Insect Pests of Corn in North Dakota

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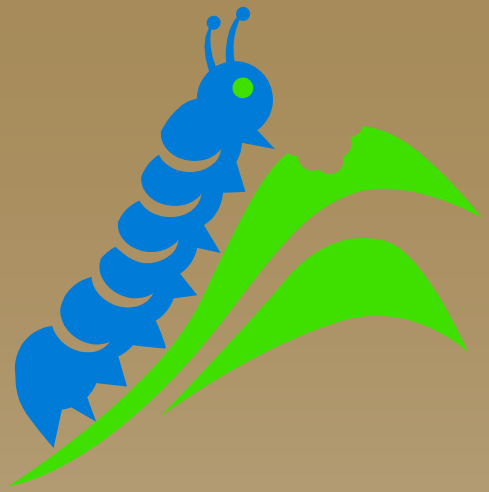
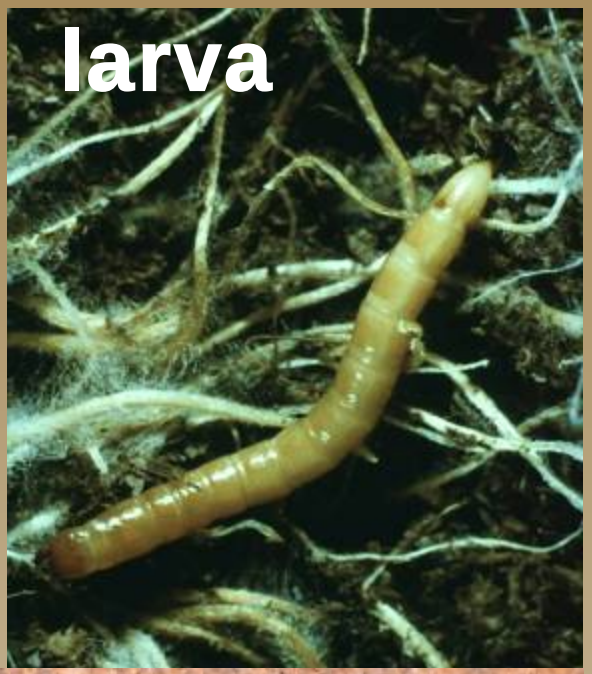
Insect Pests



- Corn
  - Wireworms
  - White grubs
  - Cutworms
  - European corn borer
  - Corn rootworm

Wireworm in corn



Thresholds

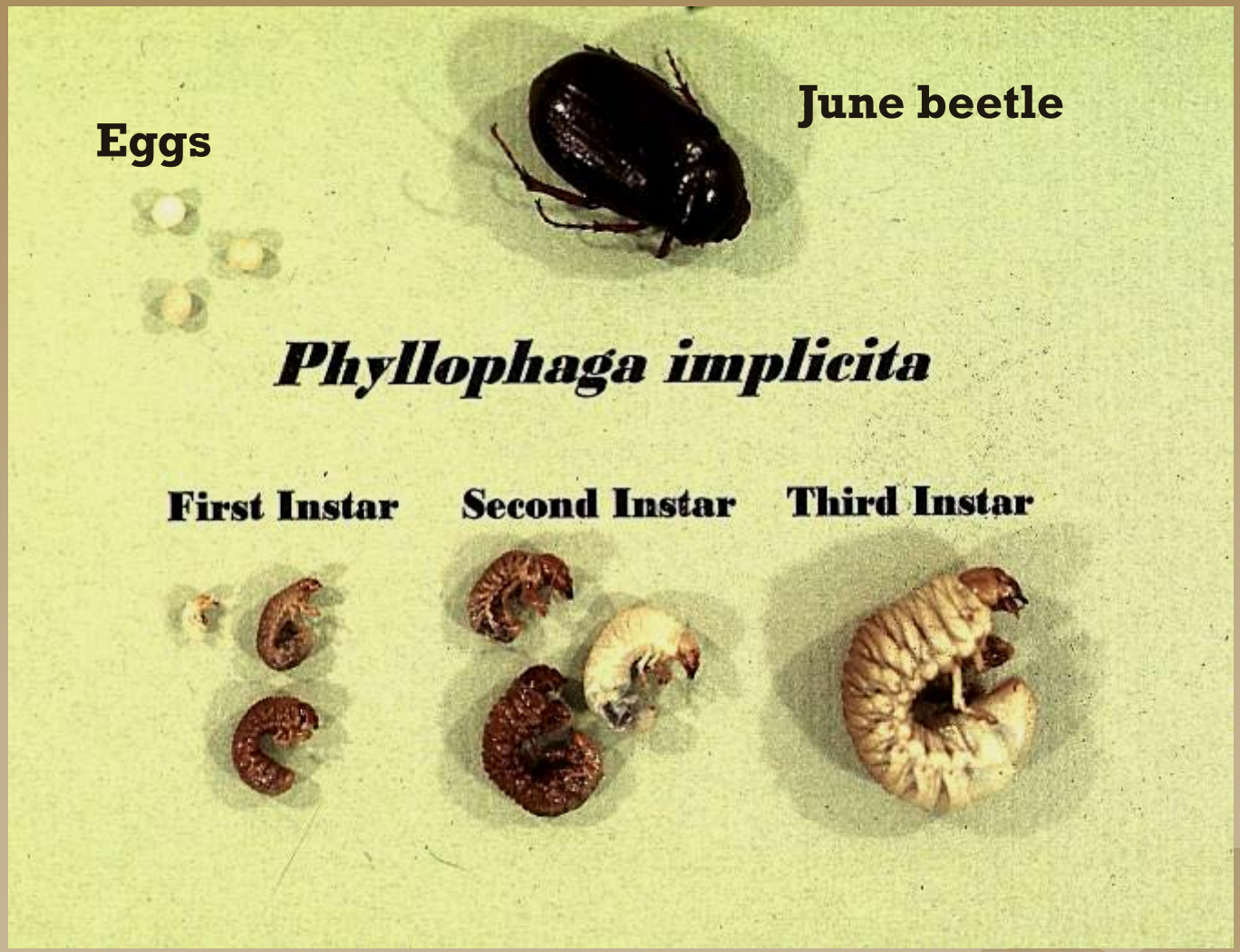
Soil Samples - 1 wireworm / sample

Bait Stations - 1 or more wireworm / station

Insecticides Options for Wireworm Control

- **Insecticide-coated Seed Treatment**
  - Commercially applied
  - Cruiser 5FS & Poncho 1250
- **Liquid Soil Insecticide**
  - T-band or In-furrow application
  - Capture LFR (Liquid Fertilizer Ready)
  - Lorsban 4E, Capture 2EC, Proaxis
- **Granular Soil Insecticide**
  - T-band or In-furrow application
  - Force 1.5 G, Fortress 2.5G, Lorsban 15G, Aztec2.1.G, Counter 15G
- **http://www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm**

Life stages of Phyllophaga spp.

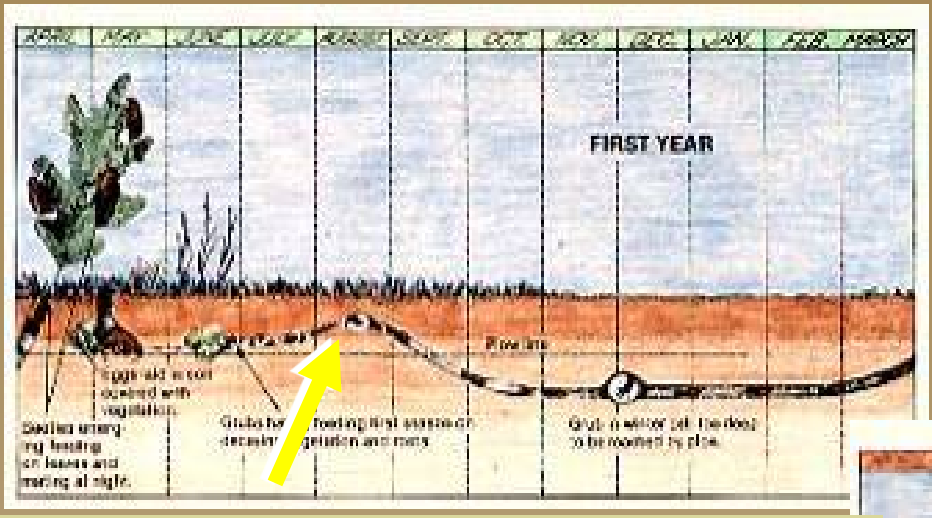


June beetles fly to trees and feed

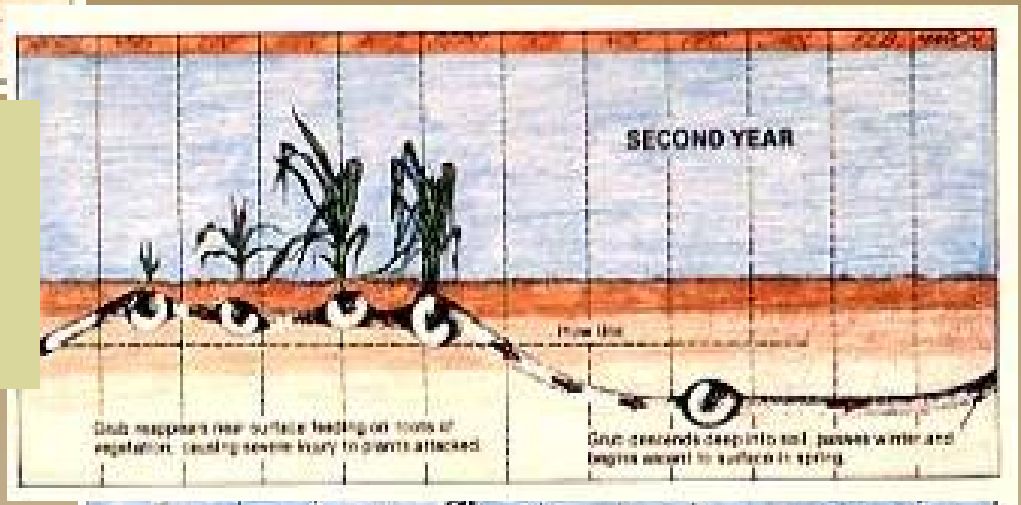
After mating, females return to fields to lay eggs

Eggs hatch in 30 days and grubs begin feeding on organic material, then roots

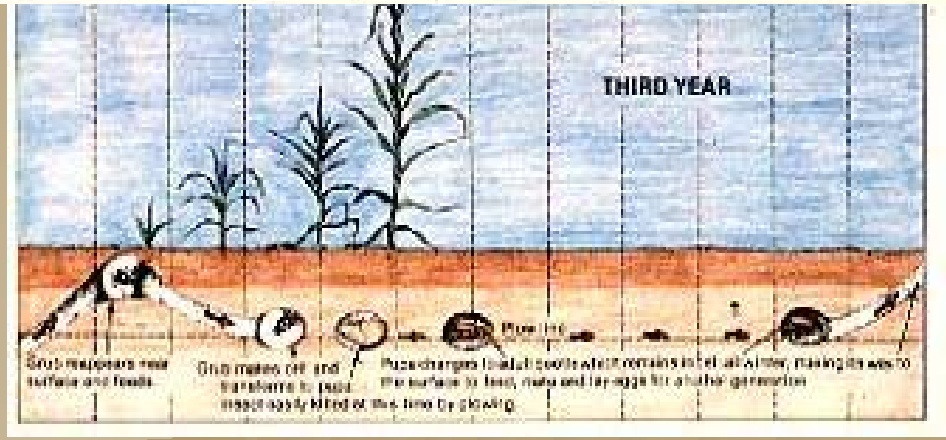
Three year Life Cycle of White grubs, *Phyllophaga* spp.



Sample in September to determine the need to treat in spring.



Year 2 is the time when most grub injury occurs and control needed.



Insecticides Options for White Grub Control

- **Insecticide-coated Seed Treatment**
  - Commercially applied
  - Suppression only
  - Cruiser 5FS & Poncho 1250
- **Liquid Soil Insecticide**
  - T-band or In-furrow application
  - Capture LFR (Liquid Fertilizer Ready)
  - Lorsban 4E, Capture 2EC
- **Granular Soil Insecticide**
  - T-band or In-furrow application
  - Fortress 2.5G, Lorsban 15G, Aztec2.1.G, Counter 15G
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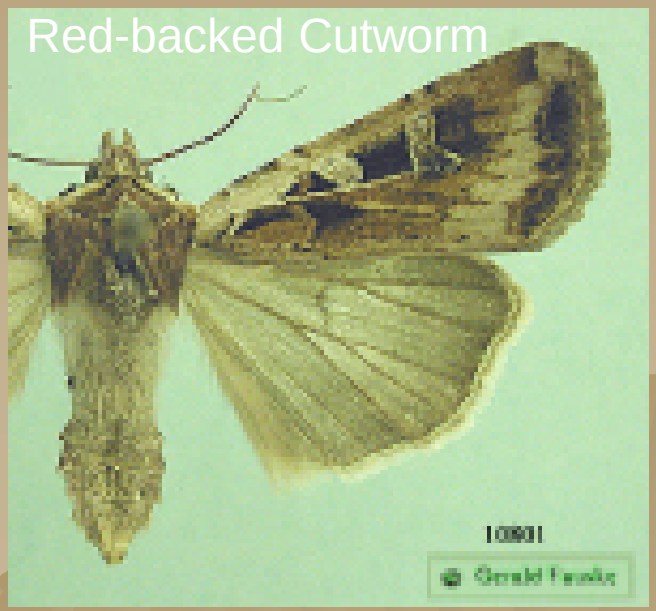
Cutworm Adult Description

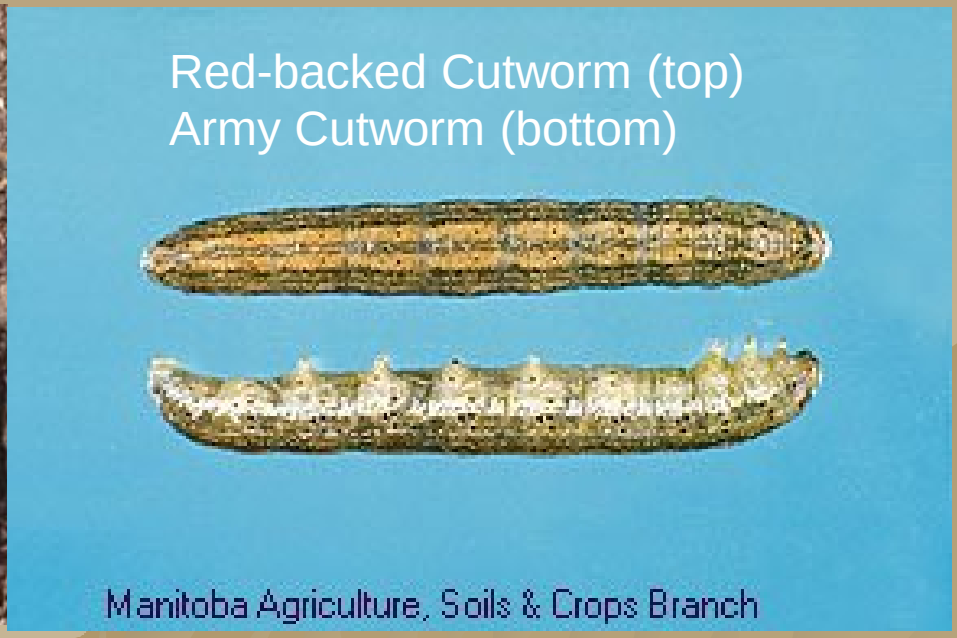
- **Adult (Family Noctuidae)**
  - **Very robust**
  - **Brown or black moths showing various spots or stripes in shades of gray, brown, black or white.**



Cutworm Larval Description

- **Larvae**
  - **stout, smooth, soft-bodied, plump caterpillars**
  - **Brown to tan to pink, green or gray and black**

Army Cutworm



Life Cycle of Cutworm

One generation per year

Overwinter as partial mature larvae or eggs

Crop Injury

- Larvae = Chewing mouthparts
- Destroy more of plant than eat
- Injury plants in 4 major ways:
  - Solitary surface cutworms
    - Black, Bronzed, Clay-backed, Dingy cutworms
  - Climbing species
    - Variegated, spotted, W-marked cutworms
  - Subterranean species
    - Pale western and glassy cutworms
  - “Marching” in great numbers
    - Army cutworms

Typical plant cutting by older cutworm larvae

Cutworm eating into corn stalk from below ground

Insecticides Options for Cutworm Control

- **Scout when corn is up to mid-June**
- **Economic Threshold = 3-6% of the plants are cut and small larvae < ¾ inch are present.**
- **Foliar applied Insecticide**
  - **Application rates of 15 to 20 gallons of water per acre by ground application is suggested**
  - **Capture LFR (Liquid Fertilizer Ready)**
  - **Lorsban 4E, Capture 2EC, Asana, Baythroid XL, Delta Gold, Mustang Max, Warrior, …**
- **Insecticide-coated Seed Treatment**
  - **Commercially applied**
  - **Suppression only**
  - **Cruiser 5FS & Poncho 1250**
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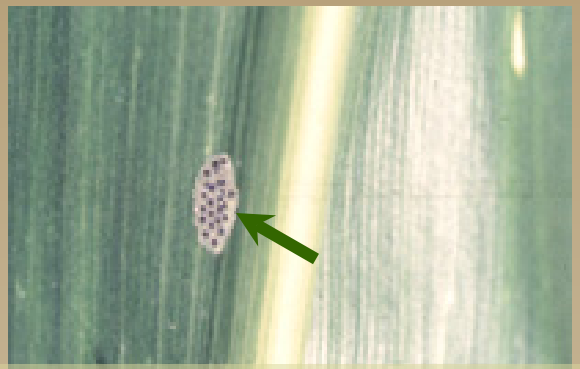
European Corn Borer

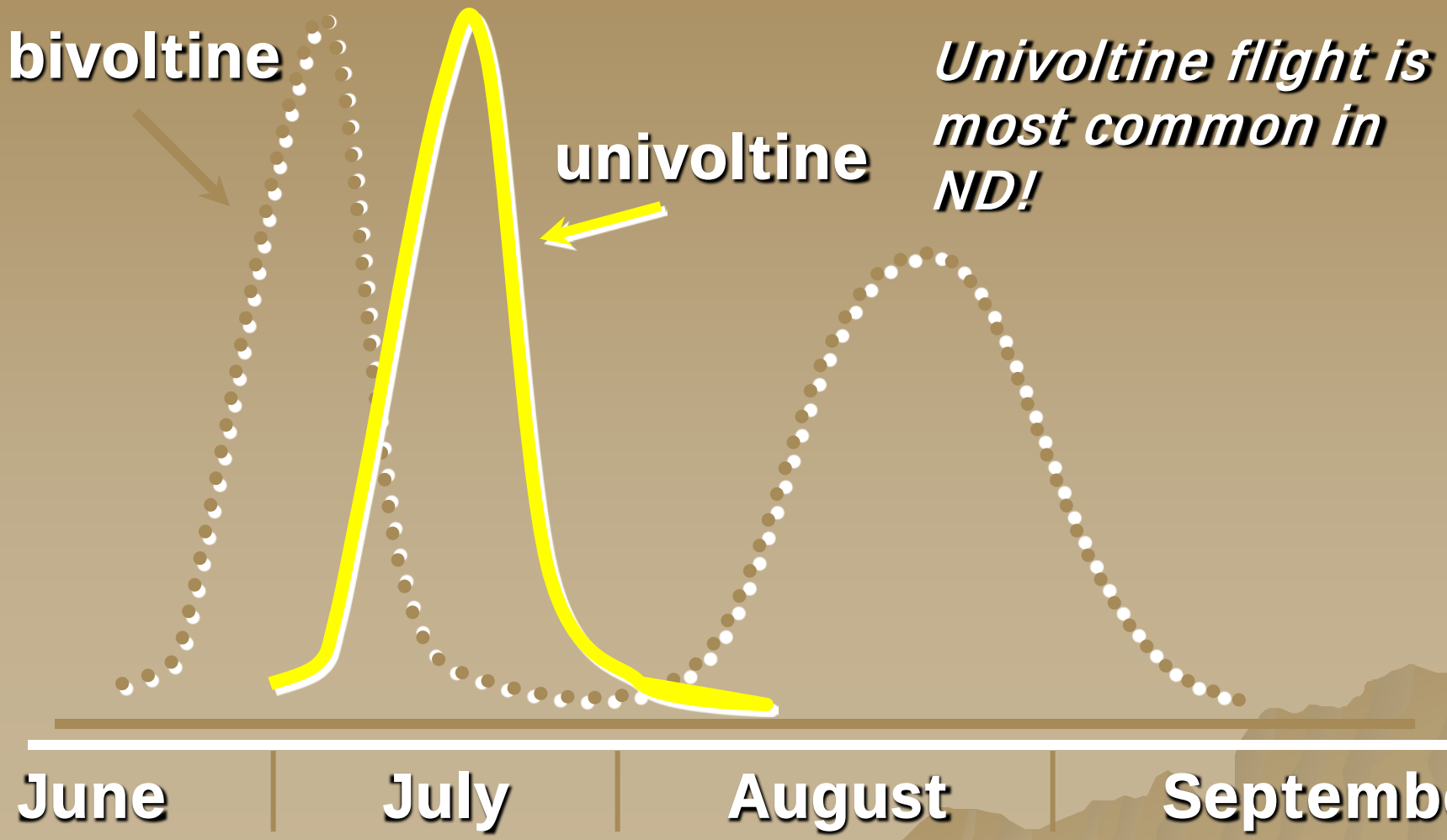
Female moth

Newly laid egg mass



Egg mass at “black-head “ stage

Typical Occurrence of European Corn Borer Moth Flights in ND




“Shot-hole” feeding injury of corn borer larvae

European Corn Borer

Economic Threshold (Corn borer/plant) when factoring Crop Value and Control Costs

Control Costs[2] ($/acre)	Value of Corn Crop[1] ($/acre)							
	200	250	300	350	400	450	500	550
7	0.88	0.70	0.58	0.50	0.44	0.39	0.35	0.32
8	1.00	0.80	0.67	0.57	0.50	0.45	0.40	0.37
9	1.12	0.90	0.75	0.64	0.56	0.50	0.45	0.41
10	1.25	1.00	0.83	0.71	0.63	0.56	0.50	0.46
11	1.38	1.10	0.92	0.79	0.69	0.61	0.55	0.50
12	1.50	1.20	1.00	0.86	0.75	0.67	0.60	0.55
13	1.63	1.30	1.08	0.93	0.81	0.72	0.65	0.59
14	1.75	1.40	1.17	1.00	0.88	0.78	0.70	0.64
15	1.88	1.50	1.25	1.07	0.94	0.84	0.75	0.68

[1] *Crop value = expected yield (bu/acre) X projected price ($/bu)*

[2] *Control costs = insecticide price ($/acre) + application costs ($/acre)*

Insecticides Options for ECB Control

- **Economic Threshold = will vary, depending on expected yield and cost of control. In North Dakota, the treatment threshold can range from 0.75 to 1.5 corn borers per stalk.**
- **Use worksheets to establish treatment guidelines in ND Field Crops Insect Guide.**
- **Foliar applied Insecticide**
  - **Application rates of 15 to 20 gallons of water per acre by ground application is suggested**
  - **Capture LFR (Liquid Fertilizer Ready)**
  - **Lorsban 4E, Capture 2EC, Asana, Baythroid XL, Delta Gold, Mustang Max, Proaxis, Warrior, Carbaryl, …**

- **http://www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm**

Focus on the Bt corns

- **Provides effective, consistent control that is better than insecticides;**
- **Control may cost less and have fewer concerns regarding health, environment, and management planning;**
- **HOWEVER . . . Season long expression of control is expected to produce selection pressure for Bt resistance corn borers**

The Refuge Plan . . .

20% of the corn on a farm planted to non-Bt corn.

- ***within 1/4 mile of Bt***
- ***no Bt treatment to site***

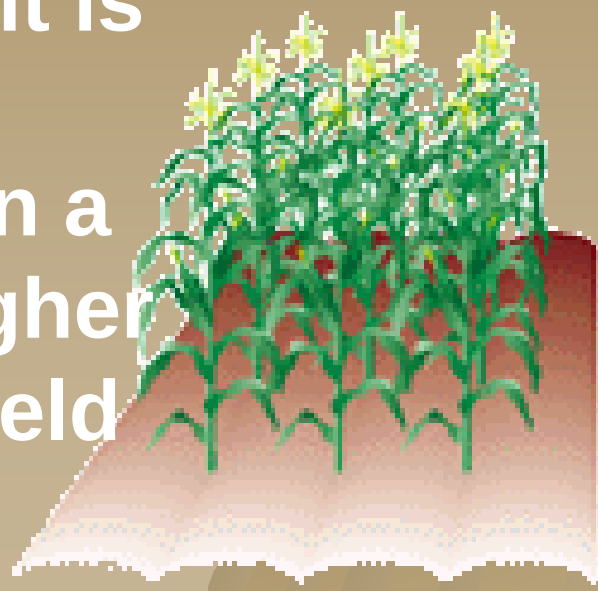
Bt Corn Registrations for "Leps" as of November 2006

Company	Insects[1]	Transformation /Event	Crystalline Protein	Trade Name
Monsanto	**ECB, SWCB**	**Mon 810**	**Cry1A(b)[2,3]**	**YieldGard Corn Borer (YGCB)**
Dow AgroSciences & Pioneer Hi-Bred	**ECB, SWCB, BCW, FAW, WBC**	**TC 1507**	**Cry1F[2,3]**	**Herculex [1] (HX1)**
Syngenta	**ECB, SWCB**	**Bt11**	**Cry1A(b)[2,3]**	**YieldGard Corn Borer (YGCB)**

[1] ECB = *Ostrinia nubilalis*; SWCB = *Diatraea grandiosella*; BCW = *Agrotis ipsilon*; FAW = *Spodoptera frugiperda*; WBC = *Richia albicosta*; [2] Protoxin - processed in insect into toxic protein. [3] Cry1A(b) = Bt subspecies *kurstaki*; Cry1F = Bt subspecies *aizawai*.

Selecting Corn Hybrids . . .

- **Choose a hybrid adapted to the region which has demonstrated good performance**
- **. . . Then consider if the Bt trait is available**
- **The presence of the Bt gene in a hybrid does not guarantee higher yields . . . The trait protects yield in the presence of borers**



Three Species of Corn Rootworm

Western Corn Rootworm
Diabrotica virgifera virgifera LeConte

Northern Corn Rootworm
Diabrotica barberi Smith

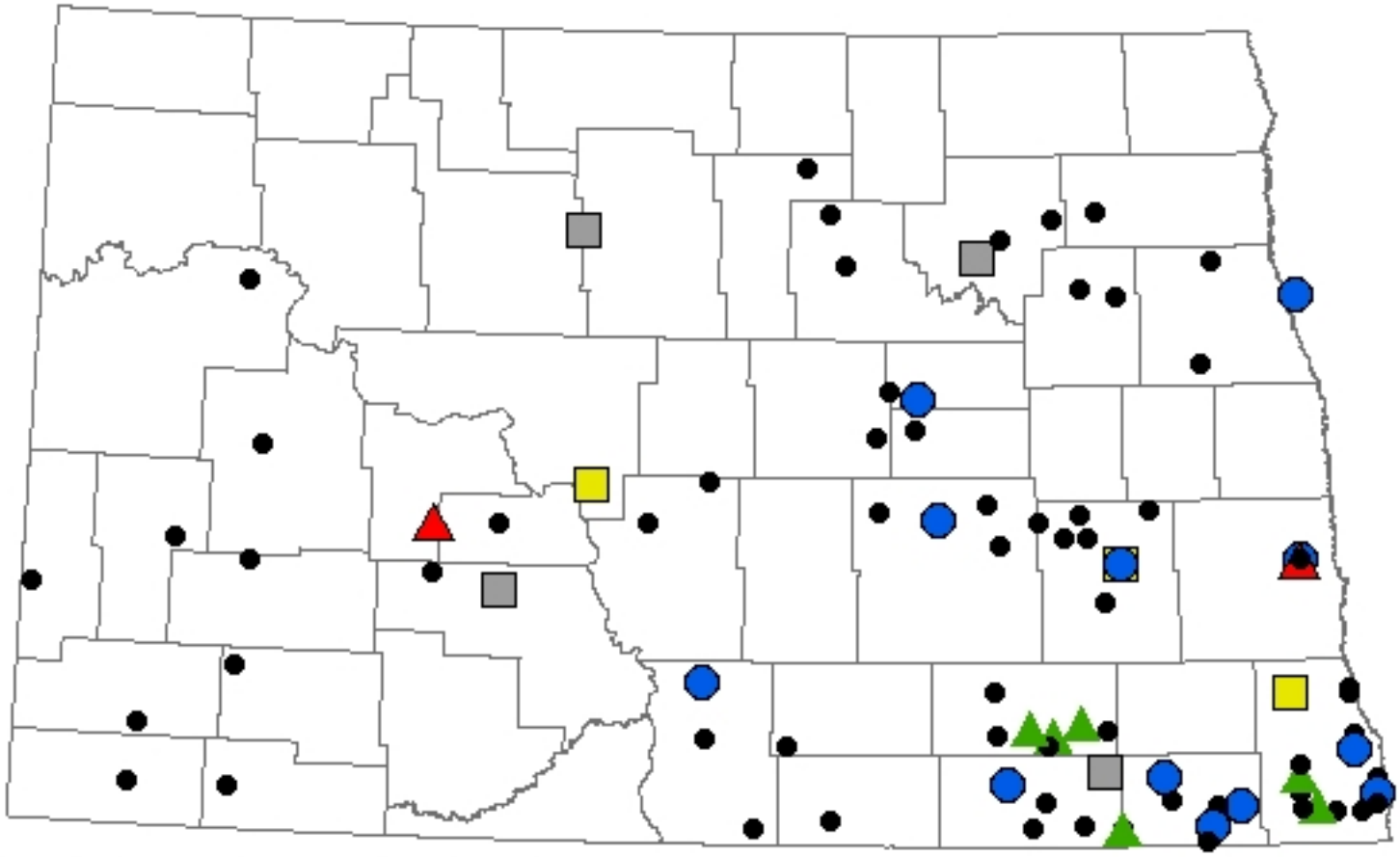
Southern Corn Rootworm
Diabrotica undecimpunctat howardi Barber

2006 IPM CRW Trap Survey in ND

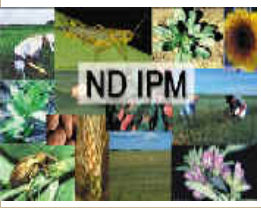
- 100 traps in 37 corn-producing counties
- Pherocon AM Yellow sticky traps
- Kairomone traps
- Mid-July to mid-August

Corn Rootworm Occurences by Species

Field Survey 2006



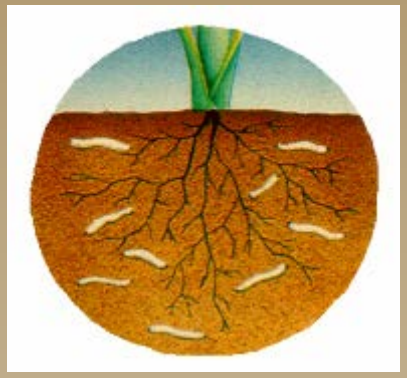
Western Corn Rootworm
Northern Corn Rootworm
Southern Corn Rootworm
Western & Northern Corn Rootworm
Western & Southern Corn Rootworm
No Corn Rootworm Detected



Corn Rootworm Life Cycle

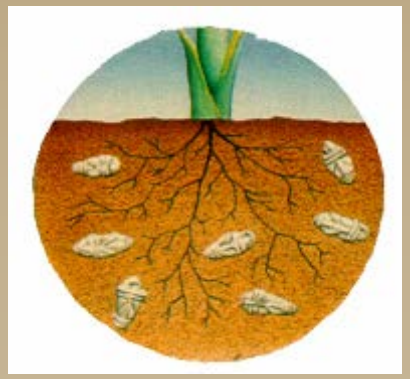
Eggs overwinter in soil

Eggs hatch (late May to early July)



Larvae

Feed for 30 d



Pupae - earthen cells in soil

Adult emerge mid-July to late September

Adults lay eggs from late summer to early fall

One generation per year

Adult corn rootworms feeding on corn silk

Rootworm larvae feeding on corn plant

Root damage due to feeding

Corn Rootworm Damage

- Cause over $1 billion in annual losses in U.S.
  - Caused by larval feeding on roots
    - Injured plant roots are attacked by disease organisms.
    - Reduces ability of plant to transport water and nutrients into plant
    - Reduces plant growth
    - Lodging of corn plant making harvest difficult
  - Yield reduction
    - Light to total loss of crop
  - Cost of control practices
    - Single largest used of conventional insecticides, many are restricted

Corn Rootworm Larvae

- 3 instars
- ⅛-½ inch long
- Cream colored with brown head and brown marking on last abdominal segment

Corn Rootworm - Damage

Goose-necked Corn

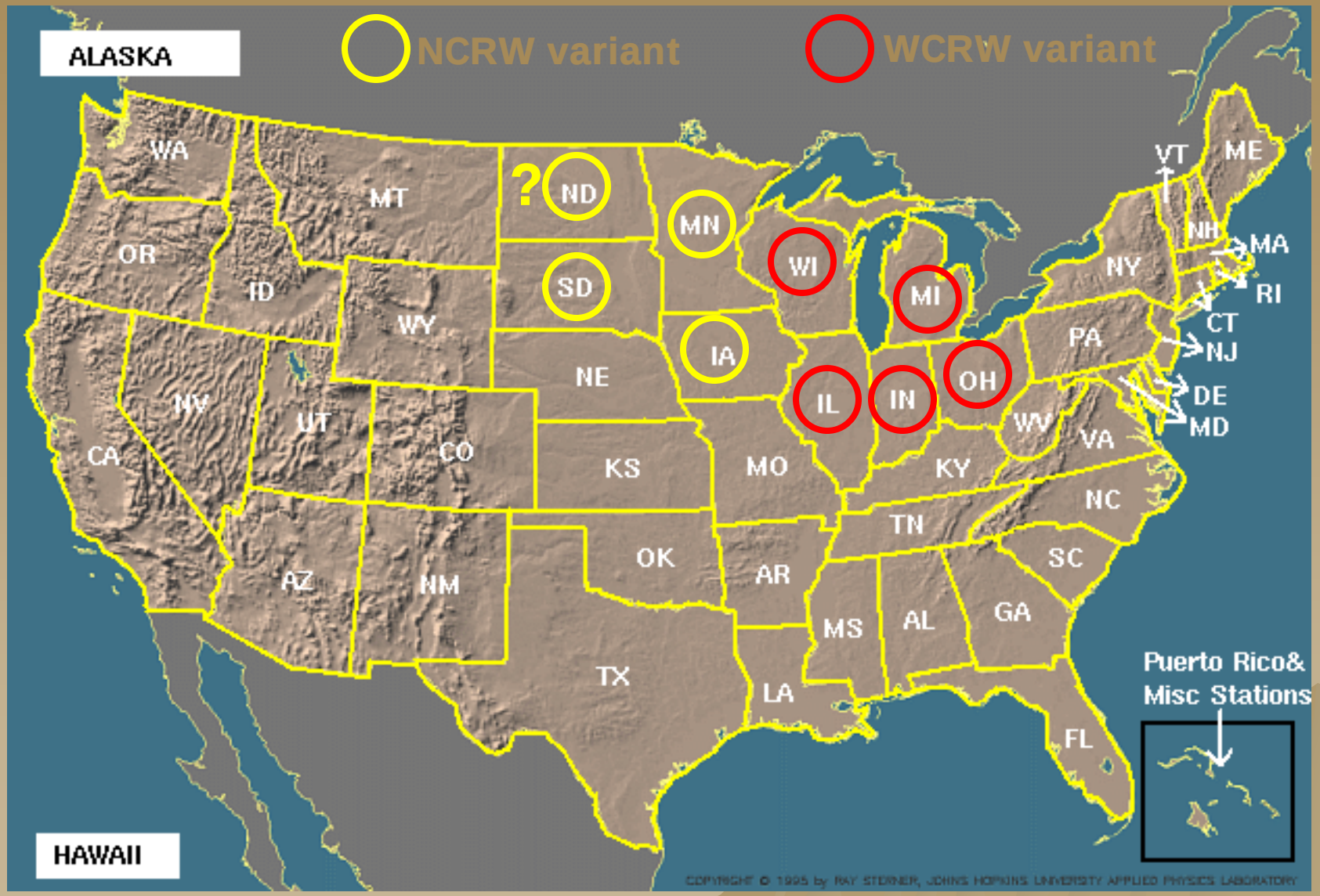
Pest Management

- Crop rotation

Problems with Crop Rotation

- Variant Strains
  - Extended or prolonged diapause
    - Northern corn rootworm
    - Selecting for rootworms that were able to remain dormant as viable eggs for more than one winter season
  - Adapted behaviors – ‘soybean’ variant
    - Western corn rootworm
    - Lay eggs in soybean fields resulting in risk of economic injury to corn planted in the same field the next year

Confirmed infestations of Variant CRW



High Risk Fields

- Corn Rootworm
  - Continuous corn
    - Late-planted year before
    - Average yield loss of 9%
    - Range of 2 to 23% yield loss
  - First-Year Corn
    - Volunteer corn
    - Weedy soybean (e.g. giant ragweed)
    - WCRW variant area (not ND)

Monitoring Adult CRW for Predicting Risk in Corn the Following Year

- Adult Beetle Counts
  - Count both NCRW and WCRW
  - August through mid-September (after pollination)
  - 2 plants at 27 sites in field
  - 3 separate counts
  - Decision to rotate from corn or use insecticide
    - >1 beetle per plant in continuous corn
    - >0.5 beetle per plant in first-year corn
    - 2 or more beetles per yellow sticky trap

Insecticides

- Not kill every last rootworm
  - 60-80% control
- Goal is to protect the primary root system from injury
- Understand the positive and negative aspects of each type of product and determine the best fit for your farm
- Know the CRW pressure in your area
  - Don’t buy protection you don’t need!

Node Injury Rating Scale (0-3)

0 No feeding damage

1 One node (circle of roots), or the equivalent of an entire node, pruned back to within 1.5 inch of the stalk.

2 Two complete nodes pruned

3 Three complete nodes pruned

Insecticides Options for Corn Rootworm Larval Control

- **Insecticide-coated Seed Treatment**
  - Commercially applied
  - Suppression only
  - Cruiser 5FS & Poncho 1250
  - More beneficial in low-moderate pressures
- **Liquid Soil Insecticide**
  - T-band or In-furrow application
  - Capture LFR (Liquid Fertilizer Ready)
  - Lorsban 4E, Capture 2EC, Regent, Proaxis, …
  - Increasing water volume of carrier improves performance
- **Granular Soil Insecticide**
  - T-band or In-furrow application
  - Force 1.5G, Fortress 2.5G, Lorsban 15G, Aztec2.1.G, Counter 15G, …
  - SmartBox® Technology improve placement of insecticide granulars
- **http://www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm**

Bt Corn Rootworm

- Most consistent in protecting corn
- Monsanto – Yieldgard RW in 2004
- Dow/Pioneer - Herculex in 2006
- Syngenta – Agrisure RW in 2007
- Stacked with ECB / herbicides
- Packed with Cruiser or Poncho (low rate)
- Refuge Guidelines
  - 20% non-Bt refuge

Bt Corn Registrations for CRW[1] as of November 2006

Company	Transformation/ Event	Crystalline Protein	Trade Name
Monsanto	**Mon 863**	**Cry3Bb1[2,3]**	**YieldGard Rootworm (YGRW)**
Dow AgroSciences & Pioneer Hi-Bred	**DAS-59122-7**	**Cry34Ab1[2,3] /Cry35Ab1[2,3]**	**Herculex RW**
Syngenta	**MIR604**	**mCry3A[2,3]**	**Agrisure RW**

[1] CRW = *Diabrotica* spp.

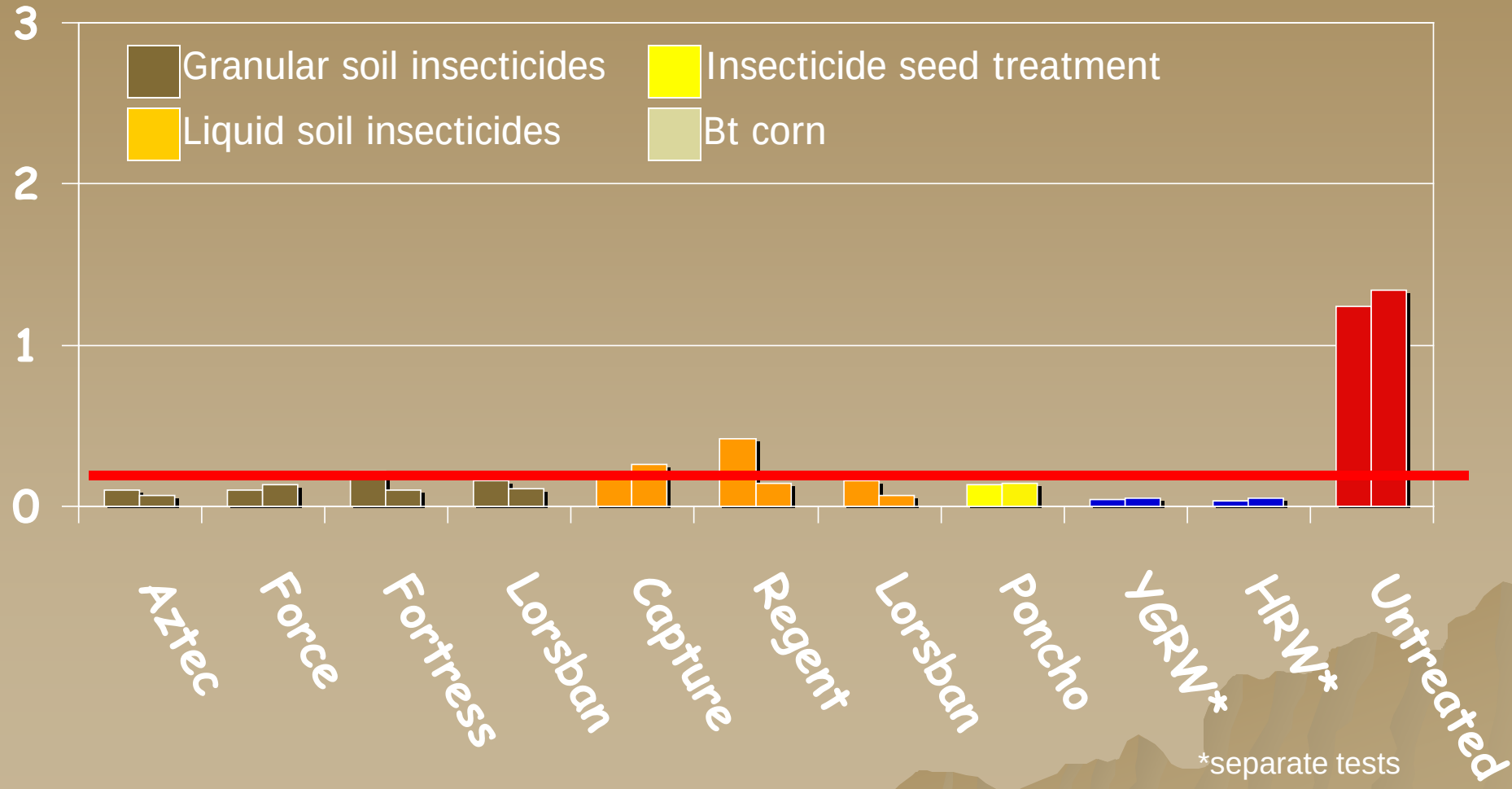
[2] Toxin - produced in the plant as toxin.

[3] Cry3Bb1 = Bt subspecies *kumamotoensis*; Cry34Ab1 = Bt subspecies *wuhanensis* (serovar designation, but cannot be categorized since it is a non-motile form- no flagellae) and Cry35Ab1 = Bt subspecies *wuhanensis* (serovar designation, but cannot be categorized since it is a non-motile form- no flagellae); mCry3A = Bt subspecies *tenebrionis*.

Root Rating Performance, 2006

Moderate Pressure

Columbia City & Farmland, IN



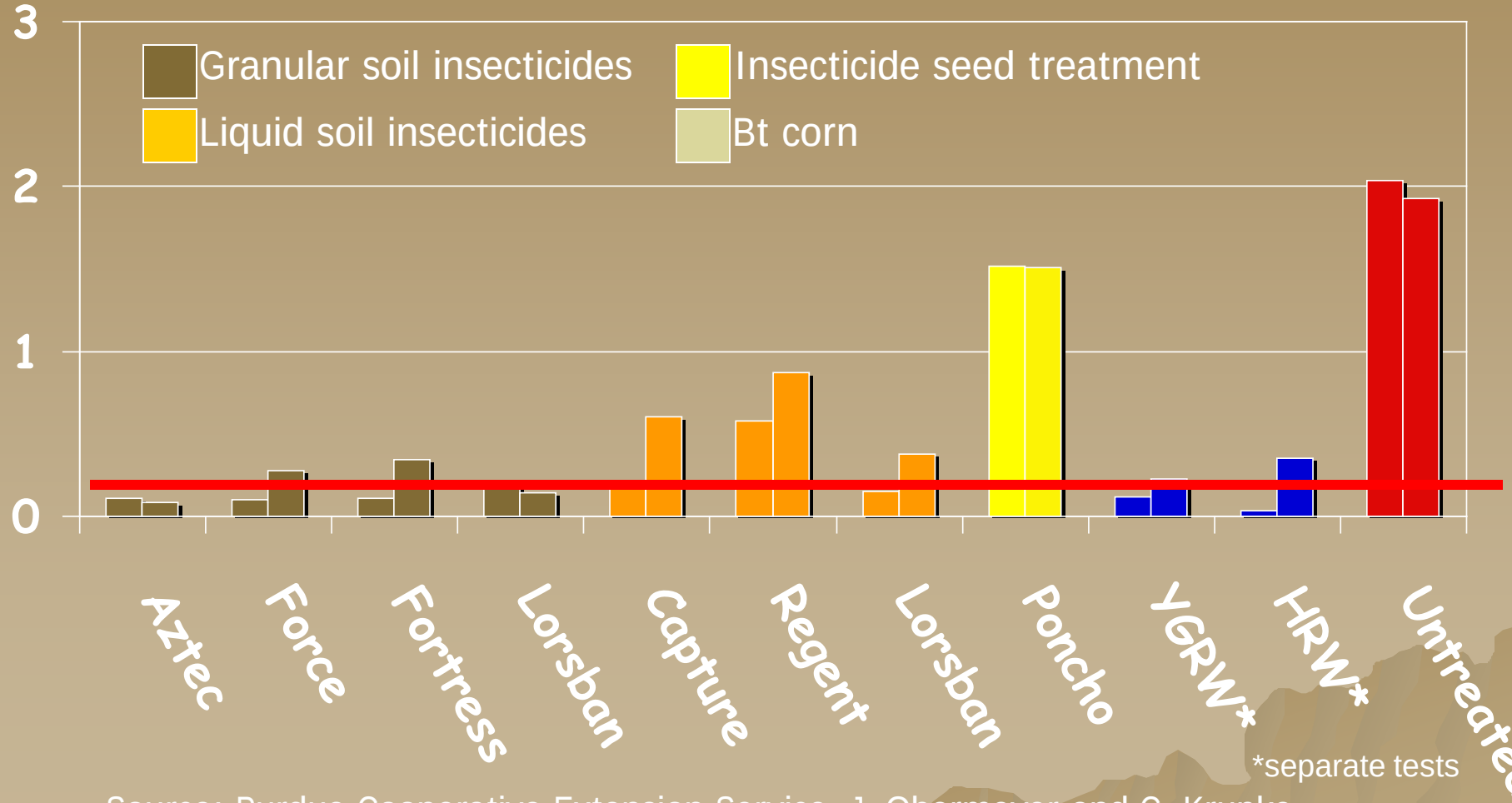
*separate tests

Source: Purdue Cooperative Extension Service, J. Obermeyer and C. Krupke

Root Rating Performance, 2006

High Pressure

Wanatah & Lafayette, IN



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