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COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

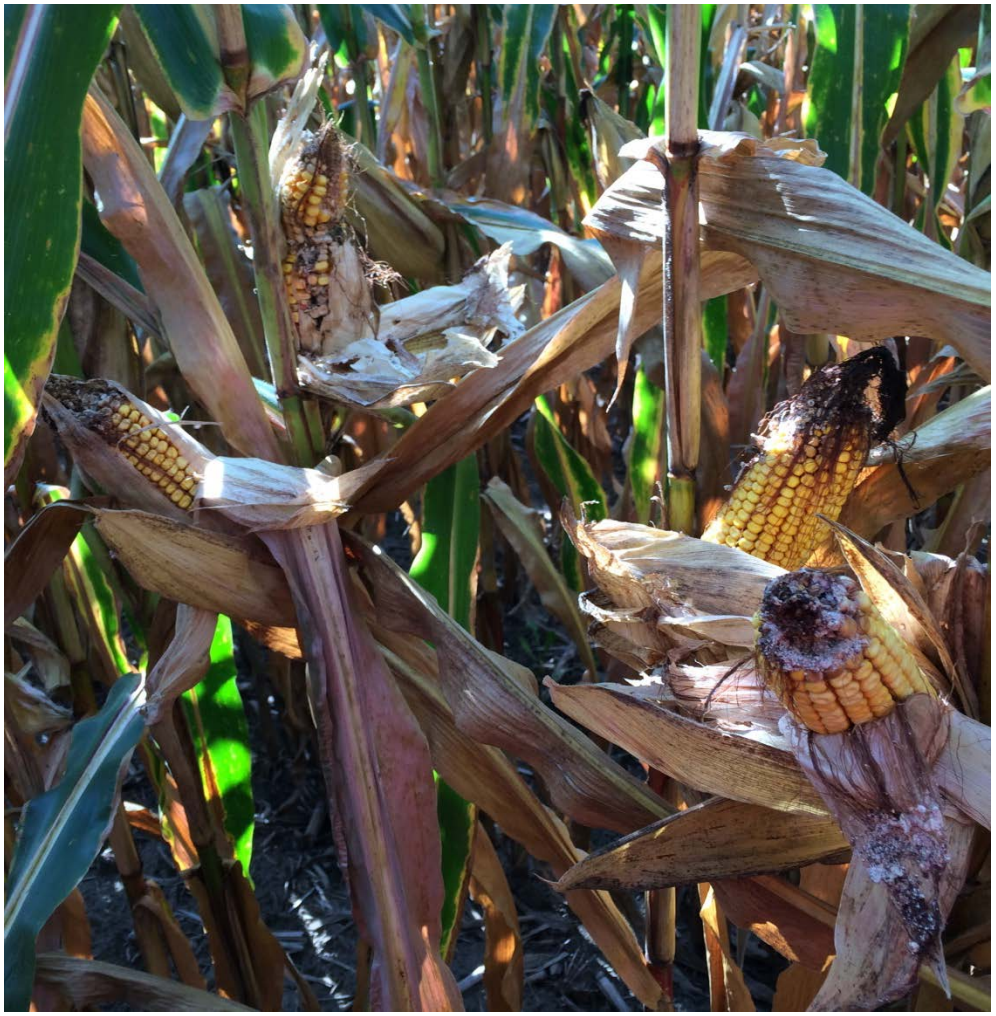
Is it Time to Cry Over Cry1F Control of Western Bean Cutworm?

Andy Michel, Associate Professor

Dept. of Entomology

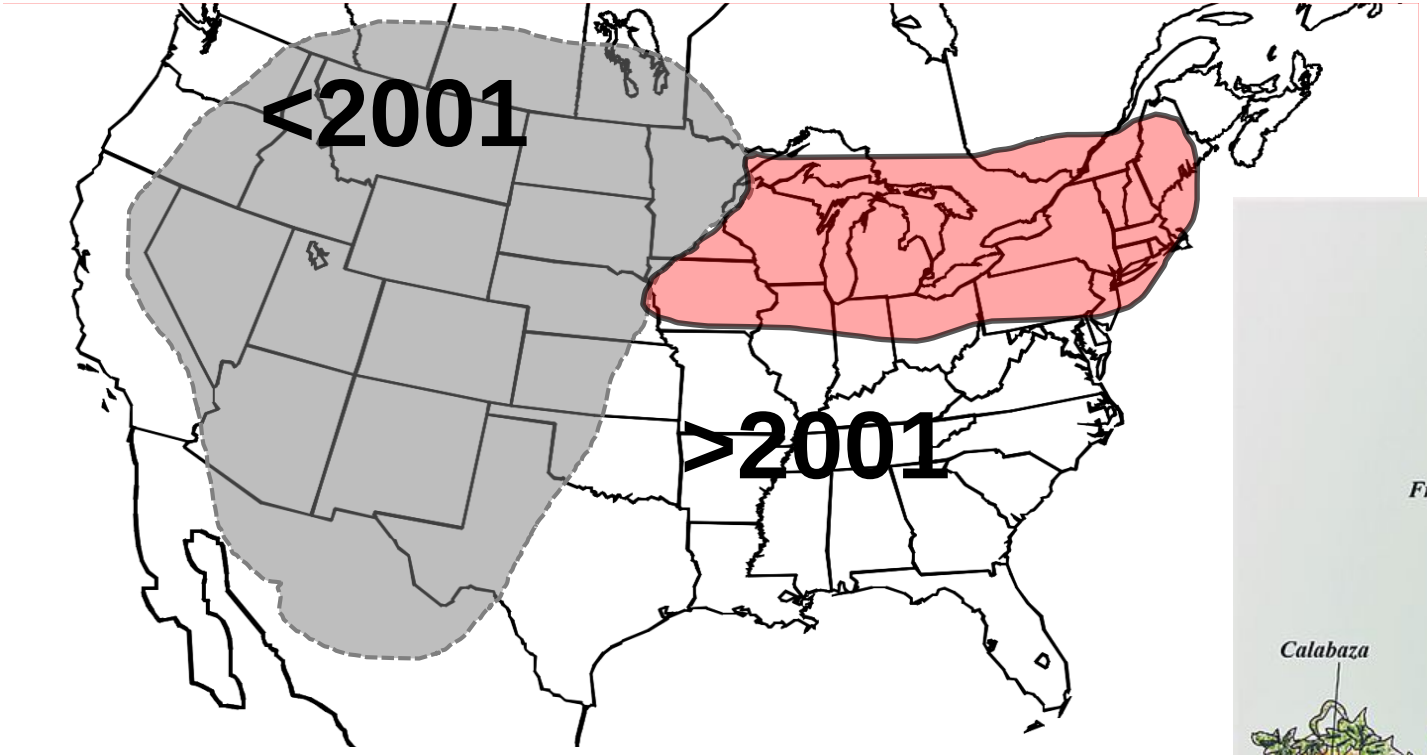
WBC-An Emerging Great Lakes Pest

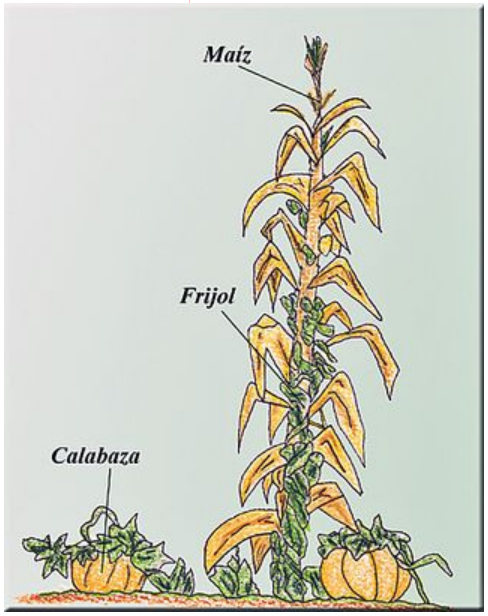
- History of WBC
- Biology
  - Identification, Trapping Scouting
- Cry1F: History for WBC & recent failures
- Best management practices for Great Lakes



Western Bean Cutworm

- Came from Western dry land states
- Found in IA 2001, spreading ever since





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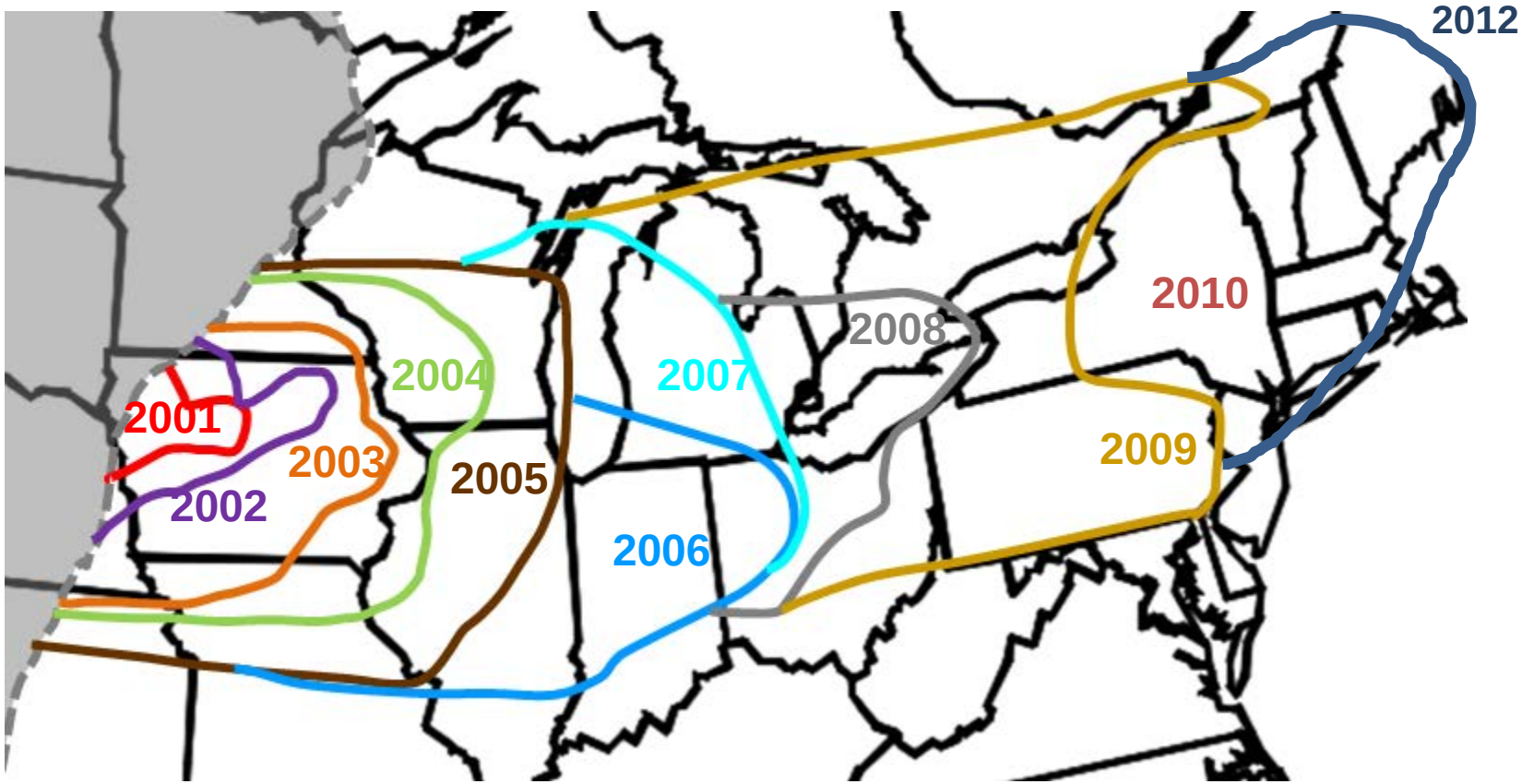
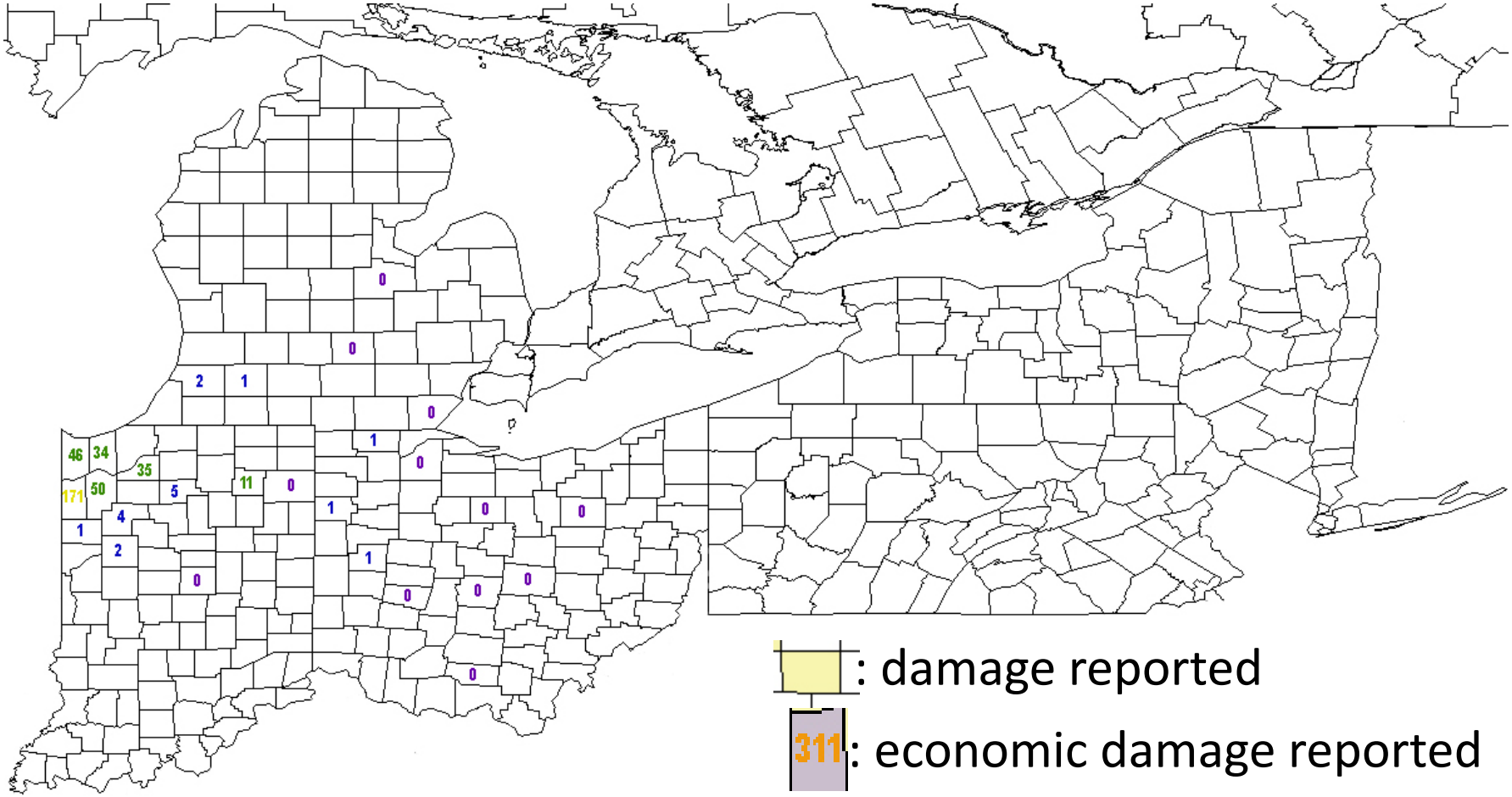
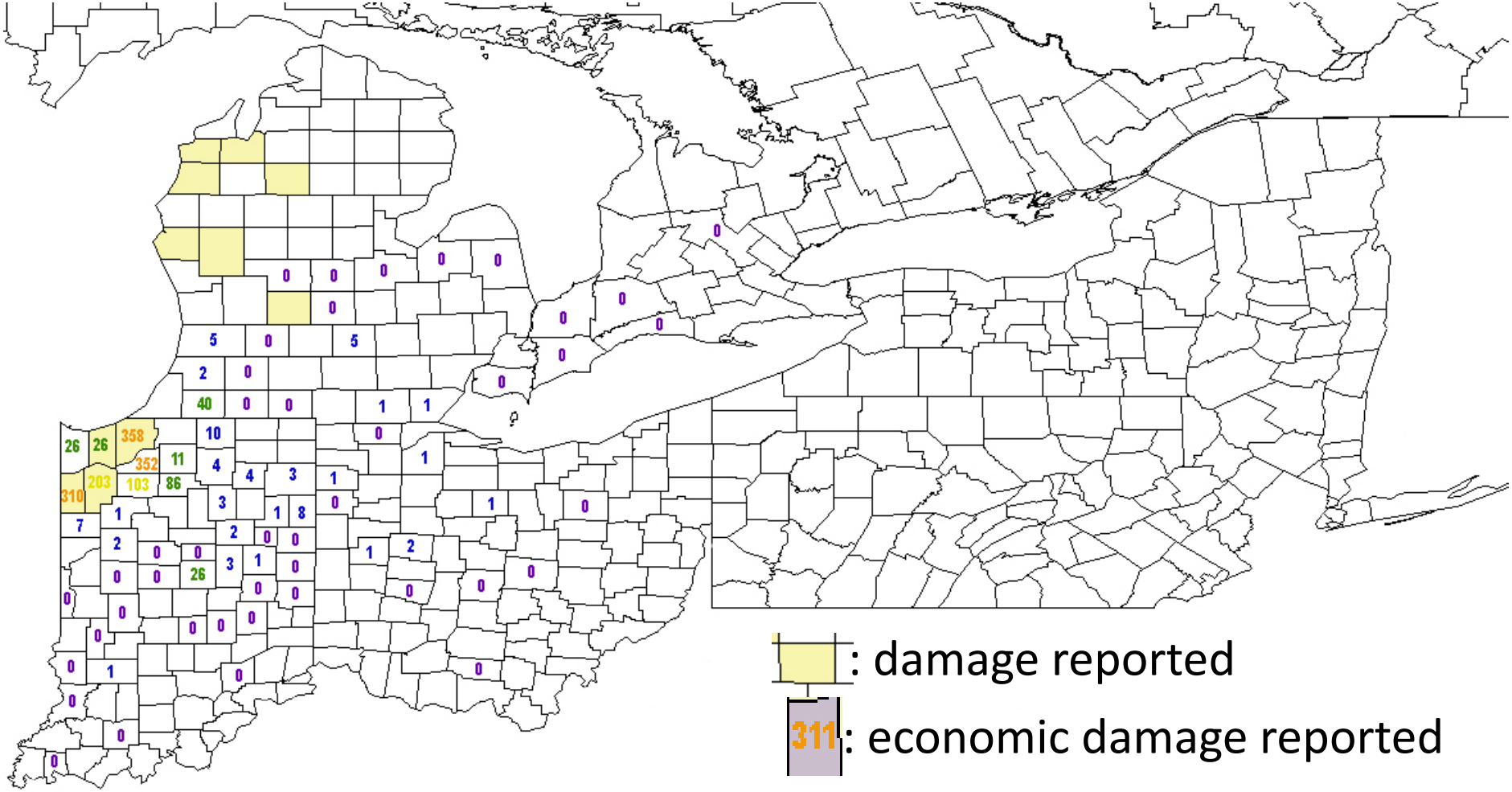


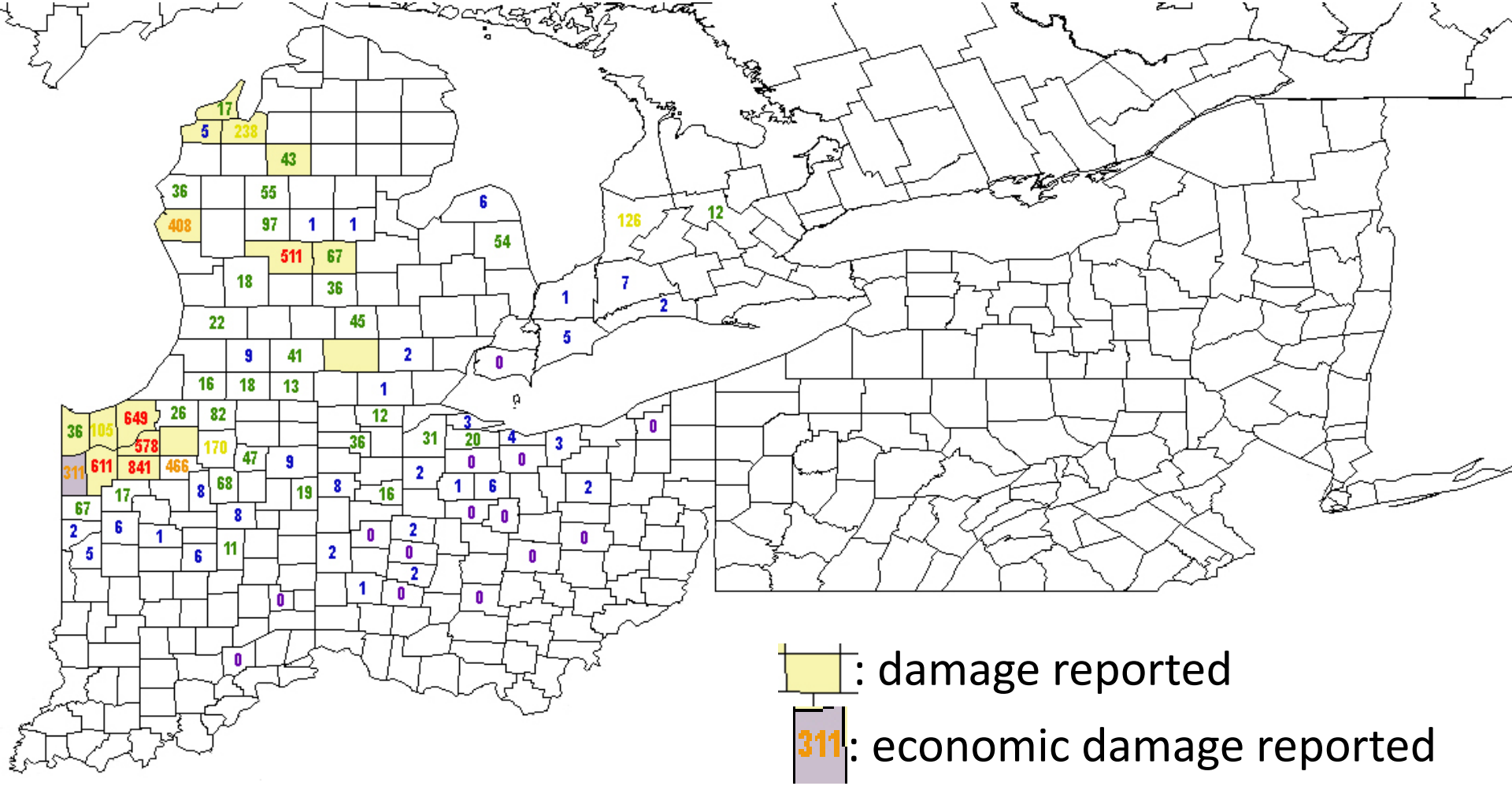
Western Bean Cutworm 2006



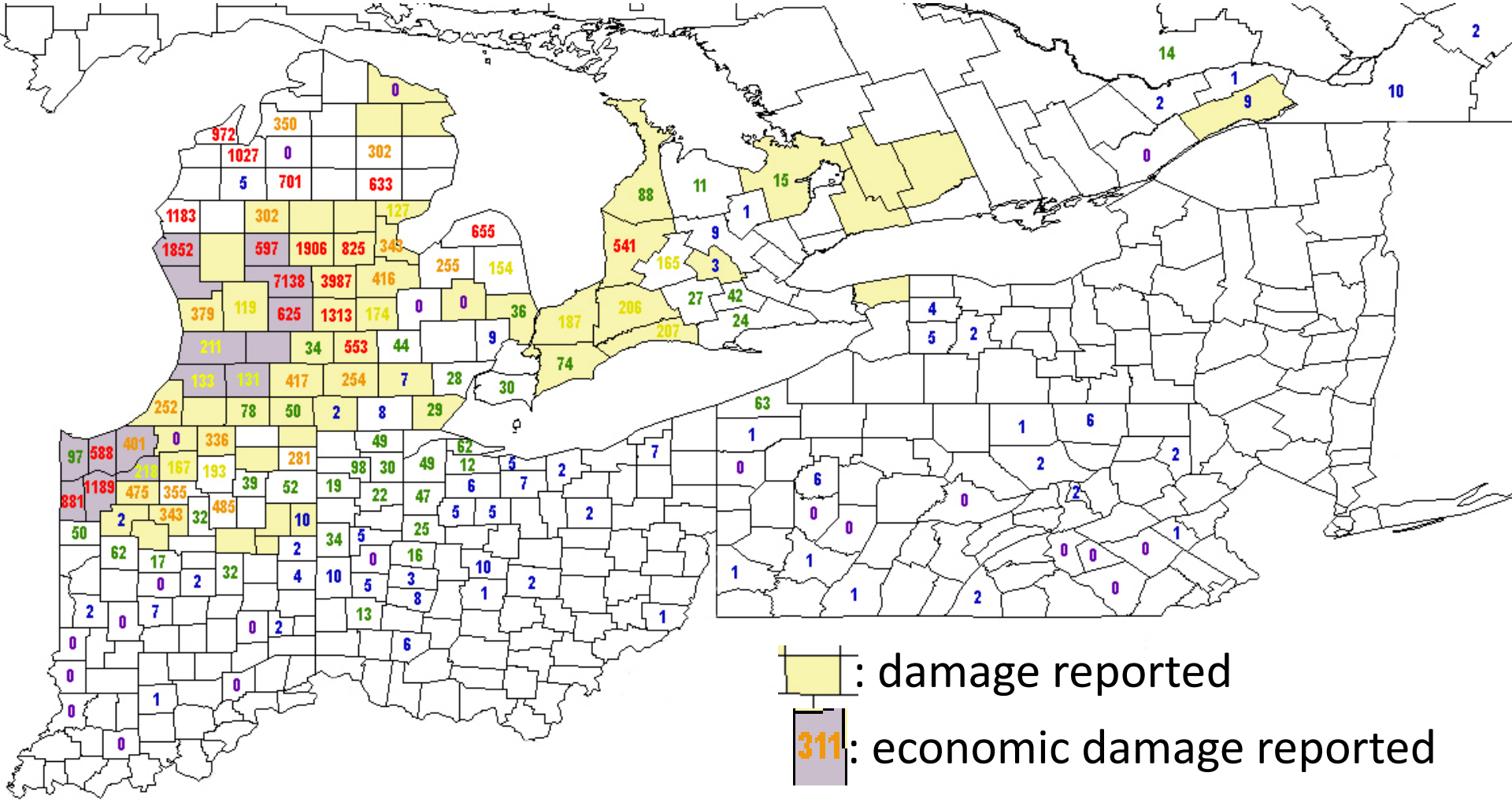
Western Bean Cutworm 2007



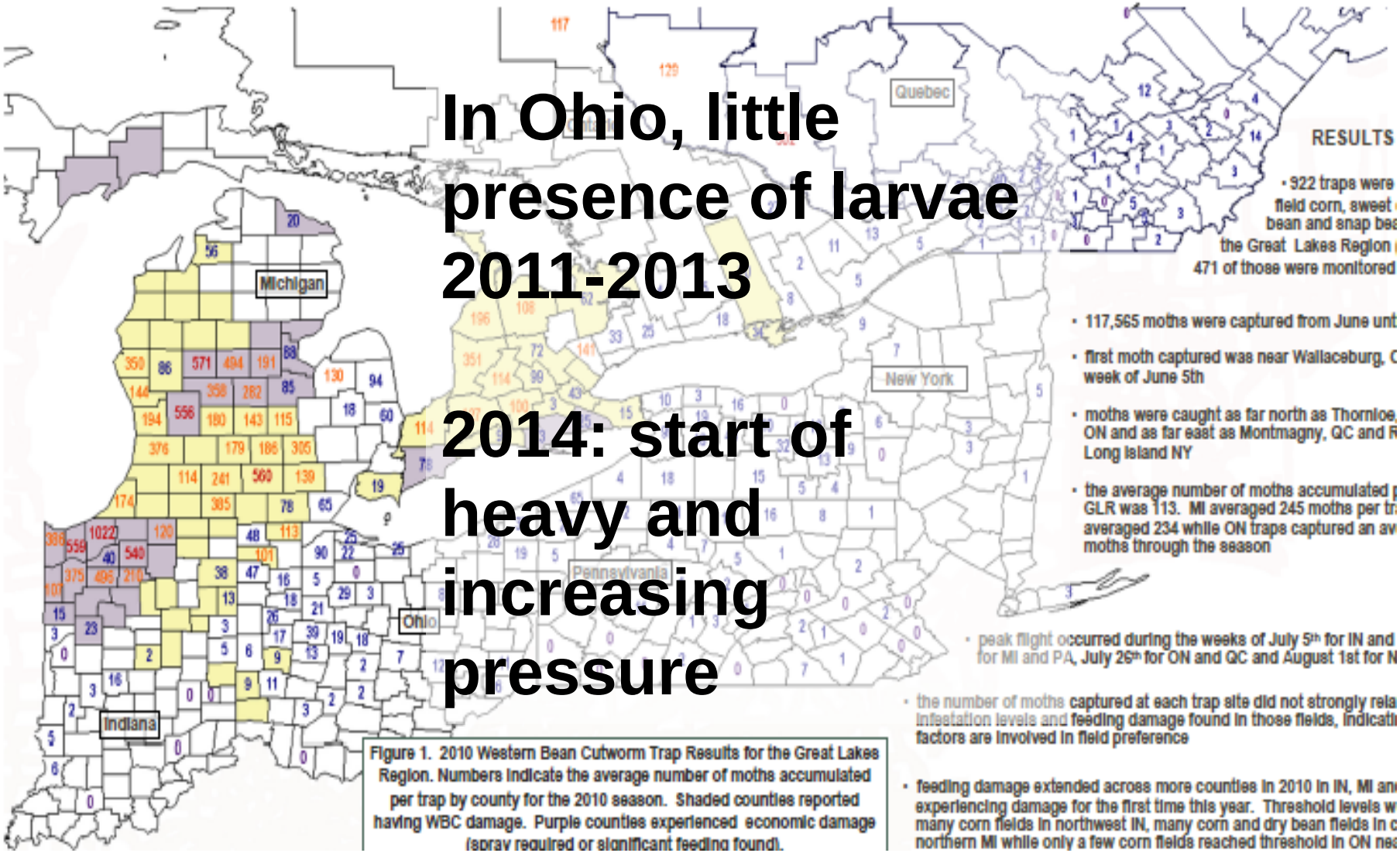
Western Bean Cutworm 2008



Western Bean Cutworm, 2009



Western Bean Cutworm, 2010



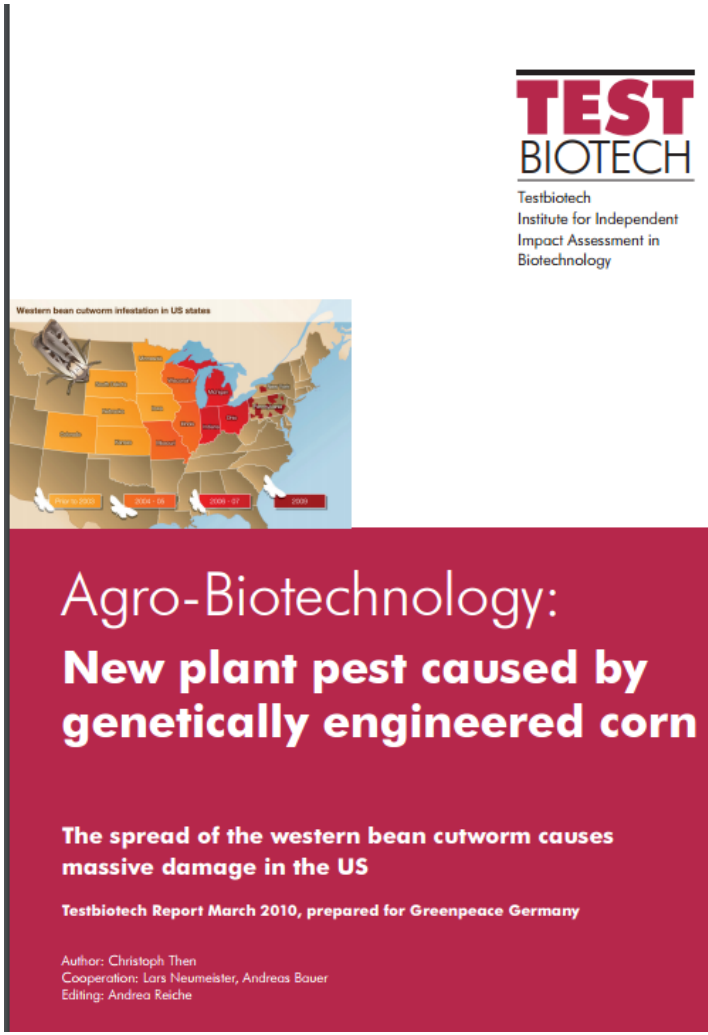
In Ohio, little presence of larvae 2011-2013

2014: start of heavy and increasing pressure

Map credit: Tracey Baute, OMAFRA

Why the rapid spread?

- Greenpeace:
  - Corn earworm eats WBC
  - Bt reduced corn earworm
  - ↑ in WBC
- Replacement
- Solution: stop planting Bt corn!

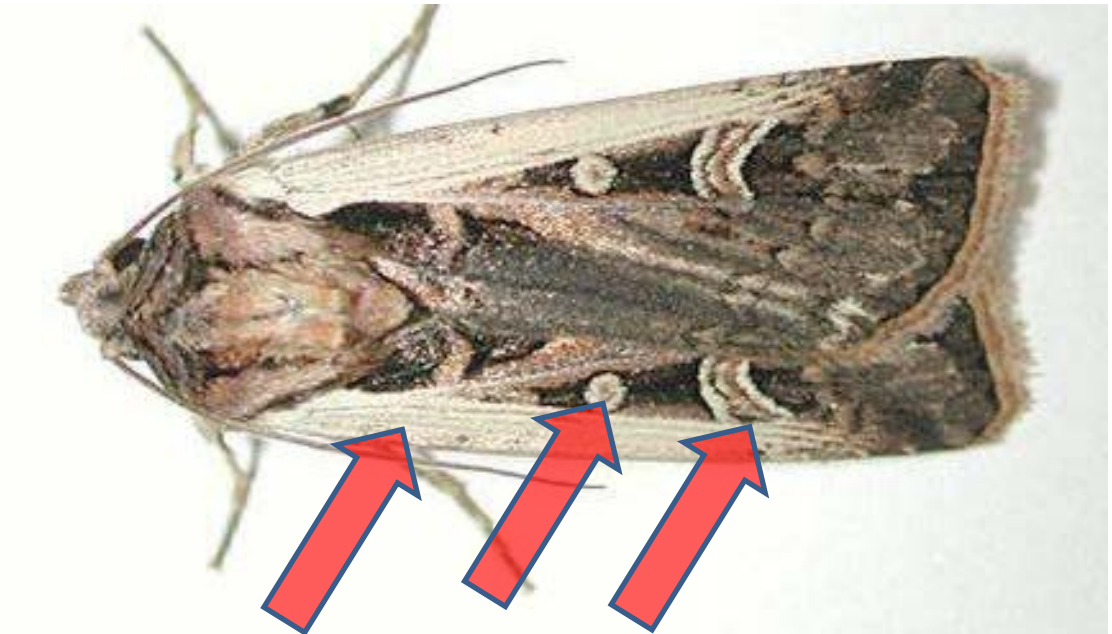


Why the rapid spread

- >10 possible reasons
- Conservation tillage
  - Equipment & herbicide resistance
- Corn Phenology/Planting
- Climate change
- ↓ Insecticide use

WBC Biology-Adults

- 1 generation per year
- Adults emerge in mid-late June
  - Fly at night, rest during day
- Fly until late August/Sept



WBC Biology-Eggs

- Eggs laid from July until August
- Clumps of 25-100, 5-7 days
- Start white, then tan/pink, then purple
- Hatch w/in 24hrs when purple

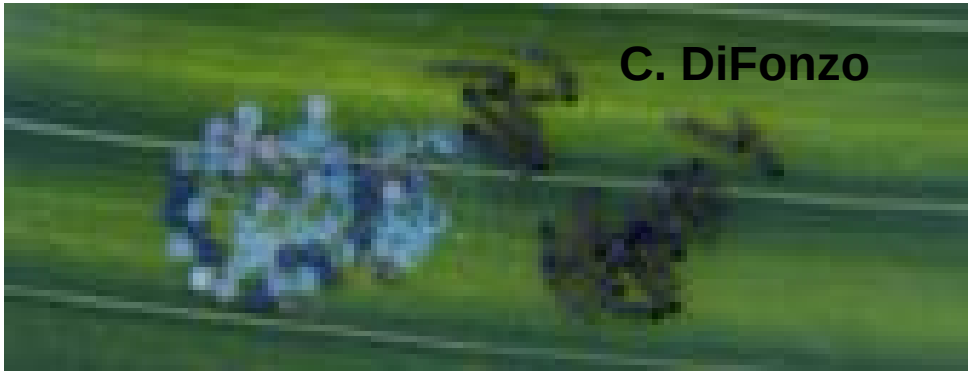
WBC Biology-Eggs

- Can be confused with stink bug eggs
- WBC are more barrel-shaped, have vertical lines
- SB have "crown of thorns"

- Can easily see with a nice hand lens

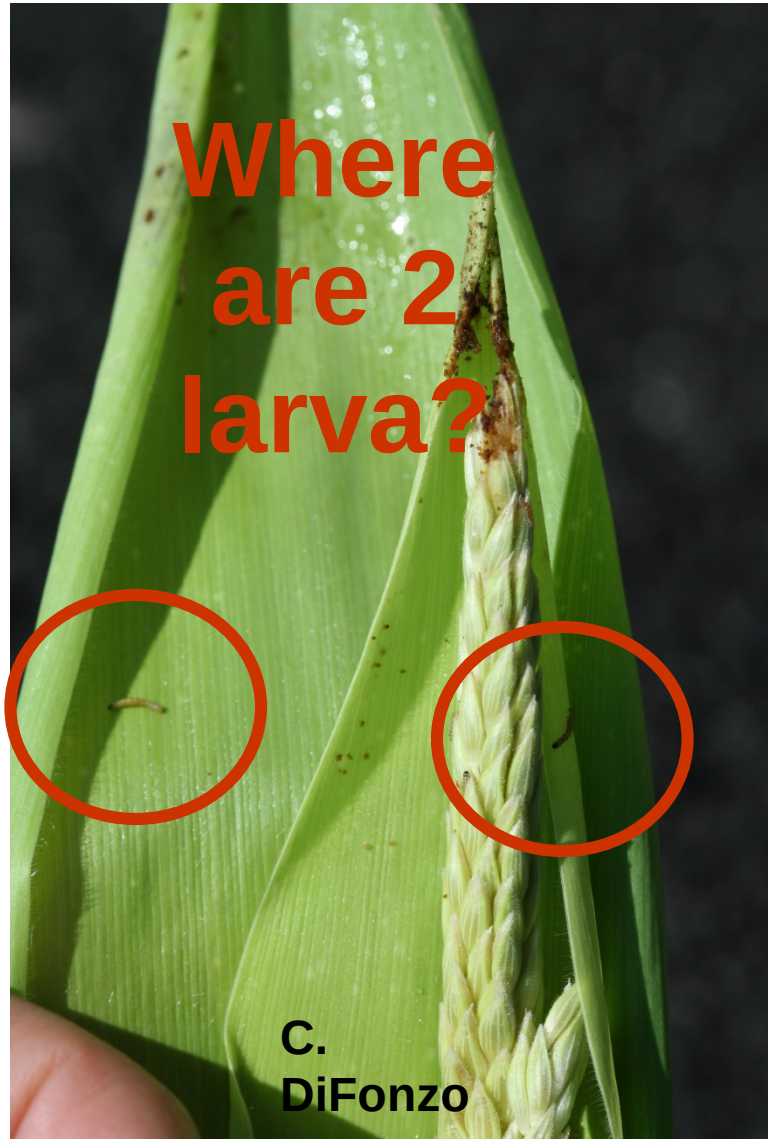
WBC Biology--Larvae

- 6 larval stages
- 1st: Very small, spotty, black heads
- Move eat shells, pollen, tassel




First Instars


USA1481176


Where are 2 larva?
C. DiFonzo

WBC Biology--Larvae

- Later stages move to ear
- ID by 2 brown stripes
- Chew on silk and enter
- Enter through the side

- Brown stripes not always apparent at 1-2 stages

John Obermeyer, Purdue

WBC-Pupae

- Larvae last until late Sept
- Fall out and form cocoon deep in soil
  - Importance of sandier soil
- Pupate in May, emerge in June

WBC-Damage

- Most damage occurs on ear
  - Some leaf feeding, but unimportant
- Tip and the middle
- Multiple larvae can be found

WBC-Damage

- Find 1, find them all
  - Infestations can be found down a row
  - Lots of movement after egg hatch

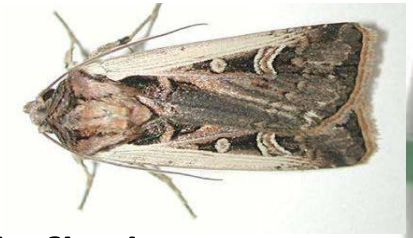
WBC-Damage

- Kernels missing
  - Chewed
  - Pollination
- "White Scraping"

WBC-Damage

- Increase in moldy ears

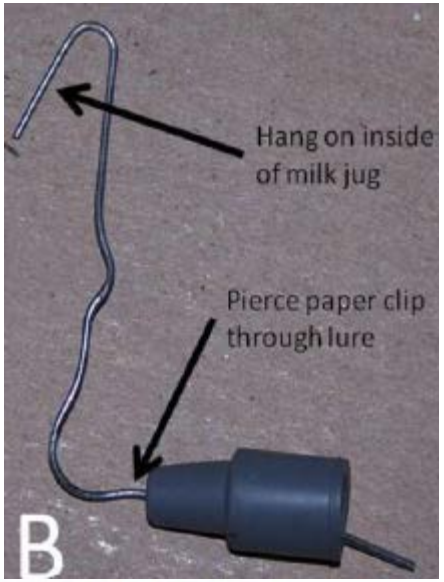
Scouting



- Adults:
  - Pheromone traps
  - Gives you idea of when peak flight is
  - And when to scout
  - **NOT WHEN TO SPRAY!!!**
- Hang near edge of field
- Check at least weekly
- 2 methods:
  - Bucket traps
  - IPM supply stores

Scouting

- Milk jug trap
  - Same idea, but cheaper (and messier)
  - 1:4, antifreeze:water+dish soap
  - lure
  - Use goldfish net



Adult ID

- Sometimes difficult:

Egg Scouting

- When >1 adults are caught/night—scout!
- High-risk area should begin scouting 1-2 week of July
- Focus on pre-tassel corn
  - Females preference
- Eggs are laid on uppermost 2 leaves
- In vertical position

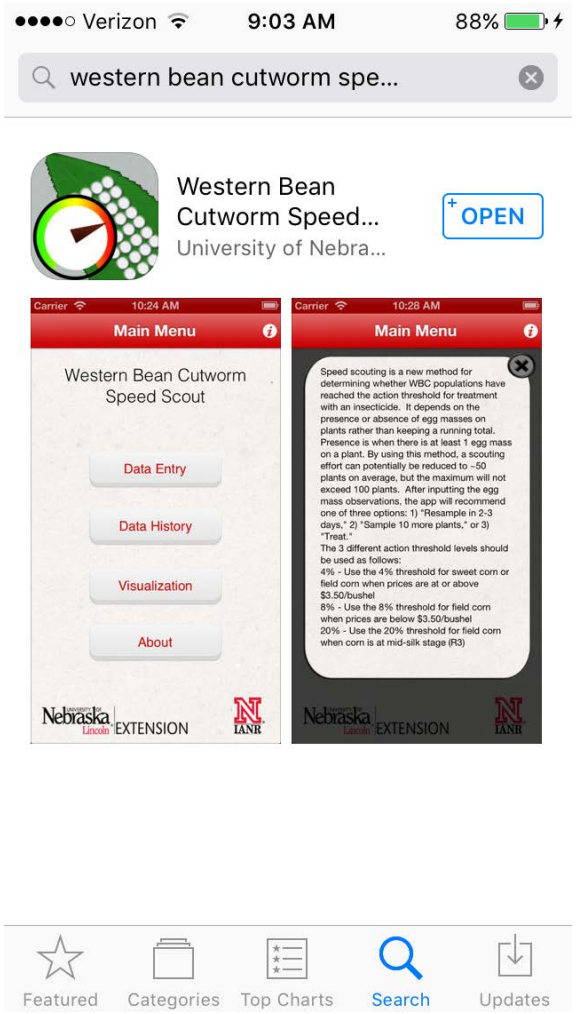
- **Where's the Egg Mass?**
- Use shadow method

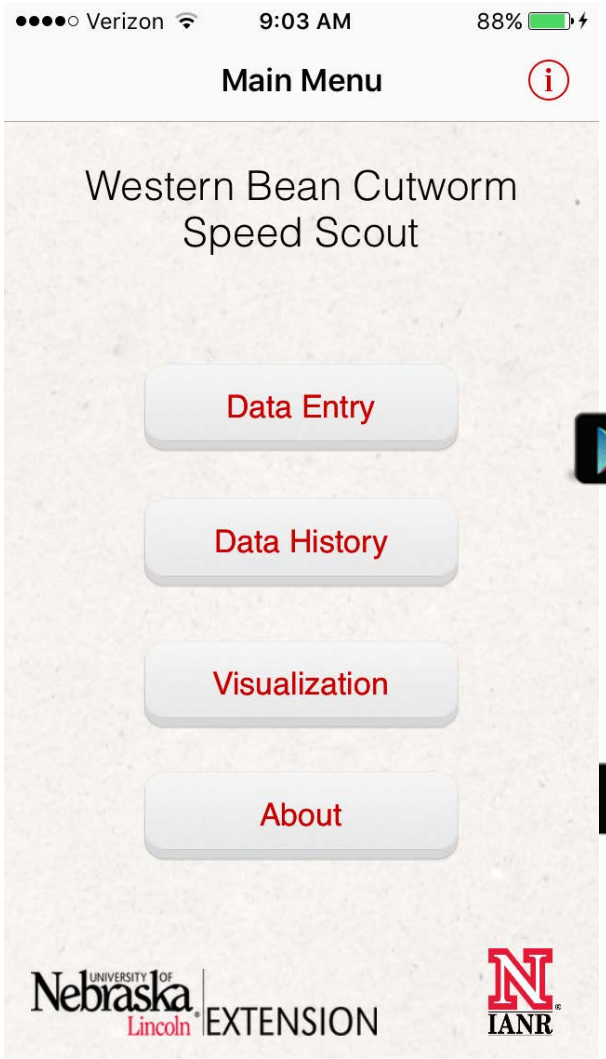
Economic Thresholds

- Inspect 10 plants in 10 locations
  - Check pre-tassel corn, replant areas
- **If ≥5%-8% have egg mass, treatment necessary**
  - Many chemicals available
  - Beware of resistance

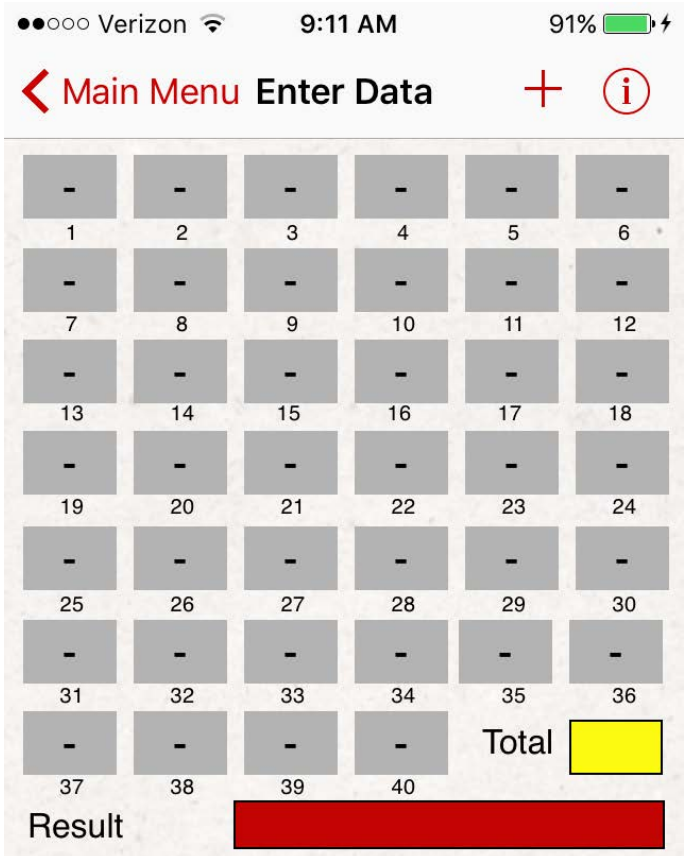
- Spray **after** egg hatch, but **before** larvae enter ear
  - Watch for purpling, will have 24-48 hrs before hatch
  - Use products with good residuals

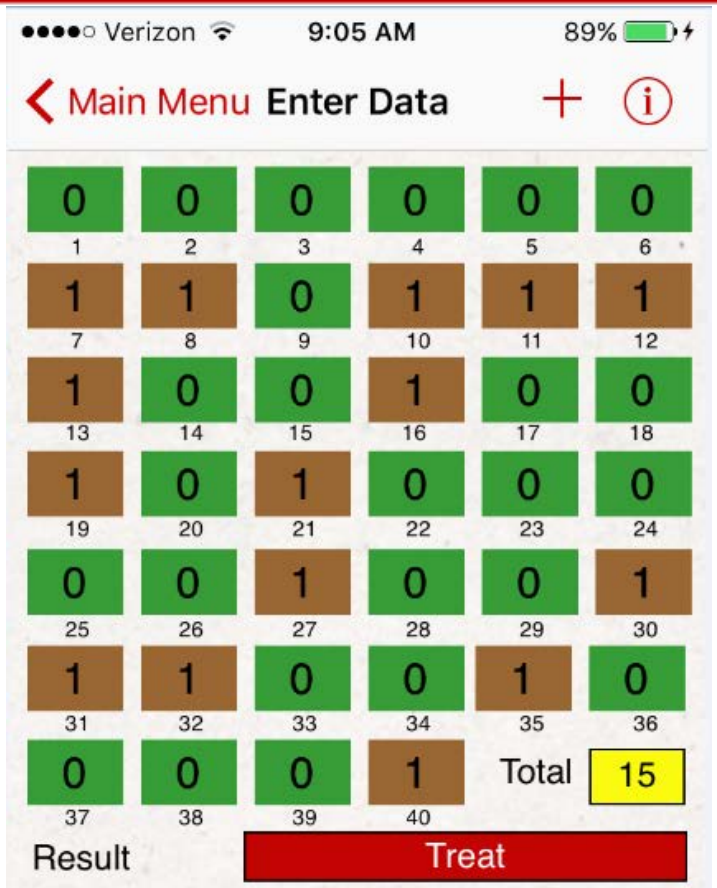
There's an App for that....





- Field name and size
- Different thresholds:
  - 4%: >$3.50
  - 8%: <$3.50
  - 20%: at or above mid-milk state





@8%:

0: Resample 2-3 days

1-3: Sample 10 more plants

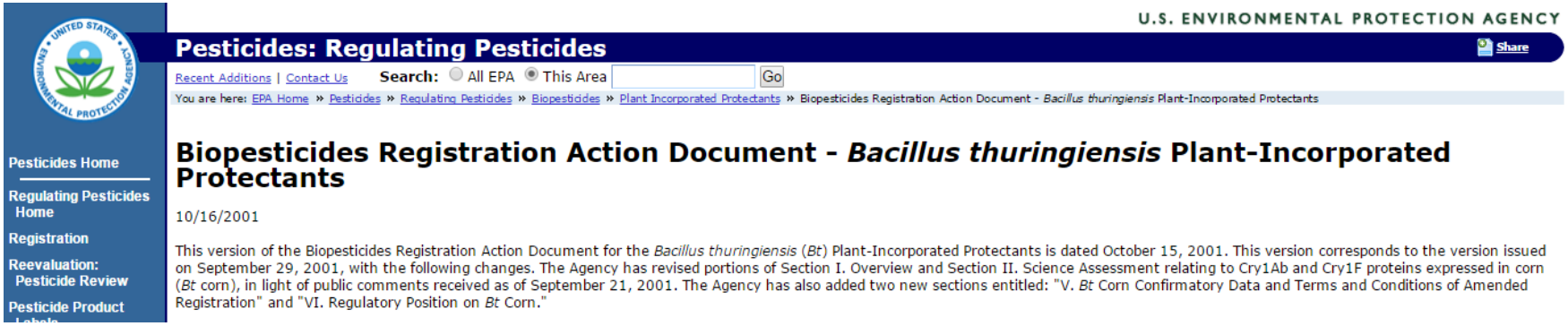
>4: Treat

Bt: The rest of the story

- WBC: Not an **initial target** of any above-ground traits
  - Not a primary pest like ECB, or CEW
  - Limited in acreage (<2000 not really found east of Missouri River)
    - Cry1F approved 2001

Bt: The rest of the story

- Biopesticide Registration Action Document (BRAD) for Cry1F Bt:
  - "The registrant-submitted data indicate that Cry1F protected corn offers excellent control of **European corn borer, southwestern corn borer, fall armyworm, black cutworm,** and **suppression for the corn earworm**."



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Regulating Pesticides Home
Registration
Reevaluation: Pesticide Review
Pesticide Product

Biopesticides Registration Action Document - *Bacillus thuringiensis* Plant-Incorporated Protectants

10/16/2001

This version of the Biopesticides Registration Action Document for the *Bacillus thuringiensis* (*Bt*) Plant-Incorporated Protectants is dated October 15, 2001. This version corresponds to the version issued on September 29, 2001, with the following changes. The Agency has revised portions of Section I. Overview and Section II. Science Assessment relating to Cry1Ab and Cry1F proteins expressed in corn (*Bt* corn), in light of public comments received as of September 21, 2001. The Agency has also added two new sections entitled: "V. *Bt* Corn Confirmatory Data and Terms and Conditions of Amended Registration" and "VI. Regulatory Position on *Bt* Corn."

IRM Section

Acronym	Common Name	Scientific Name	Crop
BCW	Black Cutworm	*Agrotis ipsilon* (Hufnagel)	corn
CBW	Cotton Bollworm	*Helicoverpa zea* (Boddie)	cotton
CEW	Corn Earworm	*Helicoverpa zea* (Boddie)	corn
CPB	Colorado Potato Beetle	*Leptinotarsa decemlineata* (Say)	potato
CSB	Common Stalk Borer	*Papaipema nebris* (Guen.)	corn
ECB	European Corn Borer	*Ostrinia nubilalis* (Huebner)	corn
FAW	Fall Armyworm	*Spodoptera frugiperda* (J. E. Smith)	corn
PBW	Pink Bollworm	*Pectinophora gossypiella* (Saunders)	cotton
SCSB	Southern Corn Stalk Borer	*Diatraea crambidoides* (Grote)	corn
SWCB	Southwestern Corn Borer	*Diatraea grandiosella* (Dyar)	corn
TBW	Tobacco Budworm	*Heliothis virescens* (Fabricius)	cotton

Products with Cry1F

Optimum TRIsect™ ABOVE BELOW

HERCULEX® I Insect Protection HX

REFUGE ADVANCED®

genuity SMARTSTAX® CORN RIB COMPLETE™

Optimum AcreMax ABOVE

XTRA HX™

Agrisure® 3122 E-Z Refuge®

genuity SMARTSTAX® CORN SmartStax®

Optimum Leptra

Intrasect® Blended Refuge

POWERCORE®

WBC and Bt

- >2001: Early field trials showed only Cry1F had some efficacy against WBC
- 2006: First published efficacy data

TRANSGENIC PLANTS AND INSECTS

Western Bean Cutworm, *Striacosta albicosta* (Smith) (Lepidoptera: Noctuidae), as a Potential Pest of Transgenic Cry1Ab *Bacillus thuringiensis* Corn Hybrids in South Dakota

MICHAEL A. CATANGUI[1] AND ROBERT K. BERG

Department of Plant Science, South Dakota State University, Brookings, SD 57007–1096

Environ. Entomol. 35(5): 1439–1452 (2006)

2000, 2003, 2004

- WBC 2003: Cry1F protected much better than other products

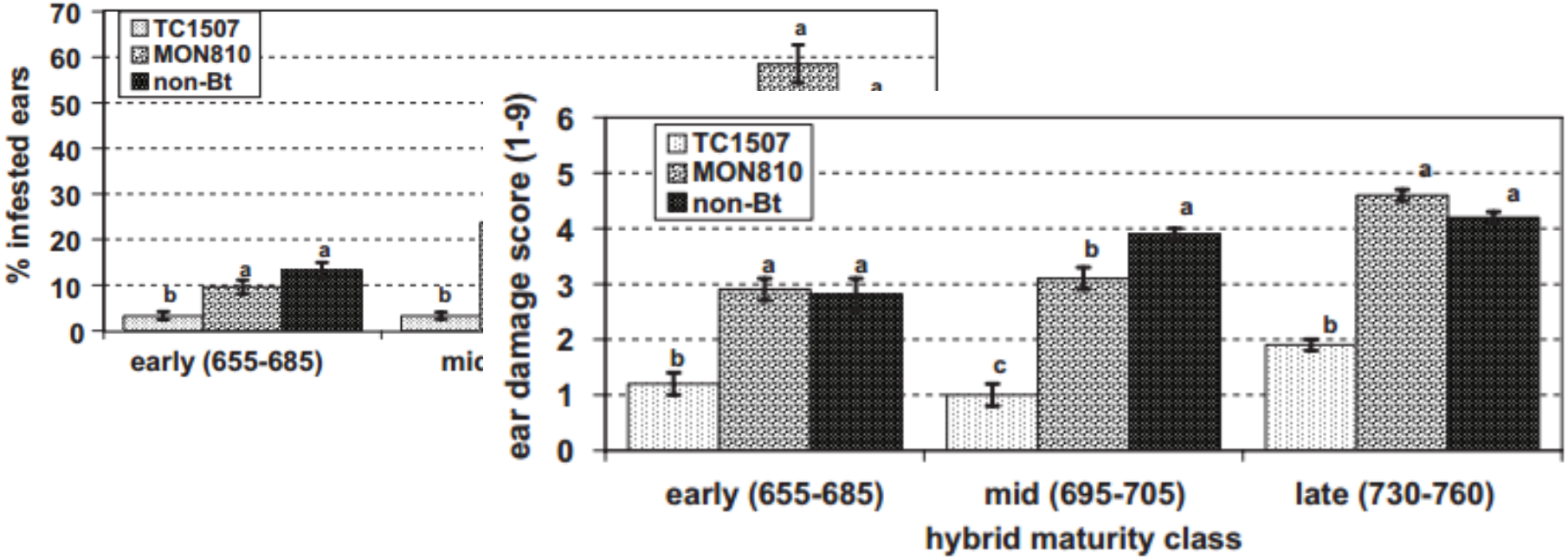
	% Infested	# Kernels Damaged
Syngenta N58-D1 (*Bt*-YGCB)	45.00 ± 11.90b	4.32 ± 1.05a
Syngenta N58-F4	10.00 ± 7.07a	4.58 ± 2.67a
Dekalb C53–32 (*Bt*-YGCB) + clothianidin	57.50 ± 12.50b	9.28 ± 2.13a
Dekalb C53–29 (*Bt*-YGRW) + imidacloprid	47.50 ± 18.87b	6.69 ± 2.44a
Dekalb 537	7.50 ± 2.50a	8.00 ± 4.64a
Dekalb 537 + clothianidin	30.00 ± 17.80b	5.56 ± 2.26a
Golden Harvest 8350 (*Bt*-YGCB)	70.00 ± 12.25b	6.46 ± 1.43a
Golden Harvest 8194RR	27.50 ± 13.15a	6.26 ± 2.48a
Pioneer 34N42 (*Bt*-HXCB)	0.00 ± 0.00a	0.00 ± 0.00a
Pioneer 34N44 (*Bt*-YGCB)	37.50 ± 8.54b	5.78 ± 0.87b
Pioneer 34N43	25.00 ± 5.00b	5.69 ± 3.47b

PLANT RESISTANCE

Frequency and Severity of Western Bean Cutworm (Lepidoptera: Noctuidae) Ear Damage in Transgenic Corn Hybrids Expressing Different *Bacillus thuringiensis* Cry Toxins

HERBERT EICHENSEER,[1] ROBERT STROHBEHN, AND JUNE "CASEY" BURKS

Crop Genetics Research and Development, Pioneer Hi-Bred International, Johnston, IA 50131-0085



Cry1F Controls Western Bean Cutworm!!!!

WBC and Bt

- By 2005/2006: only Cry1F had some level of efficacy
  - Feeding was seen, but low in comparison
  - 2006: First found in Ohio
- Reports of "substantial damage" as early as 2008 (70-90% control)
- 2009: We knew damage would occur
  - Not high-dose
  - Provide economic control

Decreased Cry1F efficacy

- 2010-2013
  - WBC populations “settling in” Great Lakes
  - Increased reports of higher damage to Cry1F

Decreased Cry1F efficacy

- 2016: Worst year yet
- Reports from ON, MI, IN, OH, NY and NE
- Open Letter (C. DiFonzo, C. Krupke, K. Tilmon, J. Tooker, E. Shields, A. Michel):

"We strongly urge seed companies to remove the designation of "control" for this pest with regard to this toxin"

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WBC infested Cry1F fields
in southcentral MI

WBC infested Cry1F fields in southcentral MI

St Joseph Co MI


mold growth in damaged ears

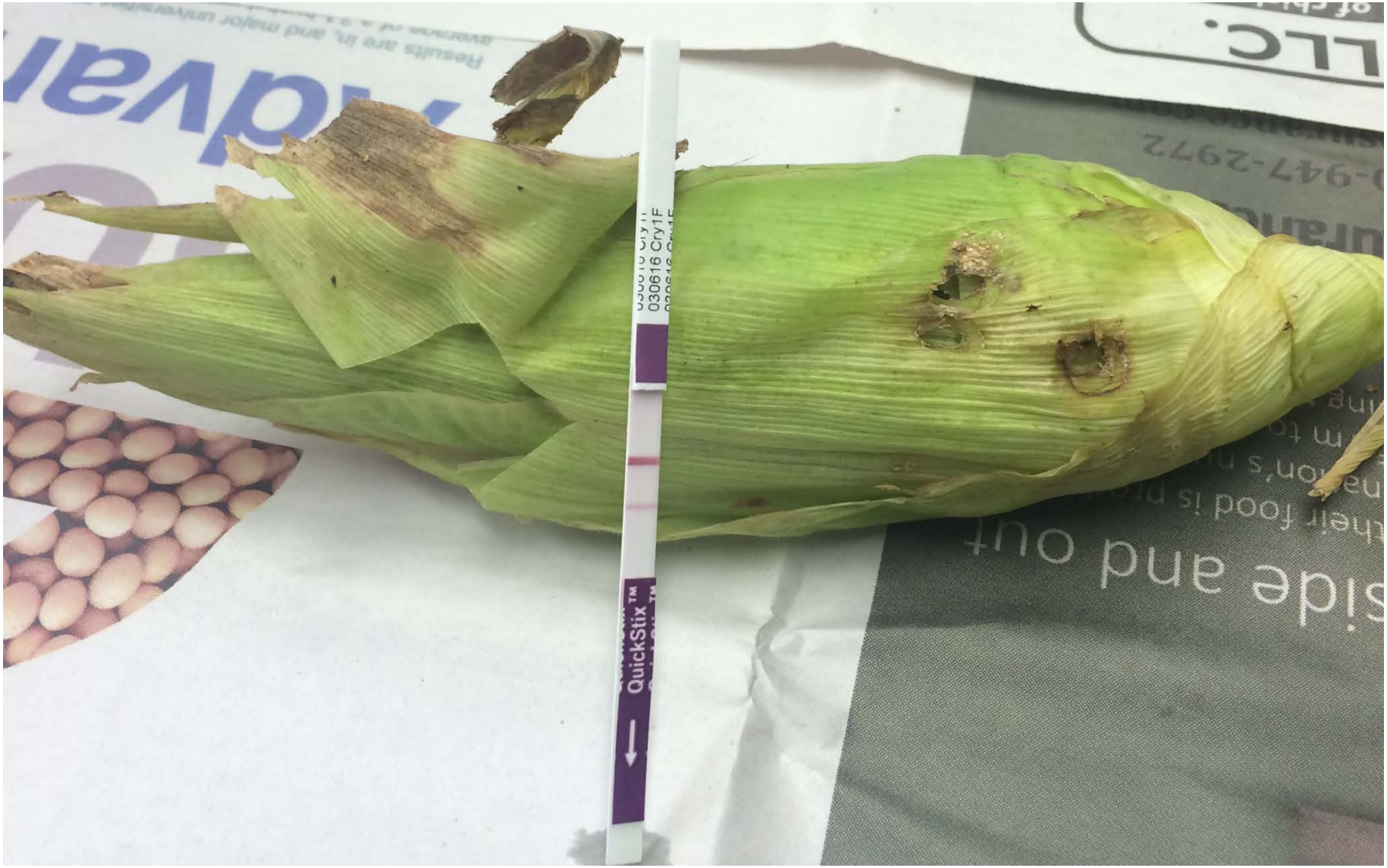
Northeast IN

Waldron Michigan
(central sand area, corn & dry beans)

Is Cry1F being expressed?

- Damage is only on the refuge plants (RIB)
- Expression is less under stress?
- Plants are too old?
- Check strips are too old?
- Strips: able to detect 1% of Bt in bulk grain sample


030616 Cry1F
030616 Cry1F
QuickStix™


030616 Cry1F
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NEWS
Ashland Implement
419-899-2151
Sherwood, OH
419-523-4131
Ottawa, OH


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QuickStix™
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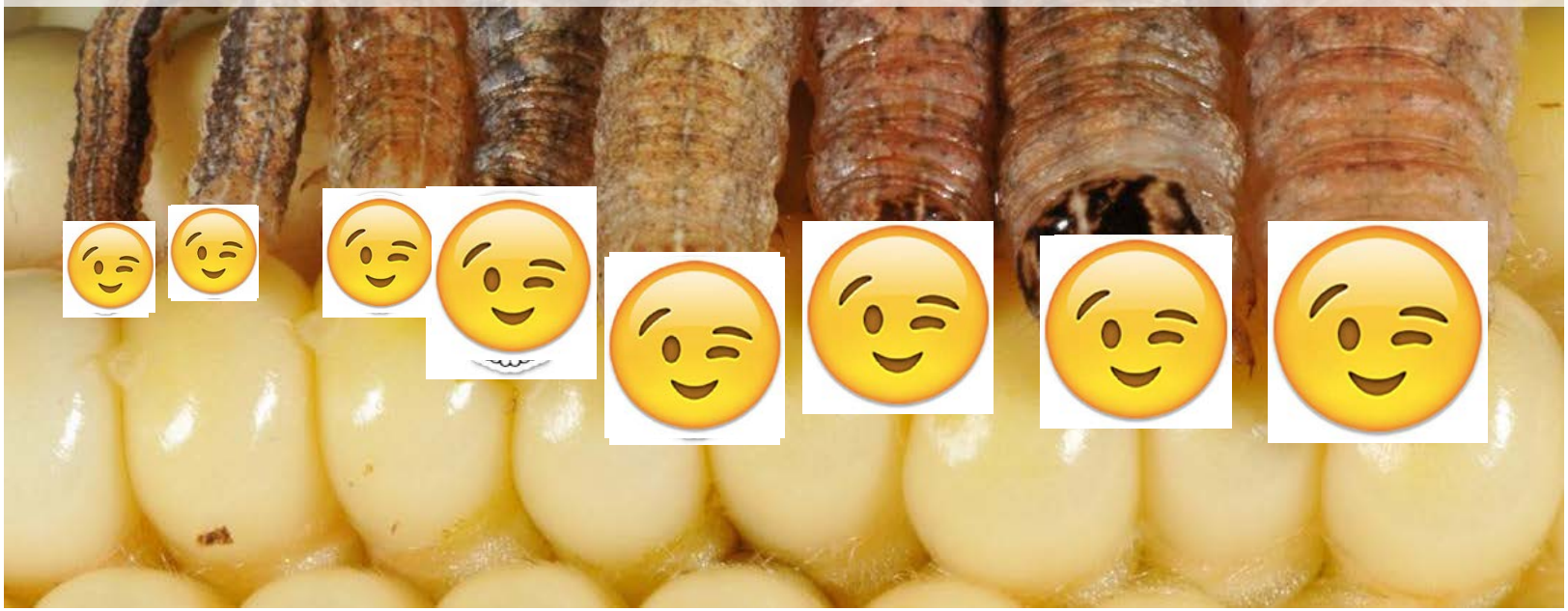
Decreased Cry1F efficacy

- Cannot depend on Cry1F for WBC control
  - No longer providing economic control
  - At very least, these fields need to be scouted



WBC Best Management Practices

- WBC is the **primary Lep pest** in Great Lakes
- Trap and **Scout**
  - Regardless of what your management plan is
- Bt: Only Viptera provides control
  - Few varieties in right maturity group are available
  - Should also control other Leps
- **Bt without VIP? Scout your fields**
  - Other AG-Bt's will control most other pests

WBC Best Management Practices

- If not Bt, scout for eggs, spray at 5-8% infestation
  - Start scouting 2nd week of July to mid-August
  - 95% tassel emergence and when the majority of egg masses are purple or hatching
  - Refuge management: if sprayed, Bt field has to be sprayed
  - Watch for European Corn Borer and other Lep pests

- Plant early
  - Post-tassel are less likely to be damaged
  - Use early maturity groups

More Information

- Search Journal of Integrated Pest Management for Western Bean Cutworm

Journal of Integrated Pest Management
OPEN ACCESS
PROFILES

Ecology and Management of the Western Bean Cutworm (Lepidoptera: Noctuidae) in Corn and Dry Beans

Andrew P. Michel,[1] Christian H. Krupke,[2] Tracey S. Baute,[3] and Christina D. Difonzo[4]

[1]Department of Entomology, Ohio Agricultural Research and Development Center, The Ohio State University, 1680 Madison Ave, Wooster OH 44691 (e-mail: michel.70@osu.edu).
[2]Depa

Journal of Integrated Pest Management
OPEN ACCESS
ISSUES

Genetically Engineered Bt Corn and Range Expansion of the Western Bean Cutworm (Lepidoptera: Noctuidae) in the United States: A Response to Greenpeace Germany

William D. Hutchison,[1,2,3] Thomas E. Hunt,[4] Gary L. Hein,[5] Kevin L. Steffey,[6] Clinton D. Pilcher,[7] and Marlin E. Rice[3,7]

Mention of a proprietary product does not constitute an endorsement or a recommendation for its use by the universities associated with this research.

Acknowledgements

- Chris DiFonzo (MSU), Christian Krupke & John Obermeyer (Purdue), Tracey Baute & Jocelyn Smith (OMAFRA), Kelley Tilmon (OSU), John Tooker (PennSt), Elson Shields (Cornell, NYS-IPM)
- North Central Regional IPM