BIOPESTICIDES REGISTRATION ACTION DOCUMENT

Bacillus thuringiensis (*Bt*) Plant-Incorporated Protectants

This version of the Biopesticides Registration Action Document for the *Bacillus thuringiensis* (*Bt*) Plant-Incorporated Protectants is dated October 15, 2001. This version corresponds to the version issued on September 29, 2001, with the following changes. The Agency has revised portions of Section I. Overview and Section II. Science Assessment relating to Cry1Ab and Cry1F proteins expressed in corn (*Bt* corn), in light of public comments received as of September 21, 2001. The Agency has also added two new sections entitled: "V. *Bt* Corn Confirmatory Data and Terms and Conditions of Amended Registration" and "VI. Regulatory Position on *Bt* Corn."

U.S. Environmental Protection Agency
Office of Pesticide Programs
Biopesticides and Pollution Prevention Division

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BACILLUS THURINGIENSIS PLANT-INCORPORATED PROTECTANTS REGISTRATION ACTION TEAM

Benefits Assessment
Edward Brandt, M.A.
Robert Torla, Ph.D.
Felicia Wu Morris, M.A., M.S.

Environmental Fate and Effects Risk Assessment
Zigfridas Vaituzis, Ph.D.
Chris Wozniak, Ph.D.
Robyn Rose, M.S.
Gail Tomimatsu, Ph.D.

Health Effects Risk Assessment
John Kough, Ph.D.
Michael T. Watson, Ph.D.

Insect Resistance Management Assessment
Sharlene Matten, Ph.D.
Alan Reynolds, M.S.
Robyn Rose, M.S.

Registration Support
Willie Nelson, M.S.
Mike Mendelsohn

Communications Support
Brian Steinwand
Toby Tiktinski

Biopesticides Registration Action Document Team Leader
Mike Mendelsohn

Office of Pesticide Programs
William Jordan

Office of General Counsel
Keith A. Matthews
Suzanne Krolikowski

I. Overview

This version of the Biopesticides Registration Action Document for the *Bacillus thuringiensis* (*Bt*) Plant-Incorporated Protectants is dated October 15, 2001. This version corresponds to the version issued on September 29, 2001, with the following changes. The Agency has revised portions of Section I. Overview and Section II. Science Assessment relating to Cry1Ab and Cry1F proteins expressed in corn (*Bt* corn), in light of public comments received as of September 21, 2001. The Agency has also added two new sections entitled: "V. *Bt* Corn Confirmatory Data and Terms and Conditions of Amended Registration" and "VI. Regulatory Position on *Bt* Corn."

Syngenta Seeds, Inc. (formerly Novartis Seeds, Inc.) and Mycogen Seeds c/o Dow AgroSciences LLC came to the Agency indicating that as part of their business plans they would be phasing out their Event 176 corn products. Syngenta Seeds and Mycogen Seeds c/o Dow AgroSciences LLC Event 176 Cry1Ab corn registrations expired on April 1, 2001 and on June 30, 2001, respectively. Existing stocks for these products must be used before or during the 2003 growing season. EPA has determined that allowing use of existing stocks for Event 176 *Bt* corn products through the 2003 growing season will not result in unreasonable adverse effects on the environment and the plant-incorporated protectants will be gone from the environment long before resistance would have been predicted to develop. Both former registrants have agreed to comply with any increased IRM requirements that may result from this reassessment for any existing stocks.

Aventis requested voluntary cancellation of their Cry9C StarLink corn registration and this cancellation became effective on February 20, 2001.

The Event 176 and Cry9C products are not being considered for extensions. They will generally not be discussed in this reassessment document.

No regulatory changes are being required for *Bt* potato products.

A. Executive Summary

EPA has completed a comprehensive reassessment of the time-limited registrations for all existing *Bt* corn and cotton plant-incorporated protectants. As part of EPA's reassessment, the Agency has decided to extend the registrations with additional terms and conditions for the *Bt* corn and cotton plant-incorporated protectants including requiring confirmatory data to ensure protection of non-target organisms and lack of accumulation of *Bt* proteins in soils, measures to limit gene flow from *Bt* cotton to wild (or weedy) relatives, and a strengthened IRM program, especially related to compliance. Although the *Bt* potato product does not have an expiring registration, EPA has also included information on this plant-incorporated protectant in Section II. Science Assessment section of the document. This reassessment has been designed to assure that the decisions on the renewal of these registrations are based on the most current health and ecological data.

The *Bt* cotton comprehensive reassessment has been completed and the *Bt* cotton registration is now set to automatically expire on September 30, 2006 except for the external, unsprayed refuge option which will expire September 30, 2004.

The *Bt* corn comprehensive reassessment has been completed and the *Bt* corn registrations are now set to automatically expire on October 15, 2008.

During this reassessment, EPA has conducted an open and transparent public process that incorporated sound and current science, and substantial public involvement.

The complete reassessment document is fashioned after the Agency's traditional Reregistration Eligibility Document (RED). This format was selected to present the data and findings in a format that is familiar to the registrants, the users and the general public. The *Bt* Plant-Incorporated Protectants October 15, 2001 Biopesticides Registration Action Document has nine major sections:

1. Product Characterization
2. Human Health Assessment
3. Ecological Assessment
4. Insect Resistance Management
5. Benefits.
6. *Bt* Cotton Confirmatory Data and Terms and Conditions of the Amendment
7. Regulatory Position on *Bt* Cotton.
8. *Bt* Corn Confirmatory Data and Terms and Conditions of the Amendment
9. Regulatory Position on *Bt* Corn.

1. Product Characterization and Human Health Assessment

This section provides information on the specific transformation systems that were used for each product, the characterization of the DNA insert, the inheritance and stability characteristics of the product line, and the protein characterization and levels of *Bt* protein expression for the various plant tissues. Specific information and data for each of the registrations seeking renewal are included in tabular and descriptive formats.

The health effects assessment confirms EPA's original findings that there are no unreasonable adverse health effects from these products. The human health assessment for the *Bt* plant-incorporated protectants draws heavily on the science and toxicology of proteins. All the currently registered *Bt* plant-incorporated protectants are proteins. The source bacterium has been a registered microbial pesticide which has been approved for use on food crops. The *Bt* proteins approved for use in food are expected to behave as would be expected of a dietary protein. The Bt microbial pesticides have a long history of safe use without adverse health or environmental effects. Several

types of data are required for the *Bt* plant-incorporated protectants in order for the Agency to make the "reasonable certainty of no harm" finding that is required by the Federal Food, Drug, and Cosmetic Act. The data are evaluated in order to determine that (1) the protein behaves as would be expected of a dietary protein breaking down rapidly in digestive fluids; (2) the protein is not structurally related to any known food allergen or protein toxin; and (3) the protein does not display any oral toxicity when administered at high doses. In this section of the assessment, product specific data are addressed for each of the following areas: in vitro digestion assay, heat stability and amino acid sequence homology comparisons, and acute oral toxicity, including mutagenicity and developmental toxicity, subchronic toxicity and chronic exposure and oncogenicity. Product specific information is also addressed for immune system effects, endocrine effects, dose response and dietary risk characterizations. The rationale is presented for why any dietary protein, including the *Bt* proteins, would not be expected to raise concerns for subchronic and chronic effects such as mutagenicity, oncogenicity and developmental toxicity. A discussion of immune system effects, endocrine effects and dietary and non-dietary risk characterization is included for each product as would be found in any assessment for a pesticide chemical's food tolerance determination since implementation of the FQPA amendments to the FFDCA.

This document will also serve as EPA's review of the associated tolerance exemptions (i.e., tolerance exemption reassessments) under 408(q) of the FFDCA. By this reassessment, EPA has completed its tolerance reassessment for Cry1Ab (180.1173) and for Cry3A (180.1147). The tolerance exemptions for Cry1Ac (180.1155) and Cry1F (180.1217) do not require reassessment at this time.

Since the September 2000 version of the risk and benefits assessments and the October 2000 SAP meeting, these sections have been updated by indicating additional data which might be needed. Product characterization data supporting currently registered products is adequate, but would be improved with more information. This information includes: analytical methods and method validation for the currently registered Cry proteins following OPPTS guidelines, heat stability and/or processing data, amino acid sequencing data comparing to known toxins, stepwise 8 amino acid fragment comparisons to known allergens, post-translational modifications (i.e. potential glycosylation sites), and as valid methods become available, more complete analysis of the amino acid sequence expressed in the plant (known as the MALDI-TOF).

a. *Bt* Corn

Tests have shown no toxicity to mammals from the Cry1Ab and Cry1F proteins; the proteins are readily digestible in gastric fluids and are non-glycosylated, the proteins are inactivated by typical food processing, and anticipated exposure of farm workers to the proteins is negligible. The Cry1Ab protein acute oral toxicity data submitted demonstrated no effects at the relatively high dose level of 4,000 mg/kg. The Cry1F protein acute oral toxicity data submitted demonstrated no effects at the relatively high dose level of 5,050 mg/kg. The Cry1Ab and Cry1F proteins were readily degraded in gastric fluid *in vitro*. Exposure via the skin or inhalation is not likely since the Cry1Ab and Cry1F

proteins are contained within corn plant cells which essentially eliminates or reduces exposure routes to negligible. Oral exposure, at very low levels, may occur from ingestion of processed products and drinking water. Worker exposure to the Cry protein via seed dust is also expected to be negligible because of the low amount of protein expressed in seeds of the transformed plants. Taken in total, these data allow the Agency to make a determination that for human health, there is a reasonable certainty that no harm will result from aggregate exposure to the U.S. population, including infants and children, to the Cry1Ab and Cry1F proteins and the genetic material necessary for their production. Thus, EPA concludes that there are no adverse effects on human health from the use of Cry1Ab or Cry1F proteins expressed in corn.

b. *Bt* Cotton

Tests have shown no toxicity to mammals from the Cry1Ac protein; the protein is readily digestible in gastric fluids and are non-glycosylated, the protein is inactivated by typical food processing, and anticipated exposure to the protein from farm workers are negligible. The Cry1Ac protein acute oral toxicity data submitted demonstrated no effects at the relatively high dose level of 5,000 mg/kg. Cry1Ac protein is degraded between two minutes and seven minutes by gastric fluid *in vitro*. Exposure via the skin or inhalation is not likely since the Cry1Ac protein is contained within cotton plant cells which essentially eliminates or reduces exposure routes to negligible. Oral exposure, at very low levels, may occur from ingestion of processed products and drinking water. Worker exposure to the Cry protein via seed dust is also expected to be negligible because of the low amount of protein expressed in seeds of the transformed plants. Taken in total, these data allow the Agency to make a determination that for human health, there is a reasonable certainty that no harm will result from aggregate exposure to the U.S. population, including infants and children, to the Cry1Ac protein and the genetic material necessary for its production. Thus, EPA concludes that there are no adverse effects on human health from the use of Cry1Ac protein expressed in cotton.

2. Ecological Assessment

The ecological assessment section of this document focuses heavily on evaluating the impacts of *Bt* plant-incorporated protectants on non-target species. EPA recognizes that there has been considerable public concern about the potential for these products to have significant and unintended consequences for non-target species such as the monarch butterfly. This assessment relies not only on the original data developed in support of the *Bt* registrations, but additionally, on data developed and submitted to EPA under a Data Call-In (DCI) requirement as well as recently published literature. Specific data is cited for concerns related to gene outcrossing and weediness, fate in soils and potential indirect effects on soil biota, direct effects on non-target species including mammals, avian and aquatic species, insects, lepidoptera, and endangered or threatened species.

Since the September 2000 version of the risk and benefits assessments and the October 2000 SAP meeting, this section has been updated to indicate 1) Collembola and earthworm tests are no longer necessary to evaluate risk to soil non-target organisms from *Bt* crops, 2) additional *Bt* corn avian

data with a higher percentage of *Bt* corn in the diet may be needed for a more thorough assessment of chronic risk, 3) if continuing non-target insect census data was available, long-range risk characterization might be improved, 4) additional Cry protein soil accumulation data is being considered to provide a more complete exposure characterization, 5) *Bt* cotton isolation distances may need revision in Hawaii, Puerto Rico, and the Virgin Islands due to gene flow concerns, and 6) informal consultation with the Fish and Wildlife Service wad initiated regarding the Karner Blue Butterfly.

a. *Bt* Corn

EPA has also reviewed the original data base and the new data, information, and comments regarding ecological effects for *Bt* corn. EPA has reviewed the potential for gene capture and expression of the Cry1Ab/Cry1F endotoxin in corn by wild or weedy relatives of corn in the United States, its possessions or territories. The Agency has determined that there is no significant risk of gene capture and expression of any *B.t.* endotoxin by wild or weedy relatives of corn product registrations in the U.S., its possessions or territories. In addition, the USDA/APHIS has made this same determination under its statutory authority under the Plant Pest Act.

The Agency has concluded that based on the weight of evidence there are no unreasonable adverse effects of Cry1Ab or Cry1F protein expressed in corn to non-target wildlife or beneficial invertebrates. However, EPA is requiring insect census estimates from representative fields to determine if there are long-term adverse impacts from the use of *Bt* corn, field tests of Cry1Ab and Cry1F protein accumulation and/or persistence in soil under a range of conditions typical of *Bt* crop cultivation as confirmatory data, and chronic avian data.

In the Cry1Ab ecological effects testing done, no treatment related effects were observed in Bobwhite quail or catfish fed Cry1Ab corn as part of their diet. No measurable deleterious effects from the Cry1Ab protein on honey bee larvae, honey bee adults, parasitic wasps, Ladybird beetles, green lacewings, Collembola (springtails), and Daphnia were observed in submitted studies.

In the Cry1F ecological effects testing done, no treatment related effects were observed in Bobwhite quail fed Cry1Ab corn as part of their diet. No measurable deleterious effects from the Cry1F protein on honey bees, parasitic wasps, Ladybird beetles, green lacewings, Collembola (springtails), earthworms, Daphnia, and Monarch butterflies were observed in submitted studies.

MON 810 and Bt11 show relatively low toxicity to monarch larvae and the Cry1F protein has no detectable impact on monarch larvae. Overall, the available information indicates a very low probability of risk to monarchs in areas beyond the near edge of corn fields. Inside corn fields and at the near edge of corn fields there is low probability of monarch larvae encountering a toxic level of pollen for the Bt corn products covered by this risk assessment.

Limited data do not indicate that Cry proteins have any measurable effect on microbial populations in the soil. Horizontal transfer from transgenic plants to soil bacteria has not been demonstrated. Cry1Ab protein bioactivity from Cry1Ab corn tissue added to the soil decreased with an estimated DT_{50} (Degradation Time) of 1.6 days and an estimated DT_{90} of 15 days. The bioactivity of purified Cry1Ab protein in soil decreased with an estimated DT_{50} of 8.3 days and a an estimated DT_{90} of 32.5 days. The bioactivity of purified Cry1F protein in soil decreased with an estimated DT_{50} of 3.13 days.

b. *Bt* Cotton

EPA has also reviewed the original data base and the new data, information, and comments regarding ecological effects for *Bt* cotton. EPA has reviewed the potential for gene capture and expression of the Cry1Ac endotoxin in cotton by wild or weedy relatives of cotton in the United States, its possessions or territories. EPA has concluded that there is a possibility for gene transfer in limited geographic locations where wild or feral cotton relatives exist. This transfer is of concern because 1) traits which enhance the survival, invasiveness or adaptability of a plant have the potential to increase the frequency of that trait (allele) in the recipient population and result in a shift in community dynamics (*e.g.*, species abundance, distribution) for multiple species, 2) the native genome of any wild species is effectively altered by the introduction of an adaptive trait (*e.g.*, resistance to insects, diseases, stress) and a net loss in the biodiversity of the recipient species may occur as alleles or even biotypes of the species are lost through this genetic introduction and selection, and 3) wild or feral species which are genetically compatible with crop plants and other non-domesticated plant species, and are recipients of novel traits, may transfer these traits in a reciprocal fashion to these related species in subsequent generations. Therefore, EPA has imposed restrictions on the planting of commercial cotton in southern Florida, Hawaii, Puerto Rico, and the U.S. Virgin Islands. In addition, restrictions to prevent gene flow have been imposed for test plots and breeding nurseries in Hawaii and Puerto Rico although the registrant may provide data which will allow EPA to ease or remove these restrictions in the future.

The Agency has concluded that the weight of evidence indicates no unreasonable adverse effects of Cry1Ac protein expressed in cotton to non-target wildlife or beneficial invertebrates. EPA further believes that cultivation of Cry1Ac cotton may result in fewer adverse impacts to non-target organisms than result from the use of chemical pesticides. However, EPA is requiring insect census estimates from representative fields to determine if there are long-term adverse impacts from the use of *Bt* cotton and field tests of Cry1Ac protein accumulation and/or persistence in soil under a range of conditions typical of *Bt* crop cultivation as confirmatory data.

In the ecological effects testing done, no treatment related effects were observed in Bobwhite quail fed Cry1Ac cottonseed meal as part of their diet. No measurable deleterious effects from the Cry1Ac protein on honey bee larvae, honey bee adults, parasitic wasps, Ladybird beetles, green lacewings and Collembola (springtails) were observed in submitted studies. The larvae of endangered Lepidoptera species in cotton growing counties (Quino Checkerspot butterfly, Saint

Francis' Satyr butterfly and Kern Primrose Sphinx moth) are not going to be exposed to Cry1Ac protein because their habitats do not overlap with cotton fields.

Limited data do not indicate that Cry proteins have any measurable effect on microbial populations in the soil. Horizontal transfer from transgenic plants to soil bacteria has not been demonstrated. Purified microbially produced Cry1Ac protein produced a DT_{50} (Degradation Time) of 9.3-20.2 days. Ground, lyophilized Cry1A(c) cotton line 931tissue produced a DT_{50} of 41 days. Based upon estimates of 60,000 plants per acre, a total of 1.44 grams of Cry protein per acre would enter the soil when the cotton plants are incorporated after harvest.

3. Insect Resistance Management

Available data indicate that after six years of commercialization, no reported insect resistance has occurred to the *Bt* toxins expressed either in *Bt* potato, *Bt* corn, or *Bt* cotton products. The Agency believes that the existing IRM plan for *Bt* potato is adequate to mitigate Colorado potato beetle resistance. The existing IRM plan for *Bt* corn which had been strengthened for the 2000 growing season) was strengthened to further mitigate European corn borer, corn earworm, and southwestern corn borer. The existing IRM plan for *Bt* cotton (already strengthened for the 2001 growing season) was further strengthened to mitigate tobacco budworm, cotton bollworm, and pink bollworm resistance including requiring additional data to more closely examine the effectiveness of the 5% external, unsprayed refuge option.

The issue of insect resistance management has generated more data, meetings, and public comments than all of the other sections covered in this BRAD. Insect resistance management (IRM) is the set of practices aimed at reducing the potential for insect pests to become resistant to a pesticide. *Bt* IRM is of great importance because of the threat insect resistance poses to the future use of *Bt* plant-incorporated protectants and *Bt* technology as a whole. EPA considers protection of insect (pest) susceptibility of *Bt* to be in the "public good." EPA has determined that development of resistant insects would constitute an adverse environmental effect. In order to delay the development of insect resistance to *Bt* corn and cotton plant-incorporated protectants, EPA has mandated specific IRM requirements to strengthen the existing IRM programs as part of the terms and conditions of the registrations.

a. *Bt* Corn

The Agency has determined that the 20% non-*Bt* field corn refuge requirements for *Bt* corn grown in the Corn-Belt and the 50% non-*Bt* corn refuge requirements for *Bt* corn grown in cotton-growing areas are scientifically-sound, protective, feasible, sustainable, and practical to growers. Models have been developed by scientists in academia to predict the estimated time that insect resistance

would develop to compare IRM strategies for *Bt* field corn. For example, if a high dose is achieved to control ECB (as it is for the currently registered *Bt* corn products), then these models predict that ECB will not evolve resistance for at least 99 years if a 20% refuge is implemented in the Corn Belt. Models are also used to predict the evolution of CEW resistance. These models indicate that 50% non-*Bt* field corn refuge in cotton-growing areas is sufficient to delay CEW resistance for at least the time frame of the registrations. A 20% non-*Bt* field corn refuge in the Corn Belt is sufficient to delay CEW resistance because CEW do not overwinter in the Corn Belt. EPA believes that the use of these models provides confidence that resistance will not evolve under the time frame of the registrations.

For *Bt* sweet corn, no specific refuge requirements are necessary because sweet corn is typically harvested much earlier than field corn, 18-21 days after silking, and before most lepidopteran larvae complete development. However, to mitigate the development of resistance, EPA has determined that crop residue destruction is necessary within 30 days. This practice will likely destroy any live larvae left in *Bt* sweet corn stalks and prevent overwintering of any resistant insects.

The IRM program for *Bt* field and sweet corn also require: 1) anyone purchasing *Bt* corn to sign a grower agreement which contractually binds the grower to comply with the IRM program and that there will be a mechanism by the year 2003 by which every grower affirms, annually, their contractual obligations to comply with the IRM program, 2) an IRM education program, 3) an IRM compliance monitoring program including a third party compliance survey and mechanisms to address non-compliance, 4) an insect resistance monitoring program for each target insect pest, 5) remedial action plans to be implemented if resistance does develop, and 6) annual reporting of the IRM (and other) activities. No other pesticide products than the *Bt* crop products have such extensive IRM requirements.

b. *Bt* Cotton

At this time, the Agency believes that available empirical data substantiate the success of the 5% external unsprayed, 20% external sprayed, and 5% embedded structured refuge options to delay resistance. However, EPA believes that it is imprudent to allow the 5% external, unsprayed refuge option for more than a limited period of time because current data indicates that this option has a significantly greater likelihood of insect resistance than either of the other refuge options. The 2000 SAP stated that the external, unsprayed option poses the highest risk to resistance evolution especially for cotton bollworm. Therefore, the external, unsprayed option expires after three growing seasons (September 30, 2004). During the next two years, the registrant is required to develop considerable new data on alternative host plants as possible effective refuges. In addition, the registrant is required to submit protocols by December 1, 2001, to begin field tests on alternative hosts and chemical insecticide sprays on *Bt* cotton, and to provide annual reports each January 31st. If any of these terms and conditions are not met, the external, unsprayed refuge option will be eliminated. If, based upon these, and any other pertinent data, the registrant requests an amendment to the registration extending the expiration date of the external, unsprayed option, EPA will conduct

a comprehensive assessment of whether all relevant data support such regulatory action, as part of a larger requirement that would also likely involve alternative host plants.

In addition, the Agency is mandating additional improvements to the current IRM programs that will require: 1) anyone purchasing *Bt* cotton to sign a grower agreement which contractually binds the grower to comply with the IRM program and that there will be a mechanism by the year 2003 by which every grower affirms their contractual obligations to comply with the IRM program, 2) an ongoing IRM education program, 3) an ongoing IRM compliance monitoring program including a third party compliance survey and mechanisms to address non-compliance, 4) and ongoing insect resistance monitoring program for each target insect pest, 5) remedial action plans to be implemented if resistance does develop, and 6) annual reporting of the IRM (and other) activities. No other pesticide products than the *Bt* crop products have such extensive IRM requirements.

4. Benefits

EPA believes that significant benefits accrue to growers, the public, and the environment from the availability and use of certain *Bt* plant-incorporated protectants. This section outlines how those benefits are defined and evaluated. Specific information on grower cost savings, increased yields, reduced conventional pesticide use, benefits to wildlife, etc. is presented by product. Direct benefits to growers for all *Bt* products is estimated to be less than $350 million in 2000. Major environmental benefits occur through less insecticide use and improved product quality.

a. *Bt* Corn

In addition to assessing the risks from the use of Cry1Ab and Cry1F expressed in corn, EPA has evaluated the benefits from the use of these products. Direct grower benefits include improved yield and profitability, improved crop management effectiveness, reduction in farming risk, and improved opportunity to grow field corn in case of severe pest infestation. Total annual monetary grower benefits from the use of Bt field corn are less than $219 million annually. The magnitude of benefits for any year is largely a function of the level of lepidopteran insect pressure in that year. That is, other things being equal, the higher the insect pressure, the higher the benefits. The major environmental benefit is potential reduction in mycotoxins. EPA believes that use of Bt sweet corn would result in significant reductions in the use of chemical pesticides. However, the current use of Bt sweet corn is very low.

b. *Bt* Cotton

In addition to assessing the risks from the use of Cry1Ac expressed in cotton, EPA has evaluated the benefits from the use of this product. Direct grower benefits include reduced pesticide use, improved crop management effectiveness, reduced production costs, improved yield and profitability, reduction in farming risk, and improved opportunity to grow cotton in areas of severe pest infestation. Total monetary grower benefits from the use of Bt cotton are between $60 million

and $126 million. Indirect benefits may include improved populations of beneficial insects and wildlife in cotton fields, reduced pesticides runoff, reduced air pollution and waste from the use of chemical insecticides, improved farm worker and neighbor safety, and reduction of fossil fuel use. EPA believes that cultivation of Cry1Ac cotton may result in fewer adverse impacts to non-target organisms than result from the use of chemical pesticides.

6. Confirmatory Data and Terms and Conditions of the Amendment

a. Confirmatory Data

i. *Bt* Corn

The following table outlines the confirmatory data that must be provided to EPA as a condition of the amendment to the Cry1Ab and Cry1F corn product registrations including the due dates for the protocols and the data.

Data	Description	Due Date
Residue Analytical Methods	Analytical method including characterization of the antisera and independent laboratory validation required	June 1, 2002
Protein Expression	Expression data provided for initial registration; confirmatory data required to provide consistency across *Bt* crops	March 15, 2003
For *Bt*11: Amino Acid Sequencing	Comparison of AA sequence to known toxins and allergens Stepwise 8 amino acid analysis	March 15, 2003
For MON810: Amino Acid Sequencing and heat stability	Stepwise 8 amino acid analysis and processing and/or heat stability study	March 15, 2003
Cry1Ab Protein Levels in Soil	Supplemental studies; protocol to be submitted before studies are initiated	Protocol by March 15, 2002; interim report 12 months after protocol approved; final report 24 months after protocol approved
Cry1F Protein Levels in Soil	Supplemental studies; protocol to be submitted before studies are initiated	Protocol by March 15, 2002; final report due no later than March 15, 2008

Non-target Insects	Either existing studies or protocol and studies	Existing studies or protocol by March 15, 2002; interim report 12 months after protocol approved; final report 36 months after protocol approved
Monarch Long-Term Exposure for Cry1Ab	Examine fitness and reproductive costs to monarchs from subchronic exposure to *Bt* corn	January 31, 2003 or earlier.
Chronic Avian Study	Test a diet for chronic exposure to high levels of *Bt* corn that may occur in the field	Existing studies or protocol by March 15, 2003; final report 18 months after approval of protocol.
IRM–North/South Movement of Corn Earworm	Potential for north to south movement of corn earworm	Protocol by March 15 2002; interim report 12 months after protocol approved; final report 24 months after protocol approved
IRM–Insecticide Impact on Effectiveness of Refuge	Studies in areas where the refuge is commonly treated with insecticides	Protocol March 15, 2002; interim report in 12 months; final report in 24 months after protocol submitted or approved
IRM–Discriminating Concentration for Cry1F	Development of discriminating concentration for ECB, CEW, SWCB	Studies must be submitted on or before March 15, 2003

ii. *Bt* Cotton

The following table outlines the confirmatory data that must be provided to EPA as a condition of the amendment to the Cry1Ac cotton product registration including the due dates for the protocols and the data.

Data	Description	Due Date

Residue Analytical Methods	Method submitted, but independent laboratory validation required	June 1, 2002
Protein Expression	Expression data provided for initial registration; confirmatory data required to provide consistency across *Bt* crops	March 15, 2003
Amino Acid and DNA Sequence	Stepwise 8 amino acid analysis	March 15, 2003
Cry Protein Levels in Soil	Supplemental studies; protocol to be submitted before studies are initiated	Protocol March 15, 2002; interim report January 31, 2003; final report January 31, 2004
Non-target Insects	Either existing studies or protocol and studies	Existing studies or protocol March 15, 2002; studies due January 31, 2005
IRM–north/south movement of cotton bollworm	Potential for north to south movement of cotton bollworm	January 31, 2004
IRM–Alternate Hosts/Insecticide sprays	Alternate host data as an effective refuge and sprays with chemical insecticides to enhance *Bt* cotton IRM effectiveness	Protocol December 1, 2001; final protocol March 15, 2002; interim report March 15, 2003 and final March 15, 2004

b. Gene Flow Containment Provisions

i. *Bt* Corn

No provisions.

ii. *Bt* Cotton

Until thorough research on the impacts of gene flow can be completed, restriction on where *Bt* cotton can be planted are being implemented. The following terms and conditions must be instituted to mitigate gene flow concerns:

a. No planting of *Bt*-cotton south of Route 60 (near Tampa) in Florida,
b. Commercial culture of *Bt*-cotton is prohibited in the state of Hawaii,
c. Test plots or breeding nurseries established in Hawaii must be surrounded by 24 border rows of a suitable pollinator trap crop regardless of the plot size and must not be planted within 3 miles of *Gossypium tomentosum*,
d. Commercial culture, experimental plots and breeding nurseries of Bt.-cotton are prohibited in the U.S. Virgin Islands, and
e. Commercial culture of Bollgard™ cotton is prohibited in Puerto Rico. Test plots or breeding nurseries established on the island of Puerto Rico must be surrounded by 24 border rows of a suitable pollinator trap crop regardless of the plot size and must not be planted within 3 miles of feral cotton plants.

Upon approval by EPA, test plots and/or breeding nurseries in Hawaii, the U.S. Virgin Islands, and Puerto Rico may be established without restrictions if alternative measures, such as insecticide applications, are shown to effectively mitigate gene flow.

c. Insect Resistance Management (IRM) Program

i. *Bt* Corn

The Agency has determined that the unrestricted use of Cry1Ab and/or Cry1F in corn is likely to lead to the emergence of resistance in one or more of the target insect pests unless measures are used to delay or halt the development of resistant insects. Because some corn pests also attack other crops, not only would the emergence of resistance affect the benefits of *Bt* corn, such insect resistance could also affect the efficacy of *Bt* cotton products and microbial formulations of *Bt*. The loss of *Bt* as an effective pest management tool – in field corn, sweet corn, or other crops – could potentially have serious adverse consequences for the environment to the extent that growers might shift to the use of more toxic pesticides and a valuable tool for organic farmers might be lost. The emergence of resistance in corn pests could also have significant economic consequences for corn growers. Therefore, EPA continues to require the registrants to implement an Insect Resistance Management (IRM) program to mitigate the possibility that pest resistance will occur.

The required IRM program for *Bt* corn has the following elements:

1] Requirements relating to creation of a non-*Bt* corn refuge in conjunction with the planting of any acreage of *Bt* field corn;

2] Requirements for the registrants to prepare and require *Bt* corn users to sign "grower agreements" which impose binding contractual obligations on the grower to comply with the refuge requirements;

3] Requirements for the registrants to develop, implement, and report to EPA on programs to educate growers about IRM requirements;

4] Requirements for the registrants to develop, implement, and report to EPA on programs to evaluate and promote growers' compliance with IRM requirements;

5] Requirements for the registrants to develop, implement, and report to EPA on programs to evaluate whether there are statistically significant and biologically relevant changes in target insect susceptibility to Cry1Ab protein and/or Cry1F in the target insects;

6] Requirements for the registrants to develop, and if triggered, to implement a "remedial action plan" which would contain measures the registrants would take in the event that any insect resistance was detected as well as to report on activity under the plan to EPA;

7] Submit annual reports on sales, IRM grower agreements results, compliance, and educational program on or before January 31st each year.

a. Refuge Requirements

1) Field Corn

a) Corn-Belt Refuge Requirements

For Cry1Ab and Cry1F *Bt* field corn grown outside cotton-growing areas (e.g., the Corn Belt), grower agreements (also known as stewardship agreements) will specify that growers must adhere to the refuge requirements as described in the grower guide/product use guide and/or in supplements to the grower guide/product use guide.

- Specifically, growers must plant a structured refuge of at least 20% non-*Bt* corn that may be treated with insecticides as needed to control lepidopteran stalk-boring and other pests.

- Refuge planting options include: separate fields, blocks within fields (e.g., along the edges or headlands), and strips across the field.

- External refuges must be planted within ½ mile (1/4 mile or closer preferred).

- When planting the refuge in strips across the field, refuges must be at least 4 rows wide, preferably 6 rows wide.

- Insecticide treatments for control of ECB, CEW and Southwestern corn borer (SWCB) [Cry1Ab or Cry1F corn hybrids] and/or fall armyworm (FAW) and black cutworm (BCW) [Cry1F corn hybrids only] may be applied only if economic thresholds are reached for one or

more of these target pests. Economic thresholds will be determined using methods recommended by local or regional professionals (e.g., Extension Service agents, crop consultants). Instructions to growers will specify that microbial *Bt* insecticides must not be applied to non-*Bt* corn refuges.

b) Cotton-Growing Area Refuge Requirements for *Bt* Corn

For Cry 1Ab and Cry1F *Bt* field corn grown in cotton-growing areas, grower agreements (also known as stewardship agreements) will specify that growers must adhere to the refuge requirements as described in the grower guide/product use guide and/or in supplements to the grower guide/product use guide.

- Specifically, growers in these areas must plant a structured refuge of at least 50% non-*Bt* corn that may be treated with insecticides as needed to control lepidopteran stalk-boring and other pests.

- Refuge planting options include: separate fields, blocks within fields (e.g., along the edges or headlands), and strips across the field.

- External refuges must be planted within ½ mile (1/4 mile or closer preferred).

- When planting the refuge in strips across the field, refuges must be at least 4 rows wide, preferably 6 rows wide.

- Insecticide treatments for control of ECB, CEW and Southwestern corn borer (SWCB) [Cry1Ab or Cry1F corn hybrids] and/or fall armyworm (FAW) and black cutworm (BCW) [Cry1F corn hybrids only] may be applied only if economic thresholds are reached for one or more of these target pests. Economic thresholds will be determined using methods recommended by local or regional professionals (e.g., Extension Service agents, crop consultants). Instructions to growers will specify that microbial *Bt* insecticides must not be applied to non-*Bt* corn refuges.

- Cotton-growing areas[1] include the following states: Alabama, Arkansas, Georgia, Florida, Louisiana, North Carolina, Mississippi, South Carolina, Oklahoma (only the counties of Beckham, Caddo, Comanche, Custer, Greer, Harmon, Jackson, Kay, Kiowa, Tillman, Washita), Tennessee (only the counties of Carroll, Chester, Crockett, Dyer, Fayette, Franklin, Gibson, Hardeman, Hardin, Haywood, Lake, Lauderdale, Lincoln, Madison, Obion, Rutherford, Shelby, and Tipton), Texas (except the counties of Carson, Dallam, Hansford, Hartley, Hutchinson, Lipscomb, Moore, Ochiltree, Roberts, and Sherman), Virginia (only the

[1]Counties selected based on approximately 1000 A *Bt* cotton/5000 A total cotton using 1999-2001 cotton acreage reports from Monsanto and USDA/NASS.

counties of Dinwiddie, Franklin City, Greensville, Isle of Wight, Northampton, Southampton, Suffolk City, Surrey, Sussex) and Missouri (only the counties of Dunkin, New Madrid, Pemiscot, Scott, Stoddard). The correct list of counties must be in the 2003 grower guide and may be provided as a supplement for the 2002 growing season.

b. Sweet Corn Post-Harvest Requirements

Sweet corn is harvested long before field corn. Therefore, if the sweet corn stalks remaining in the field and any insects remaining in the stalks are destroyed shortly after harvest, a refuge is not needed as a part of the IRM program for sweet corn. Growers must adhere to the following types of crop destruction requirements as described in the grower guide/product use guide and/or in supplements to the grower guide/product use guide.

- Crop destruction must occur no later than 30 days following harvest, but preferably within 14 days.
- The allowed crops destruction methods are: rotary, mowing, discing, or plow-down. Crop destruction methods should destroy any surviving resistant insects.

ii. *Bt* Cotton

The Agency has determined that the unrestricted use of Cry1Ac as expressed in cotton is likely to lead to the emergence of resistance in one or more of the target insect pests unless measures are used to delay or halt the development of resistant insects. EPA is requiring the registrant to implement an Insect Resistance Management (IRM) program to mitigate the possibility that pest resistance will occur. The required IRM program for *Bt* cotton has the following elements:

1] Requirements relating to creation of a non-*Bt* cotton refuge in conjunction with the planting of any acreage of *Bt* cotton;

2] Requirements for the registrant to prepare and require *B*t cotton users to sign "grower agreements" which impose binding contractual obligations on the grower to comply with the refuge requirements;

3] Requirements for the registrant to develop, implement, and report to EPA on programs to educate growers about IRM requirements;

4] Requirements for the registrant to develop, implement, and report to EPA on programs to evaluate and promote growers' compliance with IRM requirements;

5] Requirements for the registrant to develop, implement, and report to EPA on programs to evaluate whether there are statistically significant and biologically relevant changes in susceptibility to Cry1Ac protein in the target insects;

6] Requirements for the registrant to develop, and if triggered, to implement a "remedial action plan" which would contain measures the registrant would take in the event that any insect resistance was detected as well as to report on activity under the plan to EPA;

7] Submit annual reports on or before January 31st each year.

All growers of *Bt* cotton must employ one of the following structured refuge options:

External, Unsprayed Refuge

Ensure that at least 5 acres of non-*Bt* cotton (refuge cotton) is planted for every 95 acres of *Bt* cotton. The size of the refuge must be at least 150 feet wide, but preferably 300 feet wide. This refuge may not be treated with sterile insects, pheromones, or any insecticide (except listed below) labeled for the control of tobacco budworm, cotton bollworm, or pink bollworm. The refuge may be treated with acephate or methyl parathion at rates which will not control tobacco budworm or the cotton bollworm (equal to or less than 0.5 lbs active ingredient per acre). The variety of cotton planted in the refuge must be comparable to *Bt* cotton, especially in the maturity date, and the refuge must be managed (e.g., planting time, use of fertilizer, weed control, irrigation, termination, and management of other pests) similarly to *Bt* cotton. Ensure that a non-*Bt* cotton refuge is maintained within at least ½ linear mile (preferably adjacent to or within 1/4 mile or closer) from the *Bt* cotton fields. This option expires after the 2004 growing season unless extended by amendment as described below. EPA intends to review the data specified in the data requirements concerning alternate hosts and chemical insecticide sprays applied to *Bt* cotton, and decide in 2004 whether the new data support continuation of an external, unsprayed refuge as part of a larger requirement that would also likely involve alternative host plants. If these data support the continued availability of the external, unsprayed refuge option, EPA may approve an amendment to this registration to maintain the availability of this option.

External Sprayed Refuge

Ensure that at least 20 acres of non-*Bt* cotton are planted as a refuge for every 80 acres of *Bt* cotton (total of 100A) . The variety of cotton planted in the refuge must be comparable to *Bt* cotton, especially in the maturity date, and the refuge must be managed (e.g., planting time, use of fertilizer, weed control, irrigation, termination, and management of other pests) similarly to *Bt* cotton. The non-*Bt* cotton may be treated with sterile insects, insecticides (excluding foliar *Btk* products), or pheromones labeled for control of the tobacco budworm, cotton bollworm, or pink bollworm. Ensure that a non-*Bt* refuge is maintained within at least 1 linear mile (preferably within ½ mile or closer) from the *Bt* cotton fields.

Embedded Refuge

Plant at least 5 acres of non-*Bt* cotton (refuge cotton) for every 95 acres of *Bt* cotton. The refuge cotton must be embedded as a contiguous block within the Bt cotton field, but not at one edge of the field (i.e., refuge block(s) surrounded by *Bt* cotton). For very large fields, multiple blocks across the field may be used. For small or irregularly shaped fields, neighboring fields farmed by the same grower can be grouped into blocks to represent a larger field unit, provided the block exists within one mile squared of the Bt cotton and the block is at least 150 feet wide, but preferably 300 feet wide. Within the larger field unit, one of the smaller fields planted to non-Bt cotton may be utilized as the embedded refuge. The variety of cotton planted in the refuge must be comparable to *Bt* cotton, especially in the maturity date, and the refuge must be managed (e.g., planting time, use of fertilizer, weed control, irrigation, and management of other pests) similarly to *Bt* cotton. This refuge may be treated with sterile insects, any insecticide (excluding foliar *Btk* products), or pheromones labeled for the control of tobacco budworm, cotton bollworm, or pink bollworm whenever the entire field is treated. The refuge may not be treated independently of the surrounding *Bt* cotton field in which it is embedded (or fields within a field unit).

Embedded Refuge for Pink Bollworm Only

Plant the refuge cotton as at least one single non-*Bt* cotton row for every six to ten rows of *Bt* cotton. The refuge may be treated with sterile insects, any insecticide (excluding foliar *Btk* products), or pheromones labeled for the control of pink bollworm whenever the entire field is treated. The in-field refuge rows may not be treated independently of the surrounding *Bt* cotton field in which it is embedded. The refuge must be managed (fertilizer, weed control, etc.) identically to the *Bt* cotton. There is no field unit option.

Optional Community Refuge Pilot

This option allows multiple growers to manage refuge for external, unsprayed and external, sprayed refuge options or both. This option is not allowed for the embedded/in-field options. A community refuge program will be allowed as a continuing pilot for the 2002 growing season. The community refuge for insect resistance management must meet the requirements of either the 5% external unsprayed refuge and/or the 20% sprayed option, or an appropriate combination of the two options. The registrant must implement the 2002 community refuge pilot program as described in the Bollgard® Cotton 2002 Refuge Guide.

7. Regulatory Position on *Bt* Corn

EPA's finding that Cry1Ab or Cry1F protein expressed in corn will not significantly increase the risk of unreasonable adverse effects on the environment is based on the analysis contained in the succeeding sections of this BRAD and the specific terms and conditions that are imposed upon this registration, as set forth in Section V. In general terms, EPA concludes that use of Cry1Ab or Cry1F as expressed in corn is effective at controlling significant lepidopteran pests of corn including European corn borer, corn earworm, and southwestern corn borer. Therefore, these products have

clear benefits for users. Beyond these economic benefits, EPA determines that Cry1Ab and Cry1F corn hybrids, to the extent they are an alternative to the use of other corn insecticides, will provide benefits in that use of Cry1Ab or Cry1F protein expressed in corn results in less human and environmental risk than chemical alternatives. In addition, EPA finds that the use of these products, subject to the specific terms and conditions set forth below, would not pose risks to human health or to non-target species. EPA also concludes that the use of Cry1Ab or Cry1F corn hybrids expressed in corn raises concerns with respect to: insect resistance management. As discussed below, the registrations for Cry1Ab and Cry1F proteins expressed in corn is subject to specific terms and conditions that effectively restrict the use of the product in ways that EPA determines will adequately mitigate these concerns. Therefore, EPA determines that the allowed use will not significantly increase the risk of unreasonable adverse effects on the environment. Finally, EPA has identified the need for certain confirmatory data on potential accumulation of Cry1Ab and Cry1F proteins in soil and field impacts of Cry1Ab and Cry1F proteins on non-target species. The registration of these products is specifically conditioned on submission of these data

8. Regulatory Position on *Bt* Cotton

The *Bt* cotton product was registered for commercial use in October 1995 as a conditional registration under FIFRA Section 3(c)(7)(B). The data reviewed for the initial registration as well as new data and reports received, results of public meeting, hearings, workshops, forums, and Scientific Advisory Panel meetings, and public comments received regarding the *Bt* crops reassessment have been taken into consideration. The scientific assessment has included product characterization, human health effects, gene flow, effects on non-target organisms, ecological exposure, insect resistance management, and benefits. Over the last six years, new data and information have been provided to the Agency in each of these areas and these data have been incorporated into the science assessment and been taken into account in making regulatory decisions.

The Cry1Ac product registration will automatically expire on midnight September 30, 2006 except for the external, unsprayed refuge option which will expire September 30, 2004. EPA intends to review the data specified in the data requirements concerning alternate hosts and chemical insecticide sprays on *Bt* cotton, and decide in 2004 whether the new data support continuation of an external, unsprayed refuge as part of a larger requirement that would also likely involve alternative host plants. If these data support the continued availability of the external, unsprayed refuge option, EPA may approve an amendment to this registration to maintain the availability of this option.

EPA's finding that Cry1Ac protein expressed in cotton will not significantly increase the risk of unreasonable adverse effects on the environment is based on the analysis contained in the preceding sections of this BRAD and the specific terms and conditions that are imposed upon this registration, as set forth in Section III. In general terms, EPA concludes that use of Cry1Ac expressed in cotton is effective at controlling significant lepidopteran pests of cotton, including tobacco budworm, cotton bollworm, and pink bollworm. Therefore, this product has clear benefits for users. Beyond these economic benefits, EPA determines that Cry1Ac provides benefits as an alternative to the use

of other cotton insecticides in that use of Cry1Ac protein expressed in cotton results in less human and environmental risk. In addition, EPA finds that the use of this product, subject to the specific terms and conditions set forth below, would not pose risks to human health or to non-target species. EPA also concludes that the use of Cry1Ac expressed in cotton raises concerns with respect to: 1) the risk of gene flow to feral cotton species; and 2) insect resistance management. As discussed below, the registration for Cry1Ac protein expressed in cotton is subject to specific terms and conditions that effectively restrict the use of the product in ways that EPA determines will adequately mitigate these concerns. Therefore, EPA determines that the allowed use will not significantly increase the risk of unreasonable adverse effects on the environment. Finally, EPA has identified the need for certain confirmatory data on potential accumulation of Cry1Ac protein in soil and field impacts of Cry1Ac protein on non-target species.

B. *Bt* Corn Plant-incorporated protectants

1. Bt11, Cry1Ab *Bt* Corn

OPP Chemical Code: 006444

Pesticide Name: *Bacillus thuringiensis* Cry1Ab Delta-Endotoxin and the Genetic Material Necessary for Its Production (Plasmid Vector pZ01502) in Corn

Trade and Other Names: Bt11, YieldGard®, Attribute™

Uses: Full Commercial Use in Field Corn and Sweet Corn

Registrants:

Syngenta Seeds, Inc. -Field Crops - NAFTA
P.O. Box 12257
Research Triangle Park, NC 27709-2257

Syngenta Seeds, Inc. - Vegetables - NAFTA
600 N. Armstrong Place
Boise, Idaho 83704

2. MON810, Cry1Ab *Bt* Corn

OPP Chemical Code: 006430

Pesticide Name: *Bacillus thuringiensis* Cry1Ab Delta-Endotoxin and the Genetic Material Necessary for Its Production in Corn

Trade and Other Names: MON 810, Yieldgard®

Uses: Full Commercial Use in Field Corn

Registrant: Monsanto Company
700 Chesterfield Parkway North
St. Louis, MO 63198

3. TC1507, Cry1F *Bt* corn

OPP Chemical Code: 006481

Pesticide Name: *Bacillus thuringiensis* subspecies Cry1F Protein and the Genetic Material Necessary for Its Production (Plasmid Insert PHI 8999) in Corn

Trade and Other Names: Herculex™ I Insect Protection, Pioneer Brand Seed Corn with Herculex™ I

Applicants: Mycogen Seeds
c/o Dow Agrosciences LLC
9330 Zionsville Road
Indianapolis, IN 46268-1054

Pioneer Hi-Bred International, Inc.
7250 NW 62nd Avenue
P.O. Box 552
Johnston, Iowa 50131-0552

Uses: Full Commercial Use in Field Corn

C. *Bt* Cotton Plant-incorporated protectants

Cry1Ac *Bt* Cotton

OPP Chemical Code: 006445

Pesticide Name: *Bacillus thuringiensis kurstaki* Delta-Endotoxin as Produced by the Cry1Ac Gene and Its Controlling Sequences as Expressed in Cotton.

Trade and Other Names: BollGard®

Uses: Full Commercial Use in Cotton with Geographic Limitations Due to Weedy Relatives

Target Pest(s): Cotton bollworm, tobacco budworm & pink bollworm

Registrant: Monsanto Company

700 Chesterfield Parkway North
Saint Louis, Missouri 63198

D. *Bt* Potato Plant-incorporated protectants

Cry3A *Bt* Potato

OPP Chemical Code: 006432

Pesticide Name: *Bacillus thuringiensis* Cry3A Delta-Endotoxin and the Genetic Material Necessary for its Production in Potato

Trade and Other Names: NewLeaf®

Uses: Full Commercial Use in Potatoes

Target Pest(s): Colorado Potato Beetle

Registrant: Monsanto Company
700 Chesterfield Parkway North
Saint Louis, Missouri 63198

E. *Bt* Plant-incorporated protectants Use, Registration Approval History, and Tolerance Listings

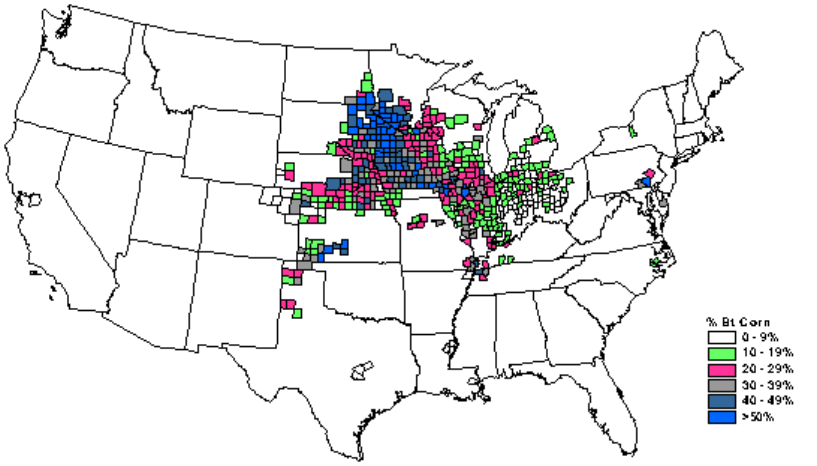
1. Use History

a) *Bt* Corn

EPA estimates adoption of *Bt* field corn was 0.4 million acres (1%) in 1996, 4.4 million acres (6%) in 1997, 14.5 million acres (18%) in 1998, 19.8 million acres (26%) in 1999, and 19.5 million acres (25%) in 2000, the last year for which EPA has firm data.

The following map was provided to the Agency by the Agricultural Biotechnology Stewardship Technical Committee (2000), from data compiled by FSI, Inc.

Figure 1. U.S. Distribution of *Bt* Corn*



* Represents the percentage of total corn acreage planted to Bt corn hybrids in counties in which > 50,000 total acres of corn were planted. (Source: Bt corn industry sales data as compiled by FSI, Inc., 1999)

b) *Bt* Cotton

The Bollgard acreage and percent of cotton acreage planted to Bollgard (provided by Monsanto in its annual sales reports) from 1996-2000 is summarized on a state-by-state level below. The 1996-2001 Beltwide Cotton Insect Loss Reports produced by Mississippi State provide additional detailed use data and are found at http://www.msstate.edu/Entomology/Cotton.html.

Bollgard acreage in each state 1996-2000

State	Bollgard®Acreage				
	1996	1997	1998	1999	2000
Alabama	348,810	251,784	306,535	398,683	314,500
Arizona	53,290	175,537	207,713	197,911	210,245
Arkansas	166,881	113,490	111,818	173,652	294,364
California	618	9,868	29,129	91,705	54,584
Florida	52,836	55,030	53,377	45,249	48,974
Georgia	375,744	533,340	508,842	693,288	580,908

State	Bollgard®Acreage				
	1996	1997	1998	1999	2000
Kansas	-	-	-	-	1,056
Louisiana	157,411	202,080	244,616	382,839	450,076
Mississippi	443,986	410,333	506,149	746,163	800,775
Missouri	498	592	519	6,254	21,415
New Mexico	393	2,693	20,869	12,263	12,242
North Carolina	20,519	21,027	77,490	274,312	424,880
Oklahoma	11,772	7,103	11,459	69,545	90,925
South Carolina	53,864	91,891	71,894	176,149	128,684
Tennessee	10,833	17,431	57,649	390,245	380,453
Texas	98,819	186,654	276,520	458,694	570,410
Virginia	86	37	1,876	6,300	24,857
U.S. Total	**1,796,390**	**2,078,890**	**2,486,493**	**3,585,437**	**4,409,348**

c. *Bt* Potato

Although no specific reporting requirements were required as part of this registration in 1995, EPA recommended the continued development of a data base to monitor the use of the genetically modified potatoes and correlate possible resistant reports with the use sites. Based on three-year averages, about 1 million acres of fall potatoes are planted in the U.S. annually. According to information provided in Monsanto/NatureMark's annual status reports and meetings with the Agency, about 10,000 A (or 1% of the total) in 1996 and 25,000 A (or 2.5% of the total) in 1997 were planted in *Bt* potatoes (marketed as NewLeaf® Russet Burbank and NewLeaf® Superior and NewLeaf® Atlantic varieties) in the U.S.

Acreage information was gathered from 94 of 112 total customers in 1996. The proportion of NewLeaf® potatoes on these farms ranged from 0.1% to 69% of total potato acreage. Farm size ranged from less than 500 to 5000 acres. About 50,000 acres (<4%) of *Bt* potatoes were planted in

1998 and 1999. *Bt* potatoes were marketed as NewLeaf® Russet Burbank, Superior, Atlantic, and Shepody varieties. About 5,000 acres (<0.4%) of NewLeaf® *Bt* potatoes were planted in 2000.

2. Registration and New Use Approval History

Date	*Bt* Crop	Company	EPA Reg. No(s)
March 1995 - Seed Increase May 1995 - Full Commercial (No expiration date)	Cry3A Potatoes	Monsanto	524-474
March 1995 - Seed Increase August 1995 - Full Commercial Note: Registration Expired 4/1/01.	Event 176 Cry1Ab Field Corn	Syngenta	66736-1
March 1995 - Seed Increase August 1995 - Full Commercial Note: Registration Expired 6/30/01.	Event 176 Cry1Ab Field Corn	Mycogen Seeds c/o Dow AgroSciences LLC	68467-1
March 1998 - Full Commercial Note: Registration Expired 4/1/01.	Event 176 Cry1Ab Popcorn	Syngenta	66736-1
May 1995 - Seed Increase October 1995 - Full Commercial September 2001 - Reassessed Full Commercial	Cry1Ac Cotton	Monsanto	524-478
May 1996 - Seed Increase August 1996 - Full Commercial October 2001 - Reassessed Full Commercial	Bt 11 Cry1Ab Field Corn	Syngenta	67979-1
February 1998 - Full Commercial October 2001 - Reassessed Full Commercial	Bt 11 Cry1Ab Sweet Corn	Syngenta	65269-1
May 1996 - Seed Increase December 1996 - Full Commercial October 2001 - Reassessed Full Commercial	MON810 Cry1Ab Corn	Monsanto	524-489
May 1996 - Seed Increase Note: MON 801 Registration Voluntarily Cancelled May 1998	MON 801 Cry1Ab Corn	Monsanto	524-492

March 1997 - Full Commercial Note: Registration Voluntarily Cancelled 12/20/2000.	Cry1Ac Corn	DeKalb/Monsanto	69575-2
May 1998 - Full Commercial for feed use only. Note: Registration Voluntarily Cancelled 2/20/01.	Cry9C Corn	Aventis CropScience USA LP	264-669
May 2001 - Full Commercial October 2001 - Reassessed Full Commercial	Cry1F Corn	Mycogen Seeds c/o Dow AgroSciences LLC	68467-2
May 2001 - Full Commercial October 2001 - Reassessed Full Commercial	Cry1F Corn	Pioneer Hi-Bred International Inc./DuPont	29964-3

3. Food Clearances/Tolerance Exemptions

By this reassessment, EPA has completed its tolerance reassessment for Cry1Ab (180.1173) and for Cry3A (180.1147) under 408(q) of the FFDCA. The tolerance exemptions for Cry1Ac (180.1155) and Cry1F (180.1217) do not require reassessment at this time. The following tolerance exemptions allow the use of the listed plant-incorporated protectants in food and/or feed.

a) *Bacillus thuringiensis* Cry3A delta-endotoxin and the genetic material necessary for its production are exempted from the requirement of a tolerance when used as a plant-incorporated protectant in potatoes. [40 CFR 180.1147; 60 FR 21728, May 3, 1995]

b) *Bacillus thuringiensis* subspecies *kurstaki* Cry1Ac delta-endotoxin and the genetic material necessary for its production in all plants are exempt from the requirement of a tolerance when used as plant-incorporated protectants in all plant raw agricultural commodities.[40 CFR 180.1155; 62 FR 17722, Apr. 11, 1997]

c) *Bacillus thuringiensis* Cry1Ab delta-endotoxin and the genetic material necessary for its production in all plants are exempt from the requirement of a tolerance when used as plant-incorporated protectants in all plant raw agricultural commodities. [40 CFR 180.1173; 61 FR 40343, Aug 2, 1996]

The following tolerance exemption is also considered reassessed because it is included in the more broad tolerance exemption described in (c) above. The Agency plans on revoking this more narrow tolerance exemption in the near future in order to reduce confusion.

Bacillus thuringiensis Cry1Ab delta-endotoxin and the genetic material necessary for its production (plasmid vector pCIB4431) in corn is exempt from the requirement of a tolerance when used as a plant-incorporated protectant in the raw agricultural commodities of field corn, sweet corn, and popcorn. [40 CFR 180.1152; 60 FR 42446, Aug. 16, 1995]

d) *Bacillus thuringiensis* Cry1F protein and the genetic material necessary for its production in corn is exempt from the requirement of a tolerance when used as a plant-incorporated protectant in the food or feed commodities of field corn, sweet corn, and popcorn. [40 CFR 180.1217; 66 FR 30321, June 6, 2001]