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

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2015 Wheat Midge Larval Survey
North Dakota

Low Risk:
Burke, Divide, Renville, Sheridan, Ward

0 – 429 midge larvae / m²
Average = 25 midge larvae / m²
2016 Wheat Midge Larval Survey
North Dakota

High Risk:
Burke, Divide

0 – 2,071 midge larvae / m²
Average = 42 midge larvae / m²

Midge larvae / sq m

0 1-200 201-500 501-800 801-1200 >1200 Not surveyed
Highest Parasitism rate in Bottineau, Burke and McLean counties
Average = 4.8% parasitism rate
89% of samples had 0% parasitism
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

Non-resistance wheat
Egan Wheat Variety

- 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)

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

Source: Bob Stougaard, Montana State University
Northwestern Agricultural Research Center
Off Station, 2016

Source: Bob Stougaard, Montana State University
Northwestern Agricultural Research Center
Effect of Sm1 genetic resistance on OWBM, 2012.

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<th>Cultivar</th>
<th>OWBM no./spk</th>
<th>Yield bu/A</th>
<th>Protein %</th>
<th>TWT lb/bu</th>
<th>FN sec</th>
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<td>52</td>
<td>17.8</td>
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</tbody>
</table>

Source: Bob Stougaard, Montana State University Northwestern Agricultural Research Center
Spring Wheat Yield Comparison, 2016

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
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
  – *Collyria 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
Parasitoid Conservation

![Graph showing cutting height and parasitoids emerged]

Taller residue is better

Parasitoids Emerged

Source: D. Weaver, MSU

Parasitoid pupa in stem
Negative – Destroy parasitoids!
Survey of *Bracon* spp. 1999-2001

Genetic Divergence of Wheat Stem Sawfly: Implications for Pest Management

- Different biological characteristics which may respond 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
Wireworms Life Cycle

- Become active when soil temperature reaches 50°F
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

Untreated check
Damaged by wireworm

Insecticide treated
Not damaged by wireworm

Rating 10
Rating 1

Photo by J. Knodel
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

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

Insecticide treated seed

No soil insecticides registered in wheat or barley

T-band system
Applications of Mustang Max in the furrow

3-7” T-Band of Mustang Max

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

It’s a “zone of protection”

Nozzle for T-band

Mustang Max at 4.0 oz/A at 3-5 gallons/acre

Seed Furrow

Sunflower seed
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

Treatment Means for Plant Population at Mohall, 2016

- Ethos XB @ 8 floz/acre: 18,469 ab, 20,473 a
- Capture LFR @ 8 floz/acre: 17,163 ab, 20,299 a
- Mustang Maxx @ 4 floz/acre: 18,731 a, 19,863 a
- Cruiser 5FS @ 0.375 mg ai/seed: 16,727 ab, 19,428 a
- Cruiser 5FS @ 0.25 mg ai/seed: 16,466 ab, 18,469 a
- Untreated Check: 16,117 b, 14,288 c
Wireworm Stand Loss

Untreated Check  Mustang Maxx

Photo by P. Beauzay
In-furrow Pyrethroid and Neonic Seed Treatment Efficacy Trial

Treatment Means for Wireworm Root Injury Rating at Mohall, 2016

- Cruiser 5FS @ 0.375 mg ai/seed: 1.36 c
- Cruiser 5FS @ 0.25 mg ai/seed: 1.48 bc
- Mustang Maxx @ 4 foz/acre: 1.54 b
- Capture LFR @ 8 foz/acre: 1.6 b
- Ethos XB @ 8 foz/acre: 1.64 b
- Untreated Check: 2.38 a
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)
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
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!!!
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