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Yield performance of Bt corn

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Abstract

Last year was a good year for evaluating Bt corn hybrids and their performance against European corn borers. Insect pressure was very high in part of the state and several companies entered the Bt corn market with new hybrids. Presented here are the results from replicated field trials conducted by Iowa State University in 14 counties.

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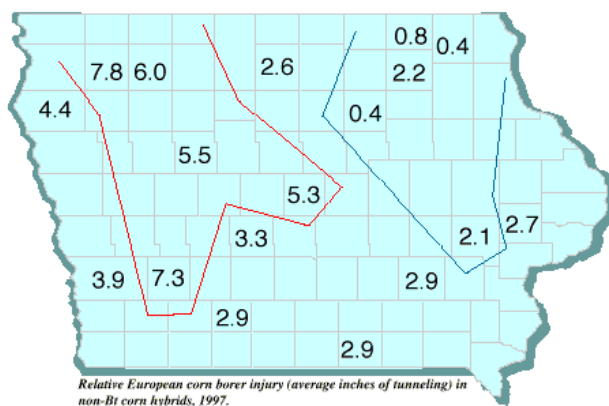


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Last year was a good year for evaluating Bt corn hybrids and their performance against European corn borers. Insect pressure was very high in part of the state and several companies entered the Bt corn market with new hybrids. Presented here are the results from replicated field trials conducted by Iowa State University in 14 counties.

Bt corn hybrids were selected by Cargill Seeds, DEKALB GENETICS, Golden Harvest Seeds, Novartis Seeds, and Pioneer Hi-Bred for planting at 14 locations. These companies, except for Novartis, also provided a non-Bt hybrid that was genetically similar to their Bt hybrid as a comparison in each county. County plots were coordinated by extension crop specialists, usually in cooperation with a local farmer. All hybrids were replicated 3-5 times in a randomized complete block design. Agronomic practices (planting date, planting rate, row spacing, fertility, harvest date, etc.) were determined by the cooperating farmer. Plots were subjected to natural infestations only of European corn borers. Grains yields were collected with a combine and calculated either with a yield monitor or with a weigh wagon. Yields were adjusted to 15.5 percent moisture.

European corn borer, inches stalk tunnelling, 1997



Yield data are shown in Table 1. There are several important points to consider when interpreting these data. First, this is information from only one year. I started evaluating experimental hybrids four years ago, but 1997 was the first year where I could evaluate a large number of commercial hybrids. We have to start somewhere; 1997 is that starting point. Hopefully, I will have additional data at the end of 1998. Second, some hybrids were evaluated at only one location. It is impossible to fairly evaluate hybrid performance based upon data from a single location. Third, European corn borer pressure was extremely variable across the state. The map shows the relative injury, measured as inches of tunneling in one of the non-Bt corn hybrids. Sections of western Iowa had large amounts of stalk tunneling whereas eastern Iowa had relatively insignificant levels of injury. Where large amounts of stalk tunneling occurred in the non-Bt hybrids at a location, the Bt hybrids often gave good protection against yield loss. Fourth, agronomic and environmental factors may greatly mitigate or exacerbate the yield losses caused by European corn borers. In other words, corn borers are not the only factor influencing yield. Poor fertility, inadequate soil moisture, and plant diseases can further pull yields down. Fifth, the easiest comparisons to make are where genetically similar Bt and non-Bt hybrids are compared against each other. Novartis Seeds did not provide non-Bt hybrids for comparison (they were provided by the farmer in Winneshiek County) so it is difficult to assess the relative protection provided by their hybrids. Sixth, all Bt hybrids are not created equal; some provide better protection against yield losses caused by European corn borers. Hybrids with the Bt11 (NK Brand with YieldGard) and MON810 (Cargill, Golden Harvest, and Pioneer, all with YieldGard) genes provide season-long control of first- and second-generation European corn borers. Hybrids with 176 (NK Brand with KnockOut) and DBT418 (DEKALB with DEKALBt) genes provide control of first-generation borers and partial second-generation control.

Many farmers already have purchased their Bt corn for 1998. Some are still uncertain and they should closely examine performance data from university and seed company trials. Then they should ask themselves several questions. Did the addition of the Bt gene improve the yield protection (or performance) of the hybrid when compared with a genetically similar non-Bt hybrid? How did the Bt hybrid perform under conditions of low pressure and high pressure from European corn borers? Does the yield difference translate into economic profit or loss? Do I expect to have economically damaging populations of corn borers in my fields in 1998?

One helpful guide that can be used in making a decision to purchase Bt corn is a gain threshold chart (Table 2). It works this way. Calculate the technology fee, or additional premium price, for Bt corn per acre. Then divide this amount by the expected market value of corn per bushel. The result is the number of bushels necessary to recover the cost of the investment. For example, if Bt corn seed costs an extra \$10 per acre and the expected market value of corn is \$2.50 per bushel, then the Bt corn must provide a return of 4 bushels per acre (or must protect an additional 4 bushels) for it to be economically profitable. All of this, of course, is dependent on the potential of economically damaging populations of European corn borers. If corn borer females lay very few eggs in the Bt cornfield, then the protection provided by the Bt gene was not necessary. On the other hand, if large populations of insects occur, then the investment would have been a wise choice.

I believe that Bt corn is an extremely valuable IPM tool, but I would advocate its use only where it will be integrated with other control tactics and planted as part of a resistance management strategy. Next month I'll discuss resistance management and why it is important for the long-term success of Bt corn.

I would like to thank extension crop specialists Mark Carlton, John Creswell, George Cummins, Joel DeJong, Jim Fawcett, Jim Jensen, John Holmes, Brian Lang, Bill Lotz, Carroll Olsen, Virgil Schmitt, Tony Weis, and Mike White for doing most of the work in setting up the plots and collecting the

data; their assistance was invaluable. The support of the Cargill, DEKALB, Golden Harvest, Novartis, and Pioneer seed companies also is gratefully acknowledged.

Table 1. Relative European corn borer injury and yields (bu/acre) from Bt and non-Bt corn hybrids planted in 14 Iowa counties.* Iowa State University, 1997.

			Win	But	How	Joh	Ced	Uni	Keo	App	Dal	Pot	Ply	Cal	Cla	O'Br	Average
Maximum inches tunneling**			0.37	0.40	0.84	2.10	2.68	2.88	2.94	2.94	3.34	3.87	4.40	5.53	6.03	7.83	
Company	Hybrid	Bt gene***															
Cargill	4327	—	146.2	114.7	149.2	—	—	—	—	—	—	—	138.9	116.4	132.4	159.2	136.7
Cargill	5021Bt	A	144.2	129.9	159.1	—	—	—	—	—	—	—	176.3	128.1	151.0	171.1	151.4
Cargill	7770	—	—	—	—	151.2	122.9	—	155.2	—	118.1	127.5	—	—	—	—	135.0
Cargill	7821Bt	A	—	—	—	151.7	128.1	—	164.4	—	119.4	136.8	—	—	—	—	140.1
Cargill	7997	—	—	—	—	—	—	98.9	—	166.9	—	—	—	—	—	—	132.9
Cargill	8021Bt	A	—	—	—	—	—	93.1	—	164.9	—	—	—	—	—	—	129.0
DEKALB	493	—	157.7	117.0	151.0	—	—	—	—	—	—	—	154.6	112.7	135.6	153.1	140.2
DEKALB	493Bt	D	154.9	121.7	153.6	—	—	—	—	—	—	—	171.9	121.2	144.3	163.3	147.3
DEKALB	566	—	—	—	—	162.5	165.1	118.0	126.9	148.1	122.4	137.6	—	—	—	—	140.1
DEKALB	566Bt	D	—	—	—	162.5	175.2	126.4	132.5	143.3	125.8	151.6	—	—	—	—	145.3
Golden Harvest	2390	—	151.5	104.8	162.4	—	—	—	—	—	—	—	155.7	117.8	145.5	168.7	143.8
Golden Harvest	2390Bt	A	143.3	105.8	156.4	—	—	—	—	—	—	—	173.7	119.6	146.6	175.8	145.9
Golden Harvest	2530	—	—	—	—	156.8	156.9	96.6	143.8	147.9	115.8	138.3	—	—	—	—	136.6
Golden Harvest	2530Bt	A	—	—	—	148.5	164.7	101.2	165.6	153.9	123.0	157.3	—	—	—	—	144.9
Novartis Seeds	4273	—	160.4	—	—	—	—	—	—	—	—	—	—	—	—	—	160.4
Novartis Seeds	MAX88	C	157.3	135.1	162.6	—	—	—	—	—	—	—	173.8	122.5	155.5	165.0	153.1
Novartis Seeds	N4640	—	154.2	—	—	—	—	—	—	—	—	—	—	—	—	—	154.2
Novartis Seeds	N4640	B	159.0	142.9	162.1	—	—	—	—	—	—	—	177.0	124.6	161.2	171.7	156.9
Novartis Seeds	N64-Z4	C	—	—	—	148.4	148.6	—	—	—	—	—	—	—	—	—	148.5
Novartis Seeds	MAX454	C	—	—	—	—	—	120.2	164.4	161.0	114.0	143.6	—	—	—	—	140.6
Novartis Seeds	N6800	B	—	—	—	158.1	159.4	—	—	—	—	—	—	—	—	—	158.8
Novartis Seeds	N7070	B	—	—	—	—	—	—	161.0	—	146.9	—	—	—	—	—	154.0
Novartis Seeds	N7333	B	—	—	—	—	—	132.6	—	172.1	—	163.7	—	—	—	—	156.1
Pioneer	3489	—	—	106.3	—	170.2	156.5	108.8	128.5	163.3	125.8	144.5	163.0	123.3	—	—	139.0
Pioneer	34R06	A	—	119.8	—	173.3	183.2	119.6	149.5	161.0	147.8	168.7	198.2	142.0	—	—	156.3
Pioneer	3563	—	154.8	—	154.5	—	—	—	—	—	—	—	—	—	145.4	173.3	157.0
Pioneer	35N05	A	155.7	—	169.5	—	—	—	—	—	—	—	—	—	165.4	186.7	169.3
LSD 0.05			10.9	15.2	9.7	14.8	12.2	16.1	11.0	16.5	19.8	18.5	5.9	15.8	8.8	6.3	

* Appanoose, Butler, Calhoun, Clay, Cedar, Dallas, Howard, Johnson, Keokuk, O'Brien, Plymouth, Pottawattamie, Union, Winneshiek

** maximum inches tunneling (average) in one non-Bt corn hybrid

*** A=YieldGard (MON810), B=YieldGard (Bt11), C=KnockOut (176), D=DEKALBt (DBT418)

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