Title: Assessing effectiveness of Bt corn against corn rootworm in Texas and effects of reduced irrigation regimes on injury to corn caused by corn rootworm

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Pest and problem overview: Western corn rootworm can cause severe economic injury to corn. Corn rootworms have one generation per year. Adult corn rootworms emerge in late June and early July, and begin to lay eggs in late July and continue until fall. Eggs hatch in the spring, and larvae of the rootworms feed on corn roots until they pupate in the soil. Larvae are slender and milky-white and can reach 1/2" in length before they pupate. Larval feeding on roots weakens the root system of corn plants, and causes characteristic goose necking of the plants that can lead to lodging.

Objective 1: Survey cornfields to assess the extent of injury caused by corn rootworm.

Corn rootworm has been successfully managed through Bt technology for many years. However, incidence of unexpected damage to corn and lab-documented resistance to toxins expressed in Bt corn reported throughout the Corn Belt prompted questions whether there was any incidence of severe corn rootworm damage to corn in Texas Panhandle. Majority of corn acreage in the Panhandle is irrigated, however, and there is anecdotal evidence for lower survival of corn rootworm larvae in irrigated fields. Thus, corn rootworm may be less likely to affect corn in continuous corn production areas under irrigation in Texas as well. In order to assess this, surveys were conducted to evaluate injury to corn caused by corn rootworm in irrigated continuous corn.

Four locations in Hereford and in Bushland were selected for assessment of incidence of corn rootworm damage to corn. All four locations were irrigated, continuous corn. Surveys were conducted in the second week of August, 2016. A total of 60 plants were surveyed in each of the four locations in each field separated by 100 feet. Root damage in locations with moderate adult emergence was assessed on 0 (no injury) to 3 (three full nodes injured to within 1.5" of stem) scale. Generally, root rating of 1 is considered relevant with respect to yield losses, although factors such as irrigation can mitigate yield losses even if corn injury exceeded a rating of 1. All surveyed fields had very low injury to corn roots (summarized in Table 1). This was despite the fact that more than 3 adult corn rootworms per plant were observed in multiple locations of each cornfield and overall average density of adult corn rootworm per field ranged from 0.5 to 1 beetles per plant. It is likely that these adult beetles emerged from the fields that were surveyed confirming corn rootworm activity in these locations. Despite this, the injury to roots was negligible and only a handful of roots bore any signs of larval feeding. This suggests that while corn rootworm larvae were present, their numbers were low and they had little effect on corn. No goose necking of plants was observed either, which is an indication of limited injury to corn roots.

Table 1. Average root rating across the surveyed field.

	Average root rating (0-3 scale)	Standard Error of the Mean
Field 1	0	0
Field 2	0.045	0.025
Field 3	0.05	0.022
Field 4	0.03	0.016

Rating of 1 is assumed to cause yield losses – all fields were significantly below this threshold.

Image representing an example of the most severely damaged root. While some injury was evident, none of the major roots were damaged to within 1.5" of the stalk and there was a healthy abundance of hair roots that were not affected by corn rootworm larvae to a significant extent.

The major conclusion reached from this outcome is that the cultural practices (i.e., irrigation) may confer some degree of protection to corn from injury caused by corn rootworm. This has several advantages for producers who do and do not use corn with Bt traits designed to suppress corn rootworm. It is possible that irrigation promotes plant health and allows corn to compensate for any injury and irrigated fields may be less suitable for corn rootworm larvae development and survival. However, we did not experimentally manipulate irrigation and impact of water abundance on corn rootworm survival at these locations is only speculative. These surveys were also limited, and

cannot be used as a definitive measure of the incidence of unexpected injury to corn in Texas Panhandle. Further surveys are planned in order to extend the scope of the study.

Objective 2: Impact of reduced irrigation on management of corn rootworm.

Corn rootworm adults collected in field surveys described above and additional locations were released in experimental plots to augment populations of beetles immigrating from surrounding fields and attracted to the late-planted plots at the Conservation and Production Laboratory Research Farm in Bushland. We observed an average of 10 adult females during 5-min visual observations (~0.1 beetles/plant). Each female can produce as many as 400 eggs, and the observed densities suggest a solid foundation for establishing a corn rootworm population. The field was under the pivot, but was irrigated sparingly (three times during the growing season).

The goal for this project is to assess how decreasing irrigation and use of drought-tolerant varieties of corn affect susceptibility of corn to corn rootworm and impact corn yield. Establishing a long-term continuous corn plots is necessary for the beetles to establish and for the experiments to be conducted, however. It will likely require multiple seasons to build up sufficient corn rootworm pressure and populating the plot with laboratory-reared eggs is logistically difficult and has a variable success rate. Thus, we will continue raising corn and infesting the plots with field-collected adults. Once we are confident that there is sufficient pressure of corn rootworm in this location to examine the impact of irrigation and drought tolerant varieties we will design and execute the experiments.