

Herculex I - Protection Against Black Cutworm, Fall Armyworm and Corn Borer

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Summary

- Pioneer and universities have conducted replicated trials to evaluate the performance of the Herculex^a I *Insect Protection* trait against black cutworm, fall armyworm and corn borer.
- In small-plot barrier studies, the Herculex I trait offered very good protection from cutting by black cutworm. Control was equivalent to soil insecticides at planting and significantly better than that of YieldGard^b hybrids, which do not claim black cutworm control.
- Under high black cutworm pressure, a low level of cutting may still occur. Additional research in field-sized plots with natural infestations of black cutworm will help to further define the level of Herculex I protection.
- Pioneer brand hybrids with the Herculex I trait provided excellent protection against fall armyworm, European corn borer and southwestern corn borer larval feeding.
- This Crop Insights presents results of Pioneer and university testing of Herculex I efficacy against black cutworm, fall armyworm and corn borer.
- A future Crop Insights will further explore corn borer protection and yield benefits of the Herculex I trait under varying corn borer levels.

Background

Herculex I insect protection is the first in a new generation of Bt traits for corn. This technology helps growers maximize their return on each acre by protecting corn plants against a broad spectrum of insects, including corn borer, black cutworm and fall armyworm. The Herculex I trait received full U.S. EPA, USDA, and FDA regulatory approval in June of 2001, and full Japanese regulatory approval in June of 2002. Canadian registration is pending and expected in 2002. Both Dow AgroSciences and Pioneer are aggressively pursuing additional regulatory approvals around the world.

Herculex I insect protection offers excellent efficacy against European and southwestern corn borer and fall armyworm,

and very good protection against cutting by black cutworm larvae. This Crop Insights will present university and Pioneer small-plot efficacy data for Herculex I technology against black cutworm, fall armyworm and corn borer.

Agronomy Sciences Black Cutworm Trials



Conventional corn plant cut by black cutworm larva.

Small plot replicated trials were conducted by Pioneer Agronomy Sciences researchers in 2001 and 2002 at five locations: Mankato, MN; York, NE; Johnston, IA; Princeton, IL; and Windfall, IN. Treatments were replicated four times at each location in a completely random design. In all trials, a plot consisted of 5 corn plants

bordered by a 14-gauge steel rectangular barrier 42 inches long by 12 inches wide by 9 inches deep. The metal barrier was inserted into the soil to a depth of approximately 3 inches. When corn plants reached the V1 to V2 stage of development, three third-instar black cutworm larvae per plant (15 per barrier) were placed inside the metal enclosures.

At various days after infestation (DAI) with the black cutworm larvae, the number of plants cut at or below the soil surface was recorded. Dead-hearted plants were counted as cut plants. Results of these barrier trials are shown below.

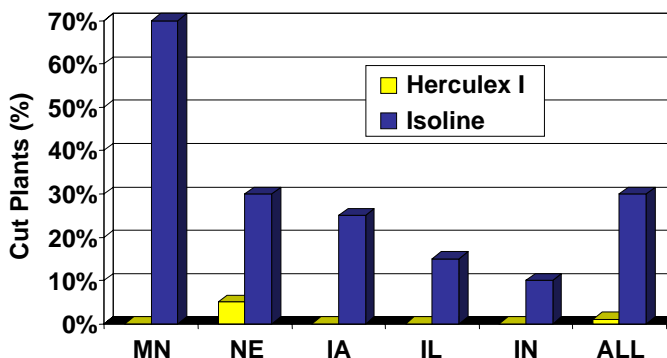


Figure 1. Percent cut plants in Herculex I and base genetics barrier trial plots for five locations in 2001. Pioneer Agronomy Sciences Research.



“Deadheart” symptoms due to black cutworm feeding in conventional corn plant.

At the Mankato, MN location in 2001, 70 percent of the base genetic plants were cut while no Herculex I plants were cut. The Johnston, IA, Princeton, IL, and Tipton, IN locations also had no plants cut in the Herculex I plots 14 DAI, while the base genetics had 25%, 15% and 10% cut plants, respectively. Although the level of cut plants for the untreated check was relatively low in these locations compared to Mankato, the level was still well above what would be considered an economic threshold.

2002 plot results are shown by location below:

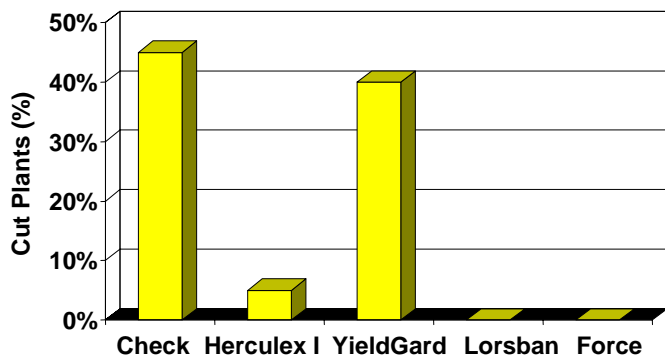


Figure 2. Percent plants cut by black cutworm for various treatments in barrier trials at Princeton, IL, 2002. Pioneer Agronomy Sciences Research.

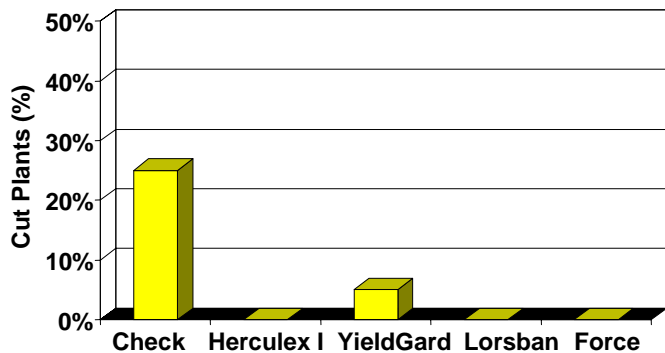


Figure 3. Percent plants cut by black cutworm for various treatments in barrier trials at Windfall, IN, 2002. Pioneer Agronomy Sciences Research.

At the Princeton location, 45 percent of the plants were cut in the untreated check, and 40% in the Yieldgard plots, but only 5 percent of the plants were cut in the Herculex I plots. At the Windfall location, 25 percent of the plants were cut in

the untreated check, with no cut plants in Herculex I plots. The Herculex I trait provided protection from black cutworm damage equivalent to planting-time granular insecticides at these two trial locations. At the three additional Agronomy Sciences locations in 2002, the percent cut plants in the untreated check plots was too low to make meaningful treatment comparisons.

University Black Cutworm Trials

Several university researchers also evaluated Herculex I insect protection for efficacy against black cutworm in 2001 and 2002. Trials were conducted at Purdue University, University of Illinois, University of Missouri, University of Kentucky, and Iowa State University. Data from these trials were averaged across locations and years and are presented in Figure 4. The means in this figure represent a combined 10 location-year trials, for a total of 40 replications of data. All are artificially infested barrier trials.

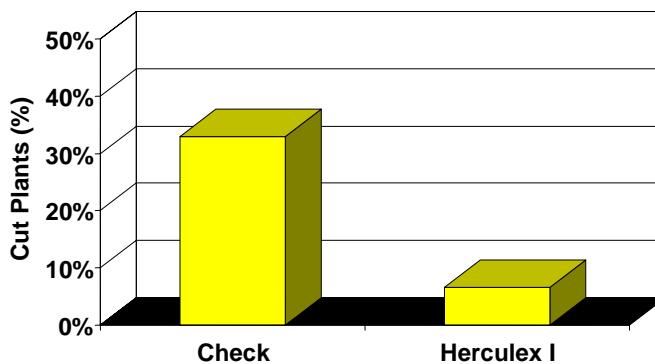


Figure 4. Percent cut plants in Herculex I and base genetics barrier trial plots for ten University locations, 2001-2002.

Percent cutting across these 40 reps of university data is significantly reduced in Herculex I plots compared to untreated check plots. Under heavy black cutworm pressure, however, some cutting in Herculex I hybrids may still occur.

Overall, the Herculex I trait showed a significant reduction



Corn plants wilting due to cutting by black cutworm.

in percent cut plants in all barrier trial studies and will be assigned a 7 on the Pioneer 1-9 scale. However, under high black cutworm pressure, a low level of cutting may still occur. Pioneer is currently sponsoring a research project to define the economic threshold for black cutworm cutting in Herculex I corn systems. Pioneer will continue to collect data from larger field-sized plots under natural black cutworm infestations to further characterize the level of protection of Herculex I hybrids against black cutworm.

Fall Armyworm Efficacy



Fall armyworm feeding damage to conventional corn plant.

Percent of whorls infested by fall armyworm was recorded for Herculex I and base genetics plots (Figure 5).

Herculex I technology offers excellent control against feeding by fall armyworm larvae. University researchers at Auburn University, University of Georgia, and North Carolina State University conducted fall armyworm efficacy trials in 2001. In these trials, plots were planted late to encourage natural infestation by fall armyworm, but plots were also manually infested with fall armyworm egg masses. Plots were evaluated at 7 and 14 days after manual infestation.

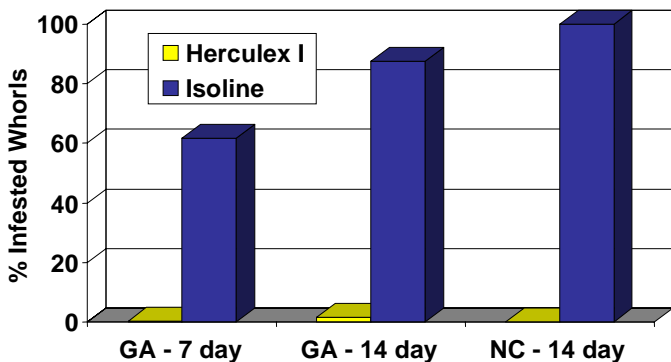
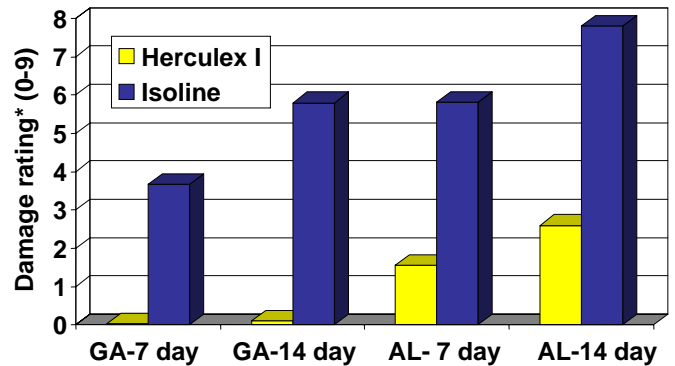


Figure 5. Percent of whorls infested with fall armyworm in plots of Herculex I hybrids compared to base genetics at two university locations, 2001. Data recorded 7 and 14 days after manual infestation with fall armyworm egg masses.

In addition, plots were evaluated on a 0-9 scale for leaf feeding damage 7 and 14 days after manual infestation at two of the locations (Figure 6).



*Davis Rating scale: 0 = no damage, 9 = whorl & furl leaves almost totally destroyed

Figure 6. Fall armyworm leaf damage ratings in plots of Herculex I hybrids compared to base genetics at two university locations, 2001. Data recorded 7 and 14 days after manual infestation with fall armyworm egg masses.



Fall armyworm larva feeding on leaf of conventional corn.

Herculex I hybrids offer excellent protection from fall armyworm feeding and will be assigned an 8 on the Pioneer 1-9 scale.

European and Southwestern Corn Borer

Both Pioneer and university data have consistently demonstrated that Herculex I technology provides excellent protection from tunneling by European corn borer and southwestern corn borer (Figures 7 and 8). Herculex I hybrids will be assigned a 9 on the Pioneer 1-9 scale for both European corn borer and southwestern corn borer efficacy. A future Crop Insights will further explore yield benefits of Herculex I hybrids under varying levels of corn borer infestation.

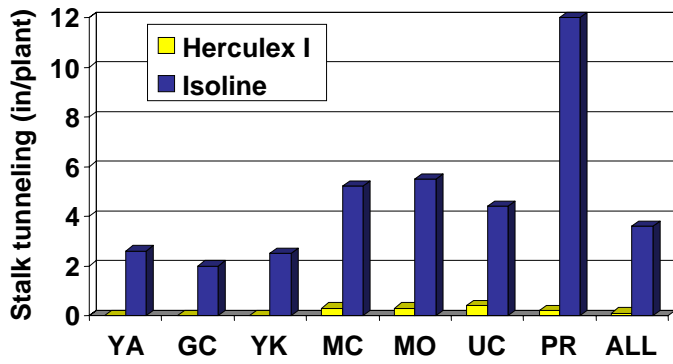


Figure 7. Stalk tunneling from European corn borer in Herculex I plots compared to untreated base genetics. 7 locations, 2001. Pioneer Agronomy Sciences Research

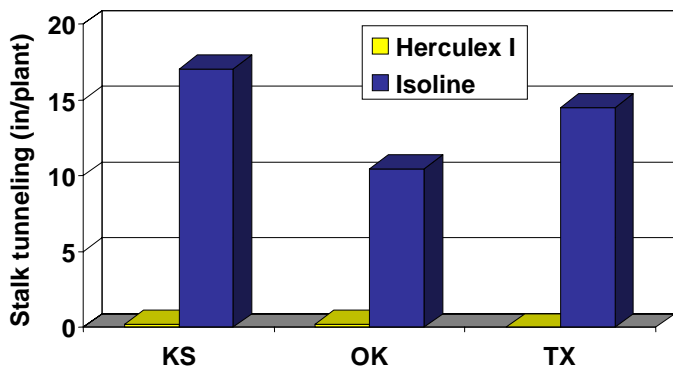


Figure 8. Stalk tunneling from southwestern corn borer in Herculex I plots compared to untreated base genetics plots from three university locations, 2001.

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^bYieldgard is a registered trademark of Monsanto Company.

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