SECTION 3

Evaluation of Force 2.1CS, SmartStax, and a seed-blend to control corn rootworm larvae (*Diabrotica spp.*) in Illinois, 2011

Ronald E. Estes, Nicholas A. Tinsley, and Michael E. Gray

Location

We established one trial at the University of Illinois Agricultural Engineering Farm near Urbana (Champaign County).

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 10 ft (four rows) x 40 ft. For the seed-blend, one root cluster was extracted from rows one and four of each plot on 13 July—each cluster contained a non-rootworm Bt refuge root system and four adjacent rootworm Bt root systems (Figure 3.1). For non-seed-blend treatments, five randomly selected root systems were extracted from rows one and four of each plot. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 was determined for each product. For the seed-blend treatment, a weighted formula was used to calculate the mean node-injury rating and percentage consistency.

Planting, Insecticide Application, and Yield

The trial was planted on 13 May using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Force 2.1CS was applied at a spray volume of 5 gallons per acre (gal/A) using a CO_2 system. The insecticide was applied in front of the firming wheels on the planter. Twisted drag chains were attached behind each of the row units to improve insecticide incorporation. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 8 October. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows had been thinned at the V7 growth stage to 32,000 plants per acre.

Agronomic Information

Agronomic information is listed in Table 3.1.

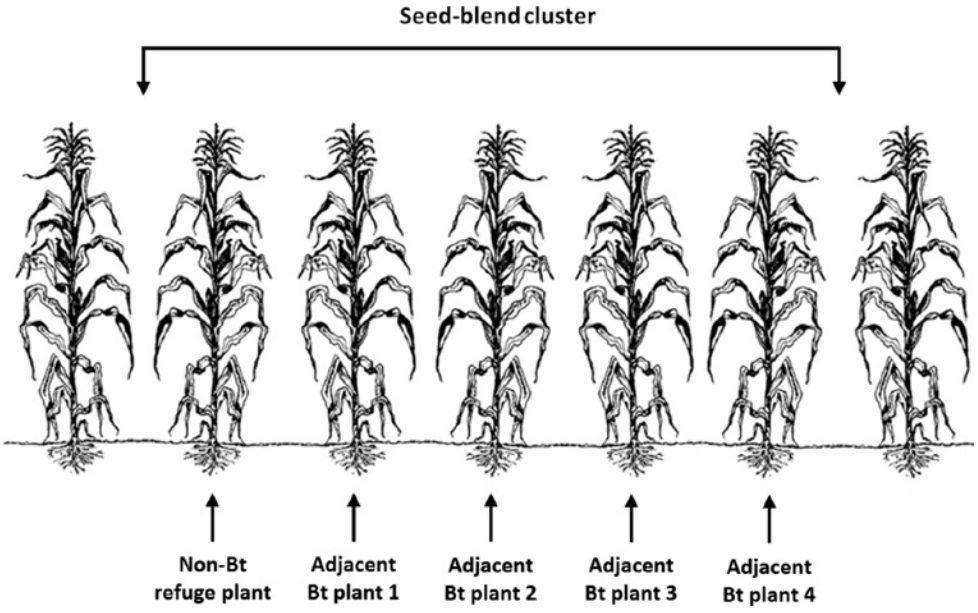

FIGURE 3.1 • Diagram of root cluster selection for the seed-blend treatment, Urbana, University of Illinois, 2011

TABLE 3.1 • Agronomic information for efficacy trial of Force 2.1CS, SmartStax, and a seed-blend to control corn rootworm larvae, Urbana, University of Illinois, 2011

Planting date	13 May
Root evaluation date	13 July
Harvest date	8 October
Hybrids	DKC61-21 DKC61-21JRM SmartStax RIB[1] (95/5) DKC61-22 RR2
Row spacing	30 inches
Seeding rate	36,000/acre
Previous crop	Trap crop[2]
Tillage	Fall—chisel plow Spring—field cultivator

[1] Refuge-in-the-bag (95% rootworm-Bt seed, 5% non-rootworm-Bt seed).
[2] Late-planted corn and pumpkins.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using SAS 9.2 (Copyright© 2002–2008 SAS Institute, Inc., Cary, NC).

Results and Discussion

Mean node-injury ratings, consistency percentages, and yield are reported in Table 3.2. The mean node-injury rating for the untreated check (UTC) was 0.75, indicating that corn rootworm larval feeding was low to moderate. Mean node-injury ratings for SmartStax and the seed-blend (95% DKC61-21 + 5% non-rootworm Bt hybrid), with and without the addition of Force 2.1CS, were very low and ranged from

TABLE 3.2 • Evaluation of Force 2.1CS, SmartStax, and a seed-blend to control corn rootworm larvae, Urbana, University of Illinois, 2011

Product	Rate[1]	Placement	Mean node-injury rating[2,3,4,5,6] 13 July	% consistency < 0.25[7,8]	Mean yield (bu/A)[9,10] 8 Oct
Force 2.1CS + DKC61-22[11]	0.46	Band	0.23 b	78	163 b
Force 2.1CS + SmartStax (DKC61-21[11])	0.46	Band	0.00 c	100	219 a
Force 2.1 CS + SmartStax RIB[12] (DKC61-21JRM[13])	0.46	Band	0.00 c	100	214 a
SmartStax (DKC61-21[11])	—	—	0.01 c	98	219 a
SmartStax RIB[12] (DKC61-21JRM[13])	—	—	0.02 c	98	208 a
UTC[14] (DKC61-22[11])	—	—	0.75 a	25	162 b

[1] Rates of application for Force 2.1CS are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] For non-seed-blend treatments, mean node-injury ratings were derived from ten root systems in each of four replications.
[4] For the seed-blend treatment, a weighted formula was used to calculate the mean node-injury rating.
[5] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[6] Data were analyzed using a square-root transformation; actual means are shown.
[7] Percentage of roots with a node-injury rating < 0.25.
[8] For the seed blend treatment, a weighted formula was used to calculate percentage consistency.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly ($P = 0.10$, PROC MIXED).
[11] Seed treated with Poncho (clothianidin), 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[12] RIB = refuge-in-the-bag (95% rootworm-Bt seed, 5% non-rootworm-Bt seed).
[13] Seed treated with Poncho (clothianidin), 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[14] UTC = untreated check.

0.00–0.02. All treatments had significantly lower node-injury ratings than the UTC, but Force 2.1CS by itself had significantly more root injury than SmartStax (and the seed-blend), with or without additional insecticide. The percentage of roots with a node-injury rating < 0.25 was very high for SmartStax and the seed-blend (98–100%), moderately high for Force 2.1CS by itself (78%), and very low for the UTC (25%). Yields in the SmartStax treatments ranged from 208 to 219 bu/A and were significantly greater than the UTC (162 bu/A). The yield of the Force treatment (163 bu/A) was not significantly different from the UTC.

Mean node-injury ratings for the root systems included in the root clusters for the seed-blend treatment are reported in Table 3.3. The mean node-injury rating for refuge root systems (0.26) was significantly greater than the adjacent Bt root systems (0.00–0.01) The mean node-injury ratings for the adjacent Bt root systems were statistically similar.

TABLE 3.3 • Spatial analysis of root-injury for seed-blend root clusters, Urbana, University of Illinois, 2011

Location[1]	Mean node-injury rating[2,3,4,5] 13 July
Refuge[6]	0.26 a
Adjacent 1 (DKC61-21[7])	0.01 b
Adjacent 2 (DKC61-21[7])	0.00 b
Adjacent 3 (DKC61-21[7])	0.00 b
Adjacent 4 (DKC61-21[7])	0.00 b

[1] Indicates location of root system within the root cluster (see Figure 3.1).
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] Mean node-injury ratings were derived from two root systems per plot in each of four replications.
[4] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[5] Data were analyzed using a square-root transformation; actual means are shown.
[6] The identity for the refuge hybrid used in DKC61-21JRM was not provided.
[7] Seed treated with Poncho (clothianidin), 0.25 milligrams (mg) of active ingredient (a.i.) per seed.