

# Corn Rootworm

Bt Resistance and Management Recommendations for Illinois



**Nick Seiter**

Research Assistant Professor  
Department of Crop Sciences

**Joe Spencer**

Principal Research Scientist  
Illinois Natural History Survey



## Western corn rootworm

*Diabrotica virgifera virgifera*

## Northern corn rootworm

*Diabrotica barberi*

# Current Rootworm Situation in Illinois

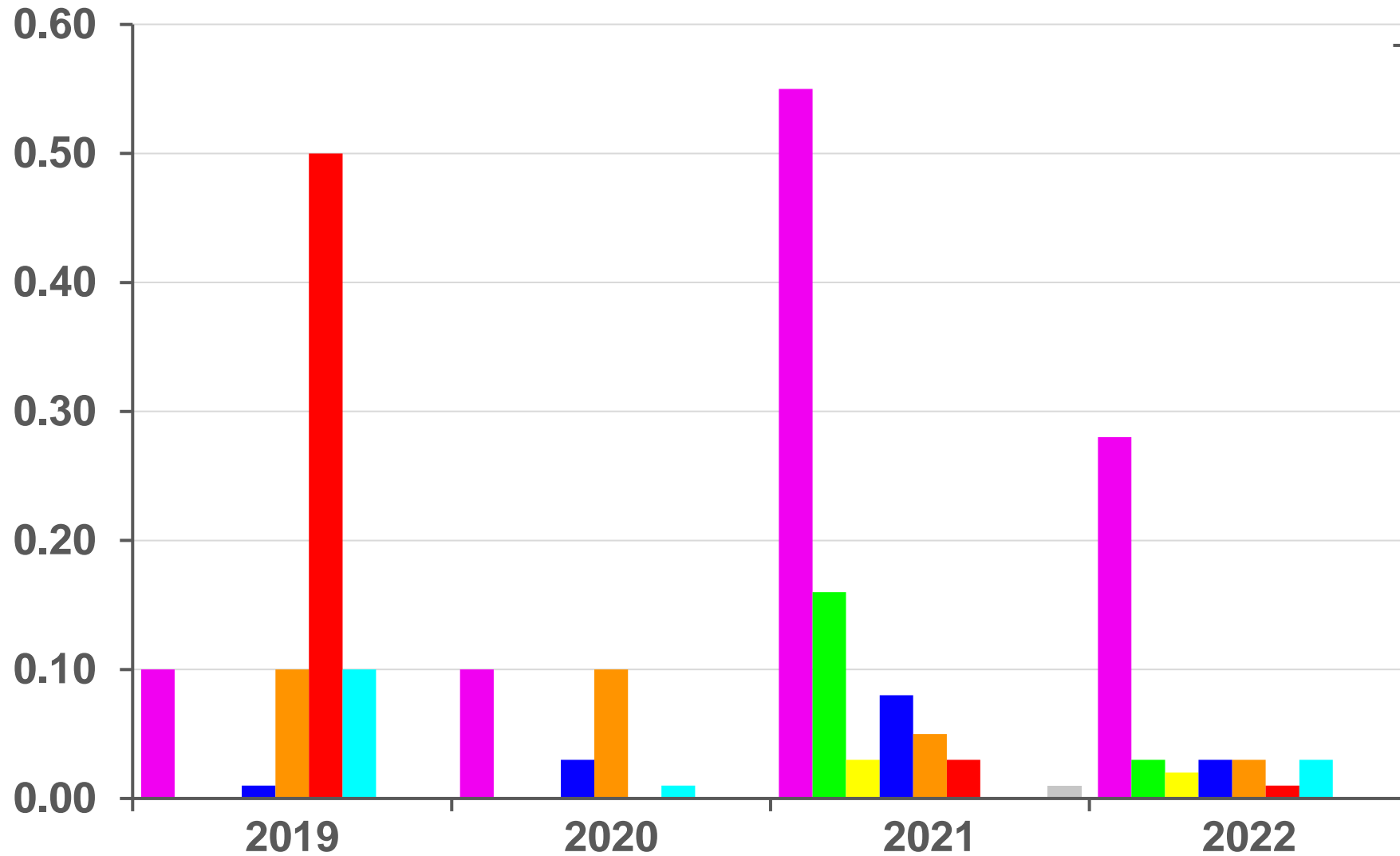
**Populations (esp. NCR) have increased in continuous corn areas**  
slightly less in 2022 compared with 2021

**Rotation-resistant “variant” pressure is very low**

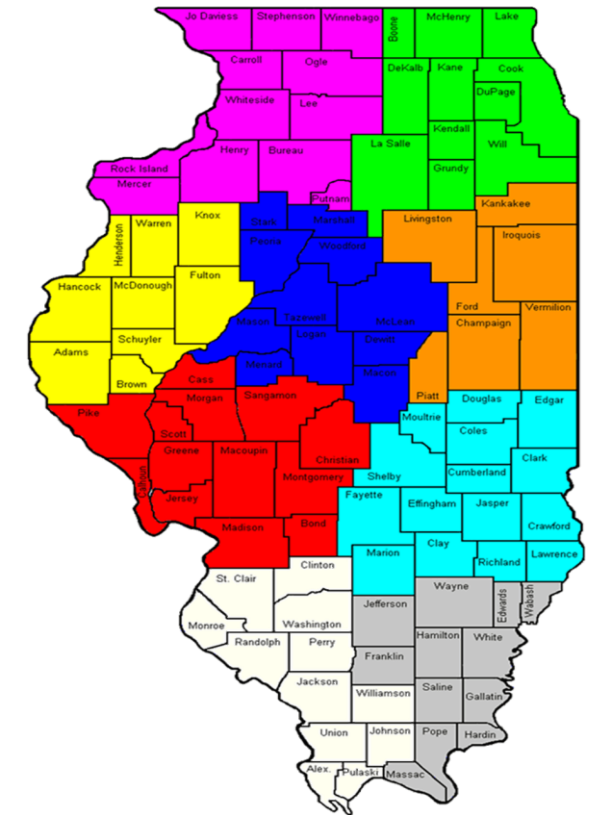
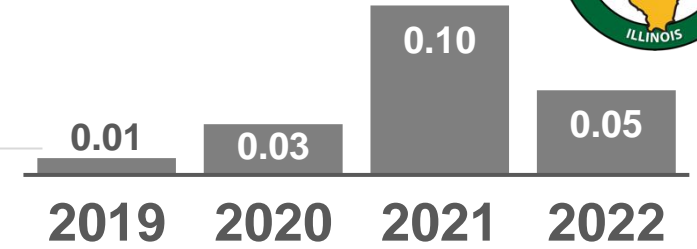
**Populations of both western and northern corn rootworm have resistance to all available Bt traits in some areas**

# Western Corn Rootworm

Average number of beetles per plant



State Average

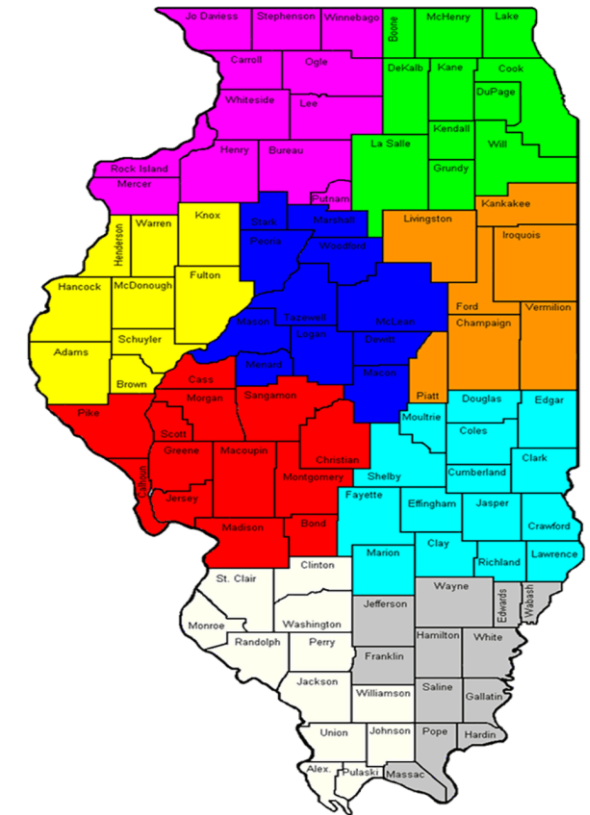
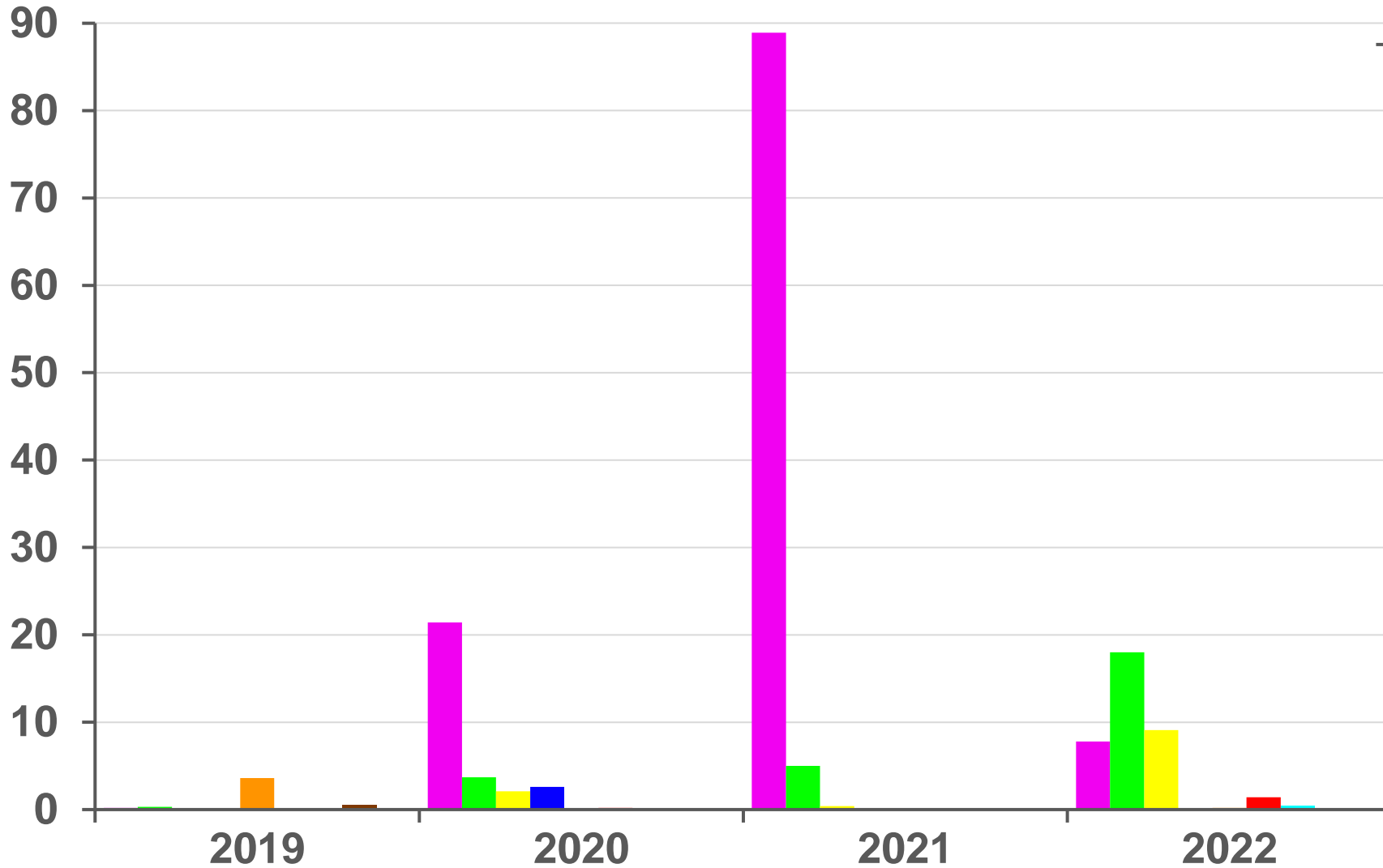
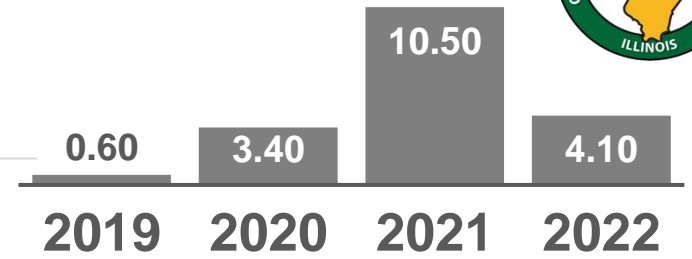


# Northern Corn Rootworm

Average number of beetles per 100 sweeps



State Average

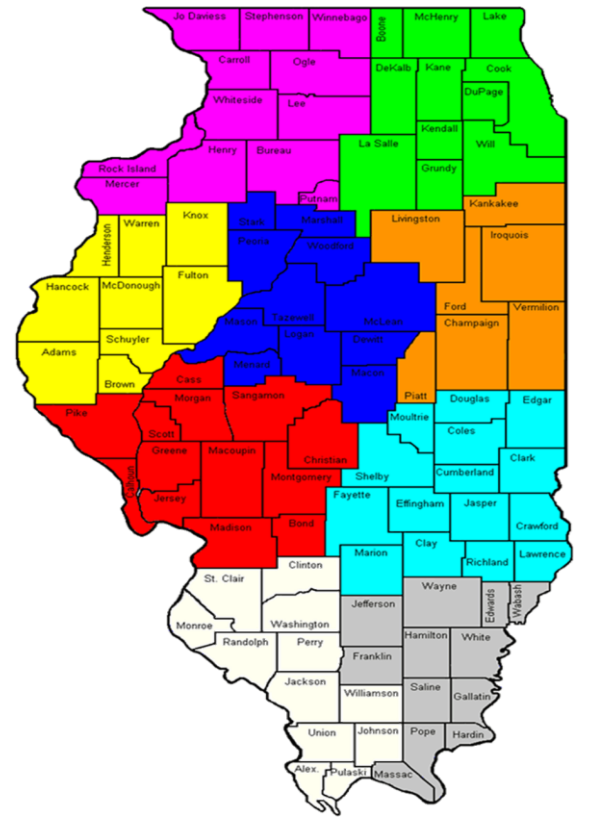
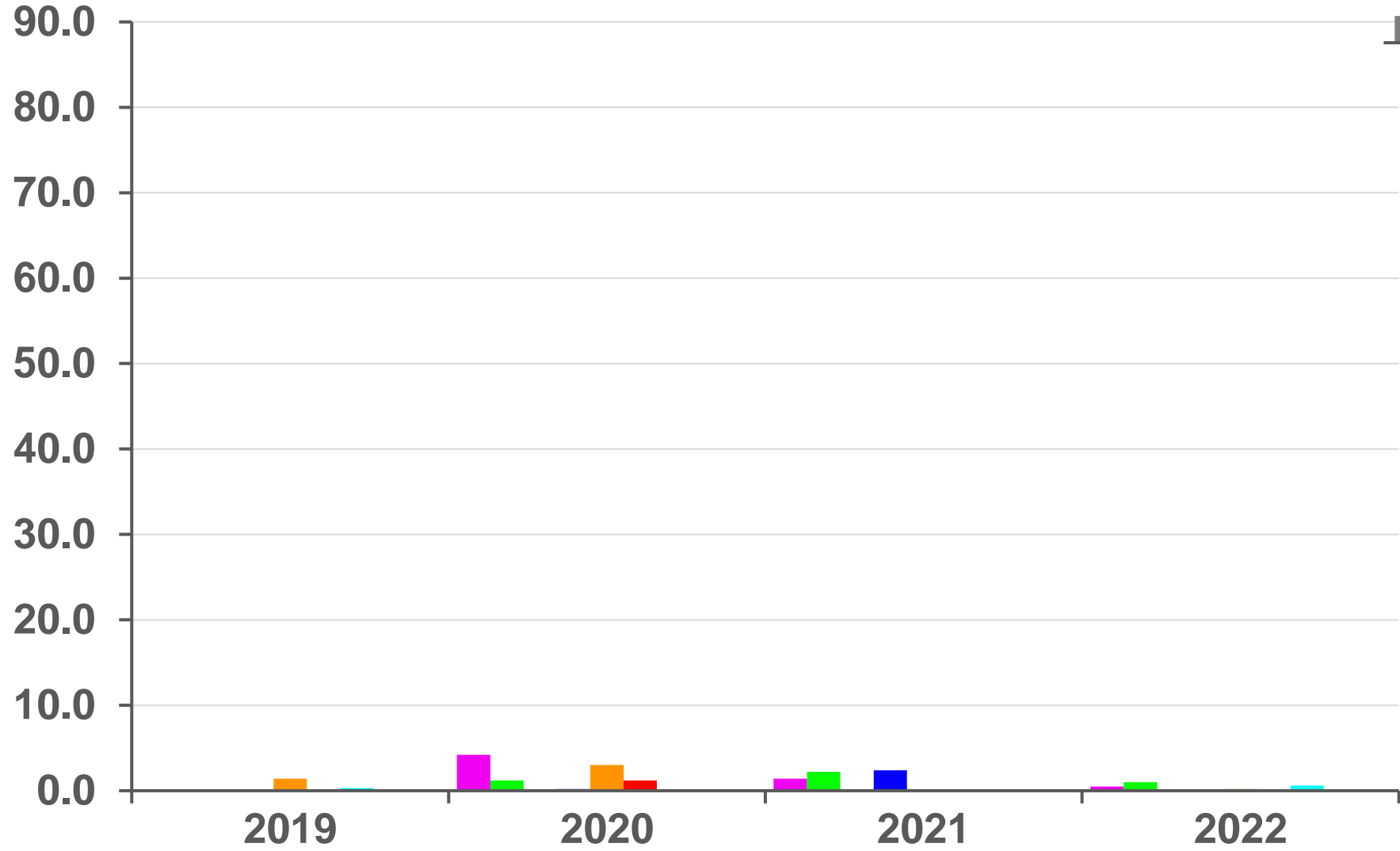
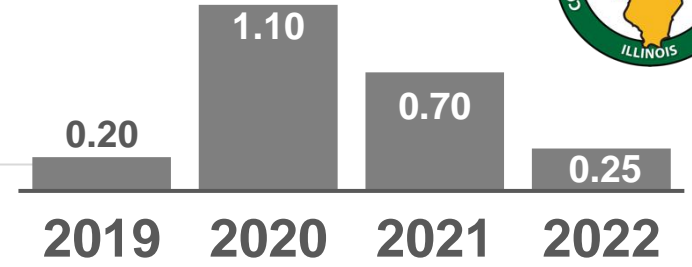


# Western Corn Rootworm

Average number of beetles per 100 sweeps

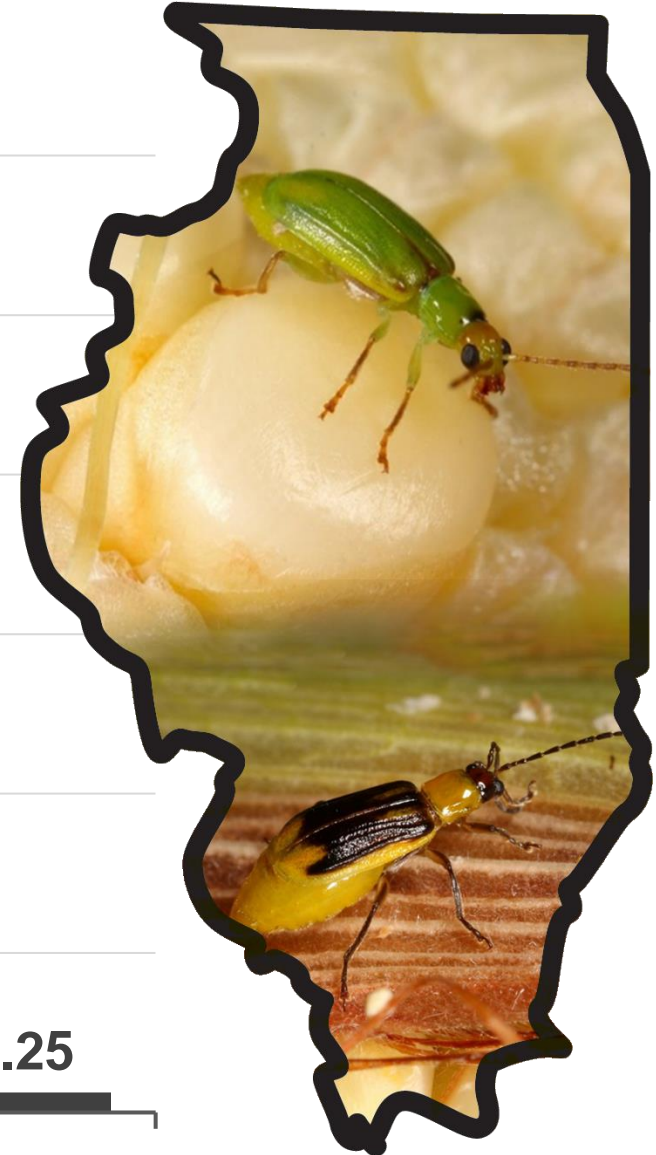
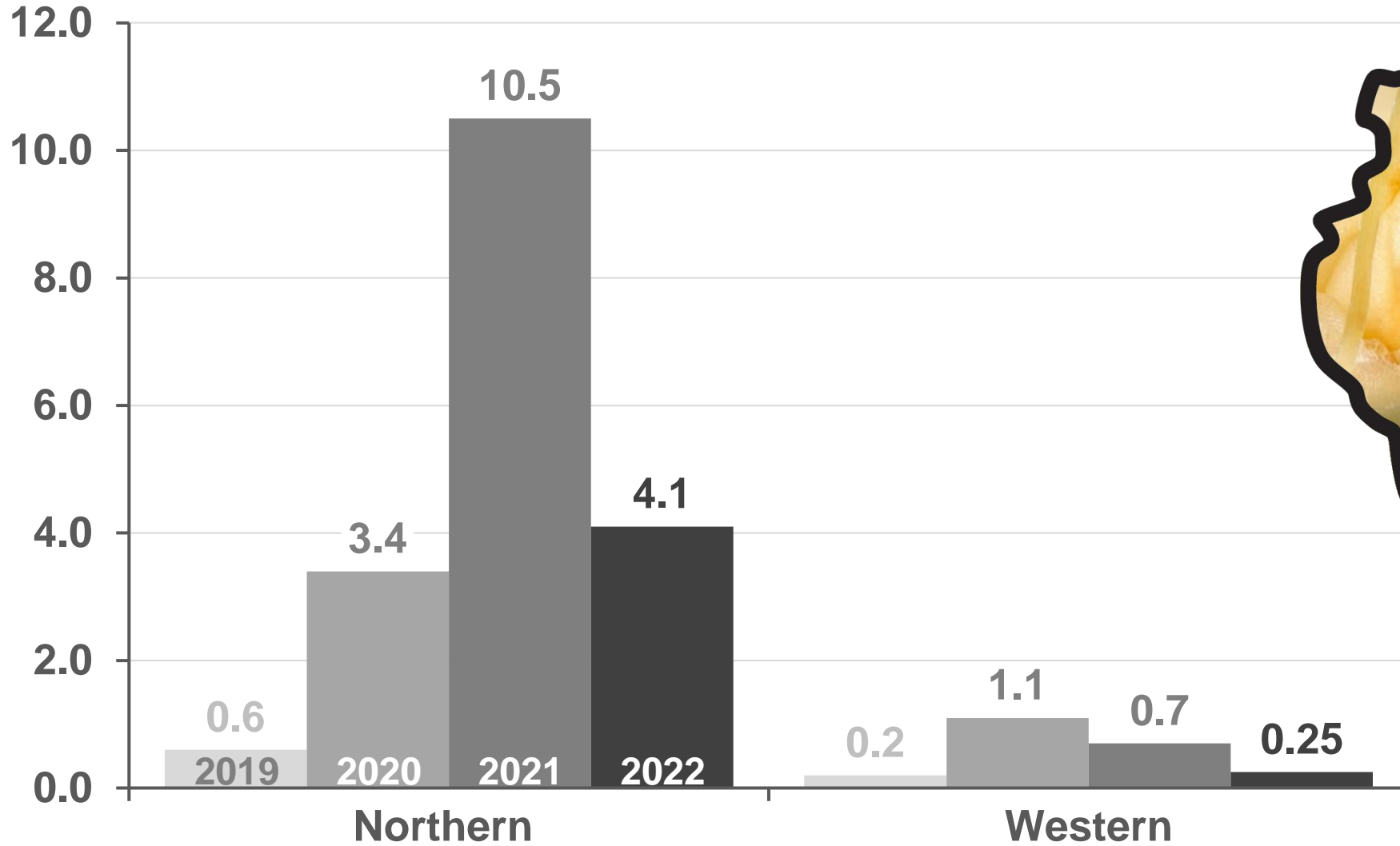


## State Average

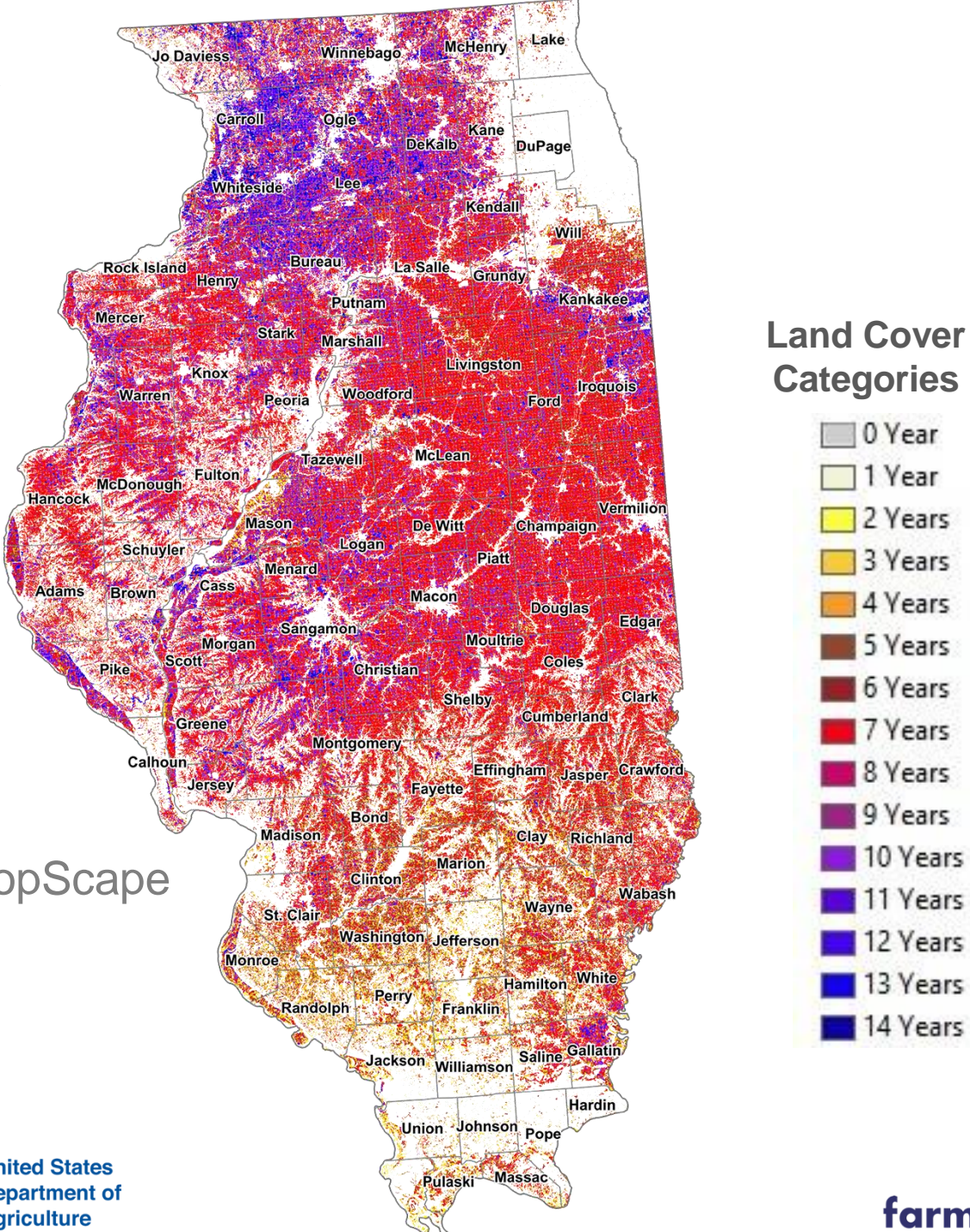


# Corn Rootworm State Average

Average number of beetles per 100 sweeps



# Corn Frequency Layer 2008 to 2021



Produced by CropScape  
<http://nassgeodata.gmu.edu/CropScape>



# Four Bt proteins, “two” modes of action, several combinations

**SmartStax** = Cry3Bb1 + Cry34/35Ab1

**Acremax Xtreme** = mCry3A + Cry34/35Ab1

**Qrome** = mCry3A + Cry34/35Ab1

**Agrisure 3122** = mCry3A + Cry34/35Ab1

**Duracade** = mCry3A + eCry3.1Ab

**Similar mode of action (“Cry3” traits)**

- Cry3Bb1
- mCry3A
- eCry3.1Ab

**Distinct mode of action**

- Cry34/35Ab1

**Cross-resistance in WCR among Cry3Bb1, mCry3A, eCry3.1Ab**

**Fitness cost reported for Cry34/35Ab1 resistance, but not for Cry 3 resistance**

<https://www.texasinsects.org/bt-corn-trait-table.html>

# Rootworm Trait Packages with RNA-interference Mode of Action

## SmartStax Pro

Bayer

Limited release: 2022

Commercial release: 2023

**Above-ground:**

Cry1A.105, Cry2Ab2, Cry1F

**Below-ground:**

Cry3Bb1, Cry34/35Ab1,  
DvSnf7 dsRNA

**Herbicide:**

glyphosate, glufosinate

**SmartStax<sup>®</sup> PRO**  
With **RNAi** TECHNOLOGY

## Vorceed Enlist

Corteva

Limited release: 2023

Larger release in  
subsequent years

**Above-ground:**

Cry1A.105, Cry2Ab2, Cry1F

**Below-ground:**

Cry3Bb1, Cry34/35Ab1,  
DvSnf7 dsRNA

**Herbicide:** glyphosate,  
glufosinate, 2,4-D

**VORCEED**  
Enlist

## VT4Pro

Bayer

Estimated commercial  
release in 2024

**Above-ground:**

Cry1A.105, Cry2Ab2,  
Vip3Aa20

**Below-ground:**

Cry3Bb1, DvSnf7 dsRNA

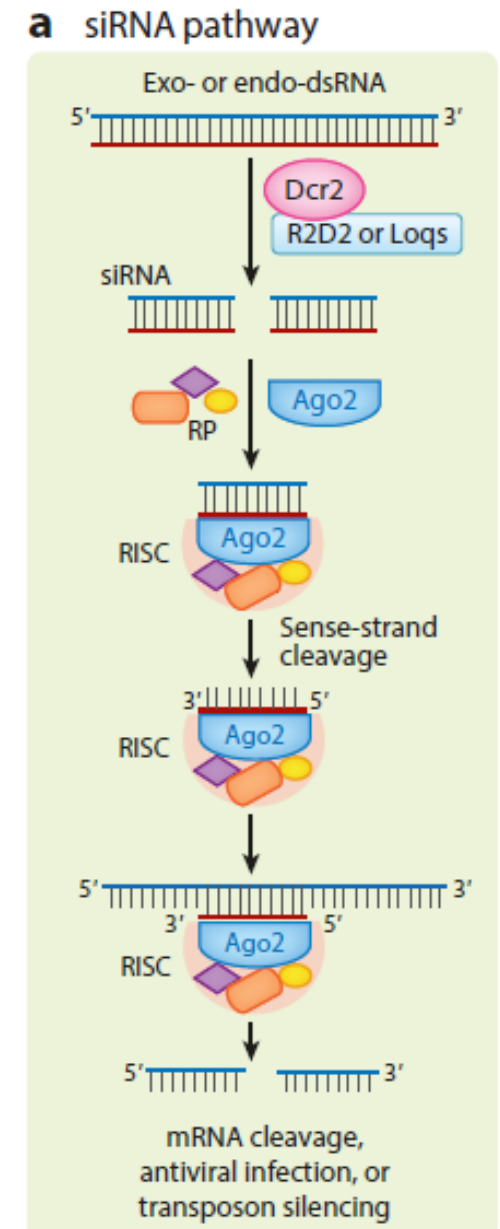
**Herbicide:**

glyphosate

**VT4PRO**  
With **RNAi** TECHNOLOGY

# How does RNAi work?

- Traited corn expresses double stranded RNA that codes for an essential rootworm protein
- Cellular machinery of the rootworm essentially recognizes this dsRNA as “foreign”, prevents protein expression
- Because this protein is essential for rootworm growth, the insect dies in ~5 days
- Requires both a local and a systemic response (response spreads among cells)
  - both occur readily in beetles



From Zhu and Palli 2020, Annu. Rev. Entomol. 65: 293-311

# Rootworm Trait Packages with RNA-interference Mode of Action

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**VT4PRO**  
With **RNAi** TECHNOLOGY

# Potential for resistance

Resistant western corn rootworm population was developed in lab from field-collected beetles

Reduced uptake of dsRNA

No cross-resistance to Bt traits

Cross-resistant to other dsRNAs

<https://doi.org/10.1371/journal.pone.0197059>



NCR and WCR have a long history of overcoming management tactics.

Insecticides, Crop Rotation,  
Bt Corn Hybrids



Genetically-based decreases in tactic susceptibility, are called “resistance”.



Review

## The Use of Insecticides to Manage the Western Corn Rootworm, *Diabrotica virgifera virgifera*, LeConte: History, Field-Evolved Resistance, and Associated Mechanisms

Lance J. Meinke<sup>1,\*</sup>, Dariane Souza<sup>2</sup> and Blair D. Siegfried<sup>2</sup>

<sup>1</sup> Department of Entomology, University of Nebraska, Lincoln, NE 68583, USA

<sup>2</sup> Entomology and Nematology Department, University of Florida, Gainesville, FL 32611, USA; dariane.souza@ufl.edu (D.S.); bsiegfried1@ufl.edu (B.D.S.)

\* Correspondence: lmeinke1@unl.edu

**Simple Summary:** The structure of agricultural enterprises in the western United States Corn Belt (large irrigated monocultures, continuous planting of maize, strong aerial pesticide application and livestock industries) has led to a tradition of extensive insecticide use over time to manage the western



## Adaptation and Invasiveness of Western Corn Rootworm: Intensifying Research on a Worsening Pest\*

Michael E. Gray,<sup>1</sup> Thomas W. Sappington,<sup>2</sup> Nicholas J. Miller,<sup>2</sup> Joachim Moeser,<sup>3</sup> and Martin O. Bohn<sup>1</sup>

<sup>1</sup> Department of Crop Sciences, University of Illinois, Urbana, Illinois 61801; email: megray@illinois.edu, mbohn@illinois.edu

<sup>2</sup> USDA-ARS, Corn Insects and Crop Genetics Research Unit, Genetics Laboratory, Iowa State University, Ames, Iowa 50011; email: Tom.Sappington@ars.usda.gov, nicholas.miller@ars.usda.gov

<sup>3</sup> Department of Crop Sciences, Georg-August University Göttingen, D-37077, Göttingen, Germany; email: jmoeser@gwdg.de

Annu. Rev. Entomol. 2009. 54:303–21

The *Annual Review of Entomology* is online at [ento.annualreviews.org](http://ento.annualreviews.org)

This article's doi: 10.1146/annurev.ento.54.110807.090434

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### Key Words

*Diabrotica virgifera virgifera*, maize rotation

### Abstract

The western corn rootworm, *Diabrotica virgifera virgifera* LeConte, is an established insect pest of maize (*Zea mays* L.) in North America. The rotation of maize with another crop—principally soybeans (*Glycine max*



Review

## Resistance to Bt Maize by Western Corn Rootworm: Effects of Pest Biology, the Pest–Crop Interaction and the Agricultural Landscape on Resistance

Aaron J. Gassmann

Department of Entomology, Iowa State University, Ames, IA 50011, USA; aaronjg@iastate.edu

*Insects* 2021, 12, 136. <https://doi.org/10.3390/insects12020136>

<https://www.mdpi.com/journal/insects>

# Bt Traits for Corn Rootworm Management



Four **Single** Bt toxins for corn rootworm management have been commercialized:

- Cry3Bb1 (Yieldgard Rootworm)
  - mCry3A (Agrisure RW)
  - eCry3.1Ab (Agrisure Duracade)
  - Cry34/35Ab1 (Herculex CRW)
- } “Cry3” toxins

# Bt Traits for Corn Rootworm Management



**Pyramided** rootworm Bt hybrids express  $\geq 2$  rootworm Bt toxins in a single plant.

- Multiple MOAs are more durable; larvae need to be resistant to  $\geq 2$  Bt toxins.
- To fully exploit the benefits, novel toxins should be pyramided.

**Rootworm Bt trait/toxin commercialization dates:**

2003: Cry3Bb1

2006: Cry34/35Ab1

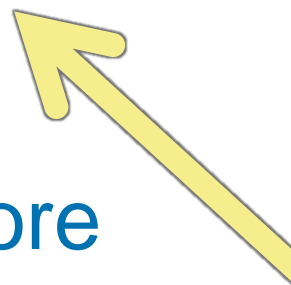
2007: mCry3A

2010: Cry3Bb1 + 34/35Ab1

2012: mCry3A + 34/35Ab1

2014: eCry3.1Ab + mCry3A

2022: Cry3Bb1 + 34/35Ab1 + **DvSnf7 (RNAi)**





# Rootworm Resistance to Bt Traits

2009

First evidence of field-evolved resistance to Cry3Bb1 in western corn rootworm: *6 years after commercialization.*

- Gassmann et al. 2011 PLOS One 6 (7)

## Cross-resistance among Cry3Bb1, mCry3A, and eCry3.1Ab

- Gassmann et al. 2014. PNAS  
<https://doi.org/10.1073/pnas.1317179111>
- Zukoff et al. 2016. J. Econ. Ent.  
<https://doi.org/10.1093/jee/tow073> PMID: 27106225



# Rootworm Resistance to Bt Traits

**2016 - 2019**

**Confirmed reports of field-evolved resistance to Cry34/35Ab1 in Iowa and Minnesota**

- Gassmann et al. 2019. Pest Man. Sci. DOI: 10.1002/ps5510
- Gassmann et al. 2016. J. Econ. Ent. DOI: 10.1093/jee/tow110
- Ludwick et al. 2017. J. Appl Ent. <https://doi.org/10.1111/jen.12377>



# Rootworm Resistance to Bt Traits

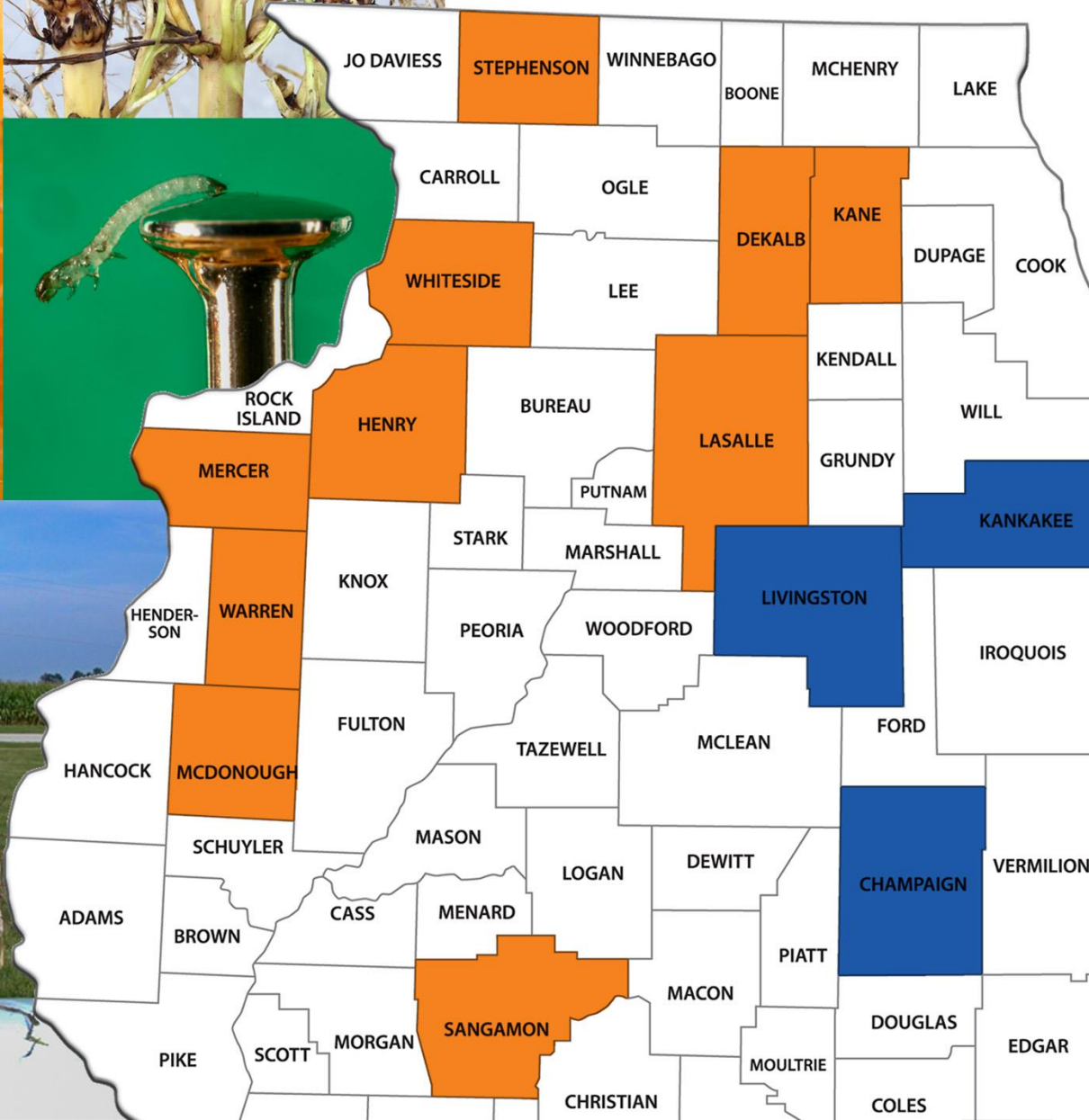
2019

Confirmed reports of field-evolved resistance to Cry3Bb1 & Cry34/35Ab1 in North Dakota WCR & NCR!

- Calles-Torrez et al. 2019. J. of Econ. Ent. DOI: 10.1093/jee/toz111



# 2022 Illinois Bt Resistance Status (~2012-2022)



- Counties with Bt resistance in *continuous corn*.
- Counties with Bt resistance in *rotated corn*.
- Injury due to Bt resistance possible in at least northern half of Illinois.
- Evidence of Cry3Bb1 resistance found wherever WCR were tested.
- Cry34/35Ab1 reduced susceptibility or resistance present in recent years.





**Single-plant Bt-resistance bioassay (Gassmann et al. 2011)**  
**Single Bt trait hybrids (Cry3Bb1 + Cry34/35Ab1) + isolines**  
**SmartStax® PRO family of hybrids**

**Suspected “R” populations vs. USDA Bt-susceptible WCR**



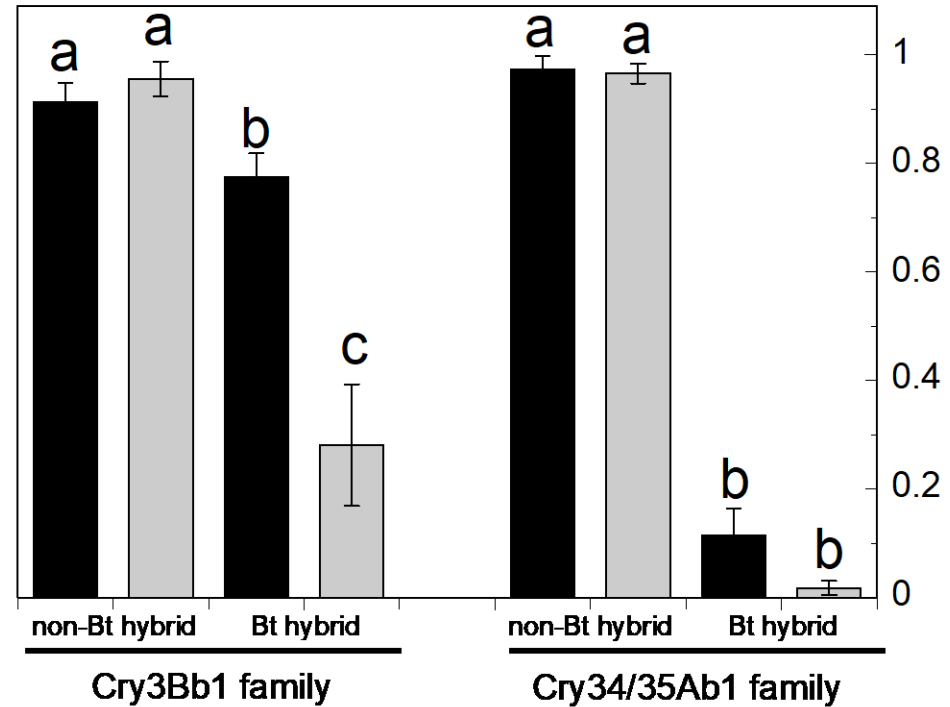
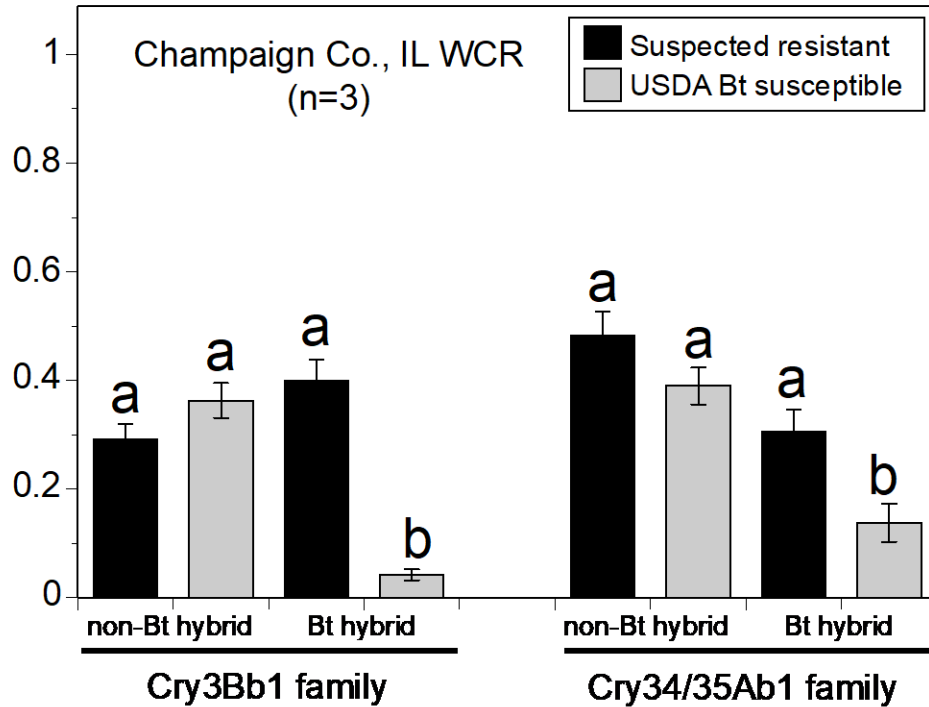
**→ Measure: proportion surviving larvae & proportion 3<sup>rd</sup> instars among survivors**



# 2022 IL Single Trait Bt Bioassay



Proportion  
larval  
survival  
(±SEM)



Single Bt trait expressed in plants



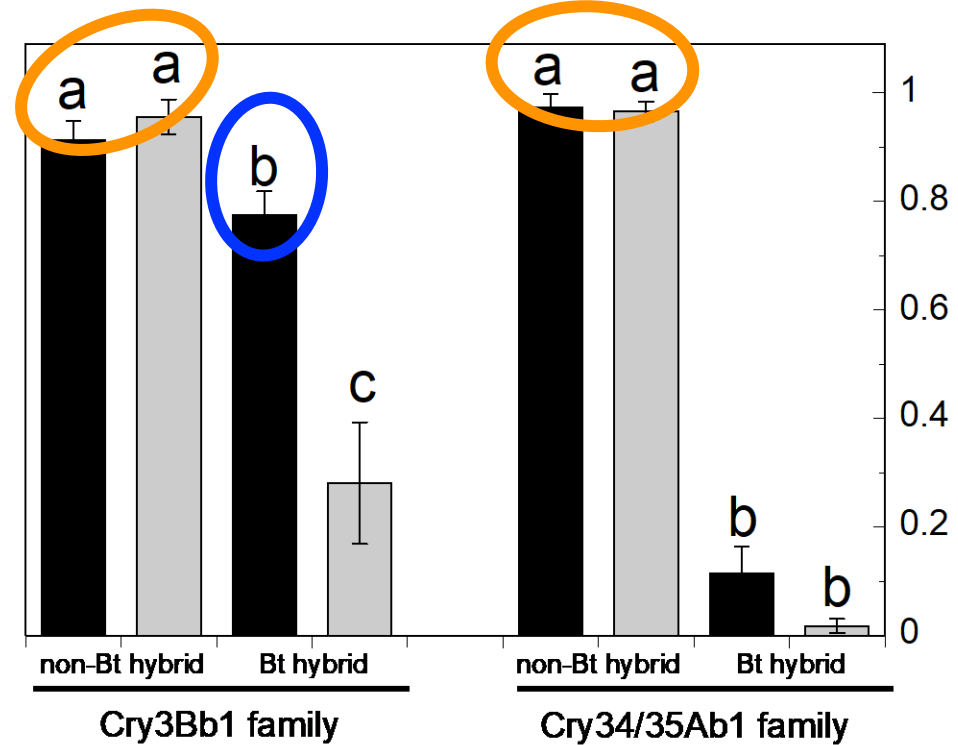
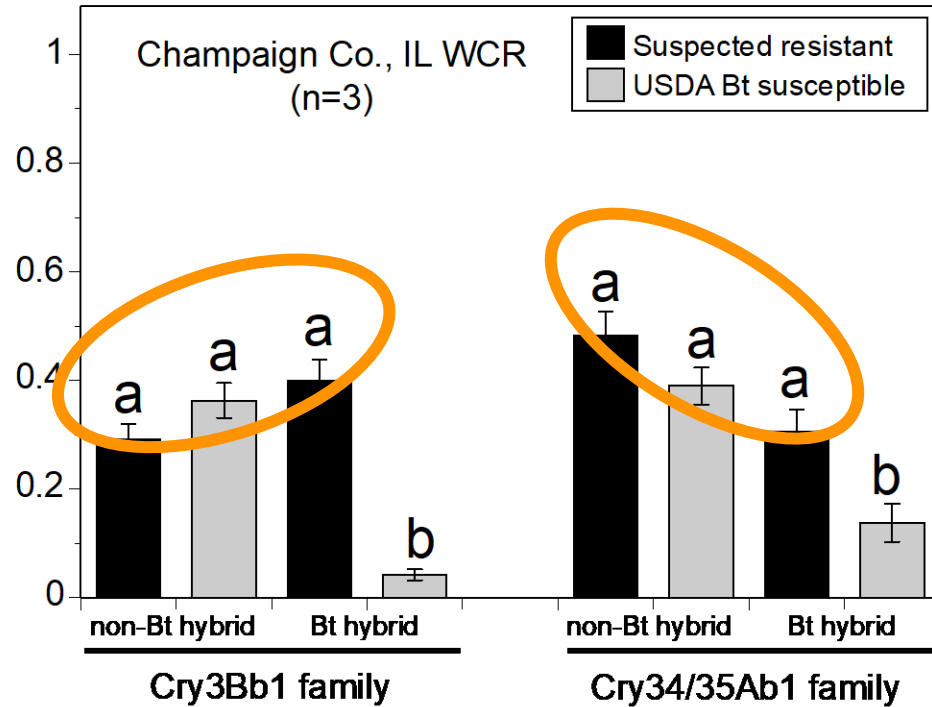
Proportion  
3rd instar  
larvae  
(±SEM)





# 2022 IL Single Trait Bt Bioassay

Proportion  
larval  
survival  
( $\pm$ SEM)

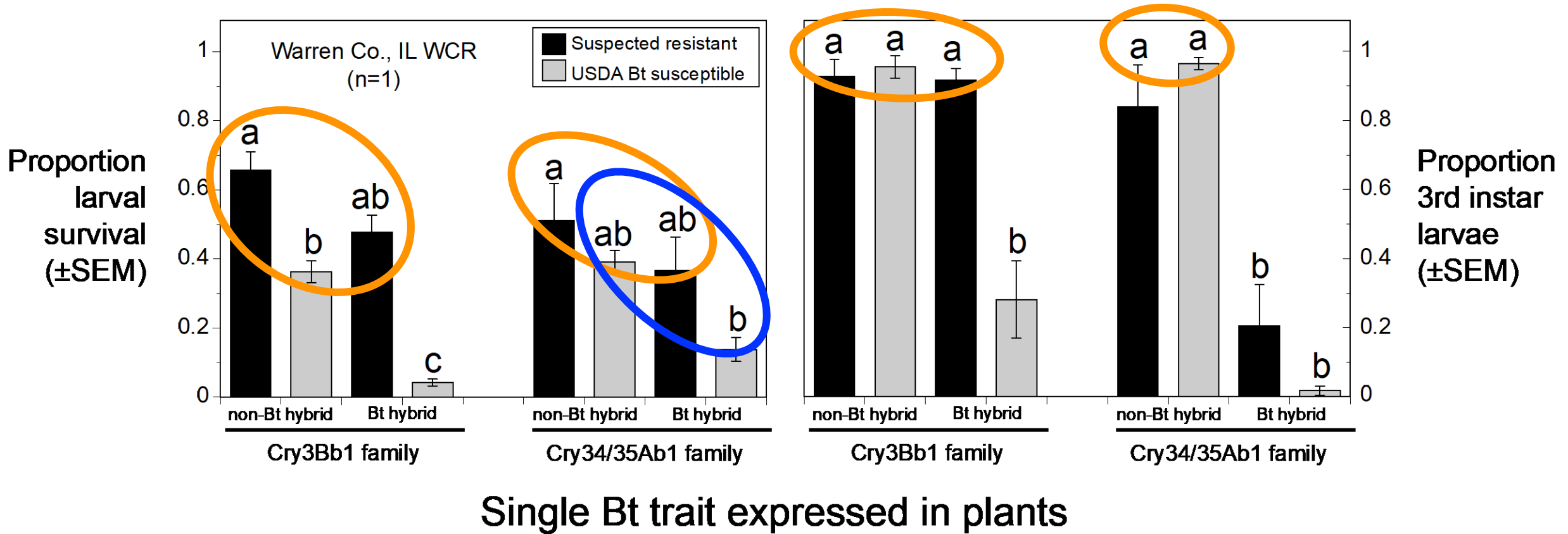


Proportion  
3rd instar  
larvae  
( $\pm$ SEM)

Single Bt trait expressed in plants



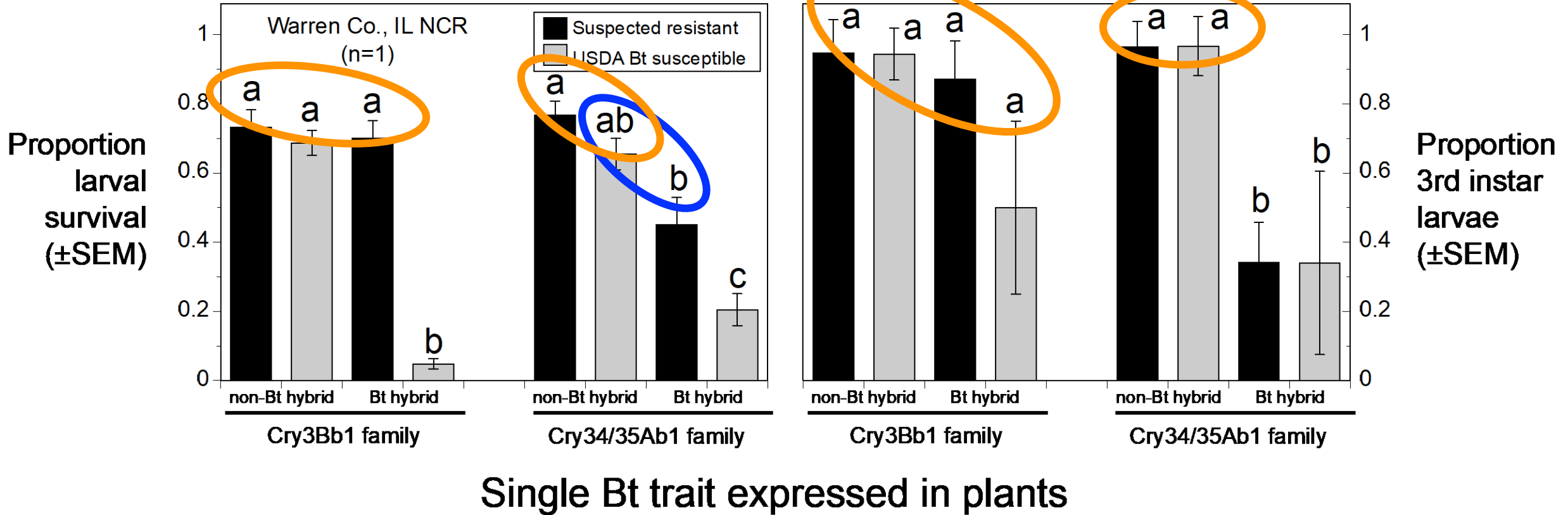
# 2022 IL Single Trait Bt Bioassay







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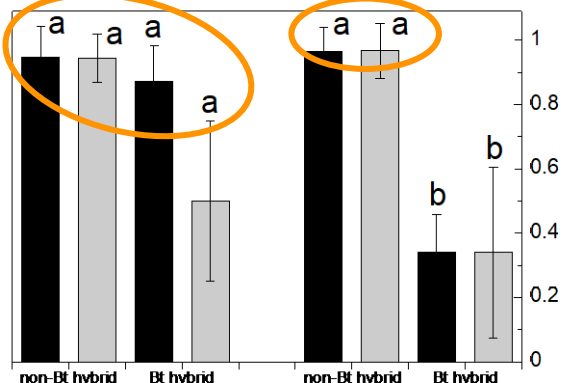
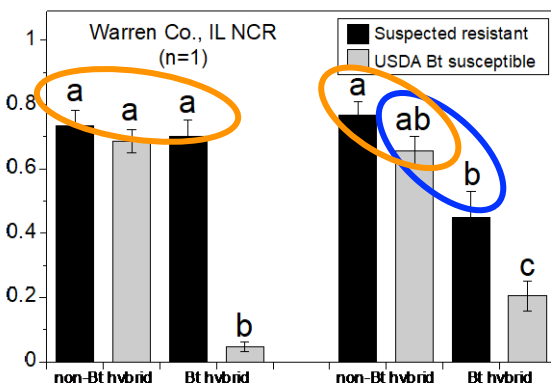
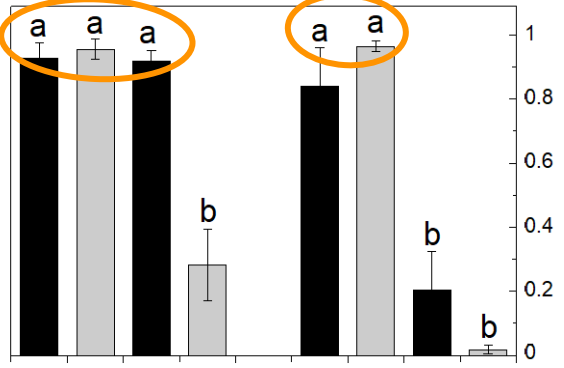
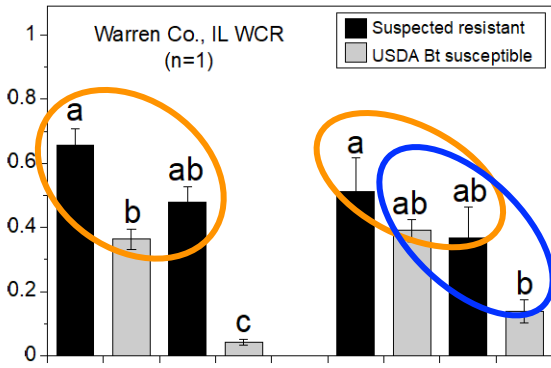
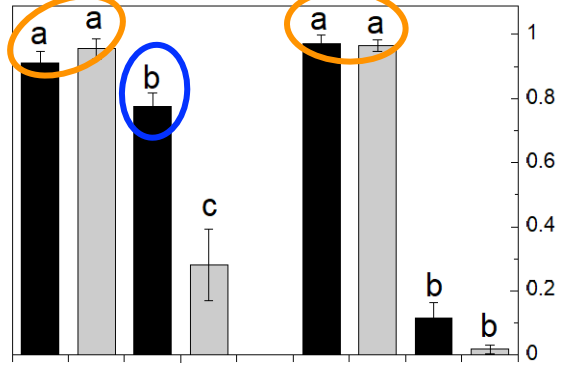
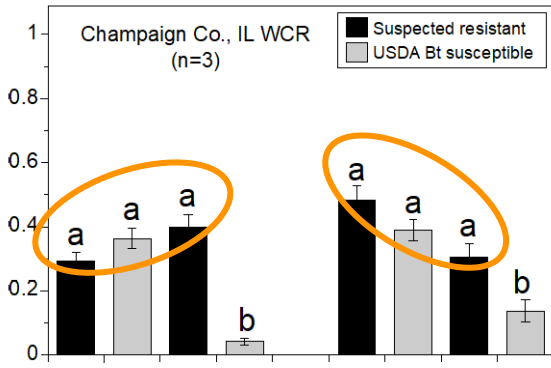


# 2022 IL Single Trait Bt Bioassay



Proportion larval survival

Proportion 3rd instar larvae



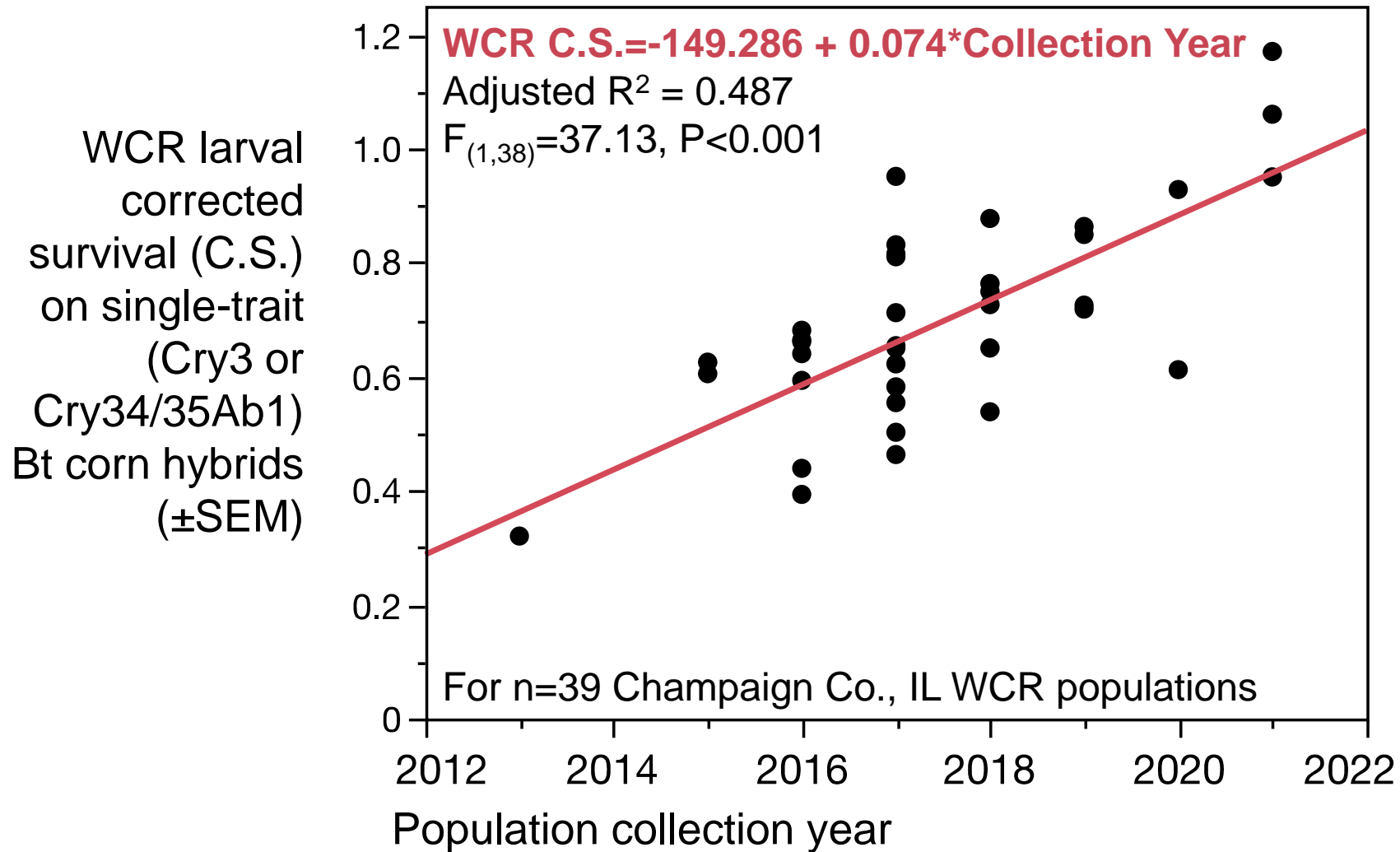
Proportion larval survival ( $\pm$ SEM)

Proportion 3rd instar larvae ( $\pm$ SEM)

Single Bt trait expressed in plants

- NCR & WCR survive equally well on Cry3Bb1 and non-Bt hybrid in bioassays.
- CRW survival on Cry34/35Ab1 hybrid is almost equal to survival on non-Bt hybrid.
- Cry3Bb1 survivors may have minor developmental delays; Cry34/35Ab1 survivors have significant delays.

# WCR Resistance to Bt traits is increasing in Illinois

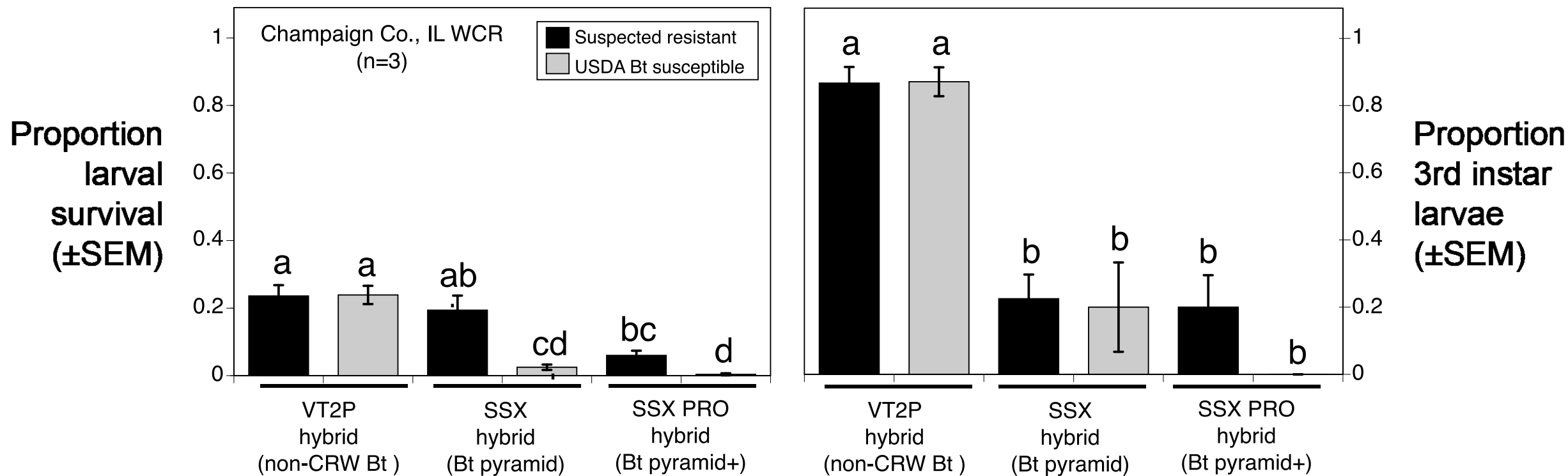


- Corrected survival (C.S.) is the quotient of larval survival on a Bt maize hybrid divided by larval survival on the non-Bt hybrid.
- Lower values indicate greater efficacy.

**2013-2021 larval survival on single trait Bt hybrids increased at 7.4%/year**



# 2022 IL SmartStax® Pro Bioassay



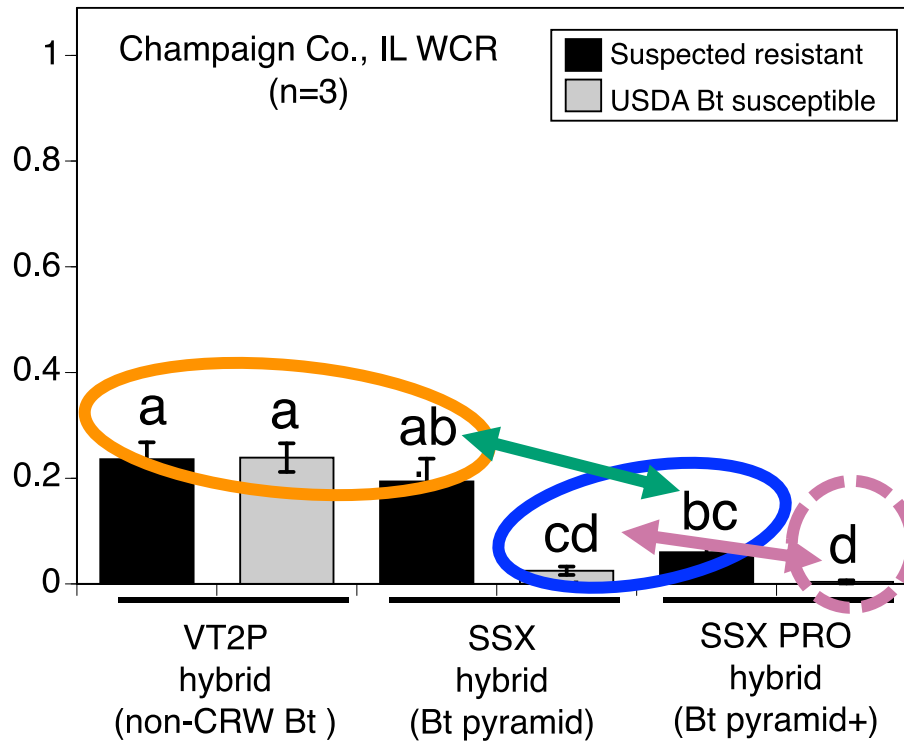
SmartStax® PRO family of corn hybrids  
(Cry3Bb1 + Cry34/35 + ds RNA)



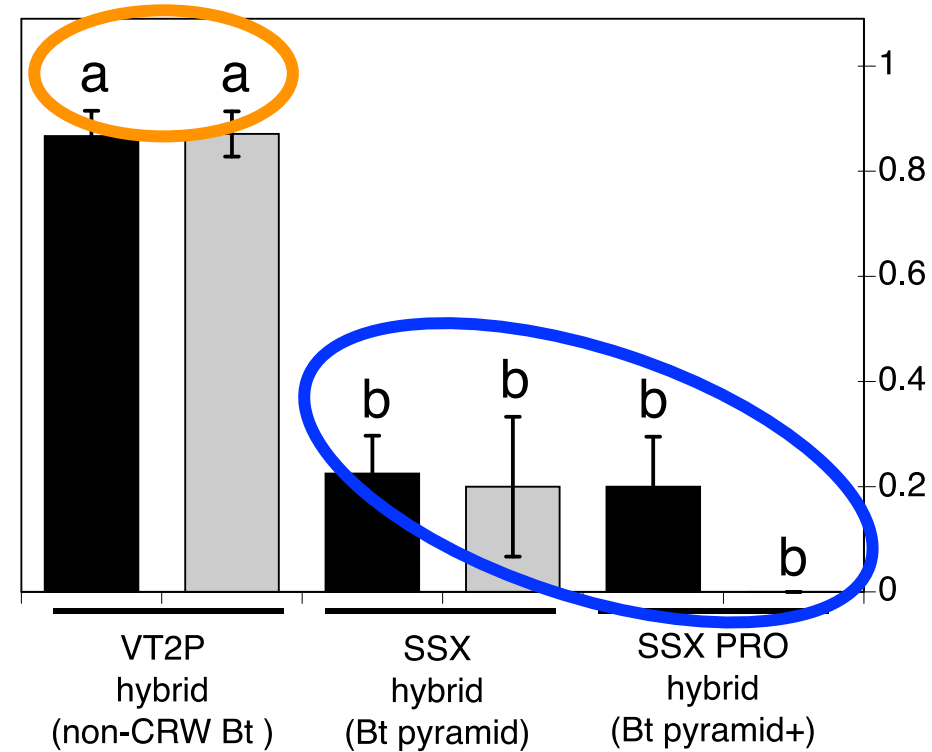
# 2022 IL SmartStax® Pro Bioassay



Proportion larval survival (±SEM)



Proportion 3rd instar larvae (±SEM)



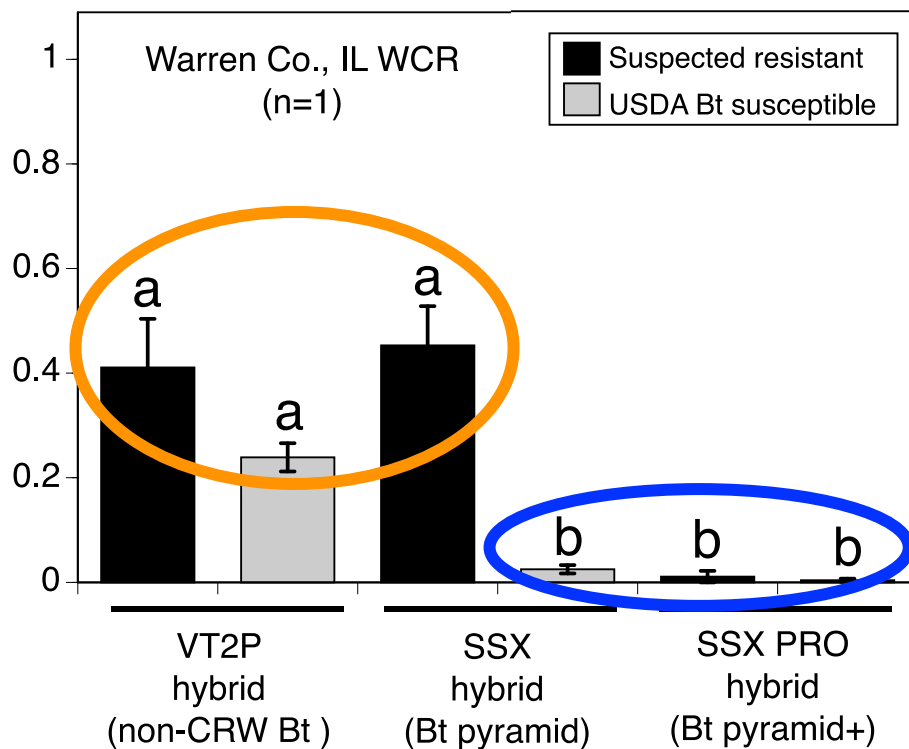
SmartStax® PRO family of corn hybrids  
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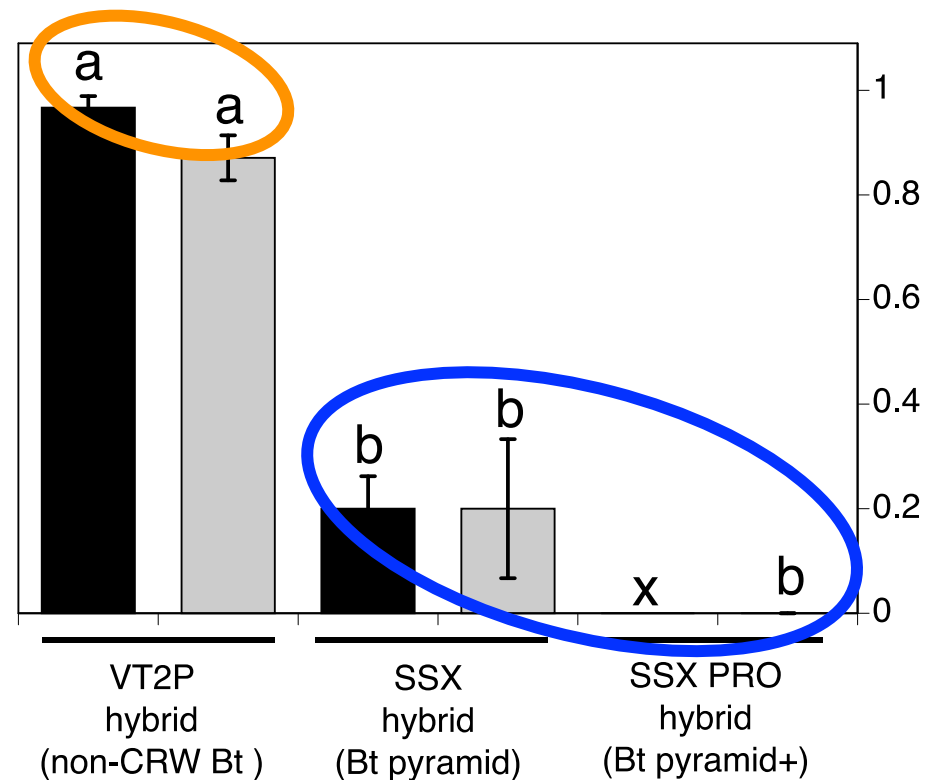
# 2022 IL SmartStax® Pro Bioassay



Proportion larval survival (±SEM)



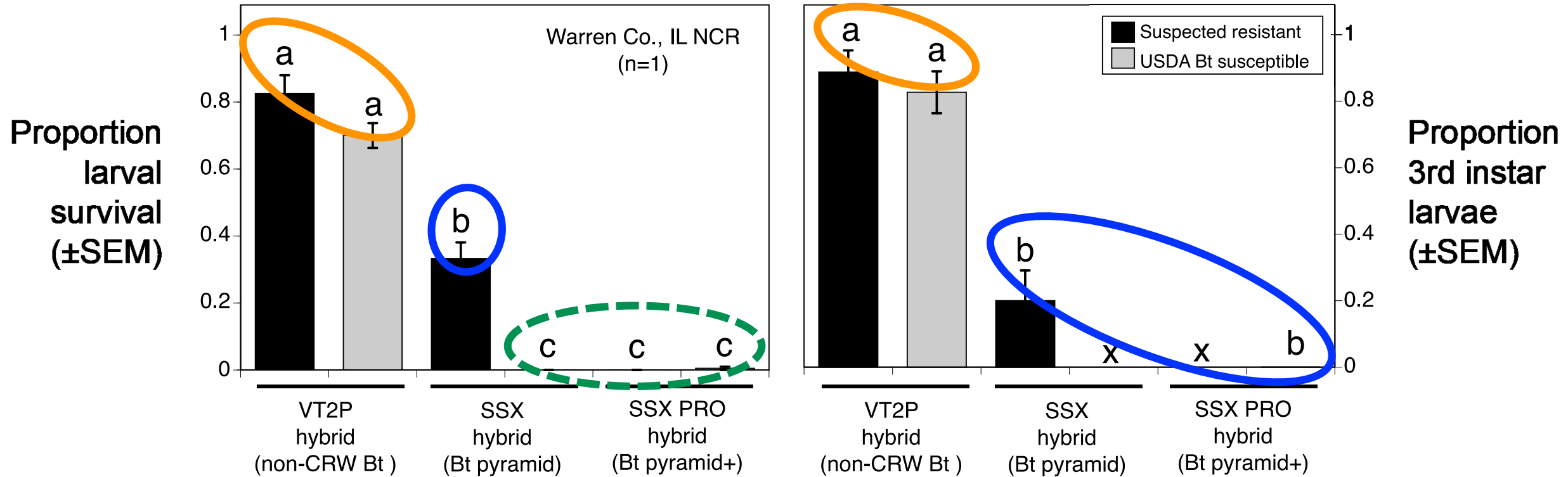
Proportion 3rd instar larvae (±SEM)



SmartStax® PRO family of corn hybrids  
(Cry3Bb1 + Cry34/35 + ds RNA)



# 2022 IL SmartStax® Pro Bioassay



SmartStax® PRO family of corn hybrids  
 (Cry3Bb1 + Cry34/35 + ds RNA)



## 2022 IL SmartStax® Pro Bioassay

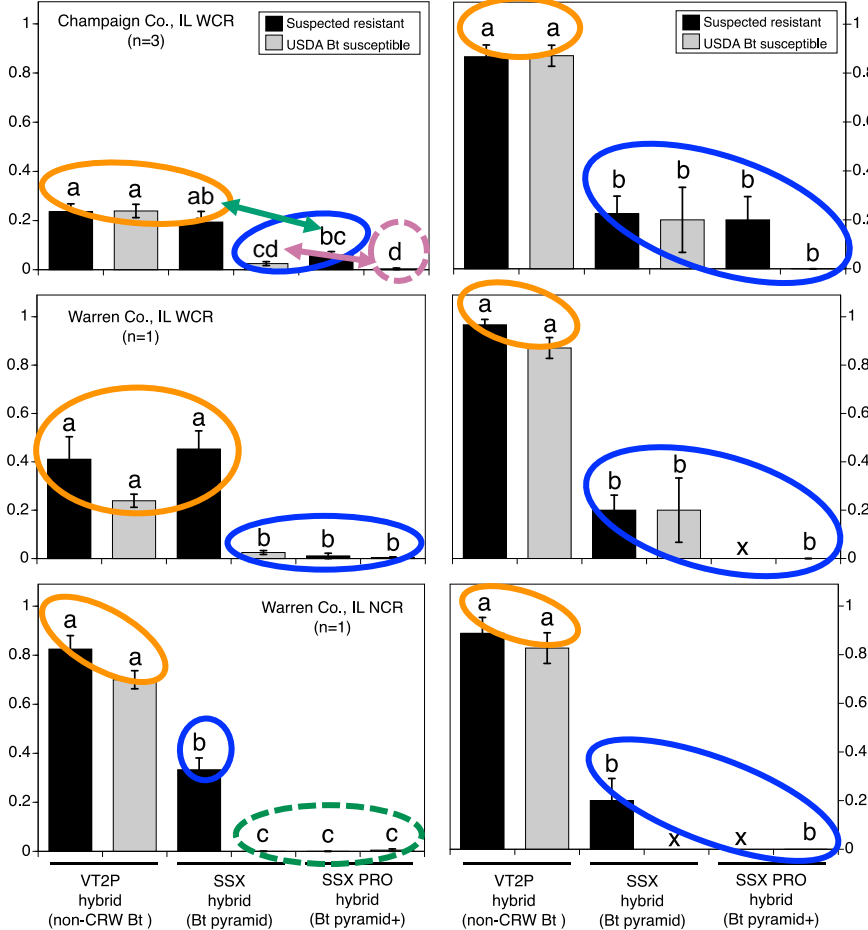


Proportion larval survival

Proportion 3rd instar larvae

Proportion larval survival (±SEM)

Proportion 3rd instar larvae (±SEM)



SmartStax® PRO family of corn hybrids (Cry3Bb1 + Cry34/35 + ds RNA)

- CRW survival on the SSX Bt pyramid is nearly equivalent to survival on non-Bt VT2P in bioassays
- CRW susceptibility to SSX PRO Bt+RNAi pyramid is good; Champaign Co. WCR were slightly (but significantly) less susceptible to SSX PRO.
- Surviving larvae from SSX and SSX PRO hybrids have significantly slowed development in bioassays.



# Delayed larval development delays adult emergence & may disadvantage the surviving beetles by:

**Shortening adult span**  
vs. earlier emerging adults

**Shortening period for access to the most nutritious foods**  
Slowing egg development

**Shortening period for laying eggs**

**Reducing total reproduction relative to beetles on non-Bt plants**



# Bioassay and resistance summary:

- Bt resistance is increasing
  - Resistance is inevitable, we can slow it down.
  - There is survival & development evidence
- RNAi pyramids performed well on NCR & WCR
  - Potential for resistance to RNAi is present
- Use monitoring to put the right hybrid on the right acres and limit unnecessary selection
  - Non-economic populations don't need to be treated
  - Rotation is the best tactic against high pressure

# Rootworm Control Evaluations 2018 to 2022

The screenshot shows a web page from the University of Illinois Urbana-Champaign. The header includes the university name, navigation links for 'Give / Volunteer / Careers', and the College of Agricultural, Consumer & Environmental Sciences logo. A search bar is present in the top right. Below the header is a navigation menu with links for 'Topics', 'Learn', 'Events', 'News', 'Connect', 'Impact', and 'About'. The main content area features a large heading for 'Field Crop Insect and Disease Applied Research' and a sub-heading for 'Annual Applied Research Report'. The primary focus is on the '2022 Applied Research Results: Field Crop Disease and Insect Management' section, which includes a paragraph of introductory text and a bulleted list of five key findings. A link to the '2021 Applied Research Results' is also visible at the bottom of the page.

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN Give / Volunteer / Careers

**I** College of Agricultural, Consumer & Environmental Sciences  
Illinois Extension Search this site

Topics ▾ Learn ▾ Events ▾ News Connect ▾ Impact ▾ About ▾

## Field Crop Insect and Disease Applied Research

### Annual Applied Research Report

#### [2022 Applied Research Results: Field Crop Disease and Insect Management](#)

The 2022 Field Crop Insect and Disease Applied Research Report provides farmers with updated control efficacy and pest distribution information for major pests of corn and soybean. Use these evaluations to guide control decisions, track performance over time, and see trends in pest populations. Included in the 2022 guide:

- 12 separate field evaluations of traits and insecticides for controlling corn rootworm
- Insect pest surveys
- Ongoing Bt-resistance monitoring results
- Evaluations of foliar insecticides and seed treatments for insect pest control in soybean
- Summaries of weather and crop production for the 2022 growing season

#### [2021 Applied Research Results: Field Crop Disease and Insect Management](#)

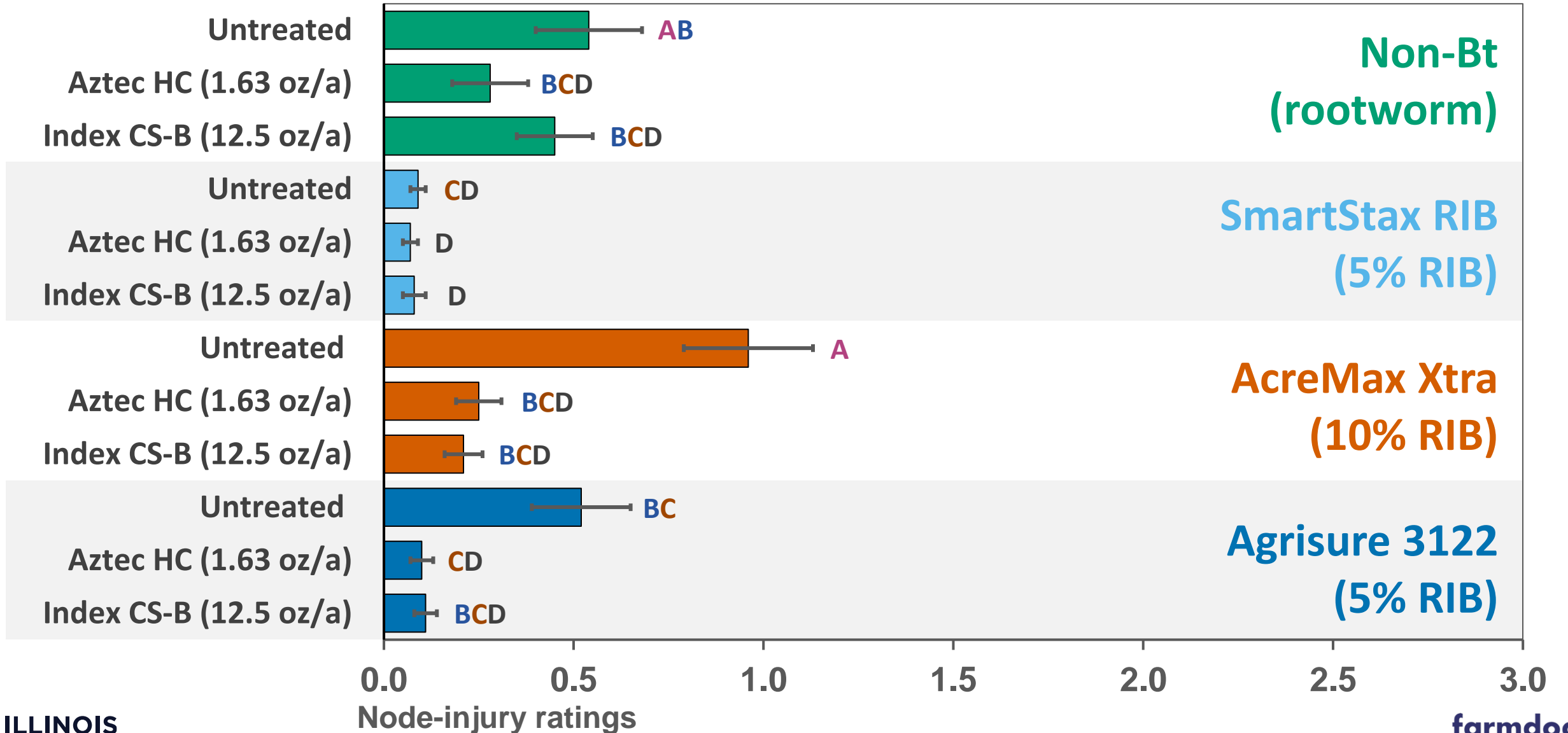
- Surveys of key insect pests, including corn rootworm Japanese beetle, and dectes stem borer.
- Western and northern corn rootworm Bt resistance monitoring and field trait performance results

# 0 to 3 Node-injury rating

Node Injury Scale	Description
<b>0</b>	<b>No damage</b>
<b>1</b>	<b>One node or the equivalent of one node eaten within two inches of stalk</b>
<b>2</b>	<b>Two nodes eaten within two inches of stalk</b>
<b>3</b>	<b>Three nodes eaten within two inches of stalk</b>

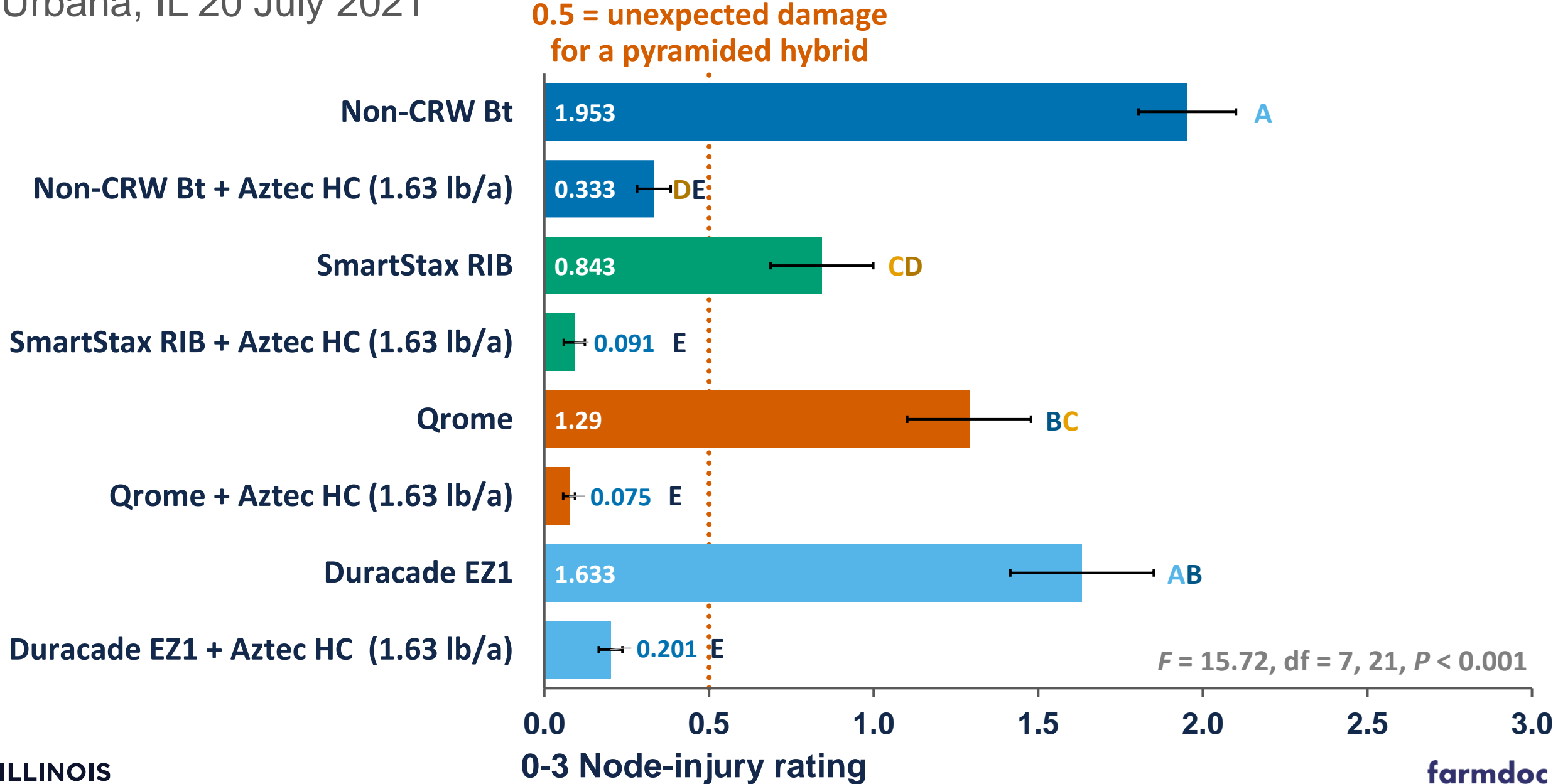
# Evaluation of Traits in Combination with Insecticides

Urbana, IL 2019



# Evaluation of Trait Packages with and without Aztec HC

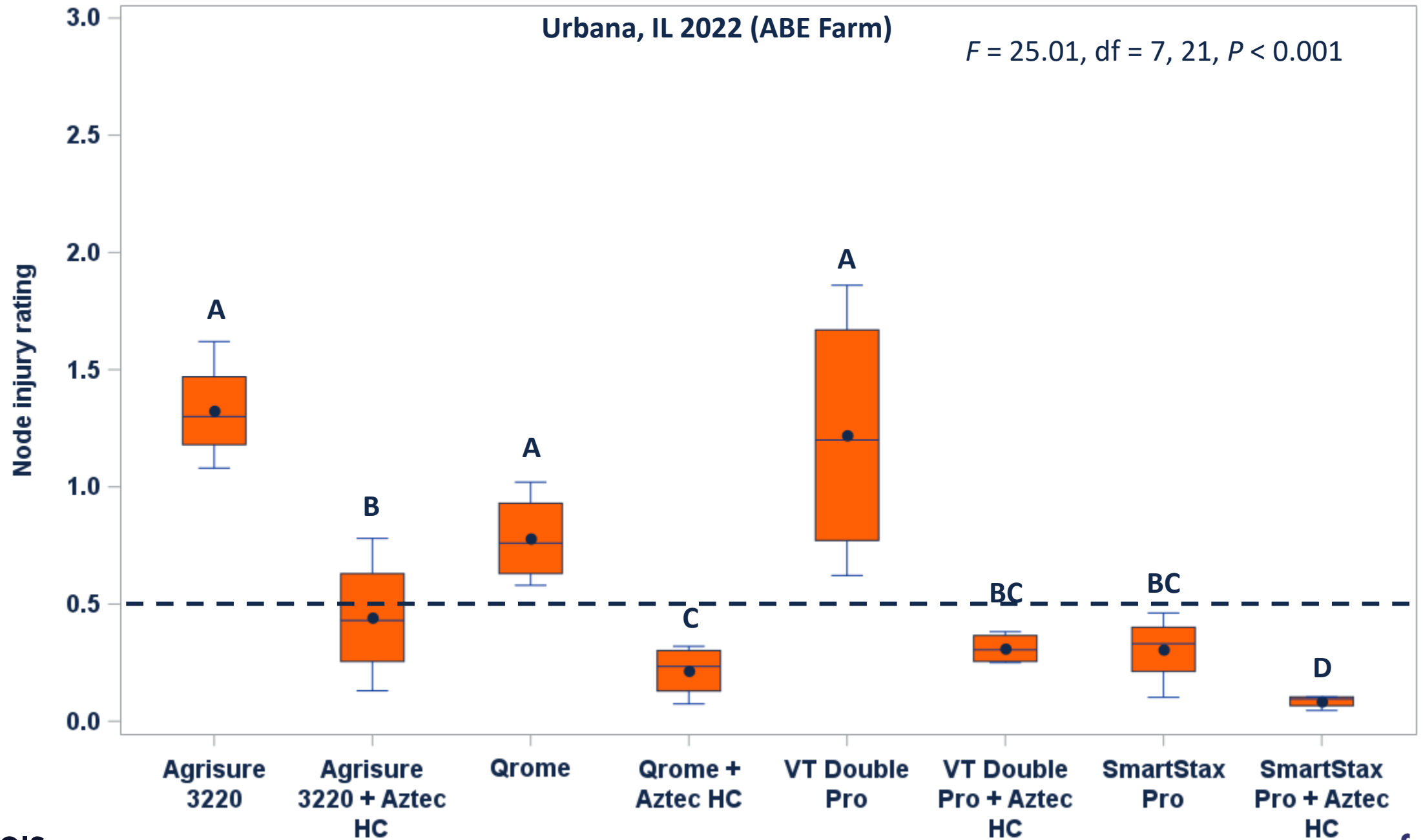
Urbana, IL 20 July 2021



# Corn Rootworm Evaluation - Traits plus Aztec HC (1.63 lb/a)

Urbana, IL 2022 (ABE Farm)

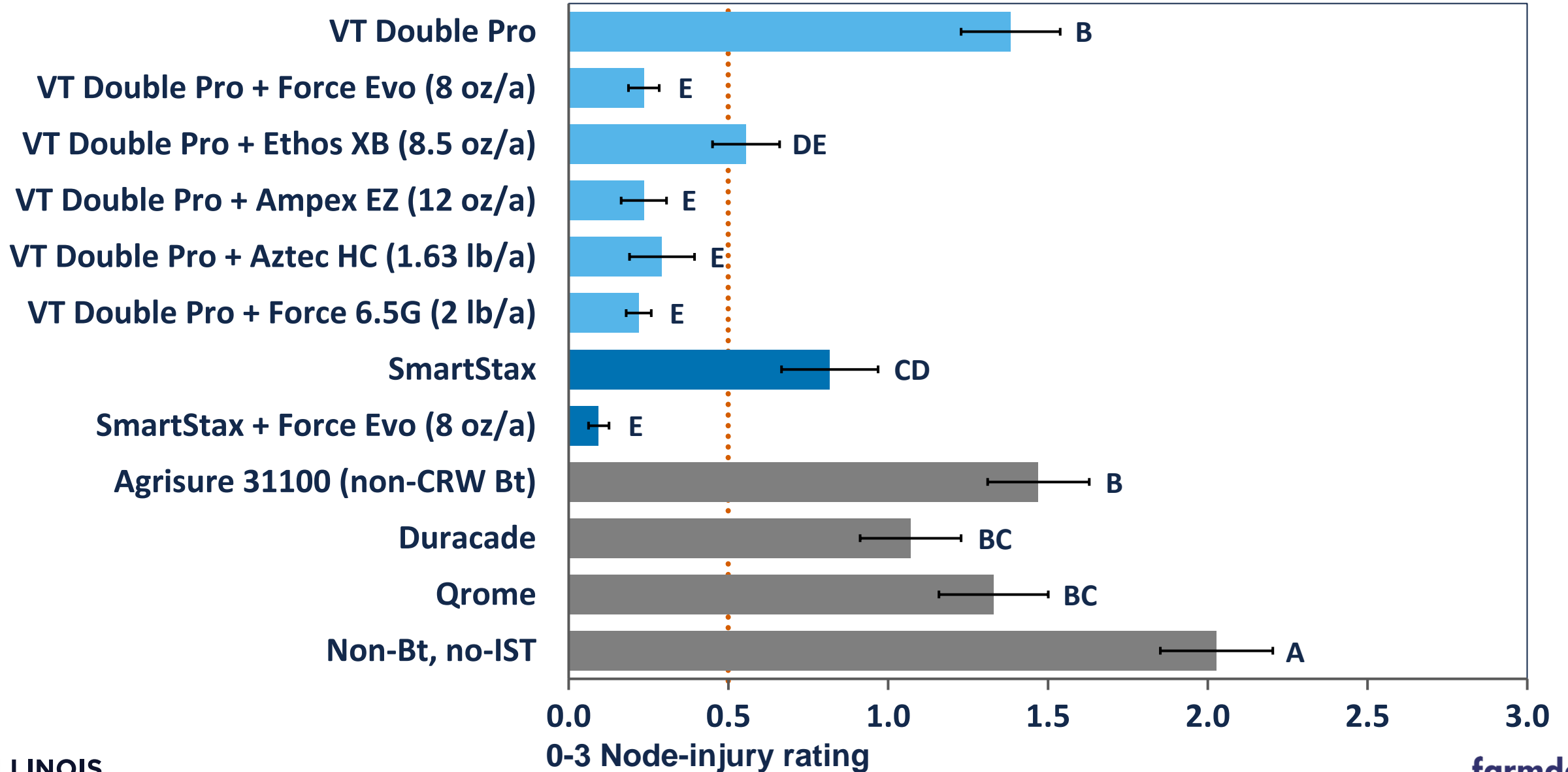
$F = 25.01, df = 7, 21, P < 0.001$



# Standard Evaluation of Corn Rootworm Traits and Insecticides

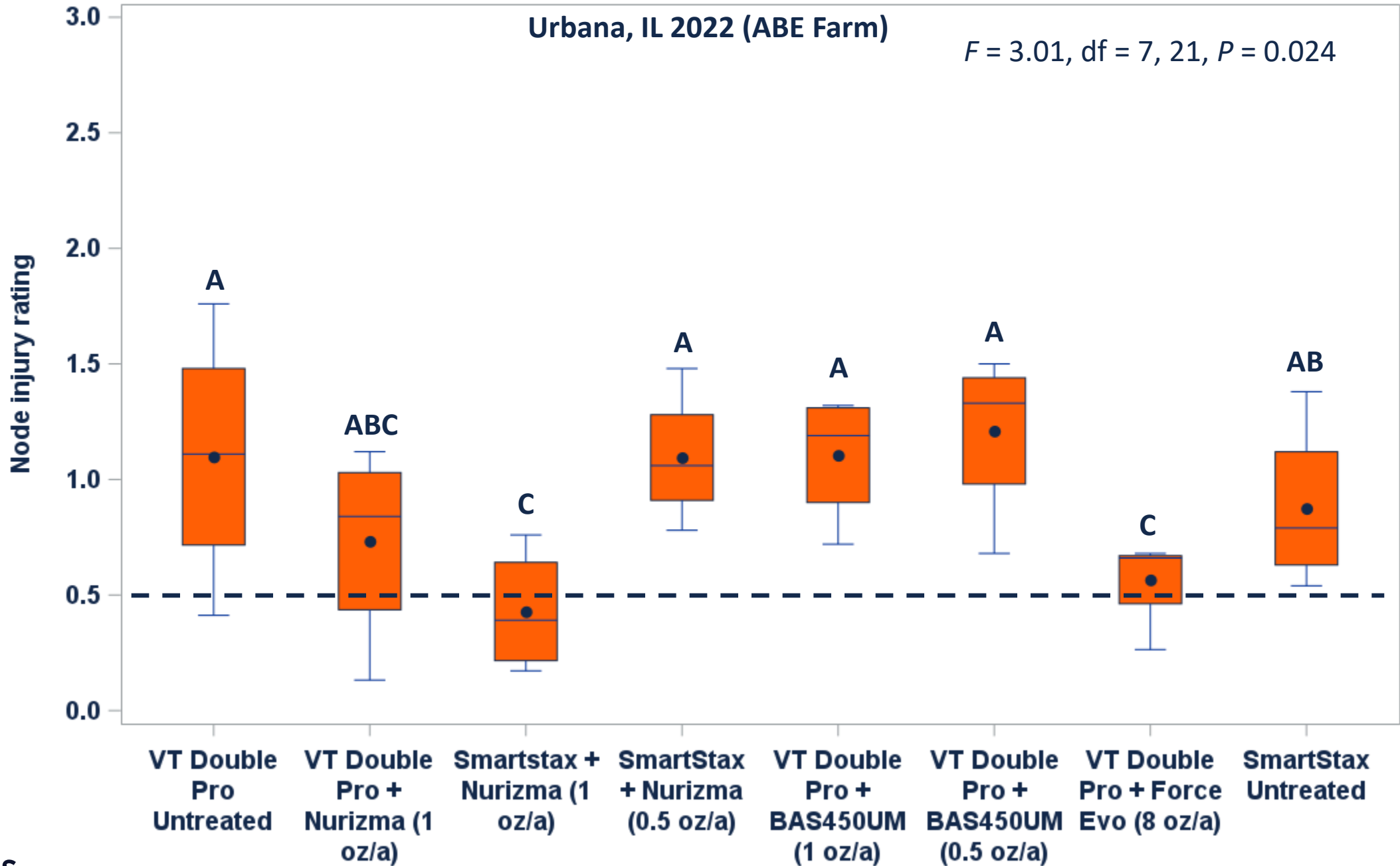
Urbana, IL 16 July 2021

$F = 12.44, df = 11, 33, P < 0.001$



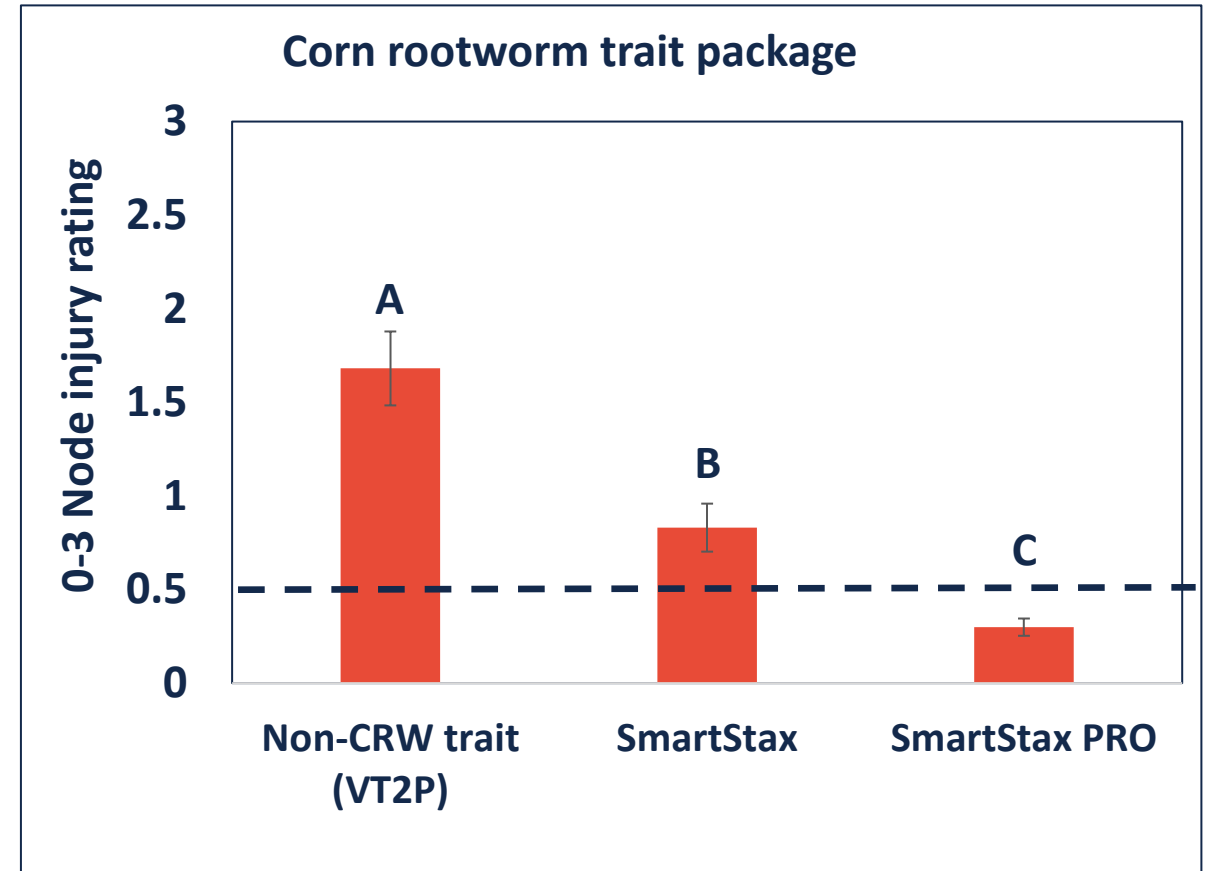
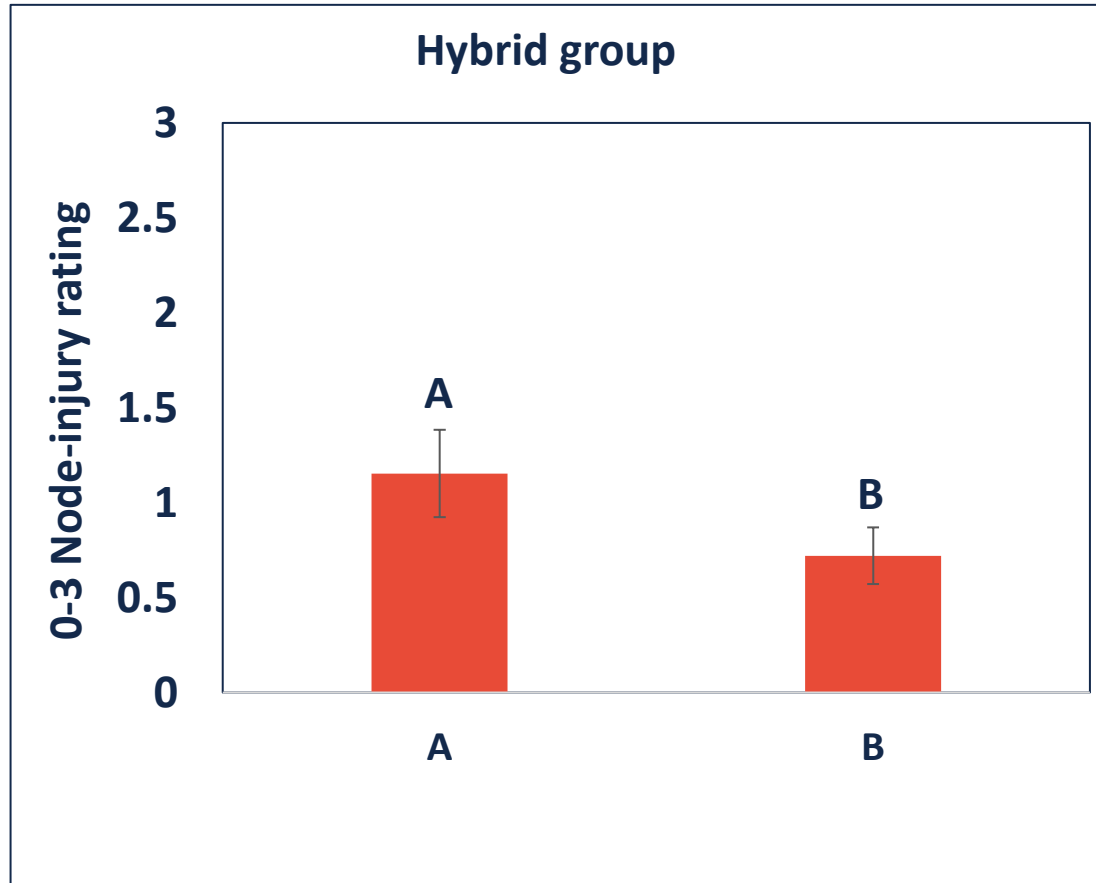


# Corn Rootworm Evaluation - BASF-3 2022



# Evaluation of SmartStax PRO for western corn rootworm control

Urbana, IL 20 July 2021

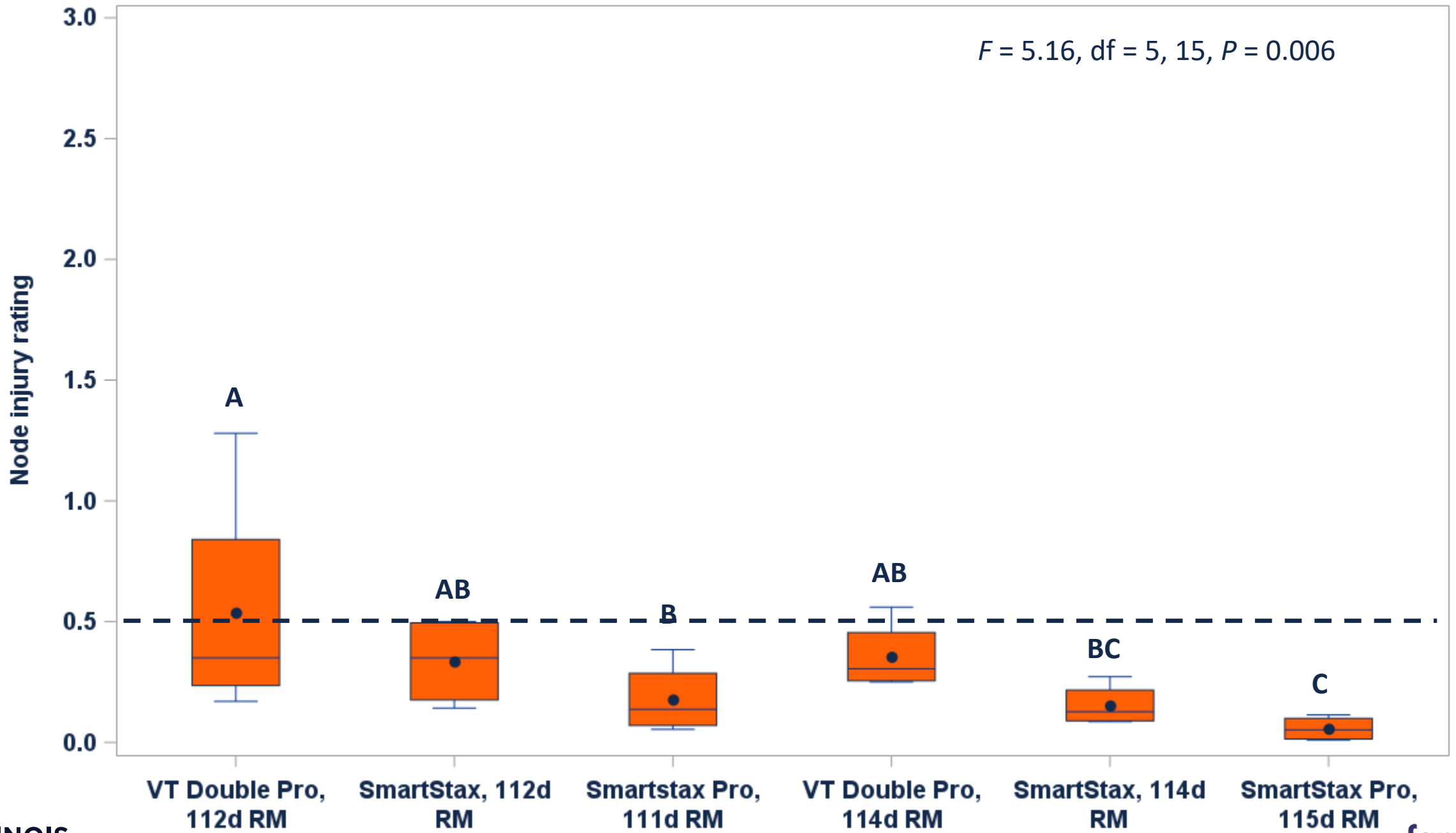


Hybrid group:  $F = 12.19$ ,  $df = 1, 15$ ,  $P = 0.003$

Trait package:  $F = 42.18$ ,  $df = 2, 15$ ,  $P < 0.001$

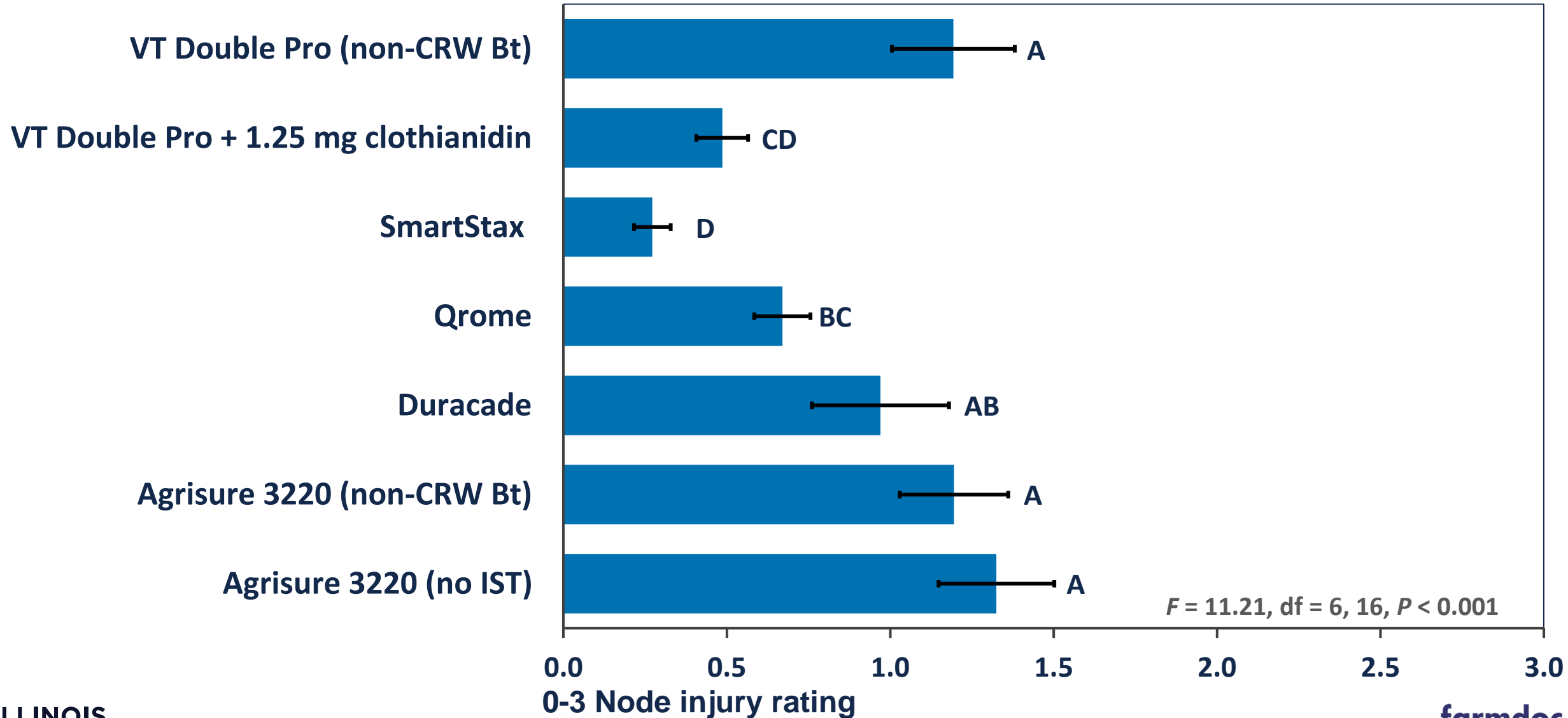
Hybrid-trait interaction:  $F = 2.14$ ,  $df = 2, 15$ ,  $P = 0.153$

# Corn Rootworm Evaluation - Bayer SmartStax Pro 2022

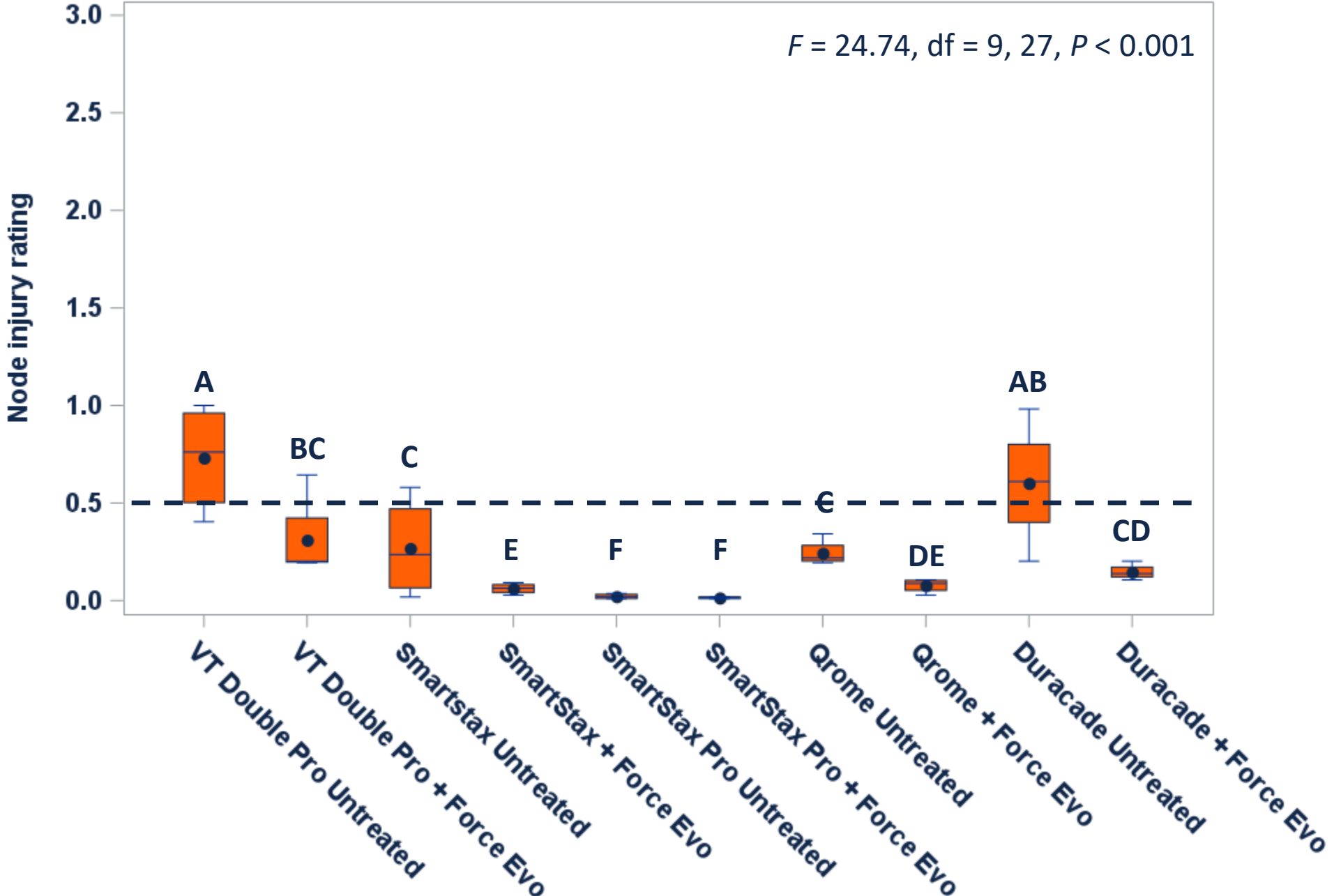


# Evaluation of Corn Rootworm Trait Packages

Monmouth, IL 21 July 2021



# Corn Rootworm Evaluation - Monmouth 2022

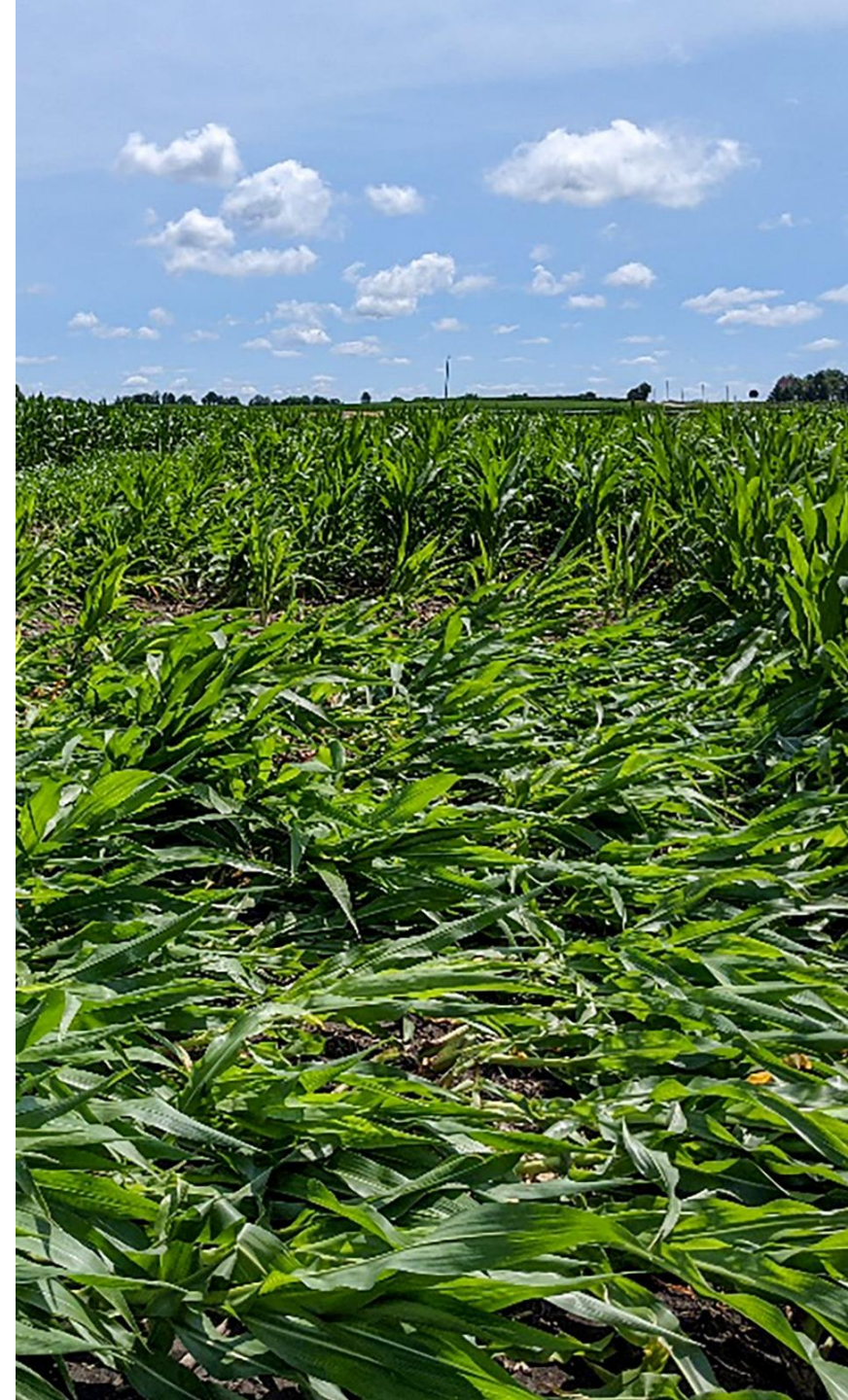


# Corn Rootworm Summary

## Illinois

**Step back in corn rootworm pressure in 2022 after increasing for several years**

Bioassays continue to show increasing resistance in both species to all traits



# Corn Rootworm Summary

## Illinois

### Dramatic difference between continuous corn and heavy rotation regions within Illinois

- High rates of resistance, failures of pyramided traits, high northern corn rootworm populations north of I-80
- Low to no pressure in much of east central Illinois
- **Injury to first-year corn has been uncommon**



# Corn Rootworm Summary

## Illinois

**Soil insecticides  
have not lost efficacy in  
Illinois field experiments**





# Current management recommendations

Where unexpected damage is observed and/or resistance is expected:



**Best option:** Rotate field to soybean  
(kills all WCR larvae in the soil at hatch)

**Next best:** Use a soil insecticide

**Worst option:** Continuous corn,  
same trait package

Local practices have a demonstrated impact  
on corn rootworm resistance development

## Unexpected damage (EPA definition)

- ½ node pruned pyramided hybrid
- 1 node pruned single-trait hybrid

# Resources

## Applied Pest Management Research 2018 to 2022 reports available

[go.Illinois.edu/PestManagementResearchReport](http://go.Illinois.edu/PestManagementResearchReport)

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### Field Crop Insect and Disease Applied Research

#### Annual Applied Research Report

#### 2022 Applied Research Results: Field Crop Disease and Insect Management

The 2022 Field Crop Insect and Disease Applied Research Report provides farmers with updated control efficacy and pest distribution information for major pests of corn and soybean. Use these evaluations to guide control decisions, track performance over time, and see trends in pest populations. Included in the 2022 guide:

- 12 separate field evaluations of traits and insecticides for controlling corn rootworm
- Insect pest surveys
- Ongoing Bt-resistance monitoring results
- Evaluations of foliar insecticides and seed treatments for insect pest control in soybean
- Summaries of weather and crop production for the 2022 growing season

#### 2021 Applied Research Results: Field Crop Disease and Insect Management

- Surveys of key insect pests, including corn rootworm Japanese beetle, and *diabrotica* stem borer.
- Western and northern corn rootworm Bt resistance monitoring and field trait performance results
- Evaluations of fungicides and insecticides (both foliar and seed treatments) in corn and soybean
- Establishment of a long-term trial to explore entomopathogenic nematodes for rootworm control
- Summaries of weather and a production overview for the 2021 growing season

#### 2020 Applied Research Results: Field Crop Disease and Insect Management

- Evaluations of foliar fungicides for control of frogeye leaf spot, white mold, purple seed stain, southern rust and more in corn and soybean
- Surveys of major pests and diseases, including red crown rot, plant-parasitic nematodes in corn, soybean gall midge, and the annual statewide insect survey
- Evaluations of insecticides and Bt traits for control of corn rootworms, as well as Bt-resistance bioassays of western corn rootworm

## Production information [go.Illinois.edu/cropcentral](http://go.Illinois.edu/cropcentral)

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#### Latest Bulletin Article

#### Mar 24 | Weekly Climate Review & Weather Forecast

Todd Gleason March 24, 2023  
Spring has sprung but you wouldn't know it based on the weather. Average temperatures this week ranged from the low to upper 30s statewide, between 4 and 10 degrees below normal for mid-March. The cooler week was led by very low temperatures and wind chills last weekend. Actual temperatures observed last weekend include 6 degrees in Will County and 8 degrees in Lee and McLean Counties. These extreme temperatures followed a winter season that was noticeably absent prolonged cold...

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#### The Bulletin Authors

Aaron Hager  
Chelsea Harbach  
Dennis Bowman  
Emerson Nafziger  
Emily Heaton  
Giovanna Preza Fontes  
Joe Spencer  
Kelly Estes  
Maddy Kangas  
Maria Villamil  
Michael Gray  
Nathan Johanning  
Nathan Kinczewski

#### Recent Bulletin Articles

#### Cooperators For Spring Moth Trapping

Kelly Estes March 30, 2023  
As in past years, our Moth Trapping Network is set to begin April 1 with our spring migratory insects. We are currently looking for cooperators to monitor both black cutworm and true armyworm traps from April 1 - May 31.

Requirements for trapping:

- Set up traps provided.
- Check traps regularly. Ideally, we'd like traps to be checked every other day to help

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#### Nitrogen For The 2023 Corn Crop

Emerson Nafziger March 15, 2023  
Helped more than hurt overall by periods of dry weather during the season, the 2023 Illinois corn averaged 214 bushels per acre, the highest yield on record. We'll look at some results from N fertilizer trials in 2022 and consider how we manage N for the upcoming season. N rate  
Figure 1 below shows N responses for corn following soybean in nine N rate trials in central Illinois in 2022. These are drawn using actual data points (yields at each N rate averaged over reps...

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#### Listen To The All Day Ag Outlook Presentations

Todd Gleason March 12, 2023  
March 7, 2023 University of Illinois Extension hosted a farmer conference at the Beef House in Covington, Indiana. The All Day Ag Outlook has been held annually since 1991. This year's event showcased U of I College of ACES farmdoc team members, Willag On Air market analysts, the Illinois FBFM, agricultural weather, and John Deere computer intelligence. We are hopeful you find the linked audio presentations from the day insightful. These files have been compiled into a single playlist which you may use to review or share the content...

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## Handy Bt trait table [www.texasinsects.org/bt-corn-trait-table.html](http://www.texasinsects.org/bt-corn-trait-table.html)

TEXAS A&M AGRILIFE EXTENSION

### Handy Bt Trait Table for U.S. Corn Production

This 2-page document list the types of Bt present in all commercialized corn in the U.S.A. in a concise format. It presents the trade names for traits, Bt event, protein(s) expressed, targeted insects and herbicide traits.

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Now in its 21st year, the Trait Table for field corn has become the standard as an authoritative reference to Bt toxins in corn. Dr. Chris DiFonzo at Michigan State University is the author, and questions or comments should be directed to her. If you would like to reprint the table in a local publication or extension bulletin, contact Chris DiFonzo (difonzo@msu.edu or 517-353-5328) for a version modifiable for your state.

Handy Bt Trait Table For FIELD CORN (New version posted 3/7/2023)

Supplements for more information:

- Checklist of Bt Events by Stack (3/2023)
- Table of Bt Events (3/2023)
- Table of EPA Registration Numbers (3/2023)
- Citations for resistance statements in the Trait Table (4 Feb. 2020)
- How to use the Trait Table (and what it tells you about your corn hybrid) (3/18/2023)

See below for a video walkthrough of how to use the Trait Table (3/30/23)

## Illinois Agronomy Handbook [go.Illinois.edu/AgronomyHandbook](http://go.Illinois.edu/AgronomyHandbook)

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### Agronomy Handbook

#### Illinois Agronomy Handbook

Several chapters of the *Illinois Agronomy Handbook* were updated in 2021 and are available for free download.

#### Managing Insect Pests

By: Nick Seiter

Insects can reduce crop yield and quality, either by feeding directly on the marketable portion or by indirectly stressing or killing the plant. Many insects can be considered pests of alfalfa, corn, soybean, or wheat; however, only a relative few are frequently encountered at economically significant densities in Illinois. This chapter considers "key" pests, which should form the basis of insect management strategies for these crops, as well as some "occasional" pests that, while frequently encountered, rarely cause economic damage. | [Read](#)

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# Questions?

## Joe Spencer

Principal Research Scientist  
Illinois Natural History Survey  
spencer1@illinois.edu  
@talkingrootworm



## Nick Seiter

Res. Asst. Professor  
UIUC Dept. of Crop Sciences  
nseiter@illinois.edu  
@nick\_seiter