Impact of Transgenic Hybrids and Insecticides on Corn Silage Yield and Quality

Greg W. Roth
Professor of Agronomy
Penn State University

Richard Taylor
Extension Agronomy Specialist
University of Delaware

Robert Kratochvil
Associate Professor of Agronomy
University of Maryland

Wade Thomason
Assistant Professor of Agronomy
Virginia Tech

Corn rootworm, European corn borer and other corn secondary pests can cause severe damage to corn on dairy farms in the mid-Atlantic region, due to corn following corn in dairy crop rotations and delayed planting dates, which often increase the severity of corn borer injury. Corn silage is an important forage crop for dairy production in the region and understanding management tactics that improve both the yield and forage quality is a top priority.

Transgenic hybrids containing the Yieldgard corn borer or the Yieldgard Rootworm genes could provide cost effective control of corn borers and western corn rootworm larva in situations where these pests are anticipated. Other alternative seed treatments, like Poncho 1250 or granular insecticide treatments, such as Force 3G are also available.

The objective of of this study was to continue to evaluate the impact of transgenic hybrids for corn borer and corn rootworm management on the yield and quality of corn grown for silage and to compare the transgenic approaches to other management tactics for controlling these insects. This study is the second of a two year program. Results from the 2005 study were presented at the NECIC meetings in 2006.

<u>Methods</u>

In this trial, five treatments were evaluated for their effects on corn produced for silage. These treatments included 1) a base treatment of Poncho 250, 2) a Yieldgard corn borer hybrid treated with Poncho 250, 3) a Yieldgard corn borer hybrid treated with Poncho 1250, 4) a Yieldgard corn borer hybrid treated with Poncho 250 and Force 3G and 5) a YieldGard Plus hybrid (Yieldgard corn borer plus Yieldgard rootworm) treated with

Poncho 250. All hybrids were Roundup Ready. Three different sets of base genetics were used in this study: these were provided by Corn States and represent adapted commercial hybrids used in the region.

Corn was planted in mid May at each location following corn at locations near Rock Springs, PA, Newark, DE, Keedysville, MD and Harrisonburg, VA. Each treatment was replicated four times and the individual plot size was 4 rows (10 feet) and 25 feet long. Problems at the Harrisonburg site with silage quality evaluation caused us to discard the data from this location.

Root ratings were made from 5 root samples dug from two replications in each treatment. These ratings were made using the Iowa State 0-3 scale. From each check plot (Treatment #1) root ratings were obtained after tasseling. Height was measured to the collar of the last leaf at the Pennsylvania location.

For both trials at harvest, yield data was collected by harvesting a single row from the interior of each plot with a two row silage plot chopper at the Pennsylvania location and by hand at the other two location. Forage obtained was weighed in the field and a subsample was collected from the harvested material. Where the plots were harvested by hand the sample consisted of five random plants, which were chopped on site and subsampled. These subsamples were sent to Dairy One, Inc., Ithaca, NY for forage quality and dry matter analysis. The weight and moisture were then used to calculate the yields. Milk per acre and milk/ton were calculated using the Milk 2000 program

Data were analyzed using SAS 8.0 in a factorial analysis averaging effects over hybrids and treatments at individual sites. Least significant differences were calculated for those measurements where significant differences occurred.

<u>Results</u>

Yields at each location were good, despite the sporadic rainfall and heat at all locations. European corn borer pressure was significant at each of the three locations but much less than in 2005, when infestations averaged 2.7 tunnels per plant. European corn borer tunnels/stalk in the non-Bt check plots averaged 1.1, 0.8 and 0.8 for the Delaware, Maryland and Pennsylvania locations respectively. Corn rootworm ratings (0-3 rating system) were generally similar to 2005 and averaged 0.3, 0.1 and 0.1.0 at the Delaware, Maryland and Pennsylvania locations respectively.

Responses to the insecticide treatments were significant only at the Pennsylvania location, although similar response trends existed at the two locations. In general, hybridxtrait interactions were not significant for yield and most forage quality traits.

The yield response relative to the check (treatment 5) from the addition of the YGCB trait (treatment 4), averaged 1.4 tons/acre and was likely due to the consistent corn borer pressure at each site. This yield response was less than 2.7 tons/acre measured in 2005 and is consistent with some of our previous studies that have shown good response to corn borer control when planting date is delayed. Previous studies have shown that yield increases of approximately 2.5%/tunnel can be anticipated. In this study, we averaged 0.9 tunnels per plant across all three locations which would result in a 6.2% silage yield increase per tunnel. This was consistent with the 4.2% increase shown in 2005 and both years the yield response was higher than the 2.5%/tunnel response reported in previous grain studies. No significant differences were noted in the forage quality due to the addition of the YGCB gene.

Differences among the rootworm control tactics, which all contained the YGCB gene, and the rootworm check (treatment 4) were less pronounced in 2006 compared to 2005. Averaged over all locations the yield of the Force treatment was similar to that of the YGPL treatment. We did not observe the lower yields associated with Force compared to the Yieldgard Plus treatment that we observed in 2005. The Yieldgard Plus and Force treatments averaged 26.5 tons/acre, while the Poncho 1250 treatment averaged 25.7 tons/acre and the check treatment without any rootworm or corn borer control averaged 24.8 tons/acre.

No trends in forage quality differences were noted among the rootworm control treatments, probably due to the lack of rootworm stress on the corn. This data also confirms for the second year that the addition of the YGRW gene has no negative impact on the forage quality of the corn when used for silage.

In 2006, we also measured levels of five mycotoxins (aflatoxin, vomitoxin, zearalanone, T2 and fumonisin) in all of the Yieldgard Plus treatments and the check RR treatments. Our analysis showed relatively low levels of mycotoxins, and only two instances of significant effects due to the insect control genes. One was at the Pennsylvania site, where vomitoxin levels averaged about 0.8 ppm and were significantly lower with the RR hybrid. There were significant differences among hybrids at this site also and for one hybrid, hybrid C, which was much higher than the other two hybrids. For this hybrid, the control averaged 2.3 ppm vomitoxin and the YieldGard Plus event averaged 0.6 pm. For the other two hybrids, differences were negligible. At Delaware, one hybrid showed a difference in aflatoxin for one hybrid between the Yieldgard Plus and the control. In this case the YieldGard Plus hybrid had aflatoxin levels of 3.3 ppb compared to 1.0 for the control.

In summary, our results confirmed most of what we found in 2005. The transgenic corn borer and rootworm traits can provide some benefits in yield in some environments. Forage quality effects from these traits were small. Effects on mycotoxins were relatively inconsistent and hybrid specific.