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# Evaluation of a Blended Refuge for Corn Rootworm

## **Abstract**

The purpose of this study was to evaluate the effectiveness of the blended refuge concept against corn rootworms. The treatments evaluated include a pure stand of Herculex XTRA (HXX), a pure stand of Roundup Ready 2 (RR2), a pure stand of RR2 with Force 3G applied overtop, and two treatments with the refuge in a bag concept—one with 95 percent HXX and a 5 percent RR2 blended refuge and the other with 90 percent HXX and a 10 percent RR2 blended refuge.

## **Keywords**

RFR A11143, Plant Pathology and Microbiology, Entomology

## **Disciplines**

Agriculture | Entomology

## Evaluation of a Blended Refuge for Corn Rootworm

### RFR-A11143

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#### Introduction

The purpose of this study was to evaluate the effectiveness of the blended refuge concept against corn rootworms. The treatments evaluated include a pure stand of Herculex XTRA (HXX), a pure stand of Roundup Ready 2 (RR2), a pure stand of RR2 with Force 3G applied overtop, and two treatments with the refuge in a bag concept—one with 95 percent HXX and a 5 percent RR2 blended refuge and the other with 90 percent HXX and a 10 percent RR2 blended refuge.

#### Materials and Methods

The corn was planted in an area that had been planted the previous year with “trap crop.” The seed planted for the trap crop was a mixed-maturity blend with a greater proportion of late-maturing varieties. This trap crop constitutes a favorable environment for adult female rootworm late in the season when other fields are maturing and results in a high abundance of rootworm larvae the following year. The experimental design for this study was a randomized complete block design with four replications. Treatments were four rows wide, and 30 ft in length. This study was planted on May 10, 2010 at a population of 35,600 seeds/acre. Seeds were pre-bagged and planted with a four row John Deere Max Emerge™ 7100 integral planter that had 30-in. row spacing. Force 3G granular insecticide was applied to one treatment with modified Noble® metering units mounted on the planter. The Noble units were calibrated in the laboratory to accurately deliver material at a tractor speed of 4 mph. Plastic tubes directed the granular treatments to a 7-in. band ahead

of the closing wheels (T-band, All-Terrain Banders).

Stand counts of plants were taken in 25-ft sections of each plot and were recorded early in the growing season. After the majority of corn rootworms had finished feeding (July 27), 30 roots were dug from each treatment. Roots were dug out of rows 1 and 4 only. Lodging counts were taken at harvest time along with final stand counts. The middle two rows of the four row treatments were machine harvested. Weights were converted to bushels/acre of No. 2 shelled corn (56 lbs/bushel) at 15.5 percent moisture.

#### Results and Discussion

Roundup Ready 2, either alone or with Force, tended to have lower stand counts than HXX and HXX with a blended refuge of RR2 (Table 1). Root injury was lowest and percent product consistency greatest for RR2 with Force 3G. Both HXX alone, the blended refuge showed similar, and intermediate, root injury and product consistency. Product consistency was lowest and injury highest for RR2 in a pure stand (Table 2). RR2 alone in a pure stand had significantly higher lodging than the other treatments (Table 3). No significant differences in yield were detected among treatments (Table 4).

#### Acknowledgements

We thank Pioneer for providing the funding and seed for this study.

#### Additional Information

The 2010 Field Evaluation of Insecticide and Plant-Incorporated Protectants is available online at [www.ent.iastate.edu](http://www.ent.iastate.edu).

**Table 1. Average stand count for evaluation of plant-incorporated protectants: Pioneer blended refuge study for corn rootworm: Ames, IA, 2010.<sup>1</sup>**

Hybrid/treatment <sup>2,3,4,5</sup>	Stand Count <sup>6</sup>
HXX (Pure stand)	44.50a
Blend (95% HXX blended refuge; 5% RR2)	44.25a
Blend (90% HXX; 10% RR2 blended refuge)	43.00ab
RR2 + Force 3G - 0.12/T-band	40.75 b
RR2 (Pure stand)	33.25 c

<sup>1</sup>Planted May 10, 2010; evaluated June 2 and 3, 2010.

<sup>2</sup>HXX = Herculex XTRA hybrid (Pioneer P0461XR); RR2 = Roundup Ready 2 hybrid (Pioneer P0461R).

<sup>3</sup>HXX = Herculex® XTRA technology. Herculex® Insect Protection technology by Dow AgroSciences and Pioneer Hi-Bred. ®Herculex and the HX logo are registered trademarks of Dow AgroSciences LLC.

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RR2 = Roundup Ready® Corn 2 gene. ® Roundup Ready is a registered trademark used under license from Monsanto Company.

Force® 3G is a registered trademark of a Syngenta Group Company.

<sup>4</sup>Means based on 16 observations (4 row trt × 25 row-ft/treatment × 4 replications).

<sup>5</sup>Insecticide listed as ounces a.i. per 1,000 row-ft; T-band = insecticide applied at planting time.

<sup>6</sup>Means sharing a common letter do not differ significantly according to Ryan's Q Test ( $P \leq 0.05$ ).

**Table 2. Average root-injury and percent product consistency for evaluation of insecticides treatments and plant-incorporated protectants. Pioneer blended refuge study for corn rootworm: Ames, IA, 2010.<sup>1</sup>**

Hybrid/treatment <sup>2,3,4,5</sup>	Node-injury <sup>6,7</sup>	Product consistency <sup>8,9</sup>
RR2 + Force 3G - 0.12/T-band	0.08a	90a
RR2 from Blend <sup>10</sup>	0.43 b	33 b
HXX from Blend <sup>11</sup>	0.46 b	42 b
HXX (Pure stand)	0.46 b	57ab
RR2 (Pure stand)	1.07 c	20 b

<sup>1</sup>Planted May 10, 2010; node injury evaluated July 27, 2010.

<sup>2</sup>HXX = Herculex XTRA hybrid (Pioneer P0461XR); RR2 = Roundup Ready 2 hybrid (Pioneer P0461R).

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<sup>4</sup>Chemical and check means based on 30 observations (5 roots/2 rows × 2 replications and 10 roots/2rows × 2 replications).

<sup>5</sup>Insecticide listed as ounces a.i. per 1,000 row-ft; T-band = insecticide applied at planting time.

<sup>6</sup>Iowa State Node-Injury scale (0-3). Number of full or partial nodes completely eaten.

<sup>7</sup>Means sharing a common letter do not differ significantly according to Ryan's Q Test ( $P \leq 0.05$ ).

<sup>8</sup>Product consistency = percentage of times nodal injury was 0.25 (¼ node eaten) or less.

<sup>9</sup>Means sharing a common letter do not differ significantly according to Ryan's Q Test ( $P \leq 0.05$ ).

<sup>10</sup>For RR2 from blend treatment of 95% HXX and 5% RR2.

<sup>11</sup>For HXX from blend treatment of 95% HXX and 5% RR2.

**Table 3. Average lodging for evaluation of plant-incorporated protectants. Pioneer blended refuge study for corn rootworm: Ames, IA, 2010.<sup>1</sup>**

Hybrid/treatment <sup>2,3,4</sup>	Lodging <sup>5,6</sup> %
Blend (95% HXX; 5% RR2 blended refuge)	0a
HXX (Pure stand)	2a
RR2 + Force 3G - 0.12/T-band	3ab
Blend (90% HXX; 10% RR2 blended refuge)	3ab
RR2 (Pure stand)	13 b

<sup>1</sup>Planted May 10, 2010; evaluated October 1, 2010.

<sup>2</sup>HXX = Herculex XTRA hybrid (Pioneer P0461XR); RR2 = Roundup Ready 2 hybrid (Pioneer P0461R).

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<sup>4</sup>Insecticide listed as ounces a.i. per 1,000 row-ft; T-band = insecticide applied at planting time.

<sup>5</sup>Means based on 16 observations (4-rows × 25 row-ft/treatment × 4 reps).

<sup>6</sup>No significant differences between means (ANOVA,  $P \leq 0.05$ ).

**Table 4. Average yield for evaluation plant-incorporated protectants. Pioneer blended refuge study for corn rootworm: Ames, IA, 2010<sup>1</sup>**

Hybrid/Treatment <sup>2,3,4,5</sup>	Yield <sup>6,7</sup>
HXX (Pure stand)	135
RR2 + Force 3G - 0.12/T-band	133
RR2 (Pure stand)	131
Blend (90% HXX; 10% RR2 blended refuge)	122
Blend (95% HXX; 5% RR2 blended refuge)	116

<sup>1</sup>Planted May 10, 2010; machine harvested October 13, 2010.

<sup>2</sup>HXX = Herculex XTRA hybrid (Pioneer P0461XR); RR2 = Roundup Ready 2 hybrid (Pioneer P0461R).

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<sup>4</sup>Means based on 4 observations (2-rows × 25 row-ft/treatment × 4 reps).

<sup>5</sup>Insecticide listed as ounces a.i. per 1,000 row-ft; T-band = insecticide applied at planting time.

<sup>6</sup>No significant differences between means (ANOVA,  $P \leq 0.05$ ).

<sup>7</sup>Yields converted to 15.5% moisture.