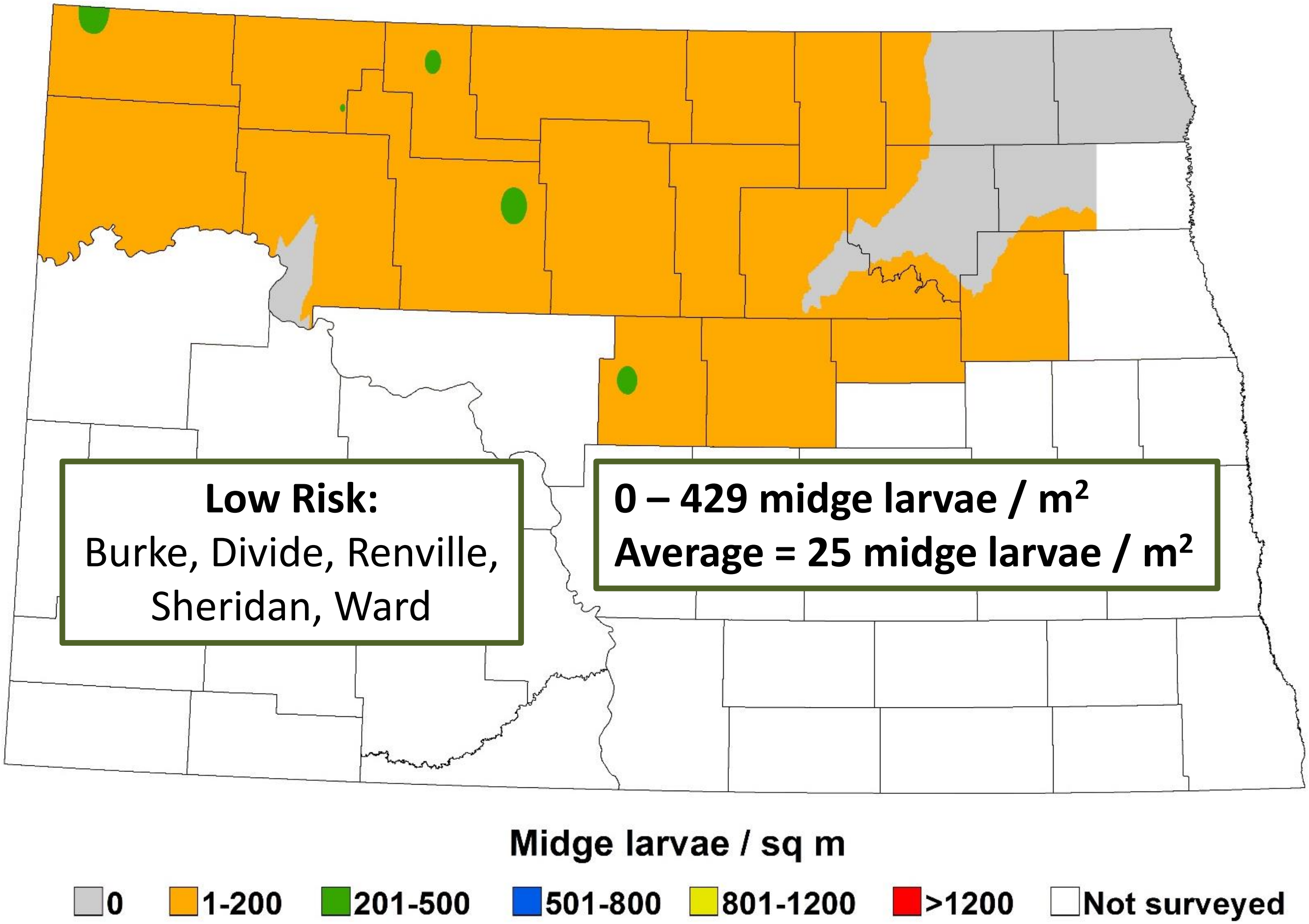
Best Practices for Managing Wheat Midge, Wheat Stem Sawfly and Wireworm

Dr. Janet Knodel
Extension Entomologist
NDSU EXTENSION SERVICE

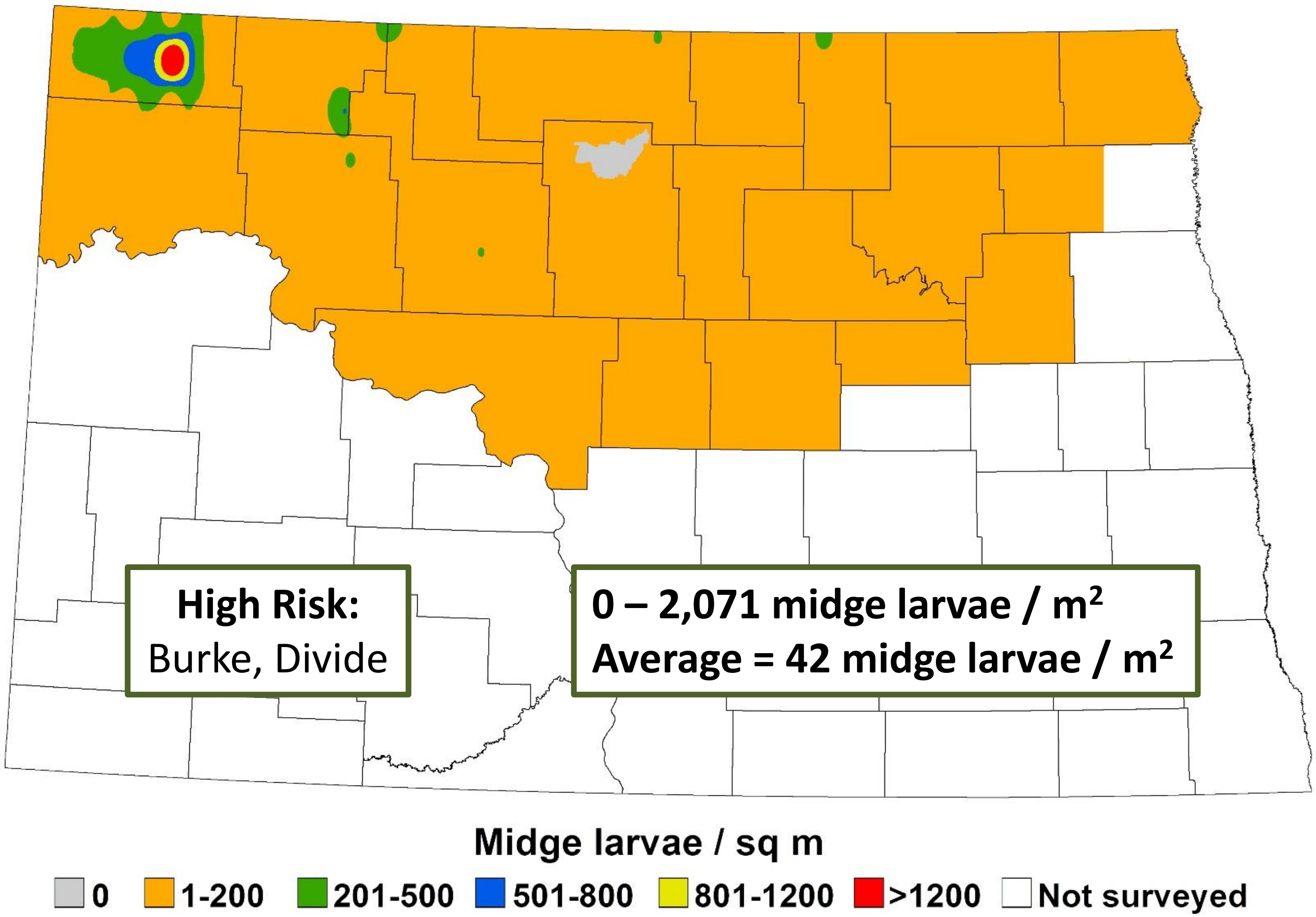
2015 Wheat Midge Larval Survey
North Dakota



NORTH DAKOTA WHEAT COMMISSION

NDSU EXTENSION SERVICE

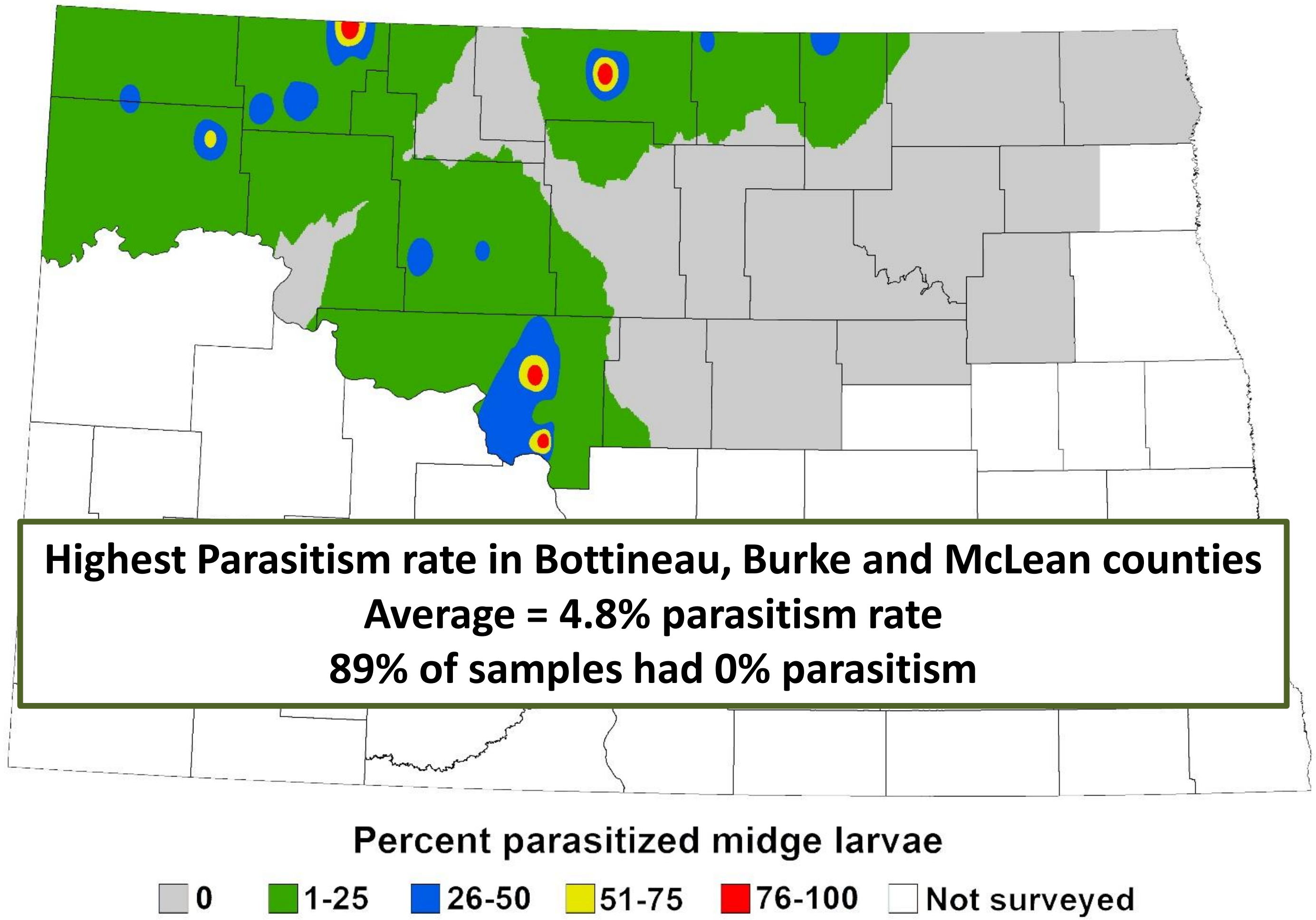
2016 Wheat Midge Larval Survey
North Dakota



NORTH DAKOTA WHEAT COMMISSION

NDSU EXTENSION SERVICE

2016 Wheat Midge Larval Survey
Percent Parasitism
North Dakota



Highest Parasitism rate in Bottineau, Burke and McLean counties
Average = 4.8% parasitism rate
89% of samples had 0% parasitism

NORTH DAKOTA WHEAT COMMISSION

NDSU EXTENSION SERVICE

IPM – Use of Resistant Wheat Varieties Against Wheat Midge

- Host Plant Resistance
  - Discovered in 1996
  - Release in 2010
  - Single gene resistance - *Sm1* gene
  - High levels of phenolic acid cause the midge larvae to stop feeding and larvae starve to death (antibiosis resistance)

IPM – Use of Resistant Wheat Varieties Against Wheat Midge

- "Refuge in the Bag" to prevent development of resistance
  - No other known source of midge tolerance
  - 90% midge tolerant variety and 10% susceptible variety
  - Canada Varieties – AC® Unity, AC® Goodeve VB, AC® Glencross VB, AC® Fieldstar VB, AC® Shaw VB, AC® Utmost VB, AC® Conquer VB, AC® Vesper VB
  - Montana Variety – Egan (released in 2014)
- Midge Tolerant Wheat Stewardship Agreement

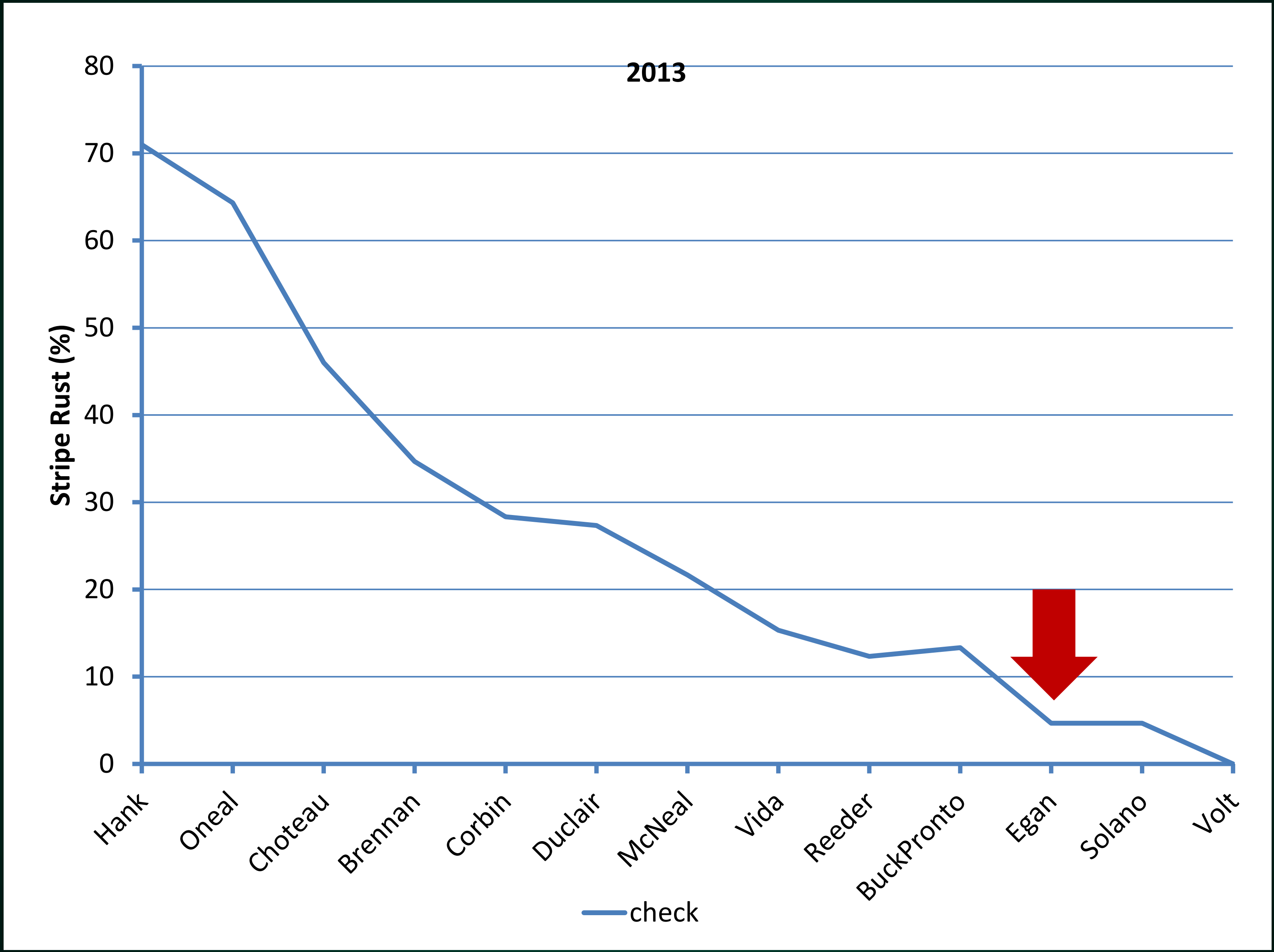
RIB…Refuge In Bag

Egan Wheat Variety

Egan Wheat field near Kalispell, MT.
Photo courtesy of MSU NW Ag. Res. Center

- MSU Spring wheat breeder
  - Dr. Luther Talbert
- Semi-dwarf
- Resistance to strip rust
- High grain protein
- Available at Montana Seed Program for production and certification
  - Certified blend
  - Lake Seed, Inc. in Ronan, MT. (http://lakeseedinc.com)

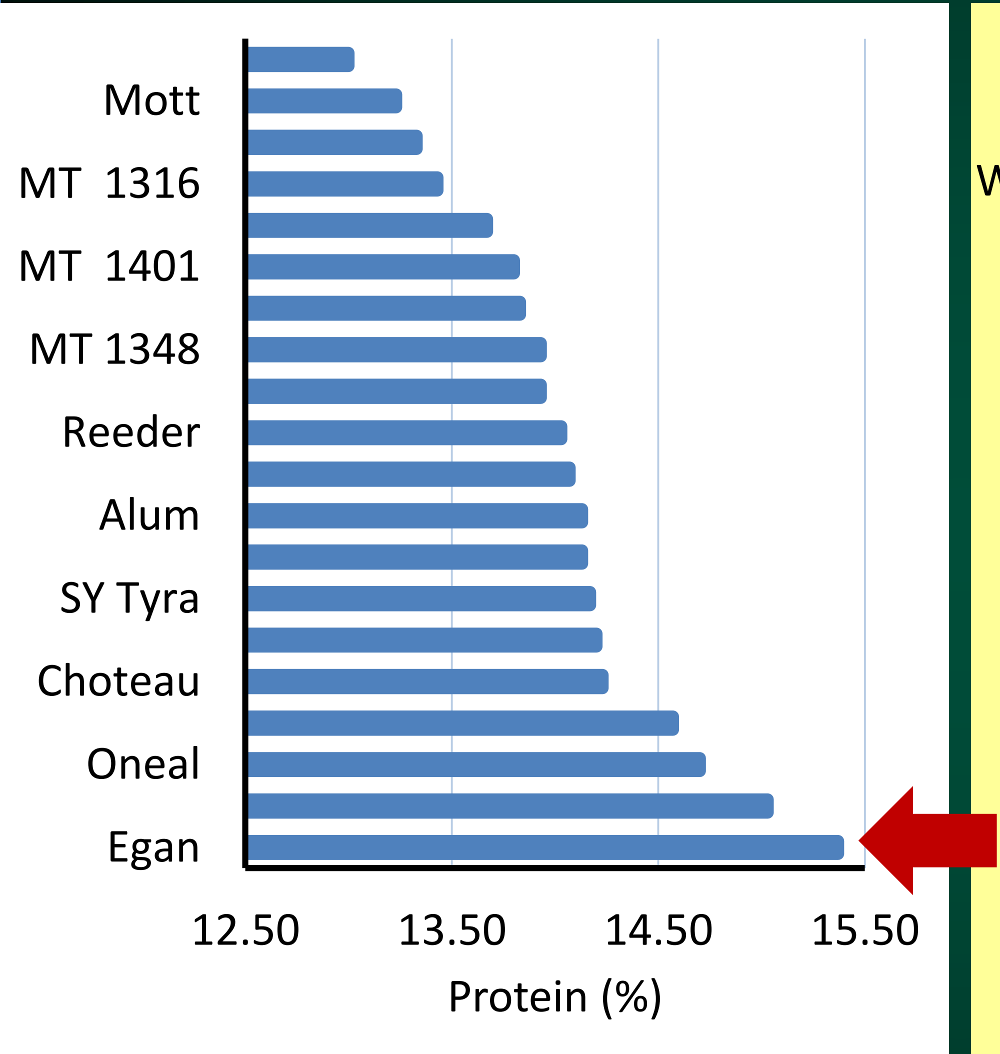
Stripe Rust Incidence

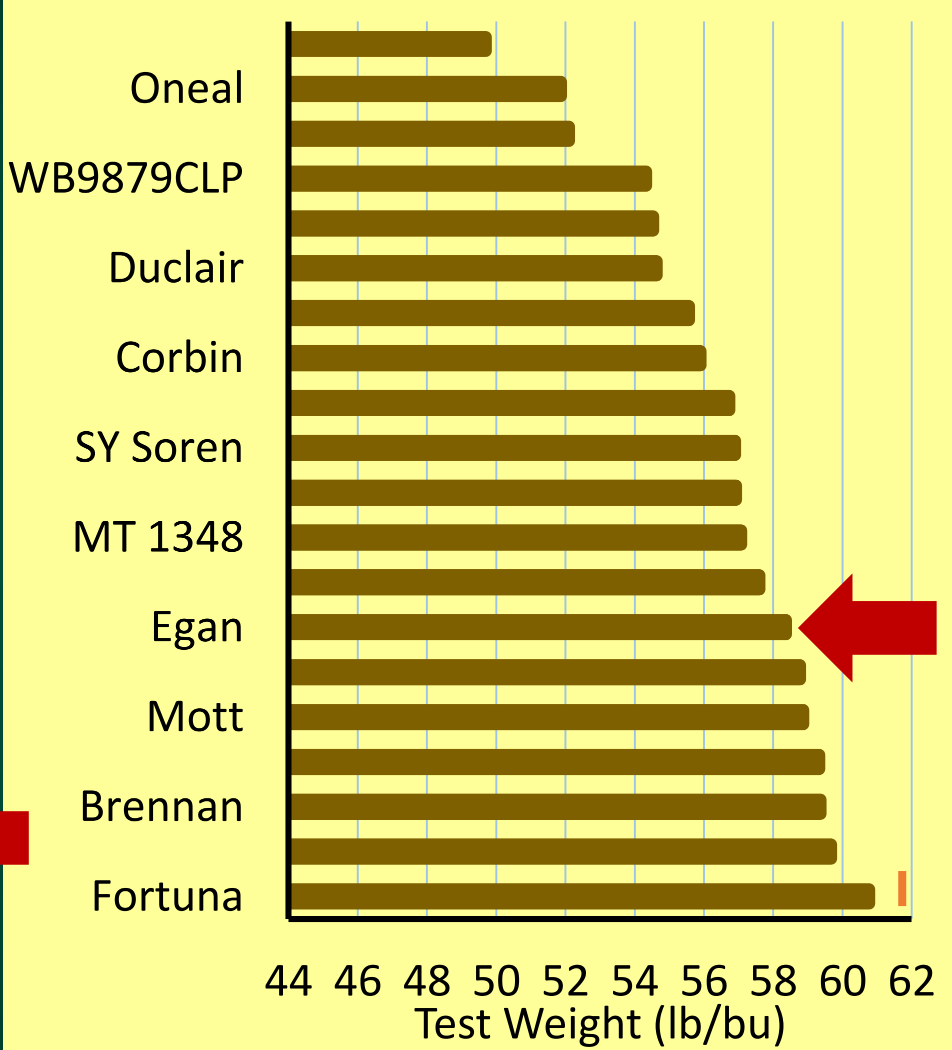


NDSU EXTENSION SERVICE

Source: Bob Stougaard, Montana State University
Northwestern Agricultural Research Center

Off Station, 2016





NDSU EXTENSION SERVICE

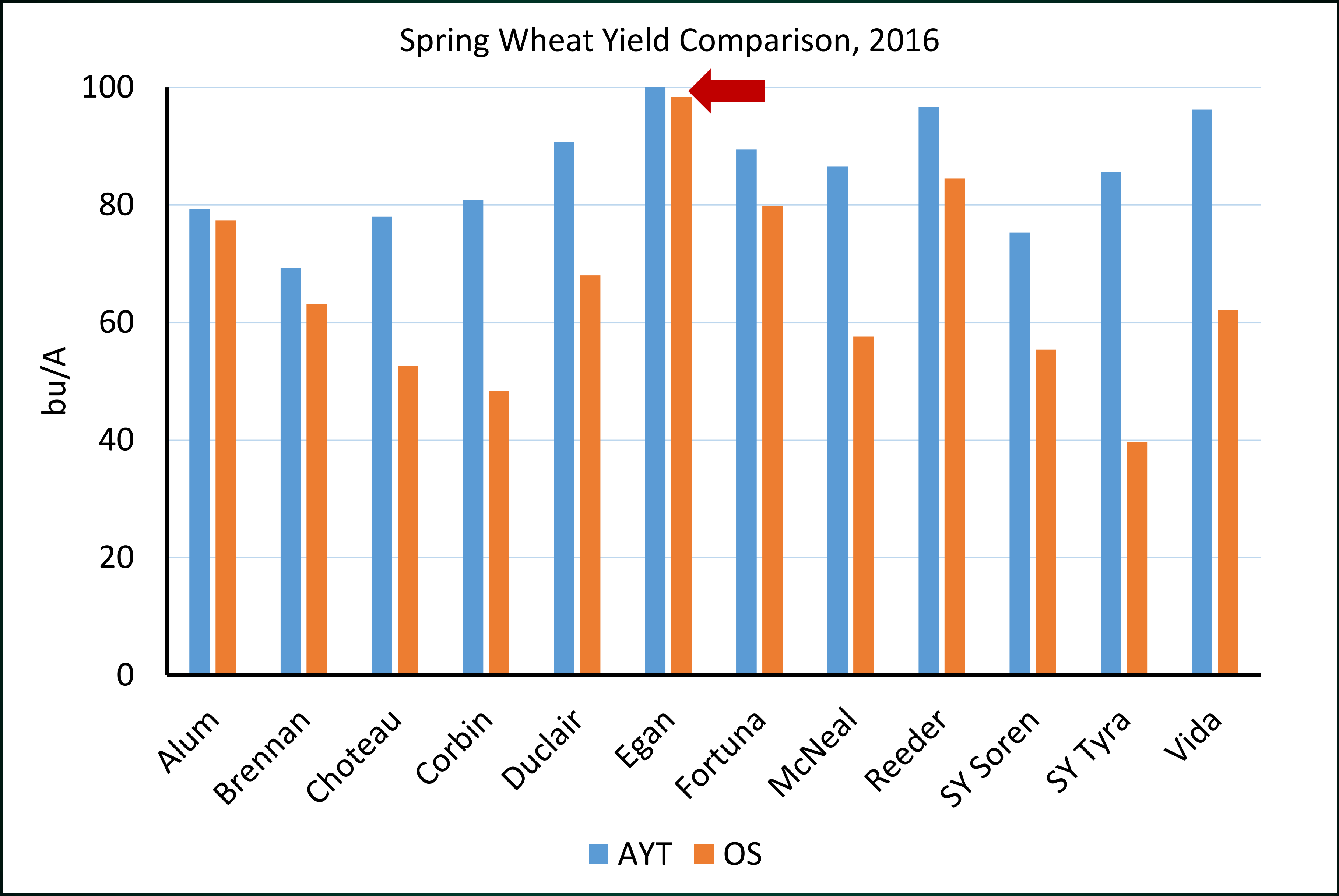
Source: Bob Stougaard, Montana State University
Northwestern Agricultural Research Center

Data from MSU - NW Ag. Res. Center

Effect of Sm1 genetic resistance on OWBM, 2012.

Cultivar	OWBM no./spk	Yield bu/A	Protein %	TWT lb/bu	FN sec
REEDER	46	34	16.7	59	180
HANK	102	15	16.1	52	193
EGAN	0	52	17.8	56	326

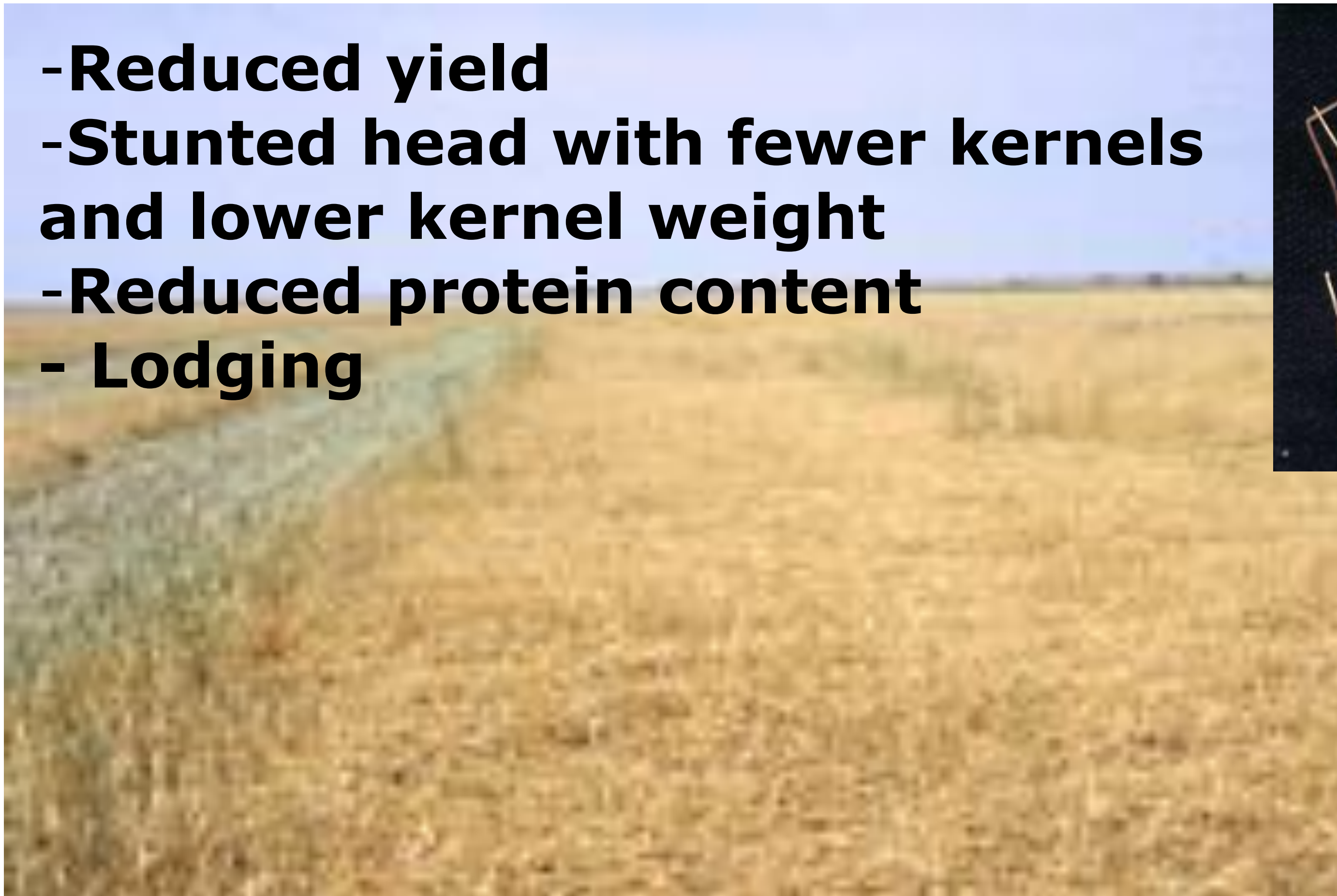
Source: Bob Stougaard, Montana State University
Northwestern Agricultural Research Center



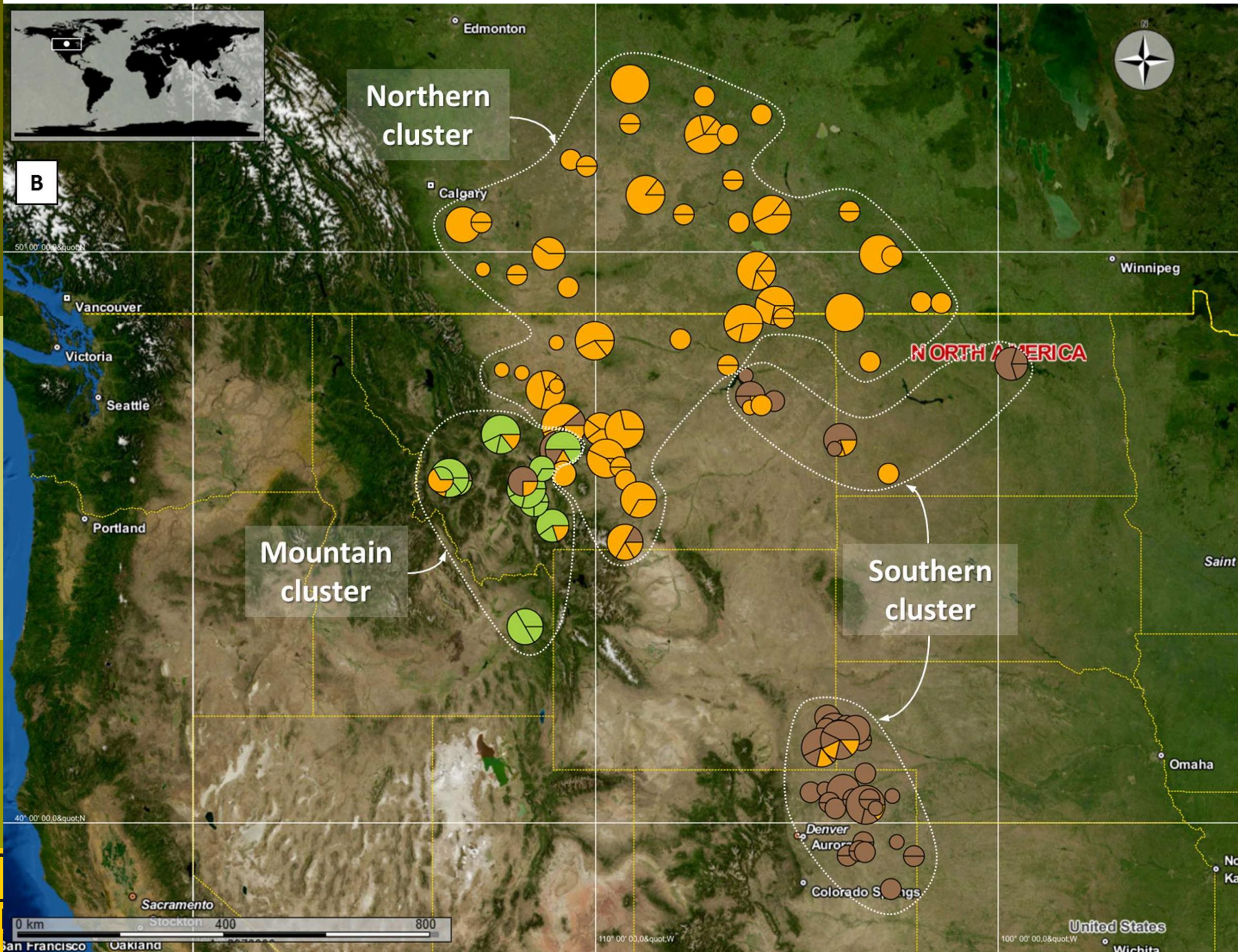
NDSU EXTENSION SERVICE

Source: Bob Stougaard, Montana State University Northwestern Agricultural Research Center


Damage caused by Wheat Stem Sawfly



-**Reduced yield**
-**Stunted head with fewer kernels and lower kernel weight**
-**Reduced protein content**
- Lodging



B
Northern cluster
Mountain cluster
Southern cluster
Edmonton
Calgary
Vancouver
Victoria
Seattle
Portland
Winnipeg
NORTH AMERICA
Omaha
Denver
Colorado Springs
Sacramento
Stockton
San Francisco
Oakland
Wichita
United States
Saint
0 km
400
800

Genetic Divergence of Wheat Stem Sawfly: Implications for Pest Management

- *Cephus cinctus* - native to North America
  - Not introduced from Asia
  - *C. cinctus* and *C. hyalinatus* – two distinct species
- Three genetic clusters that are correlated with geography
- Southern cluster correlates to movements of wheat stem sawfly from north into southern states (WY, NE, CO) causing significant damage to winter wheat (shift in host plant use)

Lesieur et al. 2016. PLOS ONE | DOI:10.1371/journal.pone.0168370

Genetic Divergence of Wheat Stem Sawfly: Implications for Pest Management

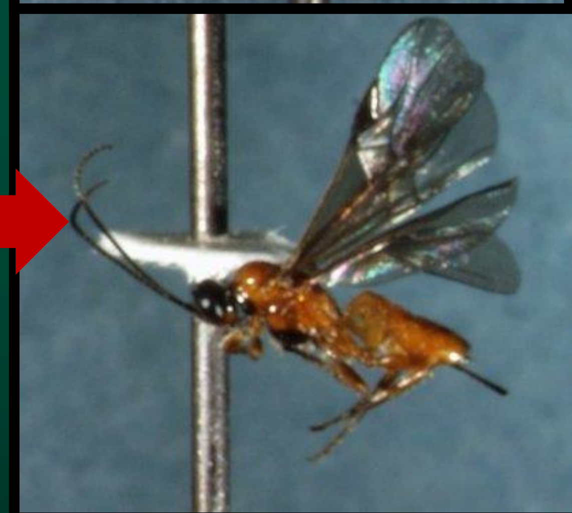
- Natural enemies coevolve with their host
  - *Bracon cephi* and *Bracon lissogaster* – N.A. origins
  - *Colllyria catoptron* – collected from China
    - *C. cinctus* not a suitable host
    - Not complete development on *C. cinctus*
- Maximize effectiveness of biological control of *Bracon* species in ND
- Use high cutting heights during harvest

Lesieur et al. 2016. PLOS ONE | DOI:10.1371/journal.pone.0168370

Biological Control

- *Bracon cephi* (Gahan)
  - Wheat
  - Effective in solid-stemmed wheat varieties

- *Bracon lissogaster Muesebeck*
  - Native grasses



Source: D. Weaver, UMT

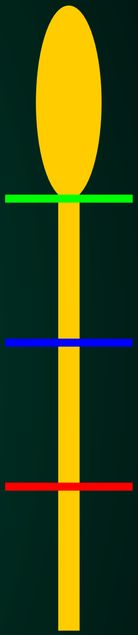
Bracon cephi and *Bracon lissogaster* (Hymenoptera: Braconidae)

- Paralyze host, deposit egg on or near host
- Ectoparasites
- 1+ parasitoid / sawfly
- Development time = 2-3 weeks
- 1+ generations / yr
- Overwinter as pupa

NDSU EXTENSION SERVICE

Parasitoid Conservation

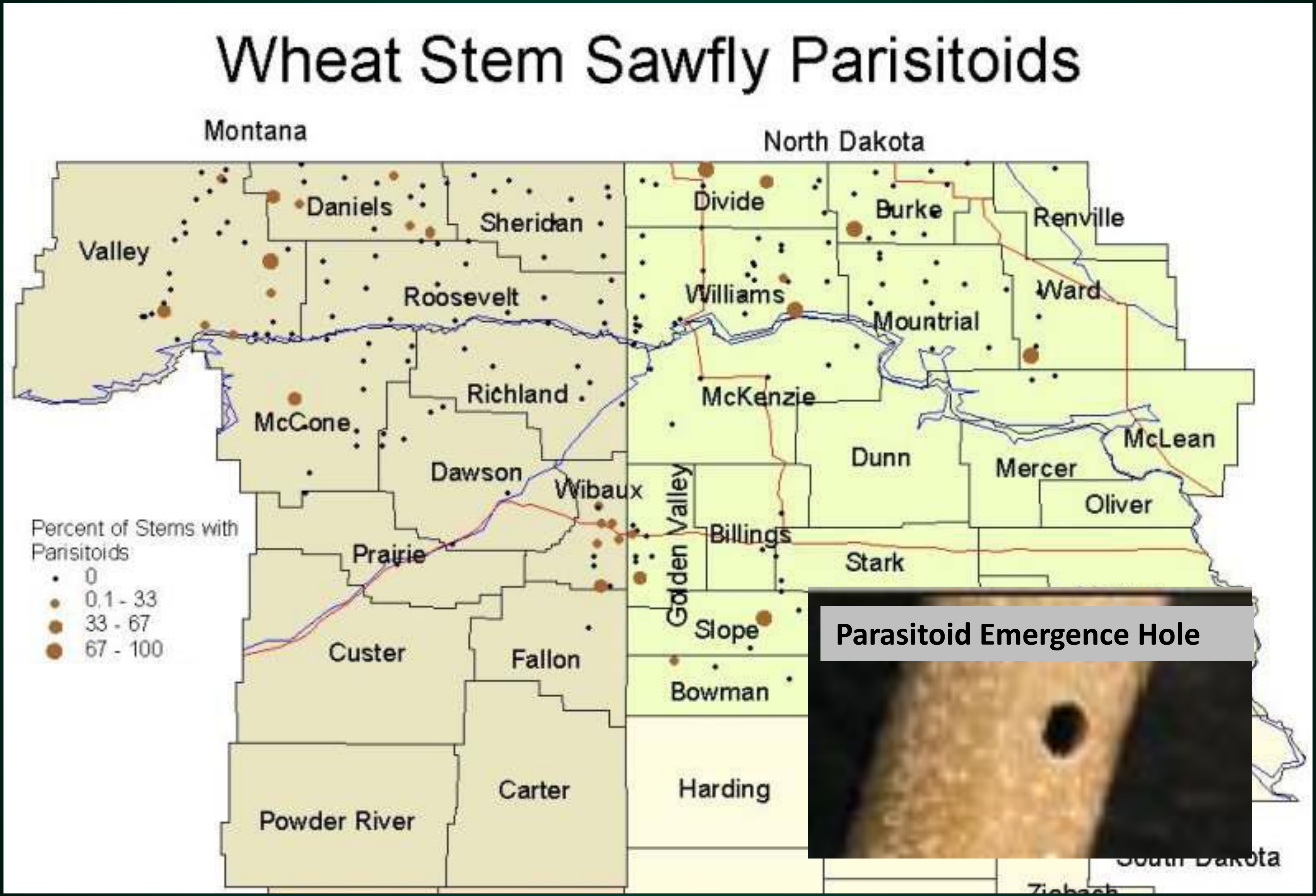
Taller residue is better



Source: D. Weaver, MSU


Negative – Destroy parasitoids!

Survey of *Bracon spp.* 1999-2001



Shanower and Waters (2006) J. Ent. Sci.

Genetic Divergence of Wheat Stem Sawfly: Implications for Pest Management

- Different biological characteristics which may response differently to management strategies
- Low mobility of wheat stem sawfly
  - Limit gene flow within populations (clusters)
  - Weak fliers and rarely fly long distances

Lesieur et al. 2016. PLOS ONE | DOI:10.1371/journal.pone.0168370

Genetic Divergence of Wheat Stem Sawfly: Implications for Pest Management

- High risk of spread of resistance alleles due to apparent gene flow, at least within clusters
  - Solid-stemmed wheat varieties
  - Maintain high genetic diversity within wheat stem sawfly populations
  - Use other IPM methods for control
    - Crop rotation – avoid continuous wheat
    - Biological control –parasitic wasps

Lesieur et al. 2016. PLOS ONE | DOI:10.1371/journal.pone.0168370

Wireworms

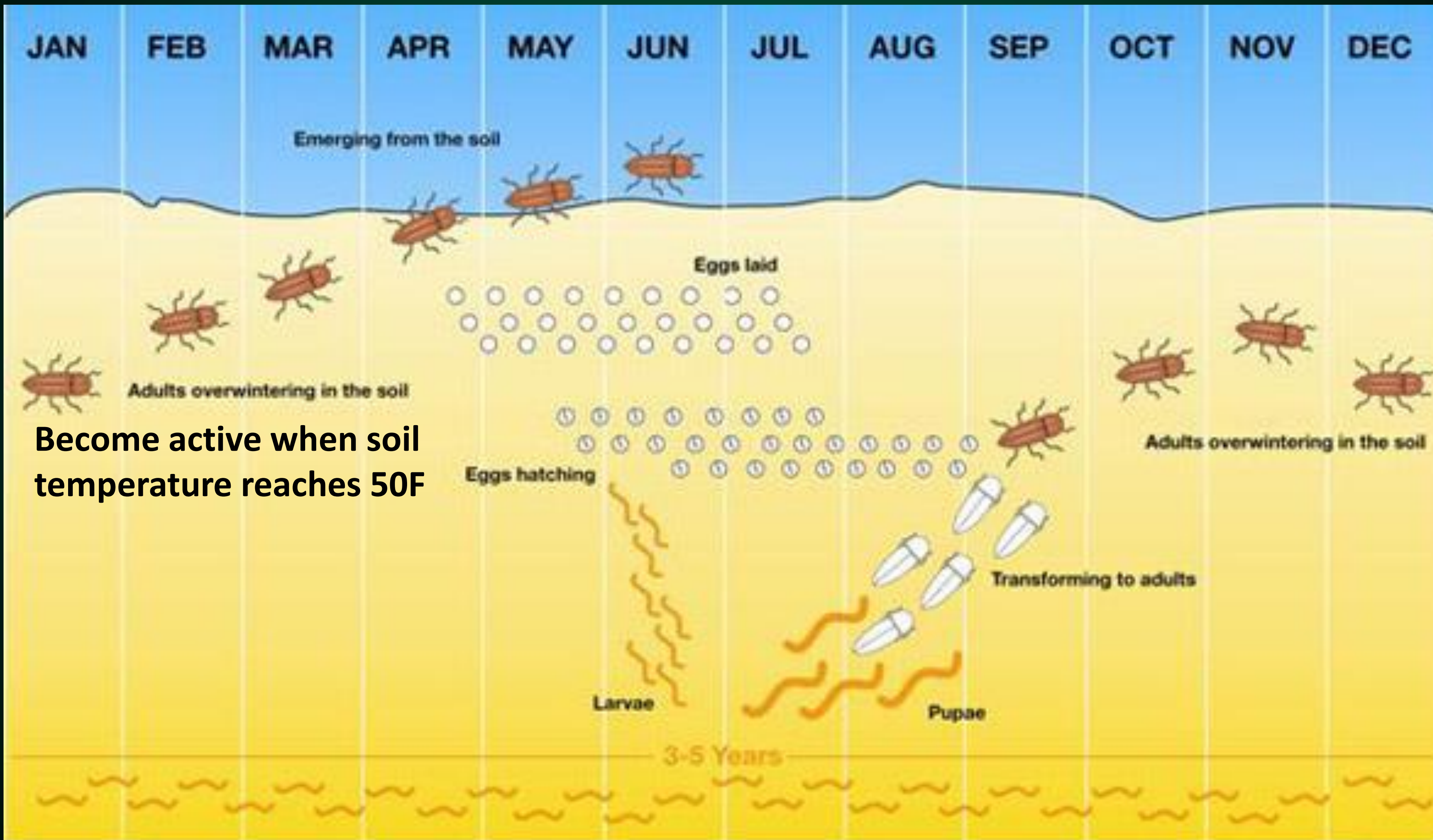
- Family Elateridae (click beetles)
- Several species in our area
- 3 to 5 year life cycle
- Adults and larvae overwinter in soil from 9” to 24” deep

S. Brown, Univ. GA, bugwood.org

M. Boetel, NDSU

NDSU EXTENSION SERVICE

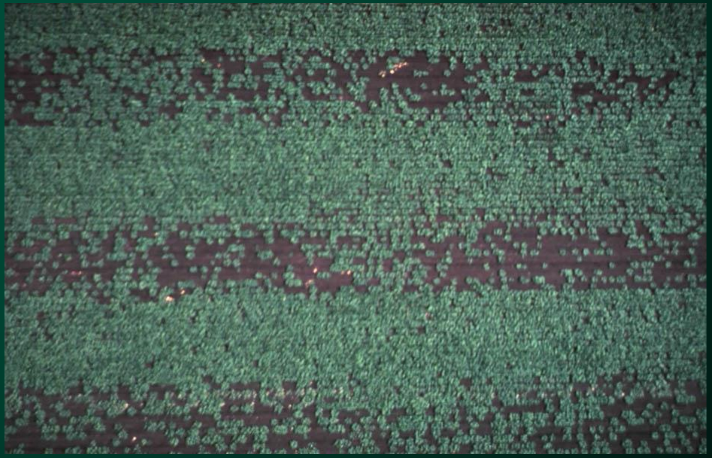
Wireworms Life Cycle



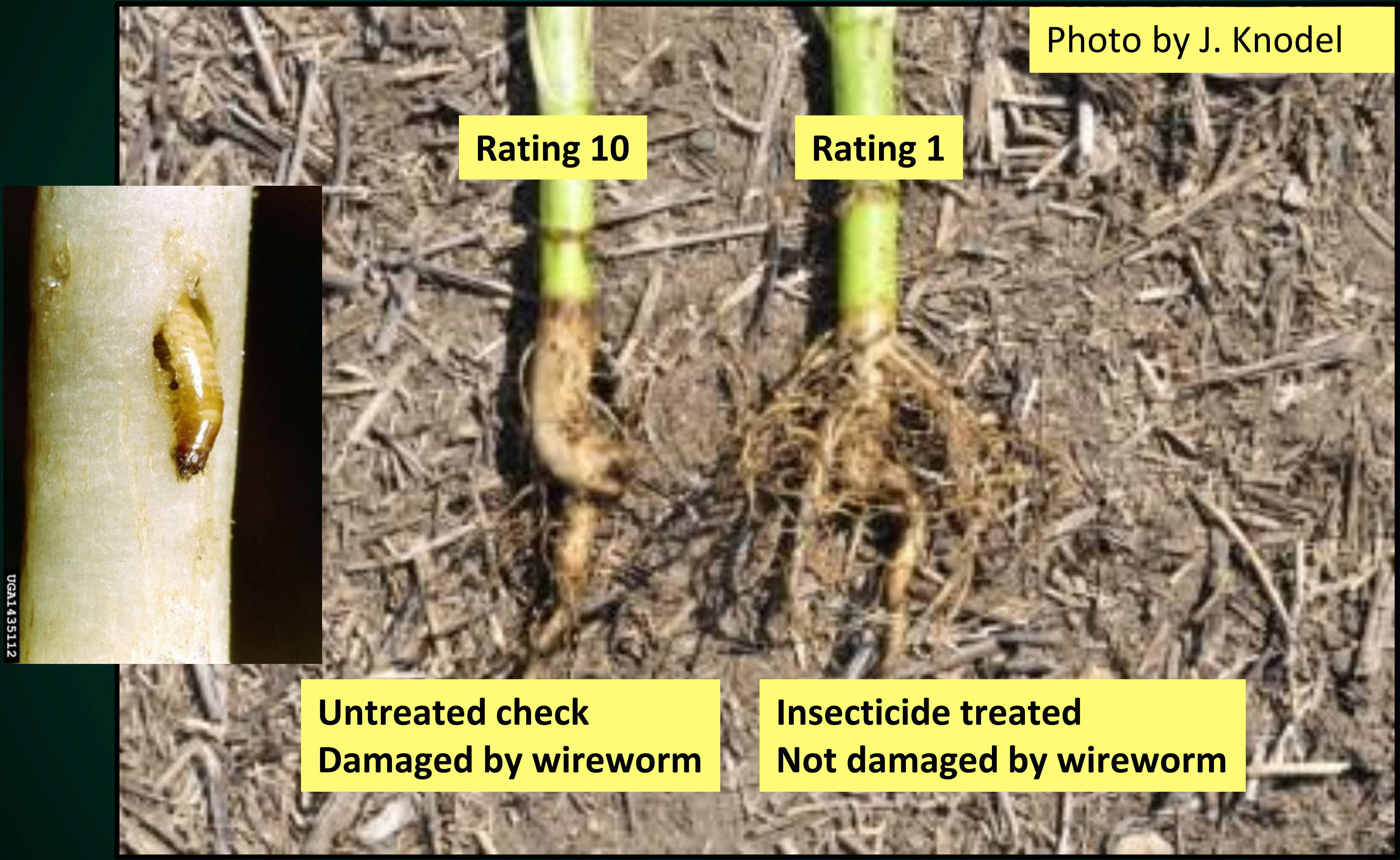
- **Become active when soil temperature reaches 50F**

Wireworms

- Plant losses due to wireworm feeding are increasing!
- Stand loss – blank spots or ‘skips’ in the rows
- Make sure the problem is actually caused by wireworms

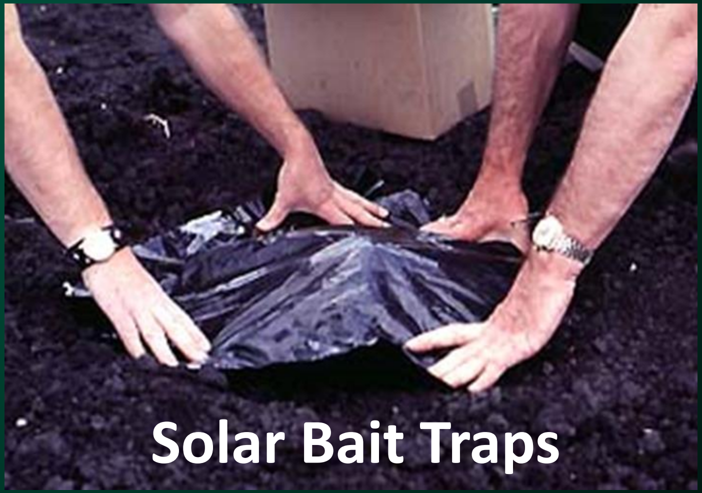


Wireworm Root Injury



Wireworms

- Difficult to survey and to predict whether wireworms will be a problem
- Wide host range, but grasses are preferred
- Crops most at risk following small grains, corn or CRP/non-crop



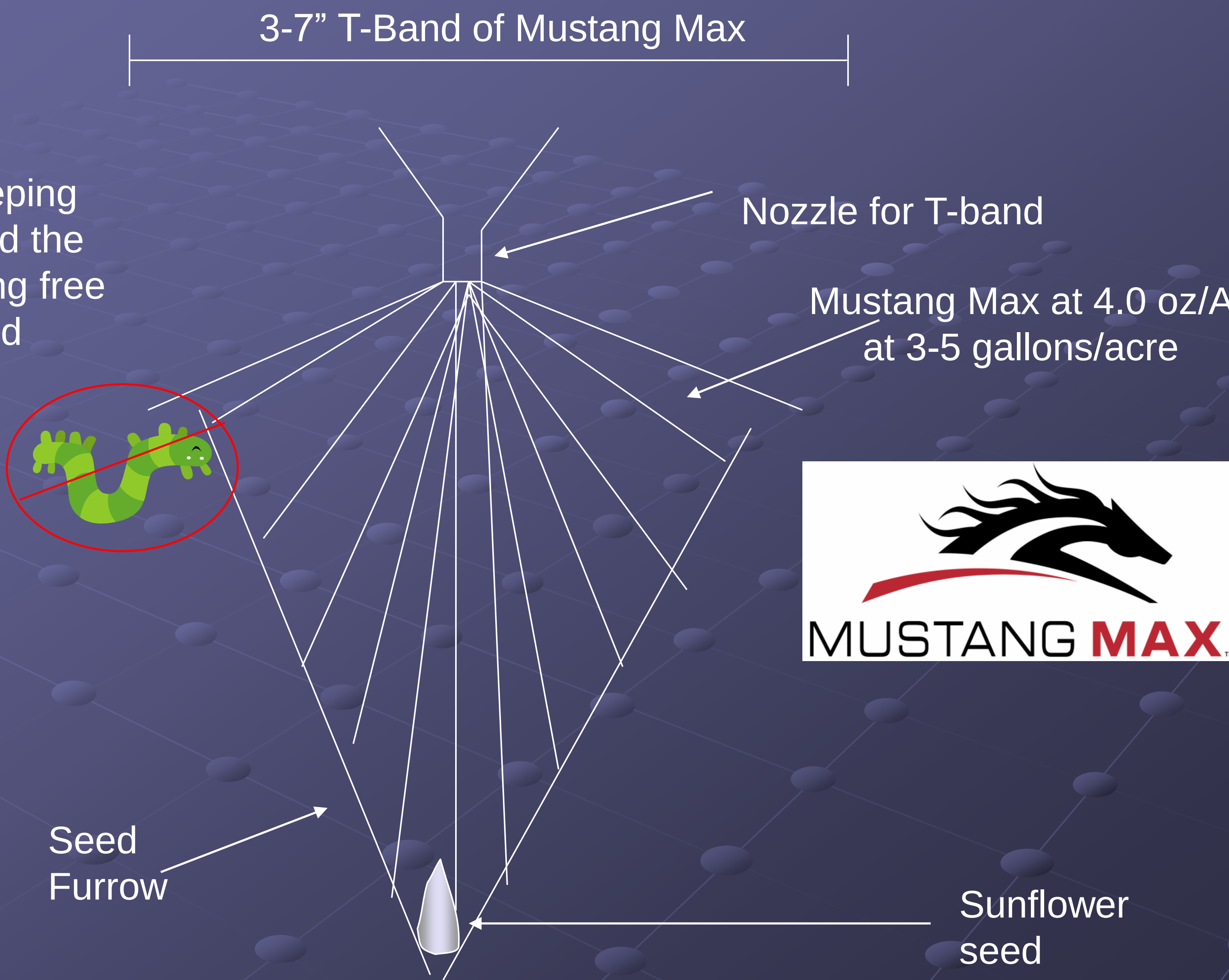
If more than one wireworm per trap, use soil insecticide or insecticide seed treatment!

Insecticide treated seed

Applications of Mustang Max in the furrow

Contact only Insecticide, keeping the band around the growing seedling free of wireworm and cutworm

It's a "zone of protection"



MUSTANG MAX™

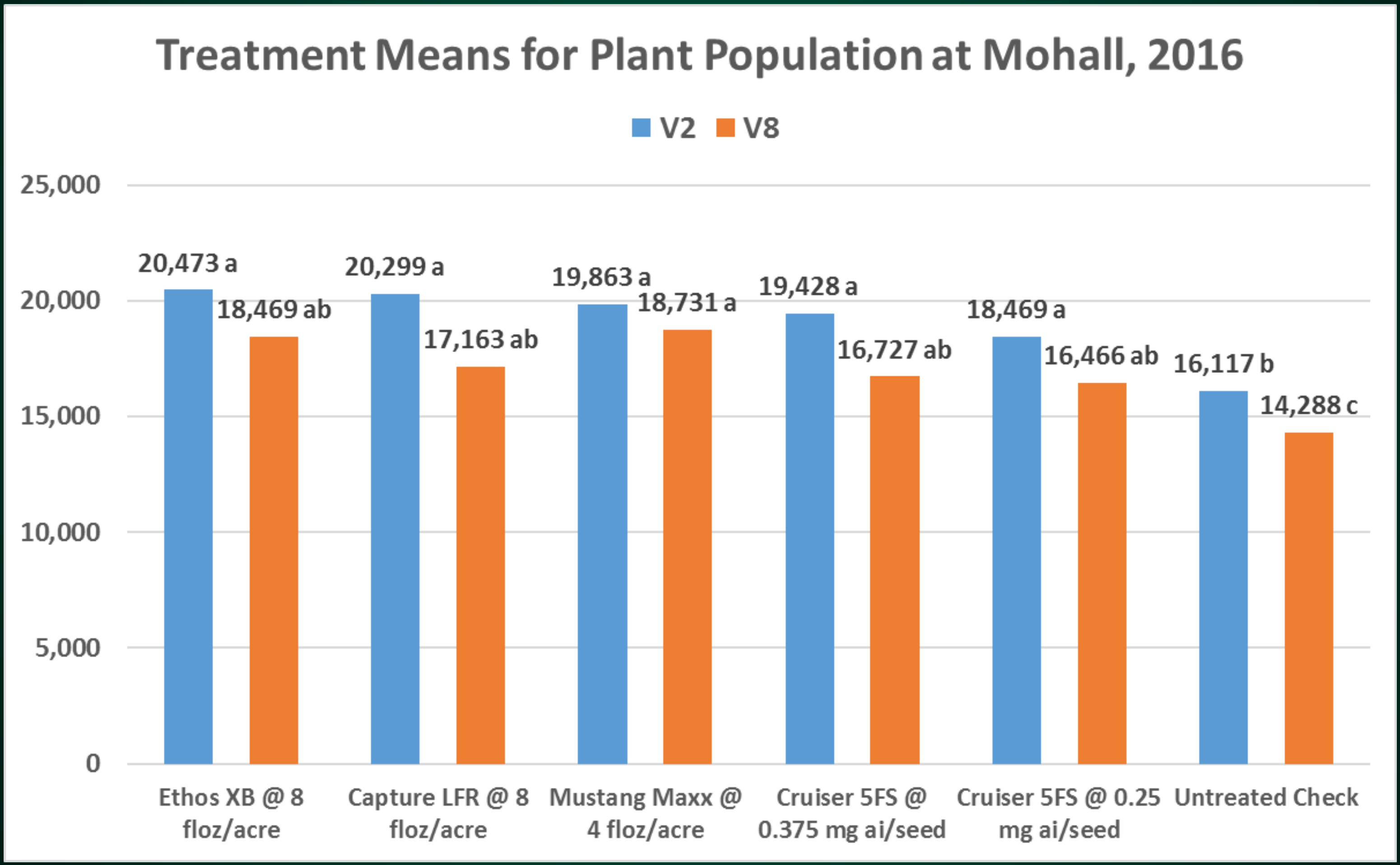
Wireworm ‘Control’

- Insecticide use is a preventive strategy – there are no rescue treatment options
- Insecticide seed treatments and in-furrow pyrethroid applications provide seedling protection – they do not provide significant wireworm mortality
  - Neonicotinoid seed treatments (such as thiamethoxam) cause ‘temporary’ morbidity
  - Pyrethroids (such as bifenthrin) are repellents and nonlethal

In-furrow Pyrethroid and Neonic Seed Treatment Efficacy Trial in Sunflowers

- Cruiser 5FS at 0.25 mg ai/seed
- Cruiser 5FS at 0.375 mg ai/seed
- Mustang Maxx in-furrow at 4 fl oz/acre
- Capture LFR in-furrow at 8 fl oz/acre
- Ethos XB in-furrow at 8 fl oz/acre
- Untreated Check
- All seed treated with Apron XL

In-furrow Pyrethroid and Neonic Seed Treatment Efficacy Trial



NDSU EXTENSION SERVICE

Wireworm Stand Loss

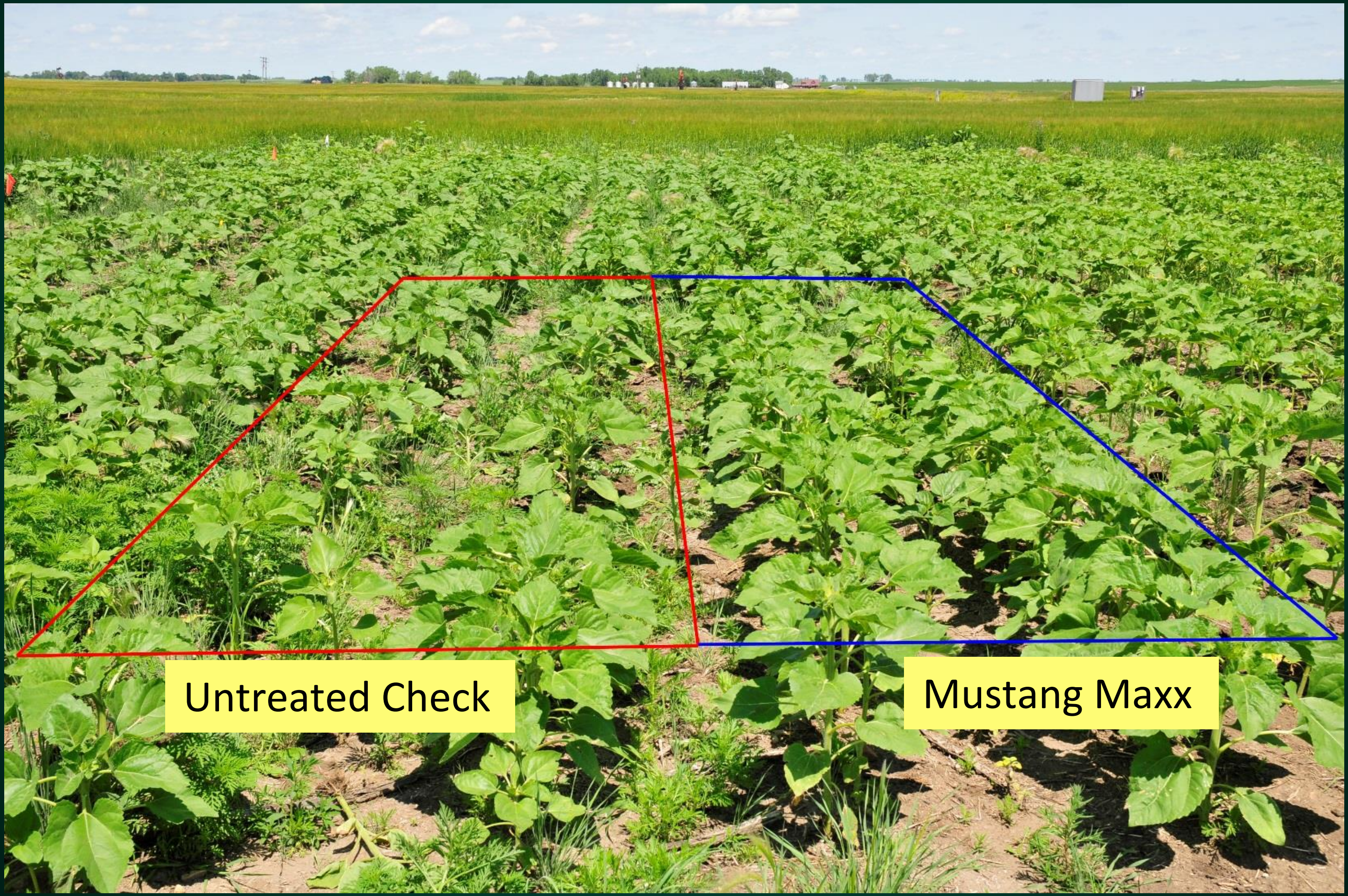
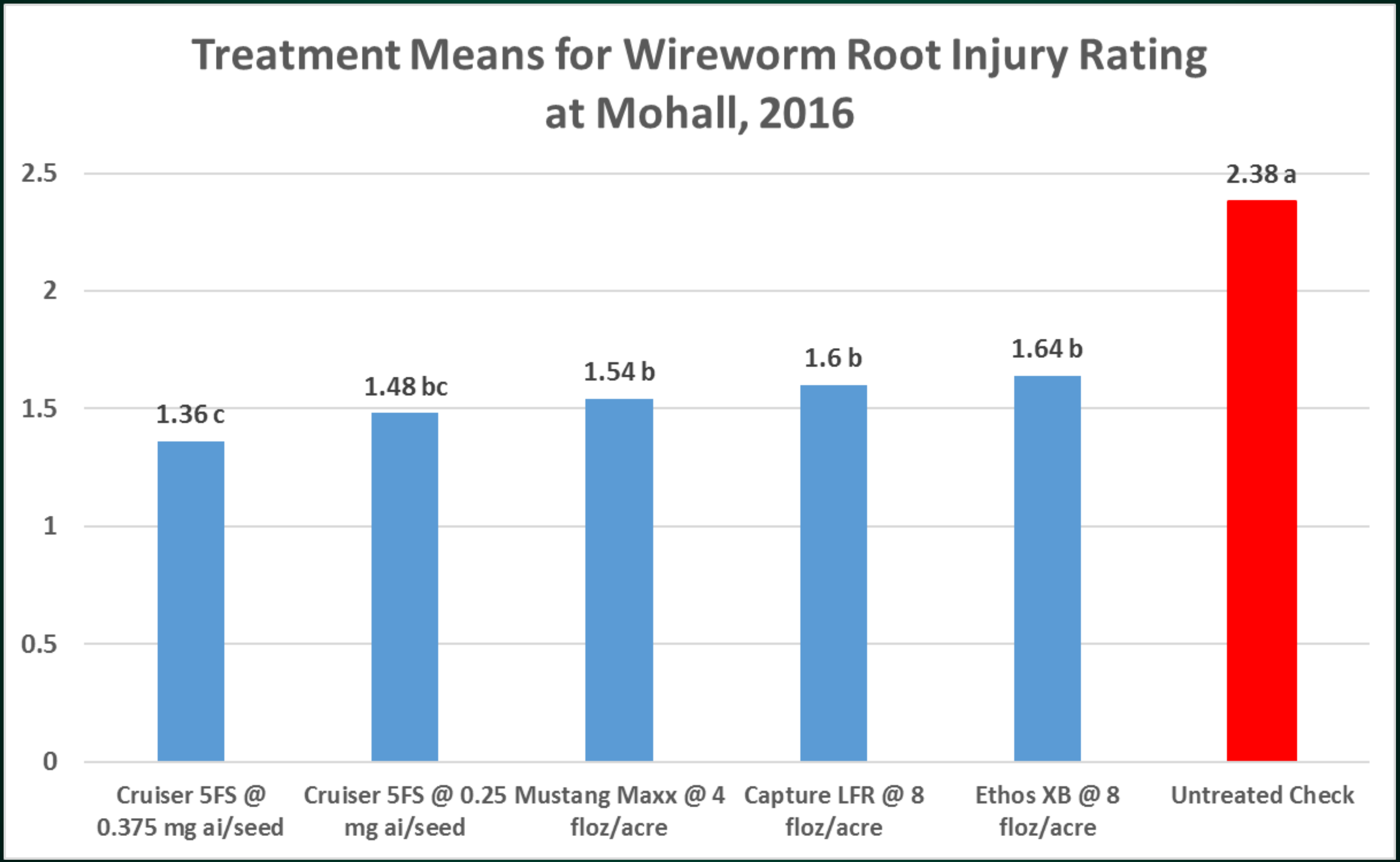


Photo by P. Beauzay

In-furrow Pyrethroid and Neonic Seed Treatment Efficacy Trial



Wireworm Management

- Thiamethoxam seed treatment and in-furrow pyrethroid applications provided acceptable protection
- Consider your crop rotation and know your field history
- Weed management
- Adjust seeding rate +10% to compensate for wireworm stand loss

Pea Leaf Weevil
Sitona lineata L.

- Discovered in Beech, Golden Valley County, SW ND in fall 2016
- Feeds on field peas, dry beans, faba beans
- Not hosts – chickpea, lentil
- Secondary hosts – alfalfa, clover (larvae do not develop)

Figure 1: Adult *S. lineatus* on pea leaf (Photo: L. Dosdall).

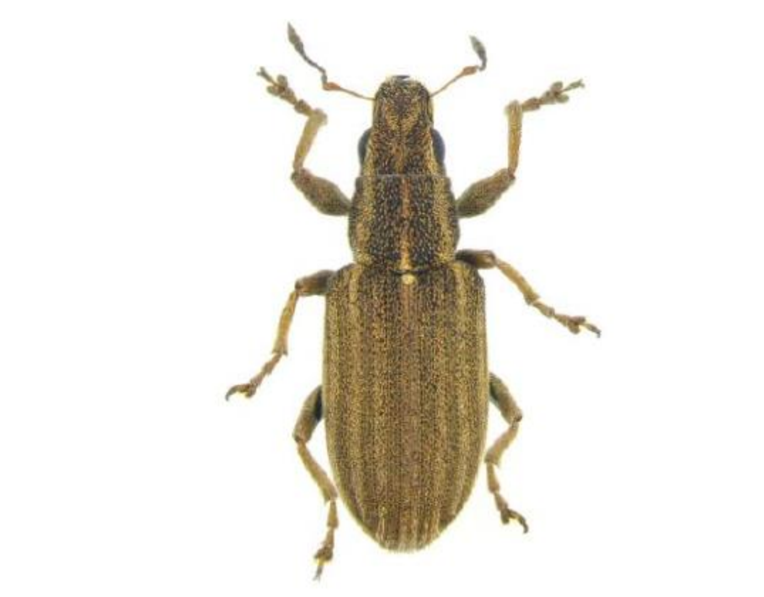


Figure 2: Dorsal view of adult *S. lineatus* (Photo: H. Goulet).

NDSU EXTENSION SERVICE

Pea Leaf Weevil Injury

- Pest of **seedling** pea plants
- Adult – chew feeding notches on leaves; often higher on field edges or fields next to pastures or riparian areas.
- Larva – chew and tunnel in nitrogen-fixing nodules
- Reduce nitrogen fixation by plant and poor plant growth and low seed yields

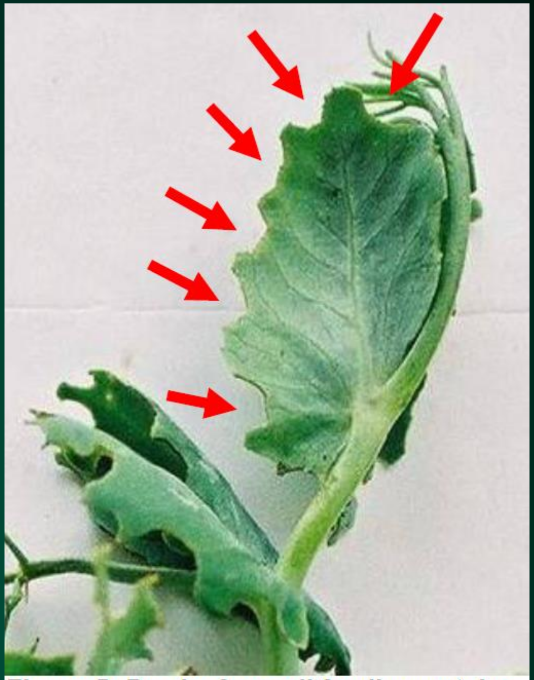


Figure 5: Pea leaf weevil feeding notches on clam leaf (Photo: L. Dosdall).

Figure 7: Pea nodules damaged by larval feeding (Photo: L. Dosdall).

New Detections of Pea Leaf Weevil

- Must be confirmed by a trained entomologist
- Mail specimens in vial to:
- Dr. Janet Knodel or Pat Beauzay
  NDSU Extension Entomology
  NDSU Dept. 7660, PO Box 6050
  Fargo, ND 58108
- 701-231-7915
- https://www.ag.ndsu.edu/extensionentomology/

NDSU Crop & Pest Report

- Free to subscribers with email but **MUST SIGN-UP ON WEBSITE!!!**
  - http://www.ag.ndsu.edu/cpr/