



Insect Management in Non-Bt Cornfields


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Outline for our discussion

- Personal introduction
 - Setting the context—Bt corn, non-Bt corn, and the insect pests
 - European corn borer biology and management
 - Western corn rootworm biology and management
 - Managing European corn borer in non-Bt corn
 - Managing western corn rootworm in non-Bt corn
 - Summary
- 




My background

- ▶ B.S. Entomology, Purdue University, 1972
M.S. Entomology, University of Missouri, 1975
Ph.D. Entomology, Iowa State University, 1979
 - ▶ Extension Entomologist, University of Illinois
1979–2009
 - ▶ Technology Transfer Leader, Insect Management
Dow AgroSciences, 2009–2016
 - ▶ Retired, June 2016–present time
- 




Rationale for inviting me to give this presentation

- ▶ My magnificent record of applied research and extension activities associated with corn insect management, 1979–2016
- ▶ or . . .
- ▶ Let's find some "old guy" who still has some dusty memories of insect management before the advent of Bt corn



Why Bt corn? The benefits

- Convenience...only need to plant seeds to control most of the major insect pests of corn
 - With insecticidal seed treatment to protect against soil insect pests
 - Effectiveness...essentially host plant resistance
 - Economic benefits
 - Less need for scouting (?), although not recommended
 - Reduced need for chemical insecticides, less environmental impact
- 



Issues associated with Bt corn... the limitations

- ▶ Inconvenience of planting non-Bt corn refuges (when not planting refuge-in-the-bag products)
 - ▶ Additional management requirements
- ▶ Segmentation of markets for some traits
- ▶ Development of insect populations resistant to Bt proteins, documented for...
 - ▶ Western corn rootworm
 - ▶ Fall armyworm



Why farmers may choose to grow non-Bt corn

- ▶ Popcorn
- ▶ Additional management planning for non-Bt corn refuges
- ▶ Price of Bt corn compared with non-Bt corn
- ▶ Anti-"GMO" benefits
 - ▶ Don't like the idea of GMOs
 - ▶ Elevators that won't accept corn with certain Bt traits
- ▶ Premium for non-Bt corn
- ▶ Lack of insect pressure over the past few years
- ▶ Insect resistance to Bt corn

The two primary culprits



Both photos courtesy of Marlin Rice
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And let's not forget the other culprits that are targets of Bt corn



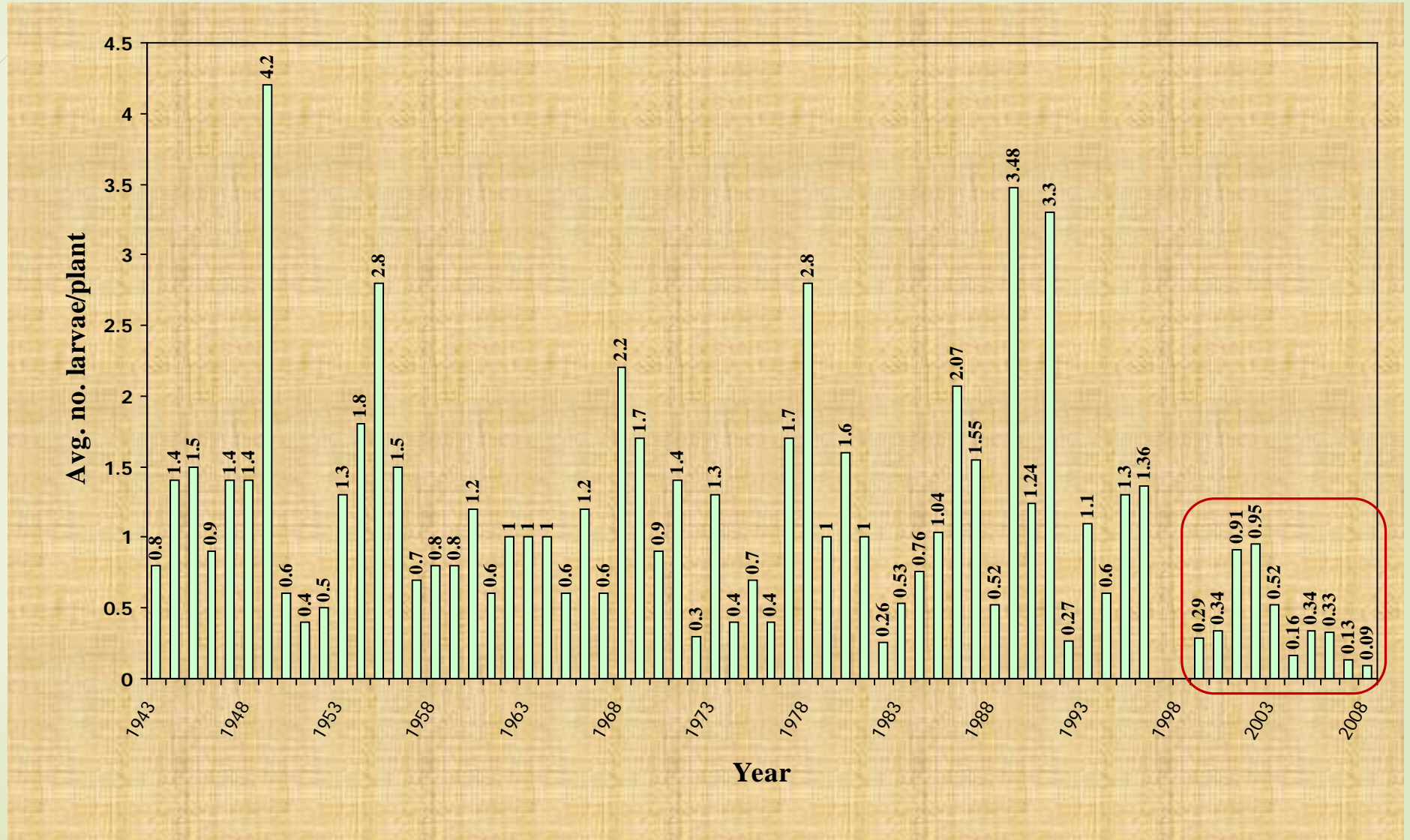
European corn borer



- ▶ 2 generations per year in most of the Midwest
- ▶ Pre-Bt corn: \$1 billion annually
- ▶ Smaller larvae feed outside stalk, larger larvae tunnel in stalks, ears
- ▶ Overwinters as larvae in stalks
- ▶ Host range >200 species
 - ▶ Many common weeds
 - ▶ Many crops, including vegetables

Annual European corn borer survey

University of Illinois





Areawide Suppression of European Corn Borer with Bt Maize Reaps Savings to Non-Bt Maize Growers (Hutchison et al., *Science* 330: 222-225)

- Data from Illinois, Minnesota, Wisconsin, Iowa, and Nebraska
- Cumulative benefits (IL, MN, WI)—\$3.2 billion
 - \$2.4 billion of this total accruing to non-Bt maize growers
- Cumulative benefits (IA, NE)—\$3.6 billion
 - \$1.9 billion of this total accruing to non-Bt maize growers

Management of European corn borer before Bt corn

- Plowing under corn residues, shredding stalks
- Growing European corn borer-tolerant hybrids
- Monitoring moth flights, scouting for injury, larvae, egg masses
- Applying insecticides when injury, or numbers of larvae or egg masses exceed published economic thresholds
 - "Benign neglect"



Western corn rootworm




- One generation per year
- “Billion-dollar” insect pest
 - Mostly larvae feeding on roots
 - Adults may interfere with pollination
- Overwinters as eggs in soil
- Limited host range for larvae
 - Corn, some grasses

Management of western corn rootworm before Bt corn


- Annual rotation of corn and non-host crop, primarily soybean
 - Before the “variant” western corn rootworm
- Widespread use of soil insecticides, primarily applied during planting to prevent larval injury
- Scouting for adults
 - Silk-clipping injury
 - To make a decision about next year
- Application of insecticides to control adults





Corn rootworm management issues over the years

- Resistance to cyclodiene insecticides (e.g., aldrin, dieldrin)
- Resistance to aerially applied insecticides—methyl parathion, carbaryl, pyrethroids
- Lack of performance of soil insecticides
 - Applied too early
 - Environmental conditions
 - Enhanced microbial degradation
- Resistance to annual corn/soybean rotation
 - “Variant” western corn rootworm that lays eggs in soybean
 - Northern corn rootworm that undergoes extended diapause
- Resistance to Bt proteins



Managing European corn borer in non-Bt corn

- Stalk destruction—shredding, plowing?
- European corn borer-tolerant hybrids?
- Early planting? Early harvest?
- Scouting! And more scouting!
 - Adults (moths)
 - First-generation whorl-feeding injury
 - Eggs for second generation
- Application of insecticides before larvae enter stalks

Monitoring for European corn borer adults (moths)

- ▶ Blacklight traps
- ▶ Pheromone traps in action sites
- ▶ “Windshield splatter” technique



Scouting for European corn borer larvae in non-Bt corn

- Scout for whorl-feeding injury by 1st-generation larvae
- Scout for egg masses for second generation





Managing corn rootworms in non-Bt corn

- Crop rotation, in areas where the “variant” western corn rootworm does not occur
- Scouting!
 - Scout for larvae?
 - Scout for adults in corn weekly, pollination through August
 - Monitor for adults in soybean with yellow sticky traps
- Based on published thresholds...
 - Do nothing
 - Apply a soil insecticide to prevent root injury by larvae
- Apply a foliar insecticide to control adults
 - Protect pollination
 - Reduce egg laying

Scouting for western corn rootworm in non-Bt corn

- Damage to root systems
- Whole-plant counts in corn
- Yellow sticky traps in soybean





Summary



- ▶ Although both European corn borer and western corn rootworm are controlled effectively by Bt corn in most areas...
- ▶ Some farmers are opting to plant non-Bt corn
- ▶ Managing European corn borer and western corn rootworm in non-Bt corn is **BACK TO BASICS!**



Thank you very much!
Questions? Comments?

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