**NATIONAL ENVIRONMENTAL POLICY ACT DECISION**
**AND**
**FINDING OF NO SIGNIFICANT IMPACT**

**Syngenta Biotechnology Incorporated**
**MIR162 Maize**
**SYN-IR162-4**

**United States Department of Agriculture**
**Animal and Plant Health Inspection Service**
**Biotechnology Regulatory Services**

This National Environmental Policy Act (NEPA) decision document has been developed by U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) in compliance with the requirements of the National Environmental Policy Act of 1969, as amended, the Council of Environmental Quality's (CEQ) regulations implementing NEPA, and the USDA and APHIS NEPA implementing regulations and procedures. This NEPA decision document is intended to state APHIS' NEPA decision and present the rationale for its selection.

In accordance with APHIS procedures implementing the NEPA Regulations (7 CFR part 372), APHIS has prepared an Environmental Assessment (EA) to evaluate and determine if there are any potentially significant impacts to the human environment following a determination of nonregulated status of a petition request (APHIS number 07-253-01p) by Syngenta Biotechnology, Inc. (hereafter "Syngenta") for their transgenic event MIR162 in corn (hereafter "MIR162 corn"). Syngenta MIR162 corn is a genetically engineered (GE) *Zea Mays* (corn) hybrid variety that was genetically engineered to be resistant to the feeding damage caused by corn earworm (*Helicoverpa zea*), fall armyworm (*Spodoptera frugiperda*), black cutworm (*Agrotis ipsilon*), and western bean cutworm (*Striacosta albicosta*) larvae that are not controlled well with existing technology. MIR162 corn has been engineered to express the bacterial protein Vip3Aa20 from *Bacillus thuringiensis* that is toxic to certain lepidopteran insect pests. This corn is also engineered to express another protein, phosphomannose isomerase (PMI) from *Escherichia coli*, which was used as a selectable marker to identify corn seedlings containing Vip3Aa20 gene during the development of MIR162 corn.

APHIS has evaluated the plant pest risks posed by the production of Syngenta MIR162 and prepared an EA to identify and evaluate any environmental impacts resulting from the approval of the petition for nonregulated status. The EA assesses alternatives to granting nonregulated status to Syngenta MIR162 and analyzes the potential environmental and social effects that result from the proposed action and the alternatives. The proposed action of USDA APHIS, Biotechnology Regulatory Services (BRS) is to grant nonregulated status to Syngenta MIR162 and remove this GE corn variety from APHIS' regulatory oversight in accordance with 7 CFR part 340. Comments from the public involvement process were reviewed for substantive issues which were considered in developing this NEPA decision.

In 1986, the Federal Government's Office of Science and Technology Policy (OSTP) published a policy document known as the Coordinated Framework for the Regulation of Biotechnology. This document specifies three Federal agencies that are responsible for regulating biotechnology in the United States: USDA-APHIS, the U.S. Department of Health and Human Services' Food and Drug Administration (FDA), and the Environmental Protection Agency (EPA). Products are regulated according to their intended use and some products are regulated by more than one agency. USDA-APHIS, FDA, and EPA enforce agency-specific regulations on products of biotechnology that are based on the specific nature of each GE organism. Together, these agencies ensure that the products of modern biotechnology are safe to grow, safe to eat, and safe for the environment.

APHIS regulates GE organisms under the Plant Protection Act of 2000. USDA APHIS-BRS' mission is to protect America's agriculture and environment using a dynamic and science-based regulatory framework that allows for the safe development and use of GE organisms. APHIS regulations at 7 CFR part 340, which were promulgated pursuant to authority granted by the Plant Protection Act, as amended (7 United States Code (U.S.C.) 7701–7772), regulate the introduction (importation, interstate movement, or release into the environment) of certain GE organisms and products. A GE organism is considered a regulated article if the donor organism, recipient organism, vector, or vector agent used in engineering the organism belongs to one of the taxa listed in the regulation (7 CFR § 340.2) and is also considered a plant pest. A GE organism is also regulated under part 340 when APHIS has reason to believe that the GE organism may be a plant pest or APHIS does not have sufficient information to determine if the GE organism is unlikely to pose a plant pest risk.

A person may petition the agency to evaluate submitted data and determine that a particular regulated article is unlikely to pose a plant pest risk, and, therefore, should no longer be regulated, under 7 CFR § 340.6 "Petition for Determination of Nonregulated Status." The petitioner is required to provide information (§ 340.6(c)(4)) related to plant pest risk that the agency uses to determine whether the regulated article is unlikely to present a greater plant pest risk than the unmodified organism. After receipt of a petition, as per the requirements of § 340.6, BRS makes a determination on whether an organism is not likely to pose a plant pest risk and is therefore no longer subject to the regulatory requirements of 7 CFR part 340. A GE organism is no longer subject to the regulatory requirements of 7 CFR part 340 when APHIS determines that it is not likely to pose a plant pest risk.

FDA regulates under the authority of the Federal Food, Drug, and Cosmetic Act. The FDA policy statement concerning regulation of products derived from new plant varieties, including those genetically engineered, was published in the Federal Register on May 29, 1992 (57 FR 22984-23005). Under this policy, FDA uses what is termed a consultation process to ensure that human food and animal feed safety issues or other regulatory issues (e.g., labeling) are resolved prior to commercial distribution of bioengineered food. Syngenta MIR162 corn has successfully completed the consultation process with the FDA concerning food and feed safety (BNF No. 000113). FDA has no more questions on nutritional or safety issues, and has provided a summary response and "concluded that maize forage and grain from the new variety are not materially different in composition, safety, and other relevant parameters from maize forage and grain currently on the market and that the genetically engineered maize event MIR162 does not raise issues that would require premarket review or approval by FDA."

The EPA regulates plant-incorporated protectants under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and certain biological control organisms under the Toxic Substances Control Act (TSCA). Because Syngenta MIR162 corn does contain genetically engineered pesticides, EPA registration was pursued by Syngenta. A tolerance for the insecticidal Vip3Aa20 protein that is contained in Event MIR162 was registered by EPA (2008). EPA has approved the conditional registration for MIR162 and the two corn hybrids Bt11 x MIR162 and Bt11 x MIR162 x MIR604 (74 FR 19956-19957) and determined that the use of this pesticide "will not cause any unreasonable effects on the environment during the time of conditional registration" (EPA 2009).

**Document History**

On September 10, 2007 APHIS BRS received a petition from Syngenta Biotechnology, Incorporated seeking a determination of nonregulated status for MIR162 corn. An amended version of the petition was received on November 14, 2007 and final additional data and response to BRS questions was dated July 16, 2008. Upon receipt of the final submissions, BRS reviewed the information and deemed the petition complete on July 23, 2008. Based upon information provided in the petition and review of the scientific literature, BRS prepared a Draft EA and Plant Pest Risk Assessment (PPRA) (USDA-APHIS 2010).

**Public Involvement**

On January 13, 2010, APHIS published a notice in the Federal Register (75 *FR* 1749-1751, Docket no. APHIS-2009-0072) announcing the availability of the Syngenta petition requesting nonregulated status for MIR162 corn, a Draft PPRA and a Draft EA for a 60 day public comment period. This comment period ended on March 15, 2010. In total, 35 comments were received from the public. All comments were analyzed to identify new issues, alternatives, or information. Responses to the substantive comments are attached to the docket submitted to the Federal Register with this Finding.

**Major Issues Addressed in the EA**

The EA describes the alternatives considered and evaluated using the identified issues. Issues considered in the EA were developed based on APHIS' determination to grant nonregulated status for certain genetically engineered organisms and for this particular EA, the specific deregulation of Syngenta MIR162 corn. The following issues were identified as important to the scope of the analysis (40 CFR 1508.25):

Corn

- Gene Movement (Pollen Flow)
- Weediness
- Human Health
- Animal Feed

Agricultural Production of Corn

- Growing Regions and Acreage
- Organic and Conventional Corn Production
- Seed Production

Insect Control Practices

- Insect Pests and Disease
- Mycotoxin Contamination
- Insecticide Use

Impacts on Non-target Organisms

- Higher Organisms
- Above Ground Arthropods
- Threatened and Endangered Species
- Soil Dwelling Organisms

Socioeconomic Impacts

- Agricultural
- Human Health and Environment
- Insect Resistance Management
- Export Market

**Affected Environment:**
Although the preferred alternative would allow for plantings of Syngenta MIR162 corn to occur anywhere in the U.S., APHIS limited the environmental analysis to those areas that currently support corn production. To determine areas of corn production, APHIS used data from the National Agricultural Statistics Service (NASS) 2007 Census of Agriculture to determine where corn is produced in the United States (USDA-NASS. 2009). Forty-nine states produce corn in the U.S. according to the 2007 Census of Agriculture. Syngenta MIR162 corn will likely partially replace some existing corn varieties because of grower needs and preferences. However, MIR162 does not express new agronomic traits or resistance traits useful against a geographically limiting insect species. Consequently, growers will not likely plant new land beyond that currently or historically used for corn production if this trait is made commercially available.

**Alternatives that were fully analyzed**:
The EA analyzes the potential environmental consequences of a proposal to grant nonregulated status to MIR162 corn. In order for MIR162 corn to be granted nonregulated status, it must be found to be unlikely to pose a plant pest risk. The analysis provided in the plant pest risk assessment (USDA-APHIS 2009) demonstrates that there is sufficient data to determine that MIR162 corn is unlikely to pose a plant pest risk; thus APHIS has no regulatory authority over MIR162 corn and this GE corn variety is eligible for nonregulated status.

The regulations at 7 CFR 340.6(d)(3)(i) state that APHIS may "approve the petition in whole or in part." Because APHIS has found that MIR162 corn is unlikely to pose a plant pest risk, the only action alternative considered in the EA is to granting nonregulated status “in whole” to MIR162 corn. Approval in part can be given if there is a plant pest risk associated with some but not all lines requested in a petition. The petition for MIR162 corn only requested APHIS to grant nonregulated status to one corn line, so this “in part” approval will not be considered. Thus, there are two alternatives that are considered in this EA: (1) no action and (2) to grant nonregulated status to MIR162 corn, “in whole.”

**Alternative A. No Action: Continuation as a Regulated Article**

Under the “no action” alternative, APHIS would deny the petition. MIR162 corn and its progeny would continue to be regulated under 7 CFR part 340. Permits issued or notifications acknowledged by APHIS would still be required for introductions of MIR162 corn and measures to ensure physical and reproductive confinement would continue to be implemented. APHIS might choose this alternative if there were insufficient evidence to demonstrate the lack of plant pest risk from the unconfined cultivation of the MIR162 corn and its progeny.

Under this no action alternative, growers and other parties who are involved in production, handling, processing or consumption of corn would continue to have access to existing deregulated GE insect resistant corn as well as conventional corn varieties. However, growers would not have widespread access to the MIR162 corn since it would continue to be regulated under Part 340. This alternative is not the preferred alternative because APHIS’ evaluation of MIR162 data in the plant pest risk assessment demonstrates that the MIR162 corn is unlikely to pose a plant pest risk (USDA-APHIS 2009). Choosing this alternative would hinder the purpose and need of APHIS to allow for the safe development and use of GE organisms given that the MIR162 corn is unlikely to pose a plant pest risk.

**Alternative B. Grant nonregulated status to MIR162 corn, “in whole” - Preferred Alternative: Determination that Syngenta MIR162 Corn is No Longer a Regulated Article**

Under this alternative, MIR162 corn and its progeny would no longer be considered regulated articles under 7 CFR part 340. Permits or notifications acknowledged by APHIS would no longer be required for introductions in the United States and its territories of the MIR162 corn or its progeny. MIR162 corn is eligible for nonregulated status because APHIS has determined that this GE organism is unlikely to pose a plant pest risk (USDA-APHIS 2009). APHIS might choose this alternative if there was sufficient evidence to demonstrate the lack of plant pest risk associated from the unconfined release of this insect resistant corn event.

Under this alternative, growers may have future access to MIR162 corn and progeny derived from this variety if the developer decides to commercialize this insect resistant corn variety. In addition, growers and other parties who are involved in production, handling, processing or consumption of corn would continue to have access to existing deregulated GE insect resistant corn as well as conventional corn varieties. If commercialized, MIR162 corn will likely be introduced in areas where corn is currently grown and is not expected to alter the current range of corn cultivation in the US. APHIS has chosen Alternative B as the preferred alternative because APHIS has determined that MIR162 corn is unlikely to pose a plant pest risk (USDA-APHIS 2009). By granting nonregulated status to MIR162 corn, the purpose and need to allow the safe development and use of GE organisms is met.

**Alternatives Considered but Rejected from Further Consideration:**

**Geographic restrictions** -APHIS considered geographic restrictions based upon geographic variation in plant pest risk. As presented in APHIS plant pest risk assessment for MIR162 corn, there is no geographic differences in the plant pest risks for MIR162 corn (USDA-APHIS 2009). This alternative was rejected and not analyzed in detail because MIR162 corn is unlikely to pose a plant pest risk and therefore, APHIS will have no regulatory authority over MIR162 corn and will be unable to impose regulatory restrictions on this GE corn variety.

**Environmental Consequences of APHIS' Selected Action**

The EA contains a full analysis of the alternatives to which we refer the reader for specific details. The following table briefly summarizes the results for each of the issues fully analyzed in the Environmental Consequences section of the EA.

Table 1. Issues Analyzed and Other Regulatory Actions

| ***Attribute/Measure*** | ***Alternative A No Action*** | ***Alternative B Deregulation in Whole (Preferred Alternative)*** |
|---|---|---|
| **Meets APHIS Purpose and Need and Objectives** | No | Yes |
| Unlikely to pose a plant pest risk | Satisfied through use of regulated field trials | Satisfied—risk assessment (USDA-APHIS 2009) |
| Farmer choice | Not available commercially | No restrictions |
| **Corn** | | |
| Gene Movement (Pollen Flow) | Minimal | Minimal |
| Weediness | None | None |
| Human Health | Unchanged | FDA approved safety of changes |
| Animal Feed | Unchanged | FDA approved safety of changes |
| **Agricultural Production of Corn** | | |
| Growing Region and Acreage | Unchanged | Unchanged |
| Organic and Conventional Corn Production | Unchanged | Unchanged |

| | | |
|---|---|---|
| Seed Production | Unchanged | Unchanged |
| **Insect Control Practices** | | |
| Insect Pests and Disease Management Practices | Unchanged | Unchanged |
| Mycotoxin Contamination | Unchanged | May decrease |
| Insecticide Use | Unchanged | May decrease |
| **Impacts on Non Target Organisms** | | |
| Higher Organisms | Unchanged | Unchanged |
| Above Ground Arthropods | Unchanged | Unchanged |
| Threatened and Endangered Species | Unchanged | Unchanged |
| Soil Dwelling Organisms | Unchanged | Unchanged |
| **Socioeconomic Impacts** | | |
| Agricultural | Unchanged | May improve |
| Human Health and Environment | Unchanged | May improve |
| Insect Resistance Management | Unchanged | May improve |
| Export Market | Unchanged | Unchanged |
| **Other Regulatory Approvals** | | |
| U. S. | Completion of FDA consultation. Registration by EPA and tolerance allowed | Completion of FDA consultation. Registration by EPA and tolerance allowed |
| Foreign Trade | Approvals from Australia, Brazil, Japan, Mexico, Philippines, Taiwan | Approvals from Australia, Brazil, Japan, Mexico, Philippines, Taiwan |
| **Compliance with Other Laws** | | |
| CWW, CAA. EOs | Fully compliant | Fully compliant |

**Finding of No Significant Impact**
The analysis in the EA indicates that there will not be a significant impact, individually or cumulatively, on the quality of the human environment as a result of this proposed action. I agree with this conclusion and therefore find that an EIS need not be prepared. This NEPA determination is based on the following context and intensity factors (40 CFR 1508.27):

*Context* – The term "context" recognizes potentially affected resources, as well as the location and setting in which the environmental impact would occur. This action has potential to affect conventional and organic corn production systems, including surrounding environments and agricultural workers; human food and animal feed production systems; and foreign and domestic commodity markets. As identified in the

Affected Environment section above, although the preferred alternative would allow for new plantings of MIR162 corn to occur anywhere in the U.S., the environmental analysis is limited to those areas that currently support corn production in forty-nine states.

*Intensity* – Intensity is a measure of the degree or severity of an impact based upon the ten factors. The following factors were used as a basis for this decision*:*

1. *Impacts that may be both beneficial and adverse.*
   Granting nonregulated status to MIR162 corn will have no significant impact on the availability of GE, conventional, organic or specialty corn varieties or corn production systems. As discussed in Chapter 6 of the EA, if deregulated by APHIS, MIR162 corn would be an additional GE insect resistant corn variety available to growers for commercial production and there are no foreseeable changes to the availability of GE, conventional, organic or specialty corn varieties on the market. Nontransgenic corn will likely still be sold and will be readily available to those who wish to plant it. Syngenta MIR162 corn will likely partially replace some existing corn varieties because of grower needs and preferences. However, MIR162 does not express new agronomic traits or resistance traits useful against a geographically limiting insect species. Consequently, growers will not likely plant new land beyond that currently or historically used for corn production if this trait is made commercially available. As discussed in Chapter 6 of the EA, the introduction of MIR162 corn will have a positive impact on current corn insect control practices. MIR162 corn has the potential to control above-ground insect pests including corn earworm, black cutworm, western bean cutworm, and fall armyworm that are not controlled by the Bt corn varieties expressing Cry proteins. This product has the potential to displace many conventional insecticide applications on corn resulting in a reduction in the number of pounds of insecticides that may be used to protect corn from insect damage. MIR162 will also provide farmers with an additional management option that will likely help farmers increase their capacity to alleviate adverse affects of mycotoxins on crops and animals.
2. *The degree to which the proposed action affects public health or safety.*
   The proposed action to grant nonregulated status to MIR162 corn would have no significant impacts on human or animal health. MIR162 is not materially different in composition, safety, or any other relevant parameter from corn now grown, marketed, and consumed, except for the expression of Vip protein. As described in Chapter 6 of the EA, numerous corn varieties that express other Bt.-derived proteins are currently available and have been used safely in the marketplace since 1996. FDA completed the safety and nutritional assessment for this product and had no further questions regarding the safety of Syngenta MIR162 corn (FDA 2009). Based on the assessment of the evidence provided in the petition and accompanying scientific literature, and on the assessments of EPA and FDA, APHIS has concluded that Syngenta MIR162 corn would have no significant impacts on human or animal health.

3. *Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.*
   There are no unique characteristics of geographic area such as park lands, prime farm lands, wetlands, wild and scenic areas, or ecologically critical areas that would be significantly affected. MIR162 will only be grown in areas suitable for the production of corn and those historically used for corn production. There is no significant difference in performance or agricultural practices for growing MIR162 corn compared to other corn varieties (aside from reduced control measures for certain lepidopterous pest insects), and no natural resources or land usage will be significantly altered through the production of MIR162 corn.
4. *The degree to which the effects on the quality of the human environment are likely to be highly controversial.*
   The effects on the quality of the human environment are not highly controversial. Although there is some opposition to the granting of nonregulated status to MIR162 corn, this action is not highly controversial in terms of size, nature or effect. Other than objections to all genetically engineered crops, the public comments did not register any specific factual concerns with the data provided APHIS for this crop or its analysis, both of which were presented in the EA.
5. *The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.*
   Based on the analysis documented in the EA, the effects on the human environment would not be significant. The effects of the proposed nonregulated status for MIR162 are not highly uncertain and do not involve unique or unknown risks. As described in Chapters 4 and 6 of the EA, well established management practices, production controls, and production practices (GE, conventional, and organic) are currently being used in corn production systems in the US. Therefore, it is reasonable to assume that farmers, who produce conventional corn, MIR162 corn, or produce corn using organic methods, will continue to use these reasonable, commonly accepted best management practices for their chosen system and varieties for agricultural corn production. Additionally, 85% of the corn acreage in the U.S. is planted to GE varieties. Of the total corn acres planted in 2009, 63% were GE Bt or Bt-stacked corn varieties (USDA-NASS 2009a). The availability of MIR162 corn would offer growers and manufacturers another choice of corn resistant to insects in addition to the options already available.
6. *The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.*
   The proposed action would not establish a precedent for future actions with significant effects or represent a decision in principle about a future decision. Similar to past petitions for nonregulated status (USDA-APHIS 2010), APHIS decision on the regulatory status of MIR162 corn will be based upon information provided in the petition submitted by the applicant. APHIS regulations at 7 CFR part 340, regulate the introduction (importation, interstate movement, or release into the environment) of certain GE organisms and products. A person may petition the agency to evaluate submitted data and determine that a particular

regulated article is unlikely to pose a plant pest risk, and, therefore, should no longer be regulated, under 7 CFR § 340.6 "Petition for Determination of Nonregulated Status." After receipt of a petition, BRS makes an independent determination about whether an organism is unlikely to pose a plant pest risk and is therefore no longer subject to the regulatory requirements of 7 CFR part 340. Each petition that APHIS receives undergoes this independent review to determine if the regulated article poses a plant pest risk.

7. *Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.*

No significant cumulative effects were identified through this assessment. The EA evaluated the potential cumulative impacts of granting nonregulated status to MIR162 corn including the effects on corn production, genetic purity of corn germplasm, genetic diversity of corn, insect resistance, threatened and endangered species and biodiversity. A cumulative effects analysis is included in Chapter 6 of the EA. If granted nonregulated status, MIR162 corn may be stacked (combined) with conventional varieties or other nonregulated GE corn varieties by traditional breeding techniques, resulting in corn that, for example, may also be resistant to herbicides or other insects. EPA has approved the conditional registration of MIR162 stacked corn hybrids. As presented in the EA, on July 23, 2008 EPA announced receipt of a petition from Syngenta to conditionally register three pesticide products containing the new active ingredient Vip3Aa20 and the genetic material necessary for its production in corn (73 FR 42799-42801). These pesticide products included MIR162 and the two corn hybrids Bt11 x MIR162 and Bt11 x MIR162 x MIR604 (Bt11 and MIR604 contain the additional insecticidal protein active ingredients Cry1Ab and Cry3A, respectively, and both have previously been deregulated by APHIS and registered as plant-incorporated protectants by EPA). On April 30, 2009, EPA announced the approval of these conditional registrations involving MIR 162 and the hybrids (74 FR 19956-19957). There is no guarantee that MIR162 corn will be stacked with any particular deregulated GE variety, as company plans and market demands play a significant role in those business decisions. Postulating and predicting any and all potential combinations of stacked varieties that could be created using both deregulated GE corn varieties and also non-GE corn varieties is too hypothetical and purely speculative.

8. *The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.*

MIR162 corn would have no impact on districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, nor would they likely cause any loss or destruction of significant scientific, cultural, or historical resources. Granting nonregulated status to MIR162 corn will not cause an increase in agricultural acreage devoted to corn production, or to acres devoted to GE corn cultivation. MIR162 corn will also not change future cultivation areas for corn production in the U.S. This corn variety does not express new agronomic traits or resistance traits useful against a geographically limiting insect species. Consequently, growers will not likely plant new land beyond that currently or historically used for corn production if this trait is made commercially available.

9. *The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.*
   APHIS evaluated the potential for negative effects on federal threatened and endangered species as listed by the U.S. Fish and Wildlife Service from cultivation of MIR162 corn and its progeny and determined that the release of MIR162 corn, following a determination of nonregulated status, would have no effect on federally listed threatened or endangered species or species proposed for listing, or on designated critical habitat or habitat proposed for designation (*see* section on Threatened and Endangered Species, Chapter 6 of the EA).

10. *Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.*
   The proposed action would be in compliance with all federal, state, and local laws. The proposed action to grant nonregulated status to MIR162 and remove this GE corn variety from APHIS' regulatory oversight would be carried out in accordance with 7 CFR part 340. MIR162 corn has successfully completed the consultation process with the FDA concerning food and feed safety (Appendix 1 of the EA). MIR162 corn expresses a genetically engineered pesticide and registration of this product as well as a tolerance for its plant-expressed insecticidal protein was required from EPA (EPA 2008, 2009, 2009a). There are no other Federal, state, or local permits that are needed prior to the implementation of this action. A list of the current status of U.S. and international approvals is found in Table 1 of this Decision Document.

**NEPA Decision and Rationale**

I have carefully reviewed the EA prepared for this NEPA determination and the input from the public involvement process. I believe that the issues identified in the EA are best addressed by selecting Alternative B - Grant nonregulated status to Syngenta MIR162 corn, "in whole".

As stated in the CEQ regulations, "the agency's preferred alternative is the alternative which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors." The preferred alternative has been selected for implementation based on consideration of a number of environmental, regulatory, and social factors. Based upon our evaluation and analysis, Alternative B is selected because (1) it allows APHIS to fulfill its statutory mission to protect America's agriculture and environment using a dynamic and science-based regulatory framework that allows for the safe development and use of genetically engineered organisms; and (2) it allows APHIS to fulfill its regulatory obligations. Since APHIS has concluded that that Syngenta MIR162 corn is unlikely to pose a plant pest risk, APHIS has no authority to continue to regulate a GE organism once it has determined that the GE organism does not pose a plant pest risk. The comments identified from public involvement did not change the results of the analysis. Therefore, it is my decision to implement the preferred alternative as described in the EA.

April 9, 2010

Mike Gregoire
Deputy Administrator
Biotechnology Regulatory Services
Animal and Plant Health Inspection Services
U.S. Department of Agriculture

Date

**Literature Cited:**

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EPA 2009. *Bacillus thuringiensis* Cry1Ab Delta-Endotoxin Protein and the Genetic Material Necessary for Its Production (*via* Elements of Vector pZO1502) in Event *Bt*11 Corn (OECD Unique Identifier: SYN-BTØ11-1)(006444) & *Bacillus thuringiensis* Vip3Aa20 Insecticidal Protein and the Genetic Material Necessary for Its Production (*via* Elements of Vector pNOV1300) in Event MIR162 Maize (OECD Unique Identifier: SYN-IR162-4)(006599) Fact Sheet. US Environmental Protection Agency. http://www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_006599-006444.html

EPA 2009a. *Bacillus thuringiensis* Cry1Ab Delta-Endotoxin Protein and the Genetic Material Necessary for Its Production (via Elements of Vector pZO1502) in Event Bt11 Corn (OECD Unique Identifier: SYN-BTØ11-1)(006444) & Bacillus thuringiensis Vip3Aa20 Insecticidal Protein and the Genetic Material Necessary for Its Production (via Elements of Vector pNOV1300) in Event MIR162 Maize (OECD Unique Identifier: SYN-IR162-4)(006599) & Modified Cry3A Protein and the Genetic Material Necessary for Its Production (via Elements of Vector pZM26) in Event MIR604 Corn (OECD Unique Identifier: SYN-IR6Ø4-5)(006509) Fact Sheet. US Environmental Protection Agency. http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_006599-006444-006509.htm

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USDA-NASS. (2009a). Adoption of Genetically Engineered Crops in the U.S.: Corn Varieties. Genetically engineered (GE) corn varieties by State and United States, 2000-2009. USDA National Agricultural Statistics Service. http://www.ers.usda.gov/data/BiotechCrops/ExtentofAdoptionTable1.htm

**Petition 07-253-01p: Syngenta's Insect-Resistant MIR162 Corn**
**Response to Comments**

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) reviewed a Syngenta petition (APHIS No. 07-253-01p) requesting a determination of nonregulated status for their genetically engineered (GE) insect-resistant corn cultivar MIR162. Syngenta submitted data supporting their petition that MIR162 corn should no longer be considered a regulated article under APHIS Biotechnology Regulations (7 Code of Federal Regulations (CFR) part 340) because MIR162 corn is unlikely to pose a plant pest risk. Prior to reaching a determination, APHIS prepared a plant pest risk assessment (PPRA) to evaluate whether MIR162 corn is likely to pose a plant pest risk. Based on the plant pest risk assessment, APHIS concluded that MIR162 corn is unlikely to pose a plant pest risk and is therefore eligible for nonregulated status. APHIS also prepared a draft environmental assessment (EA) to evaluate whether there could be significant impacts on the environment arising from a decision to grant a determination of nonregulated status to MIR162 corn. APHIS prepared the EA as part of its obligation to meet the statutory requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C.A. § 4321 *et seq*.). As part of this process, APHIS considered public comments received on the petition for a determination of nonregulated status and associated draft EA. This document provides APHIS' response to these comments.

On January 13, 2010, APHIS published a notice in the Federal Register (75 FR 1749-1751, Docket No. APHIS-2009-0072) announcing the availability of the Syngenta petition and the APHIS PPRA and EA for a 60-day public review and comment period. This comment period ended on March 15, 2010. APHIS received a total of 35 comments from various groups and individuals. Nineteen comments supported deregulation, while 16 comments generally opposed the development and use of genetically engineered foods.

Those supporting a determination of nonregulated status included six academicians, six individuals from the corn industry, four corn trade groups, and three corn growers. Those opposing a determination of nonregulated status included a corn grower, two Non Governmental Organizations (NGOs) (supplied four comments), and 11 individual consumers.

Supporters of a determination of nonregulated status for MIR162 cited a number of benefits they personally observed from growing either MIR162 corn test plots or other insect-resistant Bt corn, or because of their experience dealing with the GE insect-resistant corn. A few salient observations that provide supporting evidence for MIR162 corn are: (1) It was found effective against a broad spectrum of difficult to control lepidopteran pests such as corn earworm, fall armyworm, western bean cutworm, black cutworm, and sugarcane borer; (2) It would be a useful tool in a lepidopteran insect control strategy within corn Integrated Pest Management (IPM) programs; (3) It reduced foliar chemical spray by controlling a broad spectrum of lepidopteran pests; (4) It potentially delays lepidopteran insect resistance because it has a different mode of action than other Bt corn; (5) It reduced aflatoxin contamination of corn grain; (6) It has a potential to provide greater economic benefits to corn growers through reduced lepidopteran pest damaged grain loss and/or reduced foliar insect spray; and (7) Any such reduction in use of chemical insecticides potentially enhances environmental benefits.

A majority of those opposed to a determination of nonregulated status did not mention their specific disagreement with APHIS' analyses detailed in the EA (USDA-APHIS 2010) or the PPRA (USDA-APHIS 2009); rather they expressed their general opposition to genetically modified crops. One corn grower commented that, contrary to his expectation, the use of pesticides increased on his farm when he used GM seeds. Likewise, two individuals expressed their belief that GE corn pollen endangers all honeybees and other insects in the corn agroecosystem. Two individuals expressed their concern about genetic contamination of conventional corn from GE corn and food and feed safety of GE corn. One person specifically mentioned that there is plenty of scientific evidence that GMOs (= GE) are the root cause of many diseases. People who expressed their opposition to deregulation did not provide any supporting evidence for their claims. In the following paragraphs APHIS reiterates its findings to address the four major concerns expressed by individuals.

**1. Pesticide use on Insect Resistant GE Corn Crop**

A corn grower who opposed granting nonregulated status to MIR162 corn contends that introduction of GE crop varieties has led to increased pesticide use rather than decrease as the providers of GM seed would lead one to believe. Because of this disparity in pesticide usage claim on GM corn, the commenter believes that APHIS should not grant nonregulated status to MIR162 corn until sufficient data are generated to show that plant incorporated protectants, such as Cry and Vip proteins, act as true pesticides.

APHIS disagrees with the commenter's assertion. As summarized in the EA (B7-Agricultural Benefits, p. 28), adoption of GE crops is associated with reduced pesticide use. Insecticide use on fields planted to Bt corn has decreased substantially since introduction of Bt corn in the mid 1990s (Figure 1 in EA; also see figure 8 in Fernandez-Cornejo and Caswell 2006) and use rates (in terms of active ingredient) on corn has declined since the introduction of GE corn in 1996. Using 2001 data, USDA-ERS found that insecticide use was 8 percent lower per planted acre for adopters of Bt corn than for nonadopters (Fernandez-Cornejo and Li 2005). The USDA-ERS results generally agree with field-test and other farm surveys that have examined the effects of using GE crops (Table 1 in EA). The MIR162 corn and stacked hybrids may further reduce insecticide use if the current trend in insecticide usage continues (Figure 8 in Fernandez-Cornejo and Caswell 2006).

As discussed in the EA (III. Introduction, p. 7) and petition (I.B. Rationale for Development of MIR162 Maize, pp. 11-13), currently available insect-resistant Bt crops are highly effective against European corn borer (*Ostrinia nubilalis*) and southern and western corn rootworm species (*Diabrotica spp*). But corn is susceptible to attack by a variety of insects (Table 1, pg. 12 in petition) from the time it is planted until it is consumed as food or feed. Current Bt corn cultivars provide only limited protection against feeding damage caused by corn earworm (*Helicoverpa zea*), fall armyworm (*Spodoptera frugiperda*), black cutworm (*Agrotis ipsilon*), and western bean cutworm (*Striacosta albicosta*). Syngenta developed MIR162 to provide resistance to those latter corn insect pests. Moreover, when MIR162 corn traits are combined with previously deregulated Bt traits in one or more cultivars, such cultivars would be expected to provide a wide range of protection against a variety of insect pests, further reducing insecticide use in the future (Fernandez-Cornejo and Caswell 2006).

**2. Impact of MIR162 Corn on Honeybees and Other Beneficial Insects**

An NGO commented that pesticides harm honey bees, therefore, GE pesticides similar to the one present in MIR162 corn are going to endanger honey bee populations if such corn varieties are granted nonregulated status.

APHIS' analyses on impact of the introduced gene product in MIR162 corn are presented in the EA (B-5. Potential Impact on Non-target Organisms, Including Beneficial Organisms and Threatened or Endangered Species, pp. 22-25) and data are provided in the petition (VII.C.3. Expected Environmental Concentrations for Nontarget Organisms, pp. 78-83; Impact on Nontarget Organisms, pp. 84-89; for honey bee data please see the sections VII.C.3.c. EEC for Pollinators, p. 80 and VII.D.3. Effect of Vip3Aa on Pollinators).

The Vip3Aa20 protein is selectively toxic to a few species of insect pests belonging to the order Lepidoptera. Non-Lepidopteran insect species are not expected to be affected by theVip3Aa20 protein. Its receptor-mediated mechanism of action and the absence of activity in bioassays with multiple species outside of the order Lepidoptera support this conclusion. Furthermore, Syngenta observed no harmful effects of Vip3Aa proteins on representative non-target organisms that are associated with corn agroecosystems or in their hazard identification studies that used a wide range of taxa at expected environmental concentrations (Table 31, pg. 89 of petition). In the honey bee (*Apis mellifera*) study conducted by Syngenta, there were no observable adverse effects or differences in survival noted at doses of Vip3A proteins that were well above those expected from exposure to the Vip3Aa20 protein from MIR162 corn planted in the field (petition Table 30, p. 84 and Table 31, pg. 89). According to the Environmental Protection Agency's Biopesticides Registration Document on Vip3Aa20 Maize (EPA 2009) there are enough empirical data from peer-reviewed publications providing support that Bt crops have not caused any adverse effects on nontarget organisms, including honey bees.

**3. Genetically Engineered Corn Contaminates Conventional Corn Cultivars through Gene Flow**

Two NGOs oppose granting nonregulated status to MIR162 corn because gene flow from GE corn varieties is going to contaminate conventional corn cultivars threatening their survival.

Available data on corn gene flow and APHIS' assessment of the petition data do not support this assertion. Gene flow is a natural biological process with significant evolutionary importance. A number of flowering plants are the product of gene flow and introgression (Grant 1981; Soltis and Soltis 1993; Rieseberg 1997), and even in the existing floras, the occurrence of hybridization or introgression is reported to be widespread (Knobloch 1972; Stace 1987; Rieseberg and Wendel 1993; Peterson et al. 2002). Gene flow between crop cultivars is also very common (Ellstrand et al. 1999; Stewart et al. 2003). ). It has been a common practice by plant breeders to artificially introgress traits from wild relatives into crop plants to develop new cultivars. Traditional corn, landrace corn, or elite non-GE corn are all ultimately derived from their ancestral parental species teosinte through human selection (White and Doebley 1998; Doebley 2004). Furthermore, a few important genes, such as dwarfing genes in wheat and rice, (Hedden 2003) and the teosinte branching gene in corn (Doebley et al. 1995), have transformed agriculture across the globe. Thus, the end product of genetic engineering techniques is not different from what has been practiced through conventional breeding techniques. Also, the food, feed and environmental safety of the introduced genes, obtained either via conventional breeding or GE, solely depends on the nature of the gene products. A body of scientific evidence shows that gene flow per se does not contaminate plant populations, rather it can increase or decrease genetic diversity of plant populations.

APHIS recognizes that corn is open-pollinating and it is possible that the engineered genes could move via wind-blown pollen to an adjacent field. All corn, whether genetically engineered or not, can transfer pollen to nearby cornfields. However, an influx of pollen originating from a given corn variety may not appreciably change the characteristics of corn in adjacent fields because gene flow declines rapidly with increased distances from a pollen source population (Halsey et al. 2005). Other factors such as wind speed, host variety and temperature also affect pollen flow (Aylor et al., 2003; Jones and Brooks, 1950). For example, in a study assessing observations of a large number of commercial canola fields, the incidence of gene flow was on the order of 0.015 % at 500m (see Fig 2 in Rieger, 2002). In a smaller corn research study, the incidence of gene flow was 0.05% at 100m (Goggia et al., 2006). Methods of spatial and temporal isolation are widely used and accepted when seed producers are seeking to minimize the influx of pollen from sources outside a seed production field. These methods are readily applicable to the production of certified organic corn seed. To maintain varietal purity, AOSCA (Association of Official Seed Certifying Agencies) recommends 200 meters isolation from nearby corn populations to produce the foundation class of certified seed (AOSCA 2003).

There are many practices non-GE corn producers use to prevent movement of GE corn or the pollen from GE corn into their production fields (Bradford 2006; Schienmann 2003; Ziegler 2000). Growers may chose to plant earlier or later than neighboring farmers who may be using GE crops, ensuring that the flowering times between GE and non-GE produced crops will differ, thus minimizing the chance of pollen movement between fields. They may also employ adequate isolation distances between different corn crops field to minimize the chance that pollen will be carried between the fields.

When Syngenta receives regulatory approval from APHIS, it will likely make MIR162 corn available to growers and breeders. It is not likely that buyers and sellers who choose not to plant or sell MIR162 corn or other transgenic corn varieties will be significantly impacted by the expected commercial use of this product because: (a) non-transgenic corn varieties will likely still be sold and will be readily available to those who wish to plant them; (b) Syngenta's stewardship plan will provide farmers that purchase MIR162 corn with recommended management practices for MIR162 corn cultivation; (c) methods of spatial and temporal isolation are widely used and accepted and corn seed producers employing them can minimize the influx of pollen from sources outside the seed production field; (d) 85% of the 2008 corn acreage in the United States is already planted to transgenic herbicide tolerant and/or insect resistant varieties; and (e) APHIS expects that MIR162 may replace some of the presently available GE corn varieties without significantly affecting the overall total corn acreage. APHIS concludes that farmers who cultivate non-GE corn crops will be able to coexist with GE corn producers as they do now.

**4. Food and Feed Safety of MIR162 Corn for Humans and Animals**

Two NGOs expressed concerns that the long-term consequences of GE food are not fully understood and there is plenty of scientific evidence that GE food is the root cause of many diseases.

APHIS disagrees with commenter's' statements. As summarized in the EA (Human and Environmental Benefits, p. 32) there were no human health concerns observed with respect to toxicity or allergenicity of the proteins expressed in MIR162 corn. In a variety of field studies, other insect protected corn expressing Bt proteins have been shown to have significantly lower levels of common mycotoxins that are produced by fungal pathogens (Wu 2006).

A comprehensive safety assessment of the Vip3Aa20 and PMI (Phosphomannose isomerase) proteins demonstrated that both proteins are nontoxic to mammalian species and are unlikely to be food allergens (69 FR 26770-26775; 73 FR 45620-45624; FDA BNF No. 000113). The Vip3Aa20 protein is considered nontoxic because it does not share significant amino acid homology with known protein toxins, is non-toxic to mice at a very high dose, is rapidly degraded in simulated mammalian gastric fluid, and its insecticidal mode of action for Vip3Aa20 is not relevant to mammals.

Vip3Aa20 is also not likely to be a food allergen because it is not derived from a known source of allergenic proteins, it does not have significant amino acid sequence identity to known allergenic proteins, it is rapidly degraded in simulated mammalian gastric fluid, and it is labile upon heating at temperatures of 65ºC and above. On August 6, 2008, EPA granted an exemption from the requirement of a tolerance for residues of *B. thuringiensis* Vip3Aa proteins (including the Vip3Aa20 variant) in or on food and feed commodities of corn (73 FR 45620-45624).

PMI is considered nontoxic because it does not share significant amino acid homology with known protein toxins, it is nontoxic to mice at a very high dose, and it is rapidly degraded in simulated mammalian gastric fluid. PMI is not likely to be a food allergen because it is not derived from a known source of allergenic proteins, it does not have significant amino acid sequence identity to known allergenic proteins with implications for its allergenic potential, it is rapidly degraded in simulated mammalian gastric fluid, and it is labile upon heating at temperatures of 37ºC and above. A permanent exemption from the requirement of a food tolerance currently exists under 73 FR 45620-4562440 for Vip3Aa20 in maize and under 40 CFR §180.1252 for PMI in all plants.

As presented in Appendix II of the EA (p. 50), the compositional analyses of corn grain revealed no statistically significant differences between MIR162 and control means for 43 of the 56 analytes including carbohydrates, proteins, fats, minerals and vitamins. Collectively, even for those few analytes that showed some difference, the observed differences between MIR162 and control means are considered of no biological significance and represent typical random variance. The magnitude of the differences was small (all MIR162 values fell within normal ranges for conventional maize) and the MIR162 and control data ranges significantly overlapped. MIR162 is therefore, not compositionally different from conventional maize.

A food and feed nutritional and safety assessment of MIR162 corn has been completed by the FDA. Under Federal Food, Drug, and Cosmetic Act (FFDCA), it is the responsibility of food and feed manufacturers to ensure that the products they market are safe and properly labeled. Food and feed derived from MIR162 corn must be in compliance with all applicable legal and regulatory requirements. FDA completed their consultation on MIR162 on December 9, 2008 and concluded that it had “no further questions concerning grain and forage derived from corn event MIR162” (FDA BNF No. 000113).

According to the Society of Toxicology position paper on the safety of genetically modified foods produced through biotechnology (Hollingworth et al. 2003), the available scientific evidence indicates that the potential adverse health effects arising from biotechnology-derived foods are not different in nature from those created by conventional breeding practices for plant, animal, or microbial enhancement, and are already familiar to toxicologists. The authors contend that it is therefore important to recognize that the food product itself, rather than the process through which it is made, should be the focus of attention in assessing safety.

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# Syngenta Biotechnology, Inc.
# Insect Resistant MIR162 Corn

## OECD Unique Identifier: SYN-IR162-4

# Final Environmental Assessment

**March 2010**

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## Table of Contents

# I. Summary

The Animal and Plant Health Inspection Service (APHIS), United States Department of Agriculture (USDA), has prepared an Environmental Assessment (EA) in response to a petition (APHIS Number 07-253-01p) from Syngenta Biotechnology, Inc. (Syngenta) regarding the regulatory status of genetically engineered (transgenic) corn resistant to lepidopteran insect feeding from transformation event MIR162. This corn is currently a regulated article under USDA regulations at 7 CFR part 340, and as such, interstate movements, importations, and field tests of MIR162 corn have been conducted under permits issued or notifications acknowledged by APHIS. Syngenta petitioned APHIS requesting a determination that MIR162 corn does not present a plant pest risk, and therefore MIR162 corn and its progeny derived from crosses with other nonregulated corn should no longer be regulated articles under these APHIS regulations.

# II. Purpose and Need

"Protecting American agriculture" is the basic charge of the USDA-APHIS. APHIS provides leadership in ensuring the health and care of plants and animals. The agency improves agricultural productivity and competitiveness, and contributes to the national economy and the public health. USDA asserts that all methods of agricultural production (conventional, organic, or the use of genetically engineered varieties) can provide benefits to the environment, consumers, and farm income.

### *Federal Regulatory Authority*

In 1986, the Federal Government's Office of Science and Technology Policy (OSTP) published a policy document known as the Coordinated Framework for the Regulation of Biotechnology. This document specifies three Federal agencies that are responsible for regulating biotechnology in the U.S.: USDA's APHIS, the Environmental Protection Agency (EPA), and the U.S. Department of Health and Human Services' Food and Drug Administration (FDA). APHIS regulates genetically engineered (GE) organisms under the Plant Protection Act of 2000. The EPA regulates plant-incorporated protectants under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and certain biological control organisms under the Toxic Substances Control Act (TSCA). FDA regulates GE organisms under the authority of the Federal Food, Drug, and Cosmetic Act. The FDA policy statement concerning regulation of products derived from new plant varieties, including those genetically engineered, was published in the Federal Register on May 29, 1992 (57 FR 22984-23005). Under this policy, FDA uses what is termed a consultation process to ensure that human food and animal feed safety issues or other regulatory issues (e.g., labeling) are resolved prior to commercial distribution of bioengineered food. Together, these agencies ensure that the products of modern biotechnology are safe to grow, safe to eat, and safe for the environment. USDA, EPA, and FDA enforce agency-specific regulations to products of biotechnology that are based on the specific nature of each GE organism. Products are regulated according to their intended use and some products are regulated by more than one agency.

### *USDA Regulatory Authority*

The APHIS Biotechnology Regulatory Service's (BRS) mission is to protect the United States' agriculture and environment using a dynamic and science-based regulatory framework that allows for the safe development and use of genetically engineered organisms. APHIS regulations at 7 Code of Federal Regulations (CFR) part 340, which were promulgated pursuant to authority granted by the Plant Protection Act, as amended (7 United States Code (U.S.C.) 7701–7772), regulate the introduction (importation, interstate movement, or release into the environment) of certain GE organisms and products. A GE organism is considered a regulated article if the donor organism, recipient organism, vector, or vector agent used in engineering the organism belongs to one of the taxa listed in the regulation (7 CFR part 340.2) and is also considered a plant pest. A GE organism is also regulated under part 340 when APHIS has reason to believe that the GE organism may be a plant pest or APHIS does not have sufficient information to determine if the GE organism is unlikely to pose a plant pest risk.

A person may petition the agency to evaluate submitted data and determine that a particular regulated article is unlikely to pose a plant pest risk, and, therefore, should no longer be regulated under 7 CFR part 340.6 entitled "Petition for Determination of Nonregulated Status." The petitioner is required to provide information under § 340.6(c)(4) related to plant pest risk that the agency uses to determine whether the regulated article is unlikely to present a greater plant pest risk than the unmodified organism. A GE organism is no longer subject to the regulatory requirements of 7 CFR part 340 when APHIS determines that it is unlikely to pose a plant pest risk.

Syngenta Biotechnology, Inc. (hereafter "Syngenta") of Research Triangle Park, NC submitted a petition to APHIS seeking a determination of nonregulated status for their transgenic event MIR162 corn (hereafter "MIR162 corn"). The MIR162 corn has been engineered to express a bacterial protein Vip3Aa20 from *Bacillus thuringiensis* that is toxic to a certain lepidopteran insect pests. This corn is also engineered to express another protein, phosphomannose isomerase (PMI) from *Escherichia coli*, which was used as a selectable marker to identify corn seedlings containing Vip3Aa20 gene during the development of MIR162 corn. The MIR162 corn is currently regulated under 7 CFR part 340. This corn has been considered a regulated article because it was genetically engineered with regulatory sequences derived from plant pests and because a plant pest was used as a vector agent to deliver those sequences to the plant. Interstate movements and field trials of the MIR162 corn have been conducted under permits issued or notifications acknowledged by APHIS.

Under the authority of 7 CFR part 340, APHIS has the responsibility for the safe development and use of genetically engineered organisms under the provisions of the Plant Protection Act. APHIS must respond to petitioners that request a determination of the regulated status of genetically engineered organisms, including genetically engineered crop plants such as MIR162 corn. If a petition for nonregulated status is submitted, APHIS must determine whether the genetically engineered organism is unlikely to pose a plant pest risk.

As a Federal agency subject to compliance with the National Environmental Policy Act (NEPA)[1] (42 U.S.C. 4321 et seq.), APHIS has prepared this EA to consider the potential environmental effects of this proposed action (granting nonregulated status) and the reasonable alternatives to that action consistent with NEPA implementing regulations (40 CFR §§ 1500-1508, 7 CFR part 1(b), and 7 CFR part 372) and the USDA and APHIS NEPA implementing regulations and procedures. This EA has been prepared in order to specifically evaluate the effects on the quality of the human environment[1] that may result from the deregulation of the MIR162 corn.

### *U.S. Environmental Protection Agency and Food and Drug Administration Regulatory Authority*

The MIR162 corn is also subject to regulation by other agencies. The U.S. Environmental Protection Agency (EPA) is responsible for regulation of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. §136 et seq.). FIFRA requires that all pesticides be registered before distribution, sale, and use, unless exempted by EPA regulation. Before a product is registered as a pesticide under FIFRA, it must be shown that when used in accordance with the label, it will not result in unreasonable adverse effects on the environment. Accordingly, EPA grants permits to allow a pesticide producer to test a new pesticide product outside the laboratory under Experimental Use Permits (EUPs), which are used for large-scale (more than 10 acres of land or 1 acre of water) testing of efficacy and gathering of environmental fate, ecological effects, and crop residue chemistry (40 CFR part 172).

Syngenta obtained an experimental use permit from EPA that allowed for broad-scale field testing of the MIR162 corn; this permit was granted on March 26, 2007 and was in effect through March 31, 2008 (72 FR 34009-34010). On July 23, 2008 EPA announced receipt of a petition from Syngenta to conditionally register three pesticide products containing the new active ingredient Vip3Aa20 and the genetic material necessary for its production in corn (73 FR 42799-42801). These pesticide products included MIR162 and the two corn hybrids Bt11 x MIR162 and Bt11 x MIR162 x MIR604 (Bt11 and MIR604 contain the additional insecticidal protein active ingredients Cry1Ab and Cry3A, respectively, and both have previously been deregulated by APHIS and registered as plant-incorporated protectants by EPA). On April 30, 2009, EPA announced the approval of these conditional registrations involving MIR 162 and the hybrids (74 FR 19956-19957).

[1] Under NEPA regulations, the "human environment" includes "the natural and physical environment and the relationship of people with that environment" (40 CFR §1508.14)
[2] Cry proteins are crystal proteins that are produced within the spores of Bt bacteria. A majority of deregulated Bt crops currently available in the U.S. market express Cry proteins.

Under the Federal Food, Drug, and Cosmetic Act (FDCA) (21 U.S.C. §301 et seq.), pesticides added to (or contained in) raw agricultural commodities are prohibited unless a tolerance or exemption from tolerance has been established. EPA establishes residue tolerances for pesticides under the authority of the FDCA. The FDA enforces the tolerances set by the EPA. On April 4, 2007 EPA established a temporary exemption from the requirement of a tolerance for Vip3Aa20 residues in maize commodities, pursuant to §408(d) of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. §346a(d). On August 6, 2008, EPA granted exemption from the requirement of a tolerance for residues of *B. thuringiensis* Vip3Aa proteins (including the Vip3Aa20 variant) in or on food and feed commodities of corn (73 FR 45620-45624). On May 14, 2004, EPA granted an exemption from the requirement of a tolerance for residues in or on plant commodities of phosphomannose isomerase and the genetic material necessary for its production in all plants when applied/used as plant-incorporated protectant inert ingredients (69 FR 26770-26775). With the publication of EPA's registration document, APHIS will use this finalized information to provide additional scientific support to its consideration of potential environmental impacts.

FDA, which has primary regulatory authority over food and feed safety, published a policy statement in the Federal Register on May 29, 1992 (57 FR 22984-23005) concerning regulation of products derived from new plant varieties, including those genetically engineered. Under this policy, FDA uses what is termed a consultation process to ensure that human food and animal feed safety issues or other regulatory issues (e.g. labeling) are resolved prior to commercial distribution of a bioengineered food. Syngenta submitted a summary of their safety assessment to FDA on August 3, 2007, and additional information on December 17, 2007 and March 31, 2008. Syngenta's submissions to FDA indicated that food and feed derived from corn event MIR162 are as safe (Appendix I in this EA) and nutritious as food and feed derived from conventional corn (Appendix II in this EA). FDA completed their consultation on MIR162 on December 9, 2008 and concluded that it had "no further questions concerning grain and forage derived from corn event MIR162" (FDA BNF No. 000113).

**Public Involvement**

APHIS-BRS routinely seeks public comment on draft environmental assessments prepared in response to petitions to deregulate GE organisms. APHIS-BRS does this through a notice published in the Federal Register. This EA, the petition submitted by Syngenta, and APHIS's plant pest risk assessment, were made available for public comment for a period of 60 days. Comments that were received within the 60-day comment period were fully analyzed and used by APHIS to determine if the petition to deregulate the MIR162 corn should be granted.

**Decision to Be Made**

APHIS will use the information from this EA, and the comments received, to assist APHIS' decisionmaker to determine whether to grant nonregulated status, or to continue to regulate MIR162 corn under the regulations at 7 CFR part 340, or that an

Environmental Impact Statement is necessary prior to the decision to grant nonregulated status to this corn variety.

# III. Introduction

Corn is susceptible to attack by a variety of insects (Table 1, pg. 12 in petition) from the time it is planted until it is consumed as food or feed. Syngenta has developed a GE corn hybrid, named MIR162, that is resistant to the feeding damage caused by corn earworm (*Helicoverpa zea*), fall armyworm (*Spodoptera frugiperda*), black cutworm (*Agrotis ipsilon*), and western bean cutworm (*Striacosta albicosta*) larvae that are not controlled well with existing technology. This insect resistance in MIR162 comes from a bacterial gene called Vip3Aa20 (Vip = Vegetative insecticidal protein). The MIR162 corn also contains *manA* gene from *E. coli* encoding the enzyme phosphomannose isomerase (PMI), which was used as a selectable marker during transformant selection. The *manA* gene expression confers no other benefit to the regenerated transformed corn plant.

The family of Vip3Aa proteins, in which Vip3Aa20 belongs, are produced by the bacterium *B.thuringiensis* (hereafter "Bt") (Estruch et al. 1996) that act as toxins to kill insect prey (Estruch et al. 1996; Schnepf et al. 1998). Vip3Aa proteins are similar to certain Cry proteins[2] (Höfte and Whiteley 1989) and are demonstrated to have toxic effects only on certain insects (Table 2.1 on p. 23 in Carozzi and Koziel 1997). The mechanism by which Vip proteins exert their insecticidal activity has been studied and found to be similar, but not identical, to that which has been described for the Bt Cry proteins that are contained in several commercial insecticide formulations and APHIS deregulated GE plants engineered for insect resistance (USDA-APHIS, 2010, *see* Transgenic phenotype column in Table: examples include coleopteran-, or lepidopteran-resistant, corn borer (ECB) resistant, corn rootworm resistant, Colorado potato beetle resistant). The Vip and Cry proteins bind to different receptors in the insect (Lee et al. 2003), and the insecticidal activity of Vip3Aa proteins is limited to species within selected families of the order Lepidoptera (Table 27, pg. 74-75 in Syngenta, 2007). For example, MIR162 alone has no activity against European corn borer (*Ostrinia nubilalis*) but is efficacious in limiting feeding damage caused by the other four insect pests (corn earworm, fall armyworm, black cutworm, western bean cutworm) (Figure 21, pg. 76 in petition); whereas the Bt11 GE corn variety (containing a Cry protein) is highly efficacious against European corn borer, but it has limited or no activity against the other four insects. USDA, APHIS has previously granted nonregulated status to 11 insect resistant GE corn varieties containing Cry proteins from Bt (USDA-APHIS 2009).

The MIR162 corn has been field tested in the United States since 1999 as authorized by APHIS. Associated notifications acknowledged and permits issued by APHIS are listed in Appendix A of the petition (pg. 127-128). The list compiles more than 20 test sites in diverse regions of the U.S. including the major corn growing area of the Midwest and winter nurseries in Hawaii. Field tests conducted under APHIS oversight allow for evaluation in agricultural settings under confinement measures designed to minimize the likelihood of persistence in the environment after completion of the field trial. Under confined field trial conditions, applicants gather data for agronomic characteristics and product performance in response to insects, disease or other stresses. These data are also valuable to APHIS as the agency assesses the potential for a new corn variety to pose a plant pest risk. APHIS' evaluation of this data may be found in the APHIS plant pest risk assessment (USDA-APHIS 2009).

# IV. Affected Environment

## *A. Corn*

Corn is primarily grown in warm temperate climates (Norman et al. 1995). Field corn is the leading agricultural production crop globally, with the 2009 growing season expected to yield 789 million metric tons of grain (ICG 2009). Corn is grown for animal feed, human food, vegetable oil, high fructose corn syrups, starch, fermentation into ethanol, and a multitude of industrial uses (Hoeft et al., 2000).

*Zea mays* L. subsp. *mays*, known as maize throughout the world, and as corn in the U.S., is a member of the *Maydeae* tribe of the grass family, *Poaceae*. It is an annual plant with separate male and female flowers on each plant (monoecious) that requires human intervention for its seed dispersal and propagation. Additional information on the biology of corn can be found within the Organisation for Economic Co-Operation and Development consensus document (OECD 2003).

Corn is predominantly a wind-pollinated outcrossing species (OECD 2003). Transgenes in crops have the potential to move between sexually compatible populations, and more so in corn being a wind-pollinated plant with separate male and female flower bearing structures (inflorescences). Gene flow rate between corn populations is extremely variable depending on the spatial, temporal, genetic and environmental factors (Brookes and Barfoot et al. 2004; Messegue et al. 2006). Yet, available experimental evidence indicates that gene flow rates drop substantially (1%) beyond 20 meters (Henry et al. 2003; Ma et al. 2004; Messeguer et al. 2006). To maintain varietal purity, the AOSCA (Association of Official Seed Certifying Agencies) recommends 200 meters isolation for nearby corn populations as the foundation class of certified seed production (AOSCA 2003).

The insect resistance trait of MIR162 has the potential to enhance the fitness of wild and weedy relatives if gene flow occurs between the MIR 162 corn crop and wild or weedy corn populations. However, there are no large populations or widely distributed wild corn plants (teosinte) in the U.S., and even the few non-weedy feral populations in the U.S. have limited opportunity for outcrossing with transgenic corn cultivars (see USDA-APHIS 2009).

Corn is not weedy, and does not persist outside cultivated areas (USDA-APHIS 2009). APHIS knows of no reports in which corn propagated vegetatively under field conditions, since the only known propagation method for corn is through seed germination. Corn seed is sensitive to cold and typically does not survive freezing winter conditions. Consequently, corn has no innate dormancy (Simpson 1990; Table 18, pg. 61 Syngenta

2007). Even if corn seeds from a previous year's crop overwinter and germinate the following year, manual or chemical measures are available and are often applied to remove these volunteers (see Table 1 in Wright et al. 2009).

## *B. Agricultural Production of Corn*

The U.S. accounts for about 41% of global corn production (Bange 2007). Corn is the largest crop grown in the U.S. in terms of both volume and value. Approximately 86 million acres were planted in 2008 growing season, yielding 12 billion bushels (305 million metric tons) with a gross crop value of $47 billion ($3.9/bushel) (USDA-NASS 2008a; USDA-NASS 2008b). The upper Midwest region of the U.S. provides an ideal combination of temperature, rainfall, and soil type for the cultivation of corn. Iowa, Illinois, Nebraska, Minnesota, Indiana, Ohio, Wisconsin, Missouri, Kansas, and South Dakota are major corn growing states. Production in these ten states accounts for 77% of total annual production (USDA-NASS 2008b).

The use of corn as a source of fuel ethanol has increased dramatically over the past two years and is expected to continue to increase as the U.S. focuses on employing renewable sources of energy. The Federal Energy Act of 2005 includes a nationwide renewable fuels standard (RFS) that will result in the use of more than 7.5 billion gallons of ethanol and biodiesel by 2012 (42 USC 15801, page 1069). Over 20% of commodity corn in 2007 was used for ethanol production (Trostle 2008; USDA-ERS 2008). By 2010, U.S. ethanol production could displace the equivalent of 311,000 barrels of imported crude oil per day (GAO, 1996).

The U.S. is by far the world's largest exporter of corn, and in 2003/2004 through 2007/2008 accounted for on average 60% of world corn exports (USDA-ERS 2009a). Total U.S. agricultural exports in 2006 were valued at $71 billion, 10% of which was attributable to corn (Brooks 2007). Agricultural exports generate employment, income, and purchasing power in both farm and nonfarm sectors of the economy. Production from almost one-third of U.S. cropland moved into export channels in 2005 and generated $166.1 billion in business activity (Food Institute 2007). Technology advances, such as those attributed to GE crops, increase agricultural productivity and keep domestic growers competitive in the global market (NCRA 2010).

Based on USDA survey data, adoption of genetically engineered insect-resistant corn increased from zero percent of the U.S. corn acreage in 1996 to 63 percent in 2009 (USDA-ERS 2009). The rapid commercialization of GE insect-resistant corn (IR corn) varieties by corn growers is attributed to benefits offered by those corn varieties in terms of reduced conventional insecticide use, increased profits, and improved grain quality (Fernandez-Conejo and Caswell 2006).

In addition to insect resistant (IR) corn cultivation, U.S. farmers have also planted GE herbicide tolerant (HT) corn varieties since 1996. A few GE corn cultivars contain both IR (European corn borer resistance, corn rootworm, etc.) and HT traits (glyphosate tolerance, imidizolinone tolerance). Among GE varieties of corn (IR and HT corn cultivars), 68% of all GE corn varieties planted contained a herbicide tolerant (HT) trait

(USDA-ERS 2009b). Herbicides were applied to 97 percent of the GE and non-GE corn planted acreage in 2005, with atrazine, glyphosate, *S*-metolachlor and acetochlor being applied to 66%, 31%, 23% and 23% of planted corn acres, respectively (USDA-NASS 2006). MIR162 corn is not expected to alter current or future corn weed control practices. The main introduced trait in MIR162 is expected to provide resistance to certain groups of insect pests. Therefore, except for change in insect resistance management, all other agricultural practices of the MIR162 corn, including corn weed control practices, are not expected to be different from those of conventional corn cultivation.

According to USDA-ERS (2009) report, 15% (~13 million acres) of the U.S. corn acreage was planted with the non-GE corn varieties in 2009. Likewise, according to USDA-ERS' latest data on organic corn production, less than 1 percent (0.16%) of corn crop area in 2005 was devoted to organic corn (USDA-ERS 2009c). Under USDA National Organic Program regulations (USDA-AMS 2010), the use of synthetic pesticides, fertilizers, and genetically engineered crops is strictly limited (7 CFR part 205.105 and definition, "excluded methods"). As a result, MIR162 corn is not approved for use in organic production systems because it is genetically engineered. Maintaining the integrity of the organic production process is important to producers of organic corn.

There are many practices organic producers use to prevent movement of GE corn or the pollen from GE corn into their organic production fields (Bradford 2006, Schienmann 2003, Ziegler 2000). Growers may chose to plant only organic seed; plant earlier or later than neighboring farmers who may be using GE crops, ensuring that the flowering times between GE and organically produced crops will differ, thus minimizing the change of pollen movement between fields; and also employ adequate isolation distances between the organic field and the fields of neighbors to minimize the chance that pollen will be carried between the fields. Additionally, organic growers must maintain records to show that production and handling procedures comply with USDA organic standards (7 CFR part 205).

## *C. Corn Lepidopteran Pests*

Corn crop is susceptible to attack by a variety of insects throughout its life cycle (see pg. 12 in Syngenta 2007). Two of the five most widespread and damaging insects of corn in the U.S. Corn Belt are the European corn borer and corn rootworms (Hoeft, et al. 2000). Although a few conventional insect control practices (chemical and microbial insecticides, crop rotation etc.) are available for corn insect pests, the stalk boring insects such as the European corn borer have been difficult to control and in some areas, it is not profitable to use chemical control against such insect pests (Martin and Hyde 2001). Conventional insecticide and crop rotation practices have been proven effective in controlling the damage caused by corn rootworms (Ma et al., 2009). Prior to the introduction of GE rootworm-protected Bt varieties in 2003, an estimated 14 million acres of corn were treated annually with conventional insecticides to control corn rootworms (Ward et al. 2005); insecticides for rootworm control accounted for the largest single use of insecticides in the U.S. Treatment of corn rootworm with chemical pesticides may have decreased by 34%, the difference in acreage between use of European corn borer protected corn and corn rootworm protected Bt corn between 2003 (when CRW corn was first available) and 2009 (USDA-ERS 2009c). The use of conventional insecticide treatment is less effective for some corn insect pests, such as corn earworm (Hoeft et al. 2000), as some of these corn pests may enter areas shielded from aerial chemical applications; corn earworm follows the silk channel and enters the protected recesses of the corn ear (Burkness et al. 2009) .

In addition to direct damage caused by feeding on plant tissue, corn insect pests are also known to play an important role in the transmission and dissemination of pathogenic organisms during corn development (Dowd 1998). For example, it has been shown that insect feeding damage enhances mycotoxin contamination of corn crop (Williams et al. 2002) that have toxic and carcinogenic effects in humans and animals (see Wu 2006 for details). The introduction of GE Bt corn varieties has provided growers solutions to some of the above-mentioned pest problems by limiting damage caused by certain lepidopteran insect pests (Hurley et al. 2006) and fungal diseases (Wu 2006) without posing any significant risk to the environment or to human health (Mendelsohn et al. 2003).

# V. Alternatives

This EA analyzes the potential environmental consequences of a proposal to grant nonregulated status to the MIR162 corn. In order for MIR162 corn to be granted nonregulated status, APHIS must determine that this GE corn variety is unlikely to pose a plant pest risk. The analysis by APHIS in its plant pest risk assessment (USDA-APHIS, 2009) demonstrates that there were sufficient data to determine that the MIR162 corn is unlikely to pose a plant pest risk and therefore is eligible for nonregulated status.

The regulations at 7 CFR part 340.6(d)(3)(i) state that APHIS may "approve the petition in whole or in part." Because APHIS has found that the MIR162 corn is unlikely to pose a plant pest risk, the only action alternative considered in this EA is to grant nonregulated status “in whole” to the corn line under consideration. An “in part” deregulation can be given if there is a plant pest risk associated with some, but not all lines requested in a petition. The petition for the MIR162 corn only requested APHIS to grant nonregulated status to a single corn event, therefore, an “in part” determination is not an appropriate consideration. Thus, only two alternatives will be considered in this EA: (1) no action, or (2) to grant nonregulated status to MIR162 corn “in whole.” APHIS has assessed the potential for environmental impacts for each alternative in the “Environmental Consequences” sections below.

## *A. No Action: Continuation as a Regulated Article*

Under the “no action” alternative, APHIS would deny the petition. MIR162 corn and its progeny would continue to be regulated under 7 CFR part 340. Permits issued or notifications acknowledged by APHIS would still be required for introductions of MIR162 corn and measures to ensure physical and reproductive confinement would continue to be implemented. APHIS might choose this alternative if there were insufficient evidence to demonstrate the lack of plant pest risk from the unconfined cultivation of the MIR162 corn and its progeny.

Under this no action alternative, growers and other parties who are involved in production, handling, processing or consumption of corn would continue to have access to existing deregulated GE insect resistant corn as well as conventional corn varieties. However, growers would not have widespread access to the MIR162 corn since it would continue to be regulated under Part 340. This alternative is not the preferred alternative because APHIS' evaluation of MIR162 data in the plant pest risk assessment demonstrates that the MIR162 corn is unlikely to pose a plant pest risk (USDA-APHIS, 2009). Choosing this alternative would hinder the purpose and need of APHIS to allow for the safe development and use of GE organisms given that the MIR162 corn is unlikely to pose a plant pest risk.

### *B. Grant nonregulated status to MIR162 corn, "in whole"- Preferred Alternative: Determination that Syngenta MIR162 Corn is No Longer a Regulated Article*

Under this alternative, MIR162 corn and its progeny would no longer be considered regulated articles under 7 CFR part 340. Permits or notifications acknowledged by APHIS would no longer be required for introductions in the United States and its territories of the MIR162 corn or its progeny. MIR162 corn is eligible for nonregulated status because APHIS has determined that this GE organism is unlikely to pose a plant pest risk (USDA-APHIS 2009). APHIS might choose this alternative if there was sufficient evidence to demonstrate the lack of plant pest risk associated from the unconfined release of this insect resistant corn event.

Under this alternative, growers may have future access to MIR162 corn and progeny derived from this variety if the developer decides to commercialize this insect resistant corn variety. In addition, growers and other parties who are involved in production, handling, processing or consumption of corn would continue to have access to existing deregulated GE insect resistant corn as well as conventional corn varieties. If commercialized, MIR162 corn will likely be introduced in areas where corn is currently grown and is not expected to alter the current range of corn cultivation in the US.

APHIS has chosen Alternative B as the preferred alternative because APHIS has determined that MIR162 corn is unlikely to pose a plant pest risk (USDA-APHIS 2009). By granting nonregulated status to MIR162 corn, the purpose and need to allow the safe development and use of GE organisms is met.

## Alternatives Considered but Rejected from Further Consideration

*Geographic restrictions*

APHIS considered geographic restrictions based upon geographic variation in plant pest risk. As presented in APHIS plant pest risk assessment for MIR162 corn, there is no geographic differences in the plant pest risks for MIR162 corn (USDA-APHIS 2009). This alternative was rejected and not analyzed in detail because MIR162 corn is unlikely to pose a plant pest risk and therefore, APHIS will have no regulatory authority over MIR162 corn and will be unable to impose regulatory restrictions on this GE corn variety.

# VI. Environmental Consequences

According to APHIS regulations at 7 CFR part 340, an organism is no longer subject to regulatory requirements when it is demonstrated not to present a plant pest risk. Under the regulations, APHIS is required to render a determination on a petition for nonregulated status. The analysis of potential environmental consequences in the following sections address the potential impact to the human environment from the alternatives analyzed in this EA, namely taking no action and granting nonregulated status to MIR162 corn, "in whole."

### SCOPE OF THE ENVIRONMENTAL ANALYSIS

Although the preferred alternative would allow for new plantings of MIR162 corn to occur anywhere in the U.S., APHIS limited the environmental analysis to those areas that currently support corn production. To determine areas of corn production, APHIS used data from the National Agricultural Statistics Service (NASS) 2009 Census of Agriculture to determine where corn is produced in the United States (USDA-NASS 2009), accessed 3/5/2010). According to the 2007 Censuses of Agriculture, 49 states produce corn grain in the US.

## *A. No Action*

Under the "no action" alternative, MIR162 corn hybrids would continue to be a regulated article. APHIS' assessment of environmental consequences under the no action alternative is described below.

*A-1. Corn*

Under the 'no action' alternative, conventional and GE transgenic corn hybrids crop husbandry will remain unchanged and MIR162 corn hybrids will remain a regulated article.

The food/feed nutritional and safety assessment for the MIR162 corn has been reviewed by the FDA. Under Federal Food, Drug, and Cosmetic Act (FFDCA), it is the responsibility of food and feed manufacturers to ensure that the products they market are safe and properly labeled. Food and feed derived from the MIR162 corn must be in compliance with all applicable legal and regulatory requirements. FDA completed their consultation on MIR162 on December 9, 2008 and concluded that it had "no further questions concerning grain and forage derived from corn event MIR162" (FDA BNF No. 000113).

APHIS' assessment of the safety of this product focuses on its potential to pose a plant pest risk, and that analysis is based on the comparison of the GE corn to its non-GE counterpart (USDA-APHIS 2009). Based on the assessment of field and laboratory evidence provided in Syngenta's petition, accompanying scientific literature and safety data available on earlier insect-resistant GE corn hybrids, APHIS has concluded that MIR162 corn would have no significant impacts on human or animal health.

*A-2. Agricultural Production of Corn*

Conventional and GE corn production occurs on land that is dedicated to crop production. Most corn is planted in agricultural fields that have been in crop production for years. Most of the corn acreage in the U.S. is planted to GE corn hybrids. Of the total corn acres planted in 2008, 85% were GE corn hybrids that were either herbicide tolerant, insect resistant, or both (USDA-ERS 2009). Likewise, according to USDA-ERS latest data on organic corn production, in 2005 less than 1 percent (0.16%) of corn crop area was devoted to organic corn (USDA-ERS. 2009c).

Conventional production practices that use GE varieties will likely still dominate in terms of acreage, or perhaps increase in acreage (Fernandez-Cornejo Caswell 2006; APHIS received four new petitions for non regulated status in 2008/2009 for corn varieties), without granting nonregulated status to MIR162 corn under the "no action" alternative. The availability of conventional, GE and organic corn seed varieties will likely remain the same under the "no action" alternative, including MIR162 corn hybrids remaining unavailable for commercial use. Corn is currently produced in 49 US states (USDA-NASS 2008), and under the "no action" alternative, based upon current corn production practices and available information and trend data provide by USDA-ERA (2009 a-c) and USDA- NASS (2008), it is reasonable to expect this range of production will likely remain unchanged.

Yield losses due to weeds and diseases were substantial until the introduction of crop protection chemicals in the 1960s (Perrin, 1997; Giannessi, 2008). Weeds compete with crops for light, nutrients, water, and other growth factors. The large-scale commercial cultivation of GE herbicide tolerant (glyphosate tolerant) corn crop acreage has steadily increased from 1996 accounting for nearly 68 percent of all corn acreage in 2009 (USDA-ERS 2009). Glyphosate is a highly effective, nonselective, broad-spectrum herbicide and in general, considered "environmentally friendly" when compared to other herbicides (Cerdeira and Duke 2006). Herbicides were applied to 97 percent of all corn acreage, GE and non-GE in 2005, with atrazine, glyphosate, *S*-metolachlor and acetochlor being applied to 66%, 31%, 23% and 23% of planted corn acres, respectively (USDA-NASS 2006). In addition, corn crops are also susceptible to attack by a variety of insects from the time of planting until consumed as food or feed. Based on USDA survey data, adoption of genetically engineered insect-resistant corn increased from zero percent of the U.S. corn acreage in 1996 to 63 percent in 2009 (USDA-ERS 2009). Conventional insect control practices (chemical and microbial insecticides, crop rotation etc.) are also available to control corn insect pest damage to GE and non-GE corn varieties.

Under the "no action" alternative, herbicides and insecticides will still be used alone or in combination and selected based on their effectiveness on the different weed and insect species in the cornfield. Human and environmental exposure to insecticides and herbicides will continue to occur. Different herbicides have different modes of action; the correct herbicide rate must be used for each in order to obtain good weed control results and to minimize corn plant injury. APHIS has no authority under the Plant Protection Act to regulate pesticide (herbicide or insecticide) use. The use of pesticides is regulated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) restrictions administered by the EPA, which mandate registration for use of all pesticides. EPA includes instructions and restrictions on how pesticides can be applied, and has determined that there is no unreasonable environmental risk if the user adheres to the directions. Directions include application restrictions that minimize impacts on nearby environments. Violators of the regulations are liable for all negative consequences of their actions; therefore, farmers who use pesticides are very likely to follow its label restrictions, and thereby limiting any potential adverse impacts.

If APHIS chooses the no action alternative there would be no direct impact on organic or other non-transgenic corn farmers. The current cultivation practices are not likely to change and 85% of the corn produced would likely continue to be planted with current GE corn varieties (USDA-ERS 2009b).

*A-3. Corn Lepidopteran Pests*

Corn is susceptible to damage by a variety of insect pests throughout its developmental cycle. Corn insect pests are categorized as major and consistent pests, major and sporadic pests, and moderate to minor pests based on annual destructiveness and their geographic distribution (pg. 12 in Syngenta 2007). Yield losses due to insect pests are unpredictable and challenging for conventional (non-GE) corn farmers and insect pest problems have the potential to substantially reduce crop yield and quality. Crop losses attributable to the European corn borer (Martin and Hyde 2001) and corn rootworm infestations (Ma et al. 2009) have been well characterized and are significant.

The introduction of GE Bt corn cultivars which encode proteins (Cry proteins from *B. thuringiensis*) that are toxic to these species have provided U.S. corn growers with a powerful tool for effectively protecting crop yields and environmental benefits (Marvier et al. 2007). The large-scale commercial cultivation of both insect resistant (Bt resistant) and herbicide tolerant (glyphosate tolerant) corn crop acreage has steadily increased from 1996, accounting for 85% of corn acreage in 2009 (USAD-ERS 2009). Growers have substantially switched to GE corn hybrids because they protect the inherent yield potential of corn crops by reducing the grower's input costs. Under the "no action" alternative, GE Bt corn varieties and EPA approved insecticides will remain available for use based on the need and effectiveness against different insect species infesting commercial cornfields.

Furthermore, the planting of insect-protected corn hybrids benefits the environment by decreasing the use of conventional pesticide applications by more than 20 million pounds annually (Figure 8 in Fernandez-Cornejo and Caswell 2006; Benbrook 2004). APHIS-deregulated GE Bt corn varieties are expected to remain available for commercial use. Therefore, this environmental benefit is expected to continue under the no action alternative.

## B. Preferred Alternative

Under this alternative, MIR162 corn would no longer be a regulated article under 7 CFR part 340. Permits issued and/or notifications acknowledged by APHIS would no longer be required for introductions of MIR162 corn. APHIS has chosen the preferred alternative for the proposed action because MIR162 corn lacks plant pest characteristics, as determined in APHIS' Plant Pest Risk Assessment (USDA-APHIS 2009). APHIS' assessment of environmental consequences under the preferred alternative is described below.

*B-1. Corn*

Under this alternative, conventional and GE transgenic corn hybrid crop production will remain unchanged and MIR162 corn would be available to growers for commercial production. Similar to any commercially-available corn hybrid, a potential impact of planting this GE insect resistant corn hybrid may be gene introgression of MIR162 corn into other sexually compatible or related species. APHIS evaluated the potential for gene introgression of MIR162 corn to sexually compatible wild relatives and considered whether such introgression would result in increased weediness in wild relatives. APHIS assessed various morphological and agronomic traits, such as seed dormancy, vegetative and reproductive traits, volunteer potential, disease and pest susceptibility, and the fitness advantage of Vip3Aa20 gene of MIR162 corn (USDA-APHIS 2009). Based on the scientific analysis of data presented in APHIS' plant pest risk assessment, APHIS has determined that the MIR162 corn is no more likely to become a weed than other cultivated corn varieties; it is not a plant pest; and gene flow between the MIR162 corn and weedy and wild relatives will not occur in the United States (USDA-APHIS 2009). Based on the above considerations, APHIS decision to grant nonregulated status to the MIR162 corn will not adversely impact sexually compatible wild relatives or their weediness potential. Overall impacts would be similar to the no-action alternative.

A food and feed nutritional and safety assessment of the MIR162 corn has been completed by the FDA. Under Federal Food, Drug, and Cosmetic Act (FFDCA), it is the responsibility of food and feed manufacturers to ensure that the products they market are safe and properly labeled. Food and feed derived from the MIR162 corn must be in compliance with all applicable legal and regulatory requirements. FDA completed their consultation on MIR162 on December 9, 2008 and concluded that it had “no further questions concerning grain and forage derived from corn event MIR162” (FDA BNF No. 000113).

APHIS focused on the potential of MIR162 corn to pose a plant pest risk, and compared the GE corn to its non-GE counterpart (USDA-APHIS 2009). From the assessment of laboratory evidence provided in Syngenta’s petition and the accompanying scientific literature, APHIS has concluded that MIR162 corn would have no significant impacts on human or animal health. Overall impacts would be similar to the no action alternative.

*B-2. Agricultural Production of Corn*

In 2009, GE insect-resistant corn varieties represented 63 percent of the corn acreage in the US (USDA-ERS 2009). If deregulated by APHIS, MIR162 corn would be an additional GE insect resistant corn variety available to growers for commercial production. This corn variety will likely be introduced to areas where corn is currently grown as a replacement product for other varieties (conventional and GE) already available in the market. For example, fall armyworm damage can be suppressed using the Bt-expressing variety Herculex, but other Bt varieties such as YieldGard and Knockout/NatureGard have less activity. However, when armyworm infestations are high all three varieties may require supplemental insecticidal treatment (Bessin 2004). The proposed MIR162 variety (including varieties stacked to include the trait) would provide growers an alternative to these GE insect resistant corn lines if fall armyworm damage is expected to be high.

Similar to the no action alternative, corn will continue to be produced in 49 states (USDA-NASS 2008) and the range of corn production will likely be unchanged as a result of APHIS’ deregulating MIR162 corn. MIR162 corn does not enhance any other agronomic traits, besides insect resistance. Insects targeted by MIR 162 are commonly found in areas currently under corn cultivation (University of Illinois Extension, 2004; Penn State University, 2010) and the pest insects that MIR162 controls are not a limiting factor that prevents corn from being produced in any specific US location. Therefore, control of the susceptible pest insects will not open any new areas to corn cultivation.

Syngenta has field tested MIR162 corn since 1999 under permits issued or notifications acknowledged by APHIS across 20 representative corn growing areas (pg. 127 in Syngenta 2007). The majority of agronomic data were collected during the 2005 and 2006 growing seasons across 6-10 locations representative of the major corn-growing areas of the upper mid-west U.S. Except for test weight, grain moisture at maturity and plant emergence, the traits of MIR162-derived hybrids were not statistically significant compared with their control (non-GE) counterparts (Tables 22 & 23, pg. 65-66 in Syngenta 2007). APHIS also assessed whether the MIR162 corn is any more likely to become a weed than the isogenic nontransgenic corn line, or other corn varieties currently under cultivation (USDA-APHIS 2009). APHIS thoroughly considered the basic biology of corn and evaluated the unique characteristics of the MIR162 corn under field conditions (USDA-APHIS 2009). Based on the agronomic field data and a literature survey of corn's weediness potential, APHIS concluded that MIR162 corn lacks ability to persist as a troublesome weed (USDA-APHIS 2009).

The main introduced trait in MIR162 is expected to provide pest resistance to certain insects. Therefore, except for change in insect pest management practices, all other agricultural practices for MIR162 corn, including conventional corn weed control practices and herbicide use, are not expected to be different from those for conventional corn cultivation. These impacts, including the use of EPA registered herbicides would be similar to the no action alternative. The use of MIR162 corn should reduce human and environmental exposure to insecticides used for insect pest control in other, existing corn varieties.

*B-3. Potential Impacts of Line MIR162 Corn on Insect Control Practices*

Under this alternative, in addition to MIR162 corn, insect control options including the use of conventional insecticide applications, microbial insecticide applications, crop rotation, and planting of GE insect resistant cultivars will remain available to corn growers. Before the introduction of GE corn varieties, corn growers had difficulty controlling European corn borer, which caused up to $1 billion of annual economic loss in the U.S. including costs of pesticide treatment and lost yield (Martin and Hyde, 2001). The introduction of the first GE Bt corn hybrids in 1996 provided growers with an effective means of limiting damage caused by European corn borer. GE Bt corn use (both Bt only and stacked) grew from zero percent of corn acreage in 1996 to 63 percent in 2009 (USDA-ERS 2009). These GE corn hybrids express either a *cry1Ab* or *cry1F* gene from *B. thuringiensis*, which encode proteins that are highly toxic to European corn borer and *cry3Bb1* or *cry34Ab1*, and *cry35Ab1* that are toxic to corn rootworm. Based on the effectiveness of currently available GE Bt corn varieties (Marvier et al. 2007), it is reasonable to assume that farmers using MIR162 will observe similar positive benefits.

Controlling above-ground insects presents a challenge for corn growers, as many pests are shielded from aerial chemical applications or treatment may not be economically feasible. As a result, the majority of corn fields are not treated with pesticides for leaf-, stalk-, and ear-feeding insects. MIR162 corn has the potential to control above-ground insect pests including corn earworm, black cutworm, western bean cutworm, and fall armyworm that are not controlled by some Bt corn varieties expressing Cry proteins. Doane Marketing Research AgroTrak studies (Doane Marketing Research 2006) indicate that growers in 2005 and 2006 were treating approximately three million acres a year with conventional insecticides for control of these insects with an estimated grower cost of 20 to 23 million dollars (Table 32, pg. 94 in petition). Compared to the total number of corn acres planted annually in the U.S. (86 million acres in 2008), this represents a relatively small use of conventional pesticides (<3.5% of the total corn acreage).

In addition to direct damage caused by feeding on plant tissue, insects play an important role in the transmission and dissemination of pathogenic organisms during corn development. Feeding by *Diabrotica* rootworms has been associated with increased frequencies of *Fusarium* fungal infection (Dicke and Guthrie 1988), and rootworm feeding may also lead to increased incidences of stalk rots. Likewise, corn earworm feeding is associated with *Fusarium* infestation (Smeltzer, 1949). Ear, kernel, and cob rots occur wherever corn is grown and result in reduced test weight, poor grain quality, and mycotoxin contamination of food and feed. *Fusarium* kernel or ear rot is the most widespread disease of corn ears and is frequently associated with insect feeding damage. These pathogenic infections can lead to reduced crop quality, ability to harvest, and yield. Mycotoxin contamination of corn grain presents a potential threat to livestock health and it has been found worldwide in animal feed (Placinta et al. 1999; Monbaliu et al. 2010). Since some current Bt varieties with partial resistance to corn earworm are partially successful in reducing fumonisin content (Clements et al., 2003), the availability of MIR162 will provide farmers with an additional management option that will likely help farmers increase their capacity to alleviate adverse affects of mycotoxins on crops and animals.

Under this alternative, EPA approved insecticides will remain available for use based on the need and effectiveness against different insect species infesting commercial cornfields. However, growers may have only a narrow time window during which insecticides can be applied to corn crops. For example, optimal insecticidal application for corn earworm infestation is the period of 1-3 days during 90-100% silking stage (Burkness et al. 2009). After earworms enter into enclosed parts of the corn ear, earworms are shielded from contact with the insecticides rendering them ineffective. MIR162 corn provides excellent protection against feeding damage caused by corn earworm, black cutworm, western bean cutworm, and fall armyworm without the application limitations associated with the use of insecticides. For this reason, the introduction of MIR162 corn will have a positive impact on current corn insect control practices. This product has the potential to displace many conventional insecticide applications on corn (see pg. 92-96 in Sygenta 2007) resulting in a reduction in the number of pounds of insecticides that may be used to protect corn from insect damage.

*B-4. Organic and Other Non-transgenic Corn Production*

The National Organic Program (NOP) is administered by USDA's Agricultural Marketing Service (AMS). Organic farming operations as described by the National Organic Program requires organic production operations to have distinct, defined boundaries and buffer zones to prevent unintended contact with excluded methods from adjoining land that is not under organic management. Organic production operations must also develop and maintain an organic production system plan approved by their accredited certifying agent. This plan enables the production operation to achieve and document compliance with the National Organic Standards, including the prohibition on the use of excluded methods. Excluded methods include a variety of methods used to genetically modify organisms or influence their growth and development by means that are not possible under natural conditions or processes.

Organic certification involves oversight by an accredited certifying agent of the materials and practices used to produce or handle an organic agricultural product. This oversight includes an annual review of the certified operation's organic system plan and on-site inspections of the certified operation and its records. Although the National Organic Standards prohibit the use of excluded methods, they do not require testing of inputs or products for the presence of excluded methods. The presence of a detectable residue of a product of excluded methods alone does not necessarily constitute a violation of the National Organic Standards (USDA-AMS 2007). The unintentional presence of the products of excluded methods will not affect the status of an organic product or operation when the operation has not used excluded methods and has taken reasonable steps (such as isolation zones, use of buffer rows surrounding the organic crops or adjusting planting dates and appropriate cleaning of planting and harvesting equipment) to avoid contact with the products of excluded methods as detailed in their approved organic system plan. Organic certification of a production or handling operation is a process claim, not a product claim.

It is not likely that organic farmers, or other farmers who choose not to plant transgenic varieties or sell transgenic grain will be significantly impacted by the commercial use of MIR162 corn. Nontransgenic corn will likely still be sold and will be readily available to those who wish to plant it. Despite the introduction and adoption of transgenic corn cultivars over the past decade, including multiple varieties of Bt corn, non-GE specialty and organic corn remain readily available. In 2006, there were at least 18 seed companies in the U.S. specializing in organic corn seed (see pg. 110-111 in Syngenta 2007).

Organic and other farmers have expressed concern that the widespread planting of Bt corn plants will hasten the development of pest resistance to pesticidal Bt endotoxins. Farmers purchasing seed will know this product is transgenic because it will be marketed as Vip3aA20 lepidopteran resistant; and based on the EPA insect resistance management (IRM)[2] policy (BPPD-EPA 2001), farmers will be educated by the Syngenta's stewardship plan about recommended management practices on MIR162 corn cultivation. Transgenic corn lines resistant to lepidopteran insects, and/or tolerant to specific herbicides are already in widespread use by farmers. This particular product should not present new and different issues than existing insect resistant Bt corn cultivars with respect to impacts on organic farmers.

APHIS recognizes that corn is open-pollinating and it is possible that the engineered genes could move via wind-blown pollen to an adjacent field. All corn, whether genetically engineered or not, can transmit pollen to nearby cornfields. However, an influx of pollen originating from a given corn variety may not appreciably change the characteristics of corn in adjacent fields because gene flow declines as a power of $1/r^2$ and other factors such as wind speed, host variety and temperature also affect the results (Aylor et al., 2003; Jones and Brooks, 1950). For example, assessing observations of a large number of commercial canola fields, incidence of transgene flow was on the order

[2] Insect resistance management (IRM) is the term used to describe practices aimed at reducing the potential for insect pests to become resistant to a pesticide. Specific IRM strategies, such as the high dose/structured refuge strategy, developed by EPA are expected to mitigate insect resistance to specific Bt proteins produced in corn

of 0.015 % at 500m (see Fig 2 in Rieger, 2002) and in a smaller corn study, 0.05% at 100m (Goggia et al., 2006).

Methods of spatial and temporal isolation are widely used and accepted when seed producers are seeking to minimize the influx of pollen from sources outside the seed production field. To maintain varietal purity, the AOSCA (Association of Official Seed Certifying Agencies) recommends 200 meters isolation for nearby corn populations to produce foundation class of certified seed (AOSCA 2003). These methods are readily applicable to the production of certified organic corn seed. Gene flow rate between corn populations is extremely variable depending on the spatial, temporal, genetic and environmental factors (Brookes and Barfoot et al. 2004; Messegue et al. 2006). Yet, available experimental evidence indicates that gene flow rates drop substantially (1%) beyond 20 meters (Henry et al. 2003; Ma et al. 2004; Messeguer et al. 2006).

Data provided in the petition from agronomic trials conducted in 2005 and 2006 in a variety of locations in the U.S. demonstrated that the MIR162 corn is not significantly different in yield from its nontransgenic counterpart (Tables 22 and 23, pg. 65-66 in Syngenta 2007), and the MIR162 corn hybrids were not significantly different from control lines (non-GE) in terms of pollen viability, morphology, and diameter (Table 24, pg. 67 in Syngenta 2007). Therefore, MIR162 corn hybrids are not expected to have an increased ability to cross-pollinate other corn varieties when compared to conventional varieties that are currently available for commercial planting.

If Syngenta receives regulatory approval from all appropriate agencies, it will likely make MIR162 corn available to growers and breeders. It is not likely that other farmers who choose not to plant or sell MIR162 corn,such as organic producers, or that other transgenic corn varieties will be significantly impacted by the expected commercial use of this product as (a) non-transgenic corn varieties will likely still be sold and will be readily available to those who wish to plant them; (b) Syngenta's stewardship plan will provide farmers that purchase MIR162 corn recommended management practices for MIR162 corn cultivation; (c) methods of spatial and temporal isolation are widely used and accepted and corn seed producers employing them can minimize the influx of pollen from sources outside the seed production field; (d) 85% of the 2008 corn acreage in the United States is already planted to transgenic herbicide tolerant and/or insect resistant varieties; and (e) APHIS expects that MIR162 may replace some of the presently available GE corn varieties without significantly affecting the overall total corn acreage. APHIS concludes that organic farmers will be able to coexist with biotech corn producers as they do now.

*B-5. Potential Impact on Non-target Organisms, Including Beneficial Organisms and Threatened or Endangered Species*

APHIS evaluated the potential for MIR162 corn plants and their products to have damaging or toxic effects directly or indirectly on non-target organisms (USDA-APHIS 2009). Non-target organisms considered were those representative of the agricultural environment, including those that are recognized as beneficial to agriculture (Table 31, pg. 89 in Syngenta 2007) or as threatened or endangered in the U.S. APHIS also considered potential impacts on other "non-target" pests, since such impacts could potentially change agricultural practices. The technical details of the experiment on non-target organisms have been described in the Plant Pest Risk Assessment of MIR162 corn (USDA-APHIS 2009; see also pg. 85-88 in petition for details).

Different types (variants) of Vip proteins occur in nature, and three variants of Vip protein (Vip3Aa1, Vip3Aa19, Vip3Aa20) are used for the nontarget impact investigations. The three protein variants (Vip3Aa1, Vip3Aa19, Vip3Aa20) differ from each other by 1-2 amino acids (Table 12, pg. 48 in Syngenta 2007), and all three are found be biochemically and functionally equivalent (see Table 13 and explanation thereof on pg. 50 in Syngenta 2007). The Vip3Aa19 variant is present in Syngenta's deregulated cotton event COT102. Likewise, the Vip3Aa19 variant was also present in corn cultivar Pacha maize. Syngenta discontinued Pacha maize due to agronomic performance reasons and replaced its commercial development by MIR162 maize. Therefore each one of the nontarget exposure investigation, detailed in the following paragraphs, was carried out using one of the three Vip variant proteins (Table 30, pg. 84 in Syngenta 2007).

*Potential impacts of Vip3Aa on higher animals*. In the bird (bobwhite quail, *Colinus virginianus*), mammal (mouse, *Mus musculus*), and honey bee (*Apis mellifera*) study conducted by Syngenta, there were no observable adverse effects or differences in survival noted at doses of Vip3A proteins that were well above those expected from exposure to the Vip3Aa20 protein from the MIR162 corn planted in the field (Table 31, pg. 89 in Syngenta 2007 ).

*Potential impacts of Vip3Aa on above-ground arthropods*. Adult pink spotted ladybird beetle *(Coleomegilla maculata),* seven-spot ladybird beetle (*Coccinella septempunctata),* second-instar minute pirate bug (*Orius insidiosus*), adult green lacewings (*Chrysoperla carnea)*, and two- to three-day old *C. carnea* larvae were exposed to Vip3Aa19 protein. The difference in survival of the beetles in the treatment and control groups was not statistically significant (see pg. 86 in Syngenta 2007).

Although not an endangered or threatened species, *Danaus plexippus* (monarch butterfly) is a species of high conservation interest, and there has been concern that it may be harmed by consuming pollen from transgenic insect-protected corn. Studies of a similar Bt protein, Cry 1Ab, have shown that exposure of Monarch butterfly larvae to this protein in the vicinity of corn fields is not high enough to cause mortality (Anderson et al. 2004). However, Vip3A has no toxicity to monarch butterflies (Lee et al. 2003). APHIS concludes that because of apparent tolerance to the toxin (*D. plexippus*) and limited actual exposure, the larval monarch butterflies are not likely to be impacted by the cultivation of this Vip3Aa20-expressing crop. Effects of a Vip3A X Cry1Ab Bt corn variety on non target arthropods were assessed by Dively (2005) and compared to an isogenic control line. Populations of most insect taxa in both varieties were not significantly different, although some increases or decreases were caused by prey density responses, the absence of plant injury or some plant based factor, rather than toxicity of the host plant.

*Potential impacts on threatened and endangered arthropods*. With respect to the Endangered Species Act and oversight by the U.S. Fish and Wildlife Service (FWS), APHIS has established an agreement with FWS specifying how APHIS should review data provided by applicants. The process includes a framework to determine if a FWS consultation may be required under section 7 of the Endangered Species Act, before APHIS may grant non regulated status to products such as MIR162 corn. APHIS has obtained and reviewed the list of federally listed threatened and endangered species, species proposed for listing, and designated critical habitat or habitat proposed for designation as part of the review process. Based upon this review and adherence to the established process identified in the FWS agreement, APHIS has concluded that a consultation with FWS was not necessary for MIR162 corn.

Given the narrow specificity of the Vip3Aa20 activity, species outside the insect order Lepidoptera are not expected to be affected by Vip3Aa20 protein toxicity. Its receptor-mediated mechanism of action and absence of activity in bioassays with multiple species outside of the order Lepidoptera, as discussed in preceeding paragraphs, support this conclusion. Furthermore, Syngenta observed no harmful effects of Vip3Aa proteins in nontarget organism hazard identification studies that used a wide range of taxa at expected environmental concentrations. The test results indicated a lack of risk associated with exposure to Vip3Aa20 in the MIR162 corn (Table 31, pg. 89-90 in Syngenta 2007).

The Vip3Aa20 protein is selectively toxic to a few species of insect pests belonging to the order Lepidoptera. The only threatened or endangered lepidopteran species with potential for exposure to insecticidal proteins in corn is the Karner blue butterfly (*Lycaeides melissa samuelis*) (EPA 2001; USFWS 2007). The Karner blue butterfly requires wild lupine *(Lupinus perennis)* as an oviposition substrate and larval food source, while the adults feed on wild flowers. The potential route of exposure is consumption of maize pollen that has settled on the leaves of its food plant, the wild lupine (*Lupinus perennis*). Karner blue butterfly is known to exist along the northern extent of the range of wild lupine, where there are prolonged periods of winter snowpack, in parts of Wisconsin, Michigan, Minnesota, Indiana, New Hampshire, New York, and Illinois (Haack 1993). Although there are two counties in Wisconsin that have been identified as having a potential overlap between corn pollen shed and the presence of Karner blue larvae (Peterson et al. 2006 ), there is no evidence of Karner blue butterfly exposure to corn pollen in these locations. According to Peterson et al. (2006) the exposure of the Karner blue butterfly to maize pollen was minimal in all other locations because most lupine populations are separated from maize fields by at least 500 metres, and because maize anthesis (flowering) usually occurs after the Karner blue larvae have finished feeding.

APHIS coordinates review of petitions with other agencies that have regulatory oversight for these same products. With respect to threatened and endangered species, EPA also plays a specific role in the evaluation of GE insecticide resistant crops, including MIR162 corn. The Endangered Species Protection Program (ESPP) of EPA places geographically specific use limitations on pesticides in order to protect threatened and endangered species from pesticides (EPA 2009). Any use restrictions are identified on the EPA approved label associated with a specific EPA-registered product.

The EPA on August 6, 2008 approved a tolerance for Vip3Aa20 in corn or cotton, and on February 13, 2009 conditionally approved the use of Vip3Aa20 for use with two other Bt proteins (EPA 2009a, 2009b). In these assessments, EPA stated that the agency was not aware of any adverse effects of Vip3Aa proteins on the abundance of non-target beneficial systems in any population in a field environment, inclusive of pest parasites, pest predators or pollinators. EPA also concluded that the hybrid will produce no unreasonable harm to the environment or any federally listed threatened and endangered species. Although refuges were required for commercial use of the Vip3Aa protein, EPA did not specify any other geographic limits for use in production agriculture. EPA also concluded that the use of the pesticidal protein contained in MIR162 corn will not cause any unreasonable adverse effects on the environment during the time of conditional registration (EPA 2009a,b). APHIS concurs with the EPA assessment (EPA 2009) that the protein produced by this variety will have no adverse effects in the environment.

As previously discussed, APHIS concludes that MIR162 will not adversely impact arthropods which may be exposed to the host plant. APHIS concludes that for other endangered or threatened animals or plant species in the U.S., MIR162 corn is not expected to have any harmful effects because toxicity of Vip3Aa20 is restricted to Lepidoptera. Based upon the information available in the literature, on the EPA assessment and on the data supplied by Syngenta, APHIS determined that the unconfined release following deregulation of MIR162 corn would have no effect on federally listed threatened and endangered species, species proposed for listing, or on designated critical habitat or habitat proposed for designation (USDA-APHIS 2009).

*Environmental fate in soil and effects on soil dwelling organisms*. The purpose of a Syngenta (2007) soil fate study was to test the inherent degradability of Vip3Aa20 in a soil typical of corn-growing areas with healthy microbial activity. Most proteins do not persist or accumulate in soil because they are inherently degradable in soils (Burns 1982; Marx et al. 2005). Multiple investigations have demonstrated that Bt Cry proteins are rapidly degraded in a variety of soil types and that the proteins do not accumulate (EPA 2001; Head et al. 2002; Dubelman et al. 2005). Vip proteins are similar to Cry proteins in that they are also found in naturally occurring soil bacteria and commercial microbial insecticides (de Maagd et al. 2001). Under the activity of soil proteases, the Vip3Aa protein would be expected to be susceptible to degradation, unless specifically protected from such enzymatic hydrolysis (Marx et al. 2005)

Syngenta (2007) conducted a laboratory study to determine the degradability of Vip3Aa19 protein (Vip3Aa19 and Vip3Aa20 are functionally equivalent, see earlier text) in five soils (clay, sandy clay, loam, sandy loam, silt loam). A rapid decline in the levels of Vip3Aa19 was observed in all soil types, wherein degradation was measured as loss of insecticidal activity. The time to 50% dissipation ($DT_{50}$) was estimated to be between 6.0 and 12.6 days across soil types and test concentrations. The results of this study showed that Vip3Aa protein is rapidly degradable in normal soils. Thus, the Syngenta soil study data (Syngenta 2007) indicate that that there will not be a significant environmental impact on the soil environment by granting nonregulated status to MIR162 due to limited persistence of Vip3Aa20 in the soil.

Residual corn plant debris is oftentimes incorporated into the soil after harvest, and Syngenta (2007) assessed impacts of the MIR162 corn or its Vip3Aa protein on representative soil dwelling organisms. Data on the effects of Vip3Aa protein on earthworms, *Eisenia foetida*; a collembolan, *Folsomia candida*; and rove beetles, *Aleochara bilineat* were analyzed (see p. 87 in Syngenta 2007). These were variously incorporated as isolated protein or lyophilized leaf material as appropriate. Toxicity exposure ratios for these organisms was >9, >114 and >1316, respectively, and indicate a lack of risk for soil organisms (Syngenta 2007).

*B-6. Cumulative Effects*

APHIS considered whether the proposed action could lead to significant cumulative impacts, when considered in light of other past, present, and reasonably foreseeable future actions, regardless of what agency or person initiated such actions. APHIS has evaluated the potential cumulative impacts of granting nonregulated status to MIR162 corn. As discussed in the following paragraphs, both petitioner's data and USDA-APHIS review do not indicate any cumulative impact on the environment as a result of APHIS deregulation of MIR 162 corn (see pg. 104-108 in Syngenta 2007).

*Corn Production*
GE insect resistant corn acreage has been steadily increasing from 0% to 63% over the last 13 years in the US (USDA-ERS 2009). MIR162 is not the first Bt corn product to be granted nonregulated status. APHIS has previously made determinations of nonregulated status for several other Bt corn cultivars including petition numbers:
94-319-01p at http://www.aphis.usda.gov/brs/aphisdocs2/94_31901p_com.pdf;
95-093-01p at http://www.aphis.usda.gov/brs/aphisdocs2/95_09301p_com.pdf;
95-195-01p at http://www.aphis.usda.gov/brs/aphisdocs2/95_19501p_com.pdf;
96-291-01p at http://www.aphis.usda.gov/brs/aphisdocs2/96_29101p_com.pdf;
97-013-01p at http://www.aphis.usda.gov/brs/aphisdocs2/97_01301p_com.pdf;
97-265-01p at http://www.aphis.usda.gov/brs/aphisdocs2/97_26501p_com.pdf;
00-136-01p at http://www.aphis.usda.gov/brs/aphisdocs2/00_13601p_com.pd;
01-137-01p at http://www.aphis.usda.gov/brs/aphisdocs2/01_13701p_com.pdf;
03-181-01p at http://www.aphis.usda.gov/brs/aphisdocs2/03_18101p_com.pdf;
04-125-01p at http://www.aphis.usda.gov/brs/aphisdocs2/04_12501p_com.pdf;
04-362-01p at http://www.aphis.usda.gov/brs/aphisdocs2/04_36201p_com.pdf;
06-298-01p at http://www.aphis.usda.gov/brs/aphisdocs2/06_29801p_com.pdf;

According to Syngenta, the combined-trait Bt11xMIR162 hybrids are efficacious against five major insect pests (European corn borer, corn earworm, fall armyworm, black cutworm, western bean cutworm) and such hybrids have the potential to provide growers the means of protecting their corn crops from damage caused by a broader range of lepidopteran pests (USDA-APHIS 2009). Based upon the increasing trend in GE insect resistant corn acreage and the number of GE insect resistant corn varieties that are commercially available to growers, it is reasonable to assume that the commercial availability, acceptance and use of GE insect resistant corn crops will continue into the foreseeable future with or without APHIS deregulation of MIR162 corn. Corn will continue to be produced in 49 US states (USDA-NASS 2009) and the range of corn production will likely be unchanged as a result of APHIS deregulating MIR162 corn. Non-transgenic corn, including organic varieties will likely still be sold and will be readily available to those who wish to plant it. Despite the introduction and adoption of transgenic corn cultivars over the past decade, including multiple varieties of Bt corn, non-GE specialty and organic corn remain readily available.

*Genetic purity of corn germplasm*. APHIS does not foresee a cumulative impact on the genetic purity and diversity of non-GE corn cultivars and germplasm from granting nonregulated status to MIR162 corn (see pg. 105 in Syngenta 2007). Genetic purity and diversity has been a feature of corn improvement cultivation for decades as part of hybrid seed and specialty corn production. Many agricultural practices are effectively used by certified seed producers to grow and produce quality hybrid seed, including maintaining isolation distances to prevent pollen movement from other corn; planting border or barrier rows to intercept pollen; employing natural barriers to pollen movement such as treelines, manual or mechanical detasseling; genetic male sterility; and staggered planting dates (see for example, Bradford 2006; MRSC 2009). These widespread management practices remain in use today and have served to ensure that the broad adoption of transgenic corn in the U.S. (including the sale and cultivation of multiple Bt corn varieties over more than a decade) has had no significant impact, even in the aggregate, on the production of corn seed and specialty corn products. APHIS expects that certified growers of MIR162 and future hybrid corn seed producers will continue to follow similar types of management practices to maintain genetic purity and diversity of corn germplasm (see discussion in Syngenta, 2007 at IX C.7, Potential cumulative impacts.)

In general, all management practices used in conventional hybrid seed production to ensure quality standards are also used for the production of specialty and organic corn seed and typically are sufficient to meet assigned standards (see for example, USDA-AMS 2010a). In addition, certifiers of organic standards assess farm plans and production methods, and make inspections to determine whether grower-proposed methods for organically produced crops are accomplished and standards are maintained.

*Genetic diversity of corn*. APHIS does not foresee significant cumulative impacts on the genetic diversity or on the availability of diverse corn germplasm resources because of the adoption of multiple varieties of transgenic corn.

It is common practice in corn seed production systems (GE and non-GE) to develop genetically distinct corn hybrids for various geographies and purposes, and to continually improve these varieties through established plant breeding practices and techniques. A variety of GE and non-GE corn cultivars have been and will likely continue to remain available to those who wish to plant them. Despite the introduction and adoption of transgenic corn cultivars over the past decade, including multiple varieties of Bt corn, a variety of non-GE corn including specialty and organic varieties remain readily available.

In 2006, there were at least 18 seed companies in the U.S. specializing in organic corn seed (see pg. 110-111 in Syngenta 2007).

In addition, the adoption of genetically engineered corn was preceded by a worldwide effort to identify and preserve sources of corn genetic diversity, and to make these resources available for utilization by public and private corn breeders. Among these efforts are the Germplasm Enhancement of Maize program ("GEM"), a cooperative effort undertaken by USDA, public and private plant sector breeders, NGOs (Non Governmental Organizations) and international public cooperators. GEM was established to further identify corn genetic diversity and to provide it in useful form in order to broaden the genetic base of this crop.

*Multiple Bt corn events and insect resistance developing in the field.* APHIS does not foresee significant cumulative impacts resulting from multiple Bt corn events and insect resistance developing in the field.

MIR162 corn provides no protection against feeding damage caused by European corn borer. Syngenta has indicated that they intend to commercialize MIR162 corn as a combined-trait hybrid with Syngenta's Bt11 corn event (an APHIS deregulated GE insect resistant corn variety that contains Cry1Ab Bt protein targeting European corn borer) to control a variety of lepidopteran insect pests, such as European corn borer, corn earworm, black cutworm, western bean cutworm, and fall armyworm. According to Syngenta, the combined-trait hybrid (Bt11xMIR162) has a unique benefit. In this case, the combined-trait containing Cry1Ab and Vip3Aa20 proteins have been demonstrated to provide high-dose control of European corn borer, corn earworm, and fall armyworm. Because the type of toxicity of Vip proteins to insects seems to differ from those of Cry proteins (Lee et al, 2003), a strategy of combining such toxins would be effective in reducing risk of cross- resistance developing in lepidopterous pests that are affected by both (Tabashnik et al. 2009). Sygenta also intends to commercialize MIR162 as a combined traits hybrid with Bt11 and MIR604, and increase its targeted insects to include corn rootworm control (EPA 2009b)

Syngenta has submitted an Insect Resistant Management (IRM) plan to the EPA for Bt11xMIR162 corn that requires growers to plant a 20% structured refuge (see BBPD-EPA 2001 for details) that can be planted as strips within or surrounding the Bt corn field or as a block within, adjacent to, or up to 0.5 mile away. The proposed refuge requirements are the same in the Corn Belt and cotton growing areas (see BBPD-EPA 2001 for details). Use of these refuge strategies by growers have been shown to either delay or prevent the development of certain lepidopteran insect pest developing resistance to Bt (Bates et al. 2005). Although confirmed evidence of insect resistance to Bt corn has developed in the field in Puerto Rico (*Spodoptera frugiperda* to Cry 1F), and in South Africa (*Buseola fusca* to Cry1AB) and to Bt cultivars of cotton in the Southeast US, most pest populations remain susceptible to Bts (Tabashnik et al. 2009). Cross-resistance is possible, as between Cry1Ac and Cry2Ab in one cotton pest, and should be considered in assessing effectiveness of future strategies to avert development of resistance to Bt crops (Tabashnik et al. 2009a).

*Potential impacts on threatened and endangered species*. APHIS does not foresee significant cumulative impacts on threatened and endangered species resulting from APHIS deregulating MIR162 corn. The restriction of toxicity of Vip3Aa20 to Lepidoptera, and the minimal exposure of engendered Lepidoptera to corn, indicates that planting of the MIR162 corn is expected to have no harmful effects on any endangered or threatened species in the U.S (see lack of effects on wide range of test organisms in Syngenta 2007).

*Potential impacts on biodiversity*. APHIS has determined that there are no past, present, or reasonably foreseeable actions that would aggregate with effects of the proposed action to create cumulative impacts or reduce the long-term productivity or sustainability of any of the resources associated with the ecosystem in which the MIR162 corn is planted.

The importance of corn as a food crop, and its dependence on human management, has produced a long history of diligence to protect germplasm lines of corn (*see* Genetic purity of corn germplasm section above*)*. Decades prior to the introduction of transgenic corn products, the corn industry developed effective methods and means to maintain product segmentation and genetic purity standards. Specialty corns, for example, were successfully isolated for years and continue to be grown today, even with transgenic corn widely adopted in the U.S. Moreover, with respect to both conventional and transgenic corn, the ability to protect and maintain the genetic purity of breeding lines is critical to seed companies and developers of new varieties such as MIR162. Consequently, seed companies routinely apply standard breeding techniques including physical and temporal isolation that have proven effective at maintaining the genetic purity of breeding lines.

Genetically engineered corn lines with Bt traits (both Cry and Vip proteins) have been available on the market since 1994 and the body of evidence in peer-reviewed literature does not suggest any negative effect on biodiversity. APHIS review and analysis of Syngenta's data (USDA-APHIS 2009) indicate that the line MIR162 corn exhibits no traits that would cause increased weediness, that its unconfined cultivation should not lead to increased weediness of other cultivated corn or other sexually compatible relatives. Consequently, MIR162 is not likely to harm non-target organisms common to the agricultural ecosystem or threatened or endangered species recognized by the U.S. Fish and Wildlife Service.

*B-7. Socioeconomic Analysis*

The main body of information on socioeconomic analysis described in the following paragraphs comes from Syngenta's socioeconomic analysis (see pg. 108-112 and Appendix 1 in Syngenta 2007); the Environmental Protection Agency's (EPA) Biopesticide Registration Action Document, Vip3Aa20 corn (EPA 2009c); USDA-Economic Research Service' (USDA-ERS) report, "The First Decade of Genetically Engineered Crops in the United States" (Fernandez-Cornejo and Caswell 2006); and BioTech InfoNet Technical Paper, "Genetically Engineered Crops and Pesticide Use in the United States" (Benbrook 2004). APHIS assessment on the petitioner's socioeconomic analysis is restricted to the MIR162 corn and its stacked hybrids with other Bt traits (Bt11xMIR162, Bt11xMIR162xMIR604).

*Agricultural Benefits.* The increased adoption of Bt corn cultivars since its introduction in the mid 1990s (USDA-ERS 2009) could imply that insect resistance varieties provide benefits to corn farmers. This is more evident since the early 2000's when the Bt corn varieties that are effective against European corn borer were complemented with a second generation Bt corn cultivar that provide protection against corn root worm. According to USDA's Agricultural and Resource Management Surveys (ARMS) conducted in 2001-03 (see Figure 7 in Fernandez-Cornejo and Caswell 2006) most of the farmers adopting GE corn, cotton, and soybeans indicated that they did so mainly to increase yields through improved pest control. Because the MIR162 corn is effective against two major corn insect pests, corn earworm and western bean cutworm, which are not effectively controlled by earlier Bt corn cultivars, it is reasonable to assume that likewise, potential benefits do exist for farmers adopting the MIR162 corn cultivars. Although it is difficult at this time to accurately predict the magnitude of economic benefits of the MIR162 corn hybrids in the marketplace, because such hybrids are not currently in commercial production, the improved pest protection profile of Bt11xMIR162 corn may translate into correspondingly higher overall economic benefits to growers, consumers, and other downstream users of corn products.

Syngenta has suggested that their stacked hybrids Bt11 x MIR162 x MIR604 will provide unsurpassed control of target pests and that the product's "broad-lepidopteran control, particularly for corn earworm and western bean cutworm, potentially results in better performance than those of competitors. However, EPA's Biopesticides and Pollution Prevention Division (BPPD) notes that these statements are unverified assumptions. Although the data support that the stack containing the Bt11, MIR162, and MIR604 traits produces reasonably good efficacy against western bean cutworm, the MIR604 trait when combined with the MIR162 trait showed some evidence of a possible synergistic effect in the control of corn rootworm. BPPD reasons that the sample size used by Syngenta for the investigation is too small to delineate impacts of individual Bt traits in stacked hybrids. According to BPPD, Syngenta's specific economic benefits are based on best-case assumptions (i.e., quick and broad adoption of the product in the marketplace). Competition from previously registered Bt corn products (already established in the market) and grower familiarity with these products may reduce the overall adoption, and the potential benefits for MIR162 corn and its associated products. Despite this shortcoming however, BPPD notes that both the stack and pyramid products, and the single-trait product appear to provide good protection against European corn borer and corn earworm. For many growers, the potential broad lepidopteran control expected by Bt11xMIR162 hybrids may provide added benefits than currently available Bt corn cultivars, as corn growers with multiple pest problems are expected to be protected from major corn pests.

So far, Bt hybrids have mixed responses when it comes to monetary benefits to corn growers. In 2006, USDA-ERS published a report on "The First Decade of Genetically

Engineered Crops in the United States" focusing on GE crops and their adoption in the United States over the past 10 years (Fernandez-Cornejo and Caswell 2006). The economic analysis in that report mainly focused on the field data from 1997 and 1998 (see Table 1). On average, BT technology benefitted corn farmers with 5% higher yields in the United States, and yield effects were larger in years with high pest pressures as noted earlier by other investigators (Carpenter et al. 2002). Many field tests and farm surveys have also examined the yield and cost effects of using Bt corn crops (Table 1). The majority of the results show Bt corn crops produce higher yields than conventional crops. A more recent ERS study using 2001 survey data found that, on average, actual corn yield was 12.5 bushels per acre higher for Bt corn than for conventional corn, an increase of 9% (Fernandez-Cornejo and Li 2005).

The economic benefits of growing Bt corn do not appear to be consistent across growing seasons. There was a negative association between adoption of Bt corn and producer net returns in 1998. According to Fernandez-Cornejo and Caswell (2006) this negative trend suggests that Bt corn may have been used on some acreage where the value of protection against the European corn borer was lower than the premium paid for the Bt seed. Because pest infestations vary from one region to another and from one year to another, the economic benefits of Bt corn are likely to be greatest where pest pressures are most severe (Carpenter et al. 2002; Shelton et al. 2002). Farmers must decide to use Bt corn before they know what the European corn borer pest pressure will be that year. For that reason management practices are tailored accordingly (Mason et al. 1996). Because of this unpredictable variation, many farmers generally ignored European corn borer infestation and accepted the losses it caused (Shelton et al. 2002).

According to Gurian-Sherman (2009) there was a 3-4 percent yield advantage for Bt corn varieties in the U.S. for combining the benefits of European corn borer and corn root worm resistance. However, Gurian-Sherman's analysis also showed that Bt corn yield benefits were not much different from what was achieved through traditional breeding. For example, corn yield has been increasing on average 1 percent per year over the past several decades, and Bt corn crops had the same yearly improvement in the last 14 years since the introduction of first Bt crop in 1996. Several approaches, such as organic cultivation, wheat-corn rotation etc, other than current pesticide regimes and GE have the potential to reduce yield loss from corn borer and rootworm in corn. These approaches also have other associated benefits such as lower levels of pesticide use, improved soil qualities, increased carbon sequestration, and improved water quality (but also see the comments on the report by Sheridan 2009).

Adoption of GE crops is associated with reduced pesticide use. Insecticide use on fields planted to Bt corn substantially decreased since its introduction in mid 1990s (Figure 1 and Figure 8 in Fernandez-Cornejo and Caswell 2006) and use rates on corn (in terms of active ingredient) have declined since the introduction of GE corn in 1996. More recently, using 2001 data, USDA-ERS found that insecticide use was 8 percent lower per planted acre for adopters of Bt corn than for nonadopters (Fernandez-Cornejo and Li 2005). The USDA-ERS results generally agree with field-test and other farm surveys that have examined the effects of using GE crops (Table 1).

Table 1. Summary of primary studies on the effects of genetically engineered Bt corn on yields, pesticide use, and returns (Modified from Fernandez-Conejo and Caswell 2006).

| **Reference** | **Data Source** | **Effects on** (NA = Not analyzed in the study) | | |
|---|---|---|---|---|
| | | **Yield** | **Pesticide Use** | **Returns** |
| Rice and Pilcher, 1998 | Survey | Increase | Decrease | Depends on infestation |
| Marra et al., 1998 | Survey | Increase | Decrease | Increase |
| Benbrook, 2001 | Survey | Increase | NA | Decrease |
| McBride & El-Osta, 2002 | Survey | NA | NA | Decrease |
| Duffy, 2001 | Survey | Increase | NA | Same |
| Pilcher et al., 2002 | Survey | Increase | Decrease | NA |
| Baute, Sears, and Schaafsma, 2002 | Experiments | Increase | NA | Depends on infestation |
| Dillehay et al., 2004 | Experiments | Increase | NA | NA |
| Fernandez-Cornejo & Li, 2005 | Survey | Increase | Decrease | NA |

The MIR162 corn and stacked hybrids may further reduce the insecticide use if the current trend in insecticide usage continues (Figure 8 in Fernandez-Cornejo and Caswell 2006). But according to Benbrook (2004) the insecticide reduction rate appears to have plateaued (Figure 1), and any further reduction in insecticide use from new Bt corn cultivars may be marginal. For example, the amount of insecticide saved per acre of Bt corn in 1996 was 0.16 pounds of active ingredient. As more acres of Bt corn were planted, insecticide use was reduced on a smaller share of these Bt acres, leading to a lower average reduction in insecticide use across all acres planted to Bt corn. In recent years, the reduction has been only 0.02 pounds per acre (see Figure 1 in Benbrook 2004). Besides the monetary benefits, Fernandez-Cornejo and Caswell (2006) noted that there are several other beneficial factors, such as ease of operation and time savings, which may have made GE crops attractive to farmers. Despite the mixed results on Bt benefits, from the corn growers' perspective, as reflected in the increased rate of adoption of Bt corn cultivars ever since 1996, the farm profitability has gradually been increasing through higher yields and/or lower costs (e.g., operator labor, energy savings, pesticide purchases) by growing Bt corn crops.

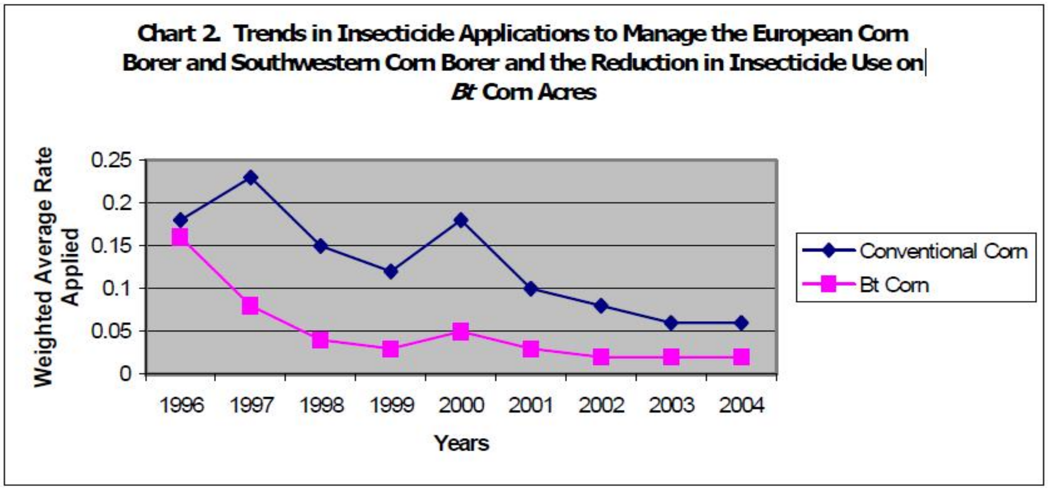


Figure 1. Reproduced from Benbrook 2004 "Chart 2. Trends in Insecticide Applications to Manage the European Corn Borer and Southwestern Corn Borer and the Reduction in Insecticide Use on Bt Corn Acres".

Another potential economic benefit for growers and downstream consumers is increased competition in the marketplace for pest-control products, including hybrid seed from multiple marketers of lepidopteran-tolerant Bt corn varieties. The commercial availability of MIR162 hybrid corn seed may represent a important new pest control option and tool for growers. Increased grower choice may exert downward pressure on the cost of products that offer control of lepidopteran pests (see pg. 110 in Syngenta 2007).

*Human Health and Environmental Benefits*. There is no human health concerns with respect to toxicity or allergenicity and no unreasonable environmental concerns with respect to toxicity of the insecticidal proteins expressed in the MIR162 corn (Appendix I in this EA; EPA 2001). Also, use of Bt corn can decrease farm worker exposure to Bt sprays and chemical insecticides and reduce the mold infestation on corn seeds (Carpenter et al. 2002). Consequently, any reduction in mold toxins resulting from use of Bt corn can provide direct benefits to people and corn-fed livestock. In a variety of field studies, other insect protected corn expressing Bt proteins have been shown to have extensively lower levels of common mycotoxins that are produced by fungal pathogens (Wu 2006); however, the mycotoxin levels in MIR 162 corn in commercial cultivation is not available at this time.

*Insect Resistance Management Benefits*. According to EPA the MIR162 corn and its stacked Bt hybrids have the potential to delay development of resistance in other corn varieties expressing Cry toxins. The introduction of MIR162 corn and its stacks or pyramids may have an additional benefit of prolonging the lifetime of other corn Plant Incorporated Protectants (PIP) technologies by providing another mode of action for European corn borer, corn earworm, fall armyworm, and corn rootworm.

*Effects on the Export Market.* Syngenta does not expect any effects on the United States corn export market by the cultivation of the MIR162 cultivars since Syngenta is actively pursuing regulatory approvals for the MIR162 corn in countries that import corn from the United States or Canada. Regulatory filings for the MIR162 corn are in process for Colombia, Japan, South Korea, Taiwan, China, the Philippines, Australia and New Zealand, South Africa, the European Union, Russia, and Switzerland. Syngenta's stewardship agreements with growers will include a term requiring growers to divert this product away from export markets (i.e. channeling) where the grain has not yet received regulatory approval for import. Syngenta will communicate these requirements to growers using a wide-ranging grower education campaign (e.g., grower Stewardship Guide (see pg. 111 in Syngenta 2007).

## *C. Consideration of Executive Orders, Standards and Treaties Relating to Environmental Impacts*

**Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"** requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high and adverse human health or environmental effects.

**EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks,"** acknowledges that children may suffer disproportionately from environmental health and safety risks because of their developmental stage, greater metabolic activity levels, and behavior patterns, as compared to adults. The EO (to the extent permitted by law and consistent with the agency's mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children.

Each alternative was analyzed with respect to EO 12898 and 13045. Based on the information submitted by the applicant and assessed by APHIS, MIR162 corn is not expected to have a disproportionate adverse effect on minorities, low-income populations, or children. MIR162 is not significantly different than conventional corn and has successfully completed the FDA voluntary consultation for food and feed use. Collectively, the available mammalian toxicity, along with the history of safe use of microbial Bt products and other corn varieties expressing Bt proteins, establishes the safety of the corn line MIR162 and its products to humans, including minorities, low income populations, and children who might be exposed to them through agricultural production and/or processing.

None of the impacts on agricultural practices expected to be associated with deregulation of the corn line MIR162 are expected to have a disproportionate adverse effect on minorities, low income populations, or children. As noted throughout the EA, the cultivation of previously deregulated corn varieties with similar insect resistant traits has been associated with a decrease or shift in pesticide applications for those who adopt these varieties that is either favorable or neutral with respect to environmental and human toxicity. If pesticide applications are reduced, there may be a beneficial effect on children and low-income populations that might be exposed to the chemicals. These populations might include migrant farm workers and their families, and other rural dwelling individuals who are exposed to pesticides through ground-water contamination or other means of exposure. It is expected that EPA and USDA Economic Research Service would monitor the use of this product to determine impacts on agricultural practices such as chemical use as they have done previously for Bt products.

**EO 13112, "Invasive Species"**, states that Federal agencies take action to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. Non-GE corn as well as GE Bt and herbicide tolerant corn varieties that have been granted nonregulated status are widely grown in the United States. Based on historical experience with these varieties and the data submitted by the applicant and assessed by APHIS, MIR162 corn is sufficiently similar in fitness characteristics to other corn varieties currently grown, and it is not expected to have an increased invasive potential (see USDA-APHIS 2009).

## INTERNATIONAL IMPLICATIONS

**EO 12114, "Environmental Effects Abroad of Major Federal Actions"** requires Federal officials to take into consideration any potential environmental effects outside the U.S., its territories and possessions that result from actions being taken. APHIS has given this due consideration and does not expect a significant environmental impact outside the U.S. should nonregulated status be determined for the corn line MIR162 or if the other alternatives are chosen. All the considerable, existing national and international regulatory authorities and phytosanitary regimes that currently apply to introductions of new corn cultivars internationally, apply equally to those covered by an APHIS determination of nonregulated status under 7 CFR part 340. Any MIR162 corn in international commerce subsequent to a determination of non-regulated status for the line MIR162 would be fully subject to national phytosanitary requirements and be in accordance with phytosanitary standards developed under the International Plant Protection Convention (IPPC).

The purpose of the IPPC "is to secure a common and effective action to prevent the spread and introduction of pests of plants and plant products and to promote appropriate measures for their control" (IPPC 2010)). The protection it affords extends to natural flora and plant products and includes both direct and indirect damage by pests, including weeds. The IPPC has set a standard for the reciprocal acceptance of phytosanitary certification among the nations that have signed or acceded to the Convention (173 countries as of August 2009). In April, 2004, a standard for pest risk analysis of living modified organisms (LMOs) was adopted at a meeting of the governing body of the IPPC as a supplement to an existing standard, International Standard for Phytosanitary Measure No. 11 (ISPM-11; Pest Risk Analysis for Quarantine Pests). The standard acknowledges that all LMOs will not present a pest risk, and that a determination needs to be made early in the PRA for importation as to whether the LMO poses a potential pest risk resulting from the genetic modification. APHIS pest risk assessment procedures for bioengineered organisms are consistent with the guidance developed under the IPPC. In addition, issues that may relate to commercialization and transboundary movement of particular agricultural commodities produced through biotechnology are being addressed in other international forums and through national regulations.

**The Cartagena Protocol on Biosafety** is a treaty under the United Nations Convention on Biological Diversity (CBD) that established a framework for the safe transboundary movement, with respect to the environment and biodiversity, of LMOs, which includes those modified through biotechnology. The Protocol came into force on September 11, 2003 and 156 countries are parties to it as of June 24, 2009 (see CBD 2010). Although the U.S. is not a party to the CBD, and thus not a party to the Cartagena Protocol on Biosafety, U.S. exporters will still need to comply with domestic regulations that importing countries that are parties to the Protocol have put in place to comply with their obligations. The first intentional transboundary movement of LMOs intended for environmental release (field trials or commercial planting) will require consent from the importing country under an advanced informed agreement (AIA) provision, which includes a requirement for a risk assessment consistent with Annex III of the Protocol, and the required documentation. LMOs imported for food, feed or processing (FFP) are exempt from the AIA procedure, and are covered under Article 11 and Annex II of the Protocol. Under Article 11 Parties must post decisions to the Biosafety Clearinghouse database on domestic use of LMOs for FFP that may be subject to transboundary movement. To facilitate compliance with obligations to this protocol, the US Government has developed a website that provides the status of all regulatory reviews completed for different uses of bioengineered products (http://usbiotechreg.nbii.gov). These data will be available to the Biosafety Clearinghouse.

APHIS continues to work toward harmonization of biosafety and biotechnology consensus documents, guidelines and regulations, including within the **North American Plant Protection Organization (NAPPO)**, which includes Mexico, Canada, and the U.S. and in the Organization for Economic Cooperation and Development (OECD). NAPPO has completed three modules of a standard for the *Importation and Release into the Environment of Transgenic Plants in NAPPO Member Countries* (see http://www.nappo.org/Standards/Std-e.html). APHIS also participates in the North American Biotechnology Initiative (NABI), a forum for information exchange and cooperation on agricultural biotechnology issues for the U.S., Mexico and Canada. In addition, bilateral discussions on biotechnology regulatory issues are held regularly with other countries including: Argentina, Brazil, Japan, China, and Korea. Many countries, e.g. Argentina, Australia, Canada, China, Japan, Korea, Philippines, South Africa, Switzerland, the United Kingdom, and the European Union have already approved Bt corn varieties to be grown or imported for food or feed (AgBios 2010). There should be no effects on the U.S. corn export market since Syngenta is actively pursuing regulatory approvals for the MIR162 corn in countries with functioning regulatory systems for genetically modified organisms and that import corn from the U.S. or Canada. Regulatory filings for the MIR162 corn are in process for Colombia, Japan, South Korea, Taiwan, China, the Philippines, Australia and New Zealand, South Africa, the European Union, Russia, and Switzerland.

**COMPLIANCE WITH CLEAN WATER ACT AND CLEAN AIR ACT**

This EA evaluated the changes in corn production due to the unrestricted use of MIR162 corn. MIR162 corn will not lead to the increased production of corn in U.S. agriculture. The inclusion of the MIR162 corn into corn hybrids and their use in agriculture is not expected to have an adverse effect on water quality, water use, or air quality. There is no expected change in water use due to the production of MIR162 corn compared to current corn production regimes, nor is it expected that air quality will change due to do the production of MIR162 corn. The commercial availability of MIR162 is expected to continue to provide improvements in water quality similar to other commercially available GE insecticide resistant crops due the potential for continued reduction in use of more hazardous chemical pesticides, many of which are toxic to aquatic organisms.

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# VIII. APPENDIX

## *Appendix I. Environmental and Human Health Safety of Vip3Aa20 Protein*

Previously deregulated Bt corn cultivars have resulted in reduced conventional pesticide use, as farmers find Bt products more effective in mitigating lepidopteran insect feeding damage. It is reasonable to expect that deregulation and commercialization of the MIR162 corn will result in further reductions in the use of conventional pesticides. This reduction in conventional pesticide use would diminish the environmental risks of chemical pesticide insect control, as the chemical alternatives to MIR162 present well-characterized risks to humans and other wildlife, whereas Vip3Aa20 presents no such risk. Substantial data support a conclusion that Vip3Aa20 toxicity will be limited to sensitive lepidopteran species that are sufficiently exposed to the protein (USDA-APHIS 2009).

The toxicity of insecticidal Bt proteins, such as Vip3a20, depends on their binding to specific receptors present in the insect midgut. Research demonstrates that this specificity limits the proteins' toxic effect to certain lepidopteran species. A discussion on the mechanism of action for Vip3Aa20, its spectrum of activity, and its lack of toxicity to non-lepidopteran species is presented in the petition (pg. 47-50).

Health and safety studies have been conducted with the novel proteins contained in MIR162 corn. A comprehensive assessment of the safety of the introduced proteins, Vip3Aa20 and PMI, demonstrate that both proteins are nontoxic to mammalian species and are unlikely to be food allergens (69 FR 26770-26775; 73 FR 45620-45624; FDA BNF No. 000113). The Vip3Aa20 protein is considered nontoxic because it does not share significant amino acid homology with known protein toxins, is nontoxic to mice at a very high dose of 1250 mg Vip3Aa20/kg bw, is rapidly degraded in simulated mammalian gastric fluid, and its insecticidal mode of action for Vip3Aa20 is not relevant to mammals.

Vip3Aa20 is also not likely to be a food allergen because it is not derived from a known source of allergenic proteins, it does not have any significant amino acid sequence identity to known allergenic proteins, it is rapidly degraded in simulated mammalian gastric fluid, and it is labile upon heating at temperatures of 65ºC and above. The PMI protein is considered nontoxic because it does not share significant amino acid homology with known protein toxins, it is nontoxic to mice at a very high dose of 3030 mg PMI/kg bw, and it is rapidly degraded in simulated mammalian gastric fluid. PMI is not likely to be a food allergen because it is not derived from a known source of allergenic proteins, it does not have any significant amino acid sequence identity to known allergenic proteins with implications for its allergenic potential, it is rapidly degraded in simulated mammalian gastric fluid, and it is labile upon heating at temperatures of 37ºC and above.

A permanent exemption from the requirement of a food tolerance currently exists under 73 FR 45620-4562440 for Vip3Aa20 in maize and under 40 CFR §180.1252 for PMI in all plants.

USDA-APHIS. 2009. Plant Pest Risk Analysis for Syngenta MIR162 corn. USDA, APHIS, Biotechnology Regulatory Service. Riverdale, MD (URL: http://www.aphis.usda.gov/brs/not_reg.html)

## *Appendix II. Syngenta MIR162 Corn Forage and Grain Compositional Analysis*

The data for the discussion and interpretation on the composition analysis of the MIR162 corn come from Syngenta's petition (Petition Appendix E, pages 158-180 for experimental details and statistical analyses, and pages 69-73 for the interpretation and discussion of results) and was reviewed by APHIS. The rationale for the composition analysis of forage and grain is to identify any changes in nutrient or anti-nutrient content of the new crop in the context of its use as food or feed and to assess its biochemical equivalence and similarity to conventional maize. Assessment of the plant's composition also allows the developer and APHIS to evaluate possible unintended effects that might arise from insertion of the Vip3Aa20 and PMI genes into the plant's genome. This assessment was undertaken by performing quantitative analyses of 65 components (Table 25, pg. 70 in petition) both from MIR162 hybrid corn and a nontransgenic control variety. The analytes measured in this study were selected based on recommendations of the Organisation for Economic Co-operation and Development (OECD, 2002) for comparative assessment of composition of new varieties of maize. The plant materials for the analysis come from six diverse corn growing regions of the U.S. (Appendix Table E-1, pg. 158 in petition) during 2005. Plants were self-pollinated by hand and the developing ears were bagged to avoid cross-pollination. All analyses were conducted using methods published and approved by the Association of Analytical Communities (AOAC) International or other industry-standard analytical methods.

Nine components of corn forage were measured; the difference between MIR162 and control mean values was found to be statistically significant for one of these analytes. Fifty-six components of grain were measured; the difference between MIR162 and control mean values was found to be statistically significant for 13 of these analytes. The results for these 14 analytes that had a statistically significant outcome for genotype effect (Table 26, pg. 72 in petition) have been discussed in the following paragraphs.

The forage compositional analyses for proximates and minerals revealed a single statistically significant difference between MIR162 and control mean values. The mean value for MIR162 Neutral Detergent Fiber (NDF) was 11.34% higher than the corresponding control value. This difference is considered relatively small and the MIR162 mean falls well within the range of normal values reported by International Life Sciences Institute (ILSI) (Ridley et al. 2004; ILSI 2006) and Organisation for Economic Co-operation and Development (OECD). No statistically significant genotype by location interactions were noted for the forage compositional analyses.

Compositional analyses of grain revealed no statistically significant differences between MIR162 and control means for 43 of the 56 analytes examined in across-location comparisons. Statistically significant differences were noted for levels of the proximates ash, NDF, starch, three grain minerals (calcium, iron, and phosphorus), levels of vitamin A (β-carotene), vitamin $B_6$ (pyridoxine), and vitamin E (α-tocopherol), linoleic and linolenic fatty acids. These differences were small (< 8%) and the MIR162 mean values were well within the ranges of normal values for the control maize. Additionally, the average values for all proximates were within the ranges reported by ILSI and OECD.

Statistically significant differences were noted between MIR162 and control mean levels of vitamin A (β-carotene), vitamin $B_6$ (pyridoxine), and vitamin E (α-tocopherol). These differences were small (< 7%) and the mean values observed for these vitamins in the MIR162 grain were well within the range of values observed for the control grain. Additionally, the MIR162 means for all vitamins fell within the normal range of values reported for conventional maize by ILSI and OECD. For vitamin A and vitamin $B_9$ a statistically significant genotype-by-location interaction was noted, which suggests that the effect of genotype was not consistent across locations, hence, the comparison of genotypes averaged across locations may not be valid. Individual location means for the two analytes are provided in Table E-8 (Appendix E). The vitamin A and vitamin $B_9$ levels at all locations were within the ranges reported in the literature.

There were no significant differences noted for any of the 18 amino acids or anti-nutrients measured and all average values were within the ranges reported by ILSI and OECD (Appedix E, pg. 158-180 in petition).

Statistically significant differences were noted for linoleic and linolenic fatty acids. These differences were very small (< 4%) and the MIR162 mean values observed for these fatty acids were within the ranges of values observed for the control grain. Furthermore, the average values for all fatty acids were within the range of normal values reported for conventional maize by ILSI and OECD.

Statistically significant differences were noted in the secondary metabolites ferulic acid and *ρ*-coumaric acid. These differences were relatively small (< 15%) and the MIR162 mean values for these secondary metabolites were within the ranges of values observed for the control grain. Additionally, the mean values for all MIR162 secondary metabolites and anti-nutrients were within the normal range of values reported for conventional maize by ILSI and OECD.

Collectively, the observed differences between MIR162 and control means are considered of no biological significance and represent typical random variance. The magnitude of the differences was small, all MIR162 values fell within normal ranges for conventional maize, and the MIR162 and control data ranges significantly overlapped. MIR162 is therefore, not compositionally different from conventional maize.

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# Plant Pest Risk Assessment for MR162 Corn

Syngenta Biotechnology, Inc., has petitioned APHIS (APHIS number 07-253-01p) for a determination that genetically engineered (GE) corn (*Zea mays*) event MIR162 is unlikely to pose a plant pest risk and, therefore, is no longer a regulated article under regulations at 7 CFR part 340. This plant pest risk assessment was conducted to determine whether MIR162 corn is unlikely to pose a plant pest risk. If APHIS determines that MIR162 corn is not a plant pest, APHIS then has no regulatory authority over that organism under its regulations at 7 CFR part 340.

## History of Development of MIR162 Lepidopteran-Resistant Corn

Corn is susceptible to attack by a variety of insects from the time it is planted until it is consumed as food or feed (Table 1 on page 12 in petition). Syngenta has developed MIR162 containing an insecticidal protein Vip3Aa20 (Vip = Vegetative insecticidal protein) that is resistant to the feeding damage caused by corn earworm (*Helicoverpa zea*), fall armyworm (*Spodoptera frugiperda*), black cutworm (*Agrotis ipsilon*), and western bean cutworm (*Striacosta albicosta*) larvae. Vip3Aa is produced by the bacterium *Bacillus thuringiensis* (Bt) (Estruch et al. 1996). Bacteria use Vip protein toxins to kill insect prey (Estruch et al. 1996; Schnepf et al. 1998) which then serves as a nutritional source (de Maagd et al. 2001). Vip3Aa proteins are similar to certain Cry proteins (Höfte and Whiteley 1989) and are demonstrated to have toxic effects only on certain insects (Table 2.1 on p. 23 in Carozzi and Koziel 1997).

The mechanism by which Vip proteins exert their insecticidal activity has been studied and found to be similar, but not identical, to that which has been previously described for the Bt Cry proteins that are contained in several commercial insecticide formulations and plants engineered for insect resistance. The Vip and Cry proteins bind to different receptors in the insect (Lee et al. 2003), and the insecticidal activity of Vip3Aa proteins is limited to species within selected families of the order Lepidoptera (Table 27 on pages 74-75 in petition). For example, the Vip3Aa protein in MIR162 does not provide corn plants protection against damage caused by European corn borer (*Ostrinia nubilalis*) and corn root worm (*Diabrotica sp*), the most widespread and damaging insect pests of maize in the U.S. Corn Belt. According to Syngenta, when MIR162 corn hybrids containing Vip3Aa are combined with European corn borer protected corn, such hybrids have the potential to provide growers the means of protecting their corn crops from damage caused by a broader range of lepidopteran pests (pages 74-75 in petition).

MIR 162 corn has been field tested under APHIS regulations since 1999. Data were provided in the petition for field trials completed prior to the petition submission.

Tolerance exemptions and conditional pesticide registrations have been granted for the plant-incorporated protectant in MIR162 corn and the genetic material necessary for its production. On August 6, 2008, the Environmental Protection Agency (EPA) granted an exemption from the requirement of a tolerance for residues of Vip3Aa proteins (including the Vip3Aa20 variant) in or on food and feed commodities of corn (73 FR 45620-45624). Likewise, on April 30, 2009, EPA also approved the conditional registrations of Vip3Aa20 produced in MIR 162 corn for use as lepidopteran insecticide (74 FR 19956-19957). An exemption from the requirement of tolerance has been established for the selectable marker gene phosphomannose isomerase (PMI) protein in all crops (69 FR 26770-26775). Syngenta's food safety summary submitted to FDA indicated that food and feed derived from corn event MIR162 are as safe and nutritious as food and feed derived from conventional corn. At the conclusion of their consultation with FDA on December 9, 2008, the FDA concluded that it had "no further questions concerning grain and forage derived from corn event MIR162" (FDA BNF No. 000113).

## Description of Inserted Genetic Material

MIR162 maize was produced by transformation of immature maize embryos using an *Agrobacterium tumefaciens* plant-pathogenic bacterium vector system that is disarmed of DNA sequences within the T-DNA (transfer-DNA), which upon integration into the plant genome of infected cells are normally responsible for the formation of crown gall tumors in plants. The disarmed *Agrobacterium tumefaciens* harbors a plasmid vector pNOV1300 that contained within its T-DNA *vip3Aa19* and *manA* gene expression cassettes.

The first expression cassette consists of four genetic elements:

- *Z. mays* polyubiquitin promoter and first intron (ZmUbiInt). This promoter provides constitutive expression in monocots (Christensen et al. 1992).

- Full length *Vip3Aa19* gene. This protein coding region is a variant of the native *vip3Aa1* gene (Estruch et al. 1996) from *B. thuringiensis* strain AB88. The *vip3Aa19* gene was codon optimized for expression in maize (Murray et al. 1989). The *vip3A19* encodes a Vip3Aa19 protein that has insecticidal activity against many lepidopteran insect pests.

- Intron #9 from the phosphoenolpyruvate carboxylase gene (iPEPC9) from *Z. mays* (Hudspeth and Grula 1989).

- 35S RNA Terminator sequence from the cauliflower mosaic virus genome. This sequence contains signals for termination of transcription and directs polyadenylation (Franck et al. 1980).

The second expression cassette consists of three genetic elements:

- ZmUbiInt (same as above).

- A *manA* gene from *E. coli* strain K-12. This gene encodes the enzyme phosphomannose isomerase (PMI) that catalyzes the interconversion of mannose-

6-phosphate to fructose-6-phosphate (Negrotto et al. 2000), which was used as a selectable marker during transformant selection.

- NOS (Nopaline Synthase) gene terminator sequence from *A. tumefaciens.* This terminates gene expression by a polyadenylation site (Depicker et al. 1982).

The production of PMI enzyme in the transformed tissue allows corn tissue containing the *vip3Aa19* and *manA* gene expression cassettes to be selected on medium containing the sugar mannose. The *manA* gene expression, which produces phosphoisomerase enzyme, confers no other benefit to the regenerated transformed corn plant. Syngenta provided evidence demonstrating that the final product does not contain any of the backbone sequences outside of the T-DNA borders from the transformation vector, pNOV1300.

Southern blot analyses and nucleotide sequencing demonstrated that MIR162 corn contains a single intact T-DNA insert in the corn genome. Furthermore, Southern blot analyses also demonstrated that the T-DNA insert contains: i) single copies of a *vip3Aa* gene and a *manA* gene; ii) two copies of the ZmUbiInt promoter; iii) one copy of the NOS terminator; and iv) no backbone sequences from transformation plasmid pNOV1300. Nucleotide sequencing additionally determined that the MIR162 maize T-DNA insert did not locate within any known *Z. mays* gene. Further, no novel open reading frames were created that spanned either the 5′ or 3′ junctions between the T-DNA and *Z. mays* genomic sequences.

Syngenta's characterization of the T-DNA in MIR 162 and Mendelian inheritance of transgene segregation data provide evidence for the functional stability and intactness of the two transgene coding sequences over several breeding generations during the development of MIR162 corn hybrids (pages 23- 46 in petition). However, the *vip3A19* coding sequence analysis also revealed two single nucleotide changes in the coding sequence contained in the MIR162 maize T-DNA, as compared with the sequence present in the transformation plasmid pNOV1300. The new gene variant incorporated into the MIR162 maize genome has been designated as *vip3Aa20*. One of the mutations resulted in a single codon change for the amino acid originally encoded, while the other mutation was a silent mutation (i.e., the amino acid produced did not change). Mutational changes in genetic elements are very common and are the ultimate source of genetic variation found in nature, and the single functional mutational change in the *vip3Aa19* gene that resulted in *vip3Aa20* is within the range of mutation rates observed in nature for plants (Kovalchuk et al. 2000). The single amino acid substitution between *vip3Aa19* and *vip3Aa20* occurs at position 129 (see the petition pages 47-48 for a detailed description). Based on Syngenta's laboratory bioassay results, the amino acid differences between *vip3Aa19* and *vip3Aa20* variants do not impact insecticidal activity against target insect pests, as the position 129 occurs outside of the core protein domain involved in insecticidal activity (Estruch and Yu 2001; Lee et al. 2003). These data also indicate that no novel proteins, other than Vip3Aa20 and PMI, will be produced in MIR162 maize. These genetic characterization data demonstrate that, apart from the well-characterized change that resulted in a single altered amino acid in the *vip3Aa19* coding sequence, there are no unintended changes in the MIR162 corn genome as a result of the T-DNA insertion (see pages 23-46 of petition).

## Plant Pest Risk Assessment

MIR162 maize was produced by transformation of corn tissue using *A. tumefaciens* to introduce a gene that confers tolerance to certain lepidopteran (caterpillar) pests of corn. Because *A. tumefaciens* is a plant pest and some of the regulatory sequences used to facilitate expression of these genes in corn were derived from plant pests, the engineered corn has been considered a regulated article under APHIS regulations at 7 CFR part 340. APHIS administers these regulations under the authority of the Plant Protection Act of 2000 (PPA) (7 U.S.C. Sec 7701 *et seq*.). APHIS' authority to regulate genetically engineered organisms under the PPA is limited to those GE organisms that are plant pests as defined under Section 14 of the PPA. APHIS regulations under 7 CFR part 340.1 defines a plant pest as "Any living stage (including active and dormant forms) of insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts thereof; viruses; or any organisms similar to or allied with any of the foregoing; or any infectious agents or substances, which can directly or indirectly injure or cause disease or damage in or to any plants or parts thereof, or any processed, manufactured, or other products of plants."

Potential impacts to be addressed in this risk assessment are those that pertain to the use of MIR162 corn and its progeny in the absence of confinement. Of the information requested by APHIS for submission of a petition for nonregulated status (§ 340.6(c)(4)), APHIS examined information submitted by the applicant related to plant pest risk characteristics, disease and pest susceptibilities, expression of the gene product, new enzymes or changes to plant metabolism, weediness of the regulated article, and any impacts on the weediness of any other plant with which it can interbreed. Furthermore, APHIS examined the effects of the regulated article on nontarget organisms, as MIR162 corn is genetically engineered to produce a lepidopteran-specific toxin. Issues related to agricultural or cultivation practices are in the Environmental Assessment for MIR162 corn.

## Potential Impacts of Genetic Modifications on Altered Disease and Pest Susceptibilities

USDA-APHIS assessed whether MIR162 corn is likely to have significantly increased disease and pest susceptibility. This assessment encompasses a thorough consideration of introduced traits and interactions with pests and disease.

Corn (*Zea mays* ssp. *mays*) is not a plant pest in the United States (USDA-APHIS 2000). Furthermore, none of the sequences derived from the plant pests (*Agrobacterium* and CaMV) that were incorporated into MIR 162 corn result in the production of infectious agents or disease symptoms in plants, and so they are unlikely to pose a plant pest risk. The description of the genetic modifications, including genetic elements, expression of the gene product and their functions for MIR162 corn has been summarized above.

Syngenta routinely monitors their corn field trials for the fungal diseases gray leaf spot, northern corn leaf blight, and southern corn leaf blight. The corn insects monitored include corn rootworm, corn flea beetle, grasshopper, stink bug, and other coleopteran beetles (personal communication to Subray Hegde, APHIS, BRS 8/27/09). The data submitted by Syngenta indicated no meaningful differences between MIR162 corn and the non-transgenic counterparts for disease, such as grey leaf spot disease (petition Tables 22 and 23, pp. 65-66, and Supplement to Petition, Tables S-5 and S-6, pp. 7-8), and non-targeted insect pests (field test reports submitted to APHIS/BRS on notifications and permits, Table A.1, pages 127-128 in petition).

The data presented in the petition indicate no difference in compositional and nutritional quality of MIR162 corn compared to conventional corn, apart from the presence of Vip3Aa20 and PMI proteins. Although some of the variables measured by the applicant showed statistically significant differences between MIR162 corn and the non-transgenic hybrid controls (Table 26 on page 72 in petition), none of the values for the forage and grain composition characteristics were outside the range of natural variability of conventional corn reported by the International Life Sciences Institute Crop Composition Database (Ridley et al. 2004; ILSI 2006) or in the OECD consensus document on corn composition (OECD 2003). Therefore, the composition of MIR162 corn is not biologically different than conventional corn (with the exception of the Vip3Aa20 and PMI proteins). Based on the known functions and mechanisms of actions of these proteins (summarized in the petition), neither of these proteins are expected to directly alter susceptibility to plant pathogens. Thus MIR 162 corn is expected to be susceptible to the same plant pathogens as conventional corn.

The Vip3Aa20 protein will decrease the susceptibility of MIR 162 corn to certain targeted insect pests (as noted below under *Potential Impacts on Target and Nontarget Organisms*), which could indirectly affect populations of other insect pests on corn, and likewise plant pathogens that infect corn as a result of feeding damage. As noted in the petition (pg. 13) insects pests of corn play an important role in the transmission and dissemination of pathogenic organisms during maize development. According to the Petitioner, "Ear, kernel, and cob rots occur wherever maize is grown and can result in reduced test weight, poor grain quality, and mycotoxin contamination of food and feed. *Fusarium* kernel or ear rot is the most widespread disease of maize ears and is frequently associated with insect feeding damage." They indicate that although crop losses attributable to *O. nubilalis* and *Diabrotica* infestations have been well characterized and are significant, there is not as much quantitative information available on the economic impacts of other major insect pests of maize, specifically the leaf and ear-feeding insects *H. zea*, *S. frugiperda*, *A. ipsilon*, and *S. albicosta*, which are the primary target pests of Vip3A120 in MIR 162 corn. These pests are not as widespread as some corn pests, but crop infestations by these pests have the potential to significantly lower grain yield and quality. Data in the petition (petition Table 22 and 23, pp. 65-66) showed no significant difference in grain yield between a MIR 162 corn hybrid and a near isogenic control line in two years of field trials in a variety of US maize growing locations (6-10 locations per year) (petition Table 21, pg. 63). These data indirectly support that MIR 162 corn does not have increased susceptibility to insects or pathogens that directly or indirectly affect yield. In a variety of field studies, other insect protected corn expressing Bt proteins have been shown to have significantly lower levels of common mycotoxin that are produced by fungal pathogens (Wu 2006); however, no data were provided on mycotoxin levels in MIR 162 corn.

## Potential Impacts from Outcrossing (Gene Flow) to Sexually-compatible Wild Relatives

Gene flow is a natural biological process with significant evolutionary importance. A number of angiosperm taxa are believed to be derived from hybridization or introgression between closely related taxa (Grant 1981; Soltis and Soltis 1993; Rieseberg 1997; Hegde et al. 2006), and even in the existing floras, the occurrence of hybridization or introgression is reported to be widespread (Knobloch 1972; Stace 1987; Rieseberg and Wendel 1993; Peterson et al. 2002). It has been a common practice by plant breeders to artificially introgress traits from wild relatives into crop plants to develop new cultivars. However, gene flow from crops to wild relatives is also thought of as having a potential to enhance the weediness of wild relatives, as observed in rice, sorghum, sunflower and few other crops (see Table 1 in Ellstrand et al. 1999).

APHIS evaluated the potential for gene introgression to occur from MIR162 corn to sexually compatible wild relatives and considered whether such introgression would result in increased weediness. Cultivated corn, or maize, *Zea mays* L. subsp. *mays*, is sexually compatible with other members of the genus *Zea*, and to a much lesser degree with members of the genus *Tripsacum* (OECD 2003). Wild diploid and tetraploid members of *Zea,* collectively referred to as teosinte, are normally confined to the tropical and subtropical regions of Mexico, Guatemala, and Nicaragua. In the U.S. a fairly rare, sparsely dispersed feral population of teosinte has been reported in Florida (USDA Plant database:
http://plants.usda.gov/java/county?state_name=Florida&statefips=12&symbol=ZEME).

The genus *Tripsacum* contains up to 16 recognized species, most of which are native to Mexico, Central and South America, but three (*T. dactyloides, T. floridatum*, and *T. lanceolatum*) exist as wild and/or cultivated species in the continental U.S (OECD 2003); and two taxa (*T. fasciculatum* and *T. latifolium*) also occur in Puerto Rico (PLANTS Database, accessed 7/13/2009). Though many of these species occur where corn might be cultivated, gene introgression from MIR162 corn under natural conditions is highly unlikely. Hybrids of *Tripsacum* species with *Zea* are difficult to obtain outside of a laboratory and are often sterile or have greatly reduced fertility, and none of them can withstand even the mildest winters. Furthermore, none of the sexually compatible relatives of corn in the U.S. are considered to be weeds in the U.S. (Holm et. al. 1979). Therefore, even in those instances of accidental gene flow between MIR162 corn and wild relatives, the transgenes of MIR162 corn are unlikely to transform corn wild relatives into more weedy species.

Introgression of genes from corn into teosinte or *Tripsacum* species has not been described to occur in nature in the U.S. While some teosinte may be considered weeds in certain instances, they are also used by some farmers for breeding improved maize (Sánchez Gonzàlez and Ruiz Corral 1997 and references therein). Teosinte is described as being susceptible to many of the same pests and diseases that attack cultivated corn (Sánchez Gonzàlez and Ruiz Corral 1997). In the wild, introgressive hybridization from corn to teosinte is currently limited, in part, by several factors including geographic isolation, differing degrees of genetic incompatibility, differences in flowering time in some cases, developmental morphology and timing of the reproductive structures, dissemination, and dormancy (Doebley 1990a and 1990b; Galinat 1988; Ellstrand 2007). First-generation hybrids are generally less fit for survival and dissemination in the wild, and show substantially reduced reproductive capacity, which thus acts as a significant constraint to introgression. Data included in the petition demonstrated that there were no significant differences in viability and morphology of pollen from collected from greenhouse-grown MIR162 hybrid plants and near-isogenic control plants (petition, Table 24 and Figure 20, pp. 67-68.); therefore, the outcrossing rate of MIR 162 corn is not expected to be any different from other corn. Based on the data presented in the petition, MIR162 corn does not exhibit characteristics that cause it to be any weedier than other cultivated corn (see below). Moreover, its potential impact due to the extremely limited potential for gene introgression into teosinte is not expected to be any different than that of other cultivated corn varieties.

Based on the above considerations, MIR162 corn will not adversely impact sexually compatible wild relatives or their weediness characters.

## Potential Impacts Based on the Relative Weediness of MIR162 Corn

In the U.S., corn is not listed as a weed (Crockett 1977; Holm et al. 1979; Muenscher 1980), nor is it present on the Federal noxious weed list (7 CFR part 360; http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist2006.pdf). Furthermore, corn is grown throughout the world without any report that it is a serious weed or that it forms persistent feral populations. Like many domesticated crops, corn seed from a previous year's crop can overwinter and germinate the following year. For instance, the appearance of corn seedlings in soybean fields following a corn crop is a common occurrence. Manual or chemical measures are often applied to remove these volunteers, but the plants that are not removed do not typically result in feral populations in following years. Corn also possesses few of the characteristics of plants that are notably successful weeds (Baker 1965; Keeler 1989).

APHIS assessed whether MIR162 corn is any more likely to become a weed than the isogenic nontransgenic corn line, or other corn varieties currently under cultivation. The assessment encompasses a thorough consideration of the basic biology of corn and an evaluation of the unique characteristics of MIR162 corn evaluated under field conditions. Syngenta conducted agronomic field trials during the 2005 and 2006 growing seasons across 6-10 locations representative of the major corn-growing areas of the upper mid-west U.S. For the majority of the traits assessed, there were no statistically significant differences between MIR162-derived hybrids and their control counterparts. Results of the 2005 agronomic equivalence trials presented in Table 22 of the petition revealed only one statistically significant difference between a control and MIR162 variant - the average number of germinated plants per plot was slightly higher in the MIR162 plots compared to control plots. But the difference was only 3.2%, and is not considered to be of biological significance because the effect was not repeated in the 2006 trials, and there was no effect of genotype observed in the seed germination and dormancy study (see Tables 18 and 19). No other differences in phenotypic characteristics that might contribute to enhanced weediness were observed between MIR162 and control lines for the wide range of phenotypic endpoints assessed in these trials or in greenhouse or laboratory experiments (see petition Table 16, pp. 57-58, for the full list of characteristics evaluated). These characteristics covered seed germination and dormancy, emergence, vegetative and reproductive growth, seed retention, and plant-ecological interactions. Furthermore, the genes inserted into MIR 162 corn do not confer tolerance to herbicides; therefore, there is no change in the ability to control MIR 162 corn as a weed on agricultural land as a result of the insertion of the foreign genes.

Based on the agronomic field data and literature survey about corn weediness potential, MIR162 corn lacks ability to persist as troublesome weed, and there would be no direct impact on current weed management practices for corn cultivation.

## Potential Impacts on Target and Nontarget Organisms, Including Beneficial Organisms

The mechanism by which Vip proteins exert their insecticidal activity has been studied and found to be similar, but not identical, to that which has been previously described for the Cry proteins. For many decades microbial products containing Bt (the organism that produces the Cry1A protein) have been used to control insect pests on a commercial scale and for home garden applications (Glare 2000; Shelton 2002). Plants that were genetically engineered to express the Cry1A protein have a history of safe use in the U.S. Since the mid-1990s, corn and cotton lines have been commercialized without substantiated reports of significant deleterious impacts on non-target organisms (EPA 2008; OECD 2007).

Vip3Aa has activity against several of the major lepidopteran pests of corn, specifically: *A. ipsilon*, *H. zea*, *S. albicosta*, and *S. frugiperda* (Table 27 on pages 74-75 in petition). Syngenta summarized data from field efficacy trials comparing the activity of MIR162 with that of Bt11 corn, hybrids of Bt 11 x MIR162, and conventional insecticide (*Warrior® Insecticide*) treated corn, relative to untreated controls, with regard to feeding damage from these insects (Petition Figure 21 on page 76 in petition). MIR162 alone has no activity against *O. nubilalis* but is efficacious in limiting feeding damage caused by the other four insect pests (mean damage ratings were at most 30% of that of the untreated controls in Petition Figure 21 on page 76 in petition). Whereas Bt11 corn lines (with Cry proteins) are highly efficacious against *O. nubilalis*, they have limited or no activity against the other four insects. According to Syngenta, the combined-trait

Bt11xMIR162 hybrids are very efficacious against all five insects (mean damage ratings were at most about 10% of untreated controls (Figure 21 on pg. 76 in petition).

The Bt Toxin Nomenclature Committee currently lists 25 variants of the Vip3Aa protein. This narrow spectrum of activity for Vip3Aa proteins is a positive attribute from an ecological perspective, as maize hybrids containing a Vip3Aa protein are unlikely to pose a risk to nontarget organisms inhabiting maize ecosystems. Like Cry proteins, Vip3Aa proteins are not expected to adversely affect non-target invertebrates, such as bees, and vertebrate organisms, including birds, mammals and humans, because they do not contain the receptor found in the midgut of target insects. Data provided in the petition (summarized in the Table 31, pg. 89) confirmed that in the bird, mammal, honey bee, above ground arthropod, and soil dwelling invertebrate studies, no observable adverse effects or differences in survival were noted at doses of Vip3A proteins that were well above those expected from exposure to the Vip3Aa20 protein from MIR162 planted in the field. The nontarget above-ground arthropods and soil-dwelling invertebrates studied (lady bird beetles, green lacewings, minute pirate bugs, collembola, earthworms, and rove beetles) were considered to be representative of the corn agro-ecosystem.

Although not an endangered or threatened species, *Danaus plexippus* (monarch butterfly) is a species of high conservation interest, and there has been concern that it may be harmed by consuming pollen from transgenic insect-protected maize. The monarch is susceptible to Cry1Ab (Hellmich et al. 2001), the most common insecticidal protein in transgenic maize. However, the distribution of the monarch's food plant (*Asclepias syriaca* - common milkweed), its pattern of migration, and the timing of maize anthesis means that very few monarchs are exposed to harmful concentrations of Cry1Ab (Sears et al. 2001).

The exposure assessments used to assess the risks of maize containing Cry1Ab to monarchs are also valid for MIR162 maize. In addition, it has been shown that monarchs are not susceptible to Vip3Aa1. Lee et al. (2003) showed that trypsin protease digested Vip3Aa1 did not form pores in the midgut of monarchs; pore formation appears to be essential for toxicity and occurs in the guts of insects susceptible to Vip3Aa1. These investigators also found no mortality of monarch butterfly in a surface diet bioassay limit test at 1000 ng/cm$^2$. MIR162 corn, therefore, poses low risk to monarchs because of minimal hazard of Vip3Aa20 and low exposure to Vip3Aa20-containing pollen. Besides, the restriction of toxicity of Vip3Aa20 to Lepidoptera, and the minimal exposure of endangered Lepidoptera to maize, indicates that Vip3Aa20 in MIR162 maize is expected to have no harmful effects on any endangered or threatened species in the U.S.

## Potential Impacts from Transferring Genetic Information from MIR162 Corn to Organisms with which It cannot Interbreed

APHIS examined the potential for the new genetic material inserted into MIR162 corn to be horizontally transferred to other organisms without sexual reproduction and whether such an event could lead directly or indirectly to disease, damage, injury or harm to plants, including the creation of more virulent pathogens. The horizontal gene transfer between unrelated organisms is one of the most intensively studied fields in the bio-sciences since 1940, and the issue gained extra attention with the release of transgenic plants into the environment (Droge et al. 1998). Potential risks from stable horizontal gene transfer (HGT) from genetically engineered organisms to another organism without reproduction or human intervention was recently reviewed (Keese 2008). Mechanisms of HGT include conjugation, transformation and transduction, and other diverse mechanisms of DNA and RNA uptake and recombination and rearrangement, most notably through viruses and mobile genetic elements. HGT has been a major contributor to the spread of antibiotic resistance amongst pathogenic bacteria and the emergence of increased virulence in bacteria, eukaryotes and viruses and in the long run has contributed to major transitions in evolution.

## Potential for Horizontal Gene Transfer to Bacteria or Fungi

The MIR 162 has two bacteria genes. Horizontal gene transfer and expression of DNA from a plant species to other bacterial species is unlikely to occur based on the following observations. Although there are many opportunities for plants to directly interact with fungi and bacteria (e.g. as commensals, symbionts, parasites, pathogens, decomposers, or in the guts of herbivores), there are almost no evolutionary examples of HGT to bacteria from eukaryotes or from plants to fungi (as reviewed in Keese 2008). The only genes likely to be transferred successfully from genetically engineered plants to bacteria are other bacterial genes. Horizontal transfer from and expression in bacteria of the foreign DNA inserted into the nuclear genome of MIR162 corn is unlikely to occur. First, many genomes (or parts thereof) have been sequenced from bacteria that are closely associated with plants including *Agrobacterium* and *Rhizobium* (Kaneko et al. 2000; Wood et al. 2001; Kaneko et al. 2002). There is no evidence that these organisms contain genes derived from plants. Second, in cases where review of sequence data implied that horizontal gene transfer occurred, these events are inferred to occur on an evolutionary time scale on the order of millions of years (Koonin et al. 2001; Brown 2003). Third, transgene DNA promoters and coding sequences are optimized for plant expression, not prokaryotic bacterial expression. Thus even if horizontal gene transfer occurred, proteins corresponding to the transgenes are not likely to be produced. Fourth, the FDA has evaluated horizontal gene transfer from the use of antibiotic resistance marker genes and concluded that the likelihood of transfer of antibiotic resistance genes from plant genomes to microorganisms in the gastrointestinal tract of humans or animals, or in the environment, is remote (http://vm.cfsan.fda.gov/~dms/opa-armg.html).

## Potential for Horizontal Gene Transfer to Viruses

APHIS also considered whether horizontal transfer of DNA from MIR162 corn to plant viruses was likely to occur and would lead to the creation or selection of a more virulent plant pathogen through recombination with other plant viruses. This issue has been considered before by other science review panels and government regulatory bodies (for a general review of the issue see Keese 2008). The only virus sequence contained within MIR 162 corn is the 35S RNA terminator and this has not been implicated in viral recombination.

Therefore, APHIS concludes that horizontal gene transfer is unlikely to occur and thus poses no significant environmental or plant pest risk. Finally, under natural conditions; no transfer of an intact functional gene has been demonstrated to date (Miki and McHugh 2004). Therefore APHIS concludes that horizontal gene transfer is unlikely to occur and thus poses no significant environmental or plant pest risk.

## Conclusion

APHIS has reviewed and conducted a plant pest risk assessment on MIR162 corn. Due to the lack of plant pest risk from the inserted genetic material, the lack of weediness characteristics of MIR162 corn, the lack of atypical responses to disease or plant pests in the field, the lack of deleterious effects on non-targets or beneficial organisms in the agro-ecosystem, and the lack of horizontal gene transfer, APHIS concludes that MIR162 corn is unlikely to pose a plant pest risk.

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**Determination of Nonregulated Status for MIR 162 Corn**

In response to petition 07-253-01p from Syngenta Biotechnology, Inc., the Animal and Plant Inspection Service (APHIS) of the United States Department of Agriculture (USDA) has determined that event MIR 162 corn and its progeny are unlikely to pose a plant pest risk and are no longer to be considered regulated articles under APHIS' Biotechnology Regulations (7 Code of Federal Regulations (CFR) part 340). APHIS has no authority to continue to regulate a genetically engineered (GE) organism once APHIS reaches a determination that a GE organism regulated under 7 CFR part 340 regulations is unlikely to pose a plant pest risk. APHIS approved permits or acknowledged notifications that were previously required for environmental release, interstate movement, or importation of MIR162 corn and its progeny are no longer required. Importation of MIR162 seeds and other propagative material shall still be subject to APHIS Foreign Quarantine Notices at 7 CFR part 319 and Federal Seed Act Regulations at 7 CFR part 201.

This determination for MIR162 corn is based on APHIS' analyses of field, greenhouse, and laboratory data submitted by Syngenta, of peer-reviewed publications and other relevant information as described in the Plant Pest Risk and Environmental Assessments, and of its response to public comments that indicated that MIR162 corn is unlikely to pose a plant pest risk.

The Plant Pest Risk Assessment conducted on MIR162 corn (http://www.aphis.usda.gov/brs/not_reg.html) concluded that it is no more a plant pest than conventional corn cultivars, it does not pose a plant pest risk and should be granted nonregulated status for the following reasons: (1) MIR162 corn is similar to its conventionally-bred corn parents and other cultivated corn cultivars in its response to disease and insect susceptibility (except for the intended change for lepidopteran insect resistance in MIR162); (2) The introgression of introduced genes from MIR162 corn into sexually-compatible wild relatives in the United States and its territories is extremely unlikely and is not likely to increase the weediness potential of any resulting progeny any more than what would be expected from the introgression between traditional or other specialty corn varieties and wild relatives; (3) MIR162 corn does not exhibit characteristics that would cause it to be weedier or make it a troublesome weed to control than the conventionally-bred parental corn lines or any other corn varieties currently under cultivation; (4) The introduced gene products have not exhibited any deleterious effects on non-target or beneficial organisms in the agro-ecosystem; and (5) Transfer of genetic information to organisms with which it cannot interbreed (horizontal gene transfer) is unlikely to occur.

In addition to our finding that the cultivation of MIR162 corn is unlikely to pose a plant pest risk, APHIS has completed an Environmental Assessment for this action and has determined that granting nonregulated status to MIR162 corn and its progeny would have no significant impact on the quality of the human environment and will have no effect on federally listed threatened or endangered species, species proposed for listing, or their designated or proposed critical habitats (http://www.aphis.usda.gov/brs/not_reg.html).

APHIS also concludes that new varieties derived from MIR162 corn are unlikely to exhibit new plant pest properties that are substantially different from the ones observed for MIR162 corn, or those observed for other corn varieties not considered regulated articles under 7 CFR part 340.

Michael C. Gregoire — April 12, 2010

Michael Gregoire — Date

Deputy Administrator
Biotechnology Regulatory Services
Animal and Plant Health Inspection Service
U.S. Department of Agriculture