Refuge rules, resistance and rootworms

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Madison, WI
January 11, 2012

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Insects Find Crack In Biotech Corn's Armor

05:14 pm
December 5, 2011

by DAN CHARLES

Enlarge Brbaker via Flickr

Scientists say the corn rootworm is growing resistant to Bt corn.

Hidden in the soil of Illinois and Iowa, a new generation of insect larvae appears to be munching happily on the roots of genetically engineered corn, according to scientists. It's bad news for corn farmers, who paid extra money for this line of corn, counting on the power of its inserted genes to kill those pests. It's also bad news for the biotech company Monsanto, which inserted the

INDUSTRIAL AGRICULTURE

The bugs that ate Monsanto 26

BY TOM LASKAWY Follow

13 DEC 2011 1:28 PM

Now that 94 percent of the soy and 70 percent of the corn grown in the U.S. are genetically modified, Monsanto -- one of the companies that dominates the GMO seed market -- might look to some like it's winning. But if we look a little closer, I'd say they're holding on by a thread.

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Home > AgPro Weekly > Monsanto plan addresses corn rootworm hot spots

Monsanto plan addresses corn rootworm hot spots

Monsanto | November 14, 2011

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Monsanto Company announced it is taking steps to ensure best management practices are

The Iowa story: 2009-2011
Slides courtesy of Aaron Gassmann, Iowa State University

OPEN ACCESS Freely available online

PLoS one

Field-Evolved Resistance to Bt Maize by Western Corn Rootworm

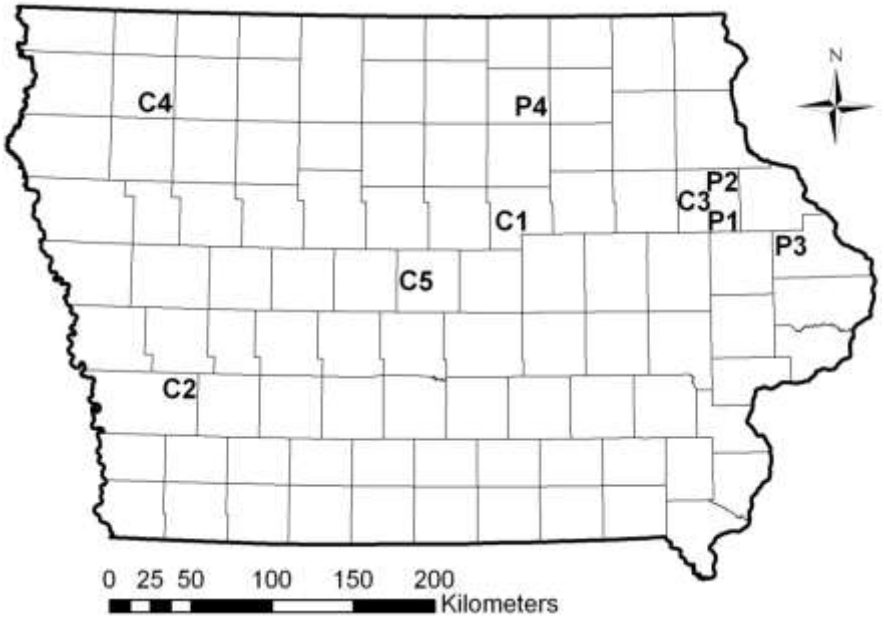
Aaron J. Gassmann*, Jennifer L. Petzold-Maxwell, Ryan S. Keweshan, Mike W. Dunbar

Department of Entomology, Iowa State University, Ames, Iowa, United States of America

Samples Obtained from Two Types of Fields in 2009

1)Problem fields: fields associated with grower complaints of rootworm injury since 2008

2) Control fields: fields not associated with grower complaints



Trends

Field history:
Control Fields: corn and soybean rotation

Problem Fields: 3 to 6 consecutive years of Cry3Bb1 maize

Type of corn in problem fields: All fields Yieldgard

Root injury in problem fields: 1.8 ± 0.7 nodes (very high – traited corn usually always below 0.25)

Minnesota 2011 Problem Fields
(photos courtesy Kenny Ostlie, U of MN)

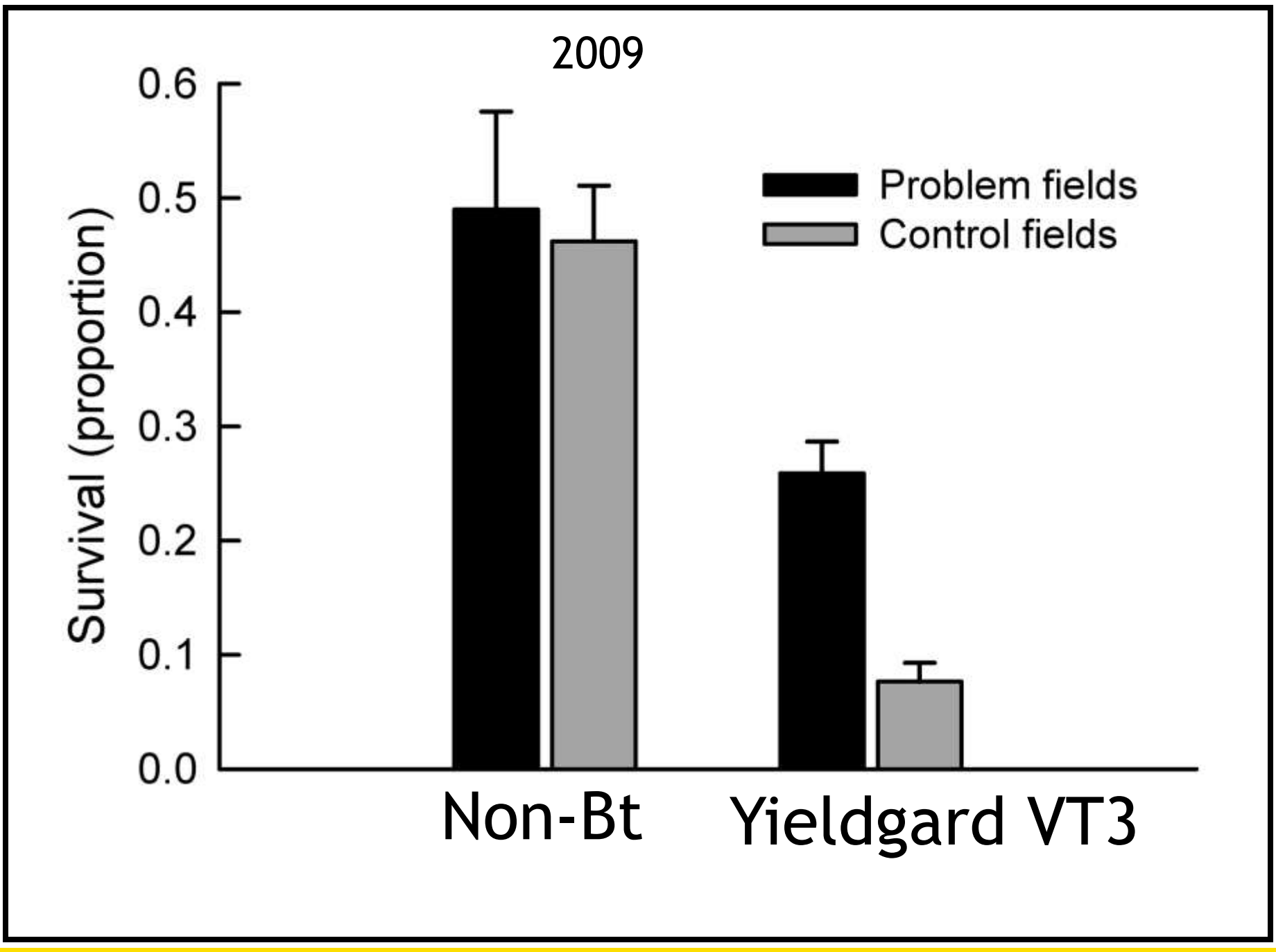
- Split planter – 4 rows refuge plus Aztec, 20 rows VT Triple
- Lodging: Refuge 0.6%, VT Triple – 35.2%
- Root injury rating: Refuge – 0.65, VT Triple - 2.08

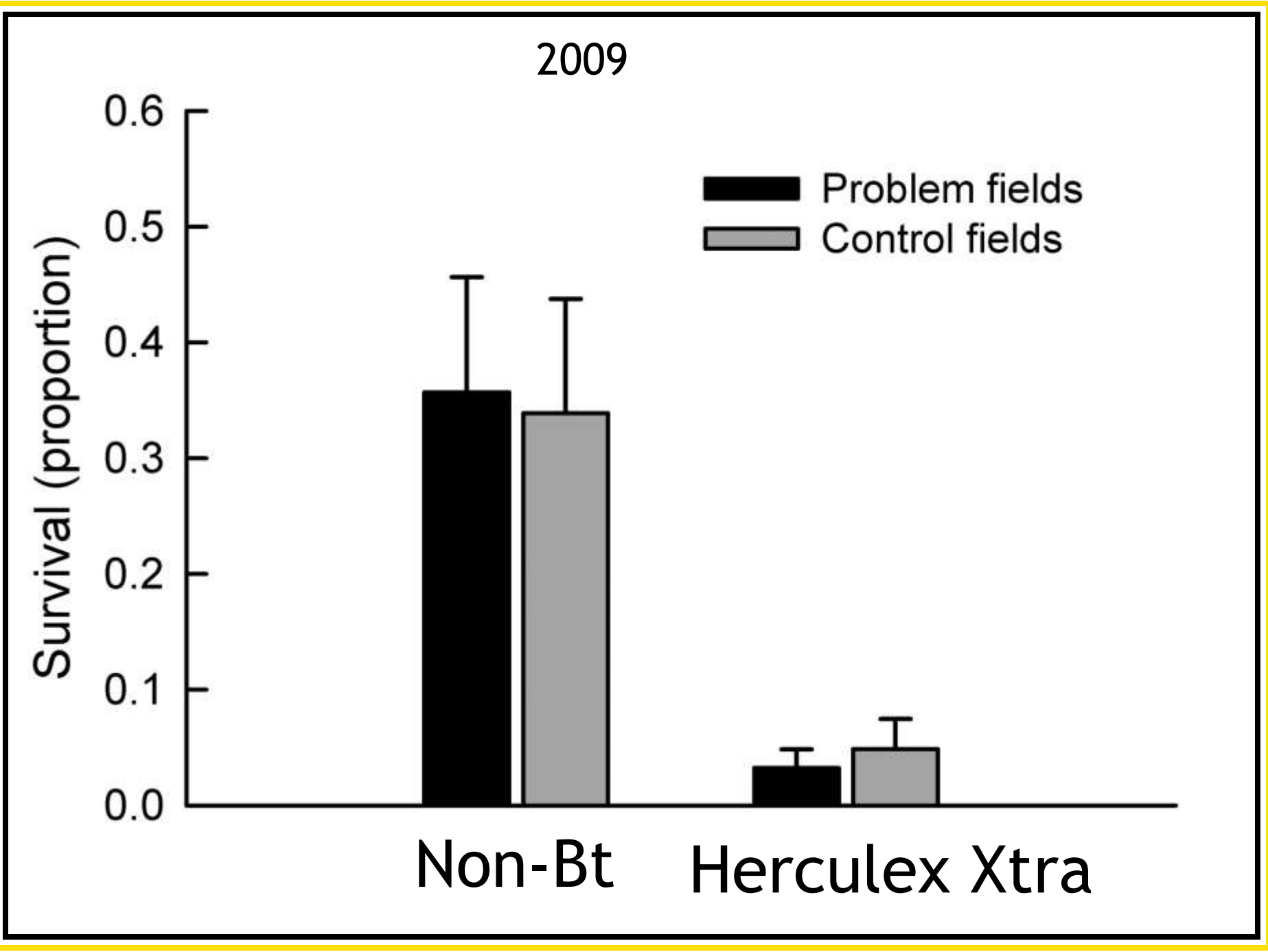
Methodology

1) Females beetles collected in fields in late summer
2) Samples held in a growth chamber to collect eggs

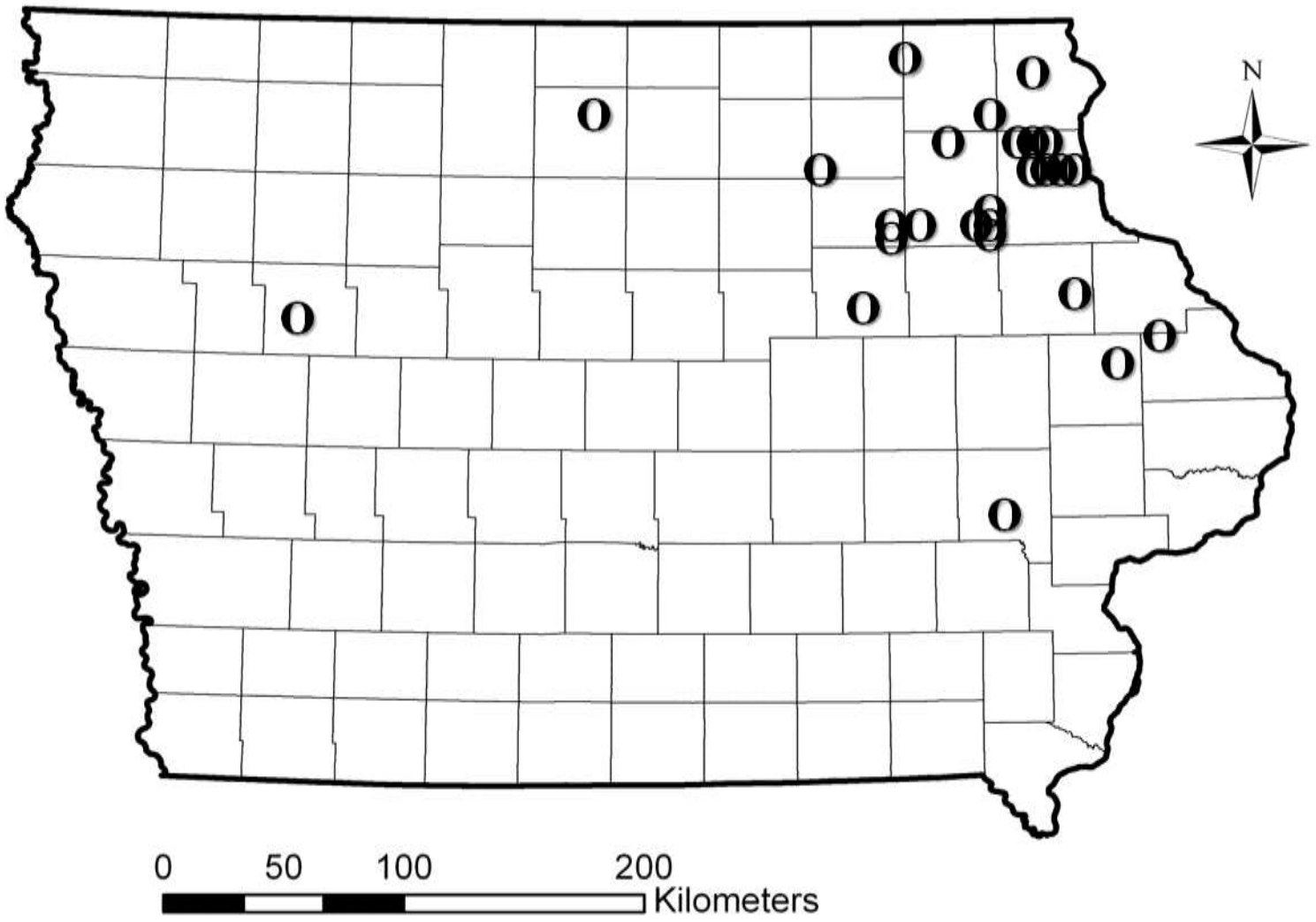
Methodology

3) Eggs placed on corn seedlings


2009
Survival (proportion)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Problem fields
Control fields
Non-Bt
Yieldgard VT3


2009
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Survival (proportion)
Problem fields
Control fields
Non-Bt
Herculex Xtra

Fields Visited in 2011



Node Injury Rating Scale (0-3)

0 No feeding damage

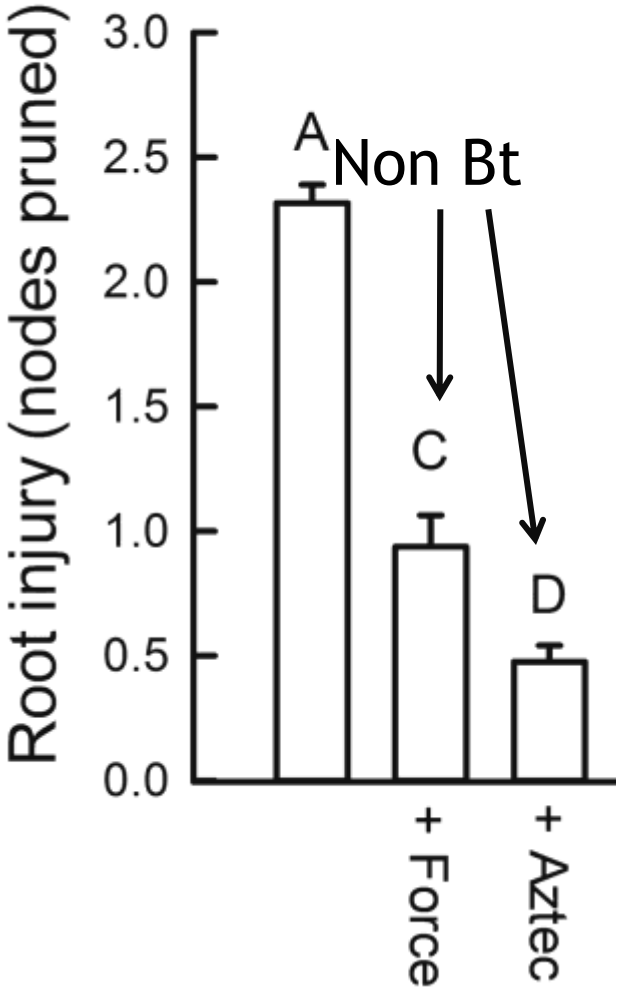
1 One node (circle of roots), or the equivalent of an entire node, pruned back to within 1.5 inch of the stalk.

2 Two complete nodes pruned

3 Three complete nodes pruned

Results from Study in Two Problem Fields in Iowa

2011



Results from Study in Two Problem Fields in Iowa

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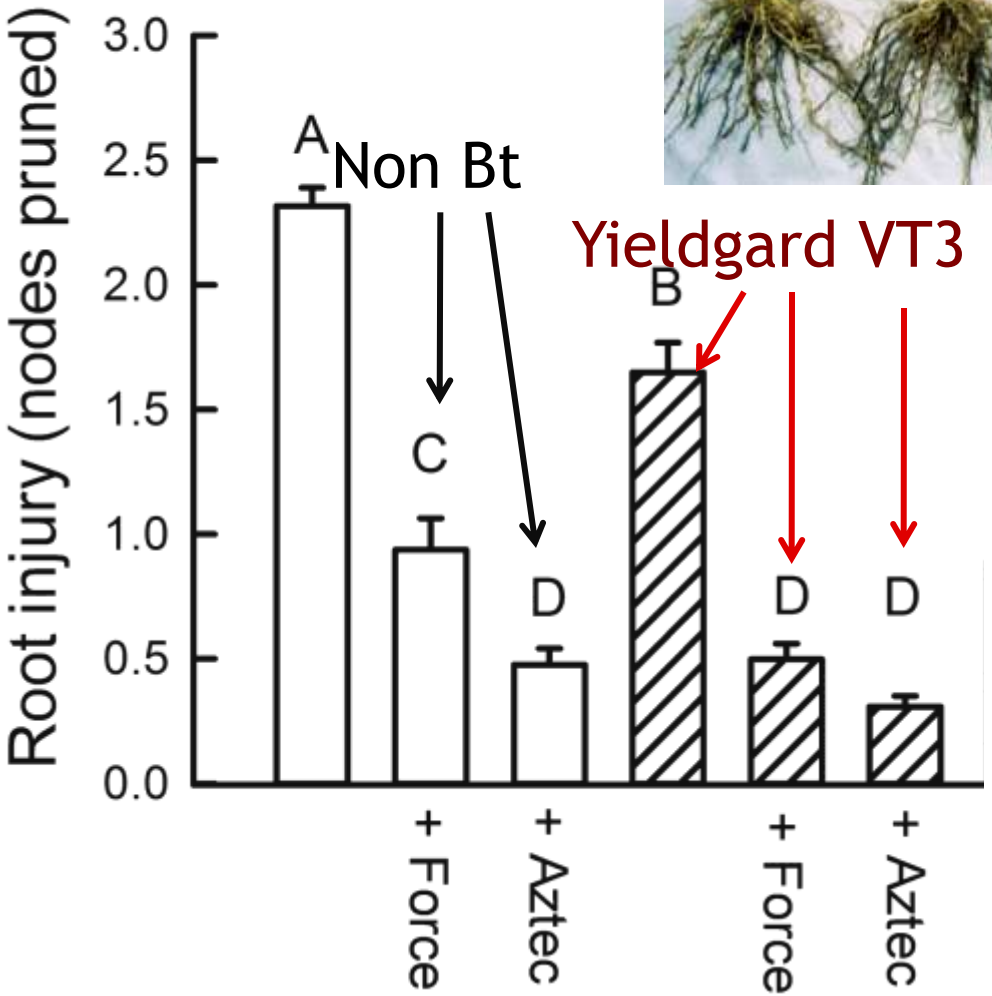
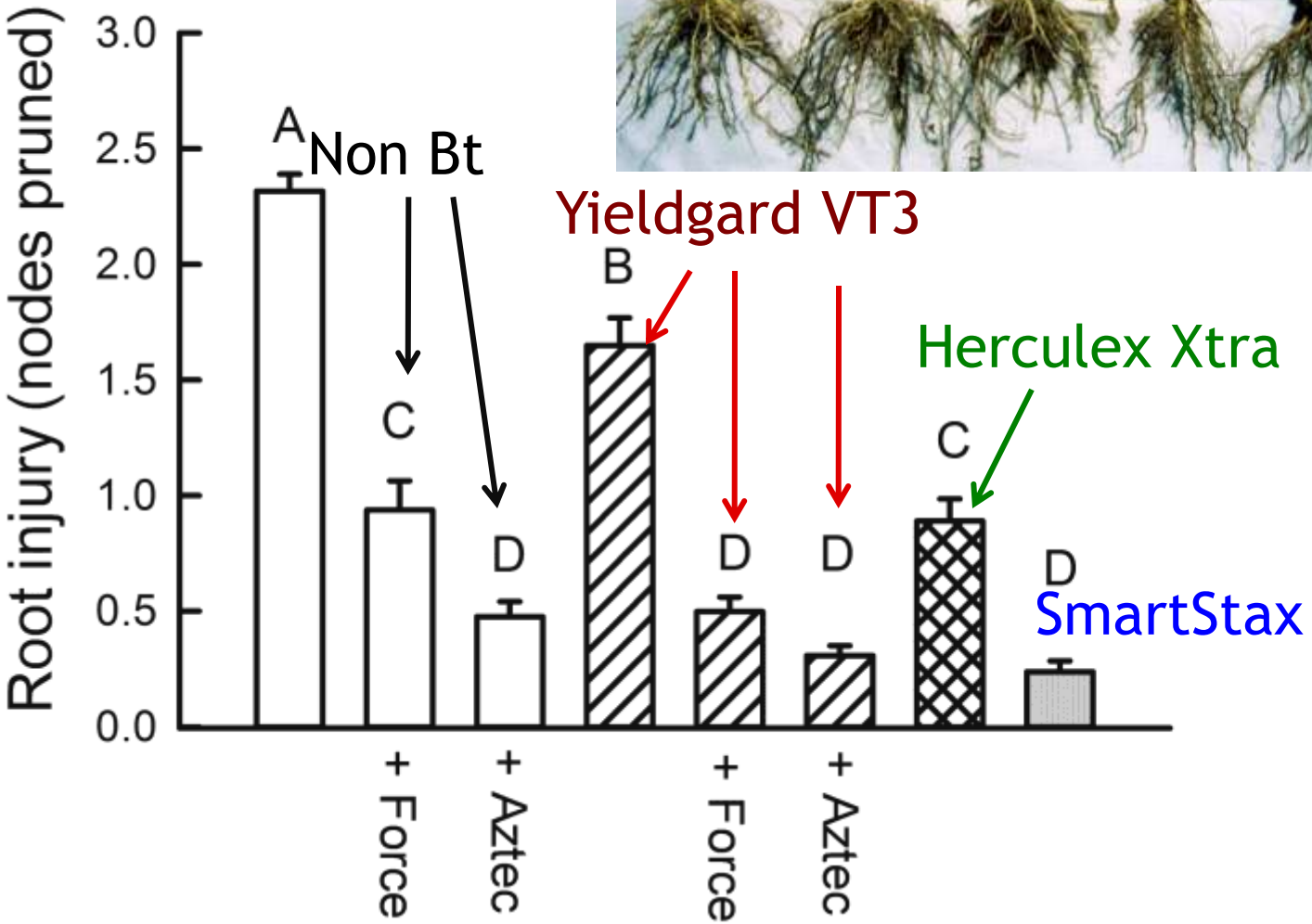


Results from Study in Two Problem Fields in Iowa

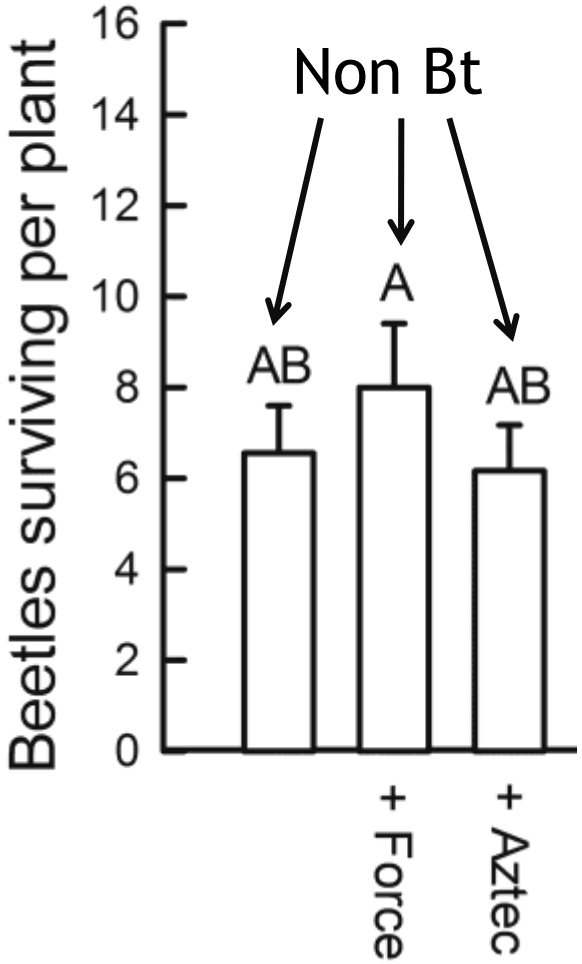
2011



Results from Study in Two Problem Fields in Iowa

2011

Emergence Cages



Results from Study in Two Problem Fields in Iowa

2011

Emergence Cages

Beetles surviving per plant

16
14
12
10
8
6
4
2
0

Non Bt

Yieldgard VT3

AB
A
AB
A
AB
BC

+ Force
+ Aztec
+ Force
+ Aztec

Results from Study in Two Problem Fields in Iowa

2011

Emergence Cages

Beetles surviving per plant

16
14
12
10
8
6
4
2
0

Non Bt

Yieldgard VT3

Herculex Xtra

SmartStax

AB
A
AB
A
AB
BC
C
C

+ Force
+ Aztec
+ Force
+ Aztec

Summary of Results

In 2009, survival for populations from problem fields was lower on Cry3Bb1 (Yieldgard) corn than non-Bt hybrid

In 2011, survival of populations from the field not significantly different between Yieldgard corn and non-Bt hybrid

Resistance problem is not going away

Summary of Results

Some good news:

For both 2009 and 2010, there was no evidence of cross-resistance between Yieldgard and Herculex.

But… this means that in some areas SmartStax is not a true “stack”

What this means for refuge strategies

With SmartStax, EPA approved reduction of refuge to 5%

This is based on 2 independent modes of action (Yieldgard and Herculex toxins are combined)

What happens if refuge is reduced, but one toxin stops working?

Handy Bt Trait Table

CDD #028
Updated
20 Oct 2011

Chris DiFonzo, Michigan State University
and
Eileen Cullen, University of Wisconsin

Pictures: Iowa State Image Gallery (Marlin Rice) and Chris DiFonzo

More corn hybrids contain multiple transgenic traits, and cost of this seed is steadily rising - $300 or more per bag is not uncommon. Meanwhile, refuge requirements are changing for multi-trait corn. Some refuges remain 20% and 'structured', planted in a block or series of rows. Others are reduced to 5% or 10%, in a block or 'in the bag' mixed with the Bt seed itself.

Different products from different seed companies now have different refuges

Purchasing the right transgenic hybrid for the right pest, and planting it with the correct refuge in the proper location, is critical to maximizing income. But this process is increasingly confusing. The table on the second page of this handout summarizes, to the best of our ability, the currently available traits and their spectrum of control. The table also lists refuge amounts and location.

**Current ** 20 October, 2011	Bt protein (s)	Insects controlled (bold) or *suppressed (italics)* *Above-ground---------- In soil*		Herbicide tolerant?	Refuge % & location in the MIDWEST
Agrisure products					
Agrisure CB/LL	Cry1Ab	**ECB** *CEW FAW SB*	---	LL	20% - ½ mile
Agrisure GT/CB/LL	Cry1Ab	**ECB** *CEW FAW SB*	---	GT LL	20% - ½ mile
Agrisure RW	mCry3A	---	**CRW**	---	20% - adjacent
Agrisure GT/RW	mCry3A	---	**CRW**	GT	20% - adjacent
Agrisure CB/LL/RW	Cry1Ab mCry3A	**ECB** *CEW FAW SB*	**CRW**	LL	20% - adjacent
Agrisure 3000GT	Cry1Ab mCry3A	**ECB** *CEW FAW SB*	**CRW**	GT LL	20% - adjacent
Agrisure Viptera 3110	Cry1Ab Vip3A	**BCW CEW ECB FAW WBC SB**	---	GT LL	20% - ½ mile
Agrisure Viptera 3111	Cry1Ab mCry3A Vip3A	**BCW CEW ECB FAW WBC SB**	**CRW**	GT LL	20% - adjacent
Agrisure 3122 Refuge Renew	Cry1Ab Cry1F mCry3A Cry34/35Ab1	**BCW CEW ECB FAW WBC SB**	**CRW**	GT LL	5% adjacent
Agrisure Viptera 3220	Cry1Ab Cry1F Vip3A	**BCW CEW ECB FAW WBC SB**	---	GT LL	5% - ½ mile
Herculex products					
Herculex 1 (HX1)	Cry1F	**BCW ECB FAW WBC** *CEW*	---	LL RR2 (some)	20% - ½ mile
Herculex RW (HXRW)	Cry34/35Ab1	---	**CRW**	---	20% - adjacent
Herculex XTRA (HXX)	Cry1F Cry34/35Ab1	**BCW ECB FAW WBC** *CEW*	**CRW**	LL RR2 (some)	20% - adjacent
Optimum products					
Optimum Intrasect	Cry1F Cry1Ab	**BCW ECB FAW WBC** *CEW SB*	---	LL RR2	5% - ½ mile
Optimum AcreMax (OAM)	Cry1F Cry1Ab	**BCW ECB FAW WBC** *CEW SB*	---	RR2	5% ***in the bag***
Optimum AcreMaxRW	Cry34/35Ab1	---	**CRW**	RR2	10% ***in the bag***
Optimum AcreMax1	Cry1F Cry34/35Ab1	**BCW ECB FAW WBC** *CEW*	**CRW**	LL RR2	10% ***in the bag*** (CRW) & 20% - ***½ mile*** (ECB)
Optimum AcreMax Xtra	Cry1F Cry1Ab Cry34/35Ab1	**BCW ECB FAW WBC** *CEW SB*	**CRW**	RR2	10% ***in the bag***
YieldGard products					
YGCB	Cry1Ab	**ECB** *CEW FAW SB*	---	RR2 (some)	20% - ½ mile
YGRW	Cry3Bb1	---	**CRW**	RR2 (some)	20% - adjacent
YieldGard Plus	Cry1Ab Cry3Bb1	**ECB** *CEW FAW SB*	**CRW**	RR2 (some)	20% - adjacent
YieldGard VTRW	Cry3Bb1	---	**CRW**	RR2	20% - adjacent
YieldGard VT Triple	Cry1Ab Cry3Bb1	**ECB** *CEW FAW SB*	**CRW**	RR2	20% - adjacent
Genuity / SmartStax products					
Genuity VT Double Pro (VT2P)	Cry1A.105 Cry2Ab2	**CEW ECB FAW**	---	RR2	5% - ½ mile
Genuity VT Triple Pro (VT3P)	Cry1A.105 Cry2Ab2 Cry3Bb1	**CEW ECB FAW**	**CRW**	RR2	20% - adjacent
SmartStax (Dow) or Genuity SmartStax (Monsanto) (GENSS)	Cry1A.105 Cry2Ab2 Cry1F Cry3Bb1 Cry34/35Ab1	**BCW CEW ECB FAW WBC**	**CRW**	LL RR2	5% - adjacent
Genuity SmartStax RIB Complete (Mon)	Same as GENSS	**BCW CEW ECB FAW WBC**	**CRW**	LL RR2	5% ***in the bag***
REFUGE ADVANCED Powered by SmartStax (Dow)	Same as GENSS	**BCW CEW ECB FAW WBC**	**CRW**	LL RR2	5% ***in the bag*** *A structured 5% refuge option may be available*

Resistance to Bt corn recently confirmed in Iowa, possibly IL, MN, SD

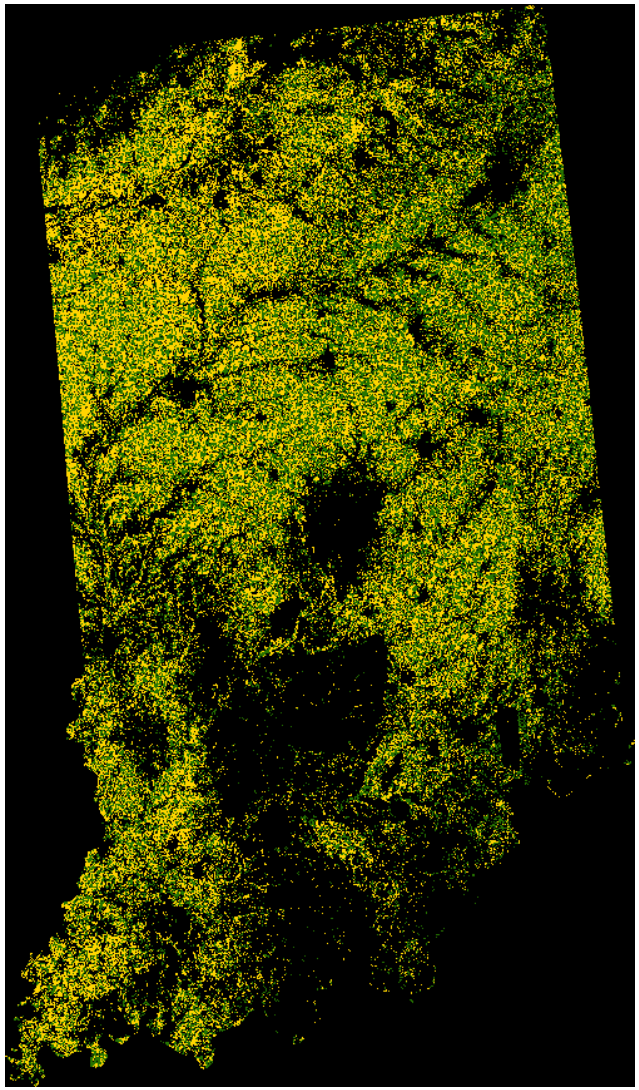
Q: What does this mean for producers in other states?

A: It could happen here, but many factors influence "when"…

Corn/Soybean Rotation

- Indiana
  - Approx. 50/50
- Iowa
  - Approx. 60/40
- NE Iowa
  - Approx. 66/34

National Agriculture Statistics Service: USDA



More good news and solutions

- Corn rootworm populations are at very low levels in many areas, reduces opportunities for resistance/damage
- Rotation helps! Reduces pressure on RW populations if fields are only in Bt corn 1 out of 2 or 3 years
- Rotating technologies also helps – change to different Bt traits or rotate into seed treatments or granular insecticides if possible, especially in continuous corn
- PLANT THE REFUGE!