Identifying and Management of Insect Pests on the Farm - Wheat, Canola and Legumes

Dale Whaley – Washington State University Extension
Dave Crowder – Washington State University
Pest

“Any organism that affects or conflicts with human profit, convenience or welfare.”
Identification Rules

1. Be accurate
2. Never guess at or “fake” an ID
3. Don’t be afraid to seek assistance
Having Trouble Deciding What You Have?
WSU Plant/Pest Diagnostic Clinic

Rachel Bomberger, M.S.
Plant Diagnostician
(509)335-3292
rachel.bomberger@wsu.edu
Insect Resources

Overview

Introduction to common insects that affect wheat and small grains farmers. Each profile includes information on insect identification, detection, management and prevention.

Find Information on:

- Aphid
- Army Worm
- Cereal Leaf Beetle
- Convergent Lady Beetle
- Sawfly
- Seven-spotted Lady Beetle
- Soft-winged flower beetles
- Wheat Midge
- Wireworms

Wheat and Barley Insect Pest Surveys

Timely Topics

Pullman WSU Plant Diagnostic Clinic Accepting Samples
January 22, 2016

Update on Grasshoppers in Small Grain Crops
June 25, 2015

New Survey System Updates Growers on Pest Populations

Special Feature

Aphid

Aphids can be problematic pests in wheat. There are several species of aphids in wheat fields. These include the English grain aphid and the bird–cherry oat aphid. Different species have different life cycles. Aphids do little direct damage to wheat plants but can be problematic due to transmission of viruses.

Interested in learning about other insects that affect wheat? Visit our Pest Insect, Occasional Pest, and Beneficial Insect lists.
Remember…

Proper identification is key to successful management!

If using a pesticide, be mindful of pollinators and always read and follow all label instructions.
Insect Pests in Cereals

Key pests

Wireworms*

Aphids

Hessian fly
Insect Pests in Cereals

Occasional pests

Grasshoppers, Wheat midge

Wheat Head Armyworm

Cereal leaf beetle*
Wireworm Damage to Wheat

Dead plant
No wireworm(s)

Nearly dead plant
No wireworm(s)

Soon to be dead plant
May find wireworm(s)
Wireworms are a Complex

- *Limonius infuscatus*
- *Limonius californicus*
- *Hemicrepidius sp.*
- *Hadromorphus glaucus*
- *Selatosomus pruininus*
- *Selatosomus aeripennis*
- *Sylvanelater limoniiformis*
- *Hypnoidus bicolor*
- *Melanotus oregonensis*
- *Dalopius asellus*
- *Ampedus sp.*
- *Agriotes sp.*
- *Aeolus mellillus*
Wireworms are a Complex

Sugarbeet wireworm, *Limonius californicus* (Mannerheim)

Western field wireworm, *Limonius infuscatus* Motschulsky

Great basin wireworm, *Selatosomus pruininus* (Horn)
Why is This Important?

Population dynamics

Feeding activity
Experiments

- Gray storage bins (70 l) – experimental units
- Wheat plants (10/unit)
- Wireworms (12/unit)
- Substitutive design
Damage Experiment
Wireworm diversity not key

Plant components

- **A** Plant dry mass (g)
  - Absent: a
  - One: b
  - Two: b
  - Three: b

- **B** Root dry mass (g)
  - Absent: a
  - One: b
  - Two: b
  - Three: b

- **C** Number of produced heads
  - Absent: a
  - One: a
  - Two: a
  - Three: a

Seed components

- **A** Seed viability (%)
  - Absent: a
  - One: c
  - Two: b
  - Three: b

- **B** Grain weight (g)
  - Absent: a
  - One: a
  - Two: a
  - Three: a

\( \alpha = 0.05 \)
Damage Differs by Species

Plant components

Seed components

α = 0.05
Damage Differs by Species

Plant components

A. Plant dry mass (g)
B. Root dry mass (g)
C. Number of produced heads

Seed components

A. Seed viability (%)
B. Grain weight (g)

α = 0.05
Field Experiments Confirm This
Where Do These Species Live?

Surveys

20 counties
What Hosts Do They Use?

40 spring wheat

20 winter wheat

20 CRP
Where Do Wireworms Live?

A

Total wireworm abundance

Crop type

SW

WW

CRP

B

Number of species

Crop type

SW

WW

CRP
Find Out What You Have?

IDENTIFYING WIREWORMS IN CEREAL CROPS

By

Ivan Milosavjevic, Washington State University Department of Entomology, Aaron D Eber, Washington State University Extension, David W Crowder, Washington State University Department of Entomology

WSU PEER REVIEWED

FS175E
Damage Differs by Crop

Comparison of yield (kg/hectare) for different crops:
- **Barley**:
- **Oats**:
- **Wheat**:

- **Control** (hatched bars)
- **Imidacloprid** (solid bars)

Statistical significance marked with an asterisk (*)
Wireworms are a complex...
Novel Control Methods?

PERCENTAGE OF WIREWORM MORTALITY

- Capture...
- Capture...
- Untreated...
- Untreated...

Capture...
Capture...
Untreated...
Untreated...
Current Status and Management of Hessian fly in Eastern Washington
Hessian fly –
Mayetiola destructor Say
Hessian fly biology and importance

Females hatch with moist and moderate weather. Lay eggs on leaves of cereals or grasses.

Spring wheat is the preferred host.

Two generations per year, one in the spring and one in the early summer, occur in this region.
Hessian fly life cycle

Life Cycle

- Adult flies
- Egg laying
- Larvae (maggots)
- Pupae (flaxseeds)
- Overwintering pupae

Time of Attack to Small Grains

- April
- May
- June
- July
- August
- Sept.
- Oct.
Hessian fly biology and importance

- Larvae develop at the base of the plant and survive adverse weather conditions as puparia.
- Larval feeding results in stunting, lodging, reduced yield and lower grain quality.
- Yield losses in susceptible varieties has ranged from 11 to over 40%.
Hessian fly
Hessian fly is increasing in importance

- Damaging infestations occurring more broadly in recent years.

- Evidence of resistance source losing effectiveness.
Rotations, Systems & Risk

- Winter wheat/ Spring wheat/Fallow - higher risk
- Annual spring wheat - very high risk
- Later planting - often higher risk in spring/lower risk in fall wheat
- Direct seed - higher risk
- Spring wheat adjacent to winter wheat - higher risk
- Poor volunteer control - higher risk
Sampling and Thresholds

- Sweeping

- Visual inspection – 5 plants (10X) and visually inspect for 30 seconds

- Pheromone traps – Males only

- If adults are detected, then tillers should be checked for eggs/larvae to determine pest levels.

- Treatment/Action if 20% of tillers in WW or 38% of tillers in SW are infested (Schmid et al 2018).
Hessian fly control

- Resistant varieties provide the most efficient means of control*

- Rotation and other cultural practices also valuable.
  - Planting/Hessian fly free date
  - Control of volunteer wheat

- Insecticides options…
  - Seed treatments Gaucho (Imidacloprid) and Cruiser (thiamethoxam). Foliar treatments Silencer (Lamda-cyhalothrin
Wheat resistance genes failing to stop Hessian flies

Brian Wallheimer, Purdue University
Jan. 24, 2011 11:18am

- Many of the genes that allow wheat to ward off Hessian flies are no longer effective and care should be taken to ensure that resistance genes that so far haven't been utilized in commercial wheat lines are used prudently, according to U.S. Department of Agriculture and Purdue University scientists.

Many of the genes that allow wheat to ward off Hessian flies are no longer effective in the southeastern United States, and care should be taken to ensure that resistance genes that so far haven't been utilized in commercial wheat lines are used prudently, according to U.S. Department of Agriculture and Purdue University scientists.
Other considerations

- Local populations of HF are selected
  - Hessian fly doesn’t travel much
- Repeated use of same resistance gene will/has led to breakdown
- Winter wheat has served as refuge crop
- Evidence of Louise/Diva source of resistance losing effectiveness
### 5. Hard Red Spring Wheat (DNS) Varieties

#### Over 20" precipitation zone

**Last updated: 10/18/2017**

<table>
<thead>
<tr>
<th>Variety Name</th>
<th>Yield (Bu/A)</th>
<th>Test Weight (lbs/bu)</th>
<th>% Protein</th>
<th>Plant Height Inches</th>
<th>Heading Date (Julian Days)</th>
<th>Stripe Rust Rating</th>
<th>Russian Fly Rating</th>
<th>Lodging (%)</th>
<th>Quality Rating</th>
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Data points with any number of * symbols indicate a variation in the number of locations years from the rest of the data set. Click on the variety to learn more.

**Directions – Sorting, column order, details, filtering, and exporting**
- By default the data is sorted by yield, but you can change the sort by clicking on the column header which will switch the data order between ascending and descending.
- Holding shift and clicking on multiple columns with create a multi sort in which the table is first organized by the first column click, then the second column click, and so forth.
- Clicking on the column header will allow you to drag and drop the columns to the left or right and rearrange the table.
- Right-clicking the column header will open a menu that allows you to alter which data points are visible in the table.
- Using the text box at the top of the column you can filter for specific data points using numeric inequalities like <10 or >50 or keywords. To don't want to see use a 1 symbol (acceptable).
- Use the export above the table to save the table to your desktop as CSV file, which can be opened in excel. The changes you have made to the table are not saved.

- • 1,2 = Resistant
- • 3,4 = Moderately Resistant
- • 5 = Moderate
- • 6,7 = Moderately Susceptible
- • 8,9 = Susceptible
Cereal Aphids in Wheat
Bird-Cherry Oat Aphids in Wheat
Insect Pests of Pulses

Pea Weevil
*(Bruchus pisorum)*

Pea Leaf Weevil
*(Sitona lineata L.)*
Pea Weevil Life Cycle

1. Adult emerges from pea
2. Feeds on pollen
3. Lays eggs on pea pod
4. Pea weevil pupates in pea seed
5. Larva emerges and bores into pod and feeds on pea contents
Pea Leaf Weevil, *Sitona lineata*

- **April - June:** Adult weevils emerge and fly into pea fields; “notch” leaves of emerging peas.
- **June - July:** Tiny larvae crawl through the soil and feed inside the nitrogen fixing root nodules.
- **Sept - Mar:** Adult weevils fly out of the pea fields and overwinter in surrounding areas.

**May - June:** After mating, the adult females scatter eggs on the soil.

**July - August:** Larvae complete their development and emerge from the soil as new adults.
Despite an increase in the number of planted pea acres in Adams, Douglas, Grant and Lincoln counties, (18,182) in 2017 yields didn’t seem to reach their potential for that area. 
Reson = Pea Weevil, Bruchus pisorum.

A second impact to feeding by this pest is that it can make plants more susceptible to aphids and aphid-transmitted viruses.

Field peas showing virus symptoms (possibly pea enation mosaic virus and bean leaf roll virus).
In Addition to Reduced Yields, H.L.G. imposed the Following Dockage:

US #1 Max weevil damage 0.3%
US #2 Weevil damage 0.3% - Max 0.7%
US #3 Weevil damage 0.8% - Max 1.5%
Market Scales- >1.5%

“Discount schedule for weevil damage will probably be -.25/cwt for #2, -$.50/cwt for #3 and $1.00/cwt Market Scales” H.N.
Objective 1: Develop a monitoring protocol and better define when this pest is active.

Objective 2: Generate data on economic thresholds for the Pea Weevil / Send out pest alerts. *(Action Threshold =1 in 25 sweeps)*

Objective 3: Extension of the information.
Monitoring Results:

Pea weevil - Bruchis pisorum Counts

May 2nd | May 9th | May 16th | June 1st

<table>
<thead>
<tr>
<th>Bruchis pisorum</th>
<th>Sitona lineata</th>
<th>Bruchis pisorum</th>
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 EMAIL

Waterville 1  Waterville 2  Waterville 3  Waterville 4  Farmer  Waterville 5
Monitoring Results:

Pea weevil - Bruchis pisorum Counts

<table>
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<tr>
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</tbody>
</table>

- 2X (D, L)
- 9X (D, SP)

Stitona lineata?
Impact:

From: Howard Nelson [mailto:howardn@highlinegrain.com]
Sent: Wednesday, July 11, 2018 6:44 PM
Subject: New company high yield, 4500 lbs.ac on first production field harvested

Hi,

I just wanted to pass on the news that Derek Schafer of Ritzville has set a new company high dryland yield record of 4500 lbs/ac...on the first field that was harvested.

From: Howard Nelson [mailto:howardn@highlinegrain.com]
Sent: Thursday, July 19, 2018 6:03 AM
To: a_landreth@hotmail.com; Aaron Reimer (doubleafarmsjv@gmail.com) <doubleafarmsjv@gmail.com>; Aaron Viebrock (ajviebrock@hotmail.com)
Subject: New company record yellow pea yield, Brad Gering, Bee Dee Farms

Good Morning,

Brad Gering of Bee Dee Farms has shattered our company dryland fall planted pea yield record with a phenomenal yield of 6,876 lb/ac. I have to say I am speechless... This yield came from a 60 acre field of Windham yellow peas in the Ritzville area.

Howard R Nelson
Manager of Member/Special Services
Highline Grain Growers, Inc
PO Box 185
145 N Aspen
Reardan, WA 99029
howardn@highlinegrain.com
509-796-4141
509-641-0281 Cell
Examining the community ecology of pea-enation mosaic virus

Dave Crowder
Washington State University
Outline

1. Do weevils affect the spread of pea-enation mosaic virus in pea crops?

2. Do soil rhizobia affect the susceptibility of peas to aphids and pea-enation mosaic virus?
Typical Framework for Plant-Insect-Pathogen Interactions

Mauck et al 2012
Eavesdropping
Concurrent infections
Herbivore feeding

Choose infected host

Anti-predator behavior

Move to uninfected host

Latent period

Parasitism

Vector phenology

Transmission

Physical plant defenses

Host Infection

Vector reproduction

Predation

Competition

Plant health

Plant species

State of primed defenses

Acquisition

Vector

Crowding with competitors

Anti-predator behavior

Herbivore-induced plant volatiles
Study System

- Pea, *Pisum sativum*
- Pea aphid, *Acyrthosiphon pisum*
- Pea enation mosaic virus (PEMV)
- Pea leaf weevil, *Sitona lineatus*
Do Communities differ on Infected Plants?
Unraveling the System
Infectious plants are defoliated more

Chisholm et al. 2018 (in press)
Questions

1) Do weevils affect PEMV in plants and does PEMV in plants affect weevils?

2) Do weevils affect the spread of PEMV?
Does weevil feeding affect PEMV?
Weevil feeding increases PEMV titer

Chisholm et al. 2018
Does weevil feeding affect aphid choice?
PEMV-infective aphids prefer weevil-damaged plants

Chisholm et al. 2018 (in press)
Does PEMV affect weevil choice?
Weevils prefer infected plants

![Graph showing leaf area removed by uninfected and infected plants.](image-url)

Chisholm et al. 2018 (in press)
Virus attracts weevils to plant
Weevils increase virus titer
What about Virus Transmission?
Weevils promote spread of PEMV

Chisholm et al. 2018 (in prep)
Unraveling the effects (SEM)

Chisholm et al. 2018 (in prep)
Phytohormone Experiment

2 PLW/plant for 48 h (W+)

(W-)

Clean aphids 10 per plant for 48 h (A-)

10 PEMV infected pea aphid/plant for 48 h (A+)

A+ A- A+ A- W+ W- W+ W-

Evidence for mutual antagonism... PEMV inhibits anti-weevil defenses

Basu et al. (submitted)
Evidence for mutual antagonism... Weevils inhibit anti-PEMV defenses
Complex Web of Interactions

Fitness
Movement
Questions

1) How do soil rhizobia affect PEMV?

2) How does PEMV affect soil rhizobia and nitrogen fixation in legumes?
20 adult infective aphids released
Rhizobia help counteract the negative effects of soil sterilization

Chisholm et al. (in press)
Unraveling the effects (SEM)

Chisholm et al. (in press)
Mutual antagonism between soil rhizobia and PEMV

Basu et al. (submitted)
Acknowledgements

Who did the work:
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- Saumik Basu
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- Akaisha Charlton
- Abigail Cohen
- Ben Lee
- Rachel Olsson

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- Kayla Fillon
- Janelle Badger
- Laura Rafferty
- Matt Brousil
Insect Pests of Canola

- Cabbage Seedpod Weevil
- Cabbage Aphid
- Lygus bug
- Flea Beetle
- Grasshopper
Cabbage Seedpod Weevil

Adult weevils are ash-grey in color, approximately 3 to 4 mm long and have a prominent curved snout with “elbowed” antennae.
Cabbage Seedpod Weevil Lifecycle

- **WINTER**
- **SPRING**
  - Flight 12°C
- **SUMMER**
  - Adults overwinter
  - Feeding on floral buds, seeds, and young seedpods. Egg-laying in young pods.
  - Larval development in seedpods.
- **FALL**
  - Pupation in the soil.
  - Adults emerge in August, feed, and overwinter in leaf litter.
Cabbage Seedpod Weevil Damage/Symptoms
Cabbage Seedpod Weevil Damage/Symptoms
Cabbage Seed Pod Weevil Monitoring

When: Look for CSPW when the crop first enters the bud stage and continue through the flowering period. (10) sweeps, perimeter and interior parts of the field.
Cabbage Seedpod Weevil
Thresholds/Management

Insecticide application is warranted when an average of 3 to 4 adult weevils are collected per sweep.
Cabbage Seedpod Weevil Management Options:

Cultural control:
- At present, trap cropping is the most promising cultural strategy for controlling the cabbage seedpod weevil.

- By planting a trap border of early flowering Canola, Cabbage seedpod weevils may be controlled with an insecticide applied to the perimeter before they spread throughout the field.

- Alternatively, a strip of the same variety planted seven to 10 days before the rest of the field, can serve as a trap for adult weevils.
Cabbage Seedpod Weevil Management Options:

Chemical: Foliar Treatments
There are several registered insecticides like: Bifen 2 AG Gold, Besiege, Delta Gold, Declare, Warrior II, and Mustang Maxx sprays that can be used once populations have reached action or treatment threshold levels.

Chemical: Seed Treatments
Gaucho 600

Remember: Spray late in the day to minimize harmful effects to beneficial insects in the crop, especially bees.
Aphids are small pear-shaped insects that may be green, yellow, brown, red, or black depending on the species and the plants they feed on. The presence of cornicles (a pair of tube-like structures attached to the abdomen) distinguishes aphids from all other insects.
Figure 2. General life cycle of aphids. Asexual reproduction occurs during most of the year (summer cycle). Some aphid species produce a generation of sexual individuals that produce overwintering eggs as shown in the winter cycle.
Cabbage Aphid Damage/Symptoms:

- Canola damaged in the seedling stage appears stunted and is more susceptible to winterkill.
- Damaged seedlings will have curled leaves with shortened nodes. The canola may exhibit a purplish tint associated with plant stress.
Cabbage Aphid Damage/Symptoms:
Aphid populations that develop during early bloom and pod-fill can cause deformed, stunted or completely sterile pods. Black sooty mold is also associated with aphid colonies. Aphids have also been reported to transmit several viruses to canola.
Cabbage Aphid Damage/Symptoms:
Cabbage Aphid Monitoring:

When: Look for Aphids from the seedling stage all the way through bloom.
- Crops should be scouted bi-weekly

Signs and Symptoms: Look for individual or masses of aphids, deformed, stunted or completely sterile pods

Remember: Aphids are small, so a hand lens or loop may help with identification.
Cabbage Aphid Thresholds/Management:

Treat for aphids when populations exceed:
- 2 per plant in the seedling stage
- 5 per leaf in the rosette stage
- or when 20 percent of the heads are infested during bloom.
Cabbage Aphid Management Options:

**Biological:**
Several natural enemies help to regulate aphid populations. The most important are a parasitic wasp and predatory ladybird beetle larvae and adults.
Cabbage Aphid Management Options:

When you see aphid mummies….think twice about spraying!
Cabbage Aphid Management Options:

Chemical: Foliar Treatments
Bifen 2 AG Gold, Besiege, Whirlwind, Beleaf, Declare, Warrior II, Transform and Mustang Maxx sprays that can be used once populations have reached action or treatment threshold levels.

Chemical: Seed Treatments
Helix, Helix Vibrance, Prosper, Prosper EverGol, Goucho

Remember: Do not treat canola after late pod-fill stage. Aphid populations can continue to increase until pod stage and can cause early flower termination.
Grasshoppers

- Eat \( \frac{1}{2} \) bodyweight forage per day.
- Damage is usually confined to field margins.
- However, during high population outbreaks, total stand loss has been known to occur.
- The economic or action threshold is 7 to 12 grasshoppers per square meter.
Grasshopper Management Options:

**Chemical:**
There are several registered Insecticides like: Bifen 2 AG Gold, Besiege, Delta Gold, Declare, Warrior II and Mustang Maxx sprays that can be used once populations have reached economic threshold levels.
QUESTIONS?
Flea Beetle

Flea beetles belong to the Family: Chrysomelidae and jump like “fleas” when disturbed hence the name. They are bluish-black, 2 – 3 mm and have enlarged hind legs.

Flea Beetles - *Phyllotreta Cruciferae* (Goeze)
Flea Beetle Life Cycle

- **Fall**: Summer generation of adults July - Oct.
- **Winter**: Overwintering adults emerge
- **Spring**: Overwintering adults emerge
- **Summer**: EGG (May - June), LARVA (June - July), PUPA (July - August), ADULT (July - August)

- **April**: Adults emerge and feed on seedlings
- **May**: Egg laying
- **June**: Larvae, Pupation, Overwintering adults die off
- **July**: Adults emerge
- **August**: Adults feed and go to overwintering sites
- **September**
- **October**

Greatest damage
Flea Beetle Damage

Thresholds/Management:
- Scout every 2 to 3 days in warm weather.
- The economic threshold for flea beetle feeding on canola is when there is 25% defoliation and flea beetles are present.
Flea Beetle Management Options:

Chemical:
Seed Treatments:
• Helix Xtra/Cruiser 5FS, Prosper 400, Helix Vibrance or Prosper Evergol

If Seed Treatments wear off; Foliar rescue treatments may be needed…
• Bifen 2 AG Gold,
• Besiege, Delta Gold,
• Declare, Warrior II, and
• Mustang Maxx sprays
Lygus bug (Tarnished Plant Bug)

- Adult are approximately 3 mm wide and 6 mm long, oval, colored pale green to reddish brown or black. They can be solid shaded or mottled, and have a distinctive triangle or V-shape on their backs.

- Larger nymphs have black dots on thorax and back abdomen.
Lygus bug Damage/Symptoms:

- Adult bugs feed on developing buds, flowers, and seedpods resulting in distortion and abortion of seed pods (blasting). Yield losses of up to 20% have been observed. Greatest damage occurs between June and August.
Immature lygus bug vs. aphid

No tailpipes, black dots, sprinter

Tailpipes, no dots, jogger
Lygus bug Thresholds/Management:

Treat for Lygus bugs if counts are 15 Lygus bugs per 10 sweeps from bud stage through petal drop, and 20 Lygus bugs per 10 sweeps after petal drop.

Once the seeds have ripened to yellow or brown, the cost of controlling Lygus bugs may exceed the damage they will cause prior to harvest, so insecticide application is not warranted.
Lygus bug Management Options:

Chemical:
There are several registered Insecticides like: Imidacloprid (seed treatment), Bifen 2 AG Gold, Besiege, Delta Gold, Beleaf 50 SG, Declare, Warrior II Mustang Maxx and Pyronyl crop sprays that can be used once populations have reached economic threshold levels.
Questions?

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