COMPARISON OF TECHNOLOGY FOR CONTINUOUS CORN PRODUCTION 2005

THE DAKOTA LAKES STAFF

INTRODUCTION:

Continuous corn production was the traditional practice under irrigation in central South Dakota until quite recently. Management considerations associated with continuous corn production include the need to control corn rootworm. The normal life cycle for the corn rootworm beetle involves the adult beetle feeding on the silks of pollinating corn plants. After mating, the gravid females lay eggs in the soil at the base of the corn plant. If corn is planted in the same field the next year the larvae that result from these eggs feed on corn roots. For more information on the life cycle of corn rootworm species you may contact your local Extension Educator or try this web site.
http://ipm.uiuc.edu/fieldcrops/insects/corn_rootworm/factsheet.html

Traditional methods of dealing with this pest mostly involved use of soil applied insecticides over the row area while seeding. Under irrigation some producers applied insecticides through the irrigator at V4. Less common control methods employed insecticide applications to control the adult beetles before they laid eggs. Another approach used baits and feeding stimulants combined with low levels of insecticide in an attempt to control the adults.

Crop rotation is a valid and highly effective means of controlling corn rootworm if done properly. Corn rootworms have shown the ability to adapt when the rotations are predictable in either sequence or interval. An extended diapause biotype has developed in the western Corn Belt. This biotype has a large percentage of its eggs that do not hatch the first year but wait for the second spring. This puts them in synchrony with the commonly used corn-soybean rotation. There are also soybean and cereal variants where the gravid females have developed the habit of flying to adjoining soybean or cereal fields before laying their eggs. This adapts them to rotations with predictable sequences like corn-soybean or wheat-corn-soybean.

A relatively recent innovation in corn rootworm control involves the development of corn hybrids with the ability to produce Bt segments in their roots that control corn rootworm larvae when they begin to feed. This is technology similar to the use of Bt segments in the above ground vegetation designed to control corn borer and other leaf feeding caterpillars.

METHODS

The field used in this study has been in no-till continuous corn since 1990. In the early years of this history significant damage occurred as a result of corn rootworm activity (mostly western corn rootworm) if insecticides were not used. It became the site of several cooperative research projects by USDA-ARS scientists (NGIRL: Jan Jackson, Walt Reidell; and others) studying options for dealing with corn rootworm.

In 2003, when the Bt rootworm technology began to be marketed, an exploratory experiment was initiated comparing a Bt corn rootworm hybrid with one of the standard conventional hybrids used by the farm. The standard hybrid outyielded the Bt corn rootworm hybrid even though no insecticide was used. The reason for this was thought to be differences in properties not associated with insects.

In 2004, four DeKalb (Monsanto) hybrids were obtained that had identical base genetics. One hybrid was DKC 60-15 with no Bt segments. One hybrid was DKC 60-16 with the base genetics plus the Yieldguard Corn Borer Bt trait. One hybrid was DKC 60-12 that had the Yieldguard corn rootworm segment added. The last was DKC 60-14 that had both the rootworm and corn borer Bt traits (stacked). These hybrids were planted at 36,000 seeds/acre in replicated strips on April 27, 2004 in two adjoining experiments. One experiment received no insecticide treatments. The other experiment received an insecticide (Lorsban at 1.5 pt/acre) through the irrigation water at the V4 growth stage. Harvest was done with a commercial combine operated the full length of the strip harvesting the center 8 rows of each 12 row strip. The sample was weighed in a scale equipped grain cart.

In 2005, the same hybrids were seeded at 36,000 seeds/acre into the same strips they occupied in 2004. This was done to assure that lack of pressure associated with control of the insect in 2004 did not bias the results. No insecticide was used on either experiment in 2005. Results from both experiments were combined for analysis.

Results:

The six slides located on the next page summarize both the 2004 and 2005 data. The data indicate there were no significant differences between hybrids in 2004 in either experiment. Part of this is due to the fact there was only room for 3 replications in each experiment. This was a surprise since corn rootworm had been a problem historically on this property. It was also surprising because corn borer had been an issue in corn production in the area for many years. There are some trends in these data but it is not valid to call them differences. There were no differences in observed lodging of either roots or stalks. Root pull and root rating numbers conducted by Walt Reidell and his crew produced no differences.

If we did take the yield numbers at their face value, there are 5 to 9 bushel yield increases between the base genetics and the different segments. This came at a cost. The corn borer segment cost almost $11/acre more than the base.

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2004

Field history-14 years continuous corn

Hybrid	Segment	Insecticide at V4
DKC 60-15	Base	178
DKC 60-16	CB only	182
DKC 60-12	CRW	181
DKC 60-14	CB + CRW	172

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2004

Field history-14 years continuous corn

Hybrid	Segment	No Insecticide
DKC 60-15	Base	165
DKC 60-16	CB only	170
DKC 60-12	CRW	172
DKC 60-14	CB + CRW	174

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2004

Cost per acre for 34,000 seeds

Hybrid	Segment	Cost per Acre
DKC 60-15	Base	$47.56
DKC 60-16	CB only	$58.18
DKC 60-12	CRW	$71.78
DKC 60-14	CB + CRW	More

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2004

Cost per bushel for 34,000 seeds

Hybrid	Segment	Cost per Bushel
DKC 60-15	Base	$0.29
DKC 60-16	CB only	$0.34
DKC 60-12	CRW	$0.42
DKC 60-14	CB + CRW	More

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2004

Cost per bushel for 34,000 seeds

Segment	Yield	Cost per Added Bushel
Base	165	$0.00
CB only	170	$2.12
CRW	172	$3.46
CB + CRW	174	More

Corn Genetic Trait Trial

Dakota Lakes Research Farm-Main 2005

Field history-15 years continuous corn

Hybrid	Segment	No Insecticide
DKC 60-15	Base	213
DKC 60-16	CB only	206
DKC 60-12	CRW	210
DKC 60-14	CB + CRW	214

The CRW segment cost over $20/acre more than the base. In 2004 the cost of the stacked genetics was not known because it just received commercial approval when this seed was purchased. For that reason, it was purchased at the same price as the CRW hybrid with the advice it would cost more next year. Part of the reason for the high cost is the high population used for irrigated production. This would be cheaper for dryland producers.

A second way to look at the cost is to express it as a cost/bushel for the extra bushels produced above that of the base genetics. The 5 bushels gained by use of the CB segment cost $2.12/bushel for the genetics. Drying, transportation, and other volume related expenses are not included. This would be sufficient to interest many producers if it were consistent or real. The CRW and CRW-CB stacked hybrids result in a cost of $3.46/bushel or more for each additional bushel they produced in 2004. That clearly is not a good investment.

The 2005, data were similar to those from 2004. Yields were higher but still no significant differences in yields occurred. Using 6 replications would have helped differentiate smaller differences. Again, the visual evidence of CRW damage was not apparent. There are adult beetles present on the property and in the surrounding area so we think it is unlikely that this is an island effect.

One possibility is that a beneficial organism has developed that interrupts the normal life cycle of the insect. This could be something that preys on the adult phase but there is no visible evidence of that. If a beneficial is the reason, it is more likely that it is an inhabitant of the soil. One possibility is a beneficial nematode that is parasitic to the larvae or CRW. These exist in parts of Central and South America where continuous corn culture has existed for centuries.

The bottom line for producers is that the technology available in seed today is a wonderful tool when used appropriately. There is no question that the Bt technology works. It is not always economically beneficial to use the technology. Every field is supposed to have a refuge area. If this is properly done, it is easy to do your own yield test to see whether it appropriate or feasible for you.