European Corn Borer Management

to Bt or not to Bt

2020 Advanced crop advisers workshop

Fargo, ND

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http://swroc.cfans.umn.edu/ag/pest-management

https://twitter.com/SWMNpest

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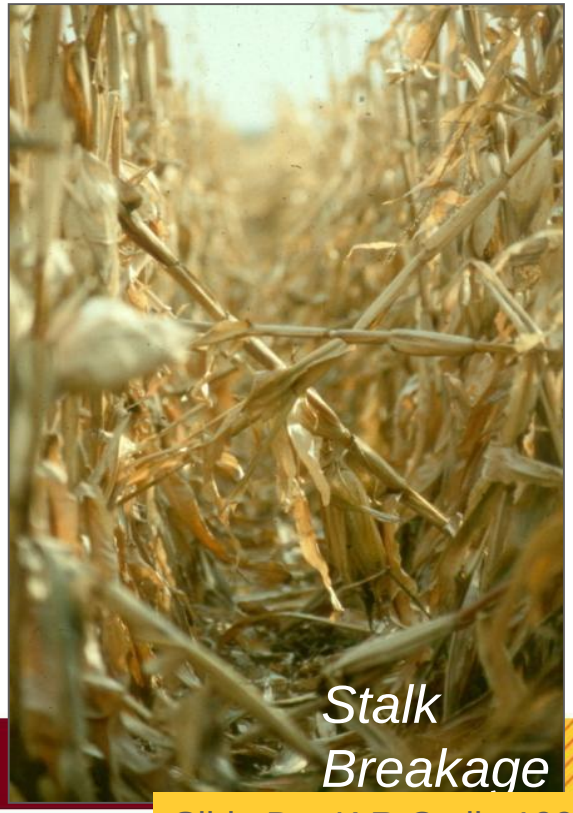
EUROPEAN CORN BORER: DAMAGE



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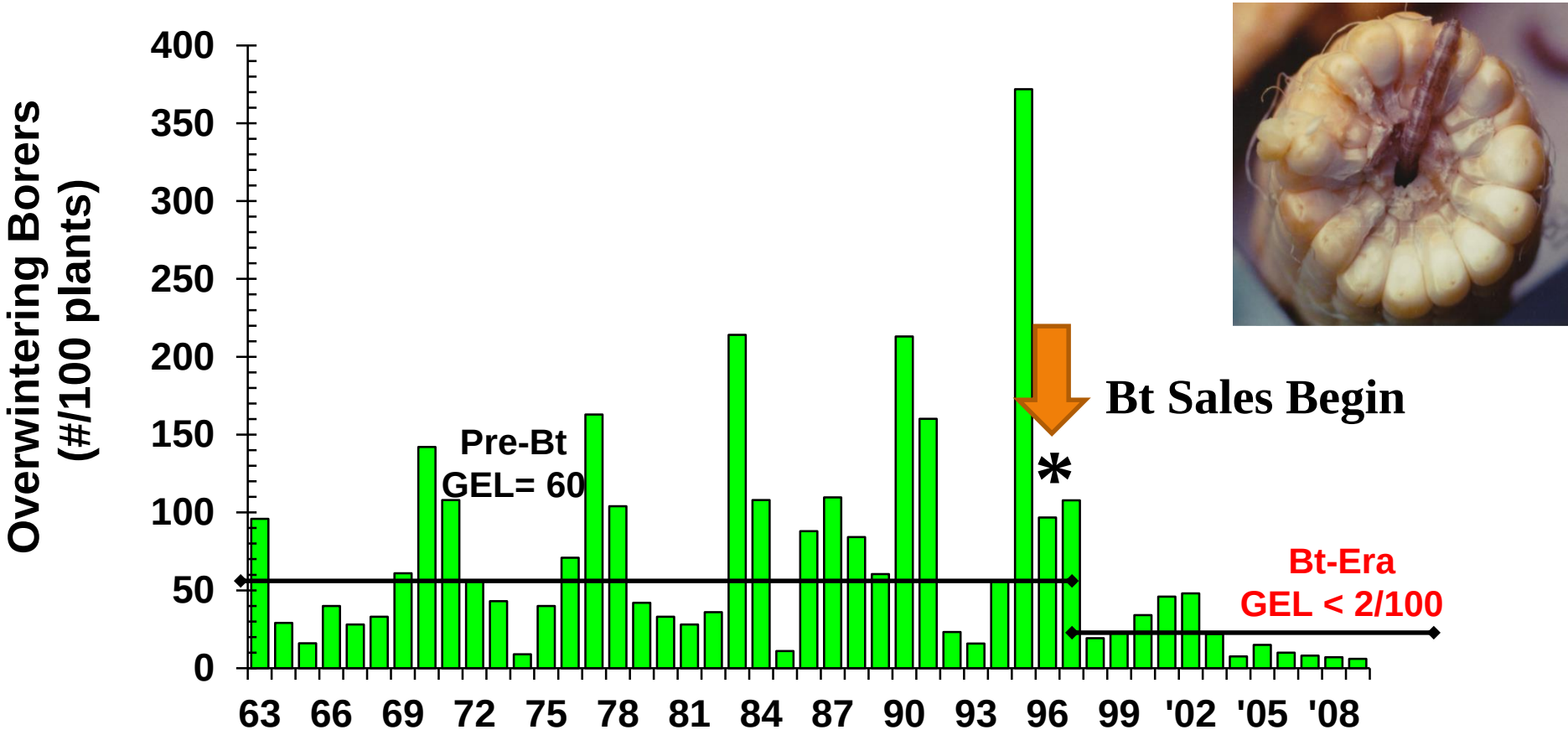
Slide Dr. K.R.Ostlie 1998

ECB Population Decline

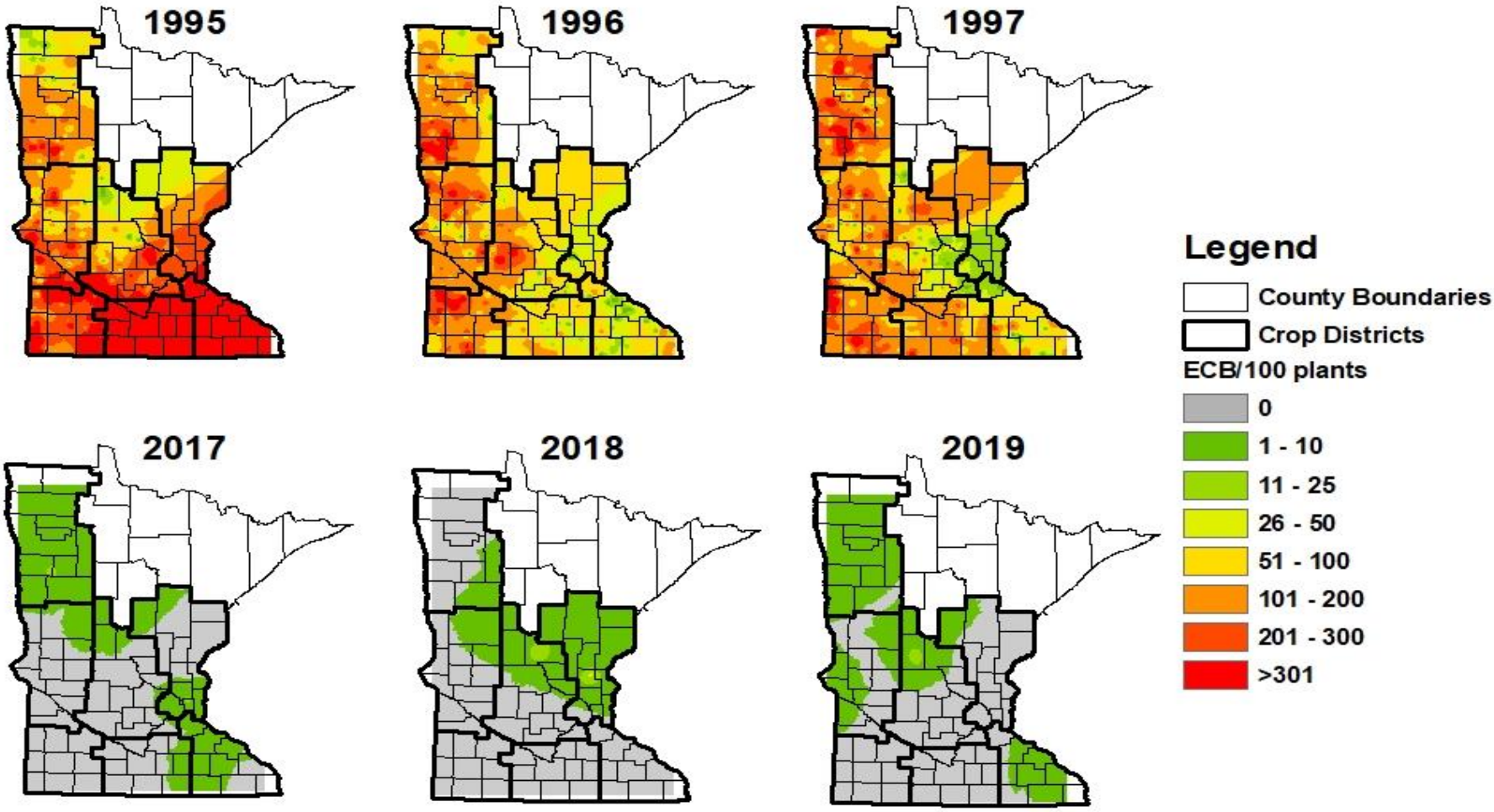
Population general equilibrium level (GEL) decreased 99% in Minnesota over past 23 years with widespread use of Bt corn



Minn. Dept. of Agriculture, & Dept. of Entomology, UMN

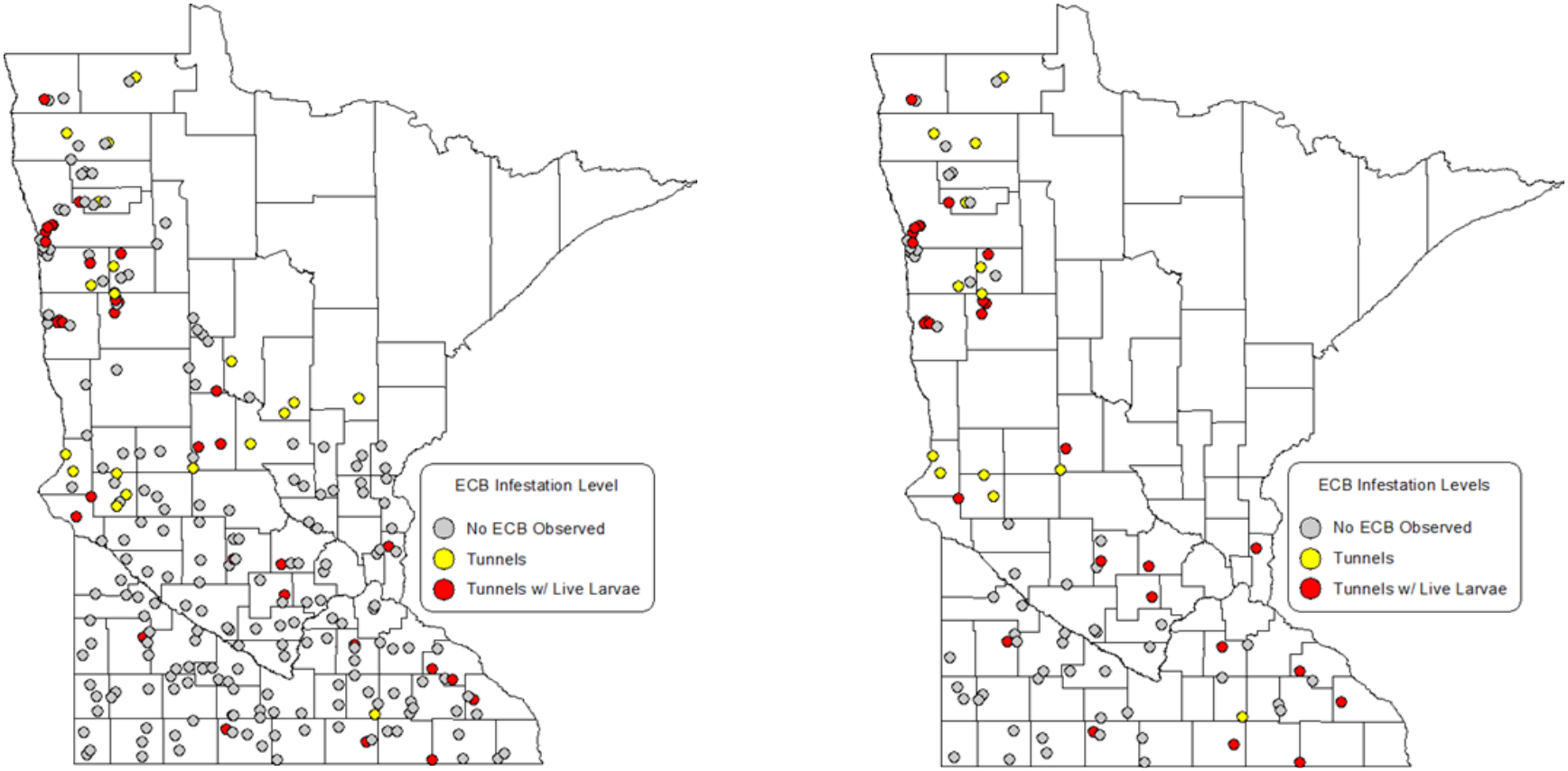
Slide courtesy Dr. Bill Hutchison

European Corn Borer populations (data interpolation) based on fall stalk dissections of MN field corn



*European corn borer data collected and summarized by Minn. Dept. of Agriculture and Univ. of Minnesota staff.

So…If you wanted to find a corn borer?

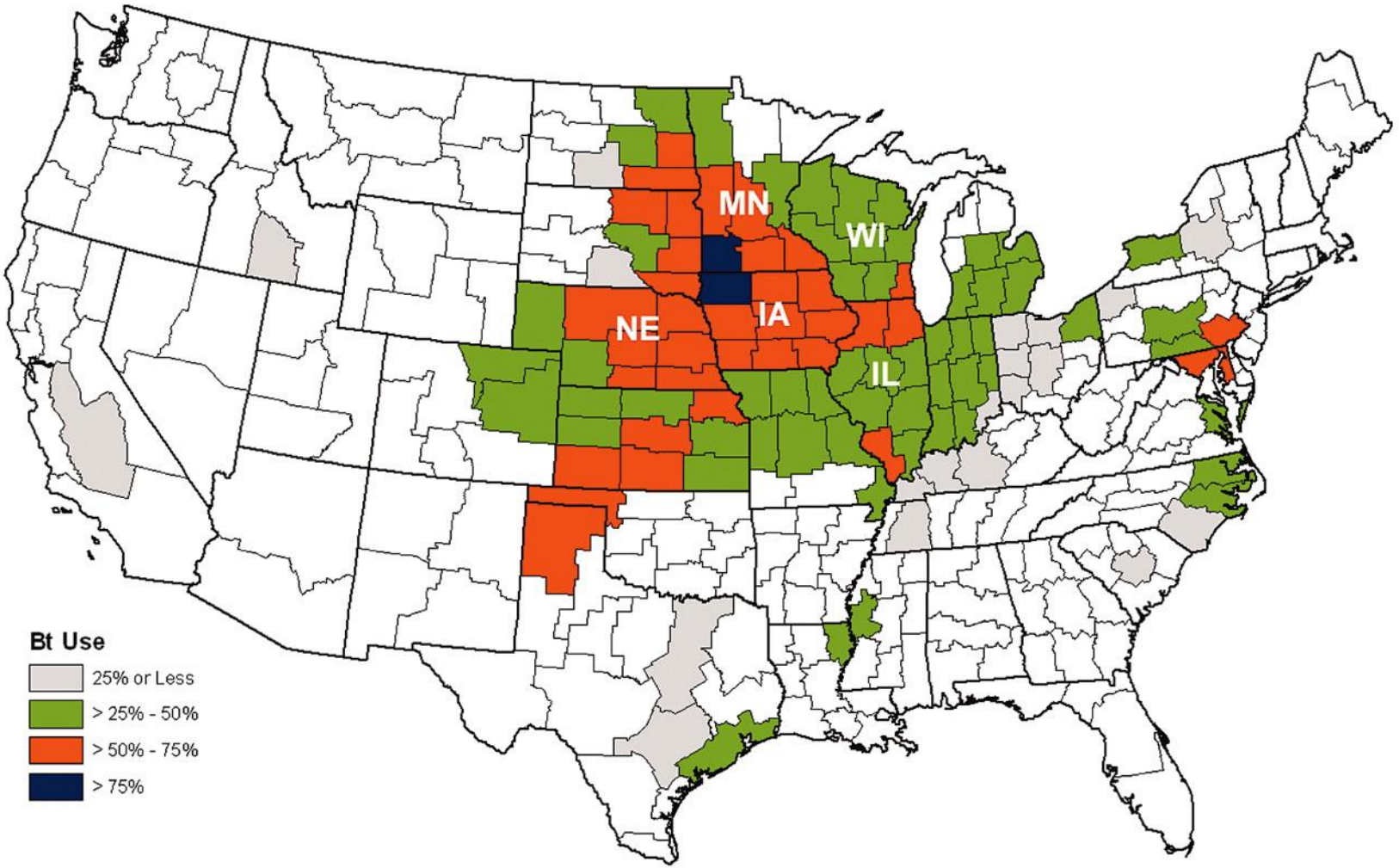


Relative location of fields sampled in 2019 for ECB (left) and those cooperator fields where Bt protection from corn borer was known to be absent (right).

Legend: White - no damage, Yellow – tunnels but no larvae, Red – tunnels and larvae both found

(E.C. Burkness, W.D. Hutchison, & B.D. Potter). ***Funding provided by MN Corn Research and Promotion Council***

Corn hybrid area, containing one or more Bt traits for ECB

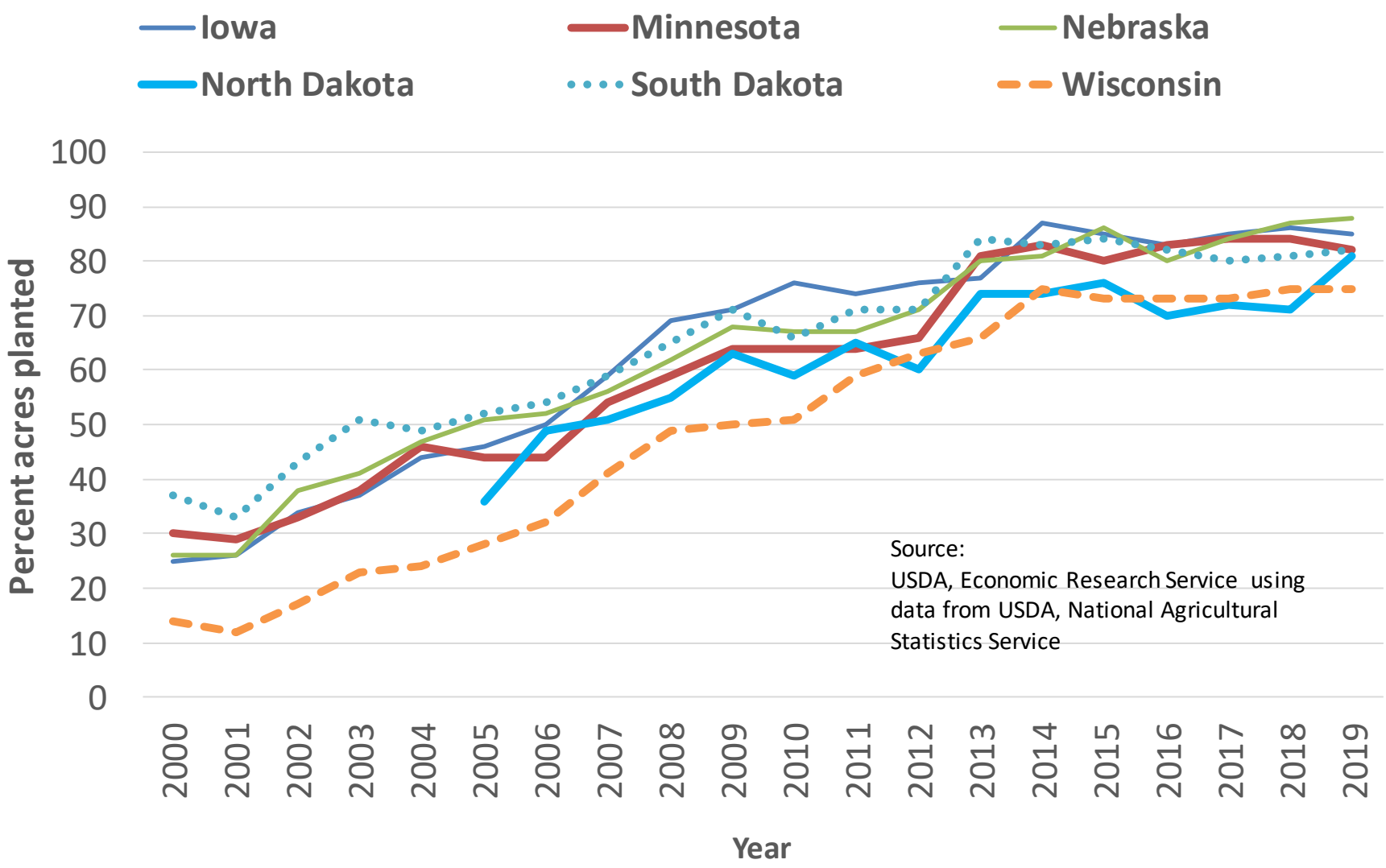


Hutchison et al. (2010) *Science* 330:222-
(Company Sales Data, as of 2006 field season), ABSTC

Science
AAAS

Published by AAAS

Percentage corn acres planted to all Bt hybrids by year and state



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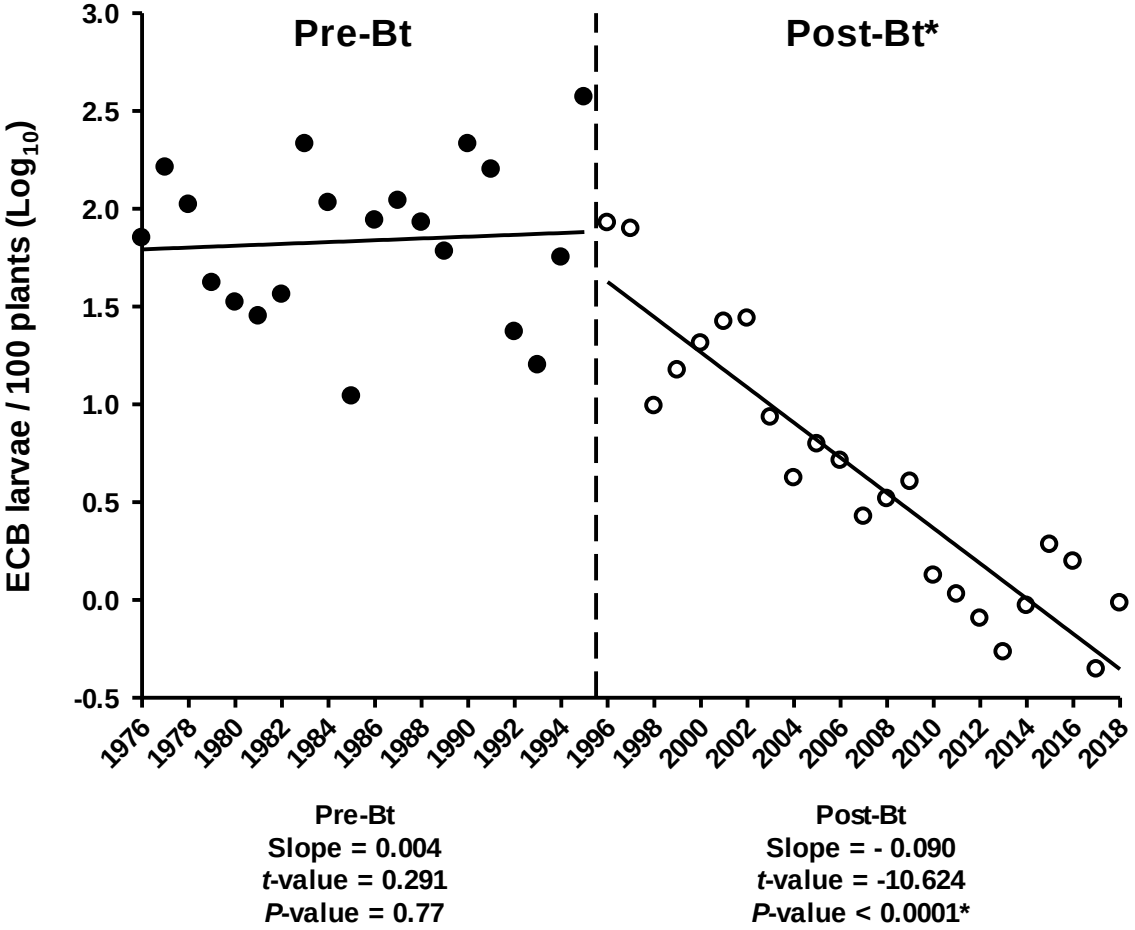
CORN BORER LARVAL DECLINE: MINNESOTA
PRE-BT MAIZE (20 YR), POST-BT (23 YR)
POST-BT DECLINE, SLOPE (-0.090)



Source: Hutchison, Burkness, Moon, Mitchell

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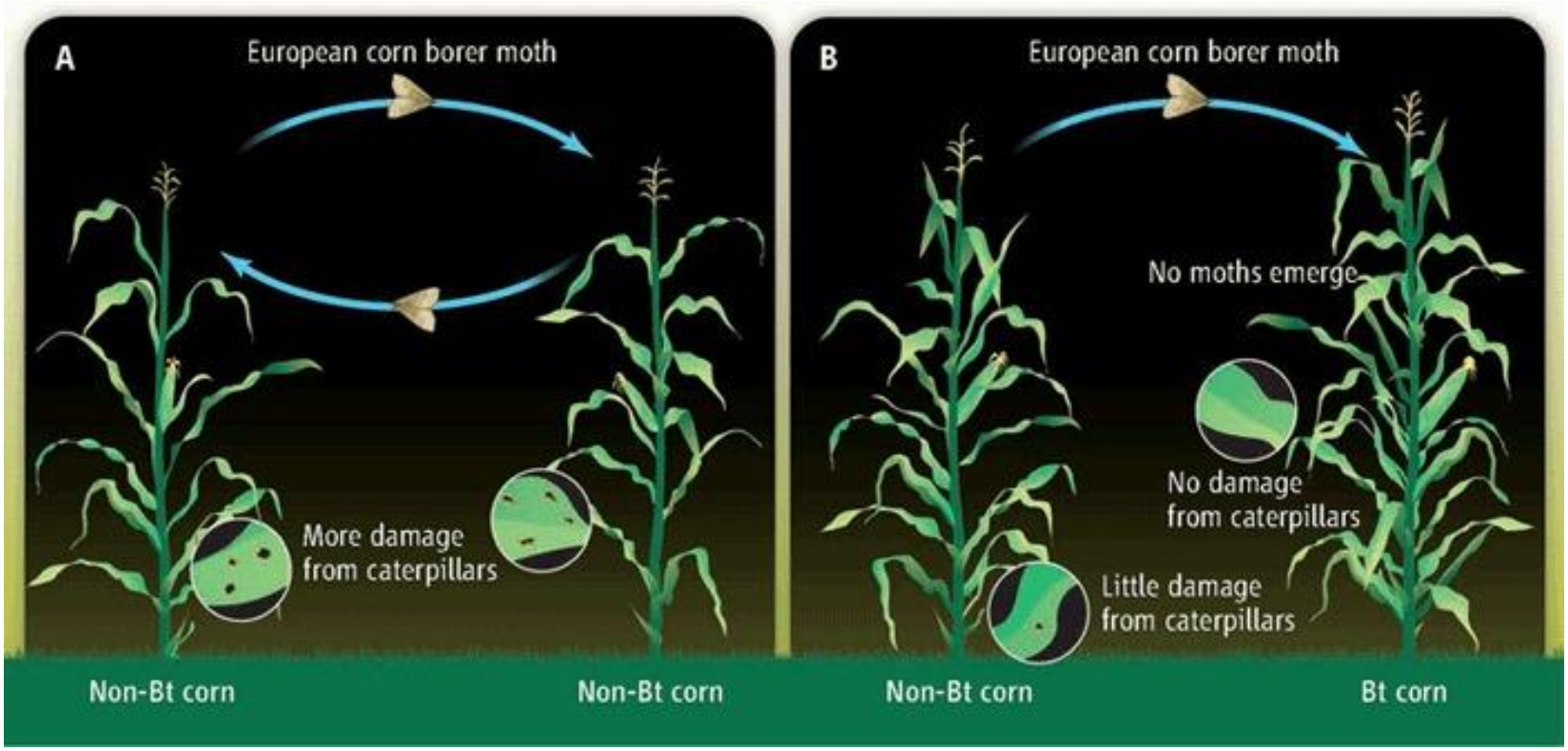
The Halo Effect: Why the Benefit to Non-Bt Corn Corn?

"Halo Effect" with ECB (& many insect species) occurs at different spatial scales. When moths emerge from a non-Bt field, mated females will randomly select Bt and Non-Bt plants to lay eggs. However, few larvae (or moths) will survive on Bt plants; when planted over a large area, the Non-Bt plants adjacent to Bt plants, will not likely be attacked by the pest

(i.e., Net Loss Moths Dispersing away from Non-Bt maize)



Bruce E. Tabashnik Science 2010;330:189-190

Published by AAAS

EUROPEAN CORN BORER: RISK & Bt

- Statewide, as a result of suppressive effects of Bt, ECB population are very low but they are not zero.
- Risk of economic problems increase over time when a high percentage of fields without an above-ground Bt trait planted.

EUROPEAN CORN BORER: RISK & Bt

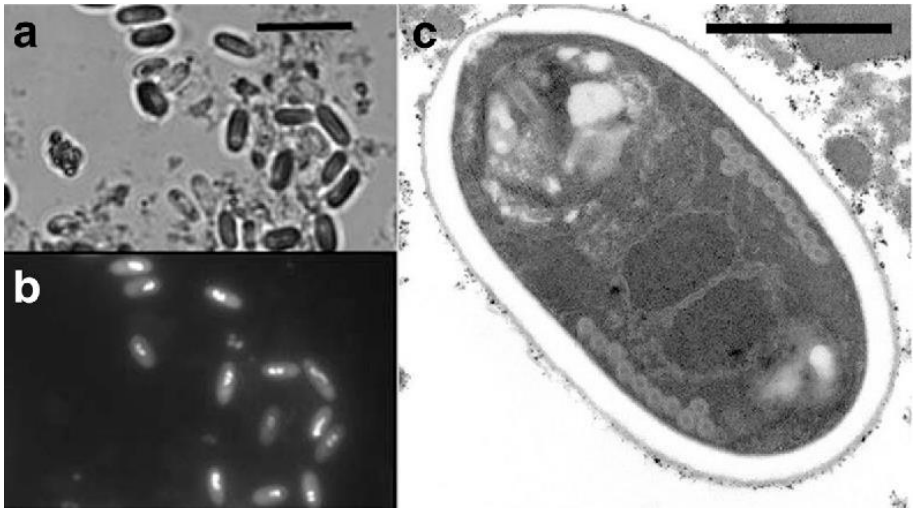
- Bt resistance not known in United States
- Bt resistant ECB reported in eastern Canada are *E*-strain, a different biotype than ours.
  - 2018 - Twenty moth MN sample all *Z*-strain

EUROPEAN CORN BORER: BIOLOGICAL CONTROL

***Nosema pyrausta*:**

- Single cell pathogen (microsporidian)
- Occurs throughout Europe, U.S.
- Transovarial (female-egg) & Horizontal (larva-larva)
- At ***ultra-low host densities = mostly transovarial transmission***

Nosema is still a factor at low 2018 MN ECB populations. Infections: Larvae (2/10), Adult F (10/10), Adult M(4/10)



Source: Hutchison, Burkness, Moon, Mitchell

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EUROPEAN CORN BORER and Bt : SUMMARY

- ECB suppression and associated economic benefits continue

- Bt corn is compatible with biological control, crop rotation, native host plant resistance traits (tolerance)

- ECB population cannot go much lower with current *Bt use (>80% Bt = <0.005/plant)*
- ECB rebound depends on rate of Non-Bt use?
  - ✓ Tracking this in parts of MN where *"substantial non-Bt"* occurs.
  - In NW Minn., with current Non-Bt use, model projection is 2-3 yrs could > 0.5/plant ($EIL)

EUROPEAN CORN BORER: LIFE CYCLE

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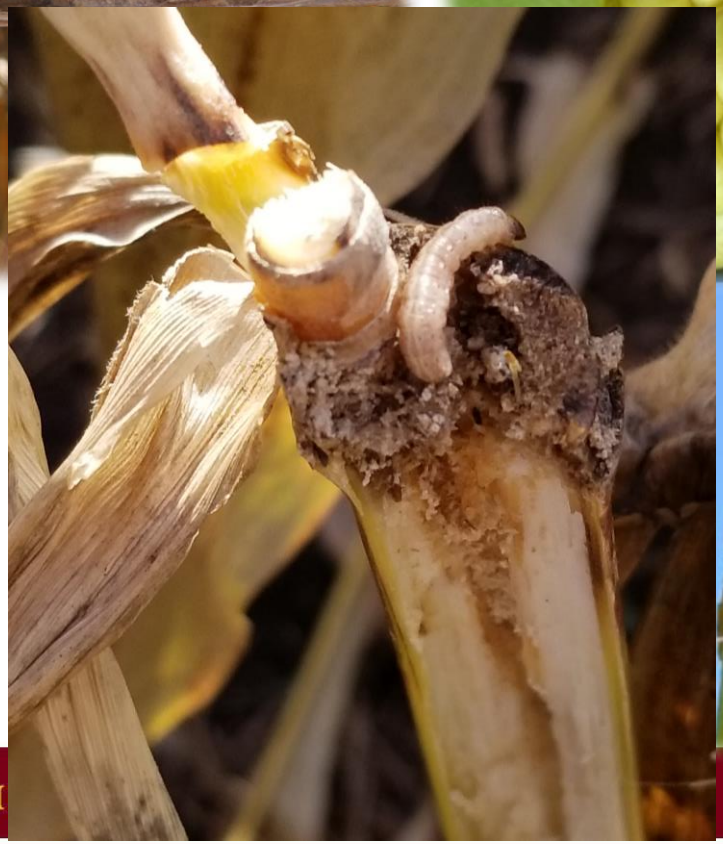
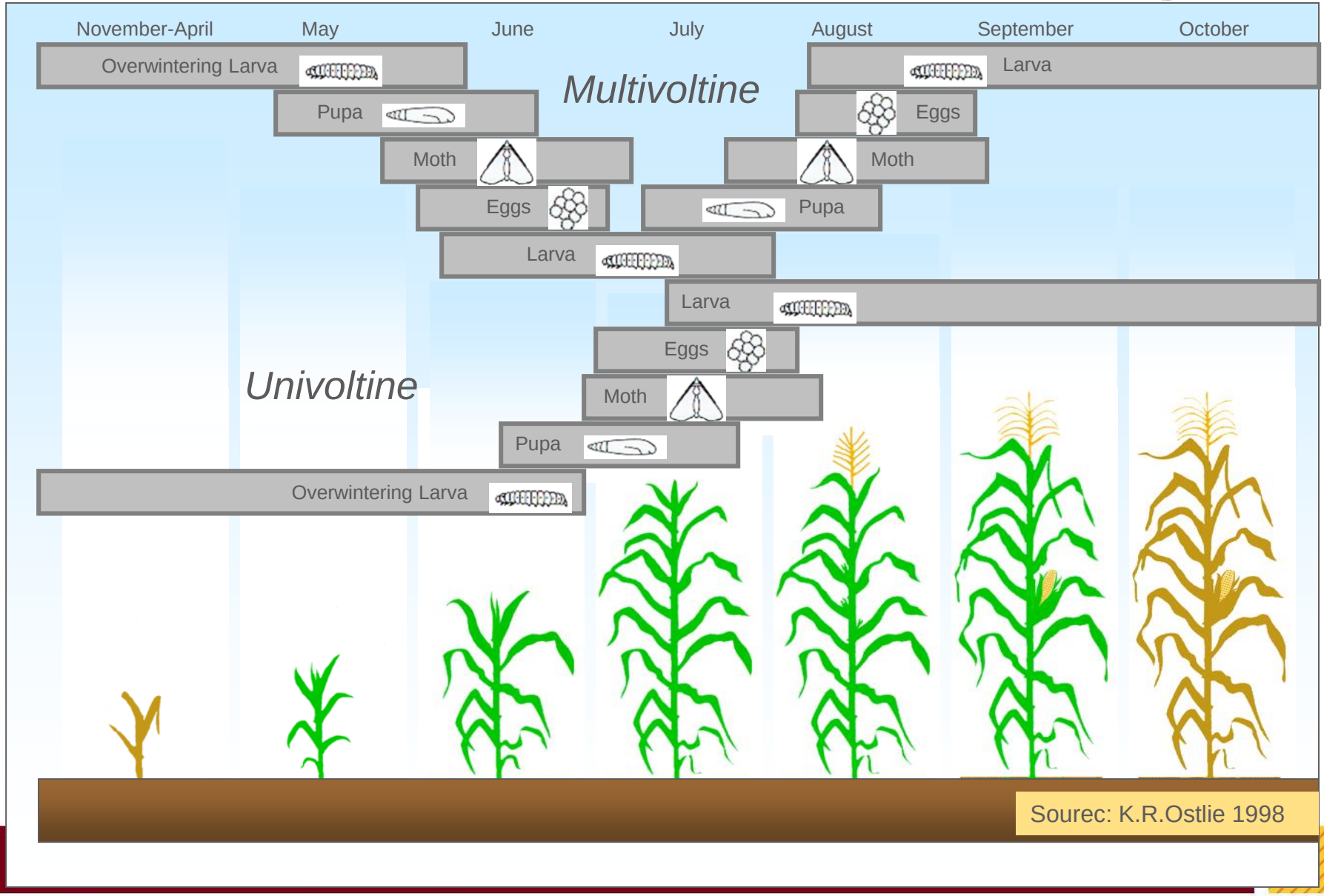
Photo: Jan Samanek, Phytosanitary Administration, Bugwood.org

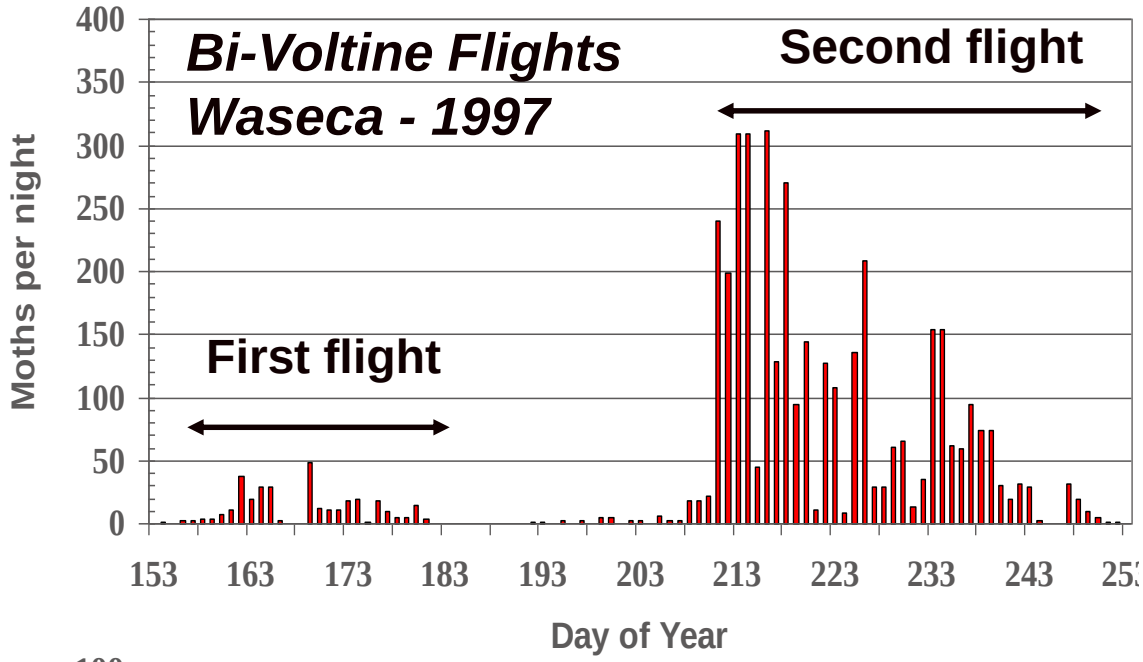


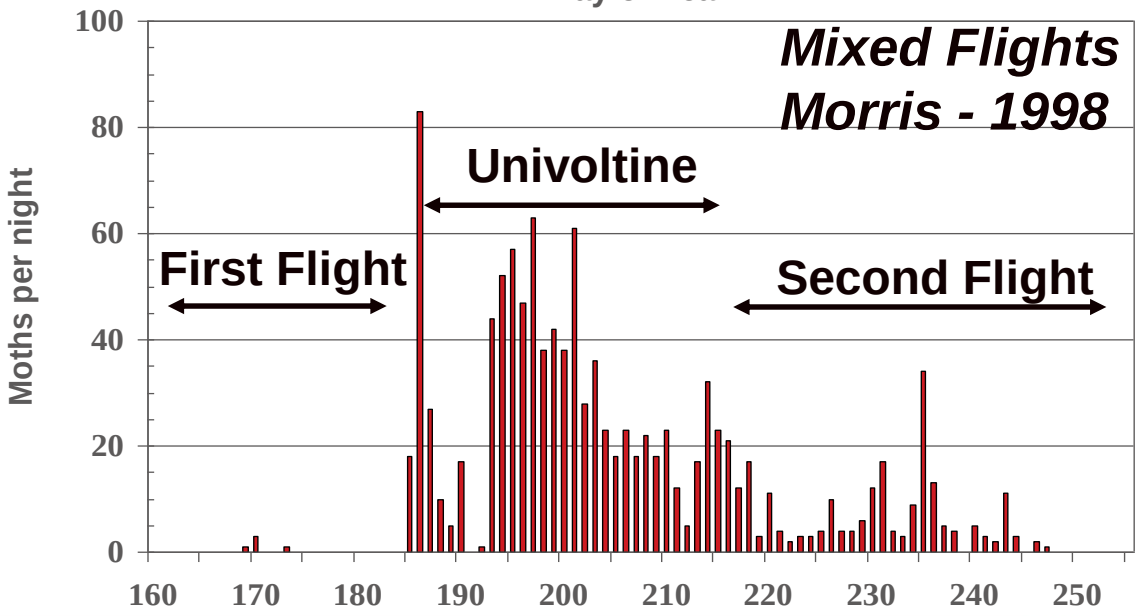
EUROPEAN CORN BORER: LIFE CYCLE



Sourec: K.R.Ostlie 1998

Corn Borer Flights in MN



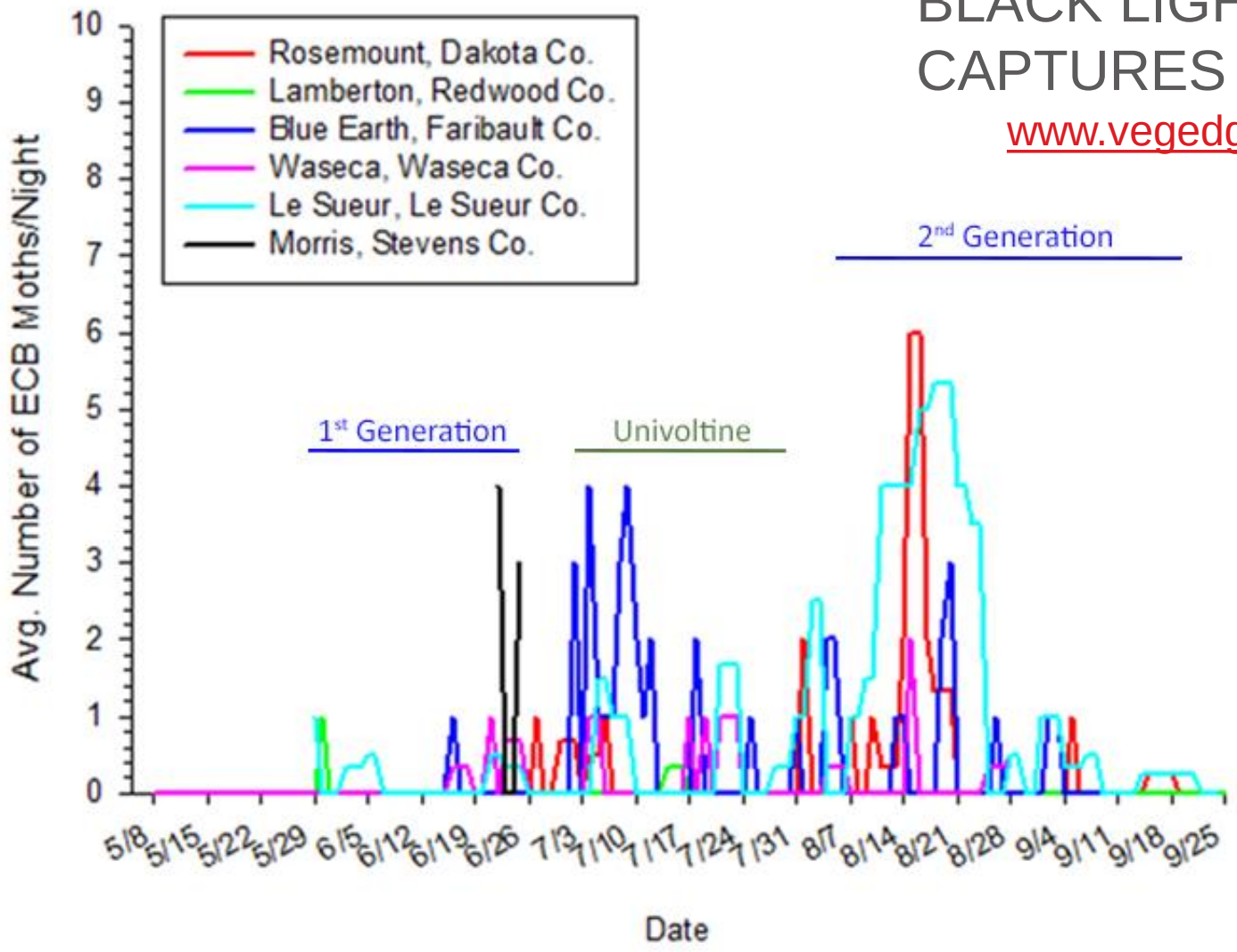


Source: K.R.Ostlie 1998

EUROPEAN CORN BORER: SCOUTING

BLACK LIGHT TRAP CAPTURES (2018)

www.vegedge.umn.edu



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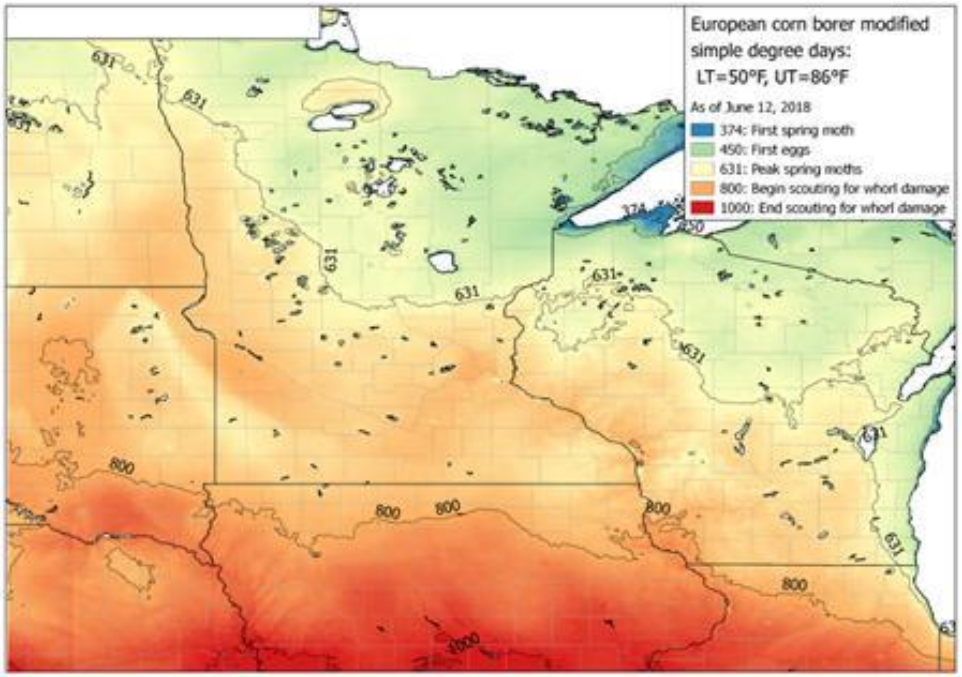
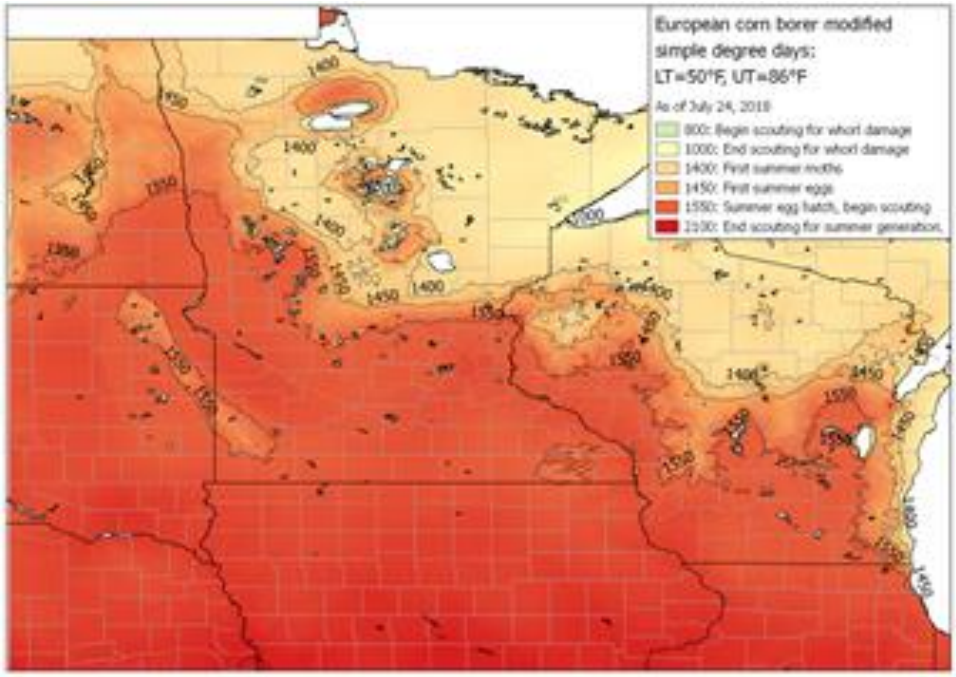
EUROPEAN CORN BORER: SCOUTING

1st Generation

2nd Generation





2018 Hanson and Hutchison U of M, Entomology

Source: https://www.vegedge.umn.edu/mndd

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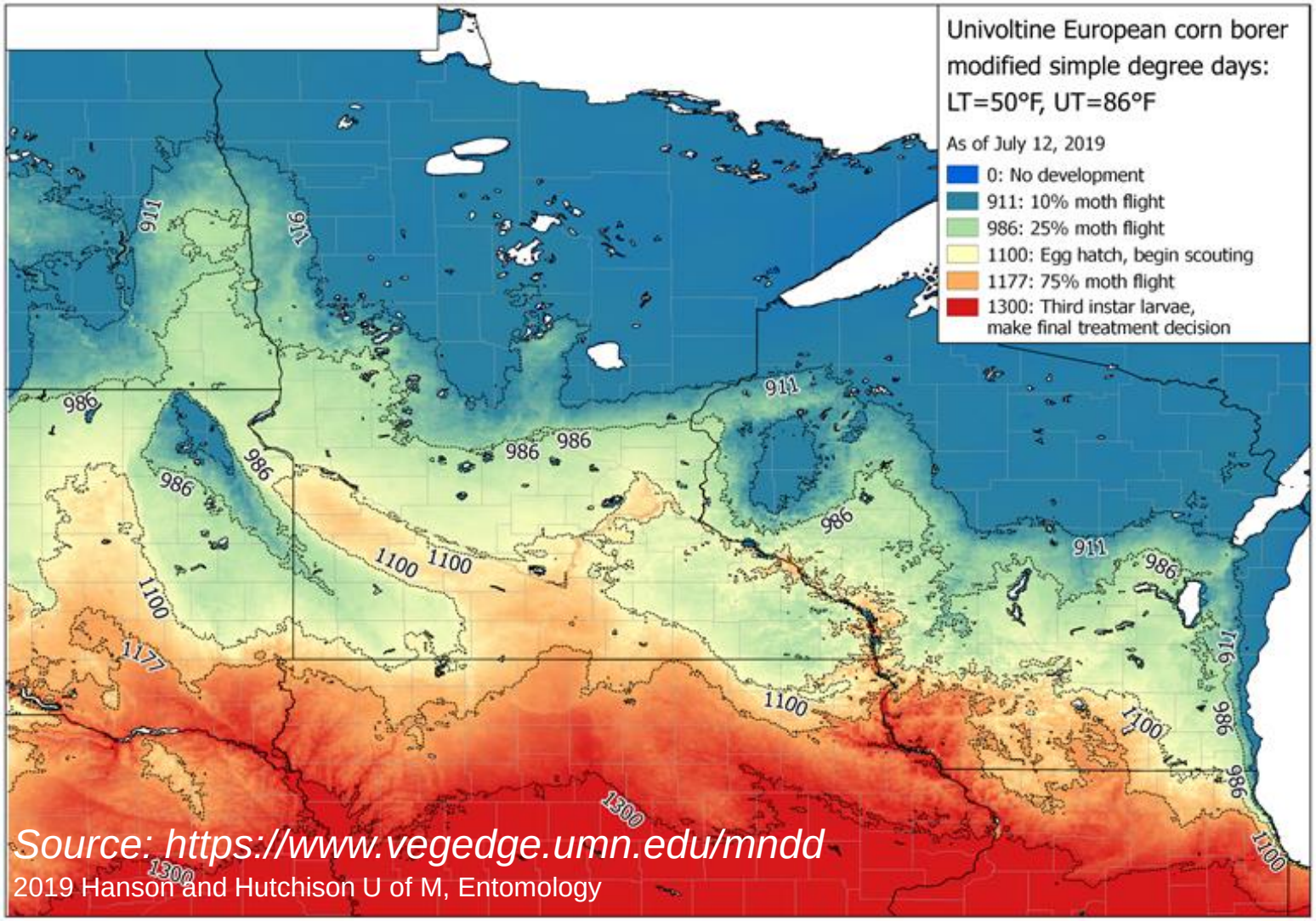
EUROPEAN CORN BORER: SCOUTING



Source: https://www.vegedge.umn.edu/mndd

2019 Hanson and Hutchison U of M, Entomology

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EUROPEAN CORN BORER: MANAGEMENT

- Investment in scouting
- Larvae susceptible to insecticides for 10-14 days during each generation.
  - Time scouting well!
- Control declines as later generations infest lower in canopy
  - 80%+ (1st generation)
  - 75% (univoltine)
  - 50 -70% (2nd generation)
  - Bt traits (>99.5%).

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ECB Scouting Guide	Multivoltine biotype		Univoltine biotype
	1st generation	2nd Generation	
When	Late May - Early June	Mid-late August	Late July- Early August
Action sites	Grassy areas	Grassy corn /Soybean	Grass/Soybean
Corn stage	Early-planted	Late-planted	Pre tassel - Pollinating
Where	Whorl (> 17 " extended leaf) 6	Ear +/- 3 leaves	Ear shoot - tassel
What	shot holing / larvae	egg masses	larvae / egg masses
% Loss / borer / plant*	5.5 - 6.0 (early whorl) 4.4 - 5.0 (late whorl)	4.4 (pollen shed) 3.0 (post pollination)	6.0 - 6.5 (pretassel) 4.4 (pollen shed)
Insecticide % Control	80	50 (50-70)	75
DDs First moths**	374	1400	< 911
DDs Start scouting**	800	1550	1100
DDs Stop scouting**	1000	2100	1300

* Physiogical loss is variable and may not include indirect losses and disease

** base 50F from March. Using a 1st moth capture biofix will be more acccurate.

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EUROPEAN CORN BORER: MANAGEMENT

ECONOMIC THRESHOLD

$$= \frac{\text{Control Costs}}{\text{(Corn Price X Yield X Loss/Borer X Survival X Insecticide Efficacy)}} \text{ X Return}$$

$$= \frac{\text{Control Costs}}{\text{Preventable loss / borer}} \text{ X Return}$$

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EUROPEAN CORN BORER: MANAGEMENT

Dynamic economic threshold forECB in post-tassel stage corn (example)

1	34	egg masses found*	÷	0.91	correction[1] factor	=	37.36	adjusted[1] egg masses
2	37.36	adjusted egg masses	÷	50	plants examined	=	0.75	egg masses/plant
3	0.75	egg masses / plant	*	3.0	larvae/egg mass[2]	=	2.24	larvae/plant
4	2.24	larvae/plant	*	0.03	percent loss/larva[3]	=	0.067	percent loss
3	0.07	percent loss	*	200	expected yield (bushels/acre)	=	13.45	bushels loss/acre
4	13.45	bushels loss / acre	*	$3.70	expected price/bushel	=	$49.77	expected $ loss/acre
5	$49.77	expected $ loss / acre	*	0.60	percent control[4]	=	$29.86	preventable loss / acre
6	$29.86	preventable loss	-	$15.00	cost of control	=	**$14.86**	(profit /loss) / acre

In five parts of the field, carefully examine plants for egg masses on the ear leaf and 3 lvs. above and below

**Can total counts from previous visit to field.*

Use decimals to represent percentages, for example 1.0 = 100% , 0.50 = 50%, 0.03 = 3%

[1] *Correction factor to account for egg masses on parts of plant other than 7 leaves examined*

[2] *Assumption of 3 larvae from each egg mass survive. Can be none or as high as 4.5. See ISU for estimation based on days after start of flight sample taken.*

[3]Use 4% when pollinating, 3% post pollination

[4] *Typically 50-70 %*

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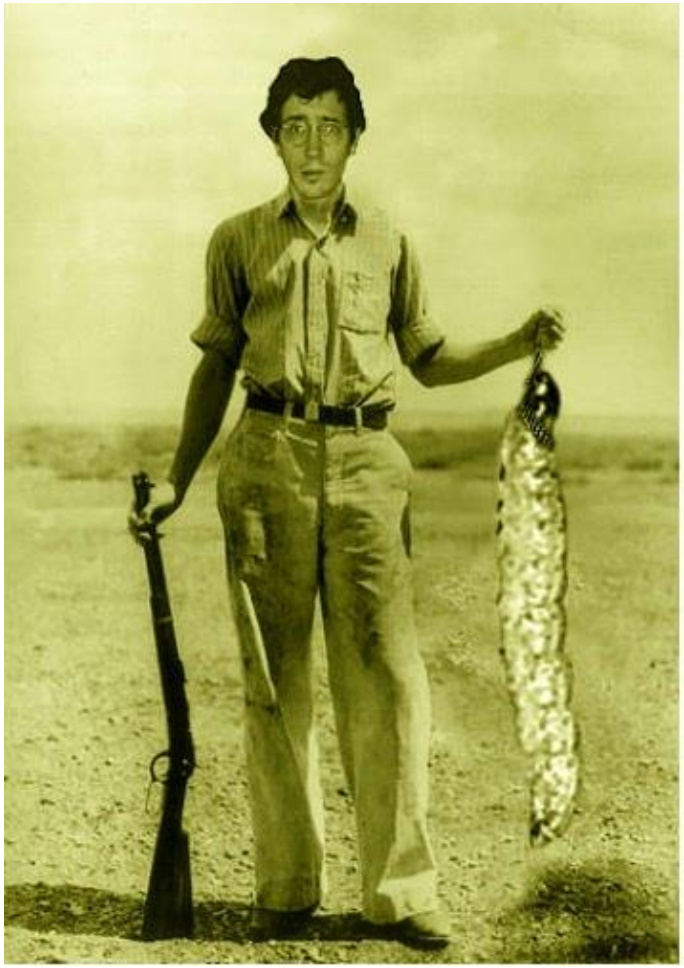
EUROPEAN CORN BORER MGMNT. SUMMARY

- Overall population low but …
- Know ***your*** problem
- Prioritize fields/farms based on history and crop stage
- Highest risk
  - History of corn borer or prolonged widespread non-Bt
  - Early or Late planted
- Primary risk is resistance!

EUROPEAN CORN BORER MGMNT. SUMMARY



Choose your weapons

- Remember economics
- Use knowledge of ECB biology for scouting and control efficiency
- Use moth captures, degree-days, scouting and thresholds to decide on insecticide use

New Corn Borer Publication

- # Thank you!

  Special thanks to :

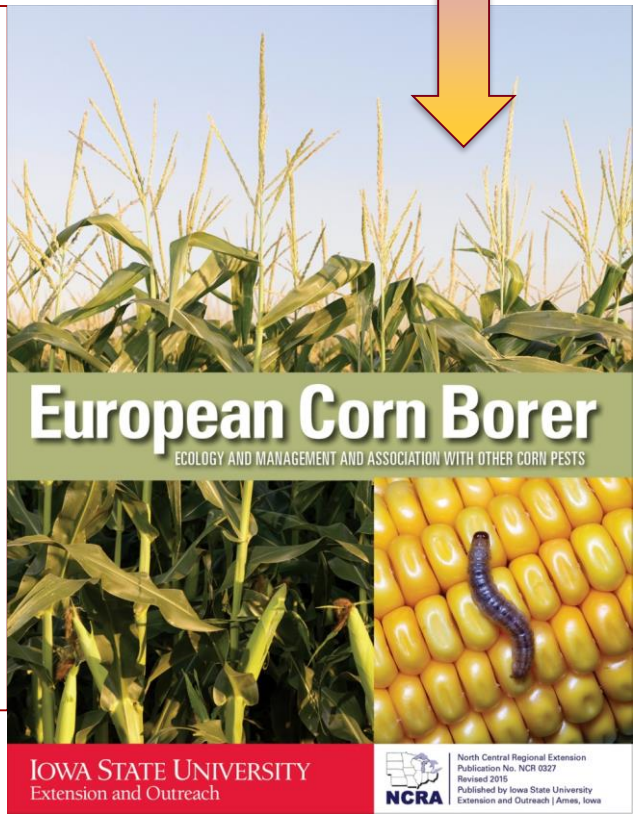
  MN Corn Research & Promotion Council

  MN farmers who allowed access to their fields

  Entomologists and others who initiated (1940s) and maintained ECB surveys

Questions?

bpotter@umn.edu



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