

# Integrated Pest Management of Insect Pests in Proso Millet



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# Insects in Proso Millet

- ◆ Major pests
  - Grasshoppers
- ◆ Occasional pests
  - European Corn Borer



# Common Grasshoppers

**Red-legged grasshopper**



**Differential grasshopper**



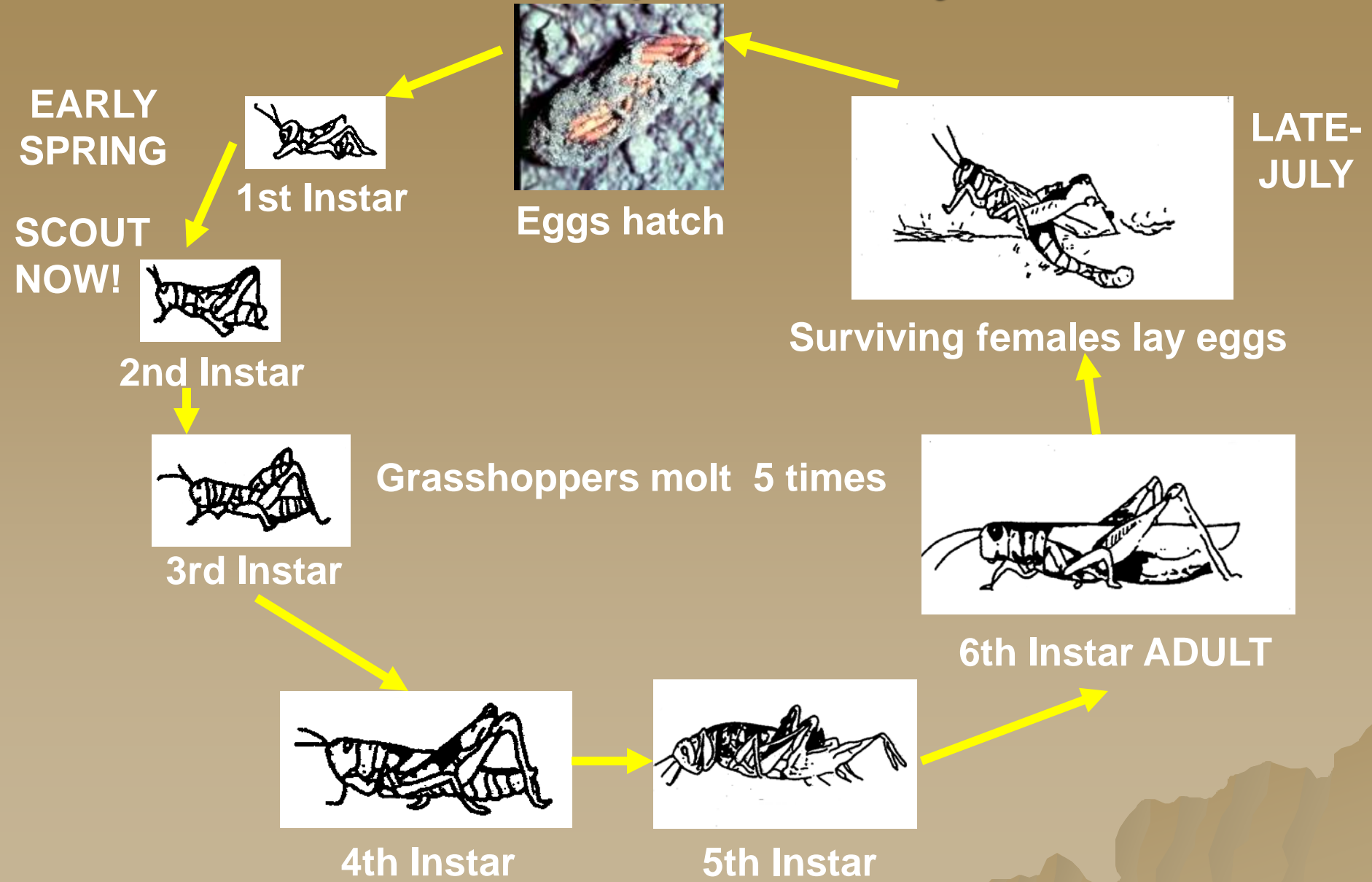
**Two-striped grasshopper**

# Young Grasshoppers or Nymphs

- ◆ Look like adults
- ◆ Smaller than adults
- ◆ Wing pad instead of wings
- ◆ 5-6 nymphal stages or instars
- ◆ 4th or 5th instars present, hatch is winding down

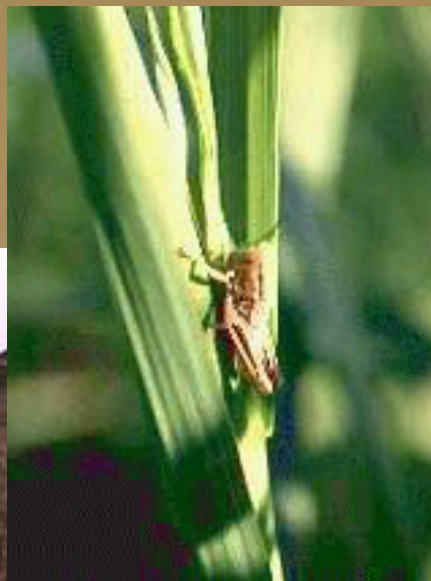


# Grasshopper Life Cycle





**May - June**



**July - August**



**August - Sept**

# Grasshoppers



- Eggs are laid in the fall;
- Embryos develop while temperatures are favorable . . . There are wide ranges of development;
- This makes it difficult to predict hatch.

**Lilac as an indicator:**

**10 days after common lilac flowered, 75% of grasshoppers were first stage**

# Grasshopper Egg Laying

Start in late July through fall

Each female = 8-25 egg masses

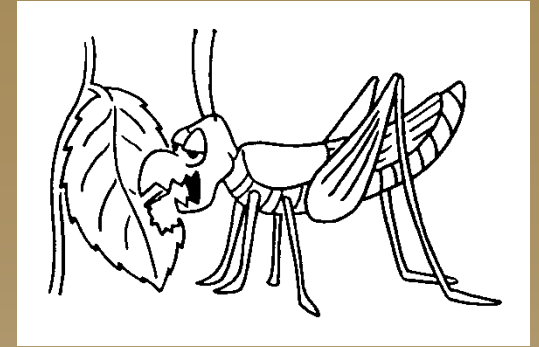


Each egg pod =  
20-120 eggs





# How Grasshopper Outbreaks Develop



- ◆ Weather dependent
    - hot, dry summers and warm falls
  - ◆ Several years of gradual increase
    - LOW YEAR = 1 GH per square yard
    - FAVORABLE YEAR = 2 GH per square yard
    - ANOTHER YEAR = 4 GH per square yard
    - ANOTHER YEAR = 8 GH per square yard
    - ONE MORE = 24+ GH per square yard
- !!OUTBREAK!!**

# How Temperature Affects Grasshoppers

- ◆ High temperature in summer-fall

- Early maturity
- Long egg laying period

- ◆ Warm spring

- Early hatch, followed by:

- ◆ <70°F - No feeding, high mortality
- ◆ Warm and dry - Good start for hoppers

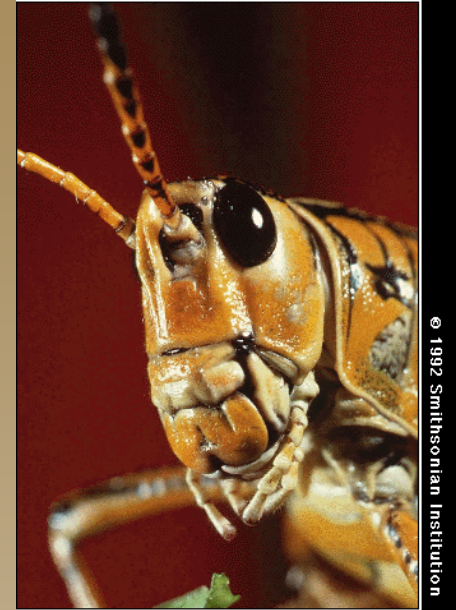


# How Rainfall Affects Grasshoppers

- ◆ Cloudy, wet weather for 1+ weeks
  - Promotes fungal pathogens
- ◆ Heavy rains during emergence
  - Kills young grasshoppers
    - ◆ Embeds young in soil
    - ◆ Physically wash them away + drown
- ◆ Extreme drought
  - Poor egg hatch
  - Hoppers starve from lack of food
  - Low egg production by adults

# Grasshopper Damage

- ◆ Chewing mouthparts
  - Leaf stripping
  - Head clipping



- ◆ High populations and scarce food plants
  - migrate --- "Migratory Locusts"
  - "Eat almost any plant they come upon"



# Grasshopper Infestation Ratings



<u>Rating</u>	<u>Nymphs / sq. yd.</u>		<u>Adults / sq. yd.</u>
	<u>margin</u>	<u>field</u>	<u>field</u>
Light	25 - 35	15 - 25	3 - 7
<b>Threatening</b>	<b>50 - 75</b>	<b>30 - 45</b>	<b>8 - 14</b>
Severe	100 - 150	60 - 90	15 - 28
Very Severe	200+	120+	28+

# Cultural Techniques

## ◆ Early seeding

- Established, vigorously growing plants can tolerate more damage than younger plants
- Risk of late season migration of adult grasshoppers is less
- Not option for late-seeded crops
  - ◆ sunflower
  - ◆ dry beans
  - ◆ safflower

## ◆ Early harvest

# Crop Rotation

- ◆ Crops should not be planted in fields with severe egg infestations
- ◆ Attractive fields = late season crops
  - dry beans
  - soybeans
  - sunflower
  - flax
  - corn



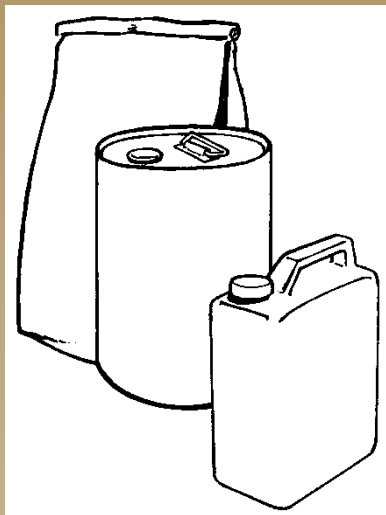
# Impact of Tillage

- ◆ Little value to destroy eggs directly
- ◆ Early spring tillage **before** egg hatch
  - Starve nymphs
- ◆ Late summer tillage
  - Destroys vegetation making area less attractive for feeding and egg laying





Proso Millet



Always Read  
Labels.

Carbamates

Carbaryl (Sevin)

Biorationals

Pyrethrin (Evergreen)

Kaolin (Surround)

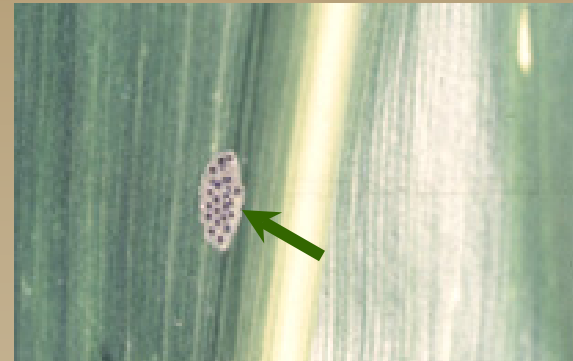


**Female moth**

# European Corn Borer

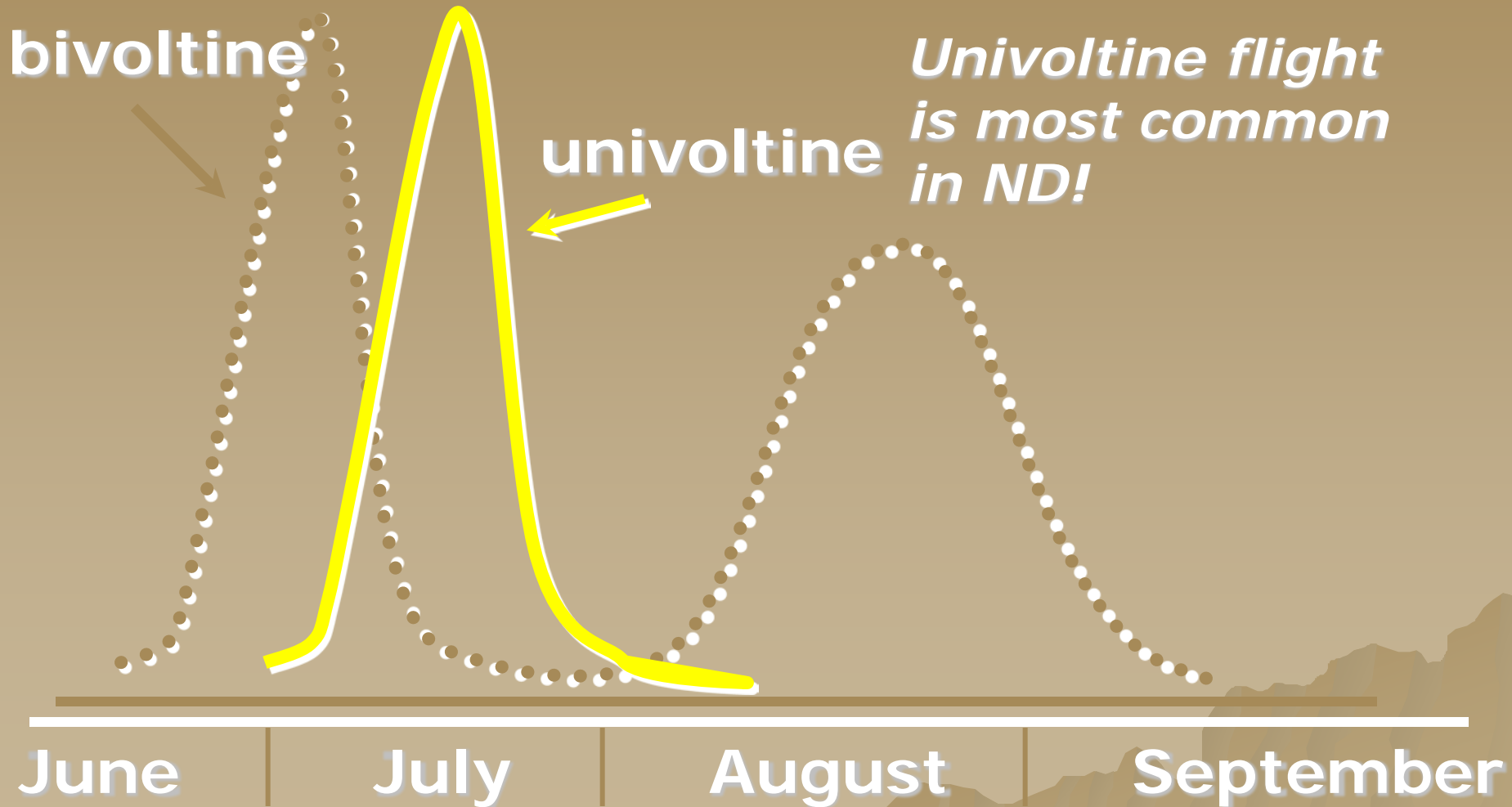


**Newly laid egg mass**



**Egg mass at  
"black-head" stage**

# Typical Occurrence of European Corn Borer Moth Flights in ND



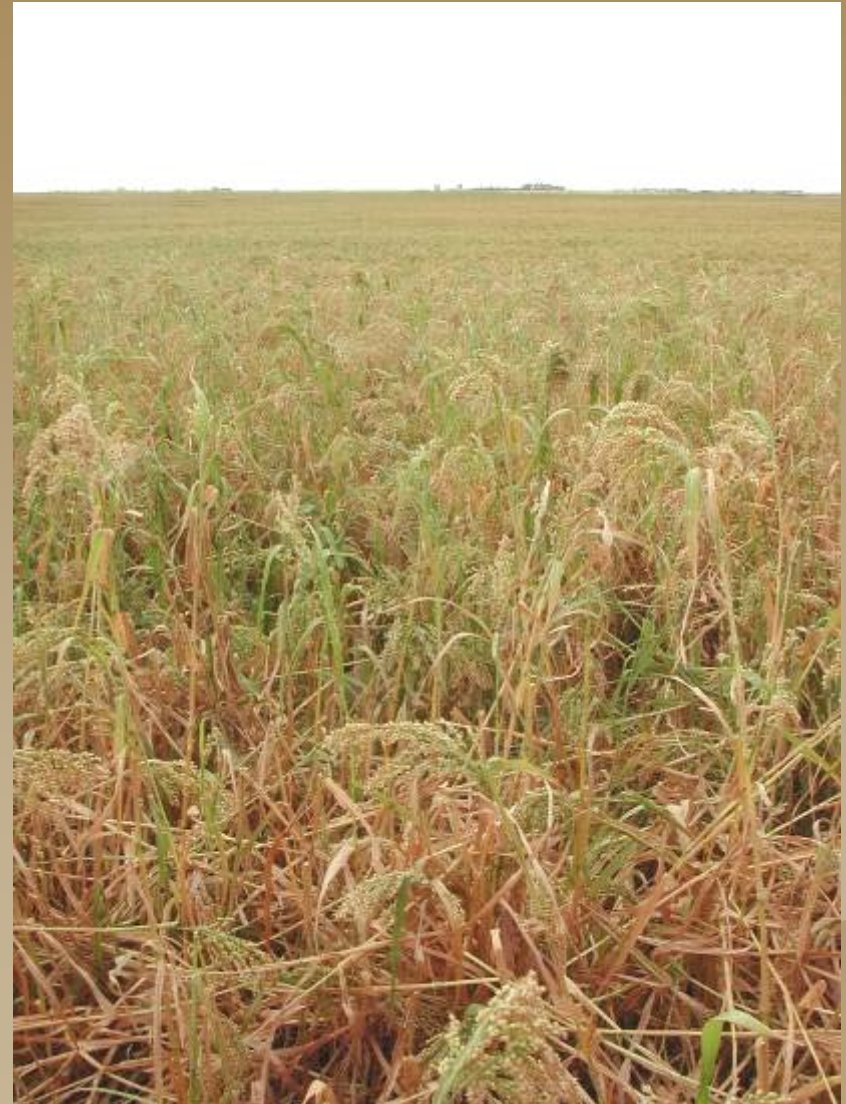
**“Shot-hole”  
feeding injury of  
corn borer larvae**



**Tunneling ECB  
larva inside stalk**

# European Corn Borer Damage

- ◆ Lodged millet from corn borer making harvest difficult



# European Corn Borer

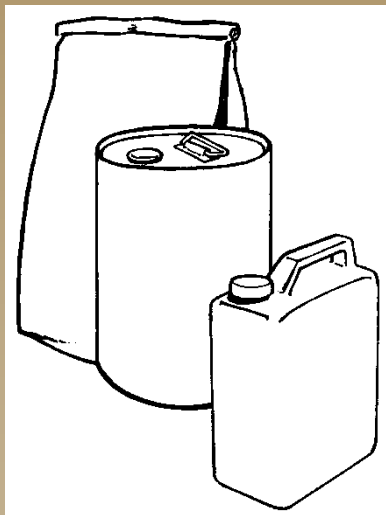


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# Insecticide Recommendations

Labeled for European corn borer Control in ND

**Proso Millet**



**Biorationals**

**Pyrethins (Evergreen,  
Pyganic)**

**Always Read  
Labels.**



**NDSU**  
**Extension Service**  
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