Crop Insects

Mike Dunbar
Department of Entomology
Iowa State University
Resilient Agriculture 2014

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Cropping Systems Coordinated Agricultural Project: Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems

Major Corn Pest

Diabrotica virgifera virgifera
western corn rootworm (WCR)

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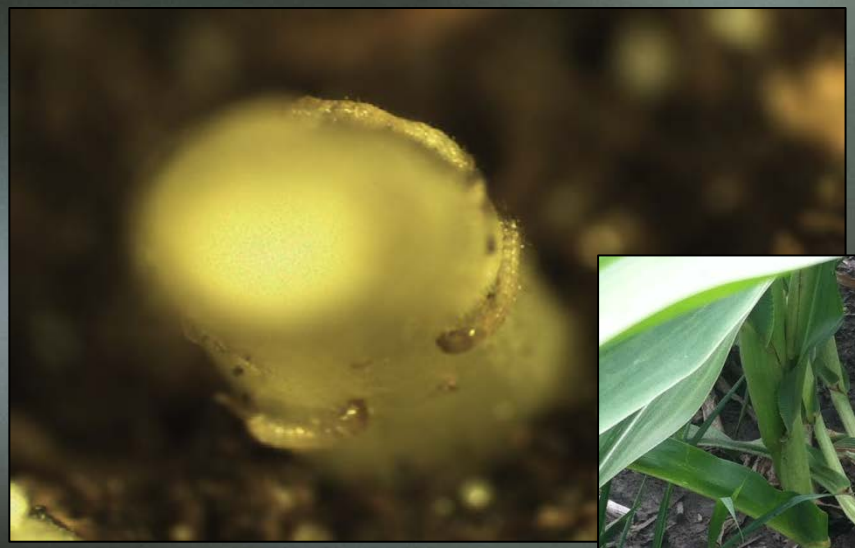
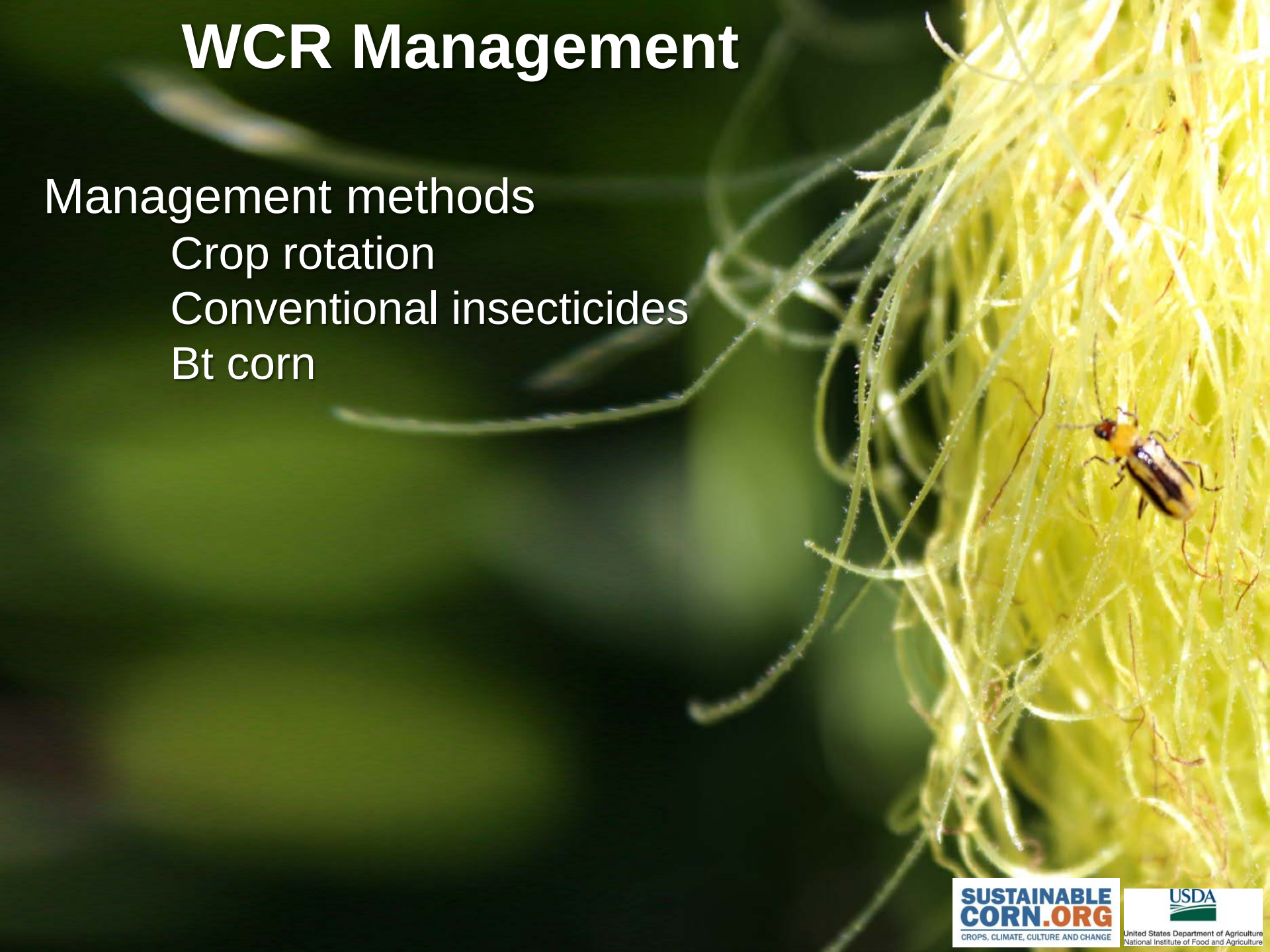


WCR Management

Management methods

- Crop rotation
- Conventional insecticides
- Bt corn



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WCR Management

Management methods
- Crop rotation
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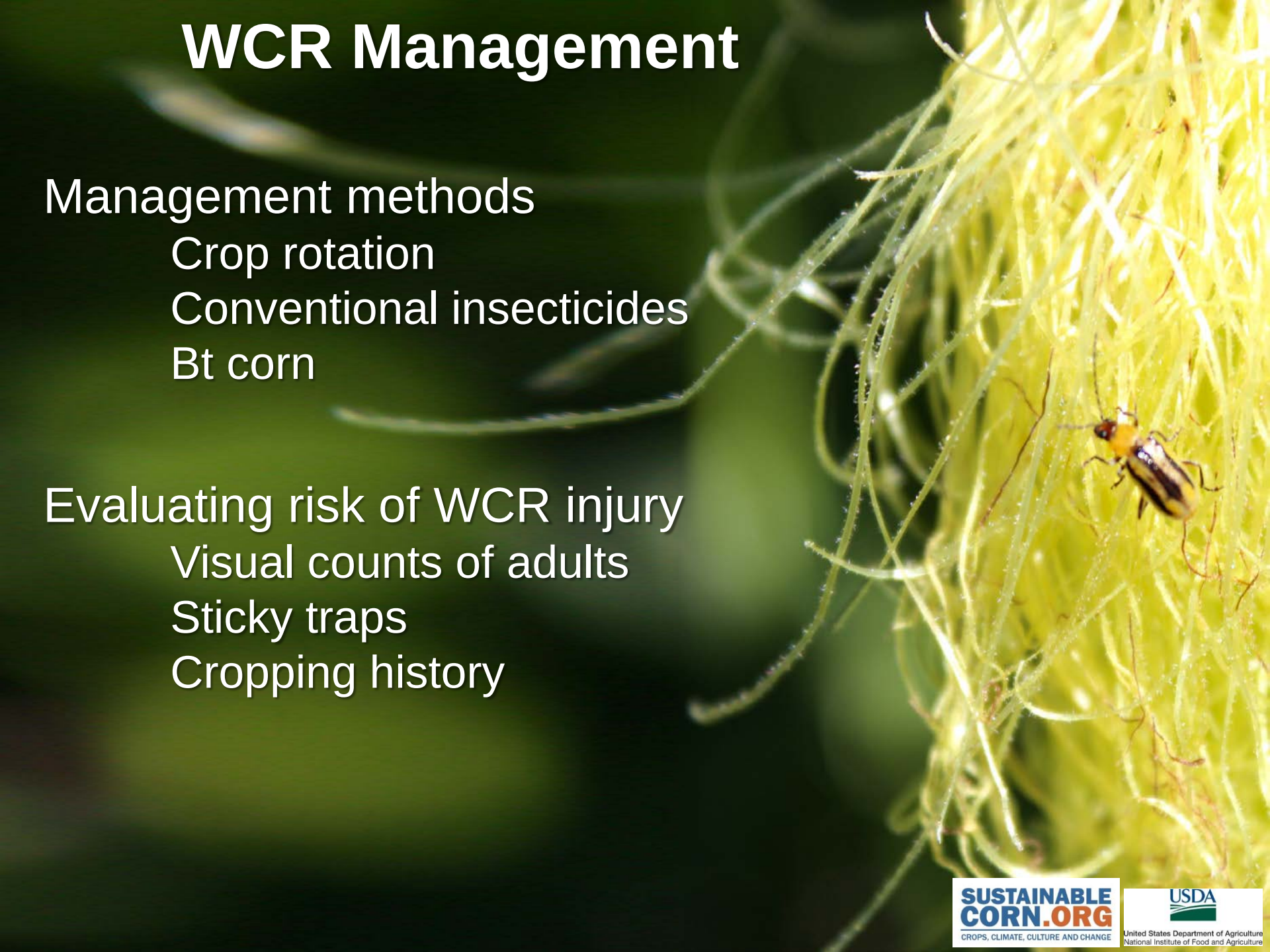
- Bt corn

Evaluating risk of WCR injury
- Visual counts of adults
- Sticky traps
- Cropping history



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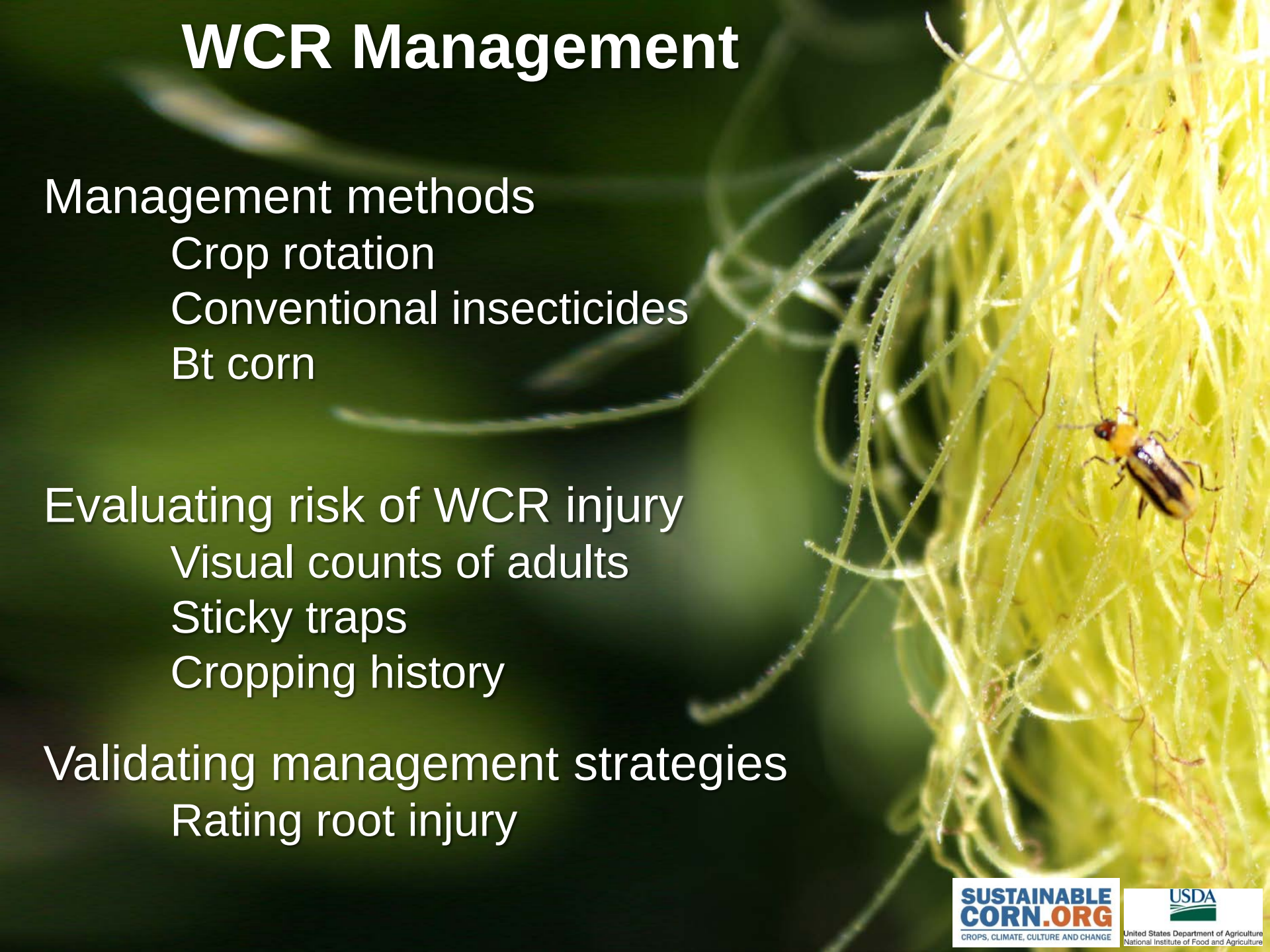
WCR Management

Management methods
- Crop rotation
- Conventional insecticides
- Bt corn

Evaluating risk of WCR injury
- Visual counts of adults
- Sticky traps
- Cropping history

Validating management strategies
- Rating root injury



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A Highly Adaptable Pest

History of WCR resistance

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History of WCR resistance

Chlorinated hydrocarbons

Ball and Weekman 1962, 1963

A Highly Adaptable Pest

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Kuhlman 1974; Meinke et al. 1998

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A Highly Adaptable Pest

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Organophosphates

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Organophosphates

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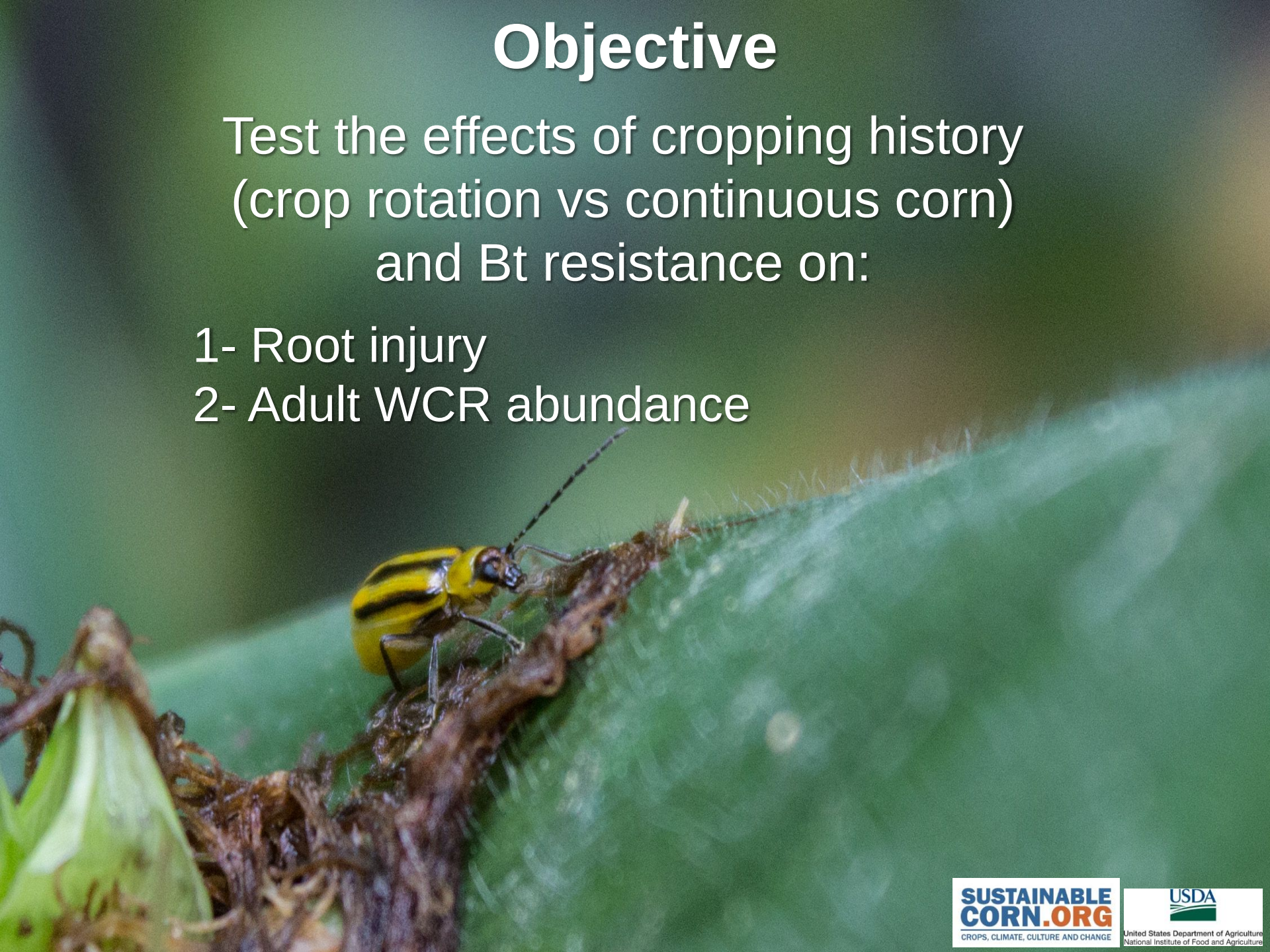
Bt corn

Gassmann et al. 2011, 2012, & 2014

Objective

Test the effects of cropping history (crop rotation vs continuous corn) and Bt resistance on:

1- Root injury
2- Adult WCR abundance



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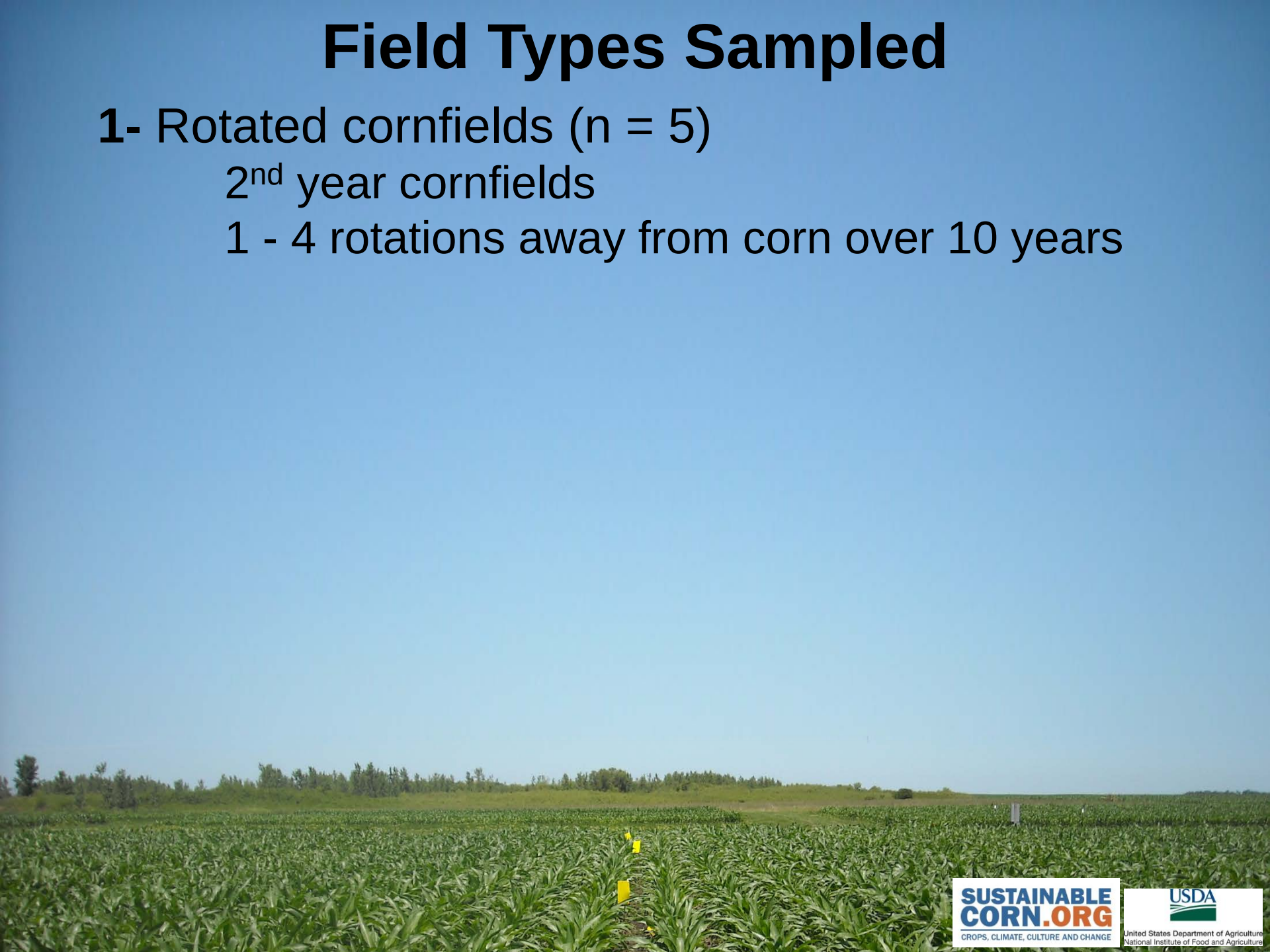
Field Types Sampled

1- Rotated cornfields (n = 5)

2nd year cornfields

1 - 4 rotations away from corn over 10 years



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2- Continuous corn production (n = 5)

7+ years planted to corn

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Field Types Sampled

1- Rotated cornfields (n = 5)

2nd year cornfields

1 - 4 rotations away from corn over 10 years

2- Continuous corn production (n = 5)

7+ years planted to corn

3- History of greater than expected injury (n = 5)

Published field-evolved resistance

Gassmann et al. 2011, 2012, & 2014

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7+ years planted to corn

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Gassmann et al. 2011, 2012, & 2014

4- Current problem cornfields (n = 9)

Reported by farmers in 2013

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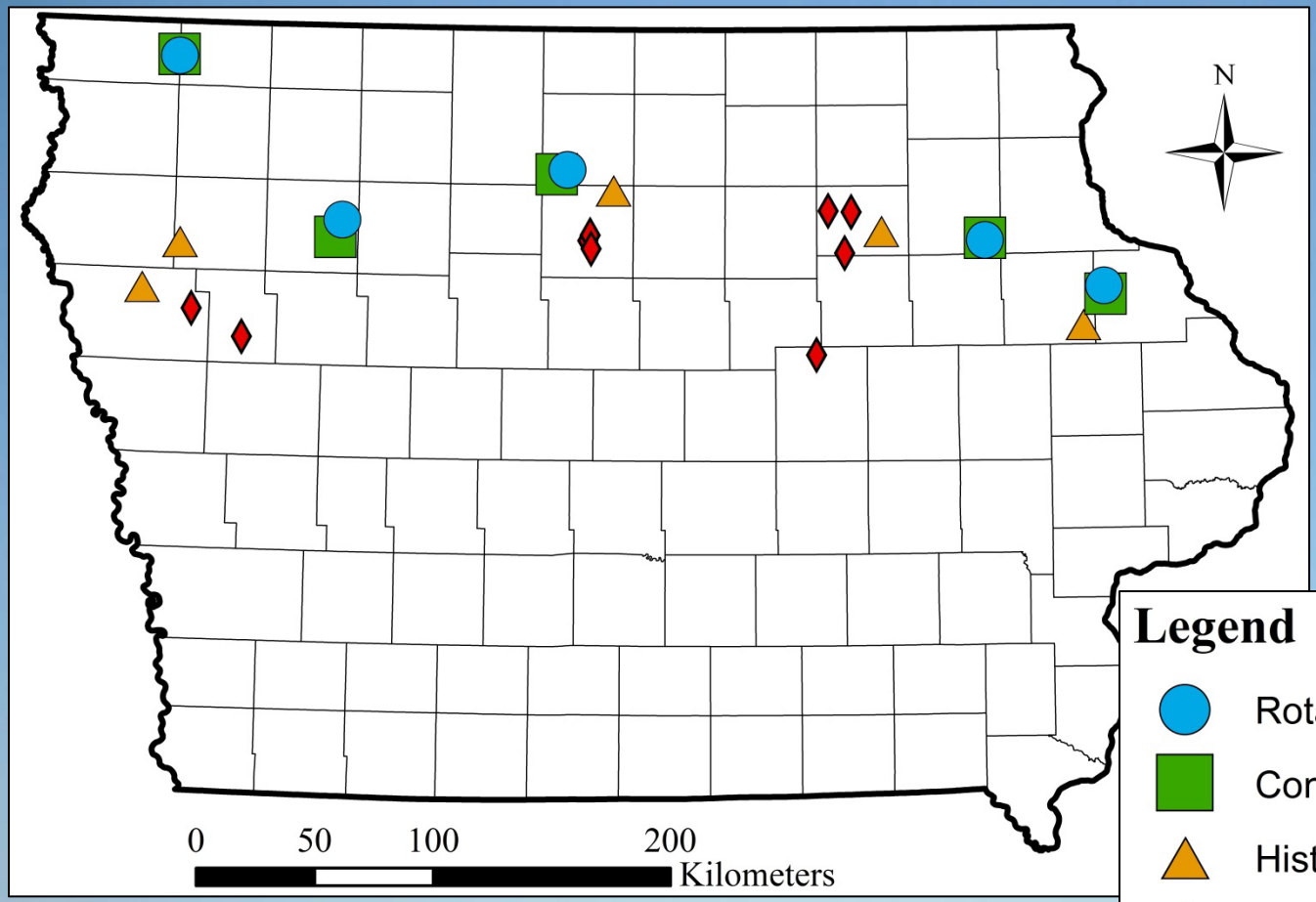
Field Locations within Iowa



Legend

- Rotated Cornfield
- Continuous Cornfield
- History of > Expected Injury
- Current Problem Cornfield

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Data Collected in 2013

1- Rated root injury

Collected roots (n = 12 per field)

Node-injury scale (0-3) Oleson et al. 2005

Presence of Bt protein with ELISA

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Data Collected in 2013

1- Rated root injury

2- Measured adult abundance

Sticky traps (n = 12 per field)

Peak abundance

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Data Collected in 2013

1- Rated root injury

2- Measured adult abundance

3- Collected adults

Collected eggs for later assays

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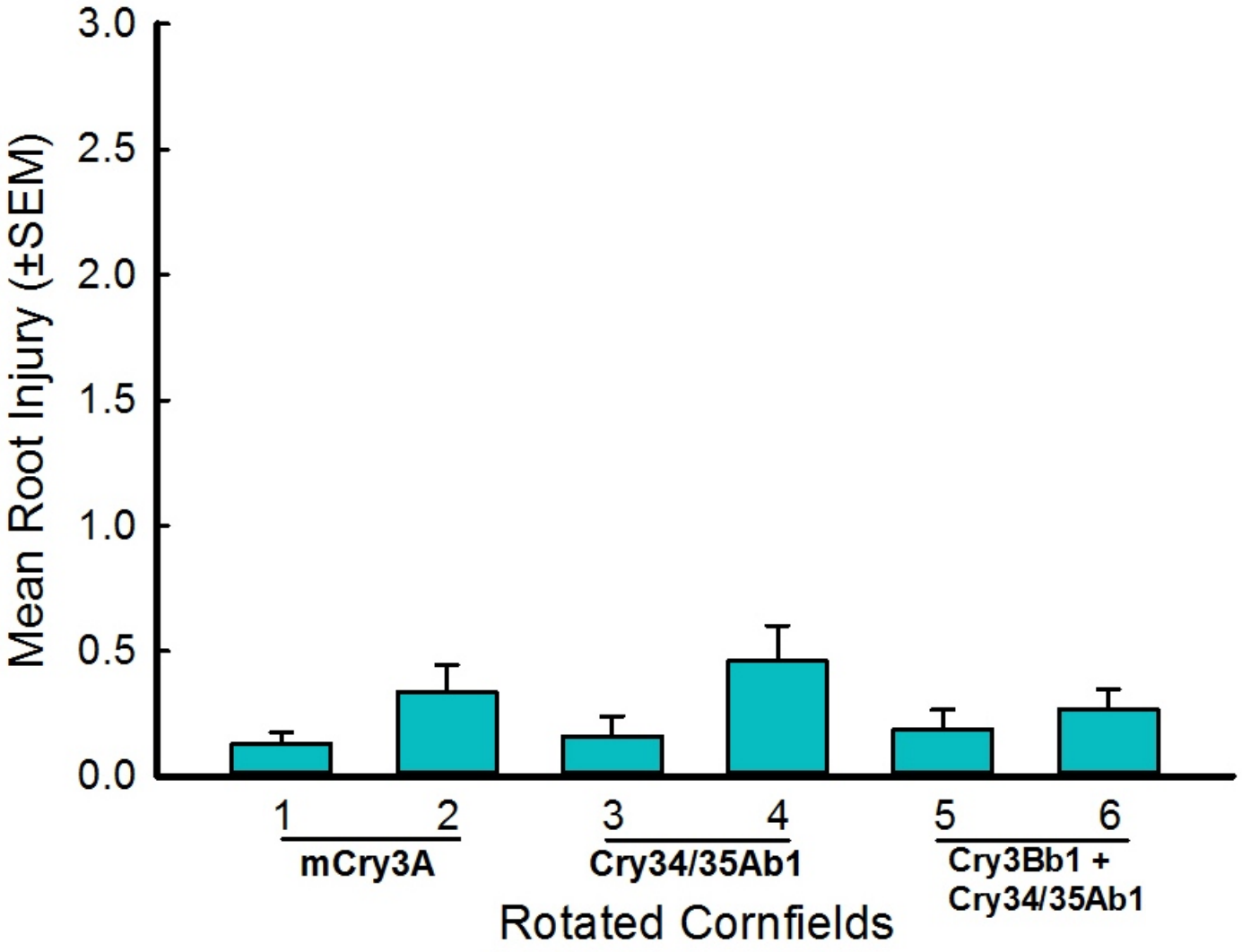
Rotated Cornfields



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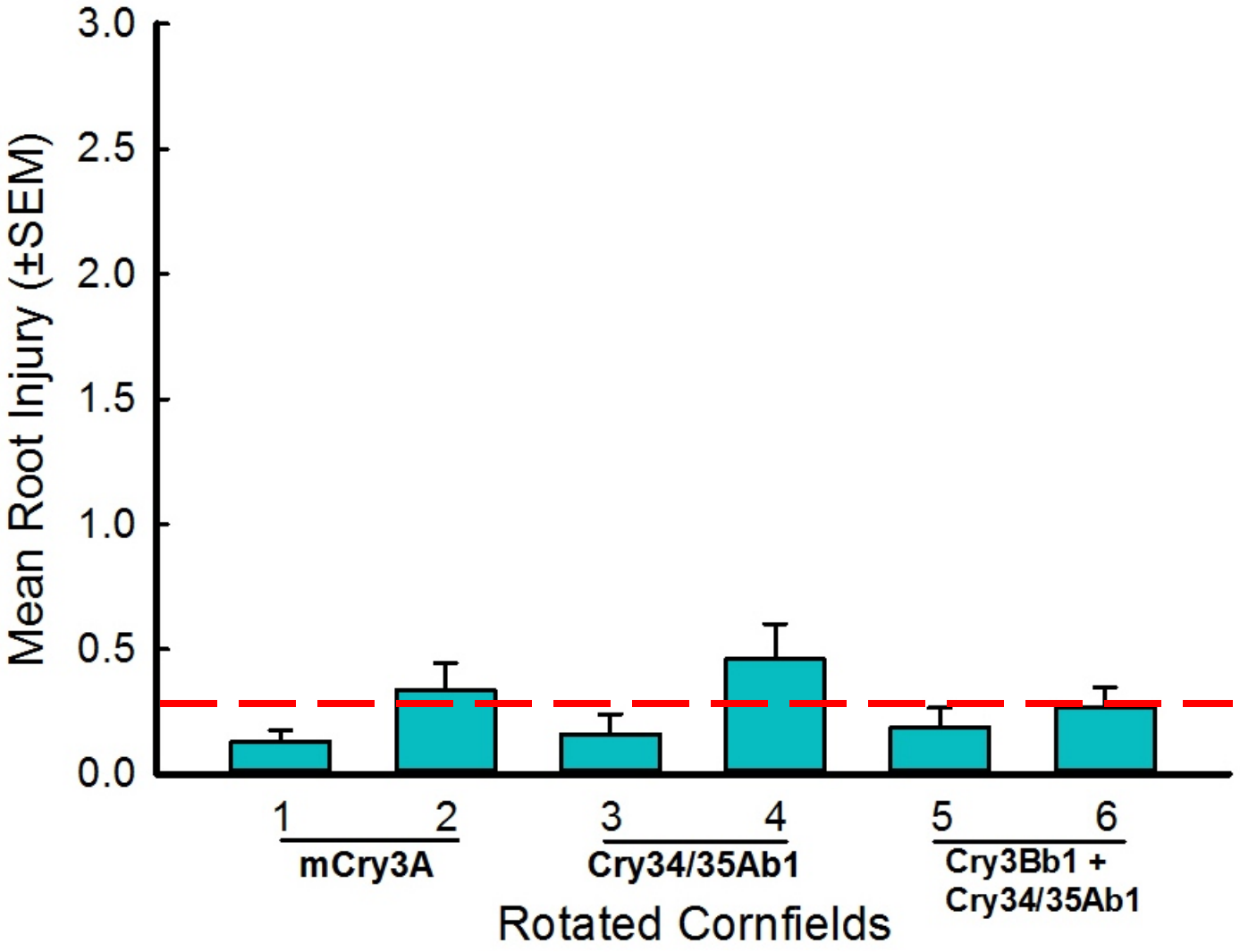

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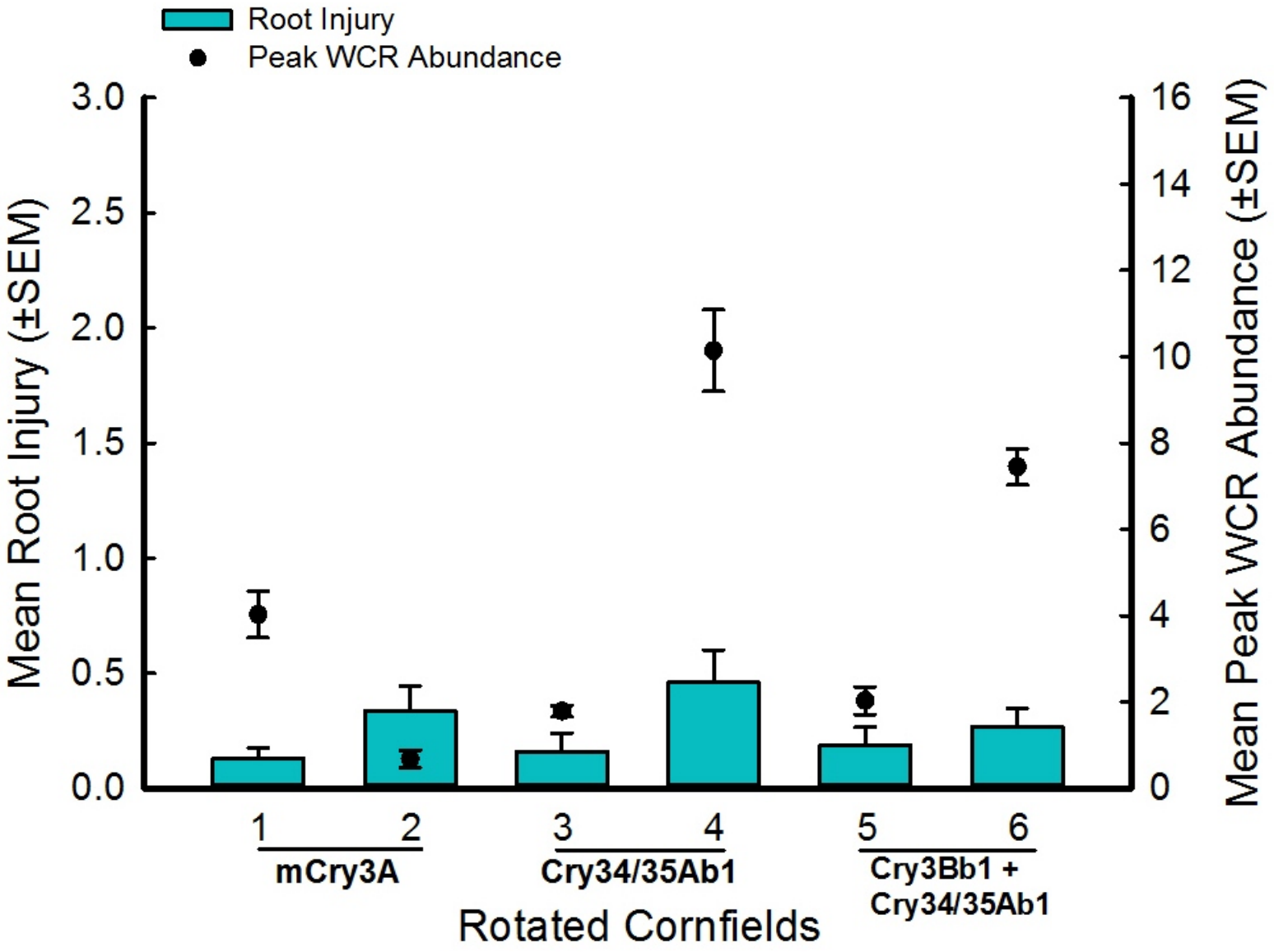

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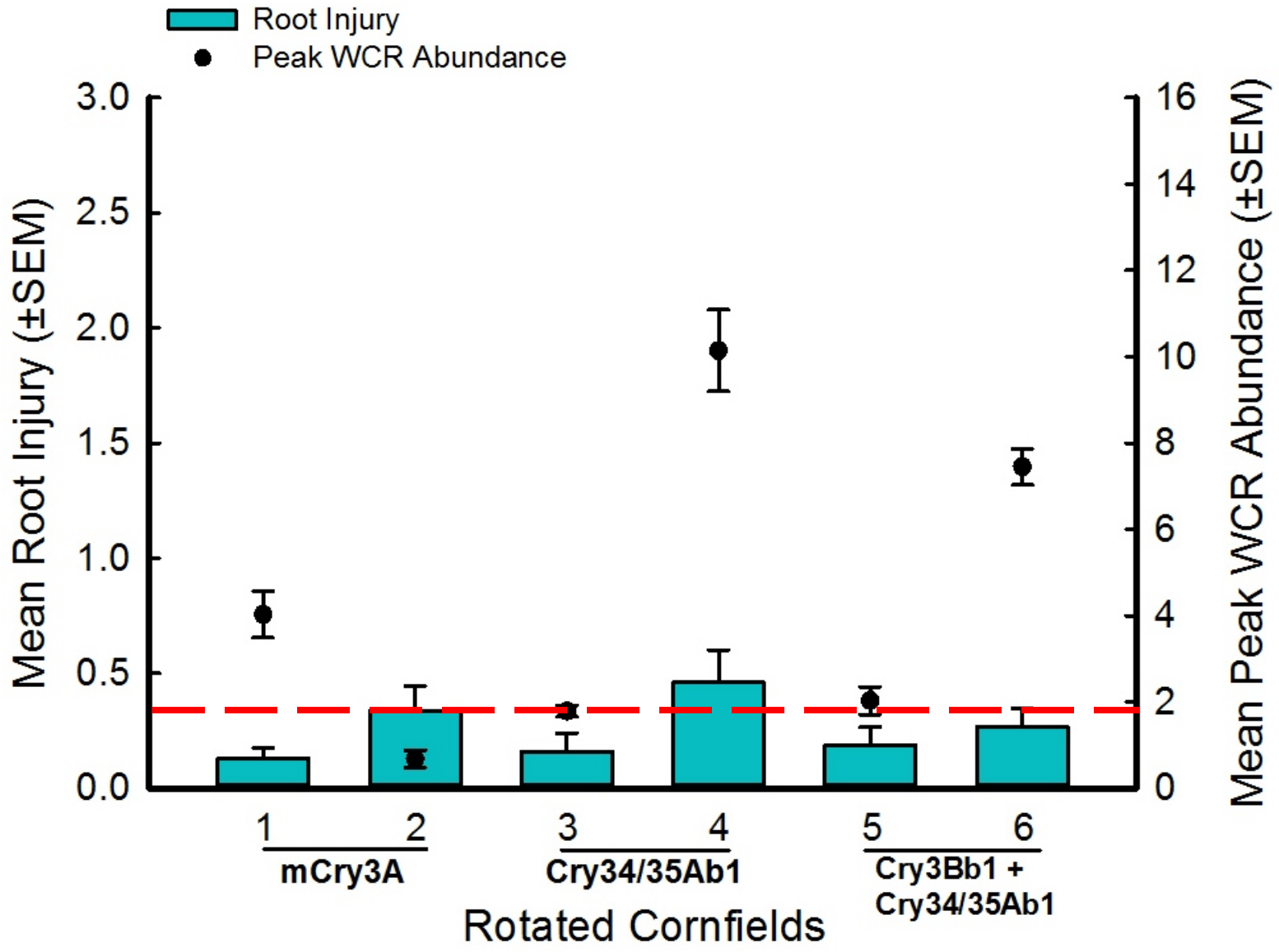

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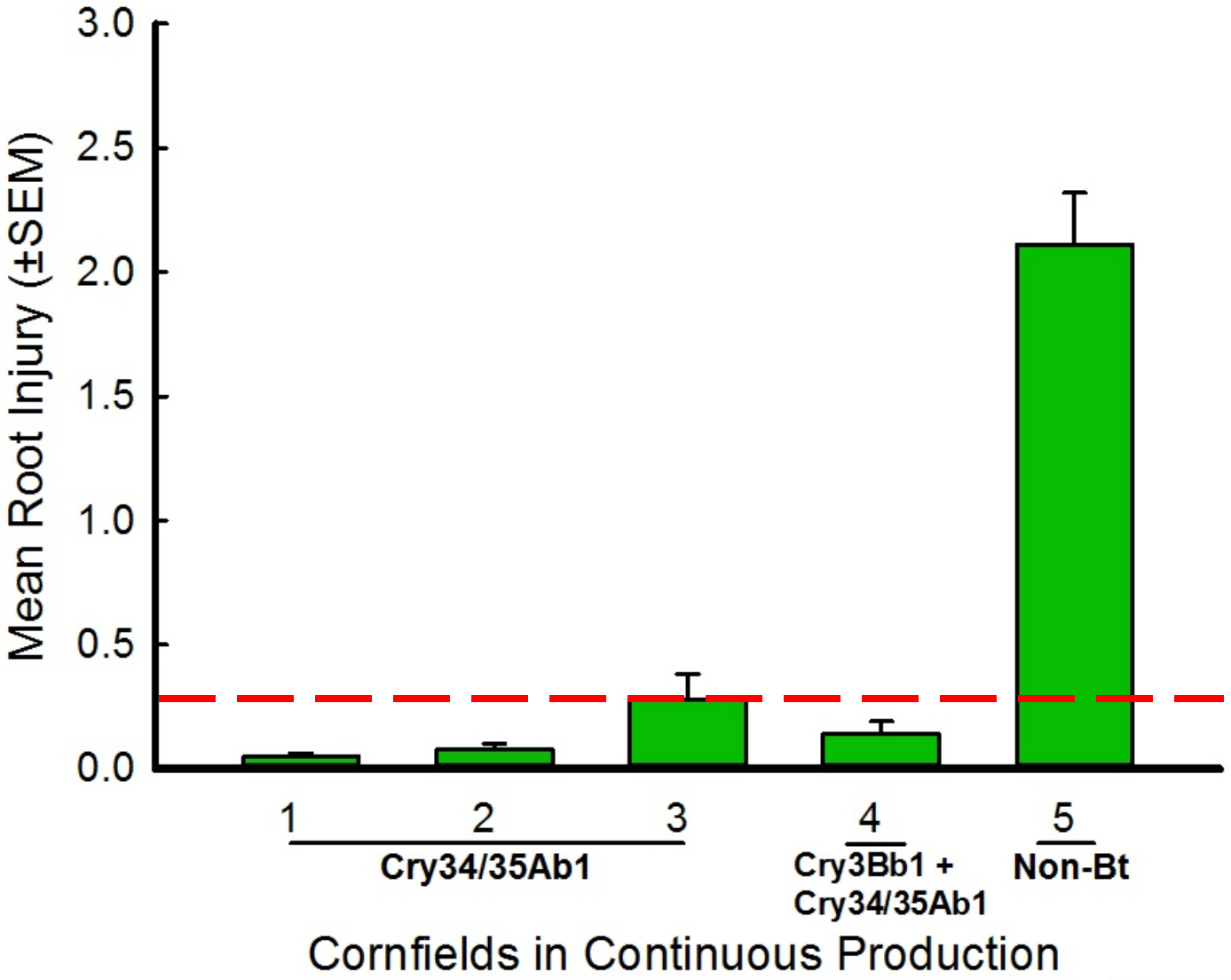
Continuous Corn Production



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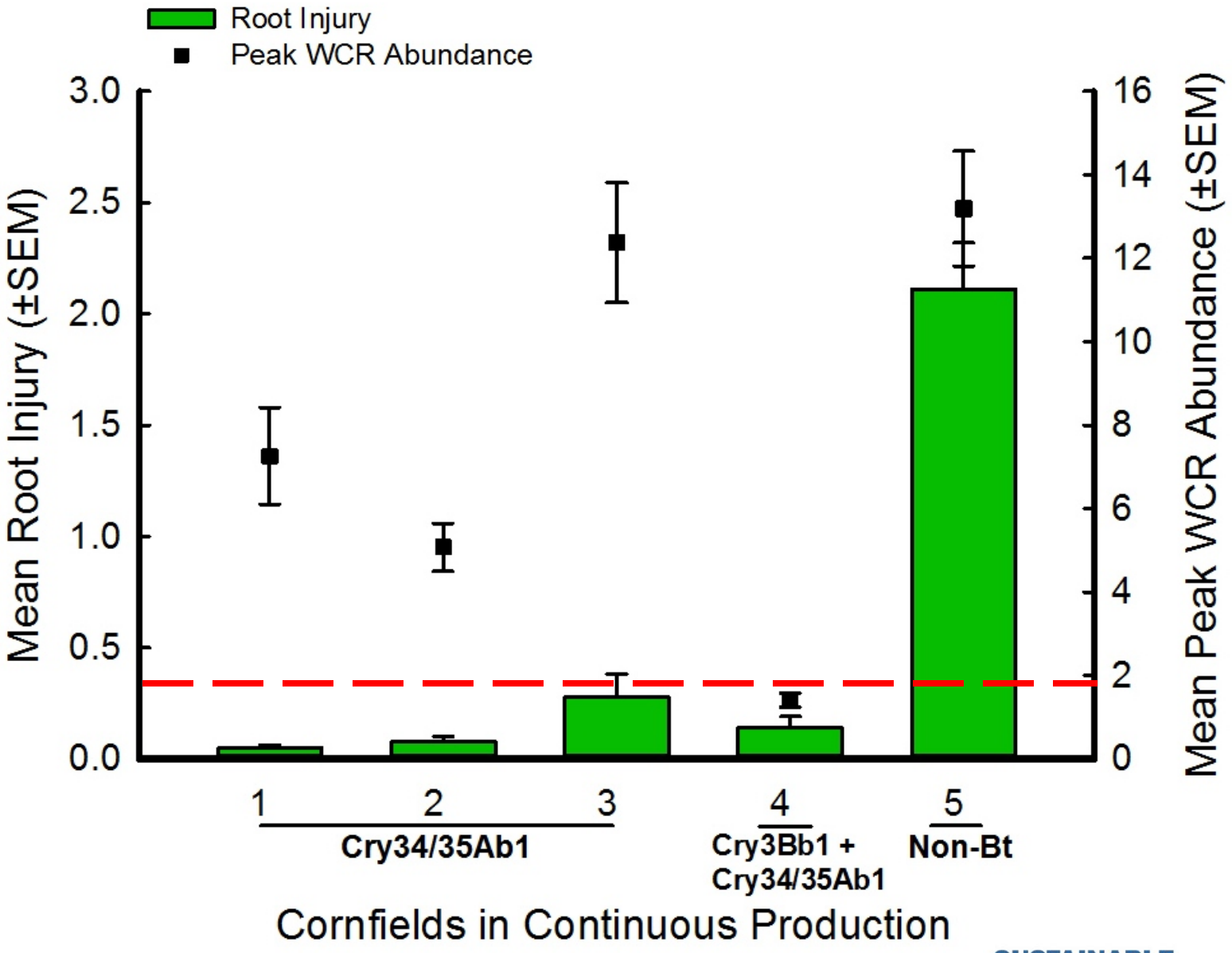

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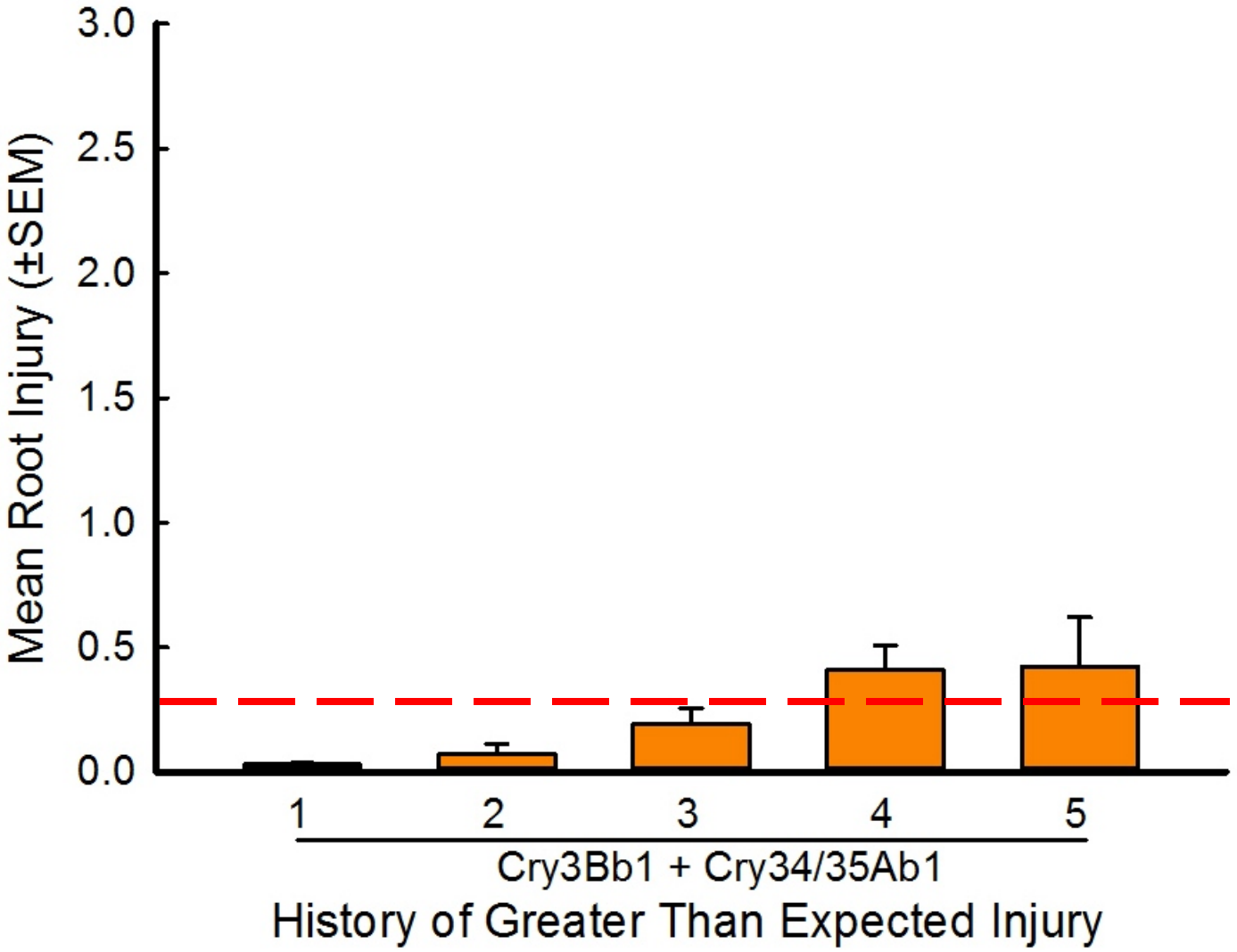
History of Greater Than Expected Injury



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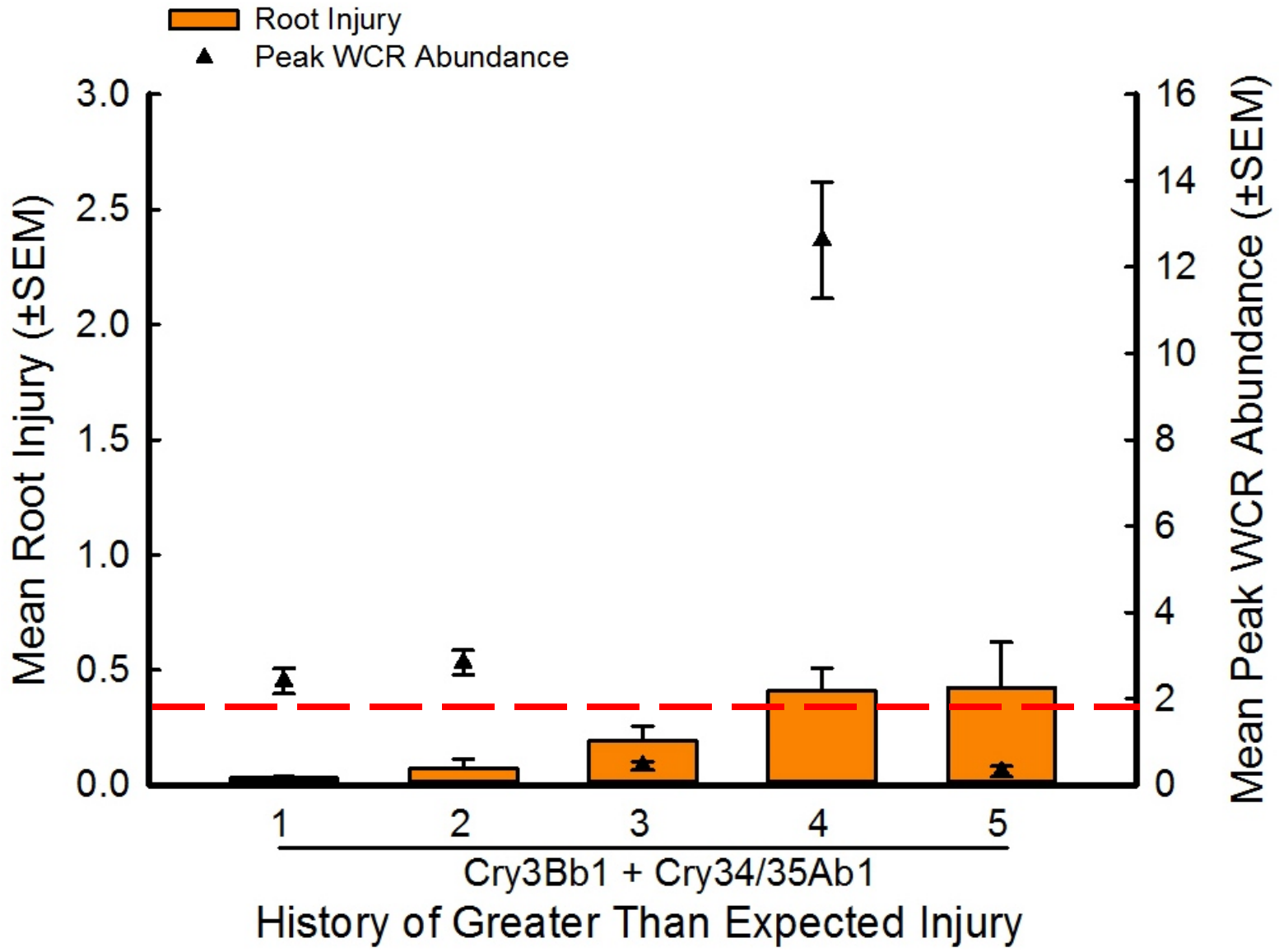
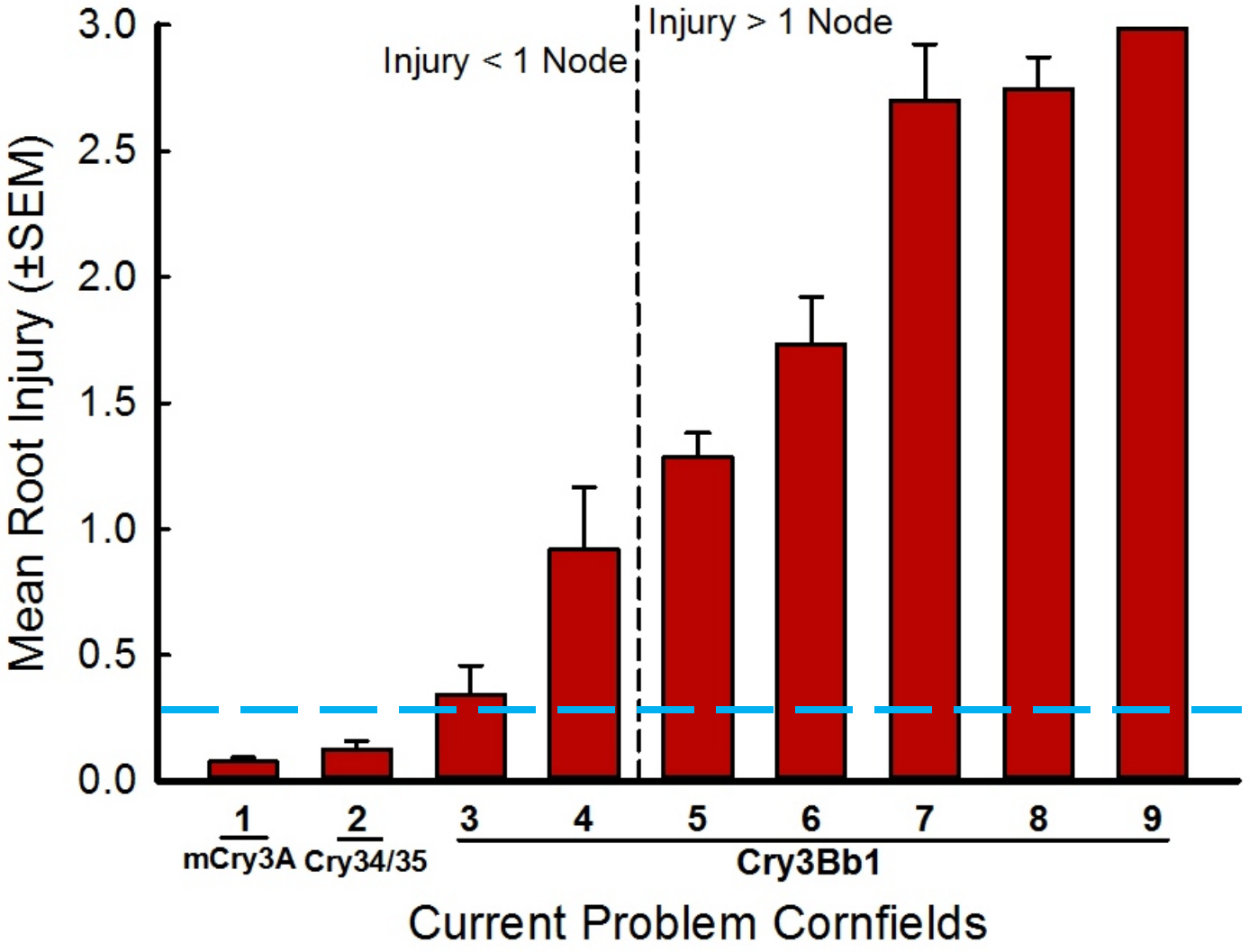


Current Problem Cornfields



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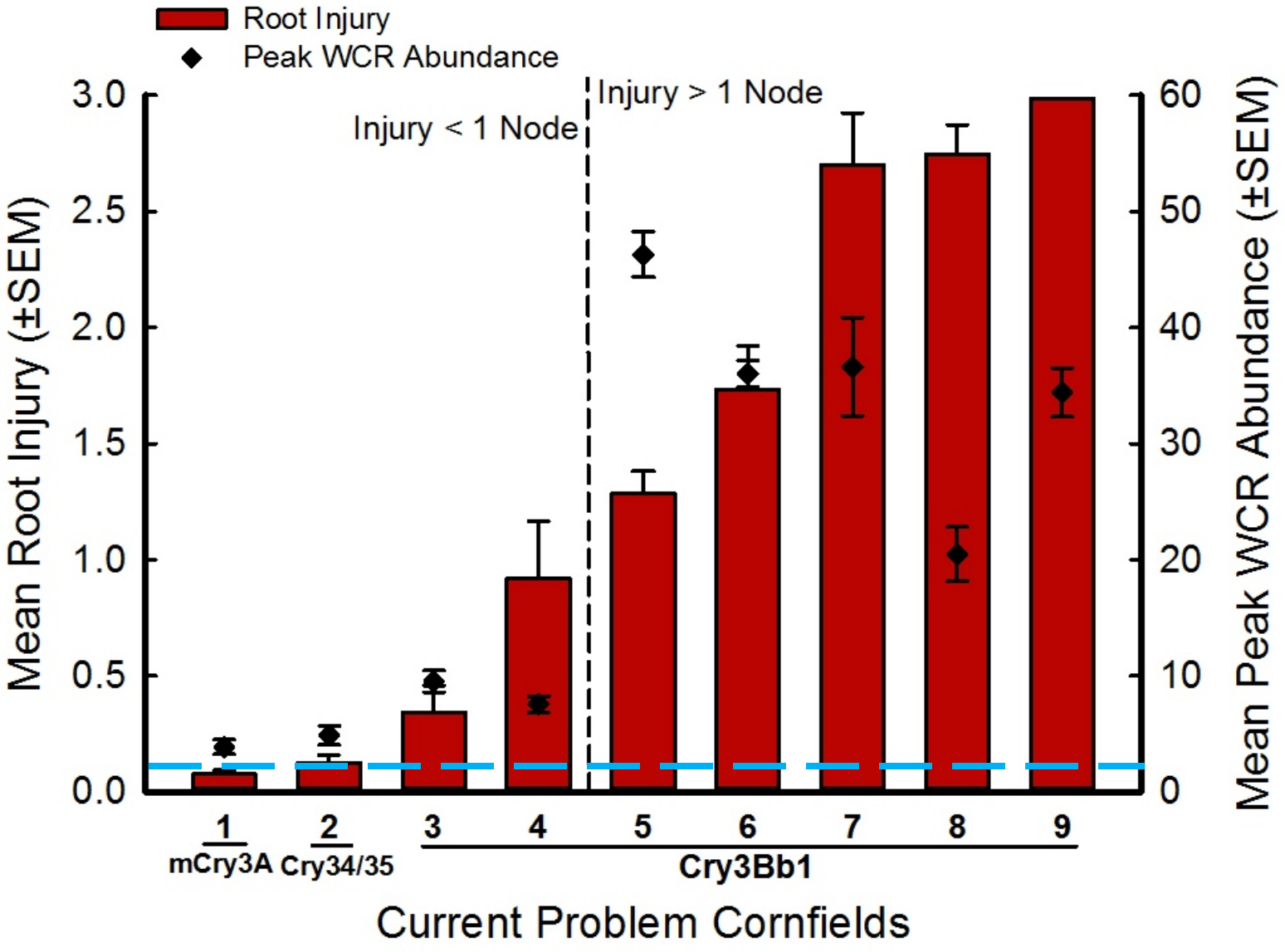

Conclusions

Greater root injury and adult abundance

Current problem fields > Other field types

Conclusions

Greater root injury and adult abundance

Current problem fields > Other field types

Variation of root injury and adult abundance within each field type

Ongoing Effort

Assay populations for susceptibility to Bt toxins

- Does management affect Bt susceptibility?

Correlate Bt susceptibility with…

- Crop rotation patterns
- Rotation of Bt toxins
- Use of insecticides

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Correlate Bt susceptibility with…

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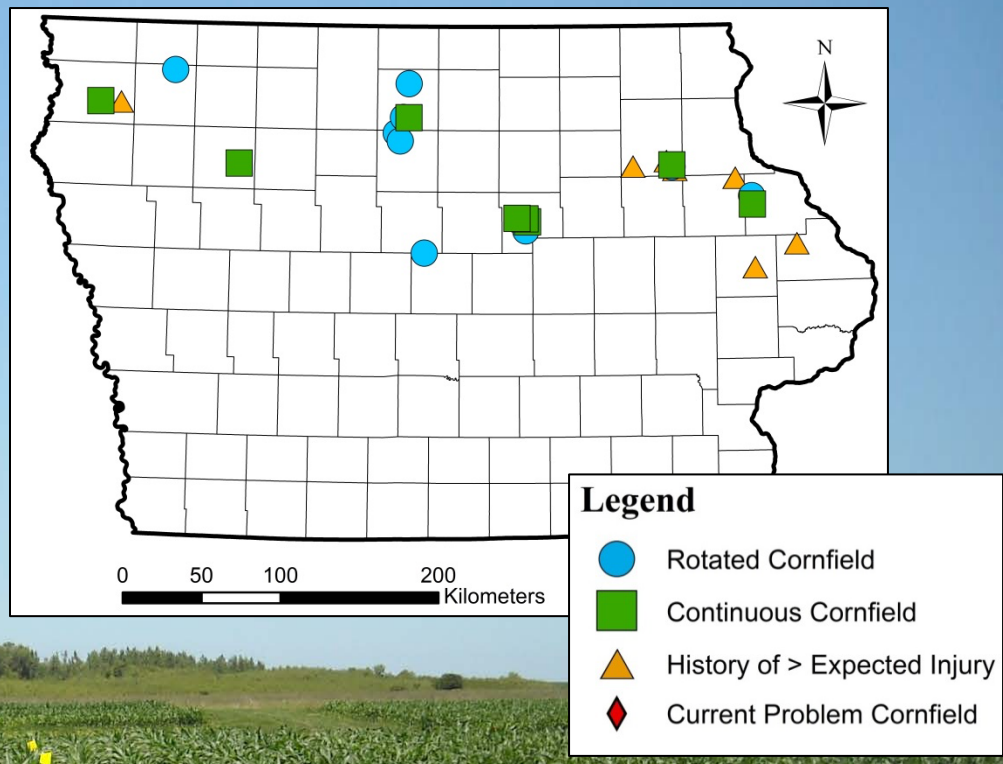

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Rye Cover Crop

Rye Cover Crop

Objective:

Measure how rye cover crop affects beneficial grown-dwelling arthropod taxa

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Pitfall Trapping

Sampling

2011-2013; 4x per year

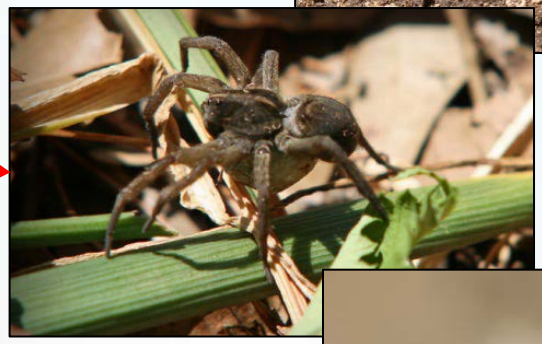
Traps left in the field ~24hrs

3 Traps per plot

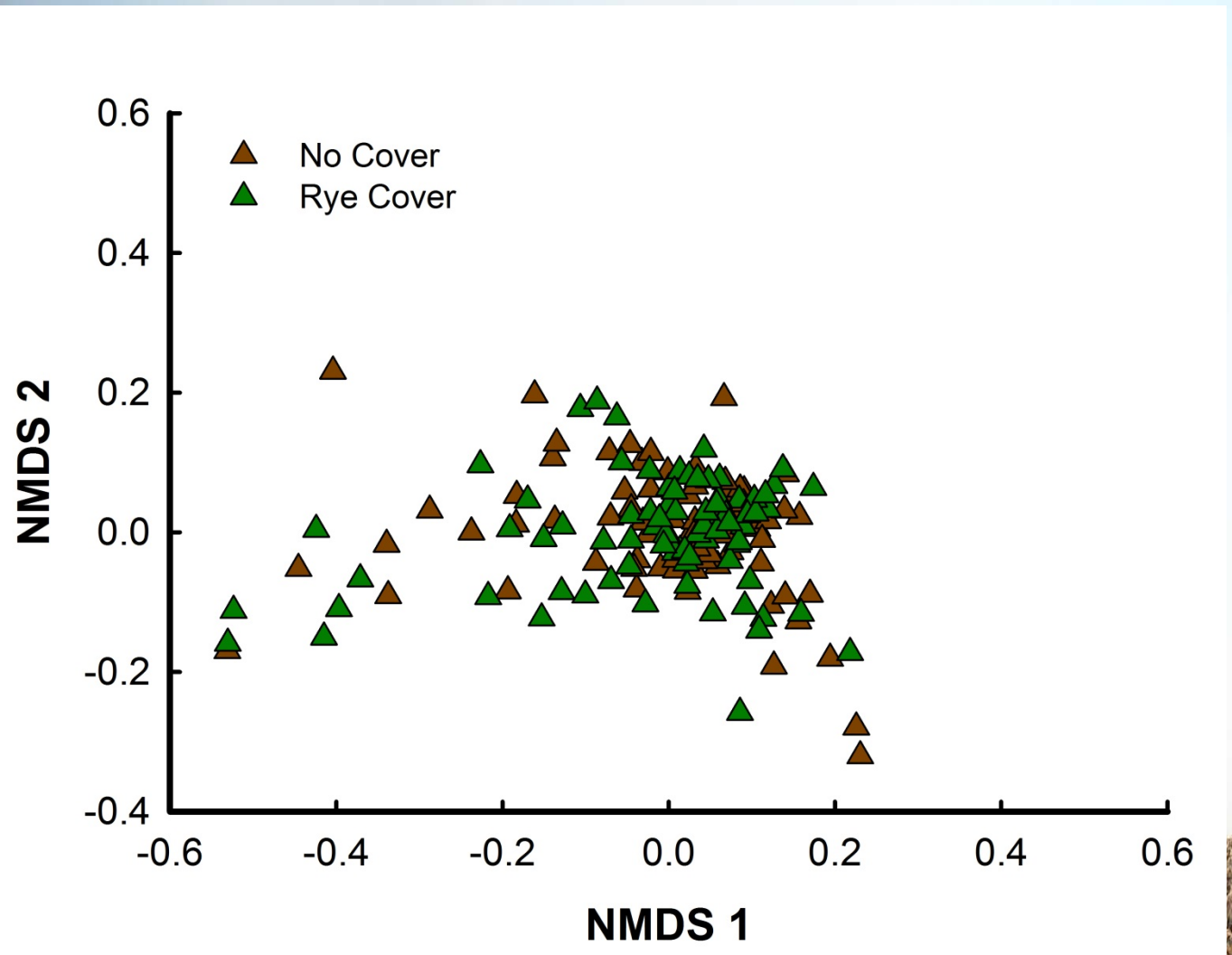
Identifying Arthropods

Beneficial taxa (the good guys)

- Chilopoda
- Diplopoda
- Isopoda
- Opiliones
- Lycosidae
- Staphylinidae
- Carabidae
- Cicindelidae
- Formicidae
- Gryllidae



No Differences in Beneficial Arthropods



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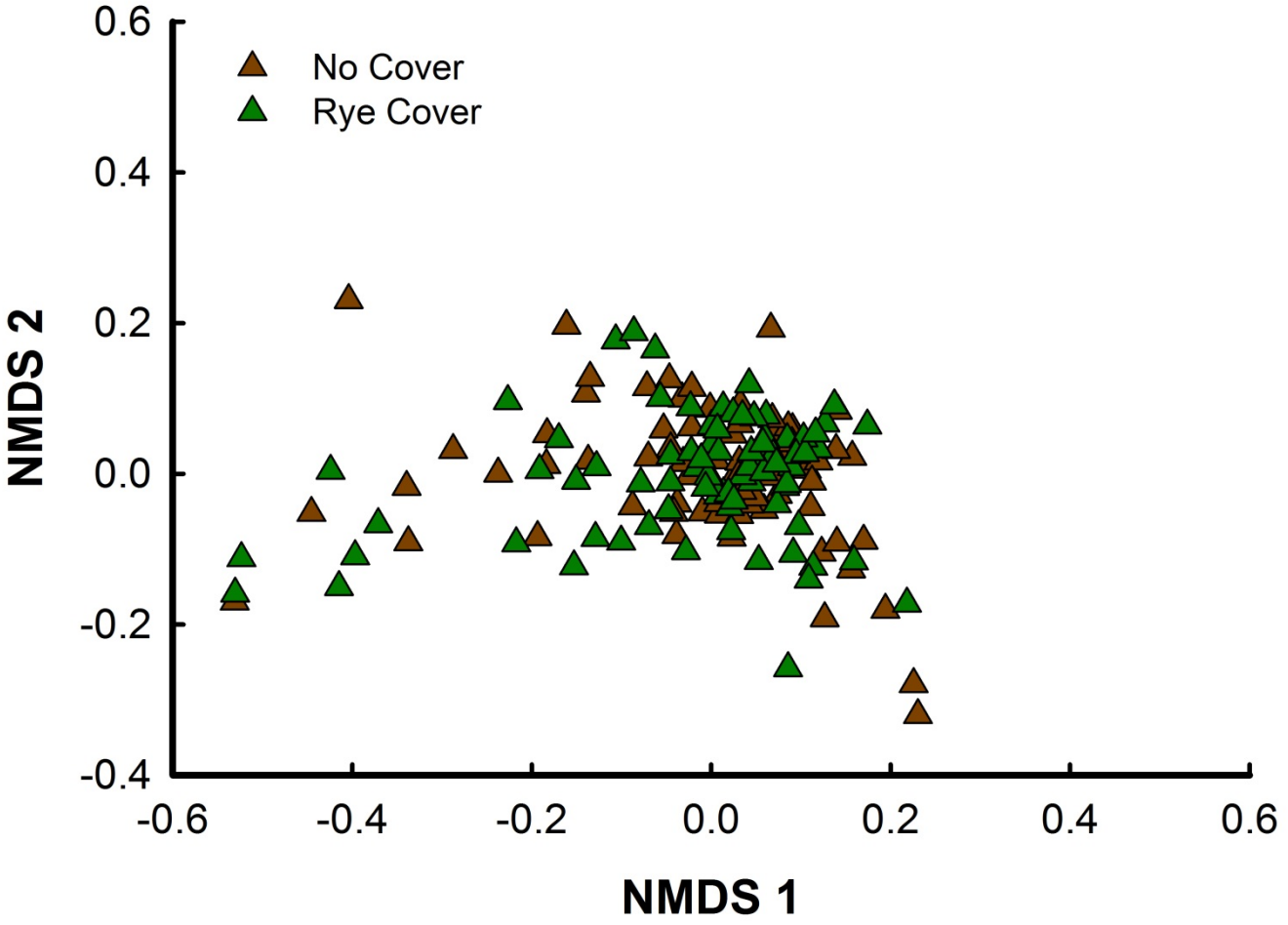

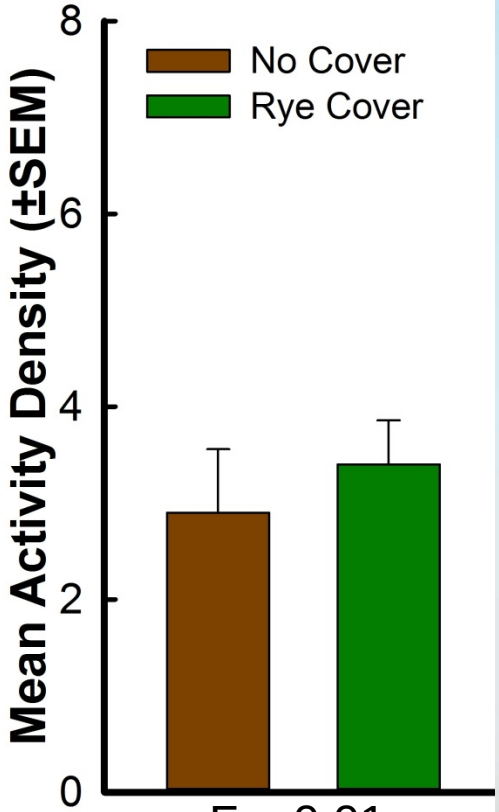

F = 0.01
df = 1; 165
P = 0.98

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Rye Cover Crop

No effect of rye cover crop on beneficial arthropods

Neither lose or gain good guys when rye is planted

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Rye Cover Crop

No effect of rye cover crop on beneficial arthropods

Neither lose or gain good guys when rye is planted

…but what about the bad guys?

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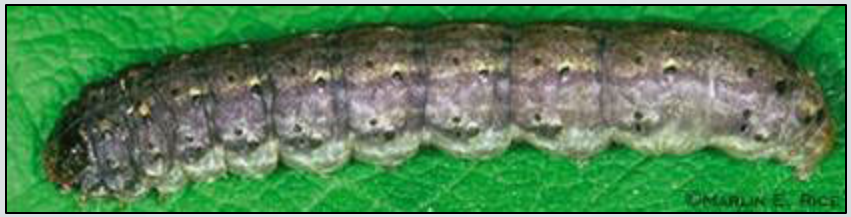
Rye Cover Crop

Objective:

Measure the arrival date, abundance, and injury caused by two early season corn pests



Agrotis ipsilon, black cutworm (BCW)

Mythimna unipuncta, true armyworm (TAW)

Pest Sampling

1- Species-specific pheromone traps

Pest Sampling

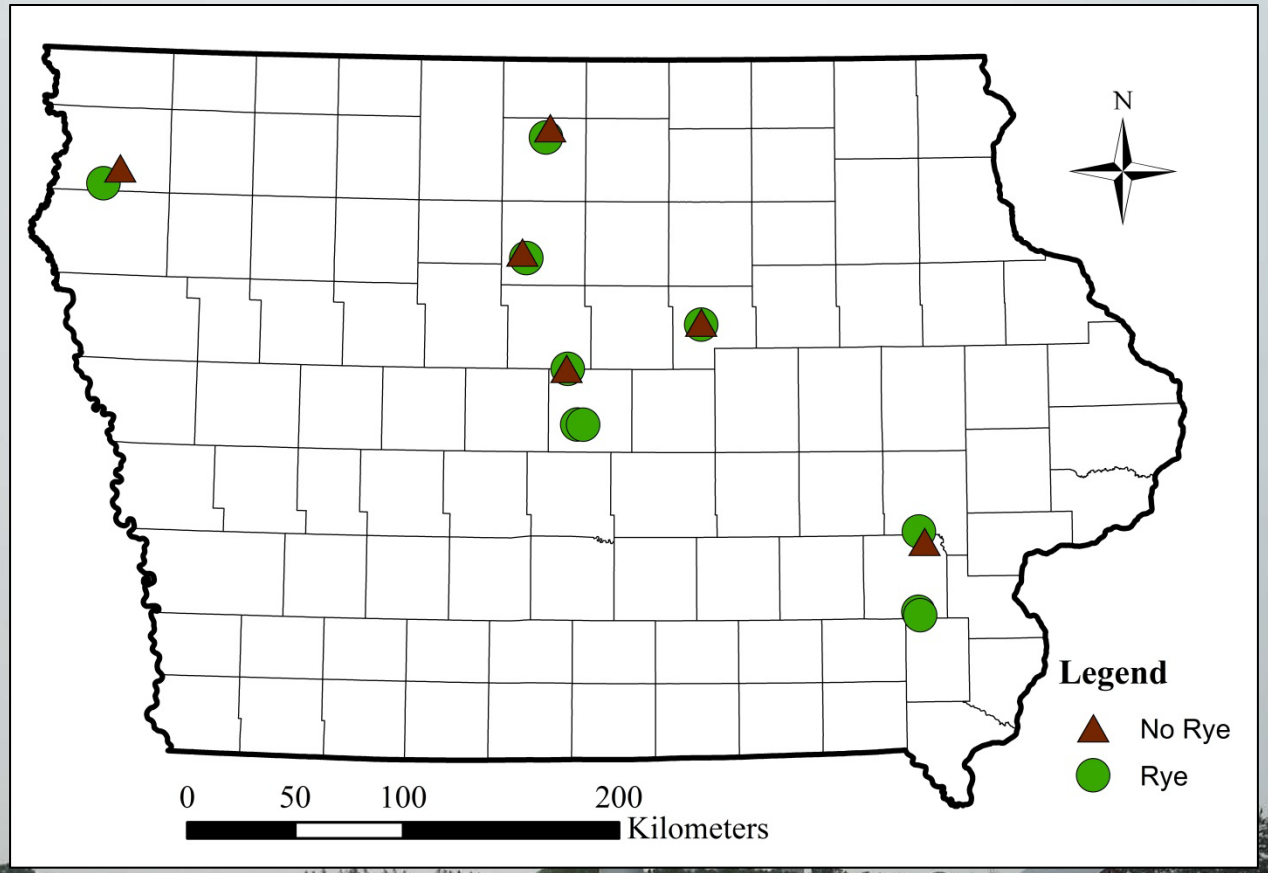
1- Species-specific pheromone traps

2- Measured plant injury & larval abundance

Pest Sampling

Spring 2014

Sampled weekly; April - May



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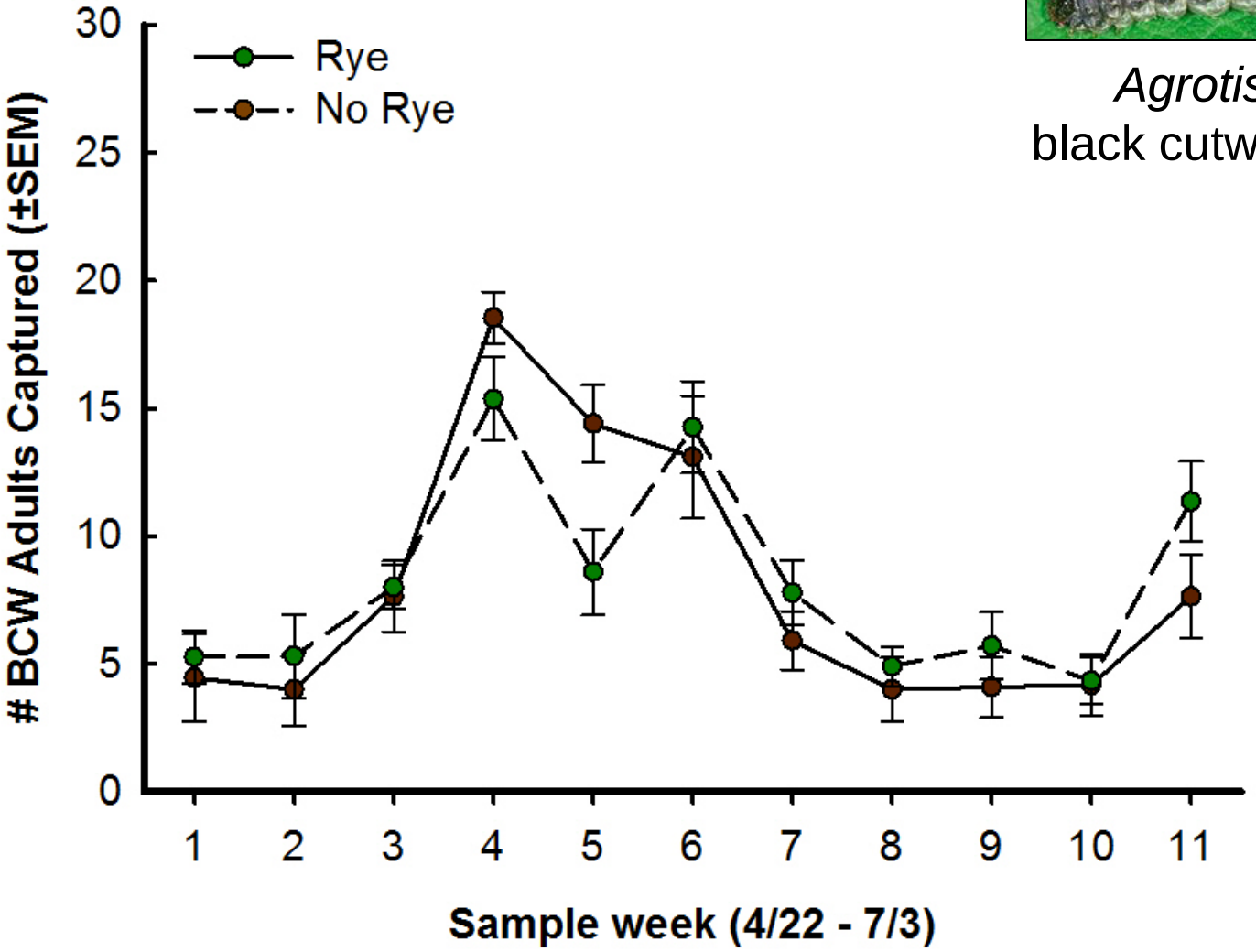
Immigration of BCW Adults

Agrotis ipsilon
black cutworm (BCW)



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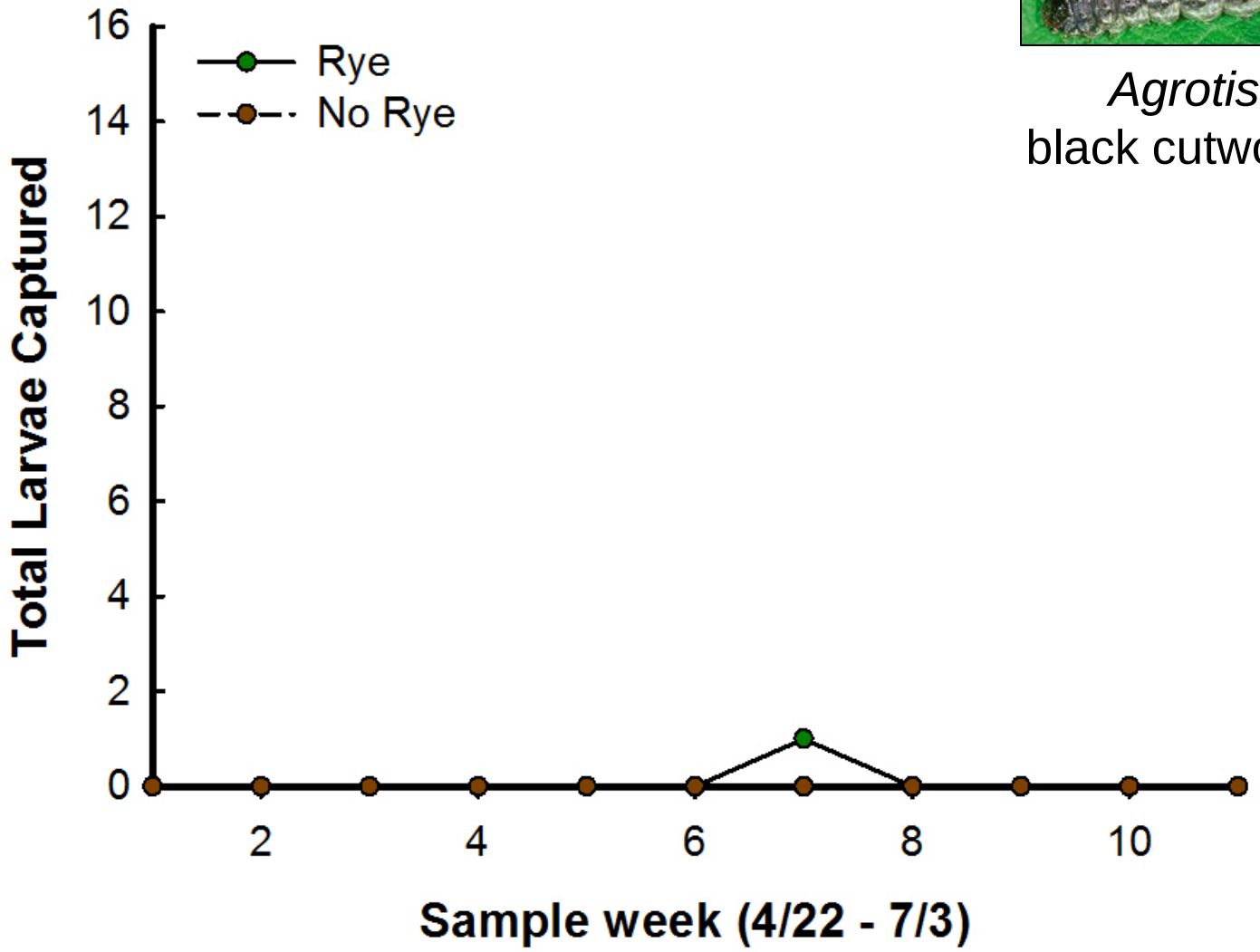
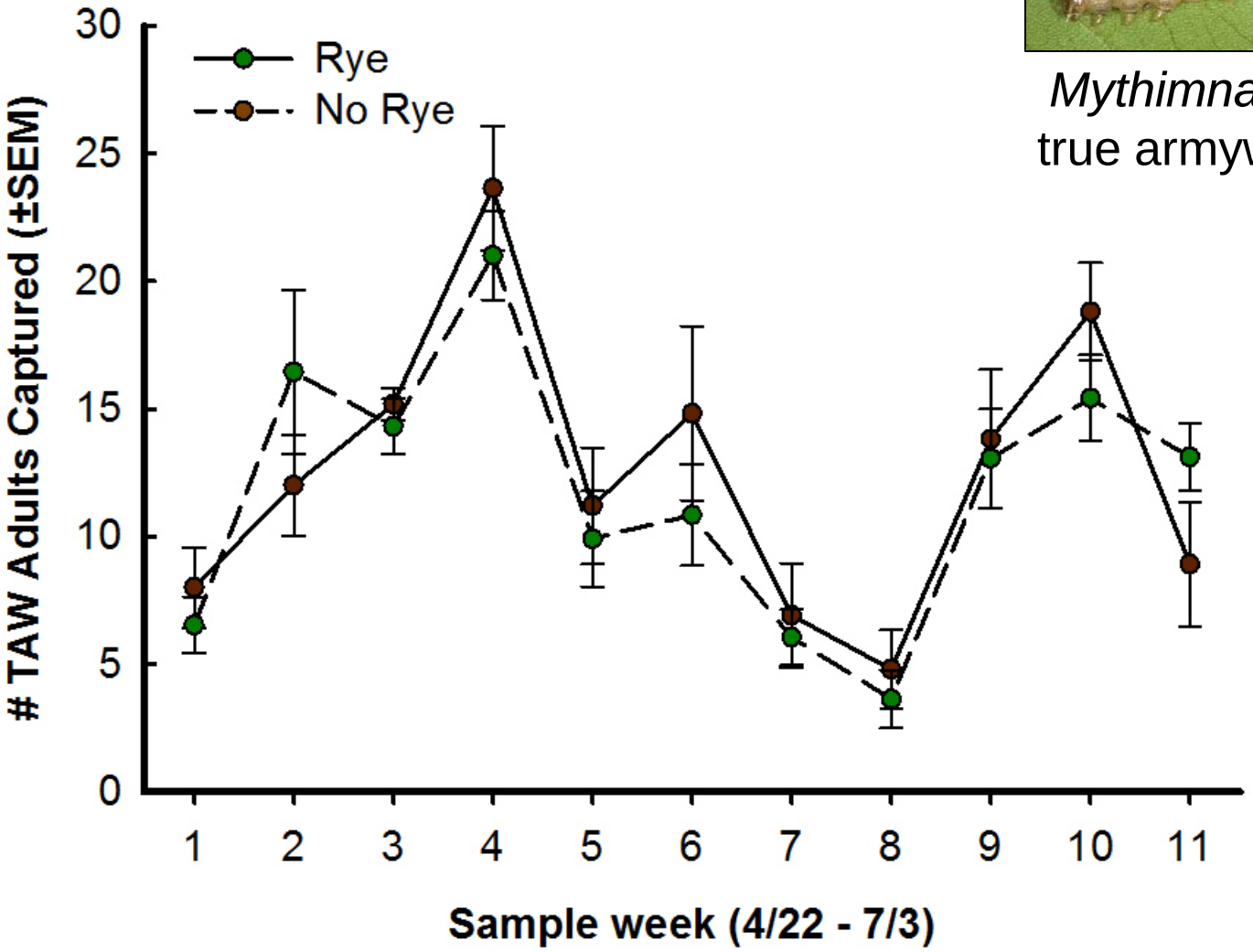
BCW Larvae

Agrotis ipsilon
black cutworm (BCW)



Immigration of TAW Adults

Mythimna unipuncta
true armyworm (TAW)



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TAW Larvae

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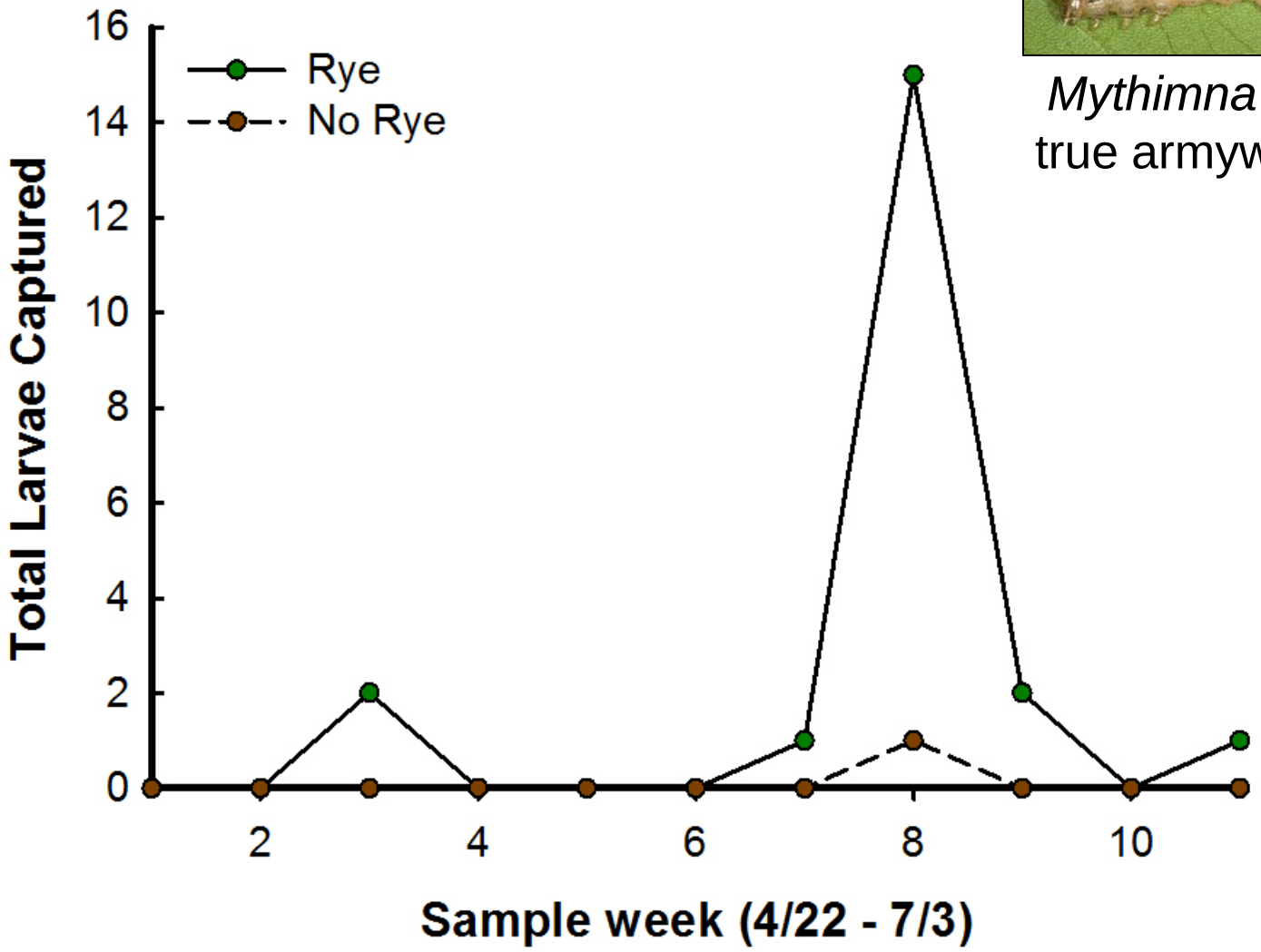

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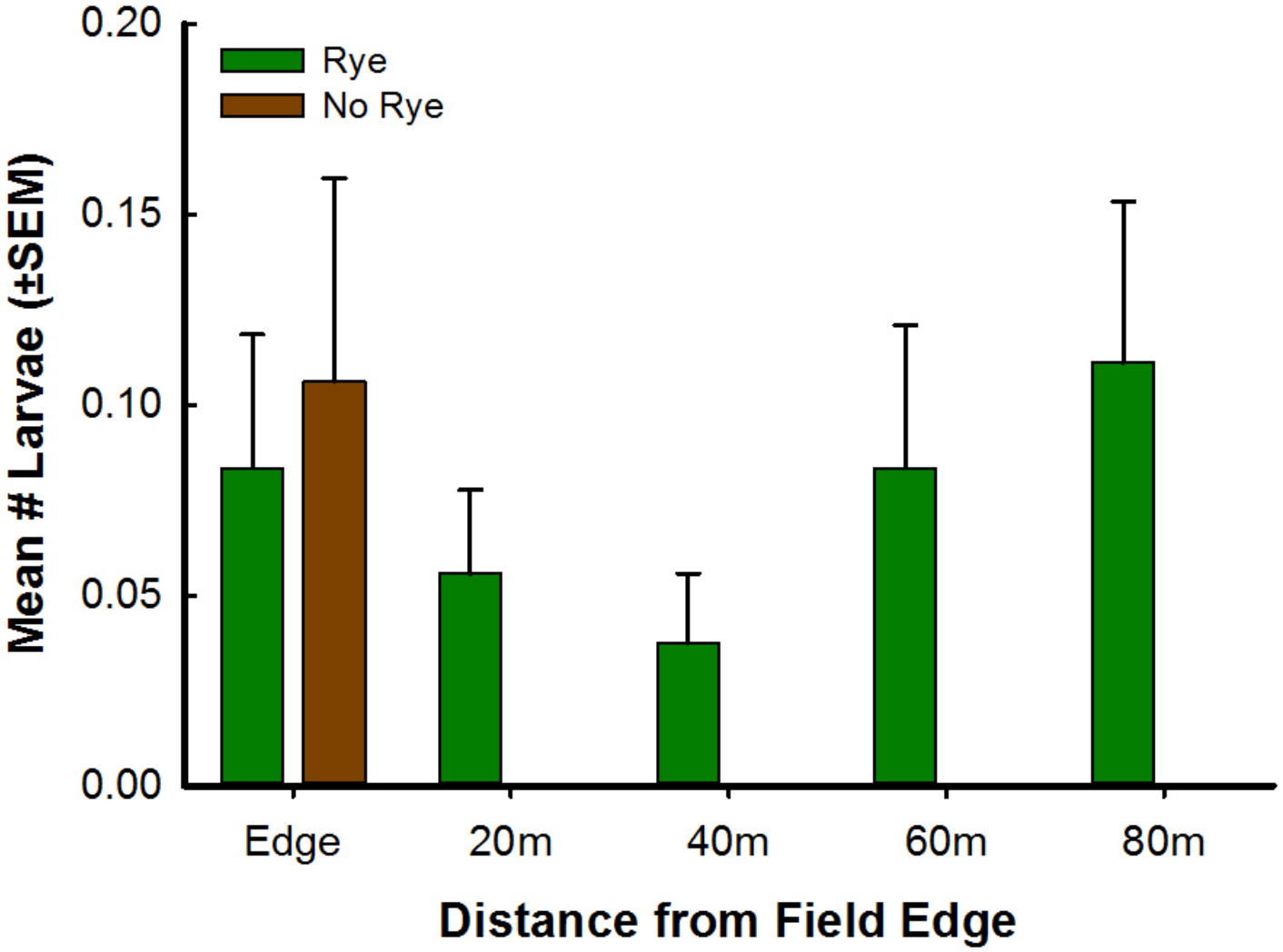
More Larvae Throughout Fields with Rye



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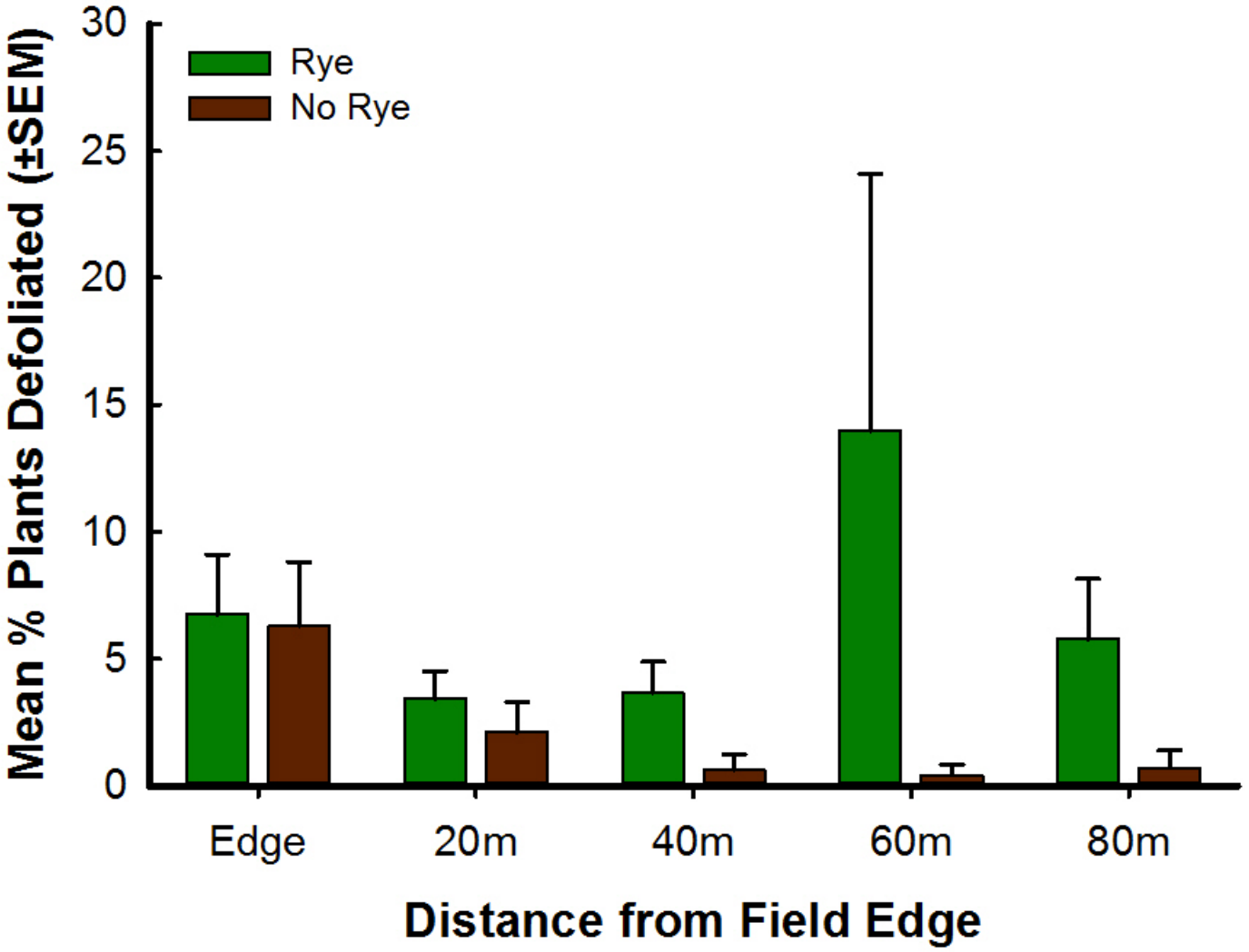
Greater Incidence of Injury with Rye



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Conclusions

Planting rye cover can still be beneficial
…however there are some risks

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No field with significant injury

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No field with significant injury

Ongoing effort

Sample again in 2015

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Acknowledgements

Thank You

Committee members

Lab mates

People who “volunteered”

- Dr Siva Jakka
- Dr Ram Shrestha
- Sean Bradley
- Patrick Weber

Funding Sources

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Questions?