

Southwest Research-Extension Center

# FIELD DAY

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KANSAS STATE UNIVERSITY  
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# Southwest Research-Extension Center

## CORN BORER RESISTANCE AND GRAIN YIELD OF BT AND NON-BT CORN HYBRIDS AT ST. JOHN, KS, 1997<sup>1</sup>

by

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### SUMMARY

Fifteen corn hybrids (six Bt- and nine non-Bt-corn) were evaluated for corn borer resistance and grain yield performance. All of the Bt hybrids were very effective at controlling first-generation corn borer damage. Second-generation corn borer damage to posttassel corn was dependent on the Bt event. Hybrids with the Bt11 and MON810 events gave superior levels of control and appeared to have very good yield potential.

### PROCEDURES

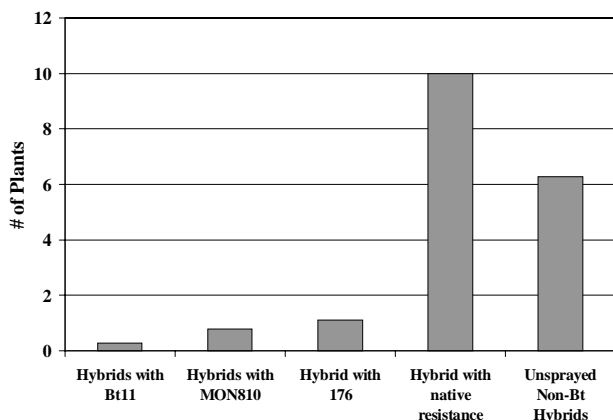
Corn hybrid plots were machine planted on 7 May at 26,000 seeds/acre at the Sandyland Experiment Field near St. John, KS. Spot replanting was done as necessary to fill in gaps in the plots, and because of an error, some plots might have contained a few off-type plants (average of 3-5). Most of these were excluded during the corn borer evaluations by avoiding unusually small plants, but they were included in the yield calculations. The plots were hand thinned to a target stand of about 45 plants per row. The plots were four rows wide (10 ft) by 30 ft long with two rows (5 ft) of Bt corn planted between the plots as border rows and 10 ft alleyways at the end of each plot. The border rows and alleyways were included to reduce larval migration between plots. The experimental design was a split-plot with four replications; however, one replication was abandoned for late-season observations because of lack of efficacy of the insecticide treatment. The main plots were insecticide-protected versus unprotected, and the subplots were the 15 corn hybrids. The protected blocks were sprayed on 4 August with Capture™ at 0.08 lb AI/acre. Most of the hybrids had relative

maturity ratings between 110 and 118 days. An attempt was made to pair each Bt hybrid with either a non-Bt sister line or another related non-Bt hybrid. The Pioneer hybrid did not have a sister hybrid, so in the discussion, it will be compared with Pioneer 3162, a leading hybrid in western Kansas. Other hybrids included were: Mycogen 7250, with reported native resistance to first generation European corn borer (ECB), and Pioneer 3751, a short-season standard check (97 days).

All corn borer infestations were natural. First-generation shot-hole damage was light, so plants in the two center rows showing noticeable damage were counted. Data for second generation corn borers were taken from five consecutive plants in one of the two center rows of each plot. The plants were dissected to measure corn borer tunneling and record the number and species of corn borer. Kernel damage (mostly corn earworm) was recorded as the estimated percentage of kernels damaged on each ear. In addition, lodged plants in the middle two rows were counted and separated into those girdled by southwestern corn borer (SWCB) and those lodged from other corn borer tunneling (mainly ECB damage). Yield was determined by hand harvesting the two middle rows of each plot in late October. Ears from standing plants and those from fallen plants were harvested separately. Grain yield for standing plants and total grain yield per acre at 15.5% moisture were calculated. To simplify the discussion, results of hybrids using the same Bt-event were averaged and compared with the average of the six comparison non-Bt hybrids (N7590, N7931, 4494, 2530, 7997, and 3162). For second-generation damage and yield information, the averages of the six non-Bt hybrids unsprayed and sprayed with Capture were compared, as well as the averages for the hybrids with the various Bt events.

<sup>1</sup>This research was supported by Kansas Corn Commission check-off funds through the Kansas Department of Agriculture.

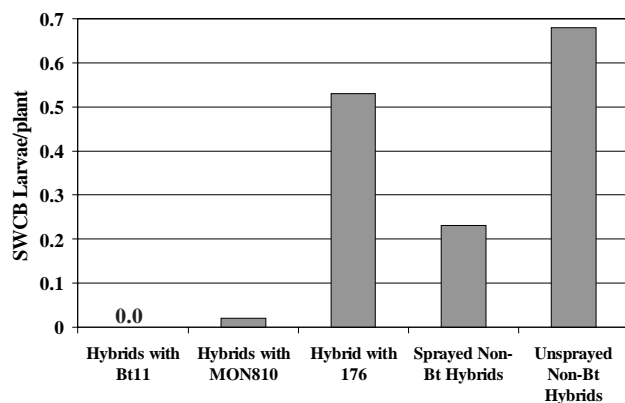
**Fig. 1. First-generation corn borer damage to whorl-stage corn expressed as the number of plants with damage out of about 90 in the two center rows of each plot, St. John, KS, 1997.**



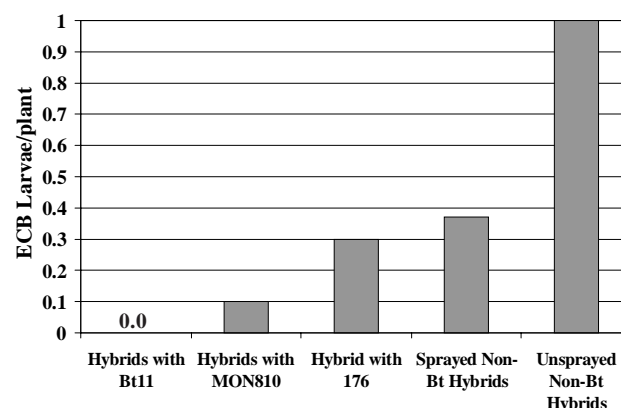
### RESULTS AND DISCUSSION

Although first-generation corn borer damage was very light, all of the Bt hybrids were found to be very effective at controlling it (Table 1, Fig. 1). Hybrids with Bt11, MON810, and 176 averaged 95, 87, and 83% reductions in the number of plants infested per plot, respectively, when compared with the average of the six non-Bt hybrids. The native resistance in Mycogen 7250 provided no reduction in the number of plants showing damage when compared to the non-Bt hybrids. Second generation ECB and SWCB pressures averaged 1.0 and 0.7 larvae per plant, respectively, in the unsprayed non-Bt plots (Tables 1 & 2). Bt11, MON810, 176 and the insecticide

**Fig. 3. Second-generation southwestern corn borer larvae per plant, St. John, KS, 1997.**

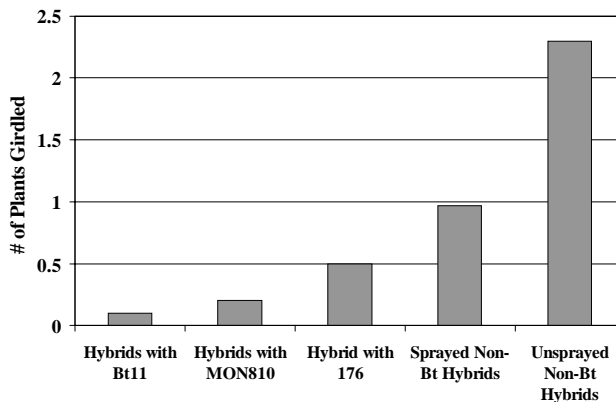


**Fig. 2. Second-generation European corn borer larvae per plant, St. John, KS, 1997.**

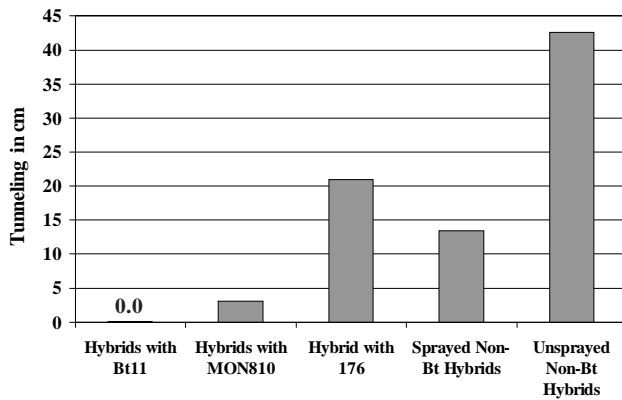


treatment respectively reduced second-generation ECB larvae by 100, 93, 69, and 62% (Fig. 2); second-generation SWCB larvae by 100, 97, 22, and 66% (Fig. 3); girdled plants by 96, 90, 78, and 58% (Fig. 4); corn borer tunneling by 100, 93, 51, and 68% (Fig.5); and reduced yield losses from lodged plants by 96, 82, 33, and 58% (Fig 6). Events Bt11 and MON810 appeared to be significantly better at reducing second-generation SWCB larvae than did event 176. The five "YieldGuard" hybrids, with Bt 11 or MON810, gave 96% and 98% controls of ECB and SWCB, respectively, compared to 62% and 66% controls, respectively, for the best available insecticide treatment and 69% and 22% controls, respectively, for the Bt 176 hybrid.

**Fig. 4. Second-generation southwestern corn borer girdling damage expressed as the number of plants girdled out of about 90 in the two center rows of each plot, St. John, KS, 1997.**

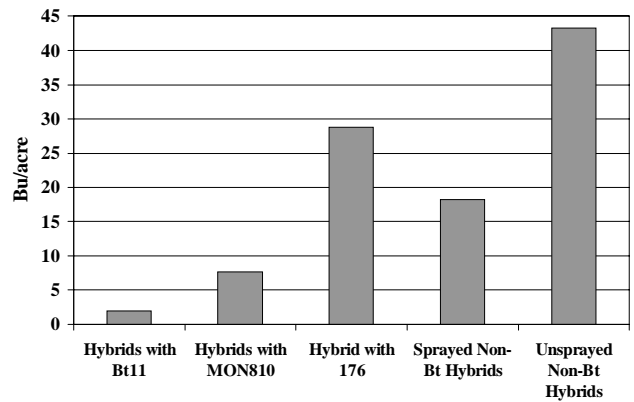


**Fig. 5. Second-generation corn borer tunneling damage expressed as centimeters of tunneling per plant, St. John, KS, 1997.**



The five YieldGard hybrids in this trial showed very good yield potential with an average standing yield of 202.3 bu/acre in the unsprayed plots (Fig 7). This was an average of 26.4 bu/acre more than the yields of four comparison lines in the sprayed plots.

**Fig. 6. Grain yield lost in plants lodged by corn borer girdling or tunneling damage, St. John, KS, 1997.**



The best unsprayed Bt hybrid (Novartis N7590BT) had a standing yield of 209.1 bu/acre which was 17.3 bu/acre better than the yield of the best sprayed non-Bt hybrid (Pioneer 3162).

**Fig. 7. Grain yield for standing plants or plants lodged by corn borer girdling or tunneling damage, St. John, KS, 1997.**

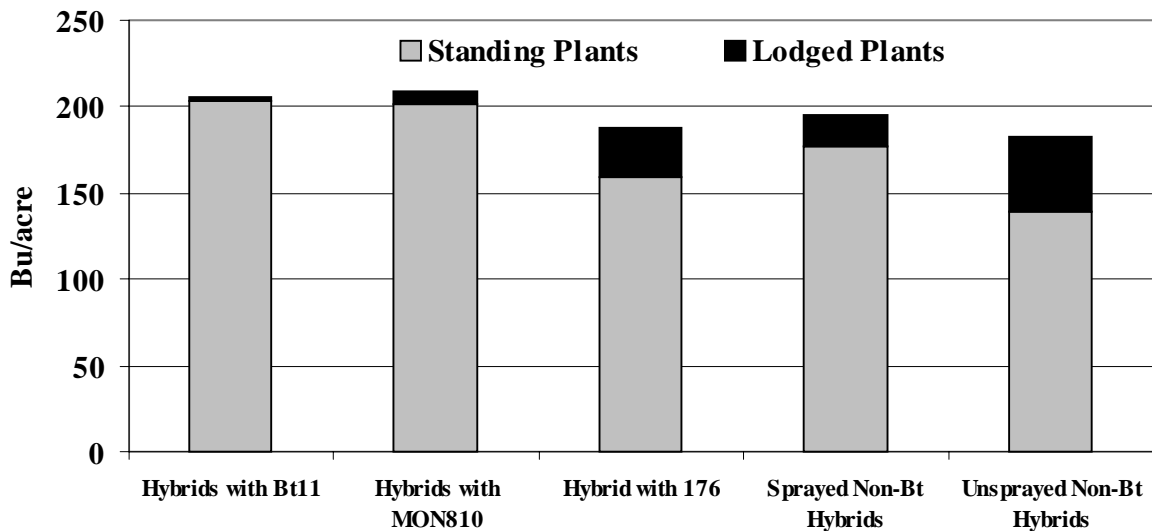


Table 1. Evaluation of corn borer resistance of Bt and non-Bt corn hybrids, unsprayed block at St John, KS, 1997.										
Hybrid	Bt Status	Company	First Gen # of plants with damage	Second Gen. Corn Borer				Grain Yield		
				ECB larvae per plant	SWCB larvae per plant	SWCB girdled plants/plot	Cm of tunneling per plant	Standing plts. bu/a	Fallen plts. bu/a	Total bu/a
N7590BT	Bt11	Novartis Seeds	0.3 e	0.0 e	0.00 d	0.1 e	0.0 e	209.1 a	3.8 c	212.8 ab
N7590	—	Novartis Seeds	5.0 d	0.7 bcde	0.93 a	2.7 abc	37.5 b	128.6 c	49.9 a	178.4 def
N7639BT	Bt11	Novartis Seeds	0.3 e	0.0 e	0.00 d	0.1 e	0.1 e	198.3 a	0.0 c	198.3 abcde
N7931	—	Novartis Seeds	5.9 cd	1.1 abc	0.93 a	2.5 abcd	47.1 ab	149.6 bc	44.6 a	194.1 abcdef
Max454	176	Novartis Seeds	1.1 e	0.3 cde	0.53 bc	0.5 e	21.0 cd	159.0 b	28.8 ab	187.7 cdef
4494	—	Novartis Seeds	5.6 cd	1.4 ab	0.53 bc	2.3 abcd	41.5 ab	139.5 bc	34.7 a	174.2 ef
7250 <sup>1</sup>	—	Mycogen	10.0 a	1.0 abcd	0.73 ab	1.9 cd	42.1 ab	129.2 c	42.1 a	171.3 f
2530	—	Golden Harvest	8.7 ab	0.4 cde	0.47 bc	1.6 d	35.5 bc	144.7 bc	47.3 a	192.0 bcdef
2530BT	MON810	Golden Harvest	0.5 e	0.0 e	0.00 d	0.2 e	0.0 e	204.0 a	3.9 c	207.8 abc
8021BT	MON810	Cargill	1.3 e	0.0 e	0.00 d	0.4 e	1.5 e	194.4 a	8.2 c	202.6 abcd
7997	—	Cargill	4.6 d	0.5 cde	0.67 abc	3.0 ab	43.0 ab	132.7 c	48.9 a	181.6 def
33A14	MON810	Pioneer	0.7 e	0.2 de	0.07 d	0.1 e	7.7 de	205.8 a	11.1 bc	216.9 a
3162	—	Pioneer	8.1 abc	1.7 a	0.53 bc	1.6 d	50.7 ab	139.9 bc	33.6 a	173.4 f
3299	—	Pioneer	6.3 bcd	1.5 ab	0.33 cd	2.1 bcd	46.3 ab	140.6 bc	34.9 a	175.4 ef
3751	—	Pioneer	7.0 bcd	1.3 ab	0.67 abc	3.3 a	58.0 a	105.3 d	38.1 a	143.4 g
LSD value p=0.05			2.41	0.72	0.33	0.93	15.40	21.53	19.54	21.42
F-test Prob.			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
<sup>1</sup> Hybrid reported to have native resistance to first generation European corn borer.										
Means separated using DMRT, P=0.05.										

Table 2. Evaluation of corn borer resistance of Bt and non-Bt corn hybrids, sprayed block at St. John, KS, 1997.										
Hybrid	Bt Status	Company	First Gen. # of plants with damage	Second Gen. Corn Borer				Grain Yield		
				ECB larvae per plant	SWCB larvae per plant	SWCB girdled plants/plot	Cm of tunneling per plant	Standing plts. bu/a	Fallen plts. bu/a	Total bu/a
N7590BT	Bt11	Novartis Seeds	—	0.0	0.0	0.0	0.0	214.6 ab	3.3	217.8 ab
N7590	—	Novartis Seeds	—	0.7	0.3	2.0	24.6	166.5 bcd	27.3	193.8 bcd
N7639BT	Bt11	Novartis Seeds	—	0.1	0.0	0.0	0.1	198.3 abc	1.4	199.7 abcd
N7931	—	Novartis Seeds	—	0.7	0.2	0.7	14.2	183.2 abcd	13.6	196.8 bcd
Max454	176	Novartis Seeds	—	0.4	0.3	0.6	16.0	166.6 bcd	23.2	189.9 cd
4494	—	Novartis Seeds	—	0.3	0.1	0.3	5.1	182.6 abcd	5.9	188.5 cd
7250 <sup>1</sup>	—	Mycogen	—	1.3	0.4	2.3	30.4	158.0 cd	21.4	179.4 de
2530	—	Golden Harvest	—	0.3	0.2	1.2	9.8	173.7 abcd	17.4	191.0 bcd
2530BT	MON810	Golden Harvest	—	0.0	0.0	0.1	0.0	208.5 abc	5.2	213.6 abc
8021BT	MON810	Cargill	—	0.0	0.0	0.0	0.0	211.0 abc	2.1	213.1 abc
7997	—	Cargill	—	0.1	0.5	1.3	22.9	164.5 bcd	32.8	197.3 bcd
33A14	MON810	Pioneer	—	0.0	0.1	0.0	2.7	224.1 a	1.6	225.7 a
3162	—	Pioneer	—	0.1	0.1	0.3	4.1	191.8 abcd	12.0	203.8 abcd
3299	—	Pioneer	—	0.1	0.1	0.4	1.9	187.6 abcd	6.0	193.7 bcd
3751	—	Pioneer	—	0.4	0.3	1.7	19.4	141.5 d	19.9	161.4 e
LSD value p=0.05			—	0.88	0.44	2.11	28.59	45.58	25.87	23.8
F-test Prob.			—	0.1881	0.3833	0.3584	0.3918	0.0347	0.2542	0.0013
<sup>1</sup> Hybrid reported to have native resistance to first generation European corn borer.										
Means separated using DMRT, P=0.05.										

