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CORN BORER RESISTANCE AND GRAIN YIELD OF BT AND NON-BT CORN HYBRIDS AT GARDEN CITY, KS, 1997¹

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 dependant 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 9 May at 30,000 seeds/acre at the Southwest Research-Extension Center near Garden City, KS. Spot replanting was done as necessary to fill in gaps in the plots, and hand thinning was done to adjust stands to a target 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. The main plots were insecticide-sprayed versus unsprayed, and the subplots were the 15 corn hybrids. The sprayed blocks were sprayed on 4 & 5 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 showing noticeable damage in this two center rows 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.

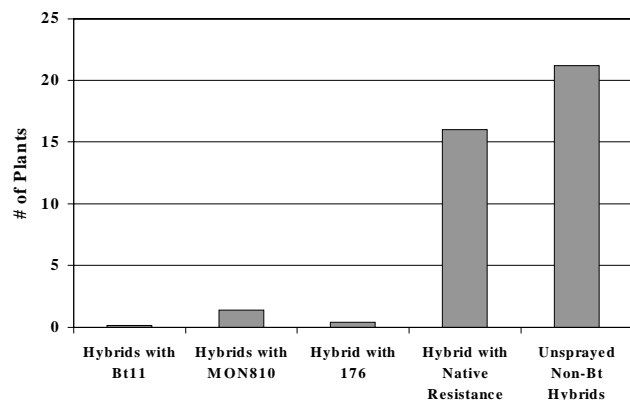
RESULTS AND DISCUSSION

Although first generation 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 99, 94, and 98%

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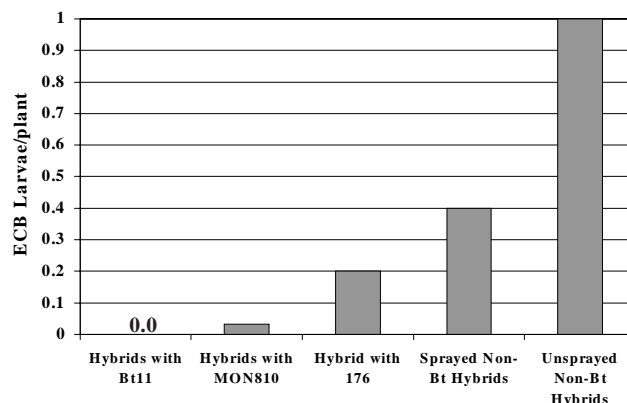
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Fig. 1. First-generation corn borer damage to whorl stage corn expressed as the number of plants with damage out of about 90 in the two center rows of each plot. Garden City, KS, 1997.



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 only a 25% reduction in the number of plants showing damage when compared to the same non-Bt hybrids. Second-generation ECB and SWCB pressures averaged 1.1 and 0.1 larvae per plant, respectively, in the unsprayed non-Bt plots (Tables 1 & 2). Bt11, MON810, 176 and the insecticide treatment respectively reduced second-generation ECB

Fig. 2. Second-generation European corn borer larvae per plant, Garden City, KS, 1997.



larvae by 100, 97, 80 and 64%, (Fig. 2); corn borer tunneling by 100, 90, 54, and 54% (Fig. 3); girdled plants by 100, 89, 42, and 69% (Fig. 4); ear tip damage by 67, 67, 26, and 18% (Fig. 5); and yield losses from lodged plants by 92, 85, 52, and 46% (Fig. 6). The five "YieldGard" hybrids, with Bt 11 and MON810, gave 98% and 93% controls for ECB and SWCB, respectively, compared to 64% and 54% controls, respectively, for the best available insecticide treatment and 80% and 54% controls, respectively,

Fig. 3. Second-generation corn borer tunneling damage expressed as centimeters of tunneling per plant, Garden City, KS, 1997.

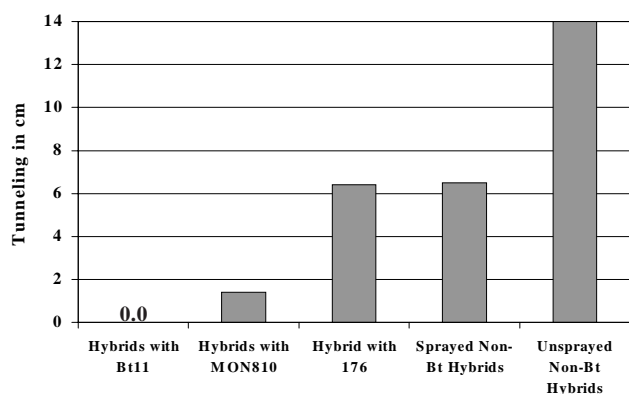


Fig. 4. Second-generation southwestern corn borer girdling damage expressed as number of plants girdled out of about 90 in the two center rows of each plot, Garden City, KS, 1997.

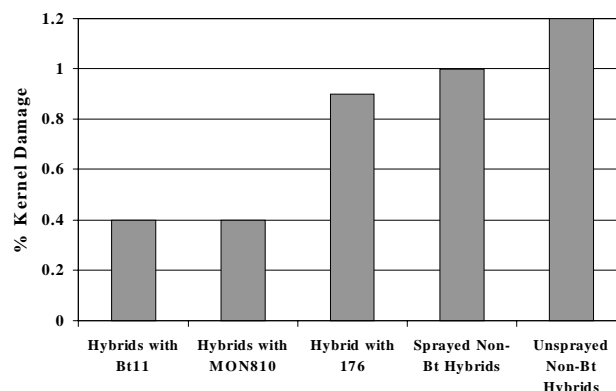


Fig. 5. Kernel damage in the ear, mostly due to corn ear worm feeding, expressed as percentage of ear damaged, Garden City, KS, 1997.

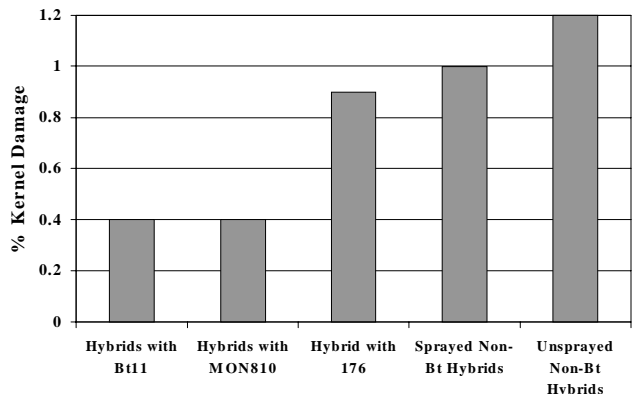
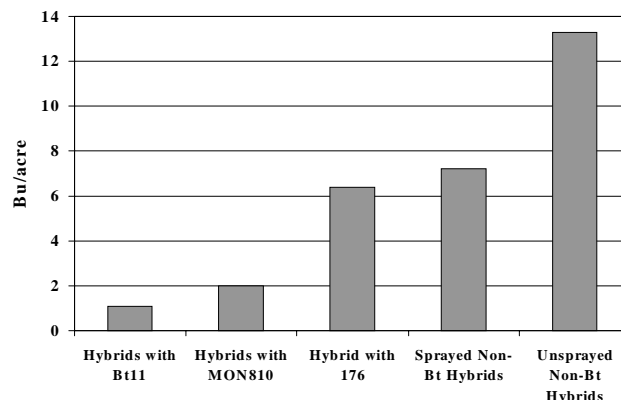


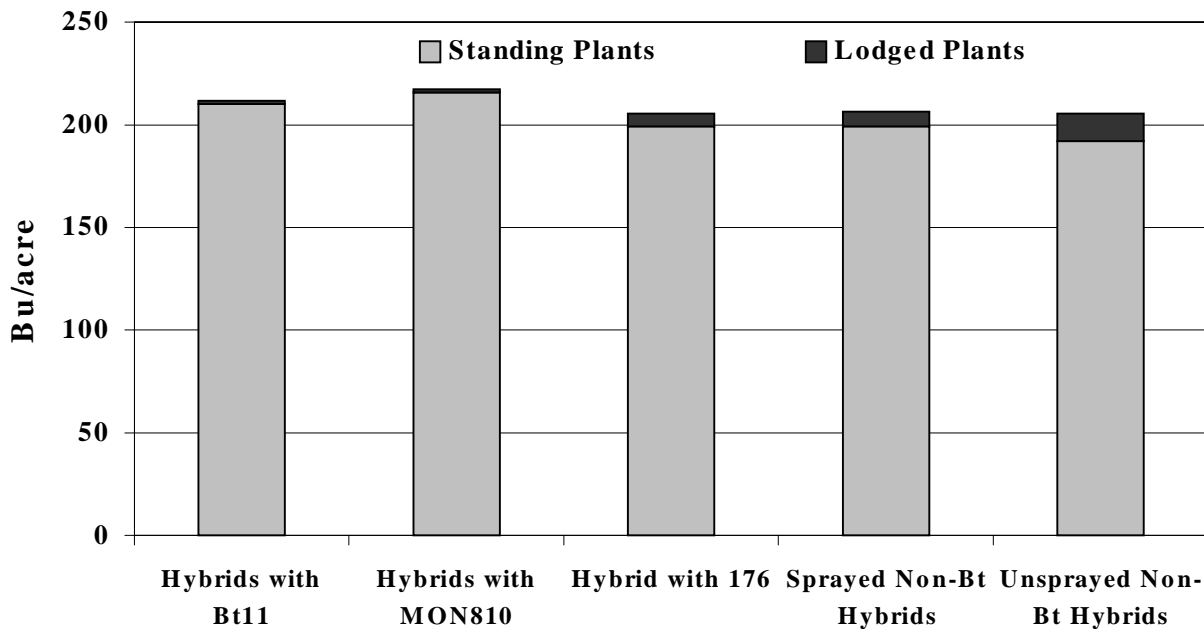
Fig. 6. Grain yield lost in plants lodged due to corn borer girdling or tunneling damage, Garden City, KS, 1997.



for the Bt 176 hybrid. The five YieldGard hybrids in this trial showed very good yield potential with an average standing yield of 213.3 bu/acre in the unsprayed plots (Fig 7). This was an average of 12.2 bu/acre more than the yields of the four comparison

lines in the sprayed plots. The best unsprayed Bt hybrid (Pioneer 33A14) had a standing yield of 231.6 bu/acre, which was 18.5 bu/acre better than the yield of the best sprayed non-Bt hybrid (Cargill 7997).

Fig. 7. Grain yield for standing plants or plants lodged by corn borer girdling or tunneling damage, Garden City, KS, 1997.



Hybrid	Bt Status	Company	First Gen.	Second Gen. Corn Borer				Grain Yield		
			# of plants with damage	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 f	0.0 d	0.00 d	0.0 d	0.5 bc	213.7 ab	2.2 cd	215.9 b
N7590	—	Novartis Seeds	14.4 de	0.5 bcd	0.40 bcd	6.7 cd	1.0 bc	196.8 bcd	13.3 bc	210.1 bc
N7639BT	Bt11	Novartis Seeds	0.3 f	0.0 d	0.00 d	0.0 d	0.3 bc	206.9 bc	0.0 d	206.9 bc
N7931	—	Novartis Seeds	11.5 e	1.7 a	1.50 a	21.9 ab	2.4 b	177.6 d	25.3 a	202.9 bc
Max454	176	Novartis Seeds	0.4 f	0.2 cd	0.35 bcd	6.4 cd	0.9 bc	199.0 bcd	6.4 bcd	205.4 bc
4494	—	Novartis Seeds	19.0 cd	1.1 abc	0.40 bcd	14.7 bc	1.1 bc	197.0 bcd	9.6 bcd	206.5 bc
7250 ¹	—	Mycogen	16.0 cde	1.1 abc	0.30 bcd	14.7 bc	0.6 bc	195.3 bcd	8.7 bcd	204.0 bc
2530	—	Golden Harvest	30.1 b	0.5 bcd	0.15 cd	6.9 cd	0.8 bc	187.6 cd	9.4 bcd	197.0 c
2530BT	MON810	Golden Harvest	1.0 f	0.0 d	0.05 d	0.1 d	0.4 bc	209.0 bc	1.8 cd	210.8 bc
8021BT	MON810	Cargill	2.0 f	0.1 cd	0.00 d	1.5 d	0.3 c	205.5 bc	0.5 d	206.1 bc
7997	—	Cargill	14.4 de	0.9 abcd	0.60 bcd	14.9 bc	0.9 bc	198.1 bcd	12.2 bcd	210.3 bc
33A14	MON810	Pioneer	1.1 f	0.0 d	0.15 cd	2.7 d	0.5 bc	231.6 a	3.6 cd	235.3 a
3162	—	Pioneer	37.9 a	1.4 ab	0.55 bcd	18.7 ab	1.1 bc	195.7 bcd	10.2 bcd	205.9 bc
3299	—	Pioneer	20.0 c	1.3 ab	0.90 b	18.1 ab	1.3 bc	188.9 cd	17.1 ab	206.0 bc
3751	—	Pioneer	14.5 de	1.8 a	0.70 bc	26.3 a	7.9 a	141.9 e	18.1 ab	159.9 d
LSD value p=0.05			5.05	0.90	0.54	9.79	1.73	18.97	10.31	13.91
F-test Prob.			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
¹ 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 Garden City, KS, 1997.										
Hybrid	Bt Status	Company	First Gen.	Second Gen. Corn Borer				Grain Yield		
			# of plants with damage	ECB larvae per plant	SWCB girdled plts/plot	Cm of tunneling per plant	Ear tip damage % kernels	Standing plts. bu/a	Fallen plts. bu/a	Total bu/a
N7590BT	Bt11	Novartis Seeds	—	0.0 c	0.0	0.0 d	0.5	207.8 bc	5.7 bcd	213.5 bc
N7590	—	Novartis Seeds	—	0.3 bc	0.1	3.9 bcd	0.9	196.4 bc	11.3 ab	207.7 bcd
N7639BT	Bt11	Novartis Seeds	—	0.0 c	0.0	0.0 d	0.4	212.4 b	0.0 d	212.4 bc
N7931	—	Novartis Seeds	—	0.3 bc	0.5	6.2 abcd	0.3	199.9 bc	12.9 a	212.8 bc
Max454	176	Novartis Seeds	—	0.2 bc	0.3	3.1 cd	1.3	199.3 bc	1.9 cd	201.2 bcd
4494	—	Novartis Seeds	—	0.1 c	0.1	5.1 bcd	1.2	190.6 c	2.9 cd	193.5 d
7250 ¹	—	Mycogen	—	0.5 abc	0.0	8.7 abc	0.9	197.9 bc	5.8 bcd	203.7 bcd
2530	—	Golden Harvest	—	0.2 bc	0.2	3.7 cd	0.5	190.5 c	6.8 bc	197.3 cd
2530BT	MON810	Golden Harvest	—	0.0 c	0.0	0.0 d	0.4	208.1 bc	1.2 cd	209.4 bcd
8021BT	MON810	Cargill	—	0.0 c	0.0	0.0 d	0.1	209.8 b	1.0 cd	210.8 bc
7997	—	Cargill	—	0.3 bc	0.1	8.0 abc	0.4	213.1 b	4.4 cd	217.5 b
33A14	MON810	Pioneer	—	0.0 c	0.0	0.3 d	0.4	235.4 a	2.3 cd	237.7 a
3162	—	Pioneer	—	1.0 a	0.1	11.8 a	2.7	205.6 bc	4.7 cd	210.3 bc
3299	—	Pioneer	—	0.9 a	0.1	10.4 ab	1.3	196.2 bc	7.2 abc	203.3 bcd
3751	—	Pioneer	—	0.7 ab	0.3	9.5 abc	2.7	146.4 d	5.6 bcd	152.1 e
LSD value p=0.05			—	0.45	0.32	5.64	2.00	15.97	5.59	14.30
F-test Prob.			—	0.0002	0.1207	<0.0001	0.2092	<0.0001	0.0008	<0.0001
¹ Hybrid reported to have native resistance to first generation European corn borer.										
Means separated using DMRT, P=0.05.										

