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Three-year summary of corn rootworm control products

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Abstract
During the past three summers, corn rootworm insecticides and YieldGard Rootworm® corn were evaluated in side-by-side trials at several locations across the state. These field trials measured performance in protecting corn roots under a wide range of environmental conditions. Performance was then measured as root injury, product consistency, plant lodging, and grain yield. The same corn hybrid (non-rootworm) was planted for all of the insecticide treatments at each location and year, plus a YieldGard RW® hybrid that contained the cry protein for corn rootworm control.

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Three-year summary of corn rootworm control products

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During the past three summers, corn rootworm insecticides and YieldGard Rootworm® corn were evaluated in side-by-side trials at several locations across the state. These field trials measured performance in protecting corn roots under a wide range of environmental conditions. Performance was then measured as root injury, product consistency, plant lodging, and grain yield.

The same corn hybrid (non-rootworm) was planted for all of the insecticide treatments at each location and year, plus a YieldGard RW® hybrid that contained the *cry* protein for corn rootworm control. All tests were planted on continuous corn ground that the previous year had been planted late to attract egg-laying females into the plots.

Roots were evaluated using the Iowa State Node-Injury Scale, which rates roots from 0 to 3 based on the number of nodes eaten. We used a node-injury score of 0.25 or less (¼ node eaten back to within 1½ inches of the stalk) to establish whether a product provided good root protection. The node-injury scale can be better understood by viewing the interactive root rating page, **http://www.ent.iastate.edu/pest/rootworm/nodeinjury/nodeinjury.html**.

Node Injury. The amount of injury from corn rootworm larvae was variable across the spectrum of products evaluated. YieldGard RW® provided the greatest root protection although it was not statistically better than Aztec® 2.1G applied in furrow. The two seed treatments, Cruiser® and Poncho®, used at the corn rootworm rate of 1.25 mg/seed had substantially more injury than most of the granule insecticides. Poncho® had nearly 1 full node damaged, and Cruiser® sustained slightly over 1½ nodes of injury.

A corn plant with a damage rating of 3 on the 0–3 Node-Injury Scale. ***(Marlin E. Rice)***

Product Consistency. Product consistency represents the percentage of times in which the roots had ¼ node or less eaten back to within 1½ inches of the stalk. This distinction allows a small amount of injury to occur without penalizing the performance of a product. If more than ¼ node was eaten on an evaluated corn

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plant, then the product was determined not to provide adequate root protection, and it was marked as being an inconsistent product in that particular test. Consistency works on the same principle as a batting average in baseball—the larger the number, the better the performance.

No product was 100 percent consistent in providing total root protection during 2003–2005; however, YieldGard RW® came very close at 99 percent (Table 1). Most of the granule insecticides gave similar levels of consistency (from a statistical standpoint), but these were at least 17 percent, or more, inconsistent than YieldGard RW®. The two seed treatments, Cruiser® and Poncho®, were very inconsistent in protecting corn roots and rated 8 and 21 percent, respectively.

Lodging and Stand Counts. Very little or no lodging occurred during the three-year study across most of the treatments. The one exception was the Cruiser®-treated plants where an average of 31 percent lodging occurred. This can easily be related to the high node-injury rating where 1.53 nodes were chewed off by the rootworm larvae. There were no differences in stand counts.

"Non-rootworm" corn (left) lodged by rootworms and standing "rootworm" corn (right) relatively unaffected by rootworm larvae. ***(Marlin E. Rice)***

Yields. YieldGard RW® averaged 21–33 bushels more grain than any of the insecticide treatments and 53 bushels more than the untreated check. Yields were statistically similar across all insecticides and varied by only 12 bushels. This was surprising considering the amount of root damage and inconsistency of the two seed treatments. A partial explanation may be gained by examining the performance during dry and wet summers. Under dry conditions, plants injured by corn rootworms suffer greater yield losses than when plants have adequate moisture (Table 2). When rainfall is adequate, the corn plant is able to get the necessary moisture and soil nutrients necessary to compensate for the root injury, and yield differences when compared to YieldGard RW® are less pronounced. Based on our data, when there is heavy rootworm feeding and drought conditions exist, significant yield losses can occur when as little as ¼ node of roots is eaten. Much greater root injury can be tolerated under normal to wet conditions.

In addition to the performance data shown here, there are other factors worthy of consideration when selecting a corn rootworm product to use next spring. These include cost, pounds of insecticide being applied to the environment, ease of handling, application equipment needed, other pests controlled, refuge requirements for YieldGard RW®, restricted use labeling on granule and liquid insecticides, potential hazards to surface water, or spray drift.

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Table 1. Three-year summary (2003–2005) of corn rootworm control products, Iowa State University (7 locations).

Treatment	Placement[1]	Node-Injury[2,3,4]	Product Consistency[2,4,5]	Percent Lodging[4,6]	Stand Count[7,8]	Yield (Bu/Acre)[4,9]
YieldGard RW	Transgenic	0.03 a	99 a	1 a	27.44	183 a
Aztec 2.1G	Furrow	0.24 ab	82 b	0 a	28.14	159 b
Aztec 4.67G	Furrow SB	0.28 bc	78 b	1 a	28.28	157 b
Force 3G	T-band	0.29 bc	76 bc	0 a	27.54	162 b
Aztec 2.1G	T-band	0.30 bc	75 bc	0 a	27.90	151 bc
Force 3G	Furrow	0.35 bcd	72 bc	0 a	28.02	159 b
Fortress 2.5G	Furrow	0.49 cd	68 bc	10 a	27.84	153 bc
Fortress 5G	Furrow SB	0.57 de	61 c	4 a	27.62	155 b
Lorsban 15G	T-band	0.80 ef	44 d	6 a	28.10	150 bc
Capture 2EC	T-band	0.80 ef	42 d	7 a	27.96	151 bc
Poncho ST	ST	0.98 f	21 e	6 a	27.24	158 b
Cruiser ST	ST	1.53 g	8 ef	31 b	27.71	152 bc
CHECK	—	2.00 h	2 f	40 c	27.38	130 c

[1]T-band and Furrow = insecticide applied at planting time; SB = SmartBox application; ST = seed treatment (1.25 mg/seed).

[2]Means based on 218 observations; replications with insufficient larval feeding pressure to challenge a product's performance (CHECK rep mean < 0.75 of a node injured) were deleted from the analysis (27 of 28 replications analyzed).

[3]Iowa State Node-Injury Scale (0–3). Number of full or partial nodes completely eaten.

[4]Means sharing a common letter do not differ significantly according to Ryan's Q Test ($P < 0.05$).

[5]Product consistency = percentage of times nodal injury was 0.25 (¼ node eaten) or less.

[6]Means based on 50 observations (plants lodged in 17.5 row-ft).

[7]Means based on 50 observations (number of plants in 17.5 row-ft).

[8]No significant differences between means (ANOVA, $P < 0.05$).

[9]Means based on 27 observations. The summary had 3 sites in 2003, and 2 sites in both 2004 and 2005. All plots were machine harvested except one 2003 test; 2-row trt, approx. 90 ft in length, with 4 replications.

Table 2. Root injury and grain yields under normal/wet and dry environmental conditions (sorted by yield).

Dry Locations[1]				Normal/Wet Locations[3]			
Treatment	Placement[2]	Node-Injury[4,5]	Yield (Bu/Acre)[5]	Treatment	Placement[2]	Node-Injury[4,5]	Yield (Bu/Acre)[5]
YieldGard RW	Transgenic	0.06 a	149 a	YieldGard RW	Transgenic	0.02 a	210 a
Force 3G	T-band	0.33 ab	116 b	Poncho ST	ST	0.84 c	200 ab
Aztec 2.1G	Furrow	0.23 ab	111 bc	Aztec 4.67G	Furrow SB	0.25 a	199 abc
Cruiser ST	ST	1.61 f	111 bc	Force 3G	Furrow	0.31 ab	199 abc
Force 3G	Furrow	0.39 ab	108 bc	Force 3G	T-band	0.27 a	198 abc
Fortress 2.5G	Furrow	0.36 ab	107 bc	Aztec 2.1G	Furrow	0.24 a	197 abc
Fortress 5G	Furrow SB	0.50 bc	107 bc	Lorsban 15G	T-band	0.82 c	196 abc
Aztec 4.67G	Furrow SB	0.32 ab	106 bc	Fortress 5G	Furrow SB	0.61 bc	194 abc
Poncho ST	ST	1.18 e	104 bc	Aztec 2.1G	T-band	0.19 a	193 abc
Aztec 2.1G	T-band	0.46 bc	98 bc	Capture 2EC	T-band	0.75 c	193 abc
Capture 2EC	T-band	0.87 d	98 bc	Fortress 2.5G	Furrow	0.58 bc	189 bc
Lorsban 15G	T-band	0.76 cd	92 bc	Cruiser ST	ST	1.48 d	182 d
CHECK	—	2.37 g	89 c	CHECK	—	1.74 d	163 d

[1]2003 Crawfordsville and Nashua; 2005 Crawfordsville. Dry conditions = rainfall during May–August 2.7–6.6 inches below normal.

[2]T-band and Furrow = insecticide applied at planting time; SB = SmartBox application; ST = seed treatment (1.25 mg/seed).

[3]2003 Sutherland; 2004 Crawfordsville and Nashua; 2005 Nashua. Wet conditions = rainfall during May–August 1.0–4.4 inches above normal.

[4]Iowa State Node-Injury Scale (0–3). Number of full or partial nodes completely eaten.

[5]Means sharing a common letter do not differ significantly according to Ryan's Q Test ($P < 0.05$).