds emerging and spreading after the deregulation of glyphosate-resistant GE crop system makes the development of rapid evolution of weeds resistant to the synthetic auxin herbicides (including 2,4-D and dicamba) a "reasonably foreseeable" consequence that must be analyzed in the DEIS, especially since APHIS has recently approved and deregulated another class of synthetic auxin-resistant crop system—Dow's 2,4-D resistant corn and soybean.77 Nonetheless, APHIS failed to consider a deregulation alternative that would impose methods to reduce the development of herbicide-resistant weeds (including weeds resistant to 2,4-D, dicamba, glufosinate, or glyphosate).

Similarly, the DEIS recognized that herbicide drift is a concern under the Preferred Alternative of deregulation of dicamba-resistant crops, which would enable dicamba use for a longer period throughout the growing season. DEIS at 151-52. Nonetheless, APHIS did not consider the imposition of isolation distances, buffer zones, or other limitations that may reduce or eliminate the risk of harm to other crops from the drift of herbicide sprayed on dicamba-resistant cotton and soybean.

APHIS's failure to consider reasonable alternatives is contrary to law and inconsistent with the agency's approach to regulating other GE, herbicide-resistant crops. In the DEIS, APHIS acknowledges that it has the authority to "approve the petition in whole or in part." DEIS at 14 (citing 7 C.F.R. § 340.6(d)(3)(i)). Nonetheless, APHIS claims that the agency's determinations in the PPRAs prohibit the agency from considering approving the petition in part. *Id*. There is no basis in the statute or regulations for this extremely limited interpretation of the agency's authority.

"An agency's consideration of alternatives 'must be more than a pro forma [ ] ritual. Considering environmental costs means seriously considering alternative actions to avoid them.'" The unconditional deregulation of dicamba-resistant cotton and soybean pose significant risks to the quality of the human environment. The potential for APHIS to reduce these significant impacts by adopting one or more of these "rejected" or "never considered" alternatives must be fully analyzed as an alternative. In light of the significant harms the deregulation of dicamba-resistant crops to agriculture, finalizing the current draft without fully analyzing reasonable alternatives would be arbitrary and capricious and contrary to law and required procedure. APHIS should have included analyses fully exploring these alternatives. Specifically, the alternatives considered by APHIS must include a "range of reasonable actions which might meet the goals of the agency by using different approaches which may reduce the environmental impacts of the agency's action."

APHIS's alternatives analysis is fundamentally flawed because it is, like the rest of the DEIS, far too limited in scope. An agency's alternatives analysis should be a function of the purpose and need of the action under review. However, "an agency may not define the objectives of its actions in such unreasonably narrow terms as to make consideration of alternatives a mere formality." But APHIS does exactly that here. On page 1 of the DEIS, when explaining its "purpose and need," APHIS starts by correctly noting its very broad mission "to protect the health and value of American agriculture and natural resources." APHIS also correctly states that it must comply with NEPA and explains that in considering the petitions for deregulating Monsanto's dicamba-resistant crops, the agency found that the proposed deregulation may have significant impacts requiring the preparation of an EIS. DEIS at 7. As the agency recognizes, an EIS provides "[a]gency decisionmakers APHIS with a mechanism for examining the broad and cumulative impacts on the quality of the human environment that may result" from approval of Monsanto's dicamba-resistant crops. *Id*. As an EIS is action-forcing procedure and analysis, APHIS's language parrots the correct role the agency's NEPA analysis should play: to analyze the potential impacts of a decision before it is made, and to meaningfully consider alternatives before deciding on an action.

Yet, in its actual process, APHIS first severely limits the scope of such review to only what it currently considers to be "plant pest risks" or, stated alternatively other places, whether the GE crop itself is going to become a "plant pest." Then, in two separate non-NEPA documents—neither of which are available for separate public comments—discussing the agency's self-determined subset of risks, APHIS cherry-picks what it does or does not consider to be such a "plant pest" risk (e.g., none of the harms caused by GE crops such as dicamba-resistant cotton and soybean are included). Then, because the agency has not found plant pest risks or risk that the GE crop itself will become a plant pest, APHIS declares itself without authority to disapprove commercial use of the GE crop. *See, e.g.,* DEIS at 9 ("If the Agency determines that a regulated article is unlikely to be a plant pest risk, a GE organism is no longer subject to the regulatory provisions of the PPA or the regulations of 7 CFR part 340."); DEIS at i-ii ("If APHIS concludes that the GE organism does not pose plant pest risk, APHIS must then issue a regulatory decision of non-regulated status…."). <u>That is, according to APHIS, even before a NEPA analysis, it has no option other than full, unmitigated approval</u>.

There are numerous problems with APHIS's approach, as discussed *supra*, but in sum, the limitations APHIS proclaims regarding its authority have no statutory or scientific basis. Rather, under the PPA, APHIS has authority over broadly defined harms, harms that fit the harms that the GE crops proposed here. APHIS admits that it has the ability to partially deregulate GE crops, but wrongly claims that it cannot use that authority here. Contrary to APHIS's overly constricted view, there is no list of factors to which

APHIS is limited in determining whether to grant or deny a deregulation petition, or to deregulate "in part." Rather, APHIS may consider any risks encompassed by the statutory definitions of "plant pest" harms and "noxious weed" harms, which are very broad.

The upshot for alternatives purposes is that APHIS cannot meaningful comply with NEPA's alternatives mandates by pretending to consider other options, while simultaneously claiming to have no such options. APHIS therefore violated NEPA when it defined the purpose and need in this DEIS so narrowly as to preclude the agency from meaningfully considering any alternatives to the course of action it selected. APHIS wants the façade of alternatives, not actual alternatives. However, NEPA unequivocally requires that APHIS meaningfully consider reasonable alternatives. In contrast, by declaring that it had no authority to select other alternative, APHIS relegated the NEPA process to a pointless exercise. APHIS's process attempts to turn the NEPA review process into a charade, subverting the requirement that "[e]nvironmental impact statements shall serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made." "NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action." <u>APHIS violates the statute's fundamental goal if it erroneously concludes that it need not or could not take into account what its NEPA analysis reveals</u>.

Finally, in considering alternatives, APHIS impermissibly relies on Monsanto's biased representations of its own products. In so narrowly defining the purported purpose and need to make the proposed approval a foregone conclusion, APHIS ignores that "NEPA requires an agency to 'exercise a degree of skepticism in dealing with self-serving statements from a prime beneficiary of the project and to look at the general goal of the project rather than only those alternatives by which a particular applicant can reach its own specific goals." Monsanto's goal is to commercialize its dicamba-resistant GE crops; thus, commercialization cannot be APHIS's goal as well. In contrast, by law, the agency must consider the "general goals" of its purview and statutory mandate under the PPA: to protect agriculture and the environment from a broadly defined array of harms, including those of GE crops.

In so doing, APHIS must consider alternatives that are reasonable, meaning feasible from a technical, practical, and common sense perspective. As CEQ has instructed:

> "In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out the particular alternative. <u>Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant</u>."

APHIS must therefore consider CFS's proposed reasonable alternatives regarding limiting approval and requiring mandatory measures to protect against transgenic contamination, herbicide-resistant weeds, and herbicide application harms from dicamba-resistant crops.

With regards to the herbicide-resistant weed epidemic, APHIS plainly admits that the entire purpose of Monsanto's dicamba-resistant crops is as the purported "solution" to the crisis of glyphosate-resistant weeds. *See*, *e.g.*, DEIS at iii. ("[T]he nearly exclusive reliance on glyphosate during the past 20 years has contributed to the selection of glyphosate-resistant weeds."); *id*. ("In cropland where GR weeds are widespread, the benefits of the RoundupReady system are diminishing and weed management has become more costly."); *id*. ("The primary purpose of MON 87708 soybean and MON 88701 cotton is to provide growers with an additional in-crop weed management option to manage GR broadleaf weed species."). In APHIS's view, the superweeds epidemic caused by GE crop systems has necessitated Monsanto's new GE crop system proposal.

However, as the agency has recognized, Monsanto's dicamba-resistant crops will themselves create new weed resistance problems (i.e., a new superweeds epidemic), in the form of dicamba-resistant (and other synthetic auxin-resistant) superweeds. In fact, APHIS correctly identified weed resistance impacts from dicamba-resistant crops as a "potential environmental impact," yet attempts to diminish the impact by describing it as "a cumulative impact" that "would only result if APHIS approves [dicamba-resistant cotton and soybean] and EPA allows registration of the proposed new uses." DEIS at v. Curiously, in the final EIS for Dow's 2,4-D-resistant corn and soybean, prepared by the same APHIS personnel and consultant team and released months prior to the present DEIS, APHIS found the same threat of possible HR weeds associated with the adoption of the 2,4-D-resistant crop to be a "potentially significant environmental impact." APHIS fails to explain how the reasonably foreseeable development of weeds resistant to dicamba, which shares 2,4-D's mode of action as a synthetic auxin herbicide, is less significant than the development of 2,4-D resistant weeds. As explained supra, the effects that must be rigorously analyzed in an EIS include the cumulative impacts of the proposed action. APHIS cannot escape its legal duty to rigorously examine the reasonably foreseeable development of dicamba-resistant weeds by calling it a cumulative impact or by simply deleting the word "significant" from the agency's description.

Thus, given the breadth and significance of the herbicide-resistant weed issue that Dow and APHIS give as the fundamental need and purpose for dicamba-resistant crops, which APHIS believes is significant enough as to warrant an EIS, <u>NEPA requires APHIS to, at a minimum, consider and evaluate a wide range of alternatives capable of addressing the same problem</u>.

An agency may not formulate an action's objectives arbitrarily or to mandate one particular outcome. However, in the DEIS, APHIS does precisely this, again and again claiming the limitations of its current, outdated regulations. The agency's purported scope argument is wrong, see supra, but even if it was correct, APHIS's purpose and need must be guided by the purpose of the statute (i.e., the PPA) under which the agency is taking action, not the agency's own regulations: "[T]he statutory objectives of the project serve as a guide by which to determine the reasonableness of objectives outlined in an EIS."

The fundamental objectives of the PPA are the "protection of the agriculture, environment, and economy of the United States." 7 U.S.C. § 7701(1). Further, as discussed, CFS is submitting its comments also as a noxious weed listing petition, triggering APHIS's broader statutory duties and oversight. In this DEIS, APHIS said nothing about these statutory goals in its purpose and need statement, instead focusing exclusively on its outdated plant pest regulations and declaring that those regulations dictate but one result: unrestricted approval. Unrestricted approval may serve the financial interests of Dow, but "[p]erhaps more importantly [than the need to take private interests into account], an agency should always consider the views of Congress, expressed, to the extent that the agency can determine them, in the agency's statutory authorization to act, as well as in other congressional directives." The Ninth Circuit has recognized "that 'NEPA's legislative history reflects Congress's concern that agencies might attempt to avoid any compliance with NEPA by narrowly construing other statutory directives to create a conflict with NEPA. Section 102(2) of NEPA therefore requires government agencies to comply 'to the fullest extent possible.'"

Finally, it is unlawful for APHIS to refuse to consider reasonable alternatives that the agency believes (rightly or wrongly) fall within another agency's jurisdiction. NEPA regulations require alternatives analyses to "include reasonable alternatives not within the jurisdiction of the lead agency." Thus APHIS's repeated reliance on and deferral to EPA when convenient, discussed infra, is not lawful NEPA compliance. As CFS has explained in great detail in our prior and concurrent comments, there are significant environmental impacts due to the massive herbicide use these proposed new crops will cause. APHIS violated NEPA in failing to analyze them. The agency also violated NEPA in failing to consider alternatives to restrict and prevent such pesticide harms, even if it believes EPA also has such authority. APHIS could for example, as a condition for its action, introduce a regulatory requirement that conditions any approval to EPA similarly reviewing the crops and preventing herbicide drift and harm to non-target species. Courts have "repeatedly recognized that if the agency fails to consider a viable or reasonable alternative, the [NEPA analysis] is inadequate.""

Response: APHIS disagrees with the comment and with the commenter's characterization of the requirements of NEPA under the circumstances presented here. In this instance, the agency focused on four reasonable alternatives and the reasons for choosing these particular alternatives were given in the Notice of Intent to prepare an EIS. Alternatives three and four were initially included because corn and soybean are often grown as rotation crops and the two additional alternatives could compare the potential impacts of approving petitions for one rotation crop without the other. These comparisons were made throughout the DEIS. In the end however, alternatives three and four, along with the No Action alternative, were not considered to be the Preferred Alternative, as these alternatives were found not to meet the purpose and need of the agency's action. The purpose and need for the agency's action is consistent with its jurisdiction over plant pests pursuant to its statutory and regulatory authority.

APHIS also disagrees with the comment's assertion that APHIS must consider alternatives that mitigate against risks which the comment refers to as transgenic contamination, development of herbicide resistant weeds and herbicide drift. These enumerated risks are not plant pest risks. Despite arguments to the contrary made by the comment, APHIS does not have statutory or regulatory authority to address the risks enumerated by the comment. APHIS is not required to analyze alternatives to unconditional deregulation absent any jurisdiction to adopt them.

The fact that the agency was constrained to make the full deregulation alternative its preferred alternative in light of its current regulatory authority for genetically engineered organisms does not render the other alternatives cursory or illusory. The analysis presented for each of the four alternatives provides the agency decisionmaker and the public with as full a picture as practicable of the effects of it determination. The agency believes the analysis of the four alternatives in this document provides the decisionmaker and public with the impacts of each of these alternatives and differences in environmental impacts that would result. Even so, in the end, the analysis contained in this document does not expand the agency's authority

Programmatic NEPA Review of Cross-Resistance to Auxin Herbicides

15. **Comment (APHIS-2013-0043-4702):** "APHIS's recent approval of Dow's 2,4-D-resistant corn and soybean will further exacerbate the likelihood of cross-resistance. In addition, Monsanto has obtained a license to deploy Dow's 2,4-D resistance trait in its own corn varieties, which will dramatically increase the acres of corn sprayed with 2,4-D, and Dow is already seeking APHIS's approval to deregulate 2,4-D-resistant cotton. The deregulation determinations of GE crops resistant to synthetic auxin herbicides are "actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter." Indeed, both Monsanto's dicamba-resistant cotton and soybean and Dow's 2,4-D-resistant corn and soybean were introduced to address the problem of glyphosate-resistant weeds. Under NEPA, APHIS should prepare a programmatic EIS to consider the potential significant impacts, especially impacts on the development of herbicide-resistant weeds and increase in herbicide use, in a single programmatic EIS."

    Response: APHIS disagrees that it is necessary to prepare a programmatic EIS considering the potential impacts associated with all auxin-resistant crops. APHIS has considered the potential impacts associated with development of cross-resistant weeds in the EIS. The increase in herbicide use is being evaluated by the EPA and is outside the scope of this EIS.

Coordination with EPA

16. **Comment (APHIS-2013-0043-4702):** "APHIS violates NEPA by relying solely on EPA's future assessment of the direct and indirect impacts the dicamba-resistant crop system, and consequent herbicide application, will have on human health and the environment. In contrast, by law federal agencies must address all "reasonably foreseeable" environmental impacts of their proposed programs, projects, and

regulations. Such a review must include analyses of direct, indirect, and cumulative effects. The assessment must be a "hard look" at the potential environmental impacts of its action. Despite having decided to undertake an EIS and recognizing that approval of dicamba-resistant crops will massively increase and change associated herbicide use in GE corn and soy, APHIS has refused to independently analyze these herbicide impacts.

Instead, APHIS artificially separated the GE crops from the impacts of the herbicide (i.e., dicamba) the plants are created and designed to be sprayed with. Indirect effects from the deregulation of dicamba-resistant crops plainly include the effects of herbicides that undisputedly will be used on the crops, since they are the crop's very purpose. Herbicide impacts are not just foreseeable, they are intended and certain. The dicamba-resistant crops were developed by Monsanto to be resistant to dicamba; they consequently have no value without it and thus must be sold together with it, as a cropping system. <u>Greatly increased dicamba use is at a minimum, an indirect effect, of APHIS's action that must be analyzed by APHIS</u>.

As noted, APHIS's reliance on EPA is unlawful. Two prior courts have ruled that APHIS must analyze the herbicide impacts of its herbicide-resistant crop decisions in EISs, for Roundup Ready alfalfa and Roundup Ready sugar beets. Moreover, the courts have long and consistently rejected agencies' attempts to avoid analyzing the pesticide impacts of their actions under NEPA by arguing that EPA has purview over pesticides under FIFRA. Thus, APHIS cannot rely solely on EPA's evaluation of effects under a separate statute to adequately fulfill its own NEPA obligations. Further, FIFRA analyses and standards are different than NEPA review. "Compliance with FIFRA requirements does not overcome an agency's obligation to comply with environmental statutes with different purposes." Absent NEPA analysis by APHIS, there will be no NEPA analysis of dicamba herbicide impacts. This violates NEPA and the APA."

Response: APHIS does not regulate pesticide use. The authorization of dicamba on MON 88701 cotton and MON 87708 soybean is solely under the discretion of EPA. As part of their decision whether to register dicamba for use on MON 88701 cotton and MON 87708 soybean, EPA is completing an risk assessments that thoroughly analyze the direct and indirect effects of pesticide use on human health and the environment. APHIS did not analyze the direct and indirect effects of pesticide use because EPA thoroughly examines these effects in its risk assessments. In the cumulative impacts section, APHIS did evaluate the potential increased selection of herbicide resistant weeds resulting from the increased use of dicamba and the associated socioeconomic impacts on growers from these weeds.

APHIS has taken the requisite "hard look" at the potential environmental impacts of its regulatory action. The action that APHIS is taking is to determine whether to grant nonregulated status to two plants. In making its determination, APHIS is looking at whether or not these plants are plant pests.

Under the Coordinated Framework, USDA, EPA and FDA each have distinct roles in regulating biotech crops. The Coordinated Framework tasks the EPA, under FIFRA, with regulating herbicide use, and it does so through labeling instructions that the herbicide user must comply with. APHIS is tasked with looking at the plant and whether or not the plant is a “plant pest” as defined in the PPA.

As stated above, APHIS has complied with NEPA and has not only given due consideration to EPA’s analyses, but has also taken an independent look at data and other analyses when warranted.

Agronomic Practices in Cotton and Soybean Production

Weed Control/Herbicide Use

17. **Comment (APHIS-2013-0043-4333):** “Weed Science is a relatively young science compared to some other disciplines. The major introduction of synthetic herbicides began in the 1940’s. Since its introduction, dicamba has been safely used for over four decades. It has undergone intense scrutiny and it remains an effective and safe tool for chemical weed control. In the years following the introduction of dicamba, many other herbicides and herbicide modes of action were introduced. It is notable that although many companies have active programs to find new modes of action that no new modes of action have been discovered in nearly two decades.

    Weed control has been and continues to be one of the most expensive and important components of crop production. The use of agrichemicals has facilitated crop production to the point that we are at today. We are blessed to have the most abundant safest food supply in the world. Our ability to effectively and efficiently produce food will be challenged in the future by an ever growing population. We must continually improve our systems in order for it to be sustainable.

    The introduction of transgenic crops was one such improvement into the production scheme. These technologies have revolutionized our production systems. These technologies have also allowed us to replace some active ingredients for those that were safer to mammals as well as to the environment. Additionally, these weed control technologies have enabled the proliferation of minimum and no-tillage systems. The adoption of these production practices has resulted in substantially less soil erosion in our cropping areas. As the demand for food grows, it is my opinion that we will be forced to utilized crop acres not previously cropped in order to feed the growing population. The ability to grow crops in a minimum tillage system will allow some of these areas to be utilized for crop production.”

    Response: APHIS acknowledges the comment.

18. **Comment (APHIS-2013-0043-0551):** “Last week I spent hours pulling pigweed from our fields. This is despite doing everything “right.” We rotate crops. We planted thick cover crop. We overlaid alternating residual chemistries. We still have pigweed in places.

You might think that at this point I am a supporter of the new herbicide tolerant technology. However, I am not. I think that this technology is a lazy way to farm and will provide only a temporary solution to the problem of weed herbicide resistance.

Even though we have pigweed, it is only in our cotton fields and it only appears as perhaps one plant per acre. The problem, of course, is that each plant produces thousands of seeds. We have found that our agronomic program of crop and chemical rotation, cover crop use, and the use of overlapping residual herbicides works well. The reason we have pigweed now is that no herbicide provides one hundred percent control. So even the new dicamba and 2,4-D technologies will not solve that problem.

Further, the new technologies only provide control on smaller weeds. They may stunt larger weeds, but that just forces them below the crop canopy where they continue to produce a seed head. We already have other herbicides that can be sprayed over the top of cotton that will provide both immediate and residual control of problem weeds as long as the residual effect persists. It is when residual action disappears that we have a problem. Again, the proposed new technologies will not solve that problem.

In effect, the proposed new technologies will only provide temporary relief without solving the long-term weed management problems farmers face. Repeated reliance on this type of technology without the use of alternative management practices will provide disappointing weed control results.

In summary, while many farmers may think these new herbicide tolerant traits will be lifesavers, that is only because they are unwilling to apply other management principles to control herbicide resistant weeds. The new technology traits will not really solve the problem that we face and will actually result in additional problems, both in weed management and in the market for crop seed."

Response: APHIS acknowledges that the advantages of the dicamba technology can be short lived if adopters fail to heed best management practices. The technology could be useful for decades if these best management practices are followed that minimize the selection of herbicide resistant weeds. APHIS concluded that MON 87708 soybean and MON 88701 cotton offer clear short-term benefits and made no prediction in the long-term because it would depend on the extent to which growers adopted best management practices. Growers are free to choose to use cover cropping, organic methods, complex crop rotations, or any other methods of non-chemical weed control. The analysis in the EIS is consistent with these comments.

19. **Comment (APHIS-2013-0043-3104):** "As the 8th generation to farm our small family farm, I take very serious the obligation to steward our long running family resource, while growing the crops and livestock we do. Over the many years we have farmed this ground, the technology used in AG has dramatically changed for the better, and that is why I fully support the unconditional deregulation of the dicamba tolerant soybeans and cotton technology. Although glyphosate resistant weeds are not a major issue for us today, I continue to see weed mgt issues everywhere I drive. The dicamba tolerant crops will give us a very valuable tool to assist in the mgt of the wee d populations, while being

able to maintain our 100% no-till cropping efforts. We've personally seen tremendous improvement in crops, soil health, and water quality since moving to no-till cropping, which we were not able to successfully do, before Roundup Ready crops came along. As the extensive EIS document concludes, water quality would be at risk of degrading if large portions of the cropland would be returned to conventional tillage. The dicamba soybean technology will also assist the US farmer in being competitive with other farmers around the world that are able to adopt new technology at a faster pace. Thank you for this consideration."

Response: APHIS acknowledges the comment. The analysis in the EIS is consistent with these comments.

20. **Comment (APHIS-2013-0043-3204):** "I have a great deal of experience in the weed control field having conducted research and extension activities over the past 11 years in academia as well as over 20 years of experience working with farmers advising them on row crop production practices. I believe the added tolerance of dicamba this product provides soybean and the dicamba and glufosinate tolerance this technology delivers to cotton will provide growers needed new tools to manage weeds, particularly herbicide resistant weeds which yearly are becoming more challenging.

    Many acres in Tennessee and indeed, in many states, are quickly becoming infested with several glyphosate resistant (GR) weeds (Heap 2014). The two of most concern in our state are GR horseweed (*Conyza canadenis* (L) Cronq.) and GR Palmer amaranth (*Amaranthus palmeri* S. Watts) (Heap 2014; Steckel et al. 2008). Both weeds can be very competitive, particularly Palmer amaranth, which is one of the most competitive weeds in the world and if left even partially controlled can dramatically reduce crop yield (MacRae 2008, Steckel 2007, Horak et al. 2000). Glyphosate provided complete control of horseweed until 2001 and Palmer amaranth up until 2006. Unfortunately that is no longer the case and as of today all counties in Tennessee that grow row crops have fields infested with GR versions of both these weeds. Moreover, Palmer amaranth that is resistant to glyphosate is also, in most cases, resistant to at least one and in some cases two or three other herbicide modes of action. The reason for this weed to develop resistance to these herbicides is due to a lack of weed control diversity in our row crop agriculture.

    I visit with soybean and cotton produces in TN on a regular basis and a number of them, just in 2014, told me they spent well over a $100/A on herbicide plus another on average $25.00/A on hand hoeing crews and still had fields with many of these weeds present. Moreover, the development of glyphosate resistance in Palmer amaranth as well as GR horseweed has increased tillage in our state, which is not a long-term sustainable practice with our topography. Quite literally these GR weeds are a threat to soybean and cotton production in my state.

    The only way to have diversity in controlling this and other weeds is to have more weed control options to utilize. In order to be sustainable for any length of time these options must include both cultural and herbicidal components. Unfortunately, the herbicidal options continue to diminish due to the continued development of herbicide resistant weed biotypes. The herbicide tolerance this trait gives soybeans and cotton will provide additional herbicide options that a grower can utilize to manage weeds, particularly GR weeds.

In my research over the last several years, I have found that weed control systems that include dicamba in soybean and dicamba and glufosinate in cotton utilized around planting time (both pre plant and early post) provide good GR Palmer amaranth and GR horseweed control. The herbicide tolerance this trait offers cotton allows for dicamba and glufosinate applications at these timings with no harm to the crop. Moreover, the good control that the dicamba and glufosinate herbicide can provide in a complete weed control system should reduce the number of "rescue" treatments desperate farmers utilize today. This will likely cut back overall herbicide use in soybean and cotton while providing better control than is typical in TN today.

In short, I believe the dicamba tolerance this technology gives soybeans will provide farmers more diversity in controlling weeds. Additionally, the ability to utilize dicamba and glufosinate that close to cotton planting should be more sustainable than the weed control methods in use today."

Response: APHIS acknowledges the comment.

21. **Comment (APHIS-2013-0043-4706):** "APHIS' assumption that herbicide use on Xtend soybean and cotton will always conform to EPA registered uses as described in Appendix 7, where APHIS describes what label it assumes EPA will require based on the proposed label for Dow's 2.4-D resistant corn and soybeans, is also unfounded, because it is contrary to experience with previously approved herbicide-resistant crops. There are well known examples of unsupported applications of herbicides to resistant crops in certain circumstances where growers find benefits (Roberson 2011: use of glufosinate on WideStrike cotton), and APHIS has not analyzed the conditions under which off-label use is likely to occur with Xtend soybean and cotton in order to assess risks. Also, herbicides are sometimes applied when environmental conditions are not as required on the label (AAPCO 2002)."

    Response: APHIS acknowledges that some herbicide use may be off label. Nevertheless, it is unlawful to apply pesticides inconsistent with label directions. Civil penalties range up to $5000 per offense and criminal penalties may include fines up to $25,000 and up to one year in prison (US-EPA, 2000). The example cited by the commenter about the use of glufosinate on Widestrike cotton is an unsupported use but not an example of off label use (Golden, 2010). Glufosinate is registered for use on cotton (Roberson, 2011). The use of glufosinate on Widestrike cotton was not supported by Dow, the developer of the cotton variety, or Bayer, the manufacturer of the herbicide, because the resistance to glufosinate in this line is limited and crop damage can result. APHIS has no way of knowing how often and in what circumstances herbicides are applied when environmental conditions are not as required on the label.

22. **Comment (APHIS-2013-0043-4360):** "U.S. farmers are facing an unprecedented crisis in the spread of herbicide-resistant weeds due to the very same company, Monsanto, that

is now lobbying the agency to deregulate its dicamba-resistant varieties. USDA's approval and the subsequent widespread planting of Monsanto's Roundup Ready varieties have led directly to the current weed crisis, in which glyphosate-resistant weeds now cover over 70 million acres of farmland. With the expected surge in dicamba use that USDA acknowledges will accompany cultivation of Monsanto's dicamba-resistant cotton and soybean varieties, farmers are likely to face the spread of intractable dicamba-resistant weed populations.

Already several weed species are resistant to dicamba, and with resistance in the case of at least two weed species conferred by a single dominant allele, that resistance could spread swiftly. Furthermore, a number of weed species have developed multiple resistance (to more than one herbicide) and/or cross-resistance (in which a metabolic adaptation in a weed species enables it to degrade several different herbicide modes of action at once)."

Response: APHIS acknowledges the comment. APHIS has assessed the potential increase in dicamba-resistant weeds arising from the increased use of dicamba associated with MON 87708 soybean and MON 88701 cotton as part of its assessment of cumulative impacts. Dicamba-resistant and multiple resistant weeds are discussed in Section 5 of the EIS.

23. **Comment (Virtual Meeting Public Comment 1):** "I'm a fourth-generation cotton farmer. I have lived and farmed in Eastern Arkansas most of my life. And I grow from five to ten thousand acres of cotton each year. I grew the dicamba-tolerant cotton trait under the regulatory review this year on my farm, approximately 2500 acres.

I would like to share my experience firsthand because not many people, and particularly farmers have been able to see this.

I would also like to say that I fully support the option to deregulate the dicamba-tolerant cotton and soybeans. Again, as a farmer, I can say with a lot of confidence that growers need new weed management technologies. As weed resistance becomes more prevalent as it is on my farm, we need additional tools at our disposal to fight them. And dicamba tolerance, it works very well.

I have significant Palmer pigweed, weed pressure on my farm. I have the additional mode of action in dicamba to control it, which is very important. This system will not only provide an additional mode of action, but it also expands the dicamba weed control window from burndown and planting to in-crop applications.

With regards to concerns about off-site movement, I believe that growers have experience with various cropping systems and are in a good position to prevent or minimize drift. We follow label instructions very closely. We go through regular training, and we invest in modern technology that enables to minimize drift.

Newer dicamba formulations along with application requirements that accompany this system can make it possible for all types of growers to coexist and prosper. I'm very happy with the performance of this system on my farm this year. Again, access to new weed management tools such as dicamba-tolerant technologies is important to me as a grower.

I would urge USDA to pursue in a timely fashion towards full deregulation of dicamba-tolerant technologies. I would like to thank you today for my comments, my ability to speak and my -- just considering my thoughts here. Thank you."

Response: APHIS acknowledges the comment.

24. **Comment (Virtual Meeting Public Comment 3):** "I'm a soybean and corn farmer from Mississippi. And I would like to speak in favor of deregulation of dicamba. I think it is certainly important for industry to continue to adopt new chemicals and new technology.

    Unfortunately, on my farm that I no longer have -- that I don't have resistant weeds yet or glyphosate-resistant weeds. But they are in my county, and I know that they are coming. And I have been able to reduce having them or not having them today because I have used multiple modes of action.

    And I think this new dicamba technology would be important in giving me that opportunity to continue to broaden the base of chemicals I use and to delay that resistance even further. And I think it is important that we move forward with this. As we delay, then it is more likely that I will have resistance in the future. And I would like to be able to delay that so that it doesn't inhibit the crops unable to grow or what I'm able to do.

    I think that farmers are able to apply this chemical. I don't think the application to -- recommendations are -- will be difficult for farmers to do, I think, if we understand drift and how to reduce that, how to use the right tips, how to look at the wind speed. So I think it is a process that farmers can comply and will comply. I know that we will need to be careful using this. But again, I think it is something that we can easily meet and be able to use this technology.

    So I think that we do need to move forward with this deregulation and give farmers an opportunity to use this technology. I know with the neighbors that do have resistant weeds, it's really an opportunity for them to be able to control those weeds.

    Again, I thank you for the opportunity to comment, and I look forward to being able to use this technology in the future. Thank you."

    Response: APHIS acknowledges the comment.

25. **Comment (Virtual Meeting Public Comment 4): "**I'm a fourth-generation farmer here from Central Ohio. We raise corn, soybeans and wheat. Been farming for over 40 years, and I have used dicamba in my cornfields for over 40 years. I'm well aware of it, and I know there is a right way and a wrong way to use these chemicals.

    We have to avoid drift, and we have to figure out ways to be cognizant of our nature's crops. And we have done that. We all have to be new neighbors. So I'm very excited about the new formulation that's going to be available to use if this dicamba-resistant variety gets released. So I think that's really good.

I disagree with one thing one of the other commenter said. I really see the advantage of using this particular product in burndowns because we have learned when we get ready to plant the crops, we have been using things like 2,4-D and having to wait a week and then go ahead and plant the corns or the beans and the – the soybeans and the stubble from after a week's worth of letting it cook.

To me, with the different times of the climate changes that we have experienced and the weather pattern that we have endured as far as big rains and dry spells, I think that's the real advantage of the farmers going to have a chance to use this new technology.

We all have learned in the past that we can overuse things. The way you bounce back from a resistance that develops -- and by the way, I have seen resistant weeds develop for the last 40 years. This is not something new just because we are talking about glyphosate resistance. There is lots of other weeds that are resistant to many other chemistries as well. But we have learned that the way you deal with resistant weeds is multiple modes of action. That's the way you do it.

We can use other -- we have used other chemistries like atrazine, which show there is 50 to 60 weeds already resistant too. But by mixing it with something else, you still get a multiple mode of action. And that's the way you control resistance. So this is some of the -- this is a new product we need to keep ahead of the resistance of weeds that are developing.

Again, I have used dicamba for many, many years, and I'm excited about the new formulation, which is much lower in off-target movement with our new sprayers. And being good stewards, we are going to have a fine time using this. So I would greatly appreciate and urge the deregulation of dicamba-resistant soybeans. I thank you for your time."

Response: APHIS acknowledges the comment.

26. **Comment (Virtual Meeting Public Comment 5): "**I am a fifth-generation farmer living in Bulloch County, Georgia. My brother and I have farmed together for over 30 years, farming several thousand acres of cotton and peanuts during that time.

In my 30 years or 30 years plus now of farming, I have seen unbelievable advances in technology and research in the agricultural industry. Without these advances, we simply would not be able to survive the economic and environmental pressures that we have seen over the last three decades.

Research and technology is what keeps us going, what keeps us surviving. Because I believe that dicamba-tolerant crop for the next big advances in a long line of important technologies, I fully support the option to deregulate dicamba-tolerant soybeans and cotton without restriction as recommended by the draft Environmental Impact

Statement. Access to this and similar technology will help us maintain healthy yields and ensure stable supply of very valuable crops just bypass with the consumers around the world.

As a Georgia farmer, I can assure you that our growers need new weed management technologies with prudent weed control over a broad spectrum of weeds, likely Roundup Ready technologies. As weed resistance becomes more prevalent on my farm, we have become more and more limited in our options to effectively fight our broad spectrum of weeds.

Weed science tells us that the best way to address weed resistance besides good management practices is using a variety of weed control tools. The dicamba-tolerant system will provide an additional mode of action while expanding the dicamba weed control window that we so desperately need.

One other very important point I would like to discuss relates to our dedication to sustainability and our desire to reduce our environmental footprint. I believe that these technologies will enable growers to continue to be good stewards of our land. Glyphosate-tolerant crops have made conservation tillage widely accepted in Georgia.

This has been the greatest advance in sustainable farming practices since the -- preservation of the topsoil, reduce fuel use and better water conservation are just a few of the benefits of conservation tillage. But I have seen it along the last few decades. That's years. And I stay away, as a lot of growers should, from conservation tillage because of the difficulty controlling weeds. The added dicamba tolerance will help us better manage weed resistance so we can continue this very important sustainable practice.

With regards to the concerns about dicamba off-site movement, I believe our growers are experienced enough with various cropping systems and are in good position to prevent or minimize drift. Education has been real strong in our area. Training is very long. We believe with those types of things available to us, we will be able to manage the drifts.

Access to new weed management tools such as dicamba-tolerant technologies is important to me as a farmer. So I just urge USDA in a timely fashion to move forward for deregulation of dicamba-tolerant technologies. I thank you for your time and considering my comments."

Response: APHIS acknowledges the comment.

27. **Comment (Virtual Meeting Public Comment 7): "**I'm a fourth-generation farmer in the Redwood Falls, Minnesota, area. I have raised soybeans, corn, sweet corn, cattle and sheep. I have grown dicamba-resistant soybeans under permit now for three years and fully support the deregulation of this trait. My experience is the weed control system is effective, economical, safe for the operator and environmentally responsible.

I also believe the technology will be effective for a long time because we have numerous corn chemistries available so we can reserve the dicamba for soybean weed control. All of these different modes of action will delay any resistance of the weed population. The need for another soybean weed control tool is apparent with increased newly difficult-to-control weeds showing up here.

Weed such as tall waterhemp and Venice mallow can be controlled with dicamba. A lot of these weeds are small-seated types that flourish under a reduced tillage system. In an effort to improve water quality, soil health and reduce fuel usage, most farmers are reducing their tillage, thereby setting up a more favorable environment for these small-seated weeds.

Compared to the 1970s and the present, we have gotten much more efficient at using our inputs in crop production. Part of the reason is we have not been wasting labor, fuel, fertility, water and sunlight on growing weeds. This is good for the environment and good for the price of food.

However, nature is always evolving and changing the rules of the game, and using the best tools and technology available will ensure its safe and sustainable food system. We also live in a global society and have a responsibility to use our resources wisely. I have traveled a fair amount and met and seen people all over the world that rely on us to provide protein for their diet.

I have met buyers of Midwest U.S. soybeans to be used for direct human consumption, animal feed and fish feed. There are millions of people that get their dietary protein on the other side of the world because we do our job correctly here. If we fail to use all the tools available to us here and have fewer tons of soybeans on the market at a price they can afford, then we have failed to live up to our responsibility. We here in the U.S. and other developed countries won't starve. The people in developing countries will be the ones left with a lower protein diet.

I base my management decisions for my farm not only on the present circumstances, but I also consider whether the people farming this land before me and after me would be pleased with my choices. I believe dicamba-tolerant soybeans are one tool -- one of those tools they would endorse because this technology helps us deliver a vital, sustainable and safe product to the public."

Response: APHIS acknowledges the comment.

28. **Comment (Virtual Meeting Public Comment 8): "**This is Wade Cowan from Brownfield, Texas, where I farm several crops, including peanuts, cotton, soybeans, grain, sorghum and vegetables. And I also represent the American Soybean Association as first vice president.

I was calling in today to support the deregulation of the dicamba soybeans and the dicamba glufosinate cotton in that they will both help us in our operation to do a better job of keeping the rotation that we have kept on our farm for over 150 years.

As we go into the 21st century here, we need more and more tools to make sure that we can farm effectively and economically. On our operation we have used dicamba since the 1970s and have been able to do so safely and efficiently on directed crops and as a burndown right next to crops. So people recognize it's very susceptible. We have done this and done it with very little, ever, if any, damage to any off-site crop or the -- a nontarget crop.

As we go forward and as you listen to the comments, I would also assert that when we have off-site applications, you do have drift volatility. Many times in the high plains of West Texas, those disputes are handled amicably between the farmer and his neighbor because they communicate with each other and they know the problems. And they are quite often handled out of court.

I would just like to encourage you to deregulate both the dicamba soybeans and the dicamba glufosinate cotton so that we can have these extra tools in our toolbox. And as we meet the needs of consumer not only in the United States, in the world, that we are able to do it in a highly efficient and sustainable way and prevent the spread of weeds that are resistant to different herbicides.

I thank you for listening to my comment, and I, once again, would hope to deregulate these two systems."

Response: APHIS acknowledges the comment.

29. **Comment (Virtual Meeting Public Comment 9): "**My family and I grow soybeans and corn in Southwest Iowa. I also am currently serving as president of the American Soybean Association and both represent our farm and also the association.

I would really like to speak in support of deregulation of dicamba-tolerant soybeans and cotton, you know, as farmers need and should have choices to address weed-resistant issues. And we are beginning to see weed-resistant issues on our farm. So those new traits and new technology are important not only to us, but our fellow soybean farmers around the country. So we need -- as farmers we need multiple modes of action, including dicamba-tolerant soybeans and cotton to address those weed-resistant issues.

The new formulations of dicamba substantially reduce volatility. And farmers are capable and are experienced using dicamba. On our farm we have used dicamba within our crop --cropping system for decades and have real personal experience with that. And with the new formulations that are out there and the new technology that we have in our equipment, we are even more capable of eliminating and reducing off-target movement.

So with that, I would urge USDA to regulate without restriction both dicamba-tolerant soybean and dicamba- and glufosinate-tolerant cotton. And I really thank you for the opportunity to comment."

Response: APHIS acknowledges the comment.

30. **Comment (Virtual Meeting Public Comment 10): "**I farm in Northwest Iowa, and I am also a crop and livestock nutrition advisor, working with diverse family farms all across the United States.

    I am encouraging the USDA to step back and take time to further analyze the dicamba soybean and cotton system as well as the 2,4-D crops. It is extremely shortsighted on USDA's part to rely predominantly on the chemical industry and chemical use for weed control in crop production. It has not and will not ever be successful. And if USDA is incapable of interpreting history that has proven this, they are unbelievably shortsighted.

    The 2,4-D and dicamba crops are going to increase the amount of toxins that we are putting in our environment. USDA has research from their own USDA ARS research scientists that have already manifested significant ill effects of glyphosate-based herbicides in the soil, in the environment and to crops. And to further add to this approach of weed control by herbicide is ill-sighted and shortsighted.

    There are effective means and mechanisms of cover and breaking model crop cycles and implementation of truly advanced natural biological crop production systems that are vastly reducing the weed pressure in fields of all types of all crops. And USDA needs to quit following the direction and the guidance of the chemical industry and the genetically engineered industry in how they are directing the crop production in our country.

    We already have significant and growing levels of glyphosate residue in virtually every crop that is being produced in our country that is inflecting significant harm on both livestock and the human population. USDA needs to be responsible and quit carrying water to the biotech and chemical industry.

    Thank you for listening to my comments.

    And I urge USDA to say no until proper environmental impact studies have been conducted on the full adverse effects of this technology."

    Response: APHIS acknowledges the comment.

31. **Comment (Virtual Meeting Public Comment 12): "**I'm counsel to corn and soybean growers and a former president of the Council For Agricultural Science and Technology and a current board member. And it is pretty clear to me that we need these crops to prevent weed resistance becoming a real problem. And as for spray drifts, as an attorney for growers, I can agree with Wade, who mentioned these are often resolved amicably.

    Also it shouldn't deny organic growers certification to have drifts. And if the certifier is denying, the problem is with the certifier and not with the drifts. It should not deny certification of the organic program. I hope you can hear me. If not, I'm not sure what to do."

    Response: APHIS acknowledges the comment.

32. **Comment (Virtual Meeting Public Comment 13): "**And I want to thank you for the opportunity to express my support for the deregulation of dicamba-tolerant soybeans and cotton without restriction as was recommended by the draft Environmental Impact Statement on dicamba-tolerant technologies.

    As I stated, my name is Vic Miller. I have been growing corn and soybeans in Oelwein, Iowa, for 41 years. I also have served our U.S. farmers as past chairman of the U.S. Grains Council, an organization that develops export markets for U.S. barley, corn, sorghum and their processed products. This is where I learned firsthand about the importance of meeting the growing demand for these products in the global marketplace.

    As I have previously commented, the use of dicamba is not new. It has been used by farmers for over 40 years in the U.S. and continues to be effective on major broadleaf weeds. Over the past ten years, it has been used very successfully on more than 250 million acres, including corn, wheat, pasture and rangeland as well as other cropland. Homeowners, golf courses and municipal parks are also among the many users.

    The equipment, the knowledge and the desire to use the product in a responsible manner by the agricultural community already exists. My intention is to leave a safe, wholesome environment for my children and grandchildren as they are the most valued things in my life. To that end, I have upgraded my sprayers to accommodate this technology, as have most of the agricultural producers in my area.

    We are also well aware of sensitive crops, many of which we grow in our community. We are all licensed and go through rigorous educational courses yearly to be better stewards of the land. Growers across the U.S. need more modes of action to limit the problem of herbicide resistance. Dicamba tolerance would be a valuable addition to today's available weed control options to maximize yield potential.

    No till and reduced tillage are very important conservation measures in my operation. If weed resistance increases without additional modes of action in new products to control that resistance, then I will be forced to increase tillage, which will have a very negative impact on those conservation measures not only for me, but for most of my counterparts as well. Without this technology, I am left with few viable alternatives to control weeds in my field, resulting in poor yields, which means I produce less on these acres.

    This means I get paid less for my crop, I deliver fewer beans to my local elevator; and this cascade of impact carries on down the line. The elevator has fewer beans and more weed seeds or foreign material that end up at the local crush plants. Those plants have reduced profitability and so is the bean quality reduced that is made into animal feed, soybean oil, biodiesel and food ingredients, just to name a few. And ultimately, these things either end up used domestically in many applications or sold to foreign buyers for their use in the international market.

Now, not only has my profitability been impacted, but very possibly hungry people around the world will find their livelihood more tenuous. Having the ability to incorporate dicamba-tolerant soybeans into my weed management program allows me to reduce the dependence that I have on ALS and PPO herbicides. And it would offer a proactive program for weed resistance management while preserving the value of glyphosate, an herbicide that is still very effective on my farm.

In closing, restricting the use or denying access to these new technologies would have a negative effect on U.S. farm operations. It would reduce weed control capabilities, increase costs, reduce farm returns, impact the U.S. producers' ability to meet foreign market demand and unfortunately reverse conservation tillage adoption. We all need this technology, and I urge you to fully deregulate it. And I thank you for taking these comments."

Response: APHIS acknowledges the comment.

33. **Comment (Virtual Meeting Public Comment 14): "**I would like to thank you for the chance to comment today. I am a third-generation farmer up here in North Dakota with my wife Pat and my son. We operate a farm in North Dakota, producing corn, soybeans and wheat as well as barley, canola, feeds, sunflowers, some potatoes and livestock, beef livestock.

    I have been involved in agriculture all my life and put my first crop in in 1964, and a past chairman of the U.S. Grains Council, past chairman of North Dakota Barley Council, a member of the North Dakota Grain Growers Association, past president of North Dakota Crop Improvement Association and is very active in regional community affairs and the university affairs.

    I fully support the option to deregulate dicamba-tolerant soybeans and cotton, MON 87708 and MON 88701, with all restriction as recommended by the draft Environmental Impact Statement on dicamba-tolerant technologies. I had made comments previously that supported deregulating the technologies that are worth repeating it as USDA considers its final regulatory actions regarding these technologies because they will impact my future and that of my friends and family and state.

    Weed control issues are as challenging as they have ever been. Waterhemp, kochia, lambsquarter and common ragweed continue to compete with our crops further, water, sun and yields. If left without effective control, these weeds could decrease our land value and our farm yield and our livelihood. To fight these weeds to protect our yields, we need new tools; and the use of dicamba in soybeans would provide excellent additional mode of action to add to our limited and valuable tool set.

    Using dicamba and dicamba-tolerant cropping system can be a proactive measure to use on my farm. Without weed management tools such as dicamba-tolerant crop system, weeds will become more difficult to control; and there will be greater selection for glyphosate resistance and PPO resistance, one of the other effective herbicide tools we have. Dicamba, which when used together with other effective mode of action such as glyphosate with dicamba-tolerant soybeans will protect not only glyphosate, but PPO herbicide and even newer herbicide such as the bleachers for sure, fells, mesotrione that are commonly used -- which are commonly used in soybean production.

We also compete in the global marketplace for the crops we harvest. If USDA does not approve or causes further delay in this new tool, it will financially harm my farming operation and restrict my ability to compete against growers in other parts of the world who are able to use these technologies such as these to control weeds and protect yield.

I urge the USDA to do their part of approval of dicamba-tolerant crops without delay or any restrictions as recommended in the draft Environmental Impact Statement so that U.S. farmers may have access to important new advancements in farming that allow farmers such as me and my son and my grandson to have tools we need to continue fighting weeds, raising vulnerable crops and be able to pass our operation onto the fifth and sixth generation.

I have a grandson named Brady Fulton, who is already at three years old actively interested in farming. His mother said it must be in the genes because he isn't old enough to understand farming. And his dad, his granddad just laughed. We need all the tools that can be made available to us to continue our farming. Thank you very much."

Response: APHIS acknowledges the comment.

34. **Comment (Virtual Meeting Public Comment 15): "**I'm a crop farmer from Minnesota. I'm 47 years old and have been crop farming near Murdock, Minnesota, my entire life. My wife Paula and I have two sons, Brett, age 18; Hunter, age 15. Crops currently being raised in our family farming operation consists of sugar beets, corn, soybeans, sweet corn, peas and alfalfa.

    I was asked to join the dicamba advisory council for the last two years, comprised of academics, industry growers and commodity organizations that worked with Monsanto to offer input on the development and commercialization of the Roundup Ready Xtend cropping system. I am calling in today to offer my support for the option to deregulate dicamba-tolerant soybeans and cotton, MON 87708 and MON 88701, without restriction as recommended by the draft Environmental Impact Statement on dicamba-tolerant technologies.

    One of the greatest challenges as a farmer is with controlling weeds. I know that growers need weed management technologies with proven control of a broad spectrum of weeds like the new Xtend technology. As weed resistance becomes more prevalent, we feel that the arsenal of tools at our disposal is limited to effectively prevent and manage weed resistance.

    Our Minnesota weed control experts tell us that the best way to address weed resistance besides good management practices is using a variety of weed management tools. The dicamba-tolerant system will provide an additional mode of action while expanding the dicamba weed control window from burndown in planting to in-crop applications.

We currently use Roundup Ready sugar beets but need to add additional modes of action. The added dicamba tolerance will help us better manage weed resistance so we can preserve and maintain the value of our land. Not only that, but the use of dicamba as part of the Roundup Ready Xtend crop system will help us preserve the value of existing pre- and post-emergent herbicides, which continue to bring significant value. In Minnesota we produce many crops such as a wide variety of vegetables.

With regard to concerns about dicamba off-site movement, I believe growers have experience with various cropping systems and are in a good position to prevent or minimize drift. We follow label instructions very closely, go through regular training and invest in modern technology that enable us to minimize drift.

I have personally seen the new dicamba formulations in field trials, and the potential for drift and volatility have been significantly reduced. Newer dicamba formulations along with best management practices can make it possible for all types of growers to coexist and prosper.

Access to new weed management tools such as dicamba-tolerant technologies is important to me as a farmer. I urge USDA to proceed in a timely fashion toward full deregulation of dicamba-tolerant technologies. Further delays will be harmful to U.S. agriculture."

Response: APHIS acknowledges the comment.

35. **Comment (Virtual Meeting Public Comment 16): "**I'm a third-generation farmer who is -- I have been farming since 1982 on a family farm. We are in the Lubbock area, which is in the panhandle area of Texas. I farm approximately 2000 acres of cotton, 2000 acres of wheat, and we have a cow-calf operation. We are under limited irrigation. Mostly I'm a dryland farmer. But we have limited irrigation, center pivot irrigations.

The last three years have been really rough on us. We pretty much have record drought for the last three years. But fortunately, this year we have had more rainfall, and it has really helped our bottom line.

A part of my life is my family, and I am blessed with a beautiful wife and a beautiful daughter. She is a senior this year at Texas Tech University here at Lubbock. Hopefully she will be graduating in December. And if you all have college-aged students, you realize what the tuition has done over the years. So hoping she is going to finish in December.

Thank you all for this opportunity just to visit with you. I fully support the option to deregulate dicamba-tolerant soybeans and cotton without restriction as recommended by the draft Environmental Impact Statement on dicamba-tolerant technologies. And I can tell you with confidence that as a Texas farmer, cotton farmer, that we as growers need weed management technologies with a proven efficiency over broad spectrum of weeds like these two Monsanto products, 87708 and 87701.

Particularly this year as weed resistance has become more prevalent, we just feel like that we need more in our arsenal of tools that we can use to effectively prevent and manage our weed resistance, the weeds that we have. This year especially with our increased rainfall, we have already witnessed a rapid increase in herbicide resistance, Palmer pigweed, careless weed or pigweed here in West Texas. And weed science tell us it is the best way to address weed resistance in addition to good management practices.

It is usually a variety and using a variety of -- dicamba-tolerant system, we feel like we are providing additional mode of action. While expanding the dicamba, we control window from burndowns and also planting in minimum crop, no-till crop applications.

Water and soil conservation are the two most key components for our area for West Texas farmers. I'm very concerned with the sustainability of my farm, and I believe that dicamba-tolerant technologies will enable growers to continue to be good stewards of the land. Compared with -- to some weed control programs, this system may result in few herbicide applications.

Glyphosate-tolerant crops make no tillage cultivation possible. This has been a tremendous advance in sustainable farming practices, thanks to the prevention of erosion, topsoil erosion, reduced fuel emissions and better water conservation. The added dicamba tolerance would help us better manage these resistant weeds so that we can preserve the value of our land.

I know and I realize that some individuals, some are very concerned about off-site movement or herbicide drift. And I believe that growers, that we have the experience with various cropping systems; and we are in a good position to prevent and minimize drift. We do our best. We do follow label instructions very closely. We participate in regular training, and we do our best to invest in modern technology. It's simply just new spray, spray tips, maintaining our equipment to minimize drift.

Newer dicamba formations along with better management practices can make it possible for all types of growers to coexist and prosper. I feel it is very important to let farmers have access to new weed management tools such as dicamba-tolerant technology, and I would urge the USDA to proceed in a timely fashion towards full deregulation of dicamba-tolerant cotton and soybeans."

Response: APHIS acknowledges the comment.

36. **Comment (APHIS-2013-0043-3331)**: "I am writing in support of dicamba-resistant soybean. I have had the opportunity to work with the technology for the past six years, and have found it to be a very effective tool for weed management. In the area of Illinois where I live herbicide resistance is becoming increasingly common in Amaranthus

tuberculatus and Conyza canadensis. Dicamba-resistant soybean have the potential to improve management of these weeds.

I know that Monsanto has worked hard to develop management practices that will minimize off-target movement of dicamba. I have found that the use of ultra-course droplets greatly minimizes drift and injury to susceptible crops. However, I recognize that some drift is still possible and am supportive of clearly defined downwind buffers to support sensitive vegetation. I also hope there will be strong enforcement of the application management practices, up to and including loss of the privilege of using the combined soybean and herbicide technologies.

My greatest concern with the technology is that it will be misused and drive the selection of dicamba resistant broadleaf weeds. My personal preference would be that the dicamba be used no more than two times per year on a given acre. My preference would also be that the use of other effective herbicide site of action groups be applied in conjunction with the dicamba herbicides or prior to dicamba to reduce the selection pressure for resistant weeds. Label language may help with this, but the real key will be a company agreement to only market the product in accordance with best management practices to reduce the risk of selecting herbicide resistant weeds."

Response: APHIS acknowledges the comment.

<u>**Increase in Herbicide Use**</u>

37. **Comment (APHIS-2013-0043-4702): "**The majority of cotton in the Delta and Southeast is infested with GR weeds, particularly the most problematic one, Palmer amaranth. Monsanto projected an additional application of dicamba for soybean acres infested with resistant *Amaranthus*, but fails to make the corresponding projection for infested cotton acres. In fact, Monsanto assumes that MON 88701 cotton growers in the Delta/Southeast region, where the country's most extensive and damaging outbreaks of glyphosate-resistant weeds have occurred on millions of acres (see Resistant Weed section below), would make the same sparing use of dicamba as MON 88701 cotton growers in California, where only one glyphosate-resistant weed biotype has been detected in cotton, GR junglerice (DEIS, Table 4-10, 4-23).

    This assumption is unwarranted, particularly given the fact that GR Palmer amaranth is not well-controlled by a single dicamba application (Merchant et al 2013). Thus, CFS has adjusted Monsanto's projection by adding one additional dicamba application for this region: 2 rather than 1 for conventionally tilled acres, and 3 rather than 2 for no-till acreage, in line with Monsanto's projection for dicamba use on MON 87708 soybeans."

    Response: APHIS has addressed this issue in the EIS, and acknowledges that herbicide application optimization is particularly important. In Merchant et al., the authors acknowledge that their results were from '*a single application to weeds larger than the optimal size for treatment. Greater control would have been expected if the Palmer amaranth had been smaller at application'* (Merchant *et al.*, 2013). This is consistent with other studies that have found that dicamba has been found to be effective at controlling problematic weeds such as GR Palmer amaranth, but weed control is dependent on weed size and density (Doherty *et al.*, 2010; Jha and Norsworthy, 2012). It is therefore important that growers are well informed to optimize results, which APHIS has stressed within the document.

38. **Comment (APHIS-2013-0043-4713)**: "Several million acres of cotton in the south are infested with glyphosate-resistant weeds, hence the increase in glufosinate use could be quite substantial if growers follow Monsanto's recommendations. In 2010, USDA figures show that just 7% of U.S. cotton acres were treated with 394,000 lbs. of glufosinate (USDA NASS AgChem 2011). If just 2 million acres of MON 88701 cotton are treated with glufosinate at the recommended rate, then glufosinate use would rise by over 1 million lbs. Finally, southern weed scientists have found that dicamba alone does not provide good control of GR Palmer amaranth, cotton farmers' worst weed, but that combining it with glufosinate improves control considerably (Merchant et al 2013). APHIS likewise (and inconsistently) acknowledges that: "When combined, dicamba and glufosinate provide control of HR weeds that include GR [glyphosate-resistant] biotypes of Palmer amaranth (Amaranthus palmeri), marestail (Conyza canadensis), common ragweed (Ambrosia artemisiifolia), giant ragweed (Ambrosia trifida) and waterhemp (Amaranthus tuberculatus)" (DEIS, 5). These facts point clearly to considerably increased use of glufosinate on MON 88701, not a reduction as APHIS speculates. APHIS declined to analyze this issue, preferring to speculate ("may decline") (DEIS, 4-21)."

    Response: Glufosinate use in recent years has been increasing annually because of the increased adoption of glufosinate-resistant crops; this adoption trend is likely to continue. APHIS acknowledges that glufosinate usage could increase if growers choose to follow Monsanto's recommendation and apply glufosinate with dicamba. APHIS has revised text in the Cumulative Impacts Section 5.7.2, Changes in Herbicide Use, to indicate that glufosinate use is expected to increase.

39. **Comment (APHIS-2013-0043-4713)**: "One of the kochia populations was found to be "highly resistant" to dicamba, requiring an 18-fold higher rate to control than the most susceptible population tested. This represents the fifth dicamba-resistant kochia biotype that has been reported, the others all occurring in the U.S. (Montana, North Dakota, Idaho and Colorado). Based on their results as well as the history of dicamba resistance in other kochia populations, it was concluded that without aggressive stewardship of dicamba-resistant soybeans, there was "a very high probability for dicamba-resistant kochia populations to be selected," and that "they will likely spread widely because of kochia's 'tumbleweed' seed dispersal" (Crespo 2011, p. 105)."

    Response: APHIS agrees with conclusions made by Crespo (Crespo, 2011) and acknowledges that the advantages of the dicamba technology can be short lived if adopters fail to heed best management practices. The technology could be useful for decades if these best management practices are followed that minimize the selection of herbicide resistant weeds. The analysis in the EIS is consistent with the findings and recommendations stated in the publication cited by the commenter.

Best Management Practices

40. **Comment (APHIS-2013-0043-0773): "**I am a weed scientist at North Carolina State University with 36 years of professional experience in weed management. I am very familiar with weed management in agronomic crops and the issues facing growers. My career has been devoted to research and education to help growers manage weeds in an economically and environmentally sustainable manner.

    I am in agreement with the conclusions [of the DEIS]; deregulation of both Xtend cotton and Xtend soybean is the preferred course of action….. The draft EIS acknowledges that adoption of Xtend cultivars would likely increase dicamba use, and this would increase selection pressure for dicamba-resistant weeds. However, the EIS rightfully acknowledges that grower awareness of resistance and the need for proactive management strategies has greatly increased as a result of educational efforts by many segments of the industry. Most growers are now incorporating resistance management techniques in their weed management programs, and this is expected to be amplified in Xtend crops because of anticipated resistance management requirements on labels of dicamba products registered for use in Xtend crops. The EIS also acknowledges that there will be selection pressure for herbicide resistance with or without Xtend crops. I think it is appropriate to point out that deregulation of Xtend crops will give growers another tool to use in weed management and will decrease selection pressure on other critical modes of action."

    Response: APHIS acknowledges the comment.

41. **Comment (APHIS-2013-0043-2241): "**Peer-reviewed, scientific journal articles have been published on the need for producers to implement Best Management Practices (BMPs) to increases sustainability and effectiveness of current weed control programs. Although multiple points are underlined in these journal articles, BMPs primarily emphasize the use of alternative weed control measures (tillage, cover crops, etc.) and utilizing multiple herbicide modes of action (MOAs) to reduce weed selection pressure and achieve sustainable control. While utilizing cultural control methods such as tillage has become more common, using multiple MOAs is difficult because of the limited number of MOAs that are currently available and effective on Palmer amaranth.

    Dicamba has value as a weed management tool because it exhibits both pre-emergence and post-emergence weed control activity and is efficacious on Palmer amaranth. This herbicide requires very little moisture for activation, making it a very effective tank-mix partner with our currently available pre-emergence herbicides. As a post-emergence herbicide product, it brings great value as an added post-emergence MOA in both cotton and soybeans. In cotton weed control programs, there is only one post-emergence MOA (glufosinate) that is only viable in select varieties and in soybean weed control programs there are only two effective post-emergence MOAs (PPO-inhibitors, and glufosinate in select varieties). These herbicides are only effective when applied in a timely fashion and under desirable conditions. Each of these herbicides often require multiple applications and still frequently leave escaped weeds. Palmer amaranth has already been documented as resistant to PPO-inhibitors in some areas of the Mid-western United

States, and history suggests that if we continue relying on such a limited number of herbicide MOAs, that it is only a matter of time before failure occurs.

The goal of the weed science community is to produce a cropping system that is efficient, effective, and sustainable from a labor, land, cost, and environmental standpoint. Previous research studies have shown that proactively including multiple herbicide MOAs and other BMPs is more economically efficient, and most importantly, sustainable than incorporating these strategies after disaster occurs. That goal of our community as a whole, is a better alternative than allowing next herbicide resistant weed to dictate changes of BMPs currently adopted by producers. Xtend technology offers the potential to be one of the most valuable introductions to make that system more durable and sustainable."

Response: APHIS acknowledges the comment.

42. **Comment (APHIS-2013-0043-4713)**: "In 2011, Bernards et al. (2012) discovered a waterhemp population that has 19.2-fold increased resistance to 2,4-D and 4.5-fold increased resistance to dicamba (DEIS, p. 188). This illustrates the common phenomenon of cross-resistance among herbicides of the same class, here synthetic auxins, and the likelihood that dicamba- and 2,4-D-resistant crops (collectively, "auxin-resistant crops") will lead to rapid evolution of auxin-resistant waterhemp:

> New technologies that confer resistance to 2,4-D and dicamba (both synthetic auxins) are being developed to provide additional herbicide options for postemergence weed control in soybean and cotton. The development of 2,4-D resistant waterhemp in this field is a reminder and a caution that these new technologies, if used as the primary tool to manage weeds already resistant to other herbicides such as glyphosate, atrazine or ALS-inhibitors, will eventually result in new herbicide resistant populations evolving. (UNL 2011)"

Response: APHIS discusses the likelihood of multiple resistance in Cumulative Impacts, Section 5, and Appendix 5. APHIS acknowledges that multiple resistance may occur and the benefits of dicamba-resistant MON 87708 soybean and MON 88701 cotton may diminish if weeds become resistant to both dicamba and 2,4-D. APHIS has concluded that multiple resistance may occur depending on the extent to which growers adopt best practices. Sustainable use of herbicides entails increasing the variety of chemistries and incorporating other non-chemical strategies into the management program. The assessment of herbicide-resistant weeds in the EIS is consistent with the information cited by the commenter.

43. **Comment (APHIS-2013-0043-4713)**: "The primary recommendation to forestall or manage herbicide resistance ("best management practice") is to use multiple herbicides or "modes of action," each of which kill the weed in different ways. However, there is increasing evidence that such an approach is often ineffective and counterproductive, even if one ignores the human health and environmental impacts of increased use of herbicides."

Response: It is well documented that weed control should optimally be done using integrated weed management practices, without over-reliance on herbicides (Norsworthy *et al.*, 2012; Fernandez-Cornejo *et al.*, 2014). It is necessary for growers to use a diversified approach to prevent overreliance on a single chemical. We also stress within the EIS that the herbicide label would also contain information on resistance management consistent with the Weed Science Society of America's BMPs for comprehensive resistance management approaches (US-EPA, 2014). It has been established that BMP, including application optimization all help to sustain herbicide viability (Doherty *et al.*, 2010; Jha and Norsworthy, 2012; Norsworthy *et al.*, 2012; Vencill *et al.*, 2012; Fernandez-Cornejo *et al.*, 2014).

44. **Comment (APHIS-2013-0043-4706):** "APHIS skirts the impacts of the specific herbicides that will be used on Xtend crops, saying that herbicide use cannot be predicted: "Herbicide use in agricultural fields can impact biodiversity by decreasing weed quantities or causing a shift in weed species. This can affect insects, birds, and mammals that use these weeds. The quantity and type of herbicide use associated with conventional and GE crops depends on many variables, including cropping systems, type and abundance of weeds, production practices, and individual grower decisions." (DEIS at 189)

Elsewhere, APHIS does predict that dicamba use will increase dramatically with adoption of Xtend soybean and cotton. Impacts of this APHIS approval-associated increase in the specific herbicide dicamba, and the other herbicides Xtend soybean and cotton were engineered to withstand, must be assessed, rather than waved away by claims that quantity and type of herbicides used are too variable to predict."

Response: The commenter seems to be asserting that APHIS is contradicting itself by stating that on the one hand it predicts that dicamba use will increase but on the other hand, it cannot predict the impacts because the quantity and type of herbicide use associated with conventional and GE crops depends on many variables. This comment is misleading because it has excerpted the second quotation out of context. The second quotation is from a discussion of factors that impact biodiversity. The point of the discussion is that "habitat loss is the greatest direct impact agriculture has on diversity" and that habitat loss can occur through the use of herbicides, tillage, and from land conversions to agriculture. Although dicamba use is predicted to increase under the Preferred Alternative, tillage is predicted to increase under the No Action Alternative. Furthermore, because weed control is expected to be better under the Preferred Alternative, yields are expected to be better under the Preferred Alternative, too, and this is expected to decrease the pressure for land conversion to agriculture. There are many management choices that affect farm level biodiversity in opposing ways and, as a result, APHIS concluded that the magnitude of this impact on biodiversity is uncertain, even if an increase of dicamba is reasonably foreseeable under the Preferred Alternative..

Herbicide impacts on resident species are outside the scope of this EIS. They have been assessed by EPA in its Environmental Risk Assessment.

Stewardship and Weed Resistance Management

45. **Comment (APHIS-2013-0043-4713)**: "The weed science community as a whole has only begun to grapple with the implications of the spread of resistance, particularly as it relates to the efficacy of weed resistance management recommendations based solely on individual farmers reducing selection pressure. It may not be effective or rational for farmers to commit resources to resistance management in the absence some assurance that other farmers in their area will do likewise. This suggests the need for a wholly different approach that is capable of ensuring a high degree of area-wide adoption of sound weed resistance management practices. This represents still another reason to implement mandatory stewardship practices to forestall emergence of dicamba -resistant weeds in the context of MON 87708 soybean and similar auxin-resistant crops."

    Response: The requirements of mandatory stewardship practices are not based on plant pest risks and, thus, are not within APHIS's authority to impose.

46. **Comment (APHIS-2013-0043-4713)**: "APHIS presumes that EPA will put in place a weed resistance management program for dicamba use on dicamba-resistant crops that is similar to the one the Agency has proposed (but not finalized) for application of Enlist Duo (a mix of 2,4-D and glyphosate) to Dow's 2,4-D-resistant (Enlist) crops (DEIS, pp. 140, 174-75, 180). An EPA official was recently quoted as saying that the proposed Enlist Duo program would serve as the model for future herbicide-resistant crop systems (Hopkinson 2014). In the discussion below, we refer to "auxin-resistant crops" and "auxins" to encompass both Enlist and Xtend crop systems.

    The major flaw in EPA's Enlist Duo plan, which would apply equally to dicamba resistant crop systems, is that the Agency has entirely failed to mandate any effective measures to prevent evolution of auxin resistance in weeds, but rather proposed only monitoring to detect them after they have already emerged. An approach based solely on monitoring is doomed to failure, because the emergence of a resistant weed population is a slow, incremental process."

    Response: EPA's potential resistance management program for dicamba use on dicamba-resistant crops is outside the scope of this EIS.

47. **Comment (APHIS-2013-0043-4713)**: "This "spatial refuge" approach is appropriate for mobile insects, while for sessile weeds a "temporal refuge" would accomplish the same purpose. This would involve imposing restrictions on the frequency with which an auxin herbicide could be applied to a particular field during a single season and over years. This is precisely the approach that many weed scientists have proposed. Frustrated by the rapid increase in glyphosate- and multiple-resistant weed populations, six weed scientists recently stated that: "The time has come to consider herbicide-frequency reduction targets in our major field crops" (Harker et al. 2012). Shaner and Beckie (2014) likewise recognize the need for "reasonable [herbicide-] frequency use intervals" to forestall evolution of weed resistance….serious weed resistance management would

require restrictions on the frequency with which dicamba resistant seeds are planted and dicamba herbicide applied to them."

Response: APHIS has no authority to regulate the use of pesticides, fungicides or other chemicals that may be used on MON 87708 soybean and MON 88701 or mitigate the impacts that may result from that use. The use of these agro-chemicals and any potential adverse effects falls under the authority of EPA and is outside the scope of this EIS.

Herbicide Drift

48. **Comment (APHIS-2013-0043-3209): "**Off-target movement of dicamba applied to these technologies poses the greatest risk and limitation to adoption of these technologies. Although it is currently unknown what restrictions will be in place to minimize off-target movement by herbicide labels, an enormous amount of research by the registrants and other scientists across the world is being conducted to develop methods to minimize the potential for off-target movement. These efforts include 1) improving herbicide formulations, thereby reducing volatility and/or drift, 2) improving application equipment techniques and application methods, thereby reducing drift, and 3) developing educational materials to assist growers in reducing off-target movement when making pesticide applications (Bagley 2013, Huff et al. 2013; Kendig et al. 2013; Magidow et al. 2013; Newsom et al. 2013; Reynolds et al. 2013A, Sandbrink et al. 2013). Benefits from these efforts will be monumental in minimizing off-target movement of ALL pesticides, not just dicamba, and will greatly improve the ability of a grower to apply pesticides that stay in the targeted area. In Georgia, a cooperative effort between The University of Georgia, Georgia Department of Ag, Agronomic Industry leaders, and Horticultural Industry leaders is underway to further define methods to minimize off-target movement and, more importantly, to train all growers thus helping them uses dicamba and other pesticides wisely."

    Response: APHIS acknowledges the comment. This comment is outside the scope of this EIS, as the EPA, not APHIS, regulates pesticide use.

Herbicide-Resistant Weeds

49. **Comment (APHIS-2013-0043-0640)**: "Recently, I served as lead author on a herbicide resistance paper commissioned by USDA-APHIS, accepted for publication in *Weed Science*, that outlines the best management practices (BMPs) that can be used to mitigate the risk of herbicide-resistant weeds evolving, general challenges to adoption of BMPs, the current level of adoption of BMPs, and recommendations for academia, industry, and governmental agencies to overcome obstacles to adopting the BMPs. Below, the BMPs as outlined in the publication are included:

    1. Understand the biology of the weeds present.
    2. Use a diversified approach toward weed management focused on preventing weed seed production and reducing the number of weed seed in the soil seedbank.
    3. Plant into weed-free fields and then keep fields as weed free as possible.
    4. Plant weed-free crop seed.

5. Scout fields routinely.
6. Use multiple herbicide mechanisms of action (MOAs) that are effective against the most troublesome weeds or those most prone to herbicide resistance.
7. Apply the labeled herbicide rate at recommended weed sizes.
8. Emphasize cultural practices that suppress weeds by using crop competitiveness.
9. Use mechanical and biological management practices where appropriate.
10. Prevent field-to-field and within-field movement of weed seed or vegetative propagules.
11. Manage weed seed at harvest and after harvest to prevent a buildup of the weed seedbank.
12. Prevent an influx of weeds into the field by managing field borders.

I have modeled resistance of Palmer amaranth to glyphosate in cotton and used this and other research as the basis for several of the above BMPs. For instance, it is known that multiple effective modes of action are necessary to minimize selection pressure placed on a weed from any single herbicide. Unfortunately, there are no over-the-top control options for Palmer amaranth in cotton, other than glufosinate in Liberty Link cotton, due to resistance to both glyphosate and the acetolactate synthase (ALS)-inhibiting herbicides such as pyrithiobac and trifloxysulfuron. In a recent screening of over 400 Palmer amaranth accessions from Arkansas, more than 90% tested positive for glyphosate and ALS resistance. In soybean, postemergence control is limited to only one herbicide, that being fomesafen, in non-Liberty Link soybean, a prescription for herbicide resistance to fomesafen and other protoporphyrinogen oxidase (PPO)-inhibiting herbicides. Furthermore, fomesafen is only effective when Palmer amaranth is smaller than 4 inches in size. Palmer amaranth can grow in excess of 2 inches per day, making proper timing of fomesafen quite challenging. Additionally, populations of waterhemp, a weed closely related to Palmer amaranth, have evolved resistance to fomesafen and other PPO-inhibiting herbicides throughout the Midwest. The fact that waterhemp in the Midwest is resistant to many of the herbicides we are currently using in cotton and soybean to manage Palmer amaranth is cause for concern. With the extensive use of PPO herbicides in cotton and soybean, the likelihood of resistance to this mode of action in the near future is high.

Preventing weed seed production and reducing the soil seedbank are also critical to sustainability of herbicides because the risk of resistance is closely correlated with the size of the soil seedbank. With a high density of Palmer amaranth in the soil seedbank and no over-the-top control option in cotton other than glufosinate, it is likely that resistance to glufosinate will occur rather quickly unless additional postemergence options soon become available. For certain, the $20 million spent annually on handweeding is not sustainable, meaning the integration of effective herbicide options with other control strategies are desperately needed in the Midsouth.

The availability of multiple herbicide technologies and mode of action diversity is a critical component of the above mentioned BMPs. Monsanto is investing in the development of the Xtend technology that enables the use of dicamba, glufosinate, and glyphosate, multiple modes of action, in cotton. In soybean, the Xtend technology will offer tolerance to glyphosate and dicamba, allowing both cotton and soybean growers options of rotating Liberty Link fields to the Xtend technology to increase mode of action diversity. While the in-crop application of dicamba in cotton and soybean is a new use, this is not a new herbicide. Dicamba has been well researched for almost 50 years and is currently labeled for use along roadsides, in range and pasture, in cereals, in corn and grain sorghum, and as a burndown herbicide prior to planting many crops, among other uses. I have evaluated dicamba-containing herbicide programs in cotton and soybean and found these to be an effective option for controlling glyphosate-resistant Palmer amaranth as well as other common broadleaf weeds in these crops.

Overuse of any product or technology will rapidly lead to herbicide resistance, but if properly integrated into our current production systems using the above BMPs, the Xtend technology will aid in protecting currently available herbicide modes of action."

Response: The analysis in the EIS is consistent with these comments.

50. **Comment (APHIS-2013-0043-3209):** "Herbicide-resistance has significantly changed agriculture forever in the Southeast; especially glyphosate-resistant Palmer amaranth. An in-depth face-to-face survey with growers was conducted in an effort to document the impacts herbicide resistance has had and is continuing to have on agriculture and our ability to feed and clothe the world (Sosnoskie and Culpepper 2014). To combat this pest, growers have relied heavily on herbicides, tillage, and hand weeding. Herbicide use in cotton has increased sharply with 2.5-times more herbicide active ingredient applied following the confirmation of glyphosate resistance in Palmer amaranth as compared to before documented resistance. Although grower herbicide input costs has nearly tripled following the evolution and spread of glyphosate resistance, Palmer amaranth control is still not adequate. Thus, 92% of Georgia cotton growers hand-weed 52% of the crop with an average cost of $23 per hand-weeded acre, which is an increase of at least 475% as compared to hand weeding costs prior to resistance. In addition to increased herbicide use and hand weeding, growers in Georgia have indicated that they are using mechanical, in-crop cultivation (44% of acres), tillage for the incorporation of preplant herbicides (20% of the acres), and deep turning (19% of the acres every three years) to aid in Palmer amaranth control. Current weed management systems are extremely diverse, complex, less environmentally friendly, and costly when compared to those systems employed only a decade ago. Growers are in desperate need of new technologies that will aid in the management of glyphosate-resistant Palmer amaranth, and other problematic weeds, for long term sustainability."

    Response: APHIS acknowledges the comment that growers are in need of new technologies that will aid in the management of glyphosate resistant weeds.

51. **Comment (APHIS-2013-0043-3209):** Dicamba is not consistently effective in controlling Palmer amaranth larger than 4 inches when applied alone (Chafin et al. 2010; Culpepper et al. 2010; Dodds et al. 2012; Merchant et al. 2013); however, weed management systems including these herbicides are more consistently effective than current standards (Dodds et al. 2012; Reynolds et al. 2013B; Shaw and Arnold 2012). Weed management programs including dicamba would improve a grower's ability to manage Palmer amaranth and several other problematic weeds in the following ways: 1)

improved consistency in weed control especially on dryland production acres where residual herbicides often are not activated with rainfall at planting time, 2) more flexibility with herbicide application timings because glufosinate plus dicamba will consistently control Palmer amaranth up to 6 inches in height (at least 2 inches larger than today's standards), 3) less herbicide carryover to subsequent crops because growers would be less dependent on long lasting residual herbicides, and 4) less yield loss from Palmer amaranth crop competition for light, nutrients, and water (Coetzer et al. 2002; Culpepper et al. 2010; MacRae et al. 2014).

Response: APHIS acknowledges the comment.

52. **Comment (APHIS-2013-0043-3209): "**USDA has voiced concerns that growers may adopt technologies and rely too heavily on dicamba thereby developing an even greater weed resistance scenario. Science has clearly shown that there are risks of resistance development to all herbicides; dicamba is no exception. In fact, weeds have developed resistance to nearly all forms of weed management including herbicides, tillage, mowing and even hand weeding. Our data and surveys contrast the assumption that rapid development of resistance to dicamba would occur in Georgia. First, our data notes that since auxin herbicides control only very small Palmer amaranth then they must be applied in tank mixtures with other herbicides such as glufosinate (Chafin et al. 2010; Merchant et al. 2013). Second, even mixtures of glufosinate plus dicamba will only control Palmer amaranth less than six inches in height and since Palmer amaranth can grow as much as two inches per day selective residual herbicides must be used throughout the season (Culpepper et al. 2010; Dodds et al. 2012). Simply put, data throughout the South supports the fact that over-use and/or over-dependence of dicamba in our cropping systems, especially cotton, would equal poor weed control and eventual crop failure which is a practice no grower would follow. Dicamba would simply be an additional tool to include in the weed management program."

    Response: APHIS acknowledges the comment.

53. **Comment (APHIS-2013-0043-3209):** "The greatest risk for developing herbicide resistance is actually occurring at this moment with the PPO herbicides and glufosinate. These products are being over used as growers have no other effective herbicidal options. New technologies such as dicamba could be used to delay resistance development to the PPO herbicides and glufosinate and, in turn, systems could be developed using the PPO herbicides, glufosinate and dicamba extending the life of each of these chemistries.

    It is also critical to highlight, at least in Georgia, no weed management program relies exclusively on herbicides. The University of Georgia Weed Science Extension Team stresses to growers at more than 50 meetings each year that herbicides are only one part of the weed management program. Sustainability is only possible with the adoption and implementation of diverse management programs and Georgia growers have accepted this message as fact (Sosnoskie and Culpepper 2014). Growers are using programs that are complex and diverse integrating herbicides, hand weeding, and tillage or cover crops. Dicamba will not change this approach but would simply be an additional tool to add into these management systems."

Response: APHIS acknowledges the comment. The information is reflected in the EIS in Section 5, Cumulative Impacts – Agronomic Practices and –Plant Communities.

54. **Comment (APHIS-2013-0043-3209):** "Glyphosate-resistant Palmer amaranth has increased herbicide pounds of active ingredient applied in Georgia cotton by a factor of 2.5 when compared to herbicide use prior to resistance (Sonoskie and Culpepper 2013). Programs developed by the University of Georgia for 2,4-D or dicamba technologies suggest the pounds of herbicide active ingredient may be able to be reduced by at least 30% while actually providing better weed control; similar results are also noted in other areas across the cotton belt (Edwards et al. 2013; Merchant et al. 2013; Smith and Hagood 2013; Steckel et al. 2013)."

    Response: APHIS acknowledges the comment

55. **Comment (APHIS-2013-0043-3812):** "I have had the opportunity to work with Monsanto's dicamba tolerant soybean trait team to train Monsanto employees and others on the topic of spray technology basics including a focus on selecting and using the proper nozzles for the application of dicamba as a part of a prescribed weed control system as it relates to the introduction of dicamba tolerant crops. For the past five years, the focus of this research has involved conducting 'commercial-sized sprayer' oriented research trials involving spray nozzles and drift reducing adjuvants to support this training, with the most recent efforts using resistant weeds plots.

    I would like to reiterate some thoughts for consideration as well as my perspective on this new weed control tool, current spray technology to reduce off-site movement and the application practices available to make herbicide applications successfully. Here are my key points:

    - Particle drift is controllable through equipment selection and conditions of use, such as formulation, spray tips and other technologies, wind speed and direction at application, sprayer speed and boom height. In some of my most recent research, selecting the proper nozzle type alone can be shown to reduce spray drift from 13.5% down to 0.5% and in some cases the inclusion of drift control additives can reduce that drift amount even more.

    - Newer dicamba formulations have been developed to substantially reduce volatility compared to first-generation dicamba products. The research is supporting this and through further research, education and training this point will be stressed.

    - Sprayer contamination will be of concern when switching between tolerant and non-tolerant crops. This will be addressed through proper sprayer clean out procedures that adequately clean out herbicide residues from the lining of the tank, boom and inner workings of the sprayer, including all hoses and filters, crevices and drain lines. Newer spray systems are being engineered to improve cleanout.

- Monsanto has addressed one concern of the potential for offsite movement by prohibiting aerial applications and other concerns by implementing specific environmental and equipment application requirements on the draft dicamba label, including a wind-directional buffer when sensitive areas are present, and the use of low volatility dicamba formulations.

- It is my opinion that US farmers and commercial applicators are capable and experienced at preventing off-site movement. Like any other herbicides, off-site movement of dicamba can be prevented through proper stewardship including application techniques, equipment settings, nozzle selection, and consideration of environmental conditions during application.

- Equipment and hand held tools such as smart phone apps that support applications to facilitate access to weather data, field plot maps, nozzle details, and other on board information now exists. This technology and capability is at work on the farm fields across America today.

- When recommended label practices are followed, growers of various crops can co-exist and prosper. I believe that in combination with approved best management practices, including the use of the proper nozzle type(s), applications using dicamba will have potential to reduce the amount of off-target drift.

The use of dicamba is not new with 2012 figures indicating its use on over 32 million acres of farmland in the US. The equipment, know-how and ability to successfully apply dicamba as part of the new dicamba tolerant soybean and cotton weed control systems under review exists today. Putting these application details on the label is an effective means of communicating and requiring these strategies to be followed. Restricting the use or denying access to these new technologies based upon concern for off-sight movement because it may not be controlled or labeled formulations may not be successfully applied are false assumptions, flawed in exaggeration and are a huge disservice to the farmers to whom I understood USDA to represent."

Response: APHIS acknowledges the comment. APHIS has no authority to regulate the use of pesticides, fungicides or other chemicals that may be used on MON 87708 soybean and MON 88701use or mitigate the impacts that may result from that use. The use of these agro-chemicals and any potential adverse effects falls under the authority of EPA and is outside the scope of this EIS.

56. **Comment (APHIS-2013-0043-4333):** "Throughout my career, I have conducted weed control research including the evaluation of many transgenic crops. I have conducted extensive research in the development of weed control programs utilizing transgenic cropping systems. My research program has also evaluated crop tolerance and safety related to fruiting patterns within cotton as related to topical tolerance to glyphosate. I have several refereed publications related to these subject areas. Most recently, I have had the opportunity to conduct research with the Roundup Ready Xtend Crop System. Thus I feel that I am qualified to objectively assess and comment on this technology.

In order for this active ingredient to be utilized in current row-crop production systems several points must be addressed which include; efficacy, off-target deposition (drift), off-target deposition (volatility), equipment sanitation, and non-transgenic crop response. My research program has active projects addressing each of these points.

Monsanto has introduced the Roundup Ready Xtend Weed Crop System. This program consists of new technologies in the form of transgenic plants with tolerance to topical applications of dicamba. I have had the opportunity to evaluate many aspects of this system for efficacy, volatility, sprayer hygiene, and drift.

The efficacy piece is by far the easiest to address. Quite simply, if the product did not work there would be no market thus it would not be used. In the replicated research trials that I have conducted, this product has shown very good efficacy on tall waterhemp, glyphosate resistant Palmer amaranth as well as numerous other species common to Mississippi cropping systems.

We have conducted simple “low tunnel” research projects to compare the relative volatility of various auxin herbicides. In these studies, soil was treated at a remote location and then introduced into the tunnel and allowed to incubate for a period of 24-48 hours after which the tunnel and treated soil was removed. Crop injury radiating away from the treated area was monitored to ascertain the intensity of injury observed as well as how far away from the treated area that injury could be observed. Data from these experiments show reduced volatility with the new dicamba formulations especially when compared to the older dimethylamine salts.

Our program has also evaluated the effect of low-dose concentrations of dicamba on non-transgenic cotton and soybean. These trials would illustrate the effect of contaminated application equipment. Data from these studies indicate that cotton is far more tolerant than soybean to dicamba. Proper sprayer hygiene will be very important to prevent crop injury to non-transgenic species following the use of dicamba. Sprayers can be used on multiple crops if proper cleaning procedures are followed.

Drift research is difficult to conduct because of the large areas needed and the ability to use commercial equipment. We have conducted large scale drift trials in both cotton and soybean. Our data show reduced drift when utilizing the designated best management practices. These include proper droplet size, specified formulations, the use of proper application criteria, and designated environmental conditions. In my opinion no system can completely eliminate drift thus one still must use good judgment in their implementation into a cropping system.

In summary, the Roudup Ready Xtend Crop System has demonstrated effective control of glyphosate resistant Palmer amaranth, reduced volatility compared to older formulations of dicamba, and reduced drift when utilizing best management practices. The availability of this transgenic technology may help preserve many conservation tillage programs by providing a viable control option for glyphosate resistant weeds. It is my opinion that our growers could benefit from the availability of this cropping system and I support its approval.”

Response: APHIS acknowledges the comment. APHIS has no authority to regulate the use of pesticides, fungicides or other chemicals that may be used on MON 87708 soybean and MON 88701use or mitigate the impacts that may result from that use. The use of these agro-chemicals and any potential adverse effects falls under the authority of EPA and is outside the scope of this EIS.

57. **Comment (APHIS-2013-0043-0551): "**There will also be additional problems associated with these technologies. The first is herbicide drift which has the potential to be a huge problem mid-season when crops are growing. The seed companies and chemical manufacturers know this and are addressing this issue, but there will still be significant risk, even if herbicides are sprayed according to label."

    Response: APHIS does not regulate pesticide use. The authorization of dicamba on MON 87708 soybean and MON 88701 is solely under the discretion of EPA. As part of their decision whether to register dicamba for use on MON 87708 soybean and MON 88701, EPA is completing an assessment that thoroughly analyzes the direct and indirect effects of dicamba use on human health and the environment. APHIS did not analyze the direct and indirect effects of pesticide use because EPA thoroughly examines these effects in its risk assessments.

<u>Conservation Tillage</u>

58. **Comment (APHIS-2013-0043-4713): "**Throughout the draft EIS (e.g. DEIS, pp. x, 21), APHIS repeatedly asserts that under the Preferred Alternative, Xtend crops would enable farmers to utilize post-emergence applications of dicamba to control glyphosate-resistant weeds, and thereby avoid soil-eroding tillage operations that would otherwise, under the No Action Alternative, become necessary to control them. APHIS accordingly credits Xtend crops with reductions in soil erosion, and a whole host of benefits commonly associated with it, including improved air, water and soil quality; and claims as well that soil erosion and the associated impacts would increase under the No Action Alternative (e.g., DEIS, p.21).

    These assertions, in turn, are based on the assumption that Roundup Ready crops have driven a reduction in soil erosion by facilitating less soil-eroding tillage practices, known collectively as "conservation tillage." APHIS argues by analogy that Enlist crops would preserve and further the benefits of reduced soil erosion purportedly conferred by Roundup Ready crops.

    On a national level, soil erosion declined by 38% from 1982 to 1997, but by just 9% from 1997 to 2010. Roundup Ready crops were introduced in 1996, and RR varieties now comprise the overwhelming majority of corn, soybeans and cotton in America, planted on over 150 million acres. If Roundup Ready crops planted on such a massive scale truly reduced soil erosion, it would be certainly be reflected in greater reductions in soil erosion post 1997 than have in fact occurred.

    Soil erosion rates on cropland actually increased a bit over this period in the Corn Belt and the Northern Plains states. It is simply impossible to reconcile no reduction in soil erosion with massive adoption of Roundup Ready crops that supposedly save soil. Either NRCS is wrong or RR crops have not saved soil (and Xtend crops would not). APHIS does not question these NRCS soil erosion figures, and in fact makes no reference to NRCS soil erosion data anywhere in the draft EIS. APHIS's only attempts to support the supposed linkage of RR/Xtend crops to reduced soil erosion are entirely bogus or unreliable.

It is extremely important to note that this purported but illusory reduction in soil erosion is the sole pretext for Xtend crops, a pretext that APHIS repeats ad nauseum throughout he EIS to make the enormous increase in dicamba and overall herbicide use and increased weed resistance that would occur under the Preferred Alternative more palatable, and to create the false negative impression of increased soil erosion under the No Action Alternative."

Response: APHIS has addressed the topic of tillage practices and erosion throughout the text, discussing the topic in greater detail in the section *Overall APHIS Responsibility and Weed Management*. It has been well documented that growers of herbicide resistant crops, particularly cotton and soybean, have increased no-till and conservation tillage practices due their ability to control weeds through herbicide application after crop emergence (NRC, 2010; Fernandez-Cornejo *et al.*, 2014). Conservation tillage practices by U.S. soybean growers increased by 12 million acres from 1996 to 2008, and cotton growers doubled conservation tillage practices over the same time period (NRC, 2010). Decreased tillage due to the use of herbicide resistant crops has been established, but soil erosion is dependent on several factors, and is difficult to predict with certainty (NRC, 2010). Within the text APHIS repeatedly states that reduced erosion is ***likely*** due to increased conservation tillage practices.

59. **Comment (APHIS-2013-0043-4713): "**APHIS further states: "Increases in total acres dedicated to conservation tillage were facilitated in part by an increased use of herbicide-resistant GE crops, reducing the need for mechanical weed control (USDA-NRCS, 2006b; Towery and Werblow, 2010; USDA-NRCS, 2010b)." (DEIS, p. 73)

The final source cited by APHIS (Towery and Werblow 2010) is an undocumented, two-page executive summary of a report by the Conservation Tillage Information Center, another agribusiness-funded organization. It makes numerous breathless claims about the putative benefits of biotechnology, including the entirely false claim that they have educed herbicide use. USDA NASS data show clearly that herbicide use has skyrocketed with adoption of Roundup Ready soybeans and cotton, as we have repeatedly informed APHIS over the years. With such blatant misrepresentation of a well-known and fundamental fact about GE crops, nothing in this report can be trusted.

USDA-NRCS (2006b) is a publication entitled "Soil Quality" that discusses the value of organic matter in soil in very broad terms, and presents data on soil erosion reductions in the period from 1982 to 1997 – that is, almost entirely before Roundup Ready crops were first introduced in 1996. It makes not a single mention of herbicide-resistant crops, and provides not one shred of support for APHIS's statement.

In fact, it is indisputable that tillage has sharply increased in response to glyphosate-resistant weeds generated by glyphosate use with Roundup Ready crops. CFS urges APHIS to make the appropriate corrections to the draft EIS, and eliminate all reference to Towery and Werblow (2010) as completely unreliable."

Response: APHIS acknowledges that the weblink provided in the citation for Towery and Werblow (2010) in the DEIS accesses the executive summary of the Towery and Werblow report rather than the full length report. The complete Towery and Werblow report[1] provides a discussion of the importance of conservation tillage and increases in conservation tillage practices, citing several published independent scientific studies. However, APHIS recognizes that the information presented in this report and the USDA-NRCS (2006b) reference does not contain an extensive examination of these topics. APHIS has therefore replaced the Towery and Werblow and NRCS references with references from the National Academies of Science National Research Council and USDA Economic Research Service, which have been cited widely by peer reviewed journals on the topic of GE herbicide resistance and soil management (NRC, 2010; Fernandez-Cornejo *et al.*, 2014). The conclusions APHIS made in the DEIS regarding the relationship between herbicide-resistant crops and conservation tillage remains unchanged.

60. **Comment (APHIS-2013-0043-3209): "**As the spread of glyphosate-resistant Palmer amaranth occurred, the adoption of tillage including deep turning of the land with moldboard plows has become common (Sosnoskie and Culpepper 2014). The return of conventional tillage has led to increased wind and water erosion. Technologies with tolerance to dicamba will not eliminate tillage, but will reduce the need for deep tillage allowing many growers the opportunity to return to reduced tillage production systems as more consistently effective management programs will likely be adopted."

    Response: APHIS acknowledges the comment.

Volunteer Corn and Soybean

61. **Comment (APHIS-2013-0043-4713)**: "It is glyphosate-resistance that has made volunteer soybean a control problem for farmers, and necessitated the use of more toxic herbicides for control. MON 87708 soybean volunteers would possess resistance to dicamba as well glyphosate, eliminating dicamba and glyphosate and reducing the efficacy of 2,4-D as herbicidal control options. These volunteer soybeans weeds would thus be still more of a management challenge than RR soybean volunteers, and lead to use of more toxic herbicides (e.g. MSMA, paraquat, atrazine) or tillage to control."

    Response: As noted in Section in Section 5.8.2, Cumulative Impacts – Plant Communties, of the EIS, volunteer soybean plants are usually killed by frost during the autumn or winter of the year germinated. If a volunteer soybean plant were to survive, it

[1] http://www.ctic.org/media/pdf/BioTechFINAL%20COPY%20SEND%20TO%20PRINTER.pdf

would not compete well with the succeeding crop, and would be controlled readily via mechanical or other chemical means.

62. **Comment (APHIS-2013-0043-4713)**: "MON 88701 cotton may well pose a serious plant pest risk by undermining boll weevil eradication efforts. Volunteer cotton in both follow-on cotton and rotational crops can harbor boll weevils. Cotton stalks left standing after harvest can also host boll weevils. Thus, in Texas, Tennessee and perhaps other states, cotton growers are required by law to eliminate all volunteer cotton and also destroy cotton stalks after harvest as part of boll weevil eradication efforts. Roundup Ready and glufosinate-resistant LibertyLink cotton have already made such control efforts more difficult by eliminating glyphosate and glufosinate as control options. Texas agronomists are very concerned that the introduction of auxin-resistant cotton varieties (MON 88701 and 2,4-D-resistant cotton) will make both volunteer cotton and cotton stalk destruction still more difficult. This is because dicamba and 2,4-D are the preferred herbicides for accomplishing these tasks, and one or both will be rendered ineffective with the introduction of MON 88701. For a documented discussion of this problem, refer to Appendix A, pp. 38-42. CFS explicitly requested that APHIS address this issue in our scoping comments on the draft EIS (see Appendix D), but we find no discussion of it in either the draft EIS or the MON 88701 Plant Pest Risk Assessment."

    Response: In addition to the use of tillage, MON 88701 cotton stalk destruction and volunteers can be managed with the use of appropriate herbicides with diverse modes-of-action (*e.g.*, ALS inhibitor, chloroacetamide, EPSPS, PPO inhibitor, PSI disruption, PSII inhibitor, synthetic auxin, and tubulin inhibitor classes). Management of MON 88701 cotton volunteers is discussed in the cumulative impacts discussion in Section 5.8.2, Plant Communities.

Socioeconomics

63. **Comment: (APHIS-2013-0043-0640) "**Herbicide-resistant weeds threaten the sustainability of Midsouth agriculture. New herbicides and/or technologies are needed to manage the weeds that have evolved resistance.

    By far, Palmer amaranth is the most troublesome weed of cotton and soybean in the Midsouth. In Arkansas, glyphosate-resistant Palmer amaranth was first documented in 2005. Since then, Palmer amaranth has spread to at least 2.5 million acres of cotton and soybean in Arkansas alone. Furthermore, expansion continues with glyphosate-resistant Palmer amaranth documented in 28 states across the US.

    Unfortunately, loss of cotton and soybean fields as a result of this one weed is a common occurrence. In Arkansas, farms have been foreclosed because of the inability of producers to control glyphosate-resistant Palmer amaranth and produce a profitable crop. In addition to lower yields in cotton and soybean, more than $20 million is spent annually hand removing Palmer amaranth from cotton and soybean fields, not including the other weed management costs such as herbicides, cultivation, etc. Most certainly cotton and soybean producers are in need of new tools that will help in managing Palmer amaranth and other herbicide-resistant weeds."

Response: APHIS acknowledges the comment.

64. **Comment (APHIS-2013-0043-4713)**: "Weed control has traditionally been one of the more labor-intensive tasks in farming. Roundup Ready (RR) soybeans have been estimated to reduce labor needs for weed control by 15% (DEIS, p. 95). USDA economists agree that: "HT [herbicide-tolerant] seeds reduce labor requirements per acre" (MacDonald et al 2013, p. 28). APHIS regards this as a "benefit" of RR crops, in that it frees up time for off-farm employment (DEIS, p. 95). However, it is unclear whether working two jobs rather than one is a benefit, since it may be an undesired consequence of insufficient income from farming. In any case, farmers may choose to employ their "saved labor" in other ways that APHIS fails to consider. For instance, RR crop growers may seek to farm more acres rather than seek off-farm employment, bidding up prices for land (including leases). Larger growers are generally in a better position to absorb these added costs, and so outcompete small and medium-size growers, who are thereby put at a competitive disadvantage and potentially put out of business. As USDA economists have concluded: "GE seeds may partly explain increased consolidation among field crop farmers since 1995" (MacDonald et al 2013, p. 27). APHIS has failed to assess the negative socioeconomic impacts of either Roundup Ready or Roundup Ready Xtend crop systems."

    Response: As the commenter noted, APHIS does consider reduced labor requirements from growing herbicide resistant crops a benefit because the overwhelming number of growers who have commented on herbicide resistant crops noted it as such. Growers also commented on benefits from the ease of management and greater flexibility. The harm to small farmers attributed to GE seeds favoring large farmers is still uncertain. The same reference cited by the commenter states, "Genetically engineered seeds were commercially introduced in 1995, so they cannot account for changes in farm size before that time, and so far they have been used primarily in corn, cotton, and soybeans, so they cannot account for the ubiquitous increase in farm size among many crops" (MacDonald *et al.*, 2013). Even if it were true to partly explain the increase in farm size, because the use of GE crops is not expected to change between the No Action and Preferred Alternatives, no impact on consolidation is expected under the Preferred Alternative.

65. **Comment (APHIS-2013-0043-3345):** "In addition to contamination risks, the presence of dicamba-resistant weeds that will arise soon after the introduction of these crops will cost farmers millions of dollars. An analysis of the costs of herbicide-resistant weeds showed that farmers face significant costs from herbicide-resistant weeds due to reduced yields and increased production costs to combat weed infestations. These costs can range from $12 to $50 an acre, or as much as $12,000 for an average-sized corn or soybean farm or $28,000 for an average cotton farm. In 2010, herbicide-resistant weeds cost farmers $17 an acre from reduced yields. In 2012, 92 percent of surveyed cotton farmers reported that their losses due to weed control were at least $50 per acre. In Tennessee, glyphosate-resistant horseweed has increased soybean farmers' production costs by $12 per acre; and Georgia and Arkansas cotton producers have seen additional costs of $19 per acre due to glyphosate-resistant Palmer amaranth.

Since U.S. farmers have found herbicide-resistant weeds in their fields, they have changed farming methods to control them, resulting in higher weed-control costs and even a return to tillage and hand hoeing. In 2009, farmers in Georgia were forced to weed half of the state's 1 million acres of cotton due to the spread of pigweed, costing $11 million. The USDA must take and in-depth look at these economic risks in their Final Environmental Impact Statement for Monsanto's dicamba-tolerant cotton and soybeans."

Response: The increased costs noted by the commenter are due to a loss of benefits, not an incremental cost. Dicamba-resistant MON 87708 soybean and MON 88701 cotton are expected to reduce costs of weed control relative to the No Action Alternative. If dicamba-resistant weeds become widely prevalent, weed control costs are expected to reach but not surpass the costs under the No Action Alternative.

Seed Market Concentration

66. **Comment (APHIS-2013-0043-4702):** "APHIS also completely failed to analyze the foreseeable impacts of its proposed action to seed market concentration in the DEIS. Seed companies have aggressively undermined independent researchers' ability to fully investigate their patented crops' performance. Research and development suffer from seed market concentration. Seed companies often want the right to approve all publications, which researchers find unreasonable. This chills research on GE crops.

    Further, "[i]t is estimated that the top ten seed corporations around the globe hold 49-51% of the commercial seed market, and the top ten agro-chemical[companies] control 84% of the agrochemicals market. Likewise, all genetically modified (GM) seeds are bio-patented by multinational corporations and 13 commercial corporations own 80% of the GM food market." As the practical options become limited to transgenic, patented varieties, there are effects on the price of seed, and in this case the price of the various commodities that the DEIS acknowledges are made with soybean and cotton, as well as the cost of groceries.

    The increased seed market concentration has already made it hard for farmers to purchase conventional soybean and cotton seeds. As a result, farmers are forced to purchase GE seed and with that pay high technology fees."

    Response: The commenter seems to imply that non-GE seeds will not be available because the major biotech companies control the seed market because they have acquired most of the independent seed companies. The commenter further implies that biotech companies will not be responsive to the demands of the market, instead only producing more profitable biotech seeds. First, APHIS emphasizes that this topic is a market issue outside the scope of the EIS. Second, the availability and adoption of MON 88701 cotton and MON 87708 soybean should not change the baseline dynamics or market forces within the soybean and cotton seed industry or the way that soybean and cotton are tested, researched, developed or marketed in the United States. GE crop varieties are developed at considerable cost, have value as intellectual property and, as such, patent holders may seek legal means to preserve, protect and limit access to such intellectual property at their discretion.

APHIS does not agree with the commenter that currently farmers are finding it difficult to find conventional seeds and, as a result, have to buy GE seeds. The information sources cited by the commenter are from 2005 and 2009 are outdated and do not reflect the current availability of non-GE seeds. Farmers weigh productivity and profit when making decisions on the types of seeds to grow. If the market demands for non-GE products result in premiums being offered to growers for non-GE products that make it profitable for farmers to grow non-GE crops; or if farmers do not find any value added in planting GE seeds, they may decide to plant non-GE conventional or organic seeds. On the other hand, growers may have insect pest occurrences, preferred management practices, or other situations that they feel may favor planting of GE crops. For example, according to a USDA-ERS 2014 publication, "Planting Bt cotton and Bt corn continues to be more profitable, as measured by net returns, than planting conventional seeds (Fernandez-Cornejo *et al.*, 2014)." The fact that growers purchase biotech seeds despite their greater cost indicates that the growers obtain value from the seeds.

The recent trends in farmers choosing to grow non-GE seeds have been reported recently in agricultural professional publications. For example, on April 21, 2013, Corn+Soybean Digest reported that the demand for non-GM corn is up in parts of the northwestern Corn Belt, where marginal land, such as former grassland, is being put into corn production. On that less productive ground, "Growers don't want to spend extra money." It was noted that "Independent regional seed companies, in particular, offer "a lot of quality conventional corn (Morrison, 2013)." Similarly, according to AgProfessional (January 11, 2013), in recent years, a trend reflecting an increase in interest in growing non-GE seeds and available varieties has been observed (Keller 2013).

The non-GMO Sourcebook website (http://www.nongmosourcebook.com/index.php) provides an extensive listing of non-GMO and organic purveyors of seeds. For example, looking at the listing of companies selling non-GMO and organic soybean, 69 non-GE soybean and 46 organic soybean seed suppliers are found in the United States.

Crop Damage from Off-Target Movement of Herbicides

67. **Comment (APHIS-2013-0043-4713)**: "Monsanto and BASF have developed lower-volatility formulations of dicamba which they claim will mitigate drift damage to crops. However, whatever improvements have been made will be swamped by the massively increased use projected with introduction of dicamba-resistant crops, and the shift to later-season application under hotter conditions that promote volatilization. Even if many growers use these formulations, dicamba would drift more, and become much more prevalent in the air and the rain. Whether from local drift, regional transport, or toxic rainfall, dicamba use under the Preferred Alternative will sharply increase injury to sensitive crops."

    Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields.

68. **Comment (APHIS-2013-0043-4713)**: "Dicamba has been a frequently cited culprit in drift-related crop injury episodes, generally ranking third behind only glyphosate and 2,4-D (AAPCO 1999, 2005). The frequency of dicamba drift damage is all the more remarkable given its limited use in comparison to 2,4-D and glyphosate. In 2007, 27 million lbs. of 2,4-D and 183 million lbs. of glyphosate were used agriculturally (EPA Pesticide Use 2011), 10-fold and 67-fold greater use, respectively, than dicamba. Under the Preferred Alternative, dicamba would be applied in much larger quantities through much of the growing season. It would be applied later in the season when higher temperatures increase the frequency of volatilization and vapor drift. Because it is more damaging to sensitive crops, and at lower levels, than glyphosate, it can be expected to cause considerable damage to neighboring crops."

    Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

69. **Comment APHIS-2013-0043-3644**: A processing tomato grower stressed that Dicamba poses a severe threat given it is volatile and can move off target even when applied according to label. The grower stressed that he had collected insurance four times when neighbors sprayed non-volatile chemicals, so he is very concerned about the consequences of volatile chemical sprays, even if they are formulated to be less volatile.

    Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

    Comment (APHIS-2013-0043-4360): "The USDA's EIS predicts that under its "Preferred Alternative" of deregulating Monsanto's dicamba---resistant seeds, dicamba use will increase 88---fold and 14---fold for soybeans and cotton, respectively, compared to current practice. With deregulation of dicamba-resistant crops, the window for spraying will be significantly widened, with more applications allowed mid-season when temperatures are warmer and volatilization occurs more readily and when vulnerable crops have leafed out and are extremely susceptible to dicamba damage. Furthermore, Monsanto has requested USDA to increase the tolerance level allowed for dicamba on cottonseed from 0.2 ppm to 3 ppm (roughly 150 times current levels). And finally, the acreage on which dicamba will be applied will increase from current levels, as farmers begin to cultivate dicamba-resistant crops. Commercialization of dicamba-resistant seeds will therefore increase crop exposure to dicamba in time (longer periods of the growing season), in space (greater acreage) and in intensity (higher tolerance levels allowed).

    Dicamba is both extremely volatile and highly toxic to broadleaf plants. Volatilization leading to drift occurs more readily at higher temperatures (e.g. midseason, when dicamba could still be applied to Monsanto's dicamba-resistant varieties). Mechanical spray drift alone (e.g. when the herbicide is applied during high wind conditions or with incorrect farm equipment) readily causes damage to vulnerable crops. Dicamba has been identified by the Association of American Pesticide Control Officials as the third most commonly involved herbicide in drift occurrences. Dicamba residues are also difficult to remove from pesticide applicators' equipment. Because miniscule, residual amounts left in a sprayer can harm crops that are subsequently sprayed with other herbicides, the likelihood that vulnerable crops treated by an applicator's dicamba-contaminated equipment will be harmed increases.

Incidences of both mechanical spray and volatilization drift, as well as unintended contamination of spray equipment, are likely to rise sharply, threatening growers of specialty crops and non-dicamba-resistant commodity crops with severe crop damage and yield loss. Highly sensitive crops include nearly all fruits, vegetables, seed and nut crops, such as grapes, beans, lettuce, tomatoes, soybeans, sunflower, cotton and peanuts, among others. The specialty crop industry as well as seed and vegetable oil and fiber production, would be seriously impacted.

Other non-crop broadleaf plants e.g. in hedge rows, at field-edge or throughout the larger landscape, are also likely to be harmed, destroying critical habitat, food and reproductive sites for birds and other beneficial species critical to agroecosystem health (pollinators, natural enemies). Commodity growers' efforts to diversify their farms with perennials and other crops, support agriculturally critical ecosystem services, reduce wind and water erosion and diversify sources of farm income, would be undermined. USDA's draft EIS does not adequately examine these effects."

Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

70. **Comment (APHIS-2013-0043-4360): "**A revised EIS must include a full assessment of the direct and indirect harms associated with these seeds and their accompanying technologies, and *base its recommendation upon the results of such an assessment*.

These harms include:

Economic harms to farmers' businesses and livelihoods caused by dicamba drift damage to vulnerable crops, the cost of managing spread of intractable dicamba-resistant weeds, the emergence of dicamba-resistant soybean and cotton plants as noxious weeds themselves, restrictions on inter-state commerce and loss of access to export markets;

Environmental harm from increased dicamba application directly resulting from deregulation and commercialization of dicamba---resistant seeds, including reduction in farm- and landscape-scale plant diversity that provide alternative income sources as well as protection from wind and water erosion; loss of habitat and resources for birds, beneficial arthropods and other species; and loss of critical ecosystem services such as pollination and natural pest control; and

Socio-cultural harm to rural communities arising from increased conflict between neighboring farmers around issues of drift, crop damage and liability."

Response: The harms mentioned by the commenter are not harms resulting from the corn or soybean plants themselves. Rather, the alleged harms are attributed to increased herbicide use. EPA regulates herbicide use, USDA does not. An herbicide cannot be registered through the EPA, nor can an existing registration be amended, unless the registered use conforms to the EPA standard of "no unreasonable adverse effects on the environment" as described in FIFRA. The registration label includes strict limits on the quantities and methods allowed for the use of an herbicide to ensure that the standard of no unreasonable adverse effect is met. This is outside the scope of this EIS.

71. Comment (APHIS-2013-0043-3345): "Food & Water Watch, in partnership with the Organic Farmers' Agency for Relationship Marketing (OFARM), conducted a survey of organic grain producers on preventative measures that they use to avoid genetic contamination and the financial losses associated with contamination. Besides contamination by genetically engineered (GE) crops, many of the responding farmers wrote that they were also experiencing financial losses associated with chemical drift from nearby farms. One farmer mentioned that a neighbor's spray drift killed ten acres of seed corn one year, while another wrote, "my only problem comes from drift when commercial chemical sprayers spray on a windy day and the spray drifts across the road or buffer strip to kill my alfalfa or other crops. I call the company and complain but they have never compensated me for my loss as of yet."

Even Roundup, considered to be less harmful and less prone to drift than 2,4-D and dicamba has been a huge problem for organic growers. One farmer wrote that, "in the last 16 years I have had three instances where spray drift has affected my fields. All three times it was Roundup. It has totaled $65,000 and I have had to start the three-year transition process [for organic certification] all over." Another farmer had a load of wheat contracted for the human food market that was redirected for animal feed due to Roundup spray drift, resulting in a lower price for the crop. Not only has spray drift negatively affected relationships between neighbors, but it has also resulted in organic farmers being forced to take some areas of their farm out of organic production completely.

These spray drift concerns were echoed in a series of investigative reports by Indiana Public Media released in 2013. Their findings included:

- An incident involving glyphosate (Roundup) drift from an adjacent field cost one Indiana farmer and his buyer, Red Gold Inc., over $45,000.
- One farmer, Larry Edwards, was exposed to fungicide when a crop duster flew over his home. The fungicide led to long---term damage to his larynx, which affected his breathing short---term and permanently altered his voice.

- According to the Office of the Indiana State Chemist, there were 97 cases in which pesticide applicators violated anti---drift laws from 2010 to 2012.
- Drift violations are penalized with a fine only about 16 percent of the time. And fines are usually under $500.
- Preventative measures for pesticide drift are listed on each pesticide label, but are complicated and are not standardized. Efforts to standardize the labeling system have not yet been approved.
- Three quarters of farm violations from 2010 to 2013 involved drift, but that number is a conservative estimate since many farmers don't report their cases.
- Monsanto's dicamba formulation that will be used with its dicamba-tolerant soy and cotton will continue to drift and additional claims and losses will "skyrocket."

The USDA must evaluate the impact that increased dicamba use on soybeans and cotton would have on total herbicide use and the risks that are posed by the more frequent spraying on a greater area of farmland in the United States."

Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

72. **Comment (Virtual Meeting Public Comment 6): "**I'm here representing Food and Water Watch, a nonprofit consumer advocacy group that supports safe, accessible and affordable food for consumers and fair access to markets for farmers.

Food and Water Watch has provided the USDA our comments on the notice of intent to prepare an Environmental Impact Statement from Monsanto's dicamba-tolerant soybean and cotton varieties last July. In our comments we brought numerous concerns about the impacts of dicamba-tolerant crops and the increased use of dicamba.

Most notably are the impact the drift will have on specialty crop, organic and non-GMO farms and the unintended environmental impact associated with more dicamba use. We also submitted a letter asking the USDA to extend this comment period, and we hope you will honor that request.

Since then Food and Water Watch with partnership with Organic Farmers' Agency for Relationship Marketing, OFARM, conducted a survey of organic grain producers on preventative measures that they use to avoid GMO contamination and their financial losses associated with that contamination.

Besides GMO contamination, many of the responding farmers wrote that they were also experiencing financial losses associated with chemical drifts from nearby farms. One farmer mentioned that a neighbor's spray drift killed 10 acres' worth of feed corn one year. Another wrote, quote, My only problem comes from drift when commercial chemical sprayers spray on a windy day and the spray drifts across the road, a buffer strip to kill my alfalfa or other crops. I called the company and complained, but they have never compensated me for my loss.

And regarding dicamba specifically, one farmer wrote, quote, I'm more concerned with spray drifts, especially with the effort to release resistant soybeans. Everyone knows how volatile that chemical can be, not only to organic farmers, but all farmers and homeowners, unquote. Even Roundup, considered to be less harmful and less prone to drift than 2,4-D and dicamba, has been a huge problem for organic growers. One farmer wrote that, quote, In the last 16 years, I have had three instances where spray drift have affected my field. All three times it was Roundup. It has totaled $65,000, and I have had to start the three-year transition process for organic certification all over.

Not only has spray drift negatively affected relationships between neighbors, but it has resulted in organic farmers being forced to take some areas of their farm out of organic production completely.

The USDA's EIS predicts that dicamba use will increase up to 88 folds and 14 folds for soybean and cotton respectively compared to current practice. Without stricter controls over pesticide use, farmers will become more complacent with the applications on crop; and farmers with nearby nontolerant crops will pay the price.

I understand that the USDA does not have authority over pesticide registration and the use, but allowing these crops to become widespread on agricultural land knowing these implications will be enabling the irresponsible use of these chemicals and doing a huge disservice to U.S. agriculture in the long run.

Recently a meta-analysis on 2,4-D and dicamba done by researchers at Penn State University found that cotton is extremely sensitive to dicamba, especially in the flowering stage. Although dicamba-tolerant soybean and cotton will not be affected by dicamba, nontransgenic varieties can be damaged in a number of ways through off-target movement from ground spraying, if herbicides is applied in windy conditions, if dicamba is sprayed in high temperature condition.

Also residues are hard to remove from farm equipment and could be applied to susceptible crops unintentionally. And in areas where dicamba is used abundantly, herbicide residues can actually accumulate in the air and return to both transgenic and nontransgenic fields in the form of precipitation.

And because dicamba affects broadleaf plants, quote, nontarget exposures may therefore lead to a net reduction in the functional diversity and floral resources provided by seminatural habitats, unquote. This is from a Penn State University study on the effects of dicamba drift on plants and arthropods. Scientists found a decline in forb cover in field edge plots with only 1 percent of the field application rate of dicamba and declines in three insect species: pea aphids, spotted alfalfa aphid and potato leaf hopper.

There are clearly gaps in scientific knowledge on the response of wild plants and plant communities to low-dose exposures, especially in realistic field settings. There is incomplete evidence available regarding the direct and the indirect effect of herbicides on arthropods. And this is also from the study: Quote, While most herbicides do not appear to be directly toxic to arthropods, herbicides do affect plant nutrient levels and hormone pathways used in defense, both of which may influence plant susceptibility to herbivores.

We just hope that the USDA to do this kind of research on plant and insect communities and biodiversity in general before approving this dicamba-tolerant system. So we urge the USDA to deny approval of Monsanto's dicamba-tolerant varieties."

Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

73. **Comment (Virtual Meeting Public Comment 11): "**I am from Pesticide Action Network. And I am calling to express concerns with the dicamba-resistant cotton and soybean system.

As been mentioned previously and is, in fact, reported in your own USDA's draft Environmental Impact Statement, the agency, based on industry studies themselves, predict an 88-fold increase in the use of dicamba compared with current practice. And we know it is highly volatile, can drift for miles. Questions of formulation of new formulations that are intended to be less volatile aside, we also know from many years of experience that spray drift as well as volatilization drift happens and can devastate vulnerable crops and also affect adjacent ecosystems and entire landscapes.

The other thing that's particularly important here is that dicamba is 75 times more toxic to plant life than the glyphosate in Roundup. And as a result, the -- combining that with the extensive increase in dicamba use will create situations that we really have not experienced before.

We recognize and respect farmers who have been using dicamba over the years, their attempts to limit off-target movement. We know that best intentions aside, off-target movement does happen. Some of it is just inevitable. You have got to call in the sprayer. You have got to make an appointment. The wind picks up. You know, the next chance of rescheduling it is just not going to be very convenient when you're trying to manage your entire farm. So sprays go ahead with – even as wind conditions change.

The problem with how very toxic this is to other plants is that it puts specialty crop growers at extreme risk. Grapes, tomatoes, beans, wheat, corn, peanuts, fruit trees and all the nonresistant corn, cotton and soybeans out there are extremely sensitive to dicamba. We are very concerned that this expected surge in dicamba use and coupled with the drift damage is very likely to set back farmers' efforts.

It can cause -- and we have heard farmers reporting cases of drift that have wiped out their crops and are causing some to be on the verge of abandoning their farms. It would also set back farmers' efforts to diversify their farm at a time where with climate change, with increasing environmental stresses, with droughts and floods, the importance of diversifying farm landscapes is very high at this point in order to both have a healthy, environmentally sustainable farm and to have a diversity of crops. So farmers' efforts to diversify their farms, introduce perennials that can help with soil health and erosion and creating pollinator-friendly habitat, these are all goals that are increasingly raised up on farmers' agendas.

And as we look toward the future of really building a sustainable farming system, these are the kinds of shifts that we are seeing farmers trying to take and wanting to take to deregulate and put into the mix the dicamba-resistant crops right on the heels of --because it looks like its the 2,4-D resistant crops come onto the market, is really going to be a serious setback to these efforts of farmers to diversify and those farmers who are already growing crops and trying to make a living, make a business, keep their communities going with their -- especially with their fruit and vegetable production.

So we would urge USDA to refrain from deregulating the dicamba-resistant cotton and soybean seeds. We would rather see USDA take a proactive position towards prioritize a search in and extension of less chemical intensive, integrated weed management practices to support our commodity growers with those less chemical intensive, less damaging to a neighboring farmer's tugi.

There is cutting-edge research coming out of Penn State, out of Ohio State, out of many places on successful integrated weed management that does rely on these kinds of chemistries, but that includes instead Integro cultivation, crop rotation, cover cropping in combination with soil building practices and limited tillage, which really the state-of-the-art science that is coming out on that now is showing us that limited tillage systems can actually have both higher productivity, comparable profits and really improve soil health and prevent some of these soil erosion problems that have been raised in the past within -- that are definitely a problem with a much more aggressive tillage.

So there are a number of alternatives. We do not need to go this way. USDA has a responsibility and a broader agency mandate to keep in mind the bigger picture for all of our farmers and take steps to protect the economic success and well-being of our specialty crop growers as well as support the vibrancy and healthy environment of rural communities.

If we lose these farmers, both the specialty crop growers or even commodity growers that are trying to diversity their farms, organic farmers, conventional farmers, if we lose those, we are just going to see the further economic erosion and demise of our already stressed rural communities. And that is something that I am sure USDA would not want to see and would join us in really wanting to take steps to protect the – and strengthen and rebuild our rural communities rather than introduce technologies that could really have the opposite effect.

So I thank you for your time and consideration. We really urge USDA to refrain from deregulating these 2,4-D and dicamba-resistant crop technologies and to instead lead double efforts to provide commodity growers with cutting-edge research and extension of less chemical intensive, ecological, integrated weed management practices."

Response: APHIS acknowledges the comment. Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers these potential effects during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

74. **Comment (Virtual Meeting Public Comment 17): "**I commented before. I just wanted to do just a quick follow-up to a couple of comments that had been made that farmers are good at minimizing drift. Farmers are good at minimizing drift if the conditions are right. And we are very concerned that the cumulative effects of 130, 140 million acres of dicamba floating around is going to make that very difficult.

    And also the comment that quite often these cases are handled out of court when there is damage, that may be true. But quite often it is not good enough if you're the victim of an off-target movement that wipes out your specialty crop. So I just wanted to make those follow-up comments from others that were made, and I appreciate the opportunity."

    Response: APHIS acknowledges the comment. Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers this harm during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

<u>Commingling of GE and non-GE crops</u>

75. **Comment (APHIS-2013-0043-0211):** "While the risk assessment provided by the petitioner is completely valid, one must consider the adverse effects on international trade, especially in terms of agricultural products. While we operate based on risk assessment, other large markets operate using the precautionary principle, which bans the use of genetically engineered (henceforth referred to as GE) products. International consumer confidence in US products will plummet if this were to pass. There have been several examples of decreased consumer confidence in US products on the international market (for example the GE uncertainty with regards to wheat from Oregon - costed millions to the industry, just based on risk not even based on actually findings of GE products).

    "Japan and South Korea suspended some imports of American wheat, and the European Union urged its 27 nations to increase testing, after the United States government disclosed this week that a strain of genetically engineered wheat that was never approved for sale was found growing in an Oregon field. Although none of the wheat, developed by Monsanto Company, was found in any grain shipments and the Department of Agriculture said there would be no health risk if any was shipped governments in Asia and Europe acted quickly to limit their risk [by banning imports]." New York Times (http://www.nytimes.com/2013/06/01/business/global/japanand-south-korea-bar-us-wheat-imports.html?_r=0)

If this were to pass the economic benefit for Monsanto would be great; however, the economic benefit for those exporting to locations like Asia and the EU would be catastrophic. The ripple effect would go beyond a loss for soybean and cotton farmers, as GE pollen could contaminant products like honey labelled "organic" preventing beekeepers from accessing niche markets, like "organic", in other countries. GE concerns are on the rise and The United States' should consider the impact on farmers and producers on a large scale, given its already punctured agricultural reputation worldwide.

We should truly consider the impact of this decision on international trade, as it is one of the main assets in rebuilding our economy."

Response: Monsanto has requested approvals in all major soybean and cotton import markets. Tables 15 and 16 of the FEIS list the approval status of MON 87708 soybean and MON 88701 cotton in various countries as of November 7, 2014. Commingling of conventional and organic soybeans and cotton with Monsanto's traits is a market issue outside the scope of this EIS. The cost of tracking and separating approved GE crops is a market issue outside the scope of this EIS.

76. **Comment (APHIS-2013-0043-3345): "**Although it may be true that organic crops make up a small percentage of overall soybean and cotton totals in the United States, any contamination or damage to organic soy and cotton could result in huge economic losses for farmers. Data supplied by the Organic Trade Association illustrates that some grain buyers reject loads with more than 0.9 percent GE presence, resulting in 0.25 percent non-GE soybean and 3.5 percent non-GE corn rejections. A rejection from the loads' intended market means a lost premium for that non-GE product if it has to be sold as conventional or for animal feed. The estimated loss from market rejections alone is $40 million annually. USDA must fully evaluate the economic impacts of GE contamination for organic and non---GE growers.

Although the United States has rapidly approved GE crops and products, many countries, including key export markets, have not approved GE foods. More than three---quarters of consumers in Japan, Italy, Germany and France are skeptical of the safety of GE foods. Europe has been restrictive in its approval of biotech foods because of the uncertainty over the safety of the products for human consumption. European Union (EU) member states currently only allow animal feed imports to contain up to 0.1 percent trace GE material. Additionally, the EU requires all foods, feeds and processed products containing more than 0.9 percent biotech content to bear labels. Japan does not grow GE crops and requires mandatory labeling of GE foods. Countries that ban GE foods typically have strict rules to prevent unauthorized GE imports. The cost of tracing and separating these various GE crops to avoid contamination of non-GE crops and the potential impact of an export market suspending U.S. crop shipments due to the discovery of contamination are not evaluated in USDA's analyses and must be considered."

Response: See response to Comment 75. The cost of tracking and separating approved GE crops is a market issue outside the scope of this EIS.

77. **Comment (Virtual Meeting Public Comment 2): "**I'm affiliated with the Save Our Crops Coalition. We appreciate -- we appreciate the chance to participate in this meeting today. And I would like to say that we have submitted written comments already. But I would like to make these verbal comments as well.

We at Save Our Crops Coalition have grave concerns about the off-target applications that will be hitting the entire crop-growing areas, particularly in the Midwest once this technology is released, if it is released. Some of the problems that we found with the EIS that we would like to have your continued research into would be that there is no definition of what a nonvolatile with any metric, nonvolatile dicamba formulation is.

And it just says other than the DMA formulations, which leads to the belief that it will be used with DGA formulation. And in no way do we consider the DGA formulations nonvolatile. They may be less volatile than the old DMA formulations, but they are known to be volatile. And it is backed up by much practical experience in university research that that's the case.

The question will become, what is an acceptable level of volatility? And we believe that this level is not acceptable as there will be crop injury widespread with its use. We also believe that in the EIS it was felt that due to the -- that the pricing of the materials would not be a problem. But due to pricing, we believe that the least volatile materials might not be the ones that would be used.

In other words, the DMA formulations will be tempting for growers to use in replacement of the DGA or the brand of products that Monsanto might be releasing with. So that any indication that volatility products will be used at the minimum, we believe, is not accurate because the least volatile products will be the more expensive.

We also want to point out that the use of this product will be primarily later – our concerns is primarily use in the later of growing season once acceptable crops are already leafed out and that the environmental temperatures are going to be higher, which lead to more volatility.

And we also would like for APHIS to recommend to EPA imposing similar label restrictions as Dow has voluntarily done with their new Enlist product. We believe that those restrictions are reasonable and would add a lot to the structural safety of the use of this material.

Then finally, just as a comment of something -- we know that USDA and APHIS can formulate about the actual use of the chemistry and the safety of it. But we do believe that USDA and APHIS has a role to play in maintaining good rural acrimony. And we believe that potential for all the off-site, off-target movements will lead to problems among neighbors that sit on – sit together on church boards, school boards. And the prospect of suing your neighbor to recover losses is not good for rural acrimony.

So with that, I appreciate the chance to speak and look forward to your decisions."

Response: APHIS has no authority to regulate the use of pesticides, fungicides or other chemicals that may be used on MON 87708 soybean and MON 88701 or mitigate the impacts that may result from that use. The use of these agro-chemicals and any potential adverse effects falls under the authority of EPA and is outside the scope of this EIS.

78. **Comment (APHIS-2013-0043-3295): "**I am writing this letter in full support of the option to deregulate dicamba-tolerant soybeans and cotton (MON 87708 and MON 88701) without restriction as recommended by the draft Environmental Impact Statement on dicamba-tolerant technologies.

Although my current role is a University of Tennessee/University of Kentucky Tobacco Specialist, I served as a USDA-ARS Soybean Research Agronomist from 2004-2009, and my training is in the field of Weed Science. As in other letters of support that you will receive, I support the approval of this technology because dicamba will be another effective tool for producers to successfully manage weed resistance while maximizing soybean and cotton yield potential.

While it is true that dicamba has a long history of safe and effective use in corn, wheat, fallow, pasture, lawn, and conservation tillage acres, I acknowledge the concerns about off-target movement on sensitive crops, such as my current crop specialization, tobacco. I know that Monsanto is also concerned about this, as evidenced by the significant research that the company has conducted and funded to develop less volatile and more stable dicamba formulations.

I also acknowledge that, upon approval, there will be sporadic instances of drift and misapplication on sensitive crops that will result in losses. However, these instances will be due to application error rather than shortcomings of the technology. Regardless of the herbicide or technology, there is always a learning curve with the adoption and effective implementation of a new technology, and sporadic problems always arrive. The approval and release of significant, needed, and effective technology, such as dicamba-tolerant crops, should not be denied or delayed because of the potential for sporadic and short-lived problems when the certain to be realized advantages of the implementation of the technology far outweigh both the potential for limited, short-lived occurrences of drift or herbicide misapplication and outweigh the significant negative consequences of failing to advance this technology.

The approval, release, and adoption of glyphosate-tolerant crops is one of the most successful innovations in agriculture, even despite current glyphosate-resistant weed issues which have resulted from the misuse of the technology rather than the technology itself. It is important to realize that we had similar concerns and sporadic problems with the adoption and implementation of glyphosate-tolerant crops, and within a very short time, producers were safely and effectively using glyphosate-based weed control programs to maximize yields and profitability. In the case of dicamba-tolerant crops, both Monsanto and we have the benefit of learning from the introduction and use of glyphosate-tolerant crops, and the lessons learned from this have been and will continue to be used to more efficiently introduce and implement dicamba-tolerant crop technology, resulting in fewer problems with this new technology.

Additionally, because of the approval and overwhelming use of glyphosate by crop producers and advancements in sprayer and pesticide application technology since the introduction of glyphosate-tolerant crops, producers and custom applicators routinely apply glyphosate in close proximity to sensitive crops without issue. Concerning dicamba specifically, corn and forage producers and homeowners have applied dicamba in close proximity to sensitive crops for years.

As mentioned in other letters of support of this technology, we rely on our regulatory system to support innovation in agriculture to produce food, feed, and fiber in a sustainable way while maintaining a competitive advantage in production agriculture over other countries. I am confident that you realize that the appropriate measures are in place to maximize the benefits of this technology and minimize the growing pains of this new system. I am also confident that you will now further advance dicamba-tolerant soybean and cotton technology by deregulating dicamba tolerant soybeans and cotton (MON 87708 and MON 88701) without restriction to help our producers to continue to be more competitive, productive, efficient, and profitable while preserving and protecting their surroundings and the environment."

Response: APHIS acknowledges the comment.

Gene Flow/Commingling

79. **Comment (APHIS-2013-0043-4702):** "Under NEPA, APHIS must analyze the risks and adverse impacts of transgenic contamination from Monsanto's dicamba-resistant cotton and soybean to natural varieties and all environmental and intertwined socioeconomic impacts of such contamination. Transgenic contamination is a multi-faceted harm that has both an environmental and intertwined economic component. Transgenic contamination happens via many myriad pathways, including but certainly not limited to cross-pollination. Repeated past experiences and scientific evidence submitted and ignored by APHIS show that transgenic contamination from GE crops to conventional and organic plants can, has, and will cause significant and widespread economic harm to the agricultural economy both domestically and abroad in the billions of dollars, as well as the fundamental loss of choice for farmers and consumers caused by loss of non-GE varieties and irreparable contamination of biodiversity. *Id.* Such economic effects are cognizable impacts that must also be analyzed under NEPA, since they are interrelated and intertwined with environmental effects. These economic effects include market rejection of organic, export, and conventional GE-sensitive products. *Id.* Transgenic contamination has caused organic and conventional farmers and exporters billions of dollars and the loss of non-engineered varieties harms the proposed crops, if not restricted, will greatly exacerbate. The economic effects also include costly burdens, such as testing and required buffer zones, on non-GE farmers and businesses that are necessary to reduce the risk of contamination if approval is granted without restriction. *Id.* Further, economic effects include the risk and harm to GE-sensitive agricultural industries overall, such as organic, and the impacts of contaminating non-GE animal feed. *Id.* These effects

also include impacts on the public's and U.S. and foreign farmers' fundamental right to choose to have non-GE varieties of these crops. *Id.*

In this DEIS, APHIS admits contamination because of its proposed action is possible, but refuses to analyze it. *See, e.g.*, DEIS at 15. In fact, the agency has never analyzed the contamination impacts of any previously approved GE corn or soy, either. Yet one of the primary goals of NEPA is to preserve and maintain "an environment which supports diversity and variety of individual choice."[123] APHIS instead puts the entire burden on non-GE farmers to attempt to avoid contamination, making assumptions regarding their ability to do without analyzing the risks, impacts or any such mitigation upon which the agency is relying. *See* mitigation section *infra*.

APHIS claims it need not analyze or consider protections from transgenic contamination or alternatives to its action that might include such protections. *See, e.g.*, DEIS at 13, 93, 119. This argument lacks legal or scientific bases. NEPA requires that APHIS analyze all reasonably foreseeable direct, indirect, and cumulative impacts of its action in this DEIS. The agency does not–cannot—dispute the action may result in contamination. As APHIS well knows, two federal courts have already squarely held that transgenic contamination is a cognizable impact that must be so analyzed, holding that APHIS must rigorously analyze transgenic contamination in an EIS, regarding Roundup Ready alfalfa and Roundup Ready sugar beets. The agency's proposal and lack of analysis here is contrary to those court decisions and the agency's past precedent, since APHIS did analyze contamination impacts at length, in the only two EISs the agency has every completed on any GE crop. The agency's refusal to do so here is unlawful and violates all applicable statutes."

Response: Both MON 88701 cotton and MON 87708 soybean are not anticipated to increase acreage of GE cotton or GE soybean, as growers already cultivating GE cotton or soybean are the growers most likely to adopt MON 88701 cotton and MON 87708 soybean, respectively. When compared to other GE varieties of soybean and cotton, MON 88701 cotton and MON 87708 soybean should not present any new or different issues and impacts for organic and other specialty producers and consumers. The economic effects associated with commingling of conventional and organic cotton and soybeans with MON 88701 cotton and MON 87708 soybean is outside the scope of this EIS. As stated above in Section 3.5.4 of the EIS, USDA recognizes the importance for coexistence for all agricultural production systems, and has several initiatives in place focused on unintended presence (see response to Comment 80).

Organic Production

80. Comment (APHIS-2013-0043-4360): "Organic farmers whose crops are drifted on by dicamba face the additional possibility of losing organic certification of their crops. The absence of established tolerances for dicamba on many fruit and vegetable crops threatens interstate commerce in these crops. Finally, conventional soybean and cotton growers may find themselves under extreme pressure to buy Monsanto's dicamba-resistant varieties, so that their own crops are not destroyed by dicamba drift. Those who have been exporting clean, non-GE soybean and cotton product to non-GE markets in

Europe or Japan, may find themselves unable to maintain their non-GMO production due to dicamba drift damage. The loss of these export markets will be devastating to their businesses."

Response: Off-target injury to sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers the potential effects of herbicide use during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields.

The National Organic Program establishes laws regulating USDA organic products including production, handling, labeling, trade and enforcement (USDA-AMS, 2010). The National Organic Program requires organic production operations to have a management plan approved by an accredited certifying agent, that may include measures such as distinct, defined boundaries and buffer zones to prevent unintended contact with excluded methods from adjoining land that is not under organic management. These guidelines would prevent drift of prohibited chemicals or pollen flow from GE organisms. This plan enables the production operation to achieve and document compliance with the National Organic Standards. Isolation established with an organic certifier is established to prevent unintended drift.

The USDA recognizes the importance of co-existence for all agricultural communities. Pollen mediated gene flow is a relatively rare event in cotton and soybean, however, post-harvest comingling could potentially occur, causing potential economic losses for organic producers due to unintended presence of GE DNA. Manufacturers and retailers that sell organic products use GE DNA tolerance levels set by private sector in the U.S. The non-profit third party verification 'Non-GMO Project Verified' is widely used. International governments may set low level presence standards (LLP) based on Polymerase Chain Reaction testing for GE DNA; buyers may set higher or even zero standards. Rejection of U.S. organic products due to the presence of GE DNA presence has occurred; soybean has been rejected in Taiwan and Korea due to the presence of GE DNA.

To address the issue of co-existence, USDA has a broad-based advisory committee, the Advisory Committee on Biotechnology and 21st Century Agriculture (AC21)[2], which was established by the Secretary of Agriculture originally in February 2003 to examine the long-term impacts of biotechnology on the U.S. food and agriculture system. Its most recent charge directly focused on issues associated with coexistence between agricultural different production systems.

<u>Increased Market Share and Consolidation in Seed Industry</u>

81. **Comment: (APHIS-2013-0043-0551)** "Seed trait companies have historically marshalled their market power (monopoly) to extract as much value as possible from farmers. They do this through contractual arrangements with seed companies. For

[2] http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=AC21Main.xml

example, between herbicide tolerance and insect resistance, Monsanto receives a technology fee payment on roughly 95% of all cotton acres planted in the US. Historically, farmers have only been able to purchase improved germplasm (higher yielding genetics) if they also purchased the genetic traits attached to those varieties.

Another example involves the technology fee for Roundup Flex or Roundup Ready crops. The development of the new herbicide tolerant traits in question is a direct result of the development of weed resistance to glyphosate. Therefore, the glyphosate tolerant trait in crop seed no longer has the value it once had. Farmers have to use residual herbicides that take the place of glyphosate. Yet, the fee paid for the Roundup Ready trait has not declined and farmers are unable to purchase seed without that trait without sacrificing yield. My concern is that these technologies will be priced and marketed as they have in the past with seed price increases for technologies that farmers don't really want. (A quick look at the NASS data on prices paid by farmers for seed will show that seed price increases have already outpaced any increases in other costs of production or in commodity prices.)"

Response: The pricing of biotech seeds, technology fees, and marketing of improved germplasm and traits are outside the scope of the EIS. The fact that growers purchase biotech seeds despite their greater cost indicates that the growers obtain value from the seeds.

Human Health

82. **Comment (APHIS-2013-0043-3345):** "Dicamba is a known carcinogen and must be adequately tested for human safety based on the proposed application rates if dicamba-tolerant cotton and soybeans were to be approved. Additionally, the synergistic effects of the Xtendimax dicamba and glyphosate tank mix must be examined.

    Additionally there is no evidence that toxicity studies on nontarget organisms used Monsanto's full formulation and not just the active ingredient. Since Monsanto will be selling its full formulation, including dicamba, glyphosate and the inert ingredients, to farmers across the country, it is prudent that they conduct studies on how all of the chemicals interact when mixed, and the effects that the combination has on human health and nontarget organisms. The USDA is responsible for protecting the public and absolutely must consider human health impacts of increased dicamba use associated with these crops in its final Environmental Impact Statement."

    Response: USDA does not regulate herbicide use. EPA is fully assessing the potential human health impacts related to increased dicamba exposure in its risk assessments. An herbicide cannot be registered through the EPA, nor can an existing registration be amended, unless the registered use conforms to the EPA standard of "no unreasonable adverse effects on the environment" as described in FIFRA. The registration label includes strict limits on the quantities and methods allowed for the use of an herbicide to ensure that the standard of no unreasonable adverse effect is met. USDA has summarized the EPA risk assessment prepared in the registration process in Appendix 8 of the FEIS.

83. **Comment (APHIS-2013-0043-3278):** "I am writing to provide comments regarding the safety of dicamba in regards to the determination of non-regulated status of dicamba resistant soybean and cotton varieties.

These comments are submitted based upon my knowledge, training, and expertise in the areas of Medicine and Medical Toxicology. I am a medical toxicologist in practice for the last 27 years, with board certification in Internal Medicine, Emergency Medicine, and Medical Toxicology. I participate in evaluation of patients with concerns about environmental and occupational exposure; and have published in the area of laboratory test interpretation, and risk assessment and risk communication.

Having reviewed literature regarding the human health effects of dicamba, and being familiar with a variety of herbicides and their health impact, I am writing in support of nonregulated status for this application. In particular, the relatively short environmental half-life of dicamba of approximately 1 month, and the very limited *in vivo* metabolism demonstrated in several animal species, the lack of significant acute health effects (particularly in comparison with some other classes of herbicide), as well as the very low concentrations detectable in population surveys (parts per trillion, if measureable: http://npic.orst.edu/factsheets/dicamba_tech.html), and the lack of evidence of endocrine-related effects or other chronic health impact from this compound all argue for its safety in appropriate agricultural use. Thus, I support the deregulation of Dicamba Resistant Soybean and Cotton, as recommended in the Draft Environmental Impact Statement (EIS)."

Response: See response to Comment 82.

84. **Comment (APHIS-2013-0043-3889):** "My studies have confirmed that Roundup is far more toxic to humans than we are being led to believe by Monsanto. The widespread adoption of Roundup-ready crops has led to an alarming increase in glyphosate residues in the food and a corresponding increase in multiple diseases and conditions that are harming our children and derailing our health system.

I am very concerned about this latest deregulation of dicamba-tolerant GE cotton and soybean. USDA continues to take American farmers down the path of increased reliance on GE crops in spite of mounting evidence that shows that these crops always lead to increased herbicide use, environmental contamination, and resistant weeds, in an escalating battle that we can never win.

The US government needs to stop this treadmill of ever-increasing of these toxic chemicals, and start funding research aimed at finding more economical ways to grow crops sustainably using organic methods. If we don't make an about face in the way we practice farming, we will destroy not only the health of the soil but also human health and perhaps the entire ecosystem of the planet."

Response: See response to Comment 82.

85. **Comment (APHIS-2013-0043-4713)**: "Dicamba exposure has been associated with increased incidence of cancer **–** including non-Hodgkin's lymphoma and multiple myeloma **–** in pesticide applicators. Exposure to pesticides has long been suspected as a risk factor in NHL and multiple myeloma due to a striking fact. While farmers are generally healthier, with lower overall cancer rates than the general population, they have higher than average risk of contracting NHL, multiple myeloma and several other cancers. This fact lends weight to epidemiology studies such as those cited above that find associations between these cancers and specific pesticides. A recent exhaustive meta-analysis covering thirty years of epidemiological investigations into links between NHL and pesticides found a 30% to 40% increased risk of NHL in farmers exposed to benzoic acid herbicides (the class to which dicamba belongs) and dicamba, respectively (odds ratios of 1.3 and 1.4) (Schinasi and Leon 2014, Table 5). More recent studies of over 50,000 farmers in Iowa and North Carolina as part of the Agricultural Health Study found suggestive associations between dicamba exposure and both lung and colon cancers."

    Response: See response to Comment 82.

86. **Comment (APHIS-2013-0043-4713)**: "Preconception exposure to dicamba exposure has also been associated with a greatly increased risk of birth defects in male offspring in the Ontario Farm Family Health Study. Animal experiments in which pregnant mice exposed to low levels of dicamba in drinking water had smaller litters also suggests developmental toxicity.

    Dicamba may also have neurological toxicity. One study found 20% inhibition of the nervous system enzyme in pesticide applicators whose only common pesticide used was dicamba."

    Response: See response to Comment 82.

87. **Comment (APHIS-2013-0043-4713)**: "Dietary exposure to dicamba in the general population may also pose health risks. In Appendix A, CFS discusses how EPA has substantially raised the level of dietary exposure that the Agency considers safe from the standard that it set in 1987, a standard also endorsed by a National Academy of Sciences committee.

    Under the Preferred Alternative, farmer and pesticide applicator exposure to dicamba would increase significantly due to higher rates, more applications, and more farmers applying the herbicide than ever before. Because dicamba has moderate persistence and is frequently detected in surface waters, the general population would also likely be exposed to more dicamba than ever before."

    Response: See response to Comment 82.

88. **Comment (APHIS-2013-0043-4702):** "APHIS passes the buck to FDA, under the Federal Food, Drug, and Cosmetic Act (FFDCA), but APHIS cannot solely rely on another agency's evaluation of impacts under a separate statute to adequately fulfill

APHIS's own NEPA obligations. Health impacts are cognizable impacts pursuant to NEPA that require analysis in an EIS if they may significantly impact the "human environment." These impacts are interrelated to environmental impacts because they would stem from the transgenic contamination of natural corn and soy (through cross-pollination and other means) and cause unknown and unwilling human exposures. Accordingly, APHIS has its own duty to comply with NEPA, including assessment of potential significant impacts to public health and safety.

In addition to being contrary to NEPA, there is a second reason APHIS should not defer completely to FDA: FDA's GE consultation process, which is merely voluntary, is extraordinarily weak and therefore fails to adequately assess human health impacts. (*See, e.g.*, DEIS at 97 ("GE organisms for food and feed may undergo a voluntary consultation process with the FDA prior to release onto the market.") (Emphases added). That consultation process is based on a statement of policy, not a binding regulation. GE crop developers may choose to consult with FDA, but this process is vitiated by its voluntary nature and a lack of any established testing standards; in particular, GE crop developers seldom if ever conduct animal feeding trials with GE crops for the purpose of detecting potential toxicity. The manufacturer merely sends FDA a summary of its findings. FDA makes no findings of safety itself. *See* DEIS at 96, 97 ("Under the FFDCA, it is the responsibility of food and feed manufacturers to ensure that the products they market are safe and labeled properly.") (Emphasis added).) In the consultation process for dicamba-resistant cotton and soybeans, FDA neither prepared any NEPA documentation (an EA or EIS) on its policy, nor provided notice and comment opportunities for the public."

Response: APHIS disagrees with the commenter that APHIS should not defer to FDA in regards to assessing the food safety of MON 87708 soybean and MON 88701 cotton. FDA has authority under the Federal Food, Drug, and Cosmetic Act (FFDCA) Act to ensure the safety of all domestic and imported foods for man or other animals in the United States market, except meat and poultry products. As explained by FDA, "Bioengineered foods and food ingredients (including food additives) must adhere to the same standards of safety under the FFDCA that apply to their conventional counterparts. This means that these products must be as safe as the traditional foods in the market. FDA has broad authority to initiate regulatory action if a product fails to meet the safety standards of the Act." Under the FFDCA, it is the responsibility of food and feed manufacturers to ensure that the products they market are safe and labeled properly. Food and feed derived from GE organisms must be in compliance with all applicable legal and regulatory requirements.

The FFDCA requires premarket approval of any food additive - regardless of the technique used to add it to food. GE organisms used for food or feed purposes undergo a voluntary consultation process with the FDA prior to release to the U.S. market. The FDA established this voluntary consultation process to review the safety of foods and feeds derived from GE crops for human and animal consumptions. Although a voluntary process, to date, all applicants proposing to commercialize a GE variety that would be included in the food supply have completed a consultation with the FDA. FDA has concluded that MON 87708 soybean and MON 88701 cotton are as safe as conventional soybean and cotton for consumption by humans and animals. APHIS agrees that "FDA's authority under current law, both pre- and postmarket provisions, is sufficient to ensure the safety in the marketplace of foods derived from new plant varieties."

89. **Comment (APHIS-2013-0043-4702):** "It is well accepted that genetic engineering has a greater likelihood of producing unintended effects than traditional breeding, some of them hazardous or detrimental (NRC, 2004). Unintended effects are rarely well understood, but can result from extensive mutations to an organism's genes caused by the genetic engineering process (Wilson *et al.*, 2006). Such disruptions are sometimes evident in the form of non-viable or debilitated organisms. However, subtler effects often are not detected in the development process. Potential adverse effects include the unintended amplification of naturally occurring toxins that are normally present at low, unobjectionable, levels; the unintended creation of novel toxins; and reduced levels of nutrients."

    Response: APHIS disagrees with the commenter's statement that "It is well accepted that genetic engineering has a greater likelihood of producing unintended effects than traditional breeding, some of them hazardous or detrimental." This statement is inconsistent with the published scientific literature on this topic, including the source the commenter cites for this information, the 2004 NRC report, *"Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects, Committee on Identifying and Assessing Unintended Effects of Genetically Engineered Foods on Human Health"* (NRC, 2004). The conclusions presented in the 2004 NRC report completely conflict with the statements made by the commenter. Below is an excerpt from the 2004 NRC report:

    > "In contrast to adverse health effects that have been associated with some traditional food production methods, similar serious health effects have not been identified as a result of genetic engineering techniques used in food production. This may be because developers of bioengineered organisms perform extensive compositional analyses to determine that each phenotype is desirable and to ensure that unintended changes have not occurred in key components of food (NRC, 2004)."

    The Wilson et al., 2006 paper cited (Crespo *et al.*, 2014) discusses transformation-induced mutations. It is well documented that the plant transformation process can cause mutations; however, the commenter's assumption that those mutations can cause a safety risk such as produce toxins or reduce nutrients is unfounded in scientific evidence. Additionally, introducing plant mutations has been a strategy used in plant breeding for many years, leading to the release of thousands of novel plant varieties (Ahloowalia *et al.*, 2004). Unlike GE varieties, varieties developed using mutation breeding do not require regulatory approval, therefore extensive testing is not required. Additionally, varieties developed using mutation breeding are even accepted in organic production systems. The commenter's claim that mutations are unique to genetic engineering is completely false.

90. **Comment (APHIS-2013-0043-4702):** "Similarly APHIS failed to analyze the impacts on public health and farm worker health from the massive increase in herbicide use that

will stem from its proposed action. Instead, APHIS relied completely on EPA. As discussed *supra*, this reliance is similarly misplaced and violates NEPA."

Response: APHIS has no authority to regulate herbicide use or mitigate the impacts that may result from that use. The EPA registration process under FIFRA ensures that pesticides will be properly labeled, and that, if used in accordance with label specifications will meet the EPA's safety standards of no unreasonable adverse effect on the environment and a reasonable certainty of no harm to humans.

The authorization of the new uses of dicamba on MON 87708 soybean and MON 88701 is solely under the discretion of EPA. As part of their decision whether to register dicamba for use on MON 87708 soybean and MON 88701, EPA is thoroughly analyzing the direct and indirect effects on human health from the use of dicamba MON 87708 soybean and MON 88701.The effects of pesticide use on human health is outside the scope of this EIS.

Biological Resources

91. Comment (APHIS-2013-0043-4706): "Xtend soybean is the first broadleaved plant that will be sprayed directly with dicamba. Therefore, it is crucial that APHIS analyzes and assesses risks to rhizobium and the nitrogen fixation process in Xtend soybeans under realistic field conditions that include herbicides that Xtend soybeans have been engineered to withstand. APHIS does not analyze or assess impacts of dicamba as used on Xtend soybeans in any specific way, nor does Monsanto provide any specific data or observations on nitrogen fixation in Xtend soybean with associated dicamba use.

Herbicide use on resistant crops has been shown to affect soil microbes. In fact, glyphosate use on glyphosate--resistant soybeans has been shown to impair nitrogen-fixing bacteria in some circumstances (Zablotwicz and Reddy 2007, Kremer and Means 2009, Zobiole et al. 2010, Bohm et al. 2009).

If approval of Xtend soybean does lead to a reduction in nitrogen fixation in soybeans, then soybean growers may need to add more nitrogen fertilizer to their fields, with increased socioeconomic costs and environmental impacts. Impacts on nitrogen fixation need to be ascertained before concluding, as APHIS does, that agronomic inputs will not be changed by a deregulation decision (DEIS at 183).

Xtend cotton is also glufosinate resistant, in addition to being dicamba resistant. Some studies have shown negative effects of glufosinate on beneficial microbes. Pampulha et al. (2007) treated soil in laboratory microcosms with the glufosinate formulation "Liberty" at different concentrations and durations, and then determined the types, numbers and functional activity of culturable microorganisms – bacteria, fungi, and actinomycetes; cellulolytic fungi, nitrite oxidizing bacteria, and dehydrogenase activity. They found a complex pattern of changes in number and activity of microbes. However, the most dramatic change in response to glufosinate was a large decrease in dehydrogenase activity over time, which they say is a good indicator of general microbial activity. They conclude that glufosinate use 'may have injurious effects on soil microorganisms and their activities.'"

Response: The direct and indirect impacts of the use of dicamba on MON 87708 soybean and MON 88701 cotton are assessed by EPA and are outside the scope of this EIS.

92. **Comment (APHIS-2013-0043-4706):** "APHIS makes an explicit assumption that there are no differences in composition between Xtend soybean and cotton and non-dicamba-resistant counterparts:

The APHIS PPRAs did not identify any changes in MON 88701 cotton or MON 87708 soybean that would directly or indirectly affect natural or biological resources. <u>These plants are compositionally similar to other cotton and soybean plants</u>. The growth habits of these plants are also similar to other cotton and soybean plants. (DEIS at 143, underlining added).

However, the PPRA analysis was based on compositional comparisons that did not include dicamba residues and metabolites.

CFS reiterates that APHIS, in making a decision to approve Xtend soybean and cotton, must go beyond a description of the genotypes resulting from genetic engineering of soybean and cotton to be dicamba resistant, to describe and assess the PPA impacts of significant changes in the phenotypes of Xtend soybean and cotton, in environments that they are likely to be grown. Instead, APHIS has limited its assessment of important aspects of phenotypes of Xtend soybean and cotton to environments that these crops will rarely encounter – environments that are absent applications of dicamba.

In order to determine impacts of Xtend soybean and cotton, APHIS first must describe how Xtend soybean and cotton differ in phenotypic characteristics as a result of the specific genetic engineering events. The first step in doing so is to determine expression patterns of the transgenes, by finding out where, when, and how much of the gene products are made in the Xtend soybean and cotton plants in environments in which they are likely to be grown. In this case, the engineered gene products are enzymes that break down, or metabolize, dicamba and some related herbicides. In it's Petitions, Monsanto provides APHIS with some transgene expression data. It measured DMO protein in several plant parts and stages of development of Xtend soybean and cotton grown with different combinations of the herbicides that the introduced enzymes allow them to withstand. Monsanto also provided expression data for the PAT protein in Xtend cotton that confers resistance to glufosinate (see Monsanto Petitions for Deregulation, "Characterization of Introduced Proteins").

APHIS uses Monsanto's description of when, where and how much of the transgenic proteins are present in Xtend soybean and cotton plants, along with analyses of protein sequence comparisons to known toxins and allergens, and *in vitro* studies of DMO protein digestion (DEIS at 111), to determine whether ingestion of the transgenic proteins themselves was likely to harm non-target animals (DEIS at 131-132, 203-204, 234).

The assumption that Monsanto's *in silico* (computer simulated) and *in vitro* studies of DMO and PAT proteins can predict toxicity of these proteins, as they exist within Xtend soybean and cotton plants, is unfounded. Proteins made in plants can have different properties than counterpart proteins in bacteria that were used in the simulated digestion studies, and computer analyses of coding sequences do not always identify toxins and allergens accurately (Freese and Schubert 2004). But the biggest problem with APHIS' assumption is that Monsanto's analyses are based on toxicity to mammals and, by extension, to humans, whereas the non-target organisms that could be impacted by approval span the taxonomic spectrum, from beneficial soil annelids (i.e. earthworms) to insect pollinators and endangered birds. Human and mammalian parameters of toxicity are simply not applicable over this range of organisms.

Pollinators ingest different plant parts than humans and livestock. Composition of pollen, nectar and guttation liquid was not determined to assess differences resulting from the Xtend events, for example. The inadequacy for pollinators of toxicity assessments based on mammals was also stressed in a recent EPA white paper on pollinator risk assessments (EPA SAP 2012). Nor were impacts on honey bees studied by Monsanto in its field trials. Therefore, there are no relevant data for making an assessment of impacts of approval to honey bees or other pollinators.

In addition, APHIS must continue on in its analyses, past the characteristics of the novel proteins themselves, to determine how the functioning of the DMO and PAT enzymes changes the phenotypic characteristics of Xtend soybean and cotton plants, and whether the changes could harm non-target species. As with the levels of DMO and PAT proteins, these phenotypic differences in metabolism should be described and assessed in the presence of the herbicides that will be used with Xtend soybean and cotton.

Monsanto's whole purpose in engineering corn and soybeans with these particular transgenes is to have the genes expressed throughout the plants at high enough levels that the resulting proteins will be active in converting dicamba and glufosinate to non-phytotoxic metabolites. The rate and extent of conversion of herbicides to metabolites, and thus the level of herbicides and metabolites, is the most relevant phenotypic difference to consider after looking at the properties of the novel proteins themselves, and this is not considered by APHIS in their assessments.

Monsanto's studies of metabolites in Xtend soybean after applications of dicamba show that the activity of the DMO enzyme metabolizes dicamba "mainly to a glucose conjugate of 3,6-dichloro-2-hydroxybenzoic acid (DCSA), with smaller amounts of conjugates of 2,5- dichloro-3,6-dihydroxybenzoic acid (DCGA) and another glucose conjugate of DCSA. The conjugates are very complex molecules which are not readily synthesized to produce analytical reference standards" (Moran and Foster 2010 at 30). It appears, then, that the major metabolites of dicamba present in Xtend soybean are not found in the metabolism studies of non---dicamba---resistant soybean, namely glucose conjugates of DCSA and DCGA. These conjugates are present in other crop plants, but at very low levels, rather than being the major products, as here. And, although the toxicity of DCSA and DCGA has been studied, apparently the toxicity of the conjugates has not been studied.

Assuming that Xtend cotton behaves similarly to Extend soybean, we expect that glycosides of DCSA will be the main metabolites of dicamba that result from activity of the engineered enzyme in Xtend cotton. Studies of conjugated metabolites of 2,4-D, such as dicholorphenol (DCP) glycosides, show that the DCP aglycone can be released during mammalian digestion with possible impacts on health (Laurent et al. 2000, 2006; Pascal-Lorber et al. 2003, 2008, 2012). Free DCSA may also be released from conjugates during digestion. These conjugates in Xtend cotton thus need to be measured and tested for toxicity.

Another concern is whether the formaldehyde produced in the breakdown of dicamba by the engineered DMO enzyme in Xtend soybean and cotton when dicamba is applied results in formaldehyde levels over and above those that naturally occur in these crops, and that may be injurious to animals that eat the plant parts, since there can be health effects from ingestion of formaldehyde (ATSDR 2008, Fig. 1.2). Formaldehyde levels in dicamba-treated Xtend soybean and cotton tissues should be tested after applications to see if they fall below or above safe limits.

Monsanto did not describe studies to test toxicity of these metabolites to non-target organisms, other than simply observing that insects were found in fields of Xtend soybean and cotton at levels comparable to non-engineered corn and soybeans (Xtend Soybean PPRA at 19-20). These observations do not constitute an appropriate study of toxicity, nor do they address the range of organisms of interest."

Response: As previously stated, only EPA has the authority to regulate pesticides, and the effects of herbicide metabolites are considered by EPA in its risk assessments. The potential toxicity of dicamba or glufosinate metabolites is outside the scope of this EIS**.**

MON 87708 DMO was isolated from MON 87708 soybean for use in the safety studies, while *E coli* produced proteins were used for the safety studies for both DMO and PAT in MON 88701 cotton APHIS disagrees with the assertion made by the commenter that Monsanto's simulated digestion studies are insufficient because they used proteins made in bacteria which can be different than proteins made in plants.

While it is true that proteins produced in plants may have sugar modifications (glycosylation) attached to the protein, Monsanto tested whether DMO and PAT are glycosylated in plants and determined they were not (Monsanto, 2012a; 2012b). Many allergens have been reported to be expressed at high levels in plants, be resistant to digestive enzymes and heat and be glycosylated. Both DMO and PAT proteins are expressed at low levels, *in vitro* digestive fate studies show that these proteins are rapidly degraded in simulated gastric fluid, and neither protein appears to be glycosylated in plants. These results indicate that the two proteins are unlikely to be allergens.

APHIS also disagrees with the commenter's assertion that *in silico* analysis of the proteins for potential toxins is not enough because it is not always possible to identify toxins and allergens. All known toxins and allergens, including those toxic to any organism, can be identified this way and unless there is a valid risk hypothesis to suggest the protein may be a toxin when its sequence does not match a known toxin, APHIS does consider it reasonable to request additional experimentation.

The commenter further raises the point that Monsanto's evidence does not rule out the possibility that the DMO and PAT proteins or plant metabolites that result from their expression in plants may be toxic to earthworms, pollinators, and birds. While the risk of harm cannot be completely ruled out, the risk of harm to these organisms is considered to be low for several reasons:

- First, the *dmo* and *pat* genes were isolated from naturally occurring widely prevalent bacteria, *Stenotrophomonas maltophilia* and *Streptomyces hygroscopicus*, respectively. Thus earthworms, birds, and bees are naturally exposed to these proteins.
- Second, the *in silico* studies include toxins to any organism, not just humans and mammals, and do not reveal a match between these proteins and any known toxin.
- Third, Monsanto has determined that the DMO protein is extremely substrate specific. Monsanto tested five endogenous compounds found in soybean and cotton that are structurally similar to dicamba (o-anisic acid, vanillic acid, syringic acid, ferulic acid and sinapic acid). Dicamba showed a high level of activity. Under the same reaction conditions, the compounds tested were not metabolized upon incubation with DMO (Monsanto, 2012a; 2012b). Based on this survey of potential substrates, there is no indication that DMO has activity on endogenous plant substrates.
- Fourth, PAT proteins are highly specific for L-phosphinothricin. Other L-amino acids, including the L-phosphinothricin analogue L-glutamate, are unable to be acetylated by PAT and do not inhibit acetylation of L-phosphinothricin in competition assays (Wehrmann *et al.*, 1996). Therefore, the PAT protein is unlikely to affect the metabolic system of cotton. Numerous glufosinate resistant crops containing the PAT protein encoded by the *bar* gene have undergone regulatory review and approval in the United States and several other countries (see lists in (OECD, 1999; 2002; ILSI, 2011)). The safety of the protein has been established in the scientific literature (Herouet *et al.*, 2005).
- Fifth, no significant differences were observed in the major metabolites between the engineered corn and soybean and untransformed lines (Monsanto, 2012a; 2012b).

Thus, the likelihood is small that the DMO and PAT proteins are toxic to a non-target organism, or that an endogenous plant compound would be metabolized by these enzymes to generate a compound that is toxic to a non-target organism.

<u>Herbicide Resistant Weeds</u>

93. **Comment (APHIS-2013-0043-4333):** "Like most organisms, continued selection pressure has resulted in weed populations resistant to various herbicides. Some species can effectively be controlled with various cultural practices or the use of herbicides with alternate modes of action. The development of glyphosate resistant Palmer amaranth has resulted in a very difficult to control weed. In some areas, conservation tillage practices

are being abandoned to use tillage to control this species. While these practices in some instances may effectively manage the resistant population, producers are mitigating the many demonstrated benefits of minimum tillage production systems. The potential to utilize the active ingredient dicamba to manage this species may enable producers to continue the use of minimum tillage systems while effectively controlling the glyphosate resistant Palmer amaranth."

Response: APHIS acknowledges the comment.

94. **Comment (APHIS-2013-0043-4713):** "Because most growers of dicamba-resistant crops will be those who have glyphosate-resistant weeds, and those resistant weeds will be immune to glyphosate, they will be exposed to only one effective mode of action. For the glyphosate-resistant weed, it is as if only a single herbicide is being used, the perfect recipe for resistance. These GR weeds will then be under intense selection pressure to evolve additional resistance to dicamba, particularly since dicamba will often be applied twice or three times per season. As APHIS concedes, under this scenario "resistance might be selected quickly" (DEIS, p. 181)."

    Response: APHIS acknowledges the comment. The analysis in the EIS is consistent with these comments.

95. **Comment (APHIS-2013-0043-2241):** "The area where I grew up and worked has a history of weed resistance dating back to the early 2000's when glyphosate resistant horseweed (*Canada canadensis*) was discovered in west Tennessee. It is now ubiquitous to the Mississippi delta region of Missouri and Arkansas and all of the cropland in west Tennessee. This weed was primarily a winter annual weed that could be held in check by the integration of tillage or 2,4-D and/or dicamba into the early burndown weed control program.

    I first encountered the difficulties producers are experiencing in controlling herbicide-resistant weeds during my tenure as a crop consultant. The focus of my job shifted from surveying fields for thrips, plant bugs, worm and disease pests to include monitoring the spread and removal of glyphosate resistant palmer amaranth (*Amaranthus palmeri*) in cotton, corn and soybean fields. Since that time, a prominent focus of each of the University research programs where I have been employed, has been around controlling this weed specie. Palmer amaranth has become ubiquitous in area fields as did horseweed, and the importance of Palmer amaranth control has rapidly become the utmost concern for producers in all geographies that I have worked. Although producers are adopting control methods that include alternative technology, multiple pre-emerge herbicides, adjustments in tillage practices, and are experimenting with alternative control measures like cover crops to control this weed, adequate control of this weed is still difficult. Sufficient control of this weed depends on adequate, timely precipitation in combination with the cultural practices previously mentioned. Even when all possible control measures are employed, hand weeding to control escapes is still a common practice. This weed is a summer annual weed that is extremely competitive with cotton and soybeans. It can produce hundreds of thousands of seeds per plant making 100%

control a necessary component to sustainability. When control methods are not extremely effective, yield loses of 30 to 40 percent are not uncommon."

Response: APHIS acknowledges the comment.

96. **Comment (APHIS-2013-0043-4713):** "Dicamba resistance must be considered in the broader context of resistance to synthetic auxin herbicides as a class …both dicamba- and 2,4-D-resistant (collectively, "auxin-resistant") varieties of three major crops will likely become available in the near future. It is quite possible that a large percentage of corn, soybeans and cotton will soon be heavily treated, multiple times per season and every year, with one or more auxin herbicides. Mortensen et al. (2012) project that combined adoption of 2,4-D- and dicamba-resistant soybeans will reach the 90% level by 2024, based on adoption trends for Roundup Ready soybeans and the huge and growing populations of glyphosate-resistant weeds these crops are meant to counter. A similar scenario would likely unfold in cotton. Given the frequent rotation of these three crops on the same fields (especially corn and soybeans), this would dramatically expand the acreage treated with an auxin herbicide every year, and make generation of weeds with resistance to one or both of these herbicides much more likely. While APHIS recognizes the potential for this to occur, its only response is wishful thinking: "…because of the potential for cross-resistance, growers will likely be cautioned not to plant 2,4-D-resistant and dicamba-resistant crops in successive years on the same field" (DEIS, p. 186).

    Dicamba resistance must be considered in the broader context of resistance to synthetic auxin herbicides as a class, for several reasons. First, weeds have evolved cross-resistance to multiple members of this herbicide family, including dicamba and 2,4-D, and the mechanisms of resistance to these two herbicides are likely similar (DEIS, pp. 187, 188). Second, MON 88708 soybeans have low-level resistance to 2,4-D, which further suggests that weeds have the potential for cross-resistance to these two auxin herbicides (DEIS, p. 187). Third, USDA has already approved Dow's 2,4-D resistant corn and soybeans, which will lead to a two- to seven-fold increase in the use of 2,4-D. In addition, Monsanto has obtained a license to deploy Dow's 2,4-D resistance trait in its own corn varieties (Farm Industry News 2013), which will dramatically increase the acres of corn sprayed with 2,4-D, and Dow is seeking approval of 2,4-D-resistant cotton. Finally, in 2010 Monsanto was already in Phase 2 development of corn resistant to both dicamba and glufosinate (Monsanto Pipeline 2010). We note that if Monsanto successfully commercializes this corn, its license from Dow for the 2,4-D resistance trait in corn would allow it to combine dicamba, 2,4-D and glufosinate resistance in its corn varieties."

    Response: APHIS discusses the likelihood of multiple resistance in the cumulative impacts section and Appendix 5. APHIS acknowledges that multiple resistance may occur and the benefits of dicamba-resistant MON 87708 soybean and MON 88701 cotton may diminish if weeds become resistant to both dicamba and 2,4-D. APHIS has concluded that multiple resistance may occur depending on the extent to which growers adopt best practices. Sustainable use of herbicides entails increasing the variety of chemistries and incorporating other non-chemical strategies into the management program. Also, the commenter seems to assume that if multiple herbicide resistance traits are available, growers will only grow crops with every trait that is available. As each trait increases the cost of the seed and growers are being encouraged by the Weed Science Society, herbicide manufacturers, and University extension agents to rotate the herbicide chemistries used for weed management, a more likely scenario is that growers will limit the traits they purchase and rotate them for an optimal weed management strategy. Furthermore, for growers who have committed to conservation tillage and who plant the same crops successively, their herbicide control options will remain if their successive crops are chosen to rotate herbicide resistance traits.

97. **Comment (APHIS-2013-0043-4713)**: "ISHRW provided estimates of acreage infested for most herbicide-resistant weed biotypes, including glyphosate-resistant (GR) weeds. As of 2012, GR Amaranthus weeds infested 8.2 of the 18.7 million acres reported to be infested with GR weeds overall, or 44% (CFS GR Weed List 9/20/12). It is now widely acknowledged that ISHRW, a passive reporting system, vastly underestimated the true extent of GR weeds. Many GR weeds were never reported to ISHRW; reports once submitted were often not updated as populations expanded. APHIS notes that 61 million acres were infested with glyphosate-resistant weeds in 2012 (DEIS, 124, 179), over three times the acreage reported to ISHRW by that year. APHIS's source for this estimate also reported GR weed-infested acreage in 2010 and 2011, revealing a sharply increasing trend (Stratus 2013, see Figure 1) that suggests (conservatively) 80 million GR weed infested acres by 2014.

Based on these data showing that GR Amaranthus weeds comprise roughly 40% of overall GR weeds, a total of 60-80 million acres infested with GR weeds, and the likelihood that all or nearly all farmers who choose to grow MON 87708 would be those with GR weed-infested fields, it appears evident that 5 million acres is far too small an estimate of MON 87708 growers with GR Amaranthus-infested fields. Monsanto does not appear to provide any explanation or documentation for its estimate of 5 million acres. (See DEIS, Table 4-9, 4-17, where the 5 million acre figure appears without explanation or documentation. We find no discussion by Monsanto anywhere in the DEIS or its supporting documents of GR weed infested acreage, which is absolutely critical). Scenario 1 is based on the assumption that GR Amaranthus weeds in soybeans comprise just one-fifth of total GR weed acreage; while Scenario 2 assumes they make up about one-fourth of total GR weed acreage, both reasonable assumptions."

Response: The acreage estimate cited from Stratus Ari-Marketing and reported in the DEIS is based on farmer observations and not confirmed resistance cases. As a result, the acreage estimate is likely to be an overestimate. While there also may be issues associated with the ISHRW estimate, it continues to provide useful information. There are other estimates that also can be considered in gauging the extent of Palmer amaranth in U.S. cropland. For example, according to Dr. Michael Owens (2010), as of March 2010, Palmer amaranth covered an estimated minimum of 200,000 to a maximum of 2,000,000 acres in Georgia, North Carolina, Arkansas, Tennessee, and Mississippi; in corn, cotton, and soybean crops.

Monsanto provides an explanation how their estimate of 5 million acres is derived on page 367 of Environmental Report. In 2010, Monsanto conducted an informal survey of weed scientists across the country to estimate the number of crop acres with glyphosate resistant weed populations. Based upon this survey it was estimated that approximately 14-16 million acres of planted row-crops (i.e., corn, soybeans, cotton) had populations of glyphosate resistant weeds. Of these acres, the majority of acres (~10 million) are infested with glyphosate resistant marestail populations where a preplant application of dicamba and glyphosate described above is suggested to be effective for control.

The remainder of resistant acres (~5 million) have resistant Ambrosia (common and giant ragweed) and Amaranthus (palmer pigweed and water hemp,) species present. Monsanto asserts that the estimate of 5 million resistant acres is conservative, overestimates current resistant acres in soybean producing areas, and also accounts for potential increases in resistant acres because not all resistant crop acres would be planted to soybean in any given year. For this reason, Monsanto employed the figure of 5 million acres in their assessment. Thus, Monsanto's estimate is also based on survey results, although they surveyed weed scientists who may be more reliable in ascertaining true instances of and the extent of weed resistance.

In terms of APHIS' assessment, what is important is the relative prevalence of and the increasing trend of GR weeds. EPA's quantitative assessments are considering the new uses of dicamba, including more frequent application and when dicamba can be applied.

98. **Comment (APHIS-2013-0043-4713):** "Roundup Ready crop farmers have shown a strong predilection for POST use of glyphosate, and it is highly likely that those who adopt Monsanto's new crops will also make primarily POST applications of dicamba or dicamba+glyphosate, probably to an even greater extent than indicated in the recommended herbicide regimes portrayed in Tables 2 and 3. POST applications of glyphosate to Roundup Ready crops carry a much higher risk of fostering glyphosate-resistant weed evolution than pre-emergence applications to conventional crops (Neve 2008), as evidenced by the virtual absence of glyphosate-resistant weeds prior to Roundup Ready crops, and the epidemic that has emerged since their widespread adoption. Preferential post-emergence use of dicamba to MON 87708 soybeans and 88701 cotton will likewise be still another factor fostering rapid evolution of dicamba-resistant weeds."

Response: APHIS acknowledges that exclusive use of an herbicide is a practice associated with a high risk of selection of herbicide resistant weeds. APHIS does not agree that postemergent use is in itself a problem. For example Neve (Neve, 2008) indicates that the "risk can be reduced to close to zero by mixing two of the three post-emergence glyphosate applications with alternative herbicide modes of action." Thus it is the exclusive use of the herbicide that is the poor practice, not the use of the herbicide in a postemergent application.

The advantages of the dicamba technology can be short lived if adopters fail to heed best management practices. The technology could be useful for decades if these best management practices are followed that minimize the selection of herbicide resistant weeds. APHIS concluded that MON 87708 soybean and MON 88701 cotton offer clear short-term benefits and made no prediction in the long-term because it would depend on the extent to which growers adopted best management practices.

99. **Comment (APHIS-2013-0043-4713)**: "APHIS continues to perpetuate the illusion fostered by Dow (Wright et al. 2010) and Monsanto that the number of auxin-resistant weeds is small compared to those resistant to other herbicide groups, and to use this as justification for projecting limited emergence of auxin-resistant weeds under the Preferred Alternative (DEIS, p. 187). APHIS is wrong on both counts. First, the number of auxin-resistant weed species is high, not low, relative to other modes of action. Of the 22 herbicide groups, synthetic auxins rank fourth in terms of the number of resistant weed species, with 31, in the upper quintile (ISHRW HR Weeds by Group 10-9-14, see also DEIS, pp. 183-185)."

    Response: APHIS disagrees with the commenter that the number of auxin-resistant weeds is high. APHIS agrees that 31 species have developed resistance to auxins worldwide. However, in comparison to ALS inhibitors and Photosystem II inhibitors with 145 and 72 total resistant weeds, respectively, the number of weeds resistant to synthetic auxins is not high. (Also, there are two other herbicide groups that also have 31 cases of resistant weeds, along with synthetic auxins). According to the ISHRW website (weedscience.org), in the United States, only two species have been identified with known resistance to dicamba (*Kochia scoparia* and *Lactua serriola*) and their prevalence is limited to five states.

100. **Comment (APHIS-2013-0043-4713)**: "Soybean and to a lesser extent cotton growers plagued by resistant kochia would be likely candidates for dicamba-resistant versions of these crops. Monsanto concedes that it has not tested the efficacy of dicamba on glyphosate-resistant kochia (Monsanto Enviro Report 2013, p. 563), but a survey of Kansas farmers found that using a mix of dicamba and glyphosate to control kochia in fallow fields was only marginally more effective than applying glyphosate alone (Stahlman et al. 2013). This could well indicate that there is already growing tolerance to dicamba in these kochia populations, and thus increased likelihood of selecting for full-blown dicamba resistance under the Preferred Alternative. Dicamba resistance would often evolve in kochia already resistant to glyphosate, ALS inhibitors and/or triazines, turning a troublesome weed into a noxious one that is extremely difficult to control."

     Response: APHIS acknowledges the comment. The advantages of the dicamba technology can be short lived if adopters fail to heed best management practices. The technology could be useful for decades if these best management practices, such as those specified by Norsworthy et al. (2012), are followed that minimize the selection of herbicide resistant weeds. The need to follow best management practices by growers, particularly on kochia populations, is echoed by Crespo et al. (2014):

     > "Farmers or advisors who plan to use dicamba to manage kochia populations that are already resistant to glyphosate or to triazine- and ALS-inhibiting herbicides should exercise extreme caution to avoid selecting populations that are resistant to dicamba.

> Dicamba should only be used in tank-mixtures or in sequence with a herbicide(s) with a different mechanism(s) of action that is effective at controlling kochia. Non-chemical weed management practices such as tillage and crop rotation also should be incorporated into the weed management program to help prevent kochia seed production. Finally, producers should monitor fields for plants that escape dicamba applications and remove them before they produce seed."

101. **Comment (APHIS-2013-0043-4713)**: "The many soybean and cotton farmers with herbicide-resistant horseweed would be prime candidates for dicamba-resistant versions of these crops. Yet Purdue University weed scientists have already founded increased tolerance to dicamba and 2,4-D in several horseweed populations, demonstrating the high potential for horseweed to evolve additional resistance to dicamba and other auxin herbicides with commercialization of dicamba-resistant crops:

> "Population 66 expressed almost twofold greater tolerance to 2,4-D ester and approximately three- to fourfold greater tolerance to diglycolamine salt of dicamba than populations 3 and 34 (Table 1). Population 43 was more sensitive to growth regulators than population 66 but expressed slightly higher levels of tolerance to 2,4-D ester and diglycolamine salt of dicamba than populations 3 and 34 based on dry weight measurements." (Kruger et al 2010b)"

Response: The commenter has misrepresented the research results and conclusions. The tolerances to auxin herbicides within the tested populations of horseweed observed by Kruger et al. (2010) are not indicative of a "high potential for horseweed to evolve additional resistance to dicamba and other auxin herbicides with commercialization of dicamba-resistant crops." Weed species can exhibit varying levels of tolerance to herbicides; this is not unexpected or uncommon for weeds to exhibit tolerance to any herbicide or even mechanical control practice. The WSSA defines tolerance as follows:

> "Herbicide tolerance is the inherent ability of a species to survive and reproduce after herbicide treatment. This implies that there was no selection or genetic manipulation to make the plant tolerant; it is naturally tolerant."

Kruger et al. (2010) state: "The maximum labeled rate of the three growth regulator herbicides tested provided greater than 90% control suggesting that these rates are likely suitable for postemergence applications on horseweed rosettes." Kruger et al. (2010) concluded that "this research demonstrates that horseweed responds differently to the various salts of 2,4-D and dicamba and it will be important to determine the appropriate use rates of each salt to control glyphosate-resistant horseweed."

Additionally, Kruger et al. (2010) state: "With the impending commercialization of 2,4-D- and dicamba-resistant crops, it appears that additional options for control of glyphosate-resistant annual broadleaf weeds will be available. However, growth regulator herbicide-resistant technologies may not provide long-term solutions if resistant or tolerant populations currently exist or if populations become resistant under selection pressure from overreliance on growth regulators for broadleaf weed management." This is consistent with the analysis presented in the EIS."

102. Comment (APHIS-2013-0043-4713): "Kruger and colleagues also predict that auxin herbicides will be applied later to larger horseweed plants in the context of auxin-resistant crop systems (Kruger et al 2010a). In follow-up research, they found that larger plants are much more difficult to control with auxin herbicides:

> "While it is realistic to expect growers to spray horseweed plants after they start to bolt, the results show that timely applications to [small] horseweed rosettes are the best approach for controlling these weeds with growth regulator herbicides [dicamba and 2,4-D]. Growers should be advised to control horseweed plants before they reach 30 cm in height because after that the plants became much more difficult to control. (Kruger et al. 2010b, emphasis added)"

As discussed elsewhere, increased survival of larger weeds means a greater likelihood of resistant individuals among them surviving to propagate resistance via cross-pollination or seed production. And as the authors acknowledge, it is "realistic" to expect late application of dicamba with MON 87708, because that is precisely how growers use these crop systems, as demonstrated with the history of Roundup Ready crops.

This tendency to delay application to kill larger weeds will be greatly facilitated by the high-level dicamba resistance of MON 87708, since larger weeds require higher rates to control. The proposed label permits 2 post-emergence applications of up to 0.5 lb./acre each, up through the time when soybeans are in full bloom (R2). However, much higher rates could be used without risk of crop injury. In fact, the developers of dicamba-resistant soybeans report resistance to dicamba at rates 5 to 10-fold higher than the maximum proposed single application rate (2.5 to 5 lbs./acre):

"Most transgenic soybean events showed resistance to treatment with dicamba at 2.8 kg/ha and 5.6 kg/ ha under greenhouse conditions (fig. S9) and complete resistance to dicamba at 2.8 kg/ha (the highest level tested in field trials) (Fig. 3)" (Behrens et al 2007).

As discussed above in relation to RR crops, farmers delay application in order to avoid the trouble and expense of a second application, whether this is a wise tactic or not. Thus, advising growers to spray weeds when they are small will likely not be any more effective with MON 87708 soybeans than were similar recommendations made for glyphosate with Roundup Ready crops.

Cultivation of MON 87708 and MON 88701 under the Preferred Alternative is thus quite likely to promote rapid evolution of horseweed resistant to dicamba and perhaps 2,4-D as well, often in combination with resistance to glyphosate and other herbicides. As noted above, tillage is a frequent response to glyphosate-resistant horseweed, and will be a still more frequent response to dicamba/glyphosate-resistant horseweed, since dicamba will be eliminated as an alternative control option. This would lead to further reductions in conservation tillage and increased soil erosion."

Response: It is well documented that weed control should optimally be done using integrated weed management practices, without over-reliance on herbicides (Norsworthy *et al.*, 2012; Fernandez-Cornejo *et al.*, 2014). It is necessary for growers to use a diversified approach to prevent overreliance on a single chemical. We also stress within the EIS that the herbicide label would also contain information on resistance management consistent with the Weed Science Society of America's Best Management Practices for comprehensive resistance management approaches (US-EPA, 2014). It has been established that Best Management Practices, including application optimization all help to sustain herbicide viability (Doherty *et al.*, 2010; Jha and Norsworthy, 2012; Norsworthy *et al.*, 2012; Vencill *et al.*, 2012; Fernandez-Cornejo *et al.*, 2014).

Non-target Effects from Herbicides

103. Comment (APHIS-2013-0043-4702): "In this DEIS, APHIS's failure to address the issue of seed treatments of dicamba-resistant cotton and soybean violates NEPA. As previously stated, NEPA requires that an EIS "shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." The DEIS falls short of that standard because APHIS fails to mention, let alone consider, the environmental and economic impacts stemming from the insecticides, fungicides, and other chemicals that will likely be used to treat the dicamba-resistant cotton and soybean seeds.

By failing to address the use of neonicotinoids as a seed treatment for dicamba-resistant cotton and soybeans, APHIS also fails to examine and address the cumulative impacts on the environment stemming from this toxic seed treatment. Neonicotinoids are extremely persistent in the environment, with half-lives that range from 148 days to 6,932 days, depending on soil types and weather conditions. Their persistent nature leads to increased contamination of surface and groundwater in addition to soil. The main pathways for human and animal exposure to neonicotinoids are residues in pollen and nectar, dust from treated seeds and soils, planter exhaust, untreated but contaminated non-crop plants adjacent to treated fields, guttation droplets on both treated and untreated but contaminated plants, and residues from foliar uses. Once treated with a neonicotinoid, a plant can become highly toxic to non-target invertebrates, including pollinators such as honey and bumble bees. In addition to the obvious effects of lethal doses neonicotinoids, sub-lethal exposures can cause significant impacts to bees, including reductions in learning, foraging abilities, and homing abilities. Studies on the impacts of neonicotinoids have primarily focused on the significant harms they cause to pollinators; however, researchers are now starting to identify harm resulting from neonicotinoid use on aquatic invertebrates and birds.

APHIS's DEIS is similarly silent on the foreseeable agro-economic impacts from the harm to honey bees and pollinators due to neonicotinoid seed treatments. According to data from the USDA, pollination contributes $20 to 30 billion in crop production annually to the agricultural economy. Indeed, one in every three bites of food for human consumption requires pollination by honey bees, and nearly 90 percent of all flowering plants require pollinators in order to reproduce. Thus, the planting of dicamba-resistant cotton and soybean treated with neonicotinoid insecticides and the resulting loss of honey bees and other pollinators can have detrimental impacts on U.S. agricultural production and the agricultural economy. The DEIS falls short of the requirements of NEPA's requirement to analyze "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.""

Response: APHIS has no authority to regulate the use of pesticides, fungicides or other chemicals that may be used on MON 87708 soybean and MON 88701 or mitigate the impacts that may result from that use. The use of these agro-chemicals and any potential adverse effects to non-target receptors falls under the authority of EPA and is outside the scope of this EIS.

<u>Environmental Impacts from Off-Target Movement of Herbicides</u>

104. Comment (APHIS-2013-0043-4706): "The recent decline of monarchs (*Danaus plexippus*) is a clear example of harm to a non-target organism from past APHIS approval of herbicide-resistant corn and soybeans, yet APHIS does not analyze impacts to monarchs of approving Xtend soybean and cotton in the DEIS.

Monarch numbers in North America are at their lowest since records have been kept, and biologists are concerned that the monarch migration is in jeopardy (Brower et al. 2011, 2012). At their most recent peak in 1997, there were almost a billion monarch butterflies overwintering in oyamel fir trees in the central mountains of Mexico (Slayback et al. 2007). This year, counts indicate an overwintering monarch population of fewer about 33 million, by far the lowest ever measured (WWF-Mexico 2014), continuing an alarming 20-year decline of more than 90% (Brower et al. 2011, 2012). In fact, CFS and Center for Biological Diversity are lead petitioners, joined by Xerces Society and monarch scientist Lincoln Brower, on a petition to FWS to list monarchs as "threatened" under the Endangered Species Act, submitted August 26, 2014 (Monarch ESA Petition 2014).

Although there are many factors at play, scientists have shown that a critical driver of the recent steep decline in monarch butterfly numbers is loss of larval host plants in their main breeding habitat, the Midwest corn belt of the US (Monarch ESA Petition 2014). Monarchs lay eggs exclusively on plants in the milkweed family, and the larvae that hatch from these eggs must consume milkweed leaves to complete the butterfly's lifecycle (Malcolm et al. 1993). Common milkweed has been largely eradicated from corn and soybean fields where it used to be common (Hartzler 2010, Pleasants and Oberhauser 2012), depriving monarchs of the plant they require for reproduction.

Common milkweed (*Asclepias syriaca*) is a perennial plant with shoots that die back in the winter, but re-sprout from buds on spreading roots in the spring to form expanding colonies (Bhowmik 1994). Common milkweed also regrows when the plants are mowed, chopped by tillers, or treated with many kinds of herbicides that only kill aboveground plant parts, or are applied before milkweed shoots emerge in late spring (Bhowmik 1994). Thus, until recently, common milkweed has been found within and around corn and soybean fields in sufficient numbers to support a large population of monarch butterflies. In fact, in the late 1990s when monarch numbers were still high, almost half of the monarchs in Mexican winter roosts had developed on common milkweed plants in the Midwest corn belt, making this the most important habitat for maintaining the monarch population as a whole (Wassenaar and Hobson 1998).

Recently, though, the widespread adoption of genetically engineered, glyphosate-resistant corn and soybeans has triggered a precipitous decline of common milkweed, and thus of monarchs (Pleasants and Oberhauser 2012). Glyphosate is one of the extremely few herbicides that efficiently kills milkweed (Waldecker and Wise 1985, Bhowmik 1994). Glyphosate moves throughout the plant – from sprayed leaves into roots, developing shoots and flowers – where it thwarts milkweed's reproductive strategies.

Glyphosate is particularly lethal to milkweed when used in conjunction with glyphosate-resistant corn and soybeans (patterns of glyphosate use on resistant crops are described in detail Monarch ESA Petition 2014). It is applied more frequently, at higher rates, and later in the season (during milkweed's most vulnerable flowering stage of growth) than when used with traditional crops. The increasingly common practice of growing glyphosate-resistant corn and soybeans every year means that milkweed is exposed to glyphosate every year without respite, and has no opportunity to recover. In fact, in the 15 years since glyphosate-resistant soybeans, and then corn, were approved by APHIS, common milkweed has been essentially eliminated from corn and soybean fields in the major breeding area for monarch butterflies (Hartzler 2010).

This loss of habitat for monarch butterflies, because of eradication of the only host plant that grows within corn and soybean fields in the Midwest, has been devastating. Fewer corn and soybean fields have milkweed plants, and where they do occur, the plants are more sparsely distributed. In a 1999 survey of Iowa, common milkweed was found in half of corn and soybean fields, and this milkweed occupied an aggregate area of almost 27,000 acres (Hartzler and Buhler 2000). A decade later in 2009, a second survey found that only 8% of corn and soybean fields had any milkweed plants at all, with an aggregate area of just 945 acres – a 96.5% decline (Hartzler 2010). By 2012, it is estimated that just over 1% of common milkweed remained in corn and soybean fields in Iowa compared to 1999, just a few hundred combined acres (extrapolated from Pleasants and Oberhauser 2012). It is clear that other Midwestern states have experienced similarly devastating milkweed losses, based on comparable land-use patterns and other evidence.

Rapid, large-scale changes in glyphosate use (Monarch Listing Petition 2014) are responsible for milkweed loss. Common milkweed in corn and soybean fields has been unable to survive the change in glyphosate use that accompanied approval of glyphosate-resistant corn and soybeans (Pleasants and Oberhauser 2012).

Milkweeds do still remain outside of agricultural fields in the Midwest, but there aren't enough of them to support a viable monarch population. The combined area of roadsides, Conservation Reserve Program (CRP) land, and pastures is only about 25% of corn and soybean acreage in Iowa, which is representative of the Corn Belt as a whole (Pleasants and Oberhauser 2012). In addition, monarchs produce almost four times more progeny per milkweed plant in corn and soybean fields than in non-agricultural areas (Monarch Larval Monitoring Project, as described in Pleasants and Oberhauser 2012), so agricultural milkweed is more valuable as habitat. Thus, even if non-crop lands have a higher density of milkweeds, they cannot begin to compensate for agricultural habitat lost to glyphosate use on glyphosate-resistant corn and soybeans. "

Response: APHIS acknowledges the comment that glyphosate use on glyphosate resistant crops has had indirect impacts on the Monarch butterfly population through the eradication of milkweed from crop fields. Milkweed is a target plant in agricultural fields because it is a problem weed that reduces yield in field crops (Pleasants and Oberhauser, 2013) and can be toxic to cattle when found in feed (Isleib, 2012). Direct and indirect herbicide impacts of herbicide use on non-target organisms, such as the Monarch butterfly, are assessed by EPA and are outside the scope of this EIS.

105. Comment (APHIS-2013-0043-4706): "As confirmed by APHIS (DEIS at 117), Xtend soybean will be sprayed post-emergence with a pre-mix formulation of glyphosate and dicamba. In addition, other herbicide resistance traits are likely to be "stacked", allowing use of glufosinate and other herbicides. Farmers may also apply the individual herbicides sequentially.

Xtend soybean will therefore not only continue to be sprayed post-emergence with glyphosate, but also with other herbicides, when common milkweed is in its most vulnerable reproductive stages (Bhowmik 1994). Even those herbicides that are weaker on perennial weeds such as milkweed (e.g. glufosinate) can be expected to cause considerable damage to aboveground plant parts. In addition, Xtend soybean is engineered to be extremely resistant to the herbicides in question, enabling application of rates higher than have ever been used before without injuring the crop. Herbicides that cause limited damage to weeds when applied at lower rates are often much more damaging at higher rates. The combination of additional active ingredients applied post-emergence, and use of higher rates, can only accelerate the demise of common milkweed in corn and soybean fields while preventing its reestablishment, especially in view of the fact that glyphosate will continue to be used at rates similar to those used at present on crops resistant to glyphosate alone."

Response: APHIS predicts that glyphosate use will remain unchanged under both the No Action and Action Alternatives (see Section 5.6.2, Agronomic Practices - Changes in Use of Glyphosate), as the majority of corn, cotton, and soybean currently planted in the United States are genetically engineered (93, 96, and 94 percent, respectively) with the majority being glyphosate-resistant varieties. Given the fact that glyphosate use has already eradicated 99% of the milkweed from corn and soybean fields (comment #104), APHIS doubts whether dicamba can have any incremental effect. The solution to the Monarch Butterfly issue, while an important conservation issue, is outside the scope of this EIS.

106. Comment (APHIS-2013-0043-4706): "Dicamba is in the synthetic auxin class of herbicides. Synthetic auxins are generally effective on perennial broadleaf weeds because these herbicides, like glyphosate, they are translocated to the root. Dicamba and 2,4-D are the auxin herbicides most frequently recommended for control of common milkweed, though neither is as consistently effective as glyphosate (Monarch ESA Petition 2014, Martin and Burnside 1984, Cramer and Burnside 1981, Bhowmik 1982).

The Ohio State University extension service recommends a high rate of glyphosate (2.25 lbs. a.e./acre) as the first option for control of common milkweed in non- crop or fallow field situations, but also notes that a lower rate of glyphosate (1.5 lbs ae/acre) combined with 2,4-D "can provide good control as well." Likewise for corn, a post-emergence application of glyphosate is recommended if the corn is Roundup Ready. For non-Roundup Ready corn, dicamba is the top choice – alone or combined with one of several other herbicides (Ohio State Extension, as cited in Isleib 2012).

Although dicamba is not consistently as effective as glyphosate, particularly for longer-term control, its efficacy is regarded as sufficient to merit recommendations for its use on common milkweed by experienced agronomists at several universities.

Xtend soybean will greatly exacerbate the negative impacts of dicamba on common milkweed for several reasons: higher rates will be used; most applications will occur during milkweed's most vulnerable reproductive phase; most applications will be in combination with glyphosate; much more cropland will be sprayed; and the frequency of use will increase both within season and over years (Monarch ESA Petition 2014).

Combined use of two herbicides known for their efficacy in killing milkweed can only hasten its eradication from crop fields and maintain its absence, with devastating consequences for monarch butterflies. APHIS does not consider these impacts of Xtend soybean approval on monarchs in its DEIS."

Response: This comment is out of the scope of the EIS. See response to Comment 104.

107. Comment (APHIS-2013-0043-4706): "Although monarch larvae are selective about food plants, only thriving on milkweeds, the adult butterflies derive nutrients from a wide variety of nectar-producing flowers (Tooker et al. 2002). They depend on flowers that are in bloom in their breeding habitat during the spring and summer, and then along migration routes to winter roosts (Brower and Pyle 2004). Monarchs that are breeding during spring and summer use energy derived from nectar for flying, laying eggs, mating, and other activities. In addition, the generation that migrates in the fall converts nectar sugars into storage lipids to fuel their metabolism during winter, and perhaps also for northern migration the following spring (Brower et al. 2006).

Herbicides are toxic to plants, by definition, and their use in agricultural landscapes has resulted in changes in flowering plant populations within and around crop fields, with impacts felt throughout ecosystems. Various models of herbicide spray drift from ground applications suggest that from 1% (commonly) to 25% (occasionally) of the applied herbicide does drifts beyond the field boundaries to affect wild vegetation (Holterman et al., 1997; Wang and Rautmann, 2008; Boutin et al. 2014), though these models made no attempt to account for unpredictable volatilization, and models generally do not account for extreme situations.

There have been no surveys of wildflowers in agricultural landscapes before and after commercialization of previously approved herbicide-resistant crops, as important as such information is for assessing environmental impacts. However, glyphosate from use on herbicide resistant crops may have already reduced abundance and diversity of nectar plants in and around agricultural fields, from direct applications as well as spray drift (e.g. Gove et al. 2007, Blackburn and Boutin 2003). Approval of Xtend soybean and cotton that are associated with use of highly active, volatile dicamba with an even greater potential for causing drift injury, in addition to glyphosate, is likely to have severe impacts on nectar resources used by monarchs and other pollinators (Brower et al. 2006).

Hugely increased spray drift, volatilization and runoff from the much greater use of herbicides with Xtend soybean and cotton are likely to alter the very habitats important for biodiversity in agroecosystems, such as hedgerows, riparian areas, unmanaged field margins, and other areas where wild organisms live near fields (Freemark and Boutin 1995, Boutin and Jobin 1998, Olszyk et al. 2004, Boutin et al. 2014, Schmitz et al. 2014a, 2014b). These areas harbor nectar plants for adult monarchs as well as milkweeds for larvae. Based on experiences with 2,4-D sensitive crops, for example, natural areas miles from agricultural applications of these herbicides will be at increased risk from the use of greater amounts on herbicide resistant crops, since these herbicides can volatilize under certain conditions, and also come down in rain (Hill et al. 2002). Also, herbicides used on resistant crops are applied over a longer span of the growing season, and thus overlap a wider range of developmental stages of nearby plants, hitting them when they may be more sensitive to injury."

Response: This comment is out of the scope of the EIS. See response to Comment 104.

108. Comment (APHIS-2013-0043-4706): "Particular species of plants are more or less sensitive to specific herbicides (Boutin et al. 2004, Strandberg et al. 2012, Olszyk et al. 2013), and at different growth stages (Carpenter and Boutin 2010, Strandberg et al. 2012, Boutin et al. 2014), so that exposure can change plant population dynamics in affected areas. Dicamba and other auxin-like herbicides are particularly potent poisons for many species of plants (US-EPA 2009), especially dicotyledons (broadleaf plants) that are sensitive to very low drift levels. Even monocots such as members of the grass and lily families can be killed by higher doses of dicamba, and suffer sub-lethal injuries from drift levels at certain times in their life cycles (US-EPA 2006).

Plants – both crop and wild species –are often very sensitive to herbicide injury as flowers and pollen are forming (Olszyk et al. 2004 Strandberg et al. 2012). This has been clearly shown with dicamba and injury to tomato plants (Kruger *et al.* 2012) and soybeans (Griffin et al. 2013), and with glyphosate injury to rice flowers (Wagner 2011). Drift levels of dicamba have also been shown to affect asexual reproduction in potatoes (Olszyk et al. 2010), and seed production in peas (Olszyk et al. 2009), sometimes without accompanying vegetative injury. Glyphosate drift to potato plants has been responsible for causing potato shoots arising from seed potatoes in the next generation to grow abnormally or not at all (Worthington 1985), without always affecting the growth of the potato plants that were actually hit with the herbicide (Potato Council 2008). There are many other examples of differential sensitivity to particular herbicides (Boutin et al.

2014). Injury affecting flowers and vegetative propagules but not the rest of the plant can easily go undetected, nevertheless having a large impact on reproduction and thus subsequent generations (e.g. Strandberg et al. 2012, Schmitz et al. 2014a, 2014b).

Differential sensitivity to herbicides can lead to changes in species composition of plant communities. For example, dicamba movement away from crop fields in mid-spring may kill sensitive dicotyledonous wildflowers at seedling stages, cause male sterility in less sensitive grasses about to flower, and have little effect on younger grasses or still-dormant perennials (Olszyk et al. 2004). These impacts can cause long-term changes in the mix of plant species, favoring annual weeds and grasses over native plants and perennial forbs (broadleaved plants), for example (Boutin and Jobin 1998, Boutin et al. 2008, Schmitz et al. 2014b). And if there are herbicide resistant plants in these habitats, they will of course be better able to withstand drift and may become more abundant (Watrud et al. 2011, CFS 2013a).

Pollinators are at particular risk from changes in plant populations and flowering behavior. Recently published comparisons of flowering plants in natural areas around fields that have been exposed to herbicides on a regular basis vs. near fields managed without herbicides show striking differences in abundance and kinds of plants in flower, and also in when these plants flower (Boutin et al. 2014). Hedgerows next to organic farms had more species, and many of them flowered earlier in the season and for a longer time span. These field observations confirmed greenhouse studies that showed significant delays in flowering of several species after exposure to herbicides (Boutin et al. 2014).

Such changes in which plants flower, and when, could affect monarchs as they breed and migrate, disrupting coordination between the butterflies and needed resources: organic farming promoted not only plant diversity but also plant flowering capacity whereas conventional farming inhibited flower production of the fewer plants found in adjacent hedgerows and resulted in a shift in flowering. This in turn may cause disharmony with pollinator activities as pollinators can be very sensitive to flowering events (Santandreu and Lloret, 1999). Effects on timing of flowering can have consequences on pollinating insects as they may be less able to survive in non-crop habitats during periods when crop plants are unavailable for pollination (Carvalheiro et al., 2010). Alternatively, delays in flowering time may expose flowers to unfavourable weather conditions (e.g. frost or drought). Herbicide effects appear to constitute yet another stressor affecting plant – insect interactions, adding to other stressors including land-use modifications at the landscape scale (Kremmen et al., 2007) that are increasingly impacting agro-ecosystems. (Boutin et al. 2014)”

Response: This comment is out of the scope of the EIS. See response to Comment 104.

109. Comment (APHIS-2013-0043-4706): "Herbicides such as dicamba that selectively kill dicots may be particularly injurious to butterflies, often considered an indicator of ecosystem health. If these herbicides are applied frequently and over a broad area – as will happen with herbicide use on Xtend soybean and cotton– negative impacts on butterflies are likely to be increased. A study by Longley and Sotherton (1997) of pesticide effects on butterflies in agricultural areas of England makes this point: The frequency and number of pesticide applications, the spatial scale of treatment and the degree of field boundary contamination during each spray occasion will determine the extent of damage to butterfly habitats and populations, and the rate at which populations will return to their original densities. (Longley and Sotherton 1997).

Researchers implemented experimental mitigation measures to determine whether changes in pesticide use would result in more butterflies in the landscape. One of these measure involved limiting the use of "persistent broadleaf herbicides" near field edges, and instead using herbicides that were more specifically targeted against grasses: The outer section of a tractor-mounted spray boom (approximately 6 m) is switched off when spraying the outer edge of a crop, avoiding the use of certain chemicals (persistent broadleaf herbicides and all insecticides other than those used for controlling the spread of Barley Yellow Dwarf Virus). Whilst the rest of the field is sprayed with the usual compliment of pesticides, more selective chemicals (e.g. graminicides rather than broadspectrum herbicides) are sprayed on the edges (Boatman and Sotherton, 1988). (Longley and Sotherton 1997, p. 8).

They found that there were indeed more butterflies after taking these measures, and also that there were more dicots, the main source of nectar, as well as more biodiversity in general: In addition, as a result of selective herbicide use, Conservation Headlands are rich in broadleaved plants, thereby increasing the availability of nectar resources for butterfly species. (Longley and Sotherton 1997, p. 8)

The unsprayed headlands have also been shown to benefit the survival of rare weeds (Schumacher, 1987; Wilson, 1994), small mammals (Tew, 1988), beneficial invertebrates (Chiverton and Sotherton, 1991; Cowgill et al., 1993) and gamebird chicks (Rands, 1985; Rands, 1986). However, to be of long-term value for butterfly conservation, unsprayed headlands need to be maintained over consecutive years to allow the survival of those species which are univoltine and have poor powers of dispersal. (Longley and Sotherton 1997, p. 9)

In conclusion, these researchers emphasize the need for research on impacts of pesticide use over time: In addition to short-term studies, covering single cropping seasons, information is also needed on the effects of different spray and cropping regimes over several seasons on butterfly communities in exposed areas. Only then will it be possible to make reliable predictions and recommendations for butterfly conservation on arable farmland. (Longley and Sotherton 1997, p. 12)

Implications of this butterfly study in England are clear for use of dicamba with Xtend soybean and cotton: dicamba is an herbicide that selectively kills broadleaved plants (dicots), the main nectar source for adult butterflies, even those species whose larvae feed on grasses. Dicamba is also likely to be used more often during a season, more extensively in an area, and from year to year with Xtend soybean and cotton than it is currently used in agriculture. This is exactly the opposite use pattern than that recommended for mitigation of pesticide impacts on butterflies, that were also shown to be protective of biodiversity in general.

Several new field studies in the United States – undertaken to assess the potential effects of dicamba use with dicamba-resistant crops – support the English findings. Bohnenblust (2014) found that drift-level doses of dicamba delayed flowering of alfalfa, and both delayed and reduced flowering of common boneset (*Eupatorim perfoliatum*), a wildflower less visited by all pollinators when treated with dicamba at rates simulating drift.

A second study explored the impact of a range of drift-level dicamba doses on the plant and arthropod communities in agricultural "edge" habitats (Egan et al. 2014). The most striking result was a significant decline in the abundance of broadleaf plants over time and with increasing dicamba dose. Impacts were observed at substantially lower levels (about one percent of the dicamba field application rate) than have been reported to affect plant communities in other studies. This study was conservative in design: dicamba alone was applied just once per year over two years. More severe impacts would be expected with longer-term use, and with the dicamba-glyphosate mix to be used with dicamba-resistant crops, which could be applied up to three times per year according to the proposed label (DEIS Appendix 8 at 8-9). In general, the complementary action of glyphosate and dicamba, applied in the form of Roundup Xtend to resistant crops, would kill or injure a broader range of plants more effectively, and over a broader range of plant growth stages, than either component alone."

Response: This comment is out of the scope of the EIS. See response to Comment 104.

110. Comment (APHIS-2013-0043-4706): "EPA guidelines for protecting non-target plants from drift injury are based on toxicity tests that include too few species, tested at only a few points in their vegetative development, and therefore underestimate the range of sensitivities in communities of wild species throughout their lifecycles (Pfleeger et al. 2012, White and Boutin 2007, Strandberg et al. 2012, Olszyk et al. 2013, Boutin et al. 2014). These deficiencies in assessment of herbicide impacts will put the monarch's nectaring habitat at further risk should Xtend soybean and cotton be approved by APHIS."

Response: This comment is out of scope of the EIS. See response to Comment 104.

111. Comment (APHIS-2013-0043-4706): "Herbicides may directly harm exposed insects, such as monarchs. Some herbicides have been shown to leave residues that cause lepidopteran larvae to stop feeding on herbicide- exposed plants, and also some herbicides directly inhibit enzymes within the exposed insects (as discussed in Russell and Shultz 2009, and in Bohnenblust et al. 2013).

For example, glufosinate may have direct effects on lepidopteran pollinators when larvae eat glufosinate-containing pollen, nectar or leaves, either after direct over-spray or from drift. Laboratory experiments with the skipper butterfly *Calpodes ethlias* showed that larvae fed glufosinate-coated leaves were injured or killed by inhibition of glutamine synthase, at doses "comparable to the amount that might realistically be acquired by feeding on GLA [glufosinate]- treated crops." These studies were done with the active ingredient, not a full formulation, and so may have underestimated field toxicity (Kutlesa and Caveney 2001). Glufosinate is one of the herbicides that will be used with Xtend cotton, and may be "stacked" into Xtend soybean."

Response: This comment is out of scope of the EIS. See response to Comment 104.

112. Comment (APHIS-2013-0043-4706): "Also, in spite of EPA's regulation, off-target herbicide movement, including drift of glyphosate applied on glyphosate-resistant crops, has resulted in many incidents where non-target organisms were harmed (US-EPA 2009). Glyphosate use has increased dramatically in concert with widespread adoption of glyphosate resistant crops (Monarch ESA Petition 2014 at 45-72). Even though glyphosate is not volatile, it nevertheless has become one of the most common herbicides detected in air and rain samples as fine droplets become airborne (Chang et al. 2011, Majewski et al. 2014). Glyphosate and its metabolites are also frequently measured in runoff and surface water (Battaglin et al. 2009, Coupe et al. 2012, Battaglin et al. 2014), glyphosate-resistant soybean samples (Bøhn et al. 2013), and in urine from both rural and urban people (Curwin et al. 2007a, 2007b). In other words, glyphosate is now practically ubiquitous in the environment. In some cases, glyphosate is measured at levels that can harm non-target organisms, such as amphibians (Relyea 2011) and plants (US-EPA 2009). Much of this glyphosate is likely to have originated in labeled applications to glyphosate-resistant crops (Coupe et al. 2012, Majewski et al. 2014). Many people find this level of off-target movement, including drift, to be unacceptable (for example, growers whose crops have been injured). APHIS does not provide evidence that off-site movement of dicamba and other herbicides used with Xtend soybean and cotton will be mitigated by EPA's regulations any more effectively, and its assumption to the contrary is belied by past crop experiences and sound science. In fact, dicamba's volatility – even with reduced volatility formulations – makes off-site movement even more prevalent and APHIS's reliance on EPA further misplaced."

Response: This comment is outside the scope of this EIS. EPA and not APHIS regulates pesticide use.

113. Comment (APHIS-2013-0043-4706): "Herbicide use on Xtend soybean and cotton may harm non-target species within and around those fields, and must be considered by APHIS in its assessments. APHIS does admit that herbicide use in agriculture impacts biodiversity (DEIS at 189), as part of its cursory look at cumulative impacts. However, APHIS relies on a few industry-associated reviews instead of the large body of independent, peer-reviewed primary studies and reviews that are available on impacts of agricultural practices on biodiversity, so does not base its assessment on sound science. For example, there are many recent reviews and studies of impacts to biodiversity of organic agriculture compared with other agricultural regimes (e.g., Andersson et al. 2012, Blaauw and Isaacs 2012, Gaba et al. 2013, Gabriel and Tscharntke 2007, Hyvonen and Huuselaveistola 2008, Kennedy et al. 2013, Kremen and Miles 2012, Lynch 2012, Morandin and Winston 2005, Nicholls and Altieri 2012, Power et al. 2012, de Snoo et al. 2013, Tuck et al. 2014).

Impacts of glufosinate use on Xtend cotton must also be analyzed by APHIS. Although APHIS follows Monsanto in assuming glufosinate use will decrease with approval of

Xtend soybean and cotton, CFS has determined that glufosinate use is likely to increase (CFS Center for Food Safety – Science Comments II – Xtend soybeans & cotton draft EIS Science Comments I submitted for this DEIS). Glufosinate is a potent broad-spectrum herbicide, toxic to non-target crops and wild plants at low levels via drift and runoff of water and soil (Carpenter and Boutin 2010, EPA EFED Glufosinate 2013). Therefore glufosinate use on Xtend cotton will impact non-target crops and wild plants, including threatened and endangered plants, with consequences for biodiversity. In addition, glufosinate is directly toxic to some animals at environmentally relevant concentrations. Beneficial insects may be particularly at risk from glufosinate use on Xtend cotton, including predatory mites and spiders, and lepidopteran pollinators (discussed below). Mammals present in the agroecosystem may experience chronic toxicity. Pest and pathogen levels may be altered. Also, threatened and endangered animals may be put at greater risk by glufosinate use on Xtend cotton. These are significant adverse impacts that APHIS must assess and meaningfully consider in its assessments."

Response: As stated in the EIS and responses above, herbicide impacts on non-target species are evaluated by EPA in its risk assessments and are outside the scope of this EIS.

114. Comment (APHIS-2013-0043-4706): "Predators of crop pests may be harmed by use of herbicides on Xtend soybean and cotton, and this was not analyzed by APHIS in the DEIS. For example, glufosinate is toxic via a metabolic pathway found in animals and microorganisms, as well as plants, and some animals are injured or killed by herbicidal doses (EPA EFED Glufosinate 2013). Arachnids such as mites and spiders are particularly sensitive to glufosinate.

Although some mite species are serious agricultural pests of many crops, including corn, the use of pesticides for their control is not generally an effective strategy. Pesticides fail because many pest mites have developed resistance; while predatory mites, spiders and other insects that are important for keeping pest mite populations low are susceptible. Therefore, Integrated Pest Management systems are recommended, where healthy predator populations are encouraged (Peairs 2010).

Glufosinate can harm predatory mites. Experiments on the direct toxicity of various pesticides to a predator mite found in Virginia vineyards showed glufosinate to be particularly toxic, causing 100% mortality within a day (Metzger and Pfeiffer 2002). Although the dose used was greater than that for resistant corn, lower doses were not tested.

Further experiments on glufosinate and beneficial arthropods were carried out in conjunction with a risk assessment by the European Food Safety Authority (EFSA 2005), and included glufosinate applications as used on corn: The European Food Safey Authority (EFSA 2005) evaluated a series of extended laboratory and semi-field studies on beneficial insects including the parasitoid wasp (*Aphidius rhopalosiphi*), predatory mite (*Typhlodromus pyri*), wolf spider (*Pardosa* ssp.), green lacewing (*Chrysoperla carnea*), ground beetle (*Poecilus cupreus*), and rove beetle (*Aleochara bilineata*). "Severe" effects were observed with a potential for population recovery in one season when glufosinate was applied at rates consistent with use on glufosinate-resistant corn (two application at 0.8 kgai/ha) (EPA EFED Glufosinate 2013 at 95)

Although there was "potential for population recovery in one season", the risks to beneficial insects were considered to be high enough to warrant mitigation: As described in the EFSA (2005) report, the EFSA Peer Review Coordination (EPCO) expert meeting (April 2004, ecotoxicology) recommended mitigation measures for risk to nontarget arthropoods, such as a 5-m buffer zone when glufosinate is applied to corn or potatoes. (EPA EFED Glufosinate 2013 at 95).

Data from EPA also indicates that large buffers may be required to protect non-target terrestrial plants from injury (EPA EFED Glufosinate 2013 at 98), and thus reduce harm to non-target predatory mites and spiders, and other beneficial arthropods."

Response: Herbicide impacts on terrestrial invertebrates are assessed by EPA and are outside the scope of this EIS.

115. Comment (APHIS-2013-0043-4706): "Some mammals and birds are considered beneficial to agriculture, including cotton and soybeans. For example, some rodents eat weed seeds, reducing the weed seed bank (EFSA 2005), or become food for predators that control pest species. Other mammals, such as bats, reduce insect pests, and may provide billions of dollars of services to US agriculture each year (Boyles et al. 2011, 2013). Some birds also control agricultural pests and provide other ecosystem services (Whelan et al. 2008).

APHIS does not analyze risks to beneficial mammals and birds from the use of dicamba and glufosinate with Xtend soybean and cotton, even though APHIS includes information from EPA about risks to mammals and birds in Appendix 8. Direct adverse effects from chronic exposure to dicamba for both listed and non-listed mammals, and from acute exposure for both listed and non-listed birds, have been identified by EPA in screening level risk assessments for the dicamba use patterns being planned for Xtend soybean and cotton (DEIS at appendix 8, pp. 12-13 appendix). EPA also identified the potential for indirect risks to mammals and birds from modification of their habitat by dicamba use with Xtend crops (DEIS at appendix 8, p. 13). CFS has commented on risks from dicamba use to mammals, birds and other animals, as well (Appendix A, Appendix B).

Of the herbicides considered for invasive species control by the US Forest Service in the Pacific Northwest, dicamba is of special concern for mammals and birds (USDA Forest Service 2005): Dicamba, triclopyr, and 2,4-D have the highest potential to adversely affect wildlife. Dicamba has a relatively low acute toxicity to adult animals, in terms of direct lethal doses, but adverse effects on reproduction and nervous systems occur at much lower doses. Dicamba shows a consistent pattern of increased toxicity to larger sized animals, across several species and animal types (i.e. birds and mammals). Dicamba exposures exceed the toxicity indices for five scenarios at the typical application rate, and nine scenarios at the highest application rate. (Bautista 2005, p. 22)

Based on this analysis, in their Record of Decision for the invasive plant control program the Forest Service decided not to use dicamba or 2,4-D: I recognize the cost-effectiveness of 2,4-D and dicamba. It has been commonly and widely used on both private and public lands for the last several decades. At the Regional scale, however, no situations were found where these herbicides would be absolutely necessary. These herbicides are inherently more risky than the ten I am approving for use. Forest Service risk assessments consistently place these two herbicides in higher risk categories for human beings, large mammal and birds (see FEIS Chapter 4.4 and 4.5). (USDA Forest Service 2005 at 25)

These concerns about dicamba impacts on wild animals, including beneficial mammals, will only be amplified by the increased use of dicamba with Xtend soybean and cotton.

Glufosinate use on Xtend soybean and cotton is likely to exceed levels of concern for chronic risk to mammals that eat insects, and plant parts other than strictly fruits, seeds and grains (EPA EFED Glufosinate 2013 at 70), as summarized: The screening level assessment with preliminary refinements concludes that the use of glufosinate in accordance with registered labels results in chronic risk to mammals that exceeds the Agency's chronic risk Level of Concern (LOC). Adverse effects in mammals following chronic exposure to glufosinate in laboratory studies include reductions in growth and in offspring fitness and viability; these effects are seen across generations and in multiple species (EPA EFED Glufosinate 2013 at 5).

Chronic effects of glufosinate at the expected exposure levels in laboratory studies "include reductions in parental and offspring growth and offspring viability. These effects have been observed in multiple studies and have been shown to extend to the second generation (no subsequent generations were tested)." (EPA EFED Glufosinate 2013 at 92)

Formulated products are more acutely toxic to mammals than the active ingredient alone by an order of magnitude (EPA EFED Glufosinate 2013 at 91), and formulations may also cause chronic toxicity at lower levels.

EFSA identified a high risk to mammals from glufosinate use in glufosinate-resistant corn based on chronic toxicity, and considered it to be "critical area of concern" (EFSA 2005)."

Response: Herbicide impacts on mammals are assessed by EPA in their risk assessments and are outside the scope of this EIS.

116. Comment (APHIS-2013-0043-4706): "Pollinators are beneficial to agriculture. Even though cotton and soybeans are mainly self-pollinating, pollinators necessary for other crops and wild plants are known to collect nectar from soybeans (Krupke et al. 2012), and pollen and nectar from cotton (Borem et al. 2003, Röse et al. 2006), and to use the other plant species found within and around cotton and soybean fields for food and other habitat requirements. Thus APHIS must assess the impacts on pollinators of herbicide use with Xtend soybean and cotton, but they did not do so in the DEIS.

Glufosinate use with Xtend cotton may have direct effects on lepidopteran (butterfly and moth) pollinators when larvae eat glufosinate-containing pollen, nectar or leaves, either after direct over-spray or from drift. Laboratory experiments with the skipper butterfly *Calpodes ethlias* showed that larvae fed glufosinate-coated leaves were injured or killed by inhibition of glutamine synthase, at doses “comparable to the amount that might realistically be acquired by feeding on GLA [glufosinate]-treated crops.” These studies were done with the active ingredient, not a full formulation, and so may have underestimated field toxicity (Kutlesa and Caveney 2001).

Nectar of glufosinate-treated Xtend cotton may accumulate significant levels of glufosinate. Although primarily a contact herbicide, glufosinate does translocate via phloem to a limited degree, depending on the plant species (Carpenter and Boutin 2010). In experiments comparing glufosinate translocation in GE resistant canola versus a susceptible variety (Beriault et al. 1999), glufosinate translocated more readily in resistant plants. However, in both resistant and susceptible canola, glufosinate moved in the phloem to developing anthers without causing injury to tissues along the way. If glufosinate is retained in leaves of resistant cotton, it may translocate to nectar later, even if the applications occur well before flower formation. It may also be present in extrafloral nectaries.

APHIS should examine data on glufosinate levels in flowers and extrafloral nectaries of Xtend cotton after labeled applications to assess risks to beneficial pollinators.

Pollinators may also be affected by changes in habitat from glufosinate toxicity to plants. Numbers and kinds of plants can change dramatically in response to herbicide applications, with impacts that ripple through ecosystems (as discussed in relation to monarchs, below). In addition, pollinators that depend on specific host plants may be affected if those plants are more sensitive to glufosinate (Pleasants and Oberhauser 2012).

Large buffers may be required to protect non-target terrestrial plants from injury (EPA EFED Glufosinate 2013 at 98), and thus reduce harm to pollinators.”

Response: Herbicide impacts on bees are assessed by EPA in their risk assessments and are outside the scope of this EIS.

117. Comment (APHIS-2013-0043-2470, -2500, -2527, -2528, -2529, -2530, -2778, -3016, -3202, -3213): Several vineyard owners and grape growers wrote in opposing the petitions for MON 87708 soybean and MON 88701 cotton. Ten comments were received. Each commenter was very concerned about dicamba spray drift and chemical volatilization as grape is very sensitive to dicamba, causing extreme damage to the crop. Several of the commenters had routinely experienced herbicide drift. In one case, the commenter indicated that USDA investigators have never been able to identify the source of the drift incidences which severely weekend vines and killed blooms. Growers in the grape industry in Minnesota, Iowa, Wisconsin, Nebraska, North and South Dakota and any other states where soybeans and grapes are grown were particularly concerned about consequences of dicamba-resistant soybean could have on grape production. Growers stressed that nonregulated status could destroy the unique Northern grape varieties of the mid-west. Growers stressed that it takes five years for plants to become fully productive; damage once in five years could therefore devastate an entire crop.

Growers were also concerned about the need for additional and potentially harsher chemicals in the future with the inevitable occurrence of dicamba resistant weeds. Commenters were also concerned that there are no residual tolerances established for dicamba on certain foods.

Response: Off-target injury to nontarget sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers these potential effects during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

118. Comment (APHIS-2013-0043-3345): "Although the use of the diglycolamine (DGA) salt would be less prone to drift than the dimethylamine (DMA) or dicamba acids, the new formulation would only reduce drift potential rather than eliminate movement. The slight reduction will probably not be enough to counter the herbicide's potential for injury to nontarget plants because much higher levels of dicamba will be applied due to the nature of the dicamba-tolerant cotton and soybeans, many more acres will be sprayed with dicamba, and more spraying mid-season (rather than pre-plant) will affect nontarget plants that have leafed out and are more vulnerable to dicamba drift injury. Dicamba can impact any broadleaf plant, but some of the most sensitive crops include grapes, soybeans, sunflower, beans, tomatoes, cotton and lettuce. Nontarget plants are not limited to farmland, but also field-edge plants that are used as forage and habitat for pollinators and other organisms could be negatively impacted by the registration of Xtendimax dicamba. Additionally, because more farmers will be adopting this formulation of dicamba, the incidence of misapplication leading to drift (such as applying in high temperatures or on windy days or not using the proper equipment) would be increased.

The approval of dicamba-tolerant crops that are engineered to work with this drift-prone herbicide could seriously threaten nearby specialty crop growers and any plants and animals that are exposed to higher concentrations of these dangerous chemicals. Steve Smith, Agriculture Director for Red Gold — the largest privately held U.S. canned tomato processing company — stresses that "the widespread use of dicamba herbicide possesses the single most serious threat to the future of the specialty crop [fruit and vegetable] industry in the Midwest."

Even if farmers use the Xtendimax dicamba formulation according to the label, non-tolerant crops could be negatively impacted. For example, peanuts have a similar growing season and are planted in close proximity to cotton and soybeans in the southeast United States.14 Field trials were conducted in Georgia to look at the impacts of dicamba on peanut yield, and found that peanuts are most sensitive to dicamba when it is applied 60 days after planting, which can result in a nearly 70 percent yield loss at the typical application rate of dicamba on soybeans (0.38 lb ai/A).15 Monsanto's Xtendimax dicamba formulation can be sprayed at even higher levels (0.50 lb ai/A) twice postemergence for cotton, and once in soybean fields afflicted with glyphosate-resistant weeds. In the University of Georgia peanut yield study, researchers found that at a 0.50 lb ai/A rate, the loss of peanut yield 60 days after planting was nearly 90 percent.16 The approval of Xtend cotton, soybeans and the associated herbicide could have a very detrimental impact on U.S. peanut production, which should be explored by the USDA in its final EIS."

Response: Off-target injury to nontarget sensitive crops from dicamba off-site drift or movement is regulated by EPA and not by APHIS. EPA considers these potential effects during its registration process and specifies conditions on the pesticide label to mitigate potential harm to human health and the environment, including drift onto neighboring fields. This is outside the scope of this EIS.

Threatened and Endangered Species

119. **Comment (APHIS-2013-0043-4706):** "In assessing potential effects of Xtend soybean and cotton on threatened and endangered plants, and on critical habitat that is composed of particular vegetation, APHIS does not consider impacts of herbicide use with Xtend soybean and cotton at all. However, in Appendix 8, APHIS provides information from EPA Environmental Fate and Effects Division showing that both non-listed and listed terrestrial dicot plants are at potential risk from direct effects of drift and runoff of dicamba use on Xtend soybean and cotton, as are listed vascular aquatic plants (DEIS Appendix 8 at 12 – 13)."

    Response: As stated in the EIS and responses above, herbicide impacts on non-target species are considered by the EPA in their risk assessments and are outside the scope of this EIS.

Cumulative Impacts

120. **Comment (APHIS-2013-0043-4713)**: "Monsanto has in the past few years conducted field trials of wheat resistant to dicamba, glufosinate and glyphosate (Monsanto DR wheat 2013) and dicamba-resistant canola (Monsanto DR canola 2012), which if commercially introduced would expand auxin use and selection pressure for auxin-resistant weed populations still more. APHIS does not mention these developments or assess the additional impacts they would have."

    Response: APHIS disagrees with the commenter that Monsanto's DR wheat and DR canola should be assessed in the EIS. According to Monsanto's website[3], the two examples listed by the commenter, Monsanto's DR wheat and DR canola are in Phase II or Early Development of Monsanto's research and development pipeline. It would be speculative for USDA to include GE crop traits that are currently in the early stages of the research pipeline in this analysis. Many combinations of traits and crop varieties are studied annually in field trials. A small number proceed to be candidates for potential

[3] http://www.monsanto.com/products/pages/specialty-crop-pipeline.aspx

commercialization. Bringing crops to market is costly, while obtaining regulatory approvals can take years, as different countries have different approval procedures. Market demands, consumer acceptance, as well acceptance by foreign importers, are all factors that exert a strong influence of decisions to proceed forward with a trait from research to commercialization. Thus, for a variety of reasons, companies decide not to proceed with further research or applications for nonregulated status on GE crop traits.

121. **Comment (APHIS-2013-0043-4706): "**Although it claims that direct and indirect effects of dicamba use on Xtend soybean and cotton are outside of the scope of the DEIS. However, in this DEIS, APHIS does consider (see Chapter 5) the potential cumulative impacts that could result in the event that it approves the petitions for nonregulated status of MON 87708 soybean and MON 88701 cotton and EPA registers the proposed new uses of dicamba on these crop varieties. Limiting the scope of its DEIS to cumulative impacts from dicamba when there are many other direct, indirect and cumulative impacts of herbicide use with Xtend soybean and cotton, including to non-target organisms, is arbitrary and contrary to sound science. Impacts of the APHIS approval of Xtend soybean and cotton must be assessed by APHIS under realistic scenarios, considering all reasonably foreseeable factors. Neither APHIS nor Monsanto provides any reason that a farmer would buy and plant Xtend crops unless he or she planned to use dicamba, alone or in combination with other herbicides to which the crops are resistant, on those fields, since the engineered traits confer no advantage in environments where the herbicides are absent."

    Response: APHIS does not address the direct and indirect impacts of herbicides on human health and the environment because EPA analyzes these potential effects in their risk assessments. This is outside the scope of this EIS.

Mitigation

122. **Comment (APHIS-2013-0043-4702):** "It is fundamental that an EIS must discuss not only the impacts of a proposed action and reasonable alternatives, but also measures that may be taken to reduce the action's impacts. This requirement is implicit in NEPA's provision that an EIS describe "any adverse environmental effects which cannot be avoided should the proposal be implemented." As the Ninth Circuit has emphasized, "The importance of the mitigation plan cannot be overestimated. It is a determinative factor in evaluating the adequacy of an environmental impact statement."

    Mitigation measures must be described "in detail," and an analysis explaining the effectiveness of the measures is "essential." Under NEPA regulations, APHIS mitigation strategy must include:

    (a) Avoiding the impact altogether by not taking a certain action or parts of an action.
    (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
    (c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.

Further, the effectiveness of mitigation measures must be supported by studies and analytical data in the record: "[T]he Ninth Circuit has repeatedly held that NEPA requires analytical data describing mitigation's effectiveness. A perfunctory description or mere listing of mitigation measures, without supporting analytical data, is inadequate." Finally, mitigation measures cannot substitute for actually analyzing environmental impacts.

In this DEIS, APHIS's repeated reliance on unanalyzed, uncertain mitigation violates NEPA. The agency includes various forms of mitigation it relies on to lessen the harms of its proposed action. In fact, pages 143 to 144 unabashedly include a long list of APHIS's "assumptions" for its analysis. This is <u>exactly</u> what the Courts have said is unacceptable: "A <u>perfunctory description or mere listing of mitigation measures</u>, without supporting analytical data, is <u>inadequate</u>.

First, as explained above, APHIS unlawfully relied completely on EPA's FIFRA process as "assumed," unanalyzed mitigation <u>for all herbicide impacts of APHIS's proposed approval action</u>:

- One assumption of the APHIS analysis is that EPA will establish label restrictions that will ensure the safety standards for human health and the environment associated with the use of dicamba on these varieties will be met;
- APHIS assumes that drift from dicamba and other pesticide applications will be mitigated to an acceptable level by the registration requirements established by EPA;

DEIS at 143 to 144 (emphases added). On page 196, entitled "mitigation measures," APHIS continues,

> Mitigation measures to oversee the proper use of herbicides are determined by EPA and are disseminated to the herbicide users through EPA-approved labels. Adherence to herbicide label requirements, including application rates and techniques and following industry herbicide stewardship programs, will largely minimize improper herbicide usage. The extent of herbicide drift will be mitigated by the requirement to use dicamba and glufosinate by conditions on the label that will require nozzles that limit drift and restrictions on when and how the herbicide can be applied. State and local governments may also impose restrictions on when and how herbicides can be applied.

Far from analyzing labeling requirements "in detail," APHIS includes no analysis of how EPA, let alone state and local governments, might accomplish this, or what levels might be acceptable or effective. Similarly, APHIS does not analyze risks from drift of dicamba, glufosinate, or glyphosate, even though these herbicides will be used as part of the Xtend crop system. This attempted mitigation reliance cannot substitute for APHIS's duty to actually analyze foreseeable environmental impacts.

Nor it is acceptable for APHIS to claim that such impacts are uncertain: "Reasonable forecasting and speculation is thus implicit in NEPA and we must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects a 'crystal ball inquiry.'" Consequently, APHIS's claim that it "approve now and ask questions later is precisely the type of environmentally blind decision-making NEPA was designed to avoid."

Second, APHIS unlawfully relied on mitigation in the form of industry's "best practices" and "stewardship:"

- APHIS assumes that growers will choose management practices appropriate for the crops planted;
- APHIS assumes that herbicide applications will conform to the EPA-registered uses for corn and soybean. . . . In addition to cotton and soybean, APHIS assumes that other approved dicamba uses (e.g. on pastures, wheat, oats, barley, millet, turf, sorghum, corn, sugarcane, asparagus) will conform to EPA-approved label requirements;
- APHIS assumes that dicamba treatments may or may not include glyphosate, although many treatments may be made with the Xtend dicamba formulation to cotton and soybean which could possibly include both as a premix; stewardship agreements (and herbicide labels with respect to Xtend-resistant crops) will include a requirement to use both dicamba and glyphosate and another herbicide in certain circumstances: "In fields where glyphosate-resistant broadleaf weeds are present or suspected, glyphosate plus dicamba will be recommended. In addition, Monsanto will recommend an additional herbicide with a 3rd mode-of-action that also has activity on the glyphosate-resistant broadleaf weed, thereby providing two effective modes-of-action to control glyphosate-resistant weeds."

DEIS at 144. On page 196 of the DEIS, APHIS again describes its reliance and clarifies that the mitigation upon which it is relying is not enforceable:

> APHIS does not have the authority to regulate types of management practices or use of herbicides. Nevertheless, mitigation can occur by a number of means. First growers may voluntarily adopt best practices recommended by weed experts. Second, any grower who uses either MON 87708 soybean or MON 88701 cotton will be expected to follow a stewardship agreement. APHIS assumes that there would be no binding enforcement mechanism to ensure that farmers follow the stewardship agreement but failure to do so could jeopardize a grower's access to the technology.

(Emphasis added.) Again, in violation of NEPA, APHIS fails to include analysis of the potential efficacy of these measures.

Moreover, APHIS admits that they are not enforceable; it is relying on Monsanto to police its own customers and sue them for any infractions, although Monsanto has no legal obligations or meaningful incentives to do so. Quite the contrary, Monsanto's financial interest in maximizing sale of its dicamba-resistant cotton and soybean seed conflicts with taking enforcement action against farmer-customers who violate its stewardship agreement. Thus, any reliance by APHIS on Monsanto's enforcement as a "mitigation" measure is by its nature arbitrary and capricious. APHIS provides no analysis of whether growers actually comply with stewardship provisions, nor any evidence that Monsanto will enforce them. "As with the question of the extent of the unremediated injury that might otherwise occur, the question of the impact of the proposed mitigation measures must be studied as part of the preparation of an EIS rather than after the injury has transpired." Therefore, APHIS's mitigation section is inadequate and violates NEPA.

Regarding transgenic contamination, APHIS states its belief that it growers of non-GE and organic soybean can use practices to protect their crops from transgenic contamination. See DEIS at 93 (soy). Once again, APHIS's mitigation assumption is without analytical basis; as discussed in CFS's here *supra* and in prior CFS comments on APHIS's NEPA analyses of deregulating GE crops, and as courts have previously held, transgenic contamination is a significant risk and substantial impact to farmers and the environment that must be analyzed in an EIS; it cannot be assumed away in a few sentences. Accordingly, APHIS's cursory assumptions and complete failure to analyze mitigation violate NEPA's mandates.

Finally, regarding herbicide-resistant weed development, APHIS correctly recognizes that deregulating dicamba-resistant crops will cause the development of dicamba-resistant weeds. DEIS at 181. APHIS thus "recommends" a list of agronomic voluntary practices "to mitigate the increased selection pressure associated with the increased use of dicamba." *Id.* APHIS states that it is "unknown" whether farmers will follow these listed practices. *Id*. APHIS then concludes that the distribution and growth of dicamba-resistant weeds is "impossible to predict" because the extent to which farmers will follow these practices is "unknown." *Id*. However, APHIS's reliance on this unanalyzed, uncertain "mitigation" violates NEPA. The effectiveness of mitigation measures must be supported by studies and analytical data in the record: "[T]he Ninth Circuit has repeatedly held that NEPA requires analytical data describing mitigation's effectiveness. A perfunctory description or mere listing of mitigation measures, without supporting analytical data, is inadequate." Nor can mitigation measures substitute for actually analyzing environmental impacts."

Response: APHIS disagrees with the commenter's characterization of the requirements of NEPA under the circumstances presented here and the commenter's assertion that APHIS's discussion of the mitigation measures is inadequate under NEPA The EIS contains a thorough discussion of the known mitigation measures that are available to address impacts from the use of dicamba, including best management practices and mitigation measures required by EPA. APHIS has no authority to impose any mitigation measures with regard to the use of any herbicides, including dicamba. APHIS has complied with NEPA in discussing the available strategies and acknowledging the limitations of available data regarding effectiveness.

PPRA

123. Comment (APHIS-2013-0043-4713): "Insect pollinators are known to effect pollination at considerable distances from the source plants, including from primarily self-pollinating crops (e.g. Pasquet et al. 2008).

In addition to MON 87708, several other HR soybean events have recently been deregulated and will likely soon be commercialized: Dow's 2,4-D/ glufosinate/ glyphosate-resistant soybeans, isoxaflutole/glyphosate-resistant soybeans from Bayer/M.S. Technologies, BASF's imidazolinone-resistant soybean, and finally soybeans with dual resistance to HPPD inhibitors and glufosinate developed jointly by Bayer and Syngenta.14 While multiple HR soybean volunteers via cross-pollination would likely be an infrequent occurrence, it could trigger serious weed management challenges where it does occur."

Response: The potential for gene flow, hybridization, and gene introgression for MON 87708 soybean is discussed in APHIS' Plant Pest Risk Assessment for MON 87708. In summary, natural outcrossing rates in soybean are usually lower than 1%. This is predominantly due to soybean flower physiology and anatomy, where the anthers mature in the flower buds and directly shed their pollen onto the stigma of the same flower before flower opening. Cross pollination and integration of a resistant trait from volunteer soybean resistant to an herbicide other than dicamba, is considered a highly unlikely event. For a detailed description on the likelihood of cross pollination of DT soybean with other volunteer HT soybean, please refer to the Plant Pest Risk Assessment for Dicamba resistant soybean.

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