INDIANA

CORN INSECTICIDE EVALUATIONS

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Department of Entomology

Purdue University

2009

CORN INSECTICIDE EVALUATIONS

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Introduction

Weather and Field Crop Pests during 2009

This weather narrative was summarized from personal observations (LWB) and Indiana State Climate Office Monthly Weather Reports (Joseph Mays).

A series rapidly moving weather systems moving across the Midwest resulted in wind and ice storms that began in the early winter of 2008/2009. December in Indiana was the 7th wettest since 1895. Late December and January began a period of widely fluctuating temperatures. January had record cold and average precipitation while February was just the opposite with much warmer and wetter conditions. March began an extended period of severe storms resulting in extremely high levels of precipitation, particularly in southern and west central counties. Early spring continued the theme of contrasts as exceptionally warm conditions would be rapidly followed by heavy snowfall. The procession of powerful weather systems continued across the state with many flood warnings through May. The rapid weather transitions, particularly in southern counties, made 2009 one of the most challenging years to get crops planted in a timely manner. June was a transitional month as the wet stormy month of May abruptly became very warm with some of the highest temperatures recorded for the entire summer. This heat was accompanied with a series of violent thunderstorms moving across central and southern Indiana. Average temperatures in July were the lowest on record in Indiana (5.2 degrees F below average). This delayed plant and arthropod development across the region. Soils finally had the chance to dry out as the cool temperatures suppressed storms. A second brief period of heat for the summer suddenly appeared in early August and just as suddenly disappeared. Increased precipitation returned and began a wet period that delayed harvest until early November. Early fall that began with normal temperatures and light precipitation was followed with 22 consecutive days of below normal temperatures in October coupled with very wet conditions. The harvest season of 2009 was the slowest in 40 years with corn and soybean harvest delayed by about one month. Dry conditions warm conditions returned in mid November allowing for a quick harvest. About 12 percent of corn was un-harvested by mid December.

Field Crop Pests

Anecdotal observations suggest that western corn rootworm, *Diabrotica virgifera*, numbers were again lower than expected. The growing use of rootworm resistant corn, the general prevalence of saturated soils in late May and June followed by the coolest July on record may all be associated with the observed reduced level of infestation. First stage larvae were first detected in Tippecanoe County on 3 June. This is three days later than the 27-year average. Adult rootworm beetles were first captured in emergence traps on 14 July. This was one to two weeks later than normal. Adults continued to emerge until about the first week of October, or about 3 weeks later than normal.

The near uniform use of highly resistant, transgenic corn hybrids resulted in a substantial reduction of European corn borer, Ostrinia nubilalis, as a pest of commercial field corn. This insect continues to be an important pest of home gardens and commercial vegetable production.

Soybean aphid, *Aphis glycines*, (SBA) were very rare for most of the growing season. However, an extended period of northerly winds in July transported many of winged aphids into the state. Economic populations developed in late planted, growth stage R2-4 beans in southern counties. Soybeans in northern Indiana were sufficiently advanced to avoid economically important numbers of SBA. A mass swarm of SBA occurred across the Midwest in late September as soybeans were senescing and the winged forms began migrating to their over-wintering hosts (*Rhamnus* spp.).

As was the situation last year, Japanese beetle, *Popillia japonica*, adult and larval injury to field crops was very localized and the overall impact was minimal. Incidence of economically important populations in horticultural settings was highly variable and localized.

Migrating corn earworm, *Helicoverpa zea*, (CEW) adults were found abnormally early in the season following the strong storms in the spring. However, only light infestations were reported in mid and late season field corn.

Western bean cutworm *Striacosta albicosta*, (WBCW) expanded its range to most of the counties in the northern one-third of the state and is rapidly becoming a pest of concern.

Alfalfa weevil, *Hypera postica*, injury to alfalfa was light in the spring. Excessive moisture is known to enhance pathogenic fungi that infect these insects.

The threat from the Asiatic garden beetle, *Maladera castanea*, to field corn continues. Larvae were found to be damaging corn roots in very localized areas within fields primarily with sandy soils in across northern counties.

EVALUATIONS OF INSECTICIDES USED TO CONTROL CORN ROOTWORM LARVAE

Introduction and Objective:

The western corn rootworm (WCR), *Diabrotica virgifera virgifera* is a very destructive corn pest in Indiana. The northern corn rootworm, *D. barberi*, and the southern corn rootworm, *D. undecimpunctata howardi* also occur in Indiana, but are not considered important pests there. Although rootworm adults can be damaging to above-ground portions of corn, larval damage to roots is most economically important. Test results included in this report compare efficacy of experimental and registered products and application technologies used to manage larvae. The overall goal of this report is to provide public information that would facilitate the most economically efficient, environmental safe, and practical options to manage WCR larval damage to corn.

Methods:

The trial was at Throckmorton-Purdue Agricultural Center, Lafayette, IN. The area was late-planted to corn (relative to surrounding corn) in 2008 to increase the probability of root damage by subsequent larvae in 2009. The experiment was a randomized complete block design with four replications. The experimental unit or plot was a single row 100 feet in length. Planting was with a John Deere® MaxEmerge model 7000 planter at a speed of 3 mph. Corn was planted in 30-inch wide rows at 27,700 kernels/acre. Mycogen 2T780 treated with fungicides (fludioxonil+mefenoxam+azoxystrobin) and the seed-applied insecticide Cruiser 25mg/kernel) was used as the base hybrid.

Granular insecticides were applied through specially modified, bench-calibrated Noble® metering units as T-band or as in-furrow treatments. Fortress 5G and Counter 15G were applied using an AMVAC SmartBox® applicator that had been modified to hold 1 pound of formulated product. Granular T-band applications were placed in front of the furrow-closure wheels using 4-inch skirted all terrain, plastic diffusers. The band coverage pattern was approximately five inches wide over an open furrow. In-furrow treatments were directed into the open furrow using 3/4-inch ID Tygon® tubing.

Liquid formulations were applied with CO2 propellant at 5 gpa using a TeeJet 80015 nozzle at 11 psi. Liquid T-band treatments had a coverage pattern of approximately five inches wide over an open furrow. Liquid formulations were agitated immediately prior to each application. Seed treatments and transgenic hybrids were planted using a modified seeder constructed from a standard John Deere finger pickup seed meter attached to a planter unit adapter frame and attached to a JD MaxEmerge 7000. The seeder was modified to contain and dispense about 4 ounces of seed.

All treatments were incorporated by a gang of five straight 5/16-inch diameter steel drag chains about eight inches long attached behind each furrow closure wheel.

Evaluation Procedures

Phytotoxicity:

Plant stand establishment was assessed to determine whether any of the insecticide treatments caused significant plant population reductions and to determine the occurrence and impact of additional insect pests. The number of healthy plants per 40 feet was recorded from each plot (4 replicates). In addition to stand counts, extended leaf heights of 10 randomly selected corn plants were measured and averaged for each replicate. This was an estimate of seedling vigor.

Larval Damage:

Five root systems were sampled and damage scores averaged from each plot (4 replicates). Each root system was washed and assigned a root damage rating.

Roots were rated using the node injury scale (Oleson et al. 2005. J. Econ. Entomol. 98:1) which had been slightly modified. The modification was that roots were declared pruned at 1.5 inches from the stalk instead of 2 inches.

Damage Rating	Description
0.00	No feeding damage (lowest rating that can be given).
1.00	One node of roots, or the equivalent of an entire node, eaten back to within approximately 1.5 inches of the stalk (soil line on the 7th node).
2.00	Two nodes eaten.
3.00	Three or more nodes eaten. (highest rating)

Damage between complete nodes is the estimated percentage of the node missing, i.e. 1.50 = 1 1/2 nodes eaten, 0.25 = 1/4 of one node eaten, etc.

Plant Lodging:

Number of plants leaning greater than 45 degrees beginning below the ear (stalk lodging) per 25 consecutive plants were counted for each plot.

Consistency of Performance:

The proportion of roots (n=5) that were rated less than or equal to 0.25 on the node injury scale was calculated per replicate. The replicates (n=4) were averaged for each test entry to provide a measure of the frequency of root ratings at or below the conventional values of the economic injury level. The arcsine square root transformation was used to adjust the variances prior to mean separation. The means of the angles were back-transformed to the original units.

Analyses:

Tukeys multiple stage test (a=0.05) was used to separate treatment means only where significant ANOVA F test occurred (P≤0.05). The ANOVA and mean separations for the consistency data (proportion of roots at or below 0.25 rating) were performed on transformed data (arcsine square root). The original means are shown. Data were segregated a-posteriori by hybrid family (Mycogen 2T780, and 2T777/89) and analyzed separately.

Weather Data:

Weather data are from the Purdue Agricultural Automated Weather Station located at the test site (Appendix I). These data include precipitation, daily maximum and minimum air and soil temperatures from April-November.

Discussion and Results:

This trial was planted atypically late due to wet conditions. Severe soil compaction was prevalent resulting in surface and furrow sidewall restriction of root growth. Seed germination and seedling growth was slow. Plant maturation in late summer was also slow. Grass weeds became common in late summer. General weather conditions for the growing season were cool and damp early, and cool and dry late. July had record cool conditions. Western corn rootworm beetle egg hatch occurred about 1 June. Adult emergence was approximately 2 weeks later than normal (about 15 July). Larval and adult abundance was generally below average for the entire season. A natural drainage pattern in the test field resulted in an exceptionally wet zone across most of Replicate 2. Erosion and long periods of saturated conditions biased product performance and an attempt was made to avoid the most severely affected portions of this area. An equipment failure resulted in the loss of data for treatment 21/rep 1.

There were no differences (P=0.05) among treatments for plant vigor measurements (stand/extended leaf height). Although nearly an entire node of roots were pruned in the controls (=seed treatments only) there were no differences (P=0.05) compared to the other

insecticide treatments. The performance of T-Band applications for reduction of rootworm injury to corn roots tended to be slightly erratic while the furrow applications tended to be consistently efficacious. Lodging (plants leaning greater than 45° below the ear) was rare on 26 October 2009. Only tabular data are provided (Table 9).

Test Information

Test name and location: Experimental and Registered Products, Small Plots, Throckmorton-Purdue Agricultural Center, Lafayette, IN.

Planting Date: 1 June 2009

Base Hybrid: Mycogen 2T780+Cruiser 0.25mg/Maxim XL/Apron XL

Row width: 30"

Planter Population: 27,700 kernels per acre

Soil Type: Chalmers silt loam

Soil Properties: Organic matter; 3.3%
pH; 6.5
CEC: 12.3
Texture: 19.2% sand, 64.4% silt, 16.4% clay

Tillage: Field cultivator, 26 May 2009

Conditions at planting: air temp; 83°F
2" soil temp; 72°F
wind dir and spd; SE 10-16 mph

Previous crop: corn (trap crop)

Previous year insecticide: none

Herbicides: Degree Xtra, 3.5 qt/a, 30 June 2009;
Moxy 2E, 6.0 oz/a + Callisto, 3.0 oz + Arrow Four surfactant 3 qt/100 gal, 7 July 2009;
Accent, 0.66 oz + 1 qt NIS/100 gal, 7 July 2009

Fertilizers: 180 lbs N/acre (UAN 28%) pre-plant, 26 May 2009.

Trial design and machinery setup:

RCBD, 4 reps, single row, 100 ft plots, JD Max-emerge 7000 planter. Granule application in a T-Band was by modified Noble meter with plastic all terrain, 4 inch diffuser over an open furrow. In-furrow granule application was applied with a modified Noble meter or the AMVAC SmartBox® system (where noted) using 0.75 inch diameter plastic tubing (Tygon®) directed to the center of the open furrow. Liquid treatments were applied at 5 gpa using a TeeJet 80015 nozzle at 11 psi over an open furrow. All planting and chemical applications were made at 3 mph.

Table 1. **Stand counts** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

No. Treatment	Rate & Application[2]	Plants per 40 ft Mean[3]	SEM
01 Aztec 2.1G	0.14 TB	49.25 a	4.385
02 Aztec 2.1G	0.14 IF	51.75 a	3.637
03 Force 3G	0.12 TB	51.50 a	2.958
04 Force 3G	0.12 IF	54.75 a	3.038
05 Lorsban 15G	1.20 TB	49.25 a	4.049
06 Lorsban 15G	1.20 IF	46.25 a	7.432
07 Aztec 4.67 G SB	0.14 IF	52.75 a	3.449
08 Fortress 5G SB	0.15 IF	49.50 a	4.173
09 Counter 20G SB	1.20 IF	49.50 a	6.144
10 C/P		49.50 a	1.848
11 Capture LFR	0.10 IF	46.75 a	4.029
12 Capture LFR	0.036 IF	51.50 a	7.240
13 Poncho 1250	1.25mg CS	46.00 a	7.326
14 Check Poncho 250	0.25mg CS	45.00 a	2.483
22 Check Cruiser 250	0.25mg CS	41.00 a	4.340
18 2T777 HX		55.50 a	2.255
18L 2T777 HX+Lorsban 15G	1.20 TB	55.50 a	2.363
21 2T789 HXX		43.00 a	5.686

[1] Planted, 1 June 2009; Sampled, 25 June 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] Different hybrid groupings were analyzed independently. Means followed by a similar letter are not significantly different based on ANOVA: hybrid 2T780 (F=1.07, P=0.414); hybrids 2T777 and 2T789 (F=2.64, P=0.165).

Table 2. **Stand counts replication** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

No. Treatment	Rate & Application[2]		Plants per 40 ft Rep1	Rep2	Rep3	Rep4
01 Aztec 2.1G	0.14	TB	38	47	54	58
02 Aztec 2.1G	0.14	IF	45	46	57	59
03 Force 3G	0.12	TB	47	46	58	55
04 Force 3G	0.12	IF	50	49	60	60
05 Lorsban 15G	1.20	TB	40	45	55	57
06 Lorsban 15G	1.20	IF	47	25	56	57
07 Aztec 4.67 G SB	0.14	IF	51	44	56	60
08 Fortress 5G SB	0.15	IF	39	48	52	59
09 Counter 20G SB	1.20	IF	44	35	62	57
10 C/P			45	48	53	52
11 Capture LFR	0.10	IF	44	46	39	58
12 Capture LFR	0.036	IF	47	34	68	57
13 Poncho 1250	1.25	CS	47	25	57	55
14 Check Poncho 250	0.25	CS	39	48	50	43
22 Check Cruiser 250	0.25	CS	39	42	52	31
18 2T777 HX			55	56	61	50
18L 2T777 HX+Lorsban 15G	1.20	TB	55	49	59	59
21 2T789 HXX		PIP	nd	54	35	40

[1] Planted, 1 June 2009; Sampled, 25 June 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

nd= no data

Table 3. **Plant height (vigor)** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

No. Treatment	Rate & Application[2]		Extended Leaf Height (cm) Mean[3]	SEM
01 Aztec 2.1G	0.14	TB	48.65 a	1.069
02 Aztec 2.1G	0.14	IF	46.00 a	1.351
03 Force 3G	0.12	TB	48.13 a	1.145
04 Force 3G	0.12	IF	49.15 a	1.212
05 Lorsban 15G	1.20	TB	47.25 a	1.229
06 Lorsban 15G	1.20	IF	46.48 a	1.193
07 Aztec 4.67 G SB	0.14	IF	48.20 a	1.088
08 Fortress 5G SB	0.15	IF	49.35 a	1.122
09 Counter 20G SB	1.20	IF	48.25 a	1.299
10 C/P			47.33 a	1.326
11 Capture LFR	0.10	IF	49.98 a	1.121
12 Capture LFR	0.036	IF	49.60 a	1.269
13 Poncho 1250	1.25	CS	46.88 a	1.430
14 Check Poncho 250	0.25	CS	46.65 a	1.250
22 Check Cruiser 250	0.25	CS	47.13 a	1.432
18 2T777 HX			49.15 a	1.054
18L 2T777 HX+Lorsban 15G	1.20	TB	51.85 a	1.117
21 2T789 HXX		PIP	50.67 a	1.017

[1] Planted, 1 June 2009; Sampled, 25 June 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] Different hybrid groupings were analyzed independently. Means followed by a similar letter are not significantly different based ANOVA: hybrid 2T780 (F=1.43, P=0.180); hybrids 2T777 and 2T789 (F=0.98, P=0.438).

Table 4. **Plant height (vigor) replication** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

No.	Treatment	Rate & Application[2]		Extended Leaf Height (cm)[3] Rep1	Rep2	Rep3	Rep4
01	Aztec 2.1G	0.14	TB	44.0	46.3	53.5	50.8
02	Aztec 2.1G	0.14	IF	39.9	41.0	50.7	52.4
03	Force 3G	0.12	TB	43.7	42.8	52.3	53.7
04	Force 3G	0.12	IF	43.8	49.1	51.1	52.6
05	Lorsban 15G	1.20	TB	43.2	44.1	52.5	49.2
06	Lorsban 15G	1.20	IF	42.2	41.3	52.5	49.9
07	Aztec 4.67 G SB	0.14	IF	42.5	46.8	48.9	54.6
08	Fortress 5G SB	0.15	IF	43.2	49.6	53.8	50.8
09	Counter 20G SB	1.20	IF	46.9	42.8	50.5	52.8
10	C/P			38.6	46.1	51.8	52.8
11	Capture LFR	0.10	IF	44.4	46.1	54.9	54.5
12	Capture LFR	0.036	IF	40.9	49.8	55.4	52.3
13	Poncho 1250	1.25mg	CS	40.7	45.2	51.7	49.9
14	Check Poncho 250	0.25mg	CS	42.5	43.8	51.3	49.0
22	Check Cruiser 250	0.25mg	CS	42.8	42.5	53.2	50.0
18	2T777 HX			47.7	47.2	48.4	53.3
18L	2T777 HX+Lorsban 15G	1.20	TB	49.2	50.9	57.3	50.0
21	2T789 HXX		PIP	nd	48.3	52.1	51.6

[1] Planted, 1 June 2009; Sampled, 25 June 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] A replicate is the average of 10 observations.

nd=no data

Table 5. **Root ratings** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

No. Treatment	Rate & Application[2]		Node Injury Scale Mean[3]	SEM
01 Aztec 2.1G	0.14	TB	0.270 a	0.1155
02 Aztec 2.1G	0.14	IF	0.083 a	0.0110
03 Force 3G	0.12	TB	0.283 a	0.0578
04 Force 3G	0.12	IF	0.310 a	0.0739
05 Lorsban 15G	1.20	TB	0.370 a	0.1068
06 Lorsban 15G	1.20	IF	0.175 a	0.0457
07 Aztec 4.67 G SB	0.14	IF	0.175 a	0.0341
08 Fortress 5G SB	0.15	IF	0.125 a	0.0349
09 Counter 20G SB	1.20	IF	0.178 a	0.0494
10 C/P			0.290 a	0.0882
11 Capture LFR	0.10	IF	0.343 a	0.0934
12 Capture LFR	0.036	IF	0.288 a	0.0588
13 Poncho 1250	1.25	CS	0.245 a	0.0594
14 Check Poncho 250	0.25	CS	0.901 a	0.2160
22 Check Cruiser 250	0.25	CS	0.920 a	0.2275
18 2T777 HX			0.468 a	0.1266
18L 2T777 HX+Lorsban 15G	1.20	TB	0.355 a	0.1862
21 2T789 HXX		PIP	0.100 a	0.0203

[1] Planted, 1 June 2009; Sampled, 28 July 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] Different hybrid groupings were analyzed independently. Means followed by a similar letter are not significantly different based on general linear model ANOVA method: hybrid 2T780 (F=2.04, P=0.038); hybrids 2T777 and 2T789 (F=1.05, P=0.420).

Table 6. Preliminary **root rating replication** for experimental and registered soil insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780 + Cruiser 0.25mg/kernel unless noted otherwise.

No. Treatment	Rate & Application[2]		Node Injury Scale[3] Rep1	Rep2	Rep3	Rep4
01 Aztec 2.1G	0.14	TB	0.78	0.10	0.12	0.08
02 Aztec 2.1G	0.14	IF	0.05	0.14	0.07	0.07
03 Force 3G	0.12	TB	0.16	0.46	0.14	0.37
04 Force 3G	0.12	IF	0.39	0.34	0.09	0.42
05 Lorsban 15G	1.20	TB	0.39	0.63	0.07	0.39
06 Lorsban 15G	1.20	IF	0.13	0.22	0.22	0.13
07 Aztec 4.67 G SB	0.14	IF	0.11	0.25	0.27	0.07
08 Fortress 5G SB	0.15	IF	0.24	0.10	0.07	0.09
09 Counter 20G SB	1.20	IF	0.15	0.37	0.06	0.13
10 C/P			0.10	0.85	0.09	0.12
11 Capture LFR	0.10	IF	0.25	0.88	0.10	0.14
12 Capture LFR	0.036	IF	0.38	0.50	0.18	0.09
13 Poncho 1250	1.25	CS	0.36	0.40	0.10	0.12
14 Check Poncho 250	0.25	CS	0.39	2.20	0.14	0.88
22 Check Cruiser 250	0.25	CS	0.62	2.45	0.14	0.47
18 2T777 HX			0.63	0.14	0.40	0.70
18L 2T777 HX+Lorsban 15G	1.20	TB	0.90	0.26	0.09	0.17
21 2T789 HXX		PIP	nd	0.14	0.08	0.10

[1] Planted, 1 June 2009; Sampled, 28 July 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] A replicate is the average of 5 observations.

nd=no data

Table 7. **Root ratings consistency of performance** for experimental and registered insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Crusier 0.25mg/kernel unless noted otherwise.

No.	Treatment	Rate & Application[2]		Percent Rating ≤ 0.25 Mean[3]	SEM
01	Aztec 2.1G	0.14	TB	85.0 a	0.15
02	Aztec 2.1G	0.14	IF	100.0 a	0.00
03	Force 3G	0.12	TB	80.0 a	0.12
04	Force 3G	0.12	IF	70.0 a	0.13
05	Lorsban 15G	1.20	TB	75.0 a	0.10
06	Lorsban 15G	1.20	IF	90.0 a	0.06
07	Aztec 4.67 G SB	0.14	IF	85.0 a	0.10
08	Fortress 5G SB	0.15	IF	95.0 a	0.05
09	Counter 20G SB	1.20	IF	90.0 a	0.10
10	C/P			80.0 a	0.20
11	Capture LFR	0.10	IF	75.0 a	0.19
12	Capture LFR	0.036	IF	70.0 a	0.13
13	Poncho 1250	1.25	CS	80.0 a	0.12
14	Check Poncho 250	0.25	CS	50.0 a	0.21
22	Check Cruiser 250	0.25	CS	50.0 a	0.21
18	2T777 HX			60.0 a	0.22
18L	2T777 HX+Lorsban 15G	1.20	TB	65.0 a	0.23
21	2T789 HXX		PIP	100.0 a	0.00

[1] Planted, 1 June 2009; Sampled, 28 July 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] Different hybrid groupings were analyzed independently. Means followed by a similar letter are not significantly different based on general linear model ANOVA method: hybrid 2T780 (F=1.58, P=0.126); hybrids 2T777 and 2T789 (F=0.83, P=0.489).

Table 8. **Root rating consistency replication** (raw data) for experimental and registered insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Crusier 0.25mg/kernel unless noted otherwise.

No.	Treatment	Rate & Application[2]	Percentage Rating ≤ 0.25[3] Rep1	Rep2	Rep3	Rep4
01	Aztec 2.1G	0.14 TB	40	100	100	100
02	Aztec 2.1G	0.14 IF	100	100	100	100
03	Force 3G	0.12 TB	100	60	100	60
04	Force 3G	0.12 IF	60	80	100	40
05	Lorsban 15G	1.20 TB	60	60	100	80
06	Lorsban 15G	1.20 IF	100	80	80	100
07	Aztec 4.67 G SB	0.14 IF	100	80	60	100
08	Fortress 5G SB	0.15 IF	80	100	100	100
09	Counter 20G SB	1.20 IF	100	60	100	100
10	C/P		100	20	100	100
11	Capture LFR	0.10 IF	80	20	100	100
12	Capture LFR	0.036 IF	60	40	80	100
13	Poncho 1250	1.25 CS	60	60	100	100
14	Check Poncho 250	0.25 CS	60	0	100	40
22	Check Cruiser 250	0.25 CS	60	0	100	40
18	2T777 HX		60	100	80	0
18L	2T777 HX+Lorsban 15G	1.20 TB	0	80	100	80
21	2T789 HXX	PIP	nd	100	100	100

[1] Planted, 1 June 2009; Sampled, 28 July 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

[3] A replicate is based on 5 observations.

nd=no data

Table 9. **Stalk lodging** (raw data) for experimental and registered insecticides for control of corn rootworm larvae at Throckmorton-Purdue Agricultural Center, Lafayette, IN, 2009[1].

Hybrid was 2T780+Crusier 0.25mg/kernel unless noted otherwise.

No.	Treatment	Rate & Application[2]	Plants > 45°(n=25) Rep1	Rep2	Rep3	Rep4	Avg
01	Aztec 2.1G	0.14 TB	0	0	0	0	0.00
02	Aztec 2.1G	0.14 IF	0	0	0	0	0.00
03	Force 3G	0.12 TB	2	1	0	1	1.00
04	Force 3G	0.12 IF	0	3	0	0	0.00
05	Lorsban 15G	1.20 TB	0	0	0	0	0.00
06	Lorsban 15G	1.20 IF	0	0	0	0	0.00
07	Aztec 4.67 G SB	0.14 IF	0	0	0	0	0.00
08	Fortress 5G SB	0.15 IF	0	0	0	2	0.50
09	Counter 20G SB	1.20 IF	0	0	0	0	0.00
10	C/P		0	0	0	1	0.25
11	Capture LFR	0.10 IF	0	0	0	0	0.00
12	Capture LFR	0.036 IF	0	0	0	0	0.00
13	Poncho 1250	1.25 CS	0	0	0	0	0.00
14	Check Poncho 250	0.25 CS	0	0	0	0	0.00
22	Check Cruiser 250	0.25 CS	0	0	0	0	0.00
18	2T777 HX		0	1	0	1	0.50
18L	2T777 HX+Lorsban 15G	1.20 TB	0	0	0	1	0.25
21	2T789 HXX	PIP	nd	0	0	0	0.00

[1] Planted, 1 June 2009; Sampled, 15 September 2009.

[2] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

nd=no data

Table 10. **Root ratings** per root. Node injury scale. Lafayette, IN. 28 July 2009. Hybrid was 2T780+Cruiser 0.25mg/kernel unless noted otherwise.

1	Aztec 2.1G	0.14 TB	1.00	0.05	2.25	0.10	0.50	0.78	0.405
3	Force 3G	0.12 TB	0.10	0.25	0.10	0.10	0.25	0.16	0.037
5	Lorsban 15G	1.20 TB	1.00	0.25	0.50	0.05	0.15	0.39	0.170
7	Aztec 4.67G SB	0.14 IF	0.10	0.10	0.10	0.05	0.20	0.11	0.024
9	Counter 20G SB	1.20 IF	0.25	0.25	0.10	0.05	0.10	0.15	0.042
11	Capture LFR	0.10 IF	0.25	0.50	0.20	0.10	0.20	0.25	0.067
13	Poncho 1250	1.25 CS	0.75	0.10	0.10	0.10	0.75	0.36	0.159
22	Check Cruiser 250	0.25 CS	0.20	0.20	0.20	1.00	1.50	0.62	0.269
18L	2T777 HX+Lorsban 15G	1.20 TB	0.50	0.50	1.25	1.25	1.00	0.90	0.170

1	Aztec 2.1G	0.14 TB	0.05	0.15	0.10	0.10	0.10	0.10	0.035
3	Force 3G	0.12 TB	0.25	1.00	0.15	0.75	0.15	0.46	0.391
5	Lorsban 15G	1.20 TB	0.25	0.15	1.50	1.00	0.25	0.63	0.594
7	Aztec 4.67G SB	0.14 IF	0.10	0.25	0.15	0.25	0.50	0.25	0.154
9	Counter 20G SB	1.20 IF	0.50	0.10	0.10	1.00	0.15	0.37	0.390
11	Capture LFR	8.5 IF	0.50	1.00	1.50	1.25	0.15	0.88	0.551
13	Poncho 1250	1.25 CS	0.75	0.20	0.20	0.75	0.10	0.40	0.322
22	Check Cruiser 250	0.25 CS	2.50	1.50	3.00	3.00	2.25	2.45	0.622
18L	2T777 HX+Lorsban 15G	1.20 TB	0.25	0.10	0.15	0.75	0.05	0.26	0.127

[1] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

Table 10 continued. **Root ratings** per root. Node injury scale. Lafayette, IN. 28 July 2009. Hybrid was 2T780 + Crusier 0.25mg/kernel unless noted otherwise.

1	Aztec 2.1G	0.14 TB	0.25	0.10	0.10	0.10	0.05	0.12	0.076
3	Force 3G	0.12 TB	0.10	0.15	0.15	0.20	0.10	0.14	0.042
5	Lorsban 15G	1.20 TB	0.10	0.05	0.05	0.05	0.10	0.07	0.027
7	Aztec 4.67G SB	0.14 IF	0.10	0.50	0.15	0.50	0.10	0.27	0.211
9	Counter 20G SB	1.20 IF	0.05	0.10	0.05	0.00	0.10	0.06	0.042
11	Capture LFR	0.10 IF	0.15	0.05	0.05	0.15	0.10	0.10	0.050
13	Poncho 1250	1.25 CS	0.00	0.15	0.05	0.10	0.20	0.10	0.079
22	Check Cruiser 250	0.25 CS	0.15	0.10	0.15	0.20	0.10	0.14	0.042
18L	2T777 HX+Lorsban 15G	1.20 TB	0.05	0.05	0.10	0.10	0.15	0.09	0.019

1	Aztec 2.1G	0.14 TB	0.00	0.15	0.05	0.05	0.15	0.08	0.067
3	Force 3G	0.12 TB	0.75	0.15	0.25	0.20	0.50	0.37	0.251
5	Lorsban 15G	1.20 TB	0.10	0.20	0.10	0.05	1.50	0.39	0.623
7	Aztec 4.67G SB	0.14 IF	0.05	0.15	0.05	0.05	0.05	0.07	0.045
9	Counter 20G SB	1.20 IF	0.10	0.10	0.10	0.20	0.15	0.13	0.045
11	Capture LFR	0.10 IF	0.05	0.20	0.20	0.15	0.10	0.14	0.065
13	Poncho 1250	1.25 CS	0.10	0.20	0.05	0.05	0.20	0.12	0.076
22	Check Cruiser 250	0.25 CS	1.00	0.50	0.50	0.15	0.20	0.47	0.338
18L	2T777 HX+Lorsban 15G	1.20 TB	0.05	0.10	0.15	0.50	0.05	0.17	0.085

[1] Rates for granules and liquids=oz ai/1000 ft and for seed treatment=mg/kernel; applications are T-band=TB, SmartBox=SB, coated seed=CS, in-furrow=IF, and plant incorporated protectant=PIP.

Appendix I. Weather Observations 2009

Table A1. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

April 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
05/01	0.15	49	54	41	46	46
05/02	0.04	47	58	37	46	46
05/03	0.54	56	70	46	50	48
05/04	0.10	44	51	37	47	47
05/05	0.00	44	58	30	47	47
05/06	0.33	45	50	38	46	46
05/07	0.01	35	43	32	42	44
05/08	0.00	37	46	30	41	42
05/09	0.00	48	54	39	47	45
05/10	0.00	48	59	32	47	46
05/11	0.12	44	51	37	46	46
05/12	0.00	42	54	33	46	46
05/13	0.00	45	56	29	46	45
05/14	0.26	42	46	38	44	44
05/15	0.16	42	45	40	44	45
05/16	0.01	45	53	38	46	45
05/17	0.00	52	64	39	51	48
05/18	0.00	57	72	38	54	51
05/19	0.00	62	76	45	56	53
05/20	0.21	56	62	50	56	54
05/21	0.04	48	56	42	52	52
05/22	0.01	42	44	37	47	48
05/23	0.00	49	64	36	47	48
05/24	0.00	55	70	38	51	49
05/25	0.00	71	83	59	61	54
05/26	0.00	74	84	66	66	58
05/27	0.00	74	84	63	67	59
05/28	0.07	70	81	64	67	60
05/29	0.26	58	65	52	62	59
05/30	0.00	56	63	49	60	57

Table A2. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

May 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
05/01	0.68	65	71	58	62	59
05/02	0.34	57	64	47	61	60
05/03	0.00	55	65	47	59	57
05/04	0.00	59	71	49	61	58
05/05	0.00	60	70	47	61	57
05/06	0.00	62	76	48	62	58
05/07	0.04	58	62	51	60	58
05/08	0.24	62	78	50	62	59
05/09	0.18	63	69	58	62	61
05/10	0.00	59	65	51	60	59
05/11	0.00	57	67	43	59	58
05/12	0.00	55	66	44	61	59
05/13	0.00	58	70	44	63	59
05/14	0.44	61	69	53	60	58
05/15	0.13	64	70	54	65	62
05/16	0.02	64	77	49	62	61
05/17	0.06	60	64	48	63	62
05/18	0.04	52	62	40	59	59
05/19	0.02	55	67	38	60	59
05/20	0.01	63	76	47	62	61
05/21	0.00	69	83	53	66	63
05/22	0.00	72	84	56	70	65
05/23	0.00	75	87	65	72	67
05/24	0.01	73	87	60	73	68
05/25	0.00	73	86	60	73	68
05/26	0.00	67	71	63	70	66
05/27	0.03	72	86	58	71	66
05/28	0.00	74	85	67	73	69
05/29	0.04	63	69	58	69	66
05/30	0.00	65	79	52	69	65
05/31	0.11	67	80	51	69	64

Table A3. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

June 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
06/01	0.00	66	78	53	69	65
06/02	0.33	72	91	61	69	65
06/03	0.11	68	78	61	71	68
06/04	0.42	58	64	51	65	65
06/05	0.00	59	69	47	64	64
06/06	0.00	64	77	47	65	64
06/07	0.00	69	80	56	67	66
06/08	0.00	72	81	62	68	66
06/09	0.12	74	81	66	69	68
06/10	0.00	70	80	62	71	70
06/11	0.00	71	81	61	72	69
06/12	1.05	69	78	62	71	70
06/13	0.00	68	76	60	72	71
06/14	0.00	70	80	61	72	71
06/15	0.00	72	82	61	72	72
06/16	0.00	71	79	62	71	70
06/17	0.28	69	72	66	69	69
06/18	0.00	74	83	66	72	71
06/19	0.11	72	83	63	72	72
06/20	1.10	79	91	69	75	75
06/21	0.00	77	87	69	76	75
06/22	0.01	77	83	70	75	75
06/23	0.12	79	90	71	77	77
06/24	0.00	80	89	69	78	78
06/25	0.00	82	95	70	78	78
06/26	0.00	83	92	72	79	78
06/27	0.00	81	91	68	78	78
06/28	0.00	77	90	62	76	76
06/29	0.00	76	83	66	76	75
06/30	0.00	72	82	62	73	71

Table A4. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

July 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
07/01	0.00	66	74	58	73	70
07/02	0.00	63	70	60	71	68
07/03	0.00	67	74	60	72	68
07/04	0.00	69	80	56	75	69
07/05	0.09	65	70	62	69	68
07/06	0.01	70	81	63	73	70
07/07	0.01	72	84	60	78	72
07/08	0.02	73	85	62	81	74
07/09	0.01	68	75	63	75	72
07/10	0.08	69	80	62	75	72
07/11	0.00	76	85	65	78	74
07/12	0.73	74	80	68	75	73
07/13	0.01	71	82	62	74	74
07/14	0.00	72	83	59	77	74
07/15	0.00	69	82	55	77	73
07/16	0.20	73	84	64	75	73
07/17	0.00	72	82	64	77	74
07/18	0.00	66	72	59	75	71
07/19	0.00	63	72	56	72	68
07/20	0.00	64	73	56	72	69
07/21	0.00	67	80	53	74	70
07/22	0.00	69	81	55	76	71
07/23	0.01	65	69	63	71	70
07/24	0.00	69	80	60	75	71
07/25	0.00	71	83	57	76	71
07/26	0.18	70	80	64	74	72
07/27	0.00	70	80	61	73	71
07/28	0.00	72	82	60	75	72
07/29	0.10	72	85	65	76	73
07/30	0.00	71	79	62	75	73
07/31	0.00	68	79	57	75	72

Table A5. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

August 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
08/01	0.00	69	80	60	78	72
08/02	0.05	68	78	58	74	71
08/03	0.00	67	76	58	76	71
08/04	0.00	71	83	58	76	71
08/05	0.16	71	80	64	73	71
08/06	0.00	72	83	62	75	73
08/07	0.00	68	80	55	75	72
08/08	0.00	68	78	57	73	71
08/09	0.00	77	87	66	77	73
08/10	0.00	80	89	74	82	76
08/11	0.00	78	86	70	83	77
08/12	0.00	75	85	65	81	76
08/13	0.00	70	83	58	78	73
08/14	0.00	72	87	56	79	74
08/15	0.00	74	87	62	81	75
08/16	0.00	76	87	62	81	76
08/17	0.00	78	89	71	82	77
08/18	0.15	77	87	71	81	77
08/19	0.00	73	82	66	77	76
08/20	0.24	73	85	65	76	75
08/21	0.24	71	78	63	73	73
08/22	0.02	66	76	59	70	71
08/23	0.00	62	69	56	68	69
08/24	0.00	63	72	54	67	68
08/25	0.00	66	80	52	70	69
08/26	0.00	69	81	55	72	71
08/27	0.00	70	81	57	72	71
08/28	0.00	73	84	64	75	72
08/29	0.32	67	70	64	72	71
08/30	0.00	63	71	54	69	69
08/31	0.00	59	70	50	65	66

Table A6. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

September 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
09/01	0.00	58	73	44	65	65
09/02	0.00	60	72	47	65	64
09/03	0.00	63	77	47	66	64
09/04	0.00	66	81	52	69	66
09/05	0.00	68	83	55	70	68
09/06	0.00	69	82	57	71	68
09/07	0.00	68	75	63	71	68
09/08	0.00	67	79	59	73	69
09/09	0.03	65	77	54	71	68
09/10	0.01	68	79	62	71	68
09/11	0.00	70	82	59	73	69
09/12	0.00	68	81	57	74	69
09/13	0.00	65	79	53	73	67
09/14	0.00	65	80	53	73	67
09/15	0.00	67	84	50	74	67
09/16	0.00	71	85	56	75	68
09/17	0.00	68	79	56	74	69
09/18	0.00	62	76	49	71	66
09/19	0.00	64	80	48	71	65
09/20	0.00	65	78	53	71	65
09/21	0.00	65	76	54	69	65
09/22	0.00	70	79	64	72	68
09/23	0.00	73	85	63	73	69
09/24	0.00	72	83	63	74	70
09/25	0.05	67	69	64	71	69
09/26	0.02	63	66	59	67	66
09/27	0.00	63	75	53	67	66
09/28	0.00	62	73	50	66	65
09/29	0.00	60	70	52	64	62
09/30	0.00	54	61	50	63	60

Table A7. Throckmorton-Purdue Agricultural Center, Lafayette, IN.

October 2009

Date	Precip (inch)	Air (degF)	Max Air (degF)	Min Air (degF)	Soil Bare°F	Soil GrassF°
10/01	0.00	55	67	44	65	61
10/02	0.34	52	63	38	59	57
10/03	0.04	55	60	50	57	58
10/04	0.02	51	55	48	54	55
10/05	0.00	51	64	42	55	55
10/06	0.00	52	69	36	56	55
10/07	0.05	55	64	46	55	56
10/08	0.00	52	62	46	55	55
10/09	0.82	50	53	43	52	53
10/10	0.40	51	53	45	54	54
10/11	0.00	45	56	34	51	53
10/12	0.00	41	51	33	49	51
10/13	0.02	47	55	40	50	51
10/14	0.00	48	53	44	52	52
10/15	0.05	44	47	41	48	49
10/16	0.07	41	43	39	46	48
10/17	0.01	42	48	36	47	48
10/18	0.00	42	51	36	46	47
10/19	0.00	43	55	29	47	47
10/20	0.00	51	66	36	48	48
10/21	0.00	57	72	48	53	51
10/22	0.00	58	71	50	55	53
10/23	0.18	58	67	51	55	54
10/24	0.81	57	68	47	58	57
10/25	0.02	44	53	38	49	52
10/26	0.00	53	67	38	50	51
10/27	0.00	57	71	50	54	53
10/28	0.11	51	54	49	53	54
10/29	0.00	53	62	46	54	54
10/30	0.00	57	64	46	54	54
10/31	0.36	62	68	52	59	58