Bt corn rootworm corn hybrid damage in Illinois trials, 2004

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Bt CRW Performance Article Highlights:

Transgenic Corn Rootworm Hybrid Stumbles in Urbana Experiment; Some Producers Also Report Severe Lodging with YieldGard Rootworm Hybrids in Commercial Fields

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Transgenic Corn Rootworm Hybrids
"Bt CRW Corn"

YieldGard Rootworm (YGRW) Corn [MON 863] Conditional EPA registration February 2003.

YGRW is not a high-dose transgenic event as are Bt Corn Borer hybrids where larval survivorship is poor.

YGRW is a non-high dose event, thus expect corn rootworm survivorship (adult emergence) in YGRW fields.

Why is MON 863 (Cry3Bb1) Low Dose?

Corn root tissue expression challenging from a molecular biology perspective.

Cry3Bb1 (Bt toxin active against rootworms) is expressed in corn root tissue at 58 ppm.

This is slightly lower than the LC_{50}* of 75 ppm.

(Dudin et al. 2001)

LC_{50}, 50% lethal concentration
Kills 50% of test subjects

Transgenic Corn Rootworm Hybrids "Bt CRW Corn"

Although a non-high dose event, root protection in University trials overall has been excellent.

Adult corn rootworm beetles in YGRW fields are present due to:

1. Immigrants from other corn fields
2. Survivors from YieldGard Rootworm corn

2001 Adult Emergence Numbers from YGRW corn (Univ. of Illinois study)

(comparable reports from other universities)

Emergence cages were placed over transgenic Bt rootworm corn and non-transgenic isoline. (n=96 cages total in replicated, split plot design).

Adult emergence projection from MON 863-corn:

2,450 male western CRW adults per acre

25,320 female western CRW adults per acre

Overall projection: 27,770 adult western CRW emergence from 1 Acre of transgenic corn (MON 863, Cry3Bb1).

Are surviving adult CRW beetles resistant to Cry3Bb1?

No, not at this point.

The moderate dose (58 ppm) expression tapers off as corn plant develops.

Late hatching rootworm larvae (e.g. 1st week in June) are exposed to a lower dose and a smaller % of later hatchers are killed.

I. 2004 CRW product efficacy trials (Univ. Illinois)

Three sites (DeKalb, Monmouth, Urbana)

Planted: (4/28, 4/27, 4/19)
Roots Rated: (7/21, 7/15, 7/10)

Heavy CRW pressure, trap-cropped fields.

Golden Harvest (H-8588 RW) YieldGard Rootworm
Golden Harvest (H-8799) Non-transgenic Isoline

Untreated Check Damage Severe:
2.0 to 3.0 nodes destroyed.

YGRW Damage: pruning observed, considerably less than 1 node destroyed.

II.

Calls from Illinois Producers
Lodging observed at U of Illinois, Urbana site

Following a mid-July storm with high winds, U of I Extension received calls on severely lodged corn. Including fields with YieldGard Rootworm hybrids.

Severe lodging of the YieldGard Rootworm hybrid (Golden Harvest H-8588RW) observed at U of I, Urbana trial site.

Monsanto personnel had checked plants from U of Ill. DeKalb, Monmouth, and Urbana trial sites for expression of Cry3Bb1 protein, **Results Positive.**

III. 2004 CRW product efficacy trials (Univ. Illinois) – Revisited in August

During 1st Week of August: 40 roots (10/replicate) were taken from YieldGard Rootworm plots in the Urbana experiment.

Root ratings on Golden Harvest H-8588RW in August, 3+ weeks after original (7/10) rating average of considerably less than 1 node destroyed:

Rep A 1.43 (nearly 1-1/2 nodes destroyed)
Rep B 1.08 (1 node destroyed)
Rep C 1.64 (slightly more than 1-1/2 nodes destroyed)
Rep D 1.24 (slightly more than 1 node destroyed)

Damage significantly greater in August than in July at the U of Illinois Urbana site.

Possible Explanations

Resistance unlikely, YGRW hybrids released commercially for the first time in 2003.

1. Early planting of Urbana Experiment (4/19)
2. Development and emergence of surviving CRW from YGRW corn is known to be delayed as compared to non-transgenic corn hybrids.
3. Intense larval pressure in Urbana trial 2004

Perhaps combined factors above compromised YGRW efficacy in the Illinois example.

Further Questions

Expression of the Cry3Bb1 protein diminishing as the season progresses?

Are there differences in expression across hybrids?

Do hybrid root characteristics influence YGRW technology performance?

Steps to take if unexpected YGRW damage or suspected resistance should occur:

1. Check planting records

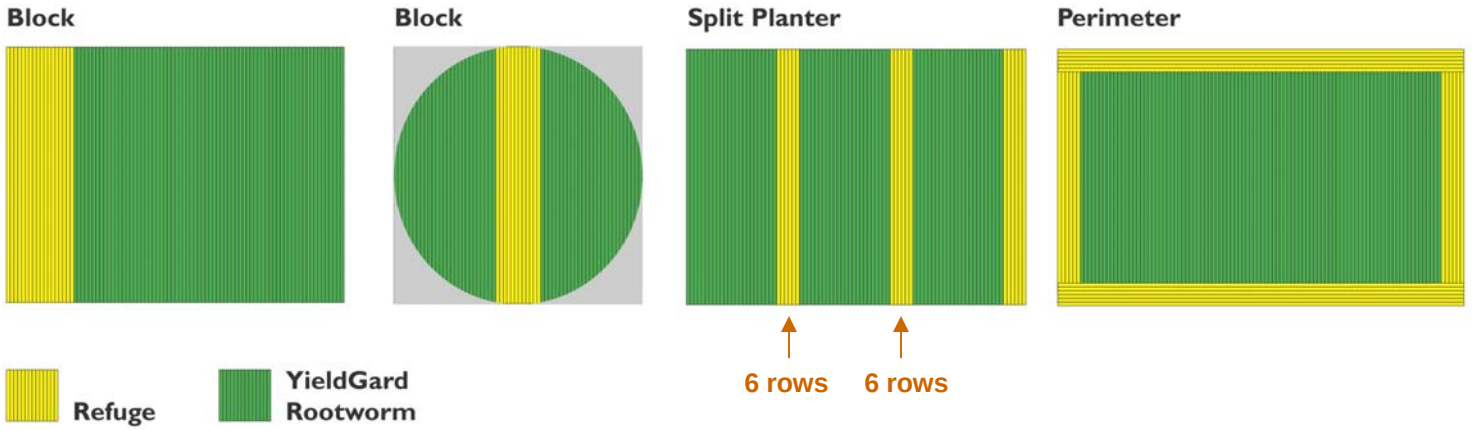
2. Rule out damage from nontarget insects, weather, or other environmental factors.

3. Conduct tests to verify MON 863 was planted and that the correct % of plants are expressing. (e.g. Monsanto personnel verification)

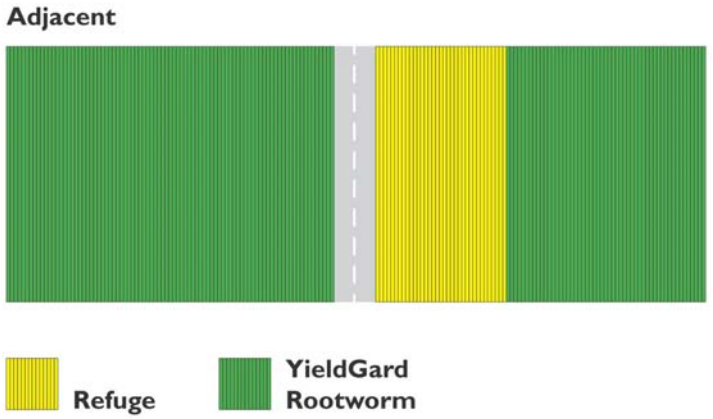
4. If expression is +, and root damage is near 0.5 (node-injury scale) on any expressing plant, Evaluate roots from **the corresponding refuge**.

YieldGard® Rootworm Refuge Configurations

Examples of Within-Field Configurations



Example of Adjacent-Field Configurations



80% of the crop can be planted to YieldGard Rootworm (Bt-corn) But 20% must be planted to non-Bt corn.

For complete IRM information please refer to the IRM Grower Guide for YieldGard Rootworm or you may also call 1-800-951-9511.

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