Performance of Soil Applied Insecticide in Corn Production

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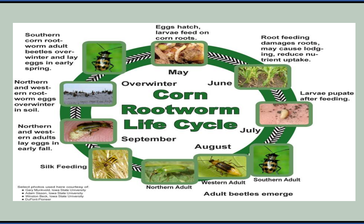
Introduction

The larval stage of corn rootworm (CRW) (Diabrotica virgifera) feeds on corn roots and can drastically reduce the plant root mass resulting in water or nutrient stress, lodging, and yield loss. 5.4 million hectares of corn was planted in Iowa in 2016, many of these hectares having been planted to corn for several consecutive years. Corn following corn fields provide an environment where the host is present each year for CRW to feed and reproduce. The primary management tactics of CRW are crop rotation to a non-host like soybean, planting a rootworm Bt hybrid, or use of a soil applied insecticide (SAI).

The objective of this study was to identify field-level factors that can explain yield responses to SAI in fields planted to rootworm Bt corn hybrids to reduce damage caused by CRW feeding on corn roots.



Methodology

Thirty six on-farm replicated strip trials were conducted by farmers working with the Iowa Soybean Association On-Farm Network from 2008 – 2015 (Fig. 5). All fields were in a corn following corn rotation. Aztec 4.67G or 2.1G (*pyrethroid*, *phosphorganic insecticide*) was the insecticide used.

Treatments:
Control – *Farmer selected rootworm Bt hybrid.*
Insecticide – *Aztec applied in furrow (172 g ai ha^{-1}) with the same rootworm Bt hybrid.*

The insecticide in the majority of the trials was applied in-furrow with the seed using a SmartBox application system installed on the farmers planter.

For strip trials conducted in 2012 – 2015, roots were sampled around the beginning of August to assess CRW damage. Roots were washed, then rated on a 0-3 scale and weighed. Georeferenced yield data were collected for all trials to assess yield response.

The data were analyzed using linear mixed effects model with random intercept and slope. The power analysis to identify the optimal number of replications and trial locations was done by simulating 500 new values of yield response based on results of variance component analysis of data collected from 2012 through 2015.

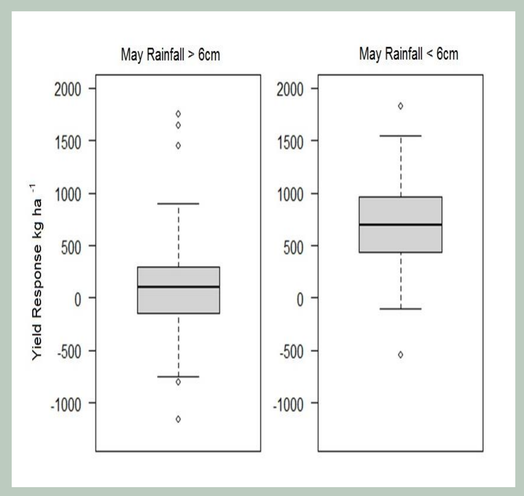


Figure 1: Significant average yield response of about 500 kg ha^{-1} to Aztec when May rainfall is <6 cm.

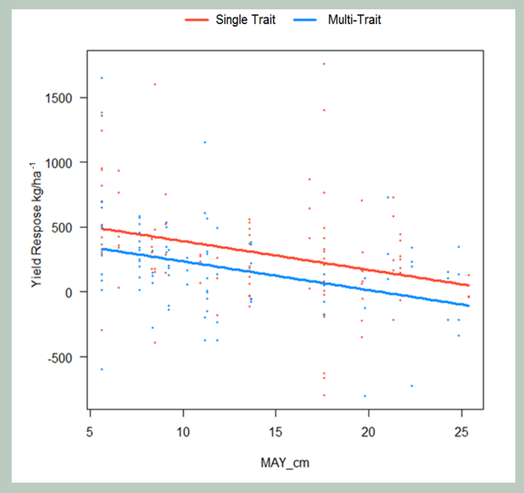


Figure 2: Yield response to Aztec for categories of fields grouped by single trait and multi-trait hybrids over the observed range of May rainfall. Single trait hybrids had about 123 kg ha^{-1} yield response higher than multi-trait hybrids.

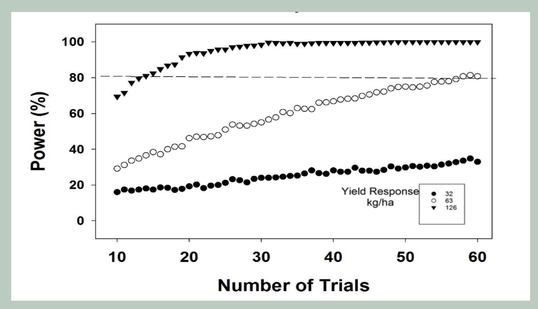


Figure 3: Power analysis: 50 trial locations would be needed to detect a yield response of 67 kg ha^{-1} at 80% power and 10% significance level.

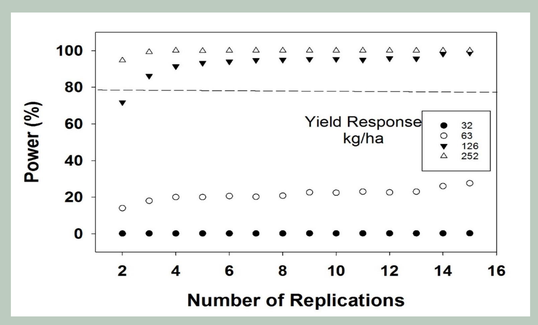
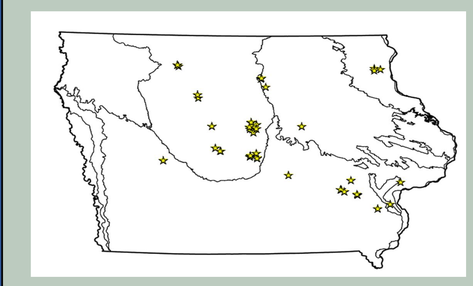
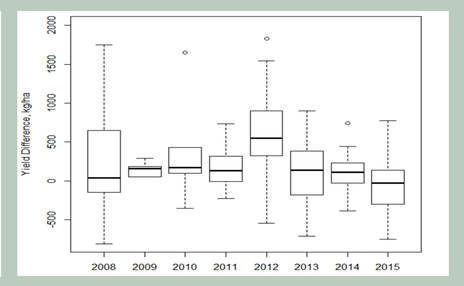


Figure 4: Power analysis: increasing the number of replications in each trial would not be sufficient to detect statistically significant yield response to SAI less than 126 kg ha^{-1}.





Figures 5 & 6: Trial location map, 36 total trials from 2008 – 20015 (left). Summaries of yield response to Aztec by year (right)

Results

Across 8 years, the average yield increase to Aztec in corn following corn fields was 186 kg ha^{-1}, which was statistically significant but not profitable at current corn prices. There was a large variation in yield response across years (Fig. 6) and across trials.

Trials that received May rainfall less than 6 cm had an average yield response from Aztec of about 600 kg ha^{-1} (which was profitable), versus about 100 kg ha^{-1} when May rainfall was greater than 6 cm (Fig. 1). In drier conditions there was more root damage and the CRW larva had better conditions for movement within the soil profile than in wet conditions.

We could not detect the significant effect of the treatments on the root weight and root injuries, but yield response tended to be higher in in fields planted later. Corn root weight decreased as corn root injury increased.

Trials planted with hybrids that had a single rootworm trait had about 100 kg ha^{-1} greater response to the insecticide than those planted with hybrids having multiple traits (Fig. 2).

The power analysis showed that to detect a statistically significant yield response of 67 kg ha^{-1} at 10% significant level at the power of 80% 50 trial location would be needed (Fig. 3). Increasing the number of replications would not be able to detect less than 126 kg ha^{-1} yield response (Fig. 4).

Conclusions

Average yield responses to Aztec in corn following corn fields were statistically significant but not profitable. Fields that received below normal May or June rainfalls had larger yield responses and could be profitable under current corn prices.

Acknowledgments

These trials were funded by AMVAC Chemical Corp. Many thanks to the farmers who participated in the on-farm studies and the ISA Analytics and On-Farm Network teams.