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Report Title

2014 Insect Resistance Management (IRM) Compliance Assurance Program Report for Corn Borer-Protected Bt Corn, Corn Rootworm-Protected Bt Corn, Corn Borer/Corn Rootworm-Protected Stacked and Pyramided Bt Corn

Data Requirement

Condition of Registration for:

Corn Borer-Protected Bt Corn (EPA Reg. Nos. 524-489, 29964-3, 67979-1, 67979-12, and 68467-2),
Corn Borer-Protected Pyramided Bt Corn (EPA Reg. No. 524-575, 524-597, 29964-7, 29964-12, 29964-19, 67979-15, and 67979-19),
Corn Rootworm-Protected Bt Corn (EPA Reg. Nos. 524-551, 29964-4, 29964-10, 67979-5, and 68467-5),
Corn Borer/Corn Rootworm-Protected Stacked Bt Corn (EPA Reg. Nos. 524-552, 524-576, 524-606, 29964-5, 29964-6, 29964-9, 29964-13, 67979-8, 67979-13, and 68467-6),
Corn Borer/Corn Rootworm-Protected Pyramided Bt Corn (EPA Reg. Nos. 524-581, 524-595, 29964-8, 29964-11, 29964-14, 29964-16, 67979-17, 67979-20, 67979-23, 67979-24, 67979-25, 67979-26, 68467-7, and 68467-16)

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Statement of No Data Confidentiality Claims

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GLP Compliance Statement

This report does not meet the U.S. EPA Good Laboratory Practice requirements as specified in 40 CFR Part 160, as it is not a study but a report summarizing information compiled from third-party IRM Grower Surveys and third-party IRM On-Farm Assessments by the ABSTC.

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Ownership Statement

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Executive Summary

The 2014 Compliance Assurance Program (CAP) report, compiled by the Agricultural Biotechnology Stewardship Technical Committee (ABSTC), describes industry-coordinated compliance assurance activities for insect resistance management (IRM) associated with Bt traits in corn that provide protection from corn borers and/or corn rootworms, including those products with stacked and pyramided traits[1], that require growers to plant a structured refuge. Methodology changes to the IRM Grower Survey and IRM On-Farm Assessments were implemented in 2011, in accordance with revised registration terms and conditions issued by U.S. EPA. This report includes a summary of the 2014 results under the enhanced CAP for the third-party[2] IRM Grower Survey, third-party IRM On-Farm Assessments, and other ABSTC CAP activities.

As a key tool for monitoring overall grower adherence to the IRM requirements and the effectiveness of IRM educational materials, the IRM Grower Survey is an annual refuge compliance survey of a statistically representative sample of Bt corn growers. This survey has been designed and conducted each year since 2000 by the independent marketing research firm, Market Probe, Inc. (St. Louis, MO), and it now incorporates the broad portfolios of Bt corn products with differing refuge requirements.

With the introduction of integrated refuge products in 2012, growers were provided an additional choice in how they adhere to refuge requirements. In 2014, forty seven percent (47%) of the growers surveyed planted integrated refuge products exclusively, compared to 18% in 2013 (MRID 46306901), and 5% in 2012 (MRID 49048401). It is projected that this rapid adoption of integrated refuge products will continue, thereby contributing to the overall increase in grower adherence to refuge requirements in the Corn Belt and helping to preserve the efficacy of the Bt corn technology.

For all growers surveyed in 2014,

- Growers who fulfilled refuge requirements by planting exclusively integrated refuge products: 47%
- Grower adherence to size requirements for all their corn borer-protected Bt corn fields[3]: 70%
- Grower adherence to size requirements for all their corn rootworm-protected Bt corn fields[4]: 75%
- Grower adherence to distance requirements for all their corn borer-protected Bt corn fields: 70%

[1] The use of a single toxin against a pest in combination with one or more single toxins for other pests is termed a stack. The use of multiple toxins against the same pest is termed a pyramid.
[2] A third party is defined for IRM Grower Survey and On-Farm Assessment purposes as a party other than the registrant, the grower or anyone else with direct interest in IRM compliance for Bt corn.
[3] Corn borer, with or without rootworm
[4] Corn rootworm, with or without corn borer

- Grower adherence to distance requirements for all their corn rootworm-protected Bt corn fields: 68%
- Percentage of growers planting no corn borer refuge acres: 12%
- Percentage of growers planting no corn rootworm refuge acres: 10%

The IRM On-Farm Assessment program is designed to identify potentially non-compliant growers and bring them back into compliance through the Phased Compliance Approach. Unlike the IRM Grower Survey, the IRM On-Farm Assessment is not a statistical tool for measuring the level of adherence with the IRM requirements.

In 2014, a tiered IRM On-Farm Assessment process was used. Each registrant identified growers who, according to its sales records, may have purchased insufficient refuge seed. The majority of IRM On-Farm Assessments were conducted in regions with the greatest risk of resistance. IRM On-Farm Assessments conducted by third parties assessed the grower's compliance with refuge requirements for the registrant's products, and the extent of deviations, if any. Growers who had been found out of compliance in 2013 were contacted with additional educational materials and a follow-up re-assessment in 2014, which resulted in the majority complying with the IRM requirements during the 2014 growing season. The Phased Compliance Approach has again proven to be an effective mechanism to correct the majority of individual instances of non-compliance identified through the IRM On-Farm Assessment program.

The ABSTC continues to enhance education and information to preserve the efficacy of the technology. Some key areas of focus include:

- Registrants have incorporated prominent display of the required refuge size for each seed product on a bag tag or the seed bag;
- Development of advertisements promoting refuge compliance and best management practices such as scouting and crop rotation;
- ABSTC partners with the National Corn Growers Association (NCGA) to ensure that NCGA's membership and networks are fully informed of refuge requirements and the CAP; and
- Registrants continue to engage with Cooperative Extension entomologists and other external educators to share key findings and key messaging.

In summary, activities under the enhanced IRM Compliance Assurance Program continue to promote refuge compliance and preserve Bt corn technology. Industry and grower commitment to Bt corn product stewardship is further demonstrated through the implementation of the enhanced CAP and rapid adoption of integrated refuge products.

Section I. Introduction

This 2014 CAP report describes the results of the industry-coordinated Bt corn IRM compliance assurance activities. These compliance activities are described in the enhanced Bt corn IRM CAP, submitted by the ABSTC to the U.S. EPA on January 31, 2011 (MRID 48375101) in response to the 2010 amended registrations for Bt corn products. Core elements of the Bt corn IRM CAP are an anonymous IRM Grower Survey used to measure adherence to the IRM requirements and an IRM On-Farm Assessment program that is used to identify individual growers who may be out of compliance with refuge requirements and provide education and assistance to those found so that they come into compliance with refuge requirements.

With recent registrations of new Bt corn products, growers now have more options from which to choose and are able to plant multiple products with differing refuge requirements on their farms. In addition, integrated refuge products have been introduced and those products simplify meeting refuge requirements in the Corn Belt. The IRM Grower Survey and IRM On-Farm Assessment tools were updated in 2014 to incorporate all Bt corn products on the U.S. market, including integrated refuge products.

Section II. Third Party IRM Grower Survey

1. Methodology

The 2014 IRM Grower Survey was designed and conducted by the independent third-party organization Market Probe (St. Louis, MO). The objective of the IRM Grower Survey is three-fold: i) determine the level of adherence to the IRM requirements; ii) measure awareness of the IRM requirements; and iii) obtain grower feedback for continuous improvement of educational and compliance programs. As with previous IRM Grower Surveys, the 2014 IRM Grower Survey was designed to incorporate the following features:

- Survey a sample size that allows for reasonable sensitivity in comparing results across regions;
- Focus on the primary corn production areas of the U.S. and on areas with the greatest potential for the development of insect resistance;
- Enable an assessment of the reasons, extent, and biological significance of deviations from the IRM requirements; and
- Minimize the potential for false positives or non-response bias.

In 2014, the IRM Grower Survey included all Bt corn products on the market, including those products with integrated refuge. The survey was conducted based on individual Bt corn products; that is, growers were asked how much of each specific Bt corn product

was planted on their farms. Results then were categorized based on the target pest (i.e., corn borer or corn rootworm) to evaluate the biological relevance of the findings.

Market Probe selected growers from among those who planted (1) either 200 or more acres of corn in the Corn Belt or 100 or more acres of corn in the Cotton Region, and (2) a minimum of 50 acres of Bt corn. In addition, respondents were screened to ensure: i) they were actively involved in farming; ii) they were the individual primarily responsible for decisions concerning seed purchase for their operation; and iii) neither they, nor any family member, work for a farm chemical manufacturer, distributor, or dealer or for a seed company in a position other than a farmer/dealer.

Telephone interviews were conducted to identify a representative sample of growers willing to complete the IRM Grower Survey. Qualified respondents then were directed to the internet, where the IRM questionnaire was available online (available Aug 25 – Nov 23, 2014). Once online, growers were prompted to respond to a series of questions about their Bt corn planting practices and awareness of IRM refuge requirements. This approach allowed the growers time to complete the survey at their own pace, helping to ensure that they understood what was being asked, and allowed time for the growers to verify information by checking their planting records, if necessary, prior to answering the questions. IRM Grower Survey questions were written in such a manner that a grower may not have recognized that it was an IRM-related survey until after a significant amount of data had been collected. IRM Grower Survey data were reviewed and tabulated by Market Probe to determine adherence to refuge requirements.

For all Bt corn products requiring structured refuge, the surveyed growers were asked about the size of refuge planted. To keep the survey from becoming unduly long, refuge distance-related questions were asked for up to five Bt products on a grower's farm. For those growers planting more than five Bt corn products, the survey prioritized the recently introduced products to ensure adequate representation of all products in the data set.

The IRM Grower Survey questionnaire also included a series of questions designed to assess grower awareness of IRM requirements. The ABSTC believes that growers should not attempt to memorize refuge requirements because such a practice undermines the long-standing advice from the U.S. EPA and registrants that growers must read and follow all use directions. IRM information is provided to growers in many locations, including product literature and seed packaging, which will help to provide the refuge information at growers' fingertips during field planning and as they begin to plant. Accordingly, several of the awareness questions focused on the availability of sufficient information to understand refuge requirements at the time of planting. The remaining questions were designed to collect feedback regarding the effectiveness of various IRM education programs and strategies.

The geographic representation desired was 900 growers from the Corn Belt and a minimum of 100 from the Cotton Region. This sample size, together with the survey prioritization strategy, was selected to ensure an adequate representation of all Bt corn products on the market.

To address BPPD's request[5] to provide survey data on a regional basis, Market Probe assessed a statistically representative number of growers in three regions. These regions were defined by the ABSTC and conveyed to BPPD in the minutes of a May 21, 2009 meeting between BPPD and the ABSTC IRM Stewardship Subcommittee.[6] To obtain statistically valid national results, survey results from the three regions were weighted according to the proportion of total U.S. corn acres in each region. The targeted regions are outlined below:

A. Eastern Corn Belt: Illinois, Indiana, Kentucky, Maine, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Tennessee (excluding Cotton Region counties), Virginia (excluding Cotton Region counties), Wisconsin

B. Western Corn Belt: California, Colorado, Idaho, Iowa, Kansas, Minnesota, Missouri (excluding Cotton Region counties), Nebraska, North Dakota, Oregon, Oklahoma (excluding Cotton Region counties), South Dakota, Texas (excluding Cotton Region counties), Wyoming

C. Cotton Region: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri (Cotton Region counties only), North Carolina, Oklahoma (Cotton Region counties only), South Carolina, Tennessee (Cotton Region counties only), Texas (Cotton Region counties only), Virginia (Cotton Region counties only)

2. Results

Of the 2,427 growers selected, 962 completed the online survey. Of those, 862 respondents were from the Corn Belt and 100 from the Cotton Region. All of these growers met the criteria that included size requirements for total corn acres and minimum acres of Bt corn. The number of growers completing the survey met overall targets for each of the identified geographic regions.

a. Grower Adherence with Refuge Size Requirements

As described in Sec. II,1, Methodology, above, the IRM Grower Survey captured data on an individual product basis, allowing Market Probe to determine if a grower had fulfilled the refuge requirements for each product planted on the grower's farm. Forty seven

[5] EPA Review of ABSTC's 2007 and 2008 Corn IRM CAP (April 15, 2009).
[6] Minutes of Meeting between BPPD and the ABSTC IRM Stewardship Subcommittee to Discuss 2007 and 2008 IRM CAP Reports (submitted by Stanley H. Abramson on behalf of the members of the ABSTC IRM Stewardship Subcommittee to Mr. Mike Mendelsohn on August 4, 2009).

percent (47%) of the growers surveyed fulfilled refuge requirements by planting exclusively integrated refuge products, while an additional 27% reported planting at least one integrated refuge product. As shown in Table 1, 89% of growers surveyed reported planting some or all of the required refuge. The majority of growers (69%) reported that they fully met the refuge size requirement for all Bt corn products planted on their farms, while an additional 20% of growers reported that they partially met the refuge size requirement. Overall, 11% of growers responded that they planted Bt corn products on their farm and planted no refuge. Adherence to refuge size requirements by Bt corn growers in the Cotton Region was consistently lower than adherence by Bt corn growers in the two Corn Belt regions.

Table 1. Grower adherence with the refuge size requirement by region

% of Growers Surveyed Who:	All Regions Combined (n=962)[1]	Eastern Corn Belt (n = 282)[1]	Western Corn Belt (n=580)[1]	Cotton Region (n=100)[1]
Met refuge size requirement	69%	71%	71%	51%
Partially met refuge size requirement	20%	22%	19%	19%
Planted no refuge acres	11%	7%	10%	30%

[1]The margin of error for the results for refuge size is: 3.2% (All regions); 5.8% (East), 4.1% (West), 9.8% (Cotton).

The survey data, separated into corn borer refuge size and corn rootworm refuge size, are presented in Table 2. These results show the percentage of growers who planted: i) the correct refuge size for all of their corn borer-protected Bt corn (that might or might not have been stacked with corn rootworm traits) and, ii) the correct refuge size for all of their corn rootworm-protected Bt corn (that might or might not have been stacked with corn borer traits). As with overall refuge size, adherence to refuge size requirements by trait type (corn borer or rootworm) was greater for the Corn Belt than for the Cotton Region. For corn borer-protected Bt corn, 70% of growers reported that they planted all of the required refuge acres, while an additional 18% reported planting at least some refuge. For corn rootworm-protected Bt corn, 75% of growers reported that they planted all required refuge acres, and an additional 15% reported partially meeting the required refuge acres.

Table 2. Grower adherence with the refuge size requirement by region and target pest

Percentage of Growers Surveyed Who:	All Regions Combined (n=947)[1]	Eastern Corn Belt (n=281)[1]	Western Corn Belt (n=577)[1]	Cotton Region (n=89)[1]
Corn borer refuge[1]				
Met refuge size requirement	70%	73%	71%	45%
Partially met refuge size requirement	18%	19%	18%	18%
Planted no refuge acres	12%	8%	11%	37%
Percentage of Growers Surveyed Who:	All Regions Combined (n=883)[2]	Eastern Corn Belt (n=266)[2]	Western Corn Belt (n=535)[2]	Cotton Region (n=82)[2]
Corn rootworm refuge[2]				
Met refuge size requirement	75%	76%	78%	59%
Partially met refuge size requirement	15%	18%	13%	19%
Planted no refuge acres	10%	6%	9%	22%

[1] Corn borer, with or without rootworm. The margin of error for the results for the corn borer refuge size is: 3.2% (All regions); 5.8% (East), 4.1% (West), 10.4% (Cotton).
[2] Corn rootworm, with or without corn borer. The margin of error for the results for the corn rootworm refuge size is: 3.3% (All regions); 6.0% (East), 4.2% (West), 10.8% (Cotton).

b. Grower Adherence with Refuge Distance Requirements

As described in Sec. II,1, Methodology, above, all growers were required to provide information regarding distance of the planted refuges for up to five Bt corn products requiring a structured refuge. For determining adherence to distance requirements on a whole farm basis, data for the growers who planted five or fewer non-integrated Bt products were included. As presented in Table 3, 939 growers surveyed planted five or fewer Bt corn products on their farm. Sixty four percent (64%) of these growers reported that they met the refuge distance requirements for all of the Bt corn products on their farm. Overall, grower adherence with refuge distance requirements was higher in the Corn Belt than the Cotton Region and higher for corn borer refuge (that can be planted up to ½ mile away from corn borer-protected Bt corn) than for the corn rootworm refuge (that must be planted within or adjacent to rootworm-protected Bt corn).

Table 3. Grower adherence with the refuge distance requirement by region and target pest

	All Regions	Eastern Corn Belt	Western Corn Belt	Cotton Region
	All products on farm[2]			
Growers[1] adhering to distance requirement for all fields:	64% (n=939)	66% (n=280)	68% (n=562)	39% (n=97)
	Corn borer-protected Bt corn[3]			
	70% (n=926)	71% (n=279)	72% (n=560)	53% (n=87)
	Corn rootworm-protected Bt corn[4]			
	68% (n=864)	70% (n=264)	72% (n=521)	37% (n=79)

[1]Only growers who planted no more than five non-integrated Bt products and/or any integrated Bt products with corn borer were queried on both size and distance compliance.
[2]The margin of error for the results for refuge distance is: 3.2% (all regions); 5.9% (East), 4.1% (West), 10.0% (Cotton).
[3]Corn borer, with or without rootworm. The margin of error for the results for the corn borer refuge distance is: 3.2% (All regions); 5.9% (East), 4.1% (West), 10.5% (Cotton).
[4]Corn rootworm, with or without corn borer. The margin of error for the results for the corn rootworm refuge distance is: 3.3% (All regions); 6.0% (East), 4.3% (West), 11.0% (Cotton).

While the survey results above represent refuge adherence across entire farms, analyzing the refuge distance requirement data on a field basis rather than a grower basis presents a more appropriate measure of the target pest resistance risk. Table 4 below presents the percentage of fields meeting the refuge distance requirement for both corn borer-protected Bt corn (½ mile refuge distance requirement) and corn rootworm-protected Bt corn (within or adjacent refuge distance requirement) on a field basis. The field-by-field analysis provides higher resolution of refuge practices on the farm. For example, a grower who has three fields, two of which meet the refuge requirements and one of which does not, is counted as not adhering to refuge requirements on a whole farm basis (Table 3). The field-by-field analysis shown in Table 4 represents a more biologically relevant measure of refuge distance adherence than the whole farm analysis because the whole farm analysis does not account for all fields that meet the distance requirements. As shown in Table 4, overall 82% of the corn borer-protected Bt cornfields had refuge planted meeting the distance requirement (within ½ mile) and 81% of the corn rootworm-protected Bt cornfields had refuge within or adjacent to the field.

Table 4: Fields meeting refuge distance requirement for each region and target pest

Adherence with distance requirement for individual Bt corn fields	All Regions	Eastern Corn Belt	Western Corn Belt	Cotton Region
Corn borer-protected Bt corn[1]	82% (n=8,963)	85% (n=4,142)	82% (n=4,214)	58% (n=607)
Corn rootworm-protected Bt corn[2]	81% (n=7,966)	83% (n=3,825)	82% (n=3,564)	61% (n=577)

[1]Corn borer, with or without rootworm. The margin of error for the results for the corn borer refuge distance is: 1.0% (All regions); 1.5% (East), 1.5% (West), 4.0% (Cotton).
[2] Corn rootworm, with or without corn borer. The margin of error for the results for the corn rootworm refuge distance is: 1.1% (All regions); 1.6% (East), 1.6% (West), 4.1% (Cotton).

c. Grower Awareness of IRM Requirements and IRM Education

Almost all growers surveyed (97%) indicated they were aware of refuge requirements for managing insect resistance. There was a small difference between the Corn Belt (98%) and the Cotton Region (90%), but the overall awareness of refuge requirements was high for all regions. Ninety-five percent (95%) of growers stated that insect resistance management plans for Bt corn are somewhat or very important, and this number was similar for the Corn Belt (96%) and the Cotton Region (90%).

The percentage of growers acknowledging that they had enough IRM information at planting was 98% in the Corn Belt and 85% in the Cotton Region. When IRM awareness options were presented, the majority of growers (71%) said that the seed dealer was the most-used source of information for refuge requirements. Seed company representatives and product use guides were also widely consulted at 44% and 40%, respectively. Growers indicated that they are receiving multiple sources of IRM information with 73% citing face-to-face meetings, 76% citing information on seed bag or tag, and 62% citing direct mailing, such as postcards from seed companies. Fifty one (51%) percent of growers surveyed also cited agricultural news and articles as source of refuge reminders.

d. Discussion

The IRM Grower Survey has shown that growers consider IRM and the use of refuges to be important practices when growing Bt corn. Nearly all growers reported multiple sources of IRM information and that they had sufficient information at the time of planting about refuge requirements, with 76% citing awareness of the refuge requirements on the seed bag or tag at time of planting. The high percentage of growers who cited the bag tag as a source of IRM information in the survey supports the usefulness of this refuge reminder.

With the introduction of integrated refuge products in 2012, growers were provided an additional choice in how they adhere to refuge requirements. In 2014, forty seven

percent (47%) of the growers surveyed planted integrated refuge products exclusively, compared to 18% in 2013 (MRID 46306901), and 5% in 2012 (MRID 49048401). It is projected that this rapid adoption of integrated refuge products will continue, thereby contributing to the overall increase in grower adherence to refuge requirements in the Corn Belt and helping to preserve the efficacy of the Bt corn technology. Growers recognize the value of the integrated refuge products to effectively meet refuge requirements, and are making a good faith effort to fulfill their refuge requirements.

The percentage of growers planting no corn borer refuge acres was 12%. The percentage of growers planting no corn rootworm refuge acres was 10%. Accordingly, as in previous years, the survey continues to indicate that there are some growers who do not adhere to refuge requirements for all their Bt corn fields, and some growers fail to plant any refuge. Inadvertent errors, logistical issues, weather conditions, and risk of yield and economic loss were often cited by growers as factors contributing to non-adherence with the refuge requirements.

In the Cotton Region, adherence to refuge requirements continued to be lower than in the Corn Belt. Factors that could be contributing to lower adherence in that region include the larger required refuge size, smaller field sizes, more diverse cropping systems, and greater complexity of operations.

Section III. Third-Party IRM On-Farm Assessments

1. Methodology

The objective of the IRM On-Farm Assessment program is to identify individual growers who are out of compliance with refuge requirements and provide education and assistance to those found so that they are better able to follow refuge requirements. Unlike the IRM Grower Survey, the IRM On-Farm Assessment program is not a statistical tool for measuring the level of adherence with the IRM requirements. Throughout the IRM On-Farm Assessment process, identifying details of the assessed growers are kept confidential by the registrant contracting the assessment.

All Bt corn products that require a structured refuge, regardless of the refuge size requirement, were included in the 2014 IRM On-Farm Assessment program. Each registrant used a similar IRM assessment form with company-specific sections customized to suit the needs of each registrant. The actual grower assessment questions were consistent across registrants.

The IRM On-Farm Assessment program in 2014 comprised the following elements:

- Contract with independent third parties to perform on-farm assessments of adherence with refuge requirements;

- Focus the majority of the on-farm assessments in regions where the risk of resistance is greatest; and
- Use available Bt corn sales records and other information to refine grower lists for on-farm assessments.

Third-party contractors were trained on objectives and mechanics of the data collection process prior to initiating the 2014 IRM On-Farm Assessment process. As in previous years, the training was conducted through a variety of mechanisms (e.g., face-to-face meetings and an on-line training module) and included the key elements of the IRM On-Farm Assessment program (e.g., steps to complete the assessment form, messages to growers, and follow-up actions).

The selection pressure for resistance and the consequences of resistance are expected to be greatest in regions where adoption of Bt corn technology is greatest and where key target insect pest pressure is greatest. Compliance with refuge requirements is therefore most critical in these regions. In 2014, approximately two-thirds of the growers scheduled for an assessment were selected from areas where pest resistance risk is highest (based on high Bt corn penetration and target pest pressure). The remaining growers were selected in areas where the registrants' Bt corn products are sold, including the Cotton Region. Geographically focusing the assessments in areas of highest pest resistance risk helps the registrants identify and correct incidents of non-compliance most critical to product durability.

In accordance with the enhanced CAP, a tiered IRM On-Farm Assessment process was used. Per the Bt product registration terms, designed to increase the probability of identifying growers not compliant with refuge requirements, each member company independently reviewed available sales data for all its Bt corn customers and identified individual growers who, according to these purchase records, may have purchased insufficient refuge seed. Each registrant shared this information on a confidential basis with independent third parties conducting the on-farm assessments. The third parties conducted on-farm assessments to gather planting information that registrants use to determine whether individual growers were in compliance with refuge requirements and the extent of any deviations. Growers selected included a range of farm sizes. Based on assessment results, a compliance assistance program will be implemented for each grower found to be non-compliant to increase that grower's adherence to refuge requirements. Repeated significant non-compliance with refuge requirements will result in a grower being denied access to the registrant's Bt corn products that require a structured refuge.

All on-farm assessments involved face-to-face discussion with growers about their plantings of Bt corn and refuge corn in 2014. Growers were encouraged to refer to invoices, planting records, and field maps to ensure accurate responses. Assessed

growers were asked to provide the number of acres planted with the registrant's Bt corn products and the number of refuge acres associated with those products. For each Bt corn field, assessed growers were asked about the proximity of refuge acres. Assessment forms were then reviewed for grower adherence with refuge requirements, and whether any non-compliance met the definition of significant non-compliance for the Bt corn product.

Registrants are addressing compliance deviations identified in 2014 according to the common set of standards outlined in the Phased Compliance Approach as identified in the 2011 enhanced CAP (MRID 48375101). Examples of materials used as part of this follow-up process (e.g., educational materials, warning letters, and the compliance assistance contact form) have been provided to the U.S. EPA in previously submitted annual CAP reports.

2. Results

a. Results of First Time IRM On-Farm Assessments in 2014

In 2014, all Bt corn products that required a structured refuge, regardless of their refuge size requirement, were included in the IRM On-Farm Assessment process for all trait registrants. First-time on-farm assessments were conducted for 1153 growers in 2014. A total of 349 growers were identified as non-compliant with at least one refuge requirement, of which 259 growers had a deviation that met the definition of significant. Registrants are addressing these deviations with each grower.

b. Results of IRM On-Farm Re-assessments of Growers Found to be Out of Compliance in 2013

In accordance with the Phased Compliance Approach, 372 growers who were found out of compliance in 2013 were re-assessed in 2014. Of the 224 growers who met the definition of significant non-compliance in 2013, nine of these growers also were significantly non-compliant in 2014. In accordance with EPA requirements, those nine growers have been denied access to the registrant's Bt corn products requiring a separate structured refuge for the 2015 planting season.

c. Discussion

As with previous years, some key refuge implementation challenges were identified by growers during the IRM On-Farm Assessment process. Some growers who planted a combination of products with differing refuge requirements appeared to miscalculate the total required refuge size. These findings continue to highlight the need to promote the refuge education program throughout the seed delivery channel, and registrants are continuing to focus their education efforts to address such calculation errors by promoting the use of the NCGA IRM Calculator (www.irmcalculator.com). Other

primary reasons for non-compliance provided by growers in 2014 were similar to those provided in previous years:

- Weather-related issues (e.g., rain prevented the grower from planting planned refuge)
- Dealer-related issues (e.g., refuge seed not delivered, preferred non-Bt hybrids not available)
- Inadvertent grower errors (e.g., planting errors)
- Logistical issues (e.g., small Bt corn field size and significant spacing between Bt corn fields made meeting refuge requirements for all fields a challenge)
- General awareness (e.g., grower misunderstood/unaware of refuge requirements)

As a result of the compliance assistance education given to non-compliant growers identified in 2013, the majority of growers re-assessed in 2014 were found to be planting an appropriate refuge. In accordance with the criteria for grower license revocation, nine growers will be denied access to the registrant's Bt corn products requiring a separate structured refuge for the 2015 planting season. The Phased Compliance Approach has again proven to be an effective mechanism to correct the majority of individual instances of non-compliance with IRM requirements identified through the IRM On-Farm Assessment program.

Section IV. Tips and Complaints

The registrants have mechanisms (e.g., toll-free customer service numbers) to receive information regarding alleged instances of non-compliance with the IRM requirements. The availability of these mechanisms continues to be communicated to growers, seed dealers, and sales representatives as part of the IRM education programs. In 2014, the registrants collectively received zero (0) tips and complaints regarding compliance with refuge requirements.

Processes are in place to manage legitimate tips and complaints (as defined in Section 5.a of the enhanced CAP) in accordance with the CAP requirements.

Section V. Publicizing the Compliance Assurance Program

The registrants have widely publicized the CAP - including the Phased Compliance Approach, which is common to all Bt corn registrations - to ensure growers are aware of the IRM On-Farm Assessment program and the consequences for non-compliance, including revocation of access to Bt technologies. The key elements of the CAP and Phased Compliance Approach are well integrated into each registrant's IRM education program, including company literature, internal training sessions, and meetings with growers and dealers. In addition, key stakeholder groups such as NCGA are educated by

the ABSTC members and continue to inform their members of the CAP. Grower awareness is strengthened by consistency of the CAP for all Bt traits in corn that provide protection from corn borers and/or corn rootworms, (including those products with pyramided traits).

Section VI. Conclusions

In accordance with the enhanced CAP implemented in 2011, this report includes a summary of the 2014 compliance assurance activities, including the IRM Grower Survey, IRM On-Farm Assessments, and other CAP activities under the enhanced program.

The IRM Grower Survey was revised and expanded again this year, to incorporate the broad portfolios of Bt corn products with differing refuge requirements. A statistically representative sample of growers was surveyed in 2014. The results from the survey for grower adherence to refuge requirements for corn borer and corn rootworm products are similar. A regional analysis of the IRM Grower Survey results presented no clear differences in adherence to the refuge requirements between growers in the eastern and western Corn Belt; however, the growers in the Cotton Region showed lower levels of adherence. In addition, growers in the Cotton Region more frequently failed to plant any refuge. On a field basis, the survey found that 82% of corn borer-protected Bt corn fields and 81% of corn rootworm-protected Bt corn fields were associated with a refuge within the required distance.

The IRM On-Farm Assessment program was designed to identify individual growers who are out of compliance with refuge requirements and provide education and assistance to those found so that they are better able to follow refuge requirements. Unlike the IRM Grower Survey, the IRM On-Farm Assessment program is not a statistical tool for measuring the level of adherence with the IRM requirements.

Each member company independently reviewed available sales data for all of their Bt corn customers. As required by terms and conditions of Bt product registrations, IRM On-Farm Assessments for 2014 were conducted with growers who, according to these sales records, may have purchased insufficient refuge seed. The use of a tiered grower selection process identified non-compliant growers. In accordance with the CAP's Phased Compliance Approach, all growers who were found out of compliance in 2013 were contacted with additional educational materials and a follow-up re-assessment in 2014, which resulted in the majority complying with the requirements during the 2014 growing season. Although there were instances in which a grower was found to be repeatedly and significantly non-compliant, and therefore denied access to the registrant's Bt corn products that require a separate structured refuge, the Phased Compliance Approach has again proven to be an effective mechanism to correct the vast majority of individual instances of non-compliance identified through the IRM On-Farm

Assessment program and to address those few instances where an appropriate level of compliance was not achieved.

These findings continue to highlight the need to emphasize the refuge education program throughout the seed delivery channel, including calculating the total refuge needed on the farm. Growers have recognized the consistent inclusion of refuge size requirements on seed packaging as a reminder of refuge requirements, especially at the time of planting. The increased advertising and agricultural articles discussing insect resistance management have also been recognized by growers as important sources of information.

As in previous years, the IRM Grower Survey indicated that adherence with refuge requirements in the Cotton Region was lower than in the Corn Belt. Factors contributing to lower adherence in this region include the larger required refuge size, smaller field sizes, more diverse cropping systems, and greater complexity of operations. Education programs continue to highlight the specific refuge requirements in this region, and the On-Farm Assessment program included key parts of this region, providing the opportunity to correct individual instances of non-compliance for future growing seasons. It is important to note that the Cotton Region represents less than 10% of the U.S. corn acres (NASS 2013).

In summary, activities under the enhanced Compliance Assurance Program continue to promote refuge compliance and help preserve the Bt corn technology. Industry and grower commitment to Bt corn product stewardship is further demonstrated through the implementation of the enhanced CAP and rapid adoption of integrated refuge products in the Corn Belt. With the introduction of integrated refuge products, growers have an additional choice in adhering to refuge requirements. The ABSTC projects that the adoption of integrated refuge products will continue to increase, thereby contributing to the overall increase in adherence to refuge requirements and helping to preserve the Bt corn technology.

References:

ABSTC. 2014. 2013 ABSTC Resistance Management Compliance Assurance Program (CAP) Report. MRID No. 46306901.

ABSTC. 2013. 2012 ABSTC Resistance Management Compliance Assurance Program (CAP) Report. MRID No. 49048401.

ABSTC. 2011. Enhanced Insect Resistance Management Compliance Assurance Program for Corn Borer-Protected Bt Corn, Corn Rootworm-Protected Bt Corn, and Corn Borer/Corn Rootworm Protected Stacked Bt Corn. MRID No. 48375101. 20 p.

NASS, 2013:
http://quickstats.nass.usda.gov/results/2439FECF-DB94-37DF-A6C8-0DA9262F2DAB

Appendix

Bt Corn Registrant Product Information

Product Name	*Event name*	*Registration Number*	*Active Ingredient*
Monsanto YieldGard® Corn Borer[1]	MON 810	524-489	Cry1Ab
Pioneer Herculex® I[2]	DAS-01507-1	29964-3	Cry1F
Dow AgroSciences Herculex® I	TC1507	68467-2	Cry1F
Syngenta Agrisure® GT/CB/LL[3]	Bt11	67979-1	Cry1Ab
Syngenta Agrisure Viptera® 3110	Bt11 × MIR162	67979-12	Cry1Ab + Vip3Aa20
Pioneer Optimum® Intrasect®	DAS-01507-1 × MON-00810-6	29964-7	Cry1F + Cry1Ab
Pioneer Optimum® AcreMax®	Seed blend of DAS-01507-1 × MON-00810-6 and 5% non-Bt seed	29964-12	Cry1F + Cry1Ab
Pioneer Optimum® Leptra	DAS-01507-1 × MON-00810-6 x MIR162	29964-19	Cry1F + Cry1Ab + Vip3Aa20
Monsanto Genuity® VT Double PRO®	MON 89034	524-575	Cry1A.105 + Cry2Ab2
Monsanto Genuity® VT Double PRO® RIB Complete®	Seed blend of MON 89034 and 5% non-Bt seed	524-597	Cry1A.105 + Cry2Ab2
Syngenta Agrisure Viptera® 3220 Refuge Renew™	Bt11×MIR162×TC1507	67979-15	Cry1Ab + Vip3Aa20 + Cry1F
Syngenta Agrisure Viptera® 3220 EZ Refuge™	Seed blend of Bt11×MIR162×TC1507 and 5% non-Bt seed	67979-19	Cry1Ab + Vip3Aa20 + Cry1F
Monsanto YieldGard VT Rootworm/RR2®	MON 88017	524-551	Cry3Bb1
Pioneer Herculex® RW[7]	DAS-59122-7	29964-4	Cry34Ab1/Cry35Ab1
Pioneer Optimum® AcreMax® RW	Seed blend of DAS-59122-7 and 10% non-Bt seed	29964-10	Cry34Ab1/Cry35Ab1
Syngenta Agrisure® RW	MIR604	67979-5	mCry3A
Dow AgroSciences Herculex® RW[4,7]	DAS-59122-7	68467-5	Cry34Ab1/Cry35Ab1
Monsanto YieldGard VT Triple®	MON 88017 × MON 810	524-552	Cry3Bb1 + Cry1Ab
Monsanto Genuity® VT Triple PRO®	MON 89034 × MON 88017	524-576	Cry1A.105 + Cry2Ab2 + Cry3Bb1
Monsanto Genuity® VT Triple PRO® RIB Complete®	Seed blend of MON 89034 × MON 88017 × and 10% non-Bt seed	524-606	Cry1A.105 + Cry2Ab2 + Cry3Bb1
Pioneer Herculex® Xtra	DAS-01507-1 × DAS-59122-7	29964-5	Cry34Ab1/Cry35Ab1 + Cry1F
Pioneer Optimum® AcreMax®1[5]	Seed blend of DAS-01507-1 × DAS-59122-7 and 10% DAS-01507-1 seed	29964-6	Cry1F + Cry34Ab1/Cry35Ab1
59122xMON810	DAS-59122-7 × MON-00810-6	29964-9	Cry34Ab1/Cry35Ab1 + Cry1Ab

[1] YieldGard®, Roundup Ready®, YieldGard VT Rootworm/RR2®, YieldGard VT Triple®, Genuity®, VT Double PRO®, VT Triple PRO®, SmartStax® and RIB Complete® are registered trademarks of Monsanto Technology, LLC.
[2] Herculex *Insect Protection* technology by Dow AgroSciences and Pioneer Hi-Bred International.
[3] Agrisure®, Agrisure® RW, Agrisure® CB/LL, and Agrisure® CB/LL/RW, Agrisure Artesian™, EZ Refuge™ and Refuge Renew™ are registered trademarks of Syngenta Seeds, LLC.
[4] Herculex® and Refuge Advanced® are registered trademarks of The Dow Chemical Company ("Dow") or an affiliated company of Dow.
[5] Optimum®, Intrasect®, TRIsect® and AcreMax® are registered trademarks of Pioneer Hi-Bred International, Inc.
[6] SmartStax® multi-event technology developed by Dow AgroSciences and Monsanto.
[7] Not included in grower survey due to no product sales.

Pioneer Optimum® TRIsect®	DAS-01507-1 × SYN-IR604-5	29964-13	Cry1F + mCry3A
Syngenta Agrisure® 3000GT Syngenta Agrisure® CB/LL/RW, Agrisure Artesian™ 4011	Bt11 × MIR 604	67979-8	Cry1Ab + mCry3A
Syngenta Agrisure Viptera® 3111	Bt11 × MIR162 × MIR604	67979-13	Cry1Ab + Vip3Aa20 + mCry3A
Dow AgroSciences Herculex® Xtra	DAS-59122-7 × TC1507	68467-6	Cry34Ab1/Cry35Ab1 + Cry1F
Monsanto Genuity® SmartStax®[6]	MON 89034 × TC1507 × MON 88017 × DAS-59122-7	524-581	Cry1A.105 + Cry2Ab2 + Cry1F + Cry3Bb1 + Cry34Ab1/Cry35Ab1
Monsanto Genuity® SmartStax® RIB Complete®	Seed blend of MON 89034 × TC1507 × MON 88017 × DAS-59122-7and 5% non-Bt seed	524-595	Cry1A.105 + Cry2Ab2 + Cry1F + Cry3Bb1 + Cry34Ab1/Cry35Ab1
Pioneer Optimum® Intrasect® Xtra	DAS-01507-1 × DAS-59122-7 × MON-00810-6	29964-8	Cry1F + Cry34Ab1/Cry35Ab1 + Cry1Ab
Pioneer Optimum® AcreMax® Xtra	Seed blend of DAS-01507-1 × DAS-59122-7 × MON-00810-6 and 10% non-Bt seed	29964-11	Cry1F + Cry34Ab1/Cry35Ab1 + Cry1Ab
Pioneer Optimum® Intrasect XTreme	DAS-01507-1 × DAS-59122-7 × MON-00810-6 x SYN-IR604	29964-14	Cry1F + Cry34Ab1/Cry35Ab1 + Cry1Ab + MIR604
Pioneer Optimum® AcreMax® XTreme	Seed blend of DAS-59122-7 × SYN-IR604 × MON-00810-6 × DAS-01507-1 × and 5% non-Bt seed	29964-16	Cry1F + Cry34Ab1/Cry35Ab1 + MIR604 + Cry1Ab
Syngenta Agrisure® 3122 Refuge Renew™	Bt11 × DAS-59122-7 × MIR604 × TC1507	67979-17	Cry1Ab + Cry34Ab1/Cry35Ab1 + mCry3A + Cry1F
Syngenta Agrisure® 3122 EZ Refuge™	Seed blend of Bt11 × DAS-59122-7 × MIR604 × TC1507 and 5% non-Bt seed	67979-20	Cry1Ab + Cry34Ab1/Cry35Ab1 + mCry3A + Cry1F
Syngenta Agrisure® 5222 Refuge Renew™	Bt11 × MIR162 × MIR604 × 5307	67979-23	Cry1Ab + Vip3Aa20 + Cry1F + mCry3A + eCry3.1Ab
Syngenta Agrisure® 5122 Refuge Renew™	Bt11 × TC1507 × MIR604 × 5307	67979-24	Cry1Ab + Cry1F + mCry3A + eCry3.1Ab
Syngenta Agrisure® 5122 EZ Refuge™	Seed blend of Bt11 × TC1507 × MIR604 × 5307 and 5% non-Bt seed	67979-25	Cry1Ab + Cry1F + mCry3A + eCry3.1Ab
Syngenta Agrisure® 5222 EZ Refuge™	Seed blend of Bt11 × MIR162 × MIR604 × 5307 and 5% non-Bt seed	67979-26	Cry1Ab + Vip3Aa20 + Cry1F + mCry3A + eCry3.1Ab
Dow AgroSciences SmartStax®	MON 89034 × TC1507 × MON 88017 × DAS-59122-7	68467-7	Cry1A.105 + Cry2Ab2 + Cry1F + Cry3Bb1 + Cry34Ab1/Cry35Ab1
Dow AgroSciences Refuge Advanced® powered by SmartStax®	Seed blend of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and 5% non-Bt seed	68467-16	Cry1A.105 + Cry2Ab2 + Cry1F + Cry3Bb1 + Cry34Ab1/Cry35Ab1