Objective

Overview of ..................

• CLB History/Background and Economic Implications

• CLB Biology, Phenology & Injury Symptoms

• Integrated Pest Management Options
Cereal Leaf Beetle
Oulema melanopus (Coleoptera:Chrysomelidae)

• Native to Europe and Asia

• First official record in U.S. = Michigan 1962

• Now widespread across eastern & mid-western states and into Canada

• First found in OR, ID & WA in 1999
Cereal leaf beetle and larval parasitoid wasp (T. julis) distribution in Oregon - 2010

ODA IPPM Annual Survey = 24 infested counties in 2012
2009 ISDA CEREAL LEAF BEETLE SURVEY INFESTED COUNTIES

Uninfested County

Infested Counties

Oulema melanopus

Oregon State University
Yield Loss Potential – Small Grains

Yield Loss = damage level + crop stage/vigor
dryland –vs- irrigated, low –vs- high vigor

In OR and WA, yield losses up to 25% in spring wheat and 18% in winter wheat have been observed.

In eastern/mid-western states, yield losses up to 55% in spring wheat and 75% in oats & barley.

Low yield impact when damage occurs during late head fill.
Acreage Treated & Estimated Cost of CLB Control in OR

[Bar chart showing year on the x-axis from 1999 to 2008 with corresponding acreage and estimated cost values.]

- **Acres Treated**
  - 1999: 0
  - 2000: 1000
  - 2001: 5000
  - 2002: 20000
  - 2003: 40000
  - 2004: 60000
  - 2005: 80000
  - 2006: 60000
  - 2007: 40000
  - 2008: 20000

- **Estimated Cost**
  - 1999: $0
  - 2000: $100,000
  - 2001: $200,000
  - 2002: $300,000
  - 2003: $400,000
  - 2004: $500,000
  - 2005: $600,000
  - 2006: $800,000
  - 2007: $700,000
  - 2008: $900,000
CA Exterior Quarantine for CLB

CLB not found in CA.....restrictions for certain ag products entering CA
  • Small grains, straw/hay, grass sod, grass & forage seed, fodder/plant liter, Christmas trees, used harvesting equipment & machinery

CLB-infested counties – products must be certified by state department of ag the shipment has been treated for CLB
  • Cleaning, fumigation

Non-CLB infested counties – must certify the origin from un-infested counties (County of Origin Certificate)

Exemptions do exist
  • Part of crop transported, previous use, packaging type, time of year, etc.
CLB – Host Crops & Weeds

Many grass crop, forage and weedy species

Small grain
  winter –vs- spring
Corn
Sorghum
Rice
Timothy
Orchardgrass
Millet
Brome spp.
Reed canarygrass

Fescue spp.
Rye grass spp.
Bluegrass
“wild” grasses
  native & introduced
Wild oat
Quackgrass
Jointed goatgrass
Foxtail
CLB – Damage on corn
Heavy CLB damage on Per. ryegrass in Marion County...

Seedling grass seed fields may serve as over-wintering sites for new adults.
CLB Life Stages - Adult

- Approx. ¼” long
- Black head
- Orange-red thorax & legs
- Metallic, bluish-black wing covers (elytra)
- Chew completely through the leaf
- Drop to the ground when disturbed
CLB Life Stages – Adult “Lookalike” spp.

- Several other small beetles that may look similar

- Soft-winged flower beetle (Coleoptera: Melyridae)

- Native predator feeds on aphids, alfalfa weevils and immature stages of several other insects.

Lookalike Collops sp. (left) and adult CLB (right). (Photo by G. Clevenger)
CLB Life Stages – Larva

~ 1/16” at 1st instar

~ ¼” at 4th instar

Black head, pale yellow body under black slime (fecal material)

Resemble small slugs

Diana Roberts, WSU Extension
CLB Life Stages – Larva

- Inter-veinal feeding
- Consume mesophyll & upper leaf cuticle
- “window-pane” or “frosted” appearance
- 90% of damage during last 2 instar stages
- Active 3 to 4 weeks

Control needed *prior to* this stage if infestation at or above threshold.
Extremely isolated case of FROST damage?
CLB Life Stages – Larva

Larva “disappear” mid to late June

Drop to ground

Pupate in soil within earthen cells (difficult to find)

CLB pupa (Photo by G. Clevenger)
Life Cycle (1 generation/year)

- Adult (over-wintering)
- Egg
- Larva
- Pupa
- Adults (new summer)

Cereals

Mature corn
New stands of grasses

April      May      June      July
Over-wintering adults can emerge late March

Eggs = early to mid-April

4th instar larvae = late May to early June
(approximately ¼” in length)
CLB – Habits & Preferences

Adults over-winter in protected sites near grain fields
  • Grain stubble, grass crowns, permanent vegetation, riparian areas, etc.

Adults very active on calm, sunny days
  • Prefer spring planted grains (e.g. oats)
  • Can migrate to successively younger stands

Females begin laying eggs ~ 2 weeks after emergence
  • can lay up to 300 eggs over 6-week period

New summer adults
  • Do not mate
  • Dormant during high heat (aestivation period)
  • Migrate to any available grass host (corn, grass seed, other) to feed prior to over-wintering

Mortality over-winter can range 40-70%
  • Extreme temperatures, introduced / natural predators
IPM Options – Field Scouting

Primary tool in all IPM programs!

Correct identification of the pest

Start when temps reach mid-50s and continue through early grain fill

- Winter wheat = 2 nodes present
- Spring grain = soon after emergence (1 – 2 leaf, adult damage concern)

**Goal** = determine peak 1\textsuperscript{st} & 2\textsuperscript{nd} instar larvae

Monitoring over time helps determine peak levels:

- adult infestation
- egg laying
- larvae development
IPM Options – Field Scouting

10 X 10 scouting technique

Check 10 tillers every 10 acres
- W pattern across field, check field edges apart

Record # of eggs, larvae per tiller and flag leaf (adults?)

High % eggs....scout again a few days later

Data sheet available in OR CLB IPM publication later in 2013
IPM Options – Economic Thresholds

Current Threshold Levels: Small Grains

Pre-Boot until Flag Leaf Fully Emerged (Feekes 1-8):

3 larvae and/or eggs per tiller

Boot stage and later (Feekes 9+):

1 larvae per tiller

Flag leaf contributes ~50% of photo-synthates during early to mid-grain fill (Simmons, 1987)
CLB Impact on Soft White Spring Wheat Yield – Union Co.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Larvae per Tiller(^1)</th>
<th>Larvae per Flag Leaf(^1)</th>
<th>Flag Leaf Damage(^2)</th>
<th>Yield Loss</th>
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<tr>
<td>No Insecticide</td>
<td>0.7</td>
<td>0.6</td>
<td>25</td>
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</table>

\(^1\) Approximately 14 days after insecticide application.
\(^2\) Flag leaf defoliation determined when 90% of CLB larvae initiated pupation.
Early detection can help reduce yield loss, improves bio-control and no “slimy”pants!
Options for Integrated Pest Management

IPM is based on interactions between ..................

pests    beneficial organisms    environment    crop

Relies on natural mortality factors & control tactics that cause least disruption to such factors

(e.g. natural predators, weather)

Important IPM Tactics = monitoring and utilizing multiple control practices

Chemical    Cultural (limited)    Biological
IPM Options – Insecticides: Small Grains

Several foliar-applied products registered for CLB

- 2012 PNW Insect Management Handbook
  [http://www.ipmnet.org/IPM_Handbooks.htm](http://www.ipmnet.org/IPM_Handbooks.htm)
- Several of these products also registered for use in field corn and/or silage corn

*Be Sure and Follow Label Instructions!*

Various restrictions for grazing, forage, fodder, hay, straw & grain (PHI, max amount applied per season, etc.)
## IPM Options – Insecticides: Small Grains

<table>
<thead>
<tr>
<th>IRAC Site of Action</th>
<th>Group #</th>
<th>Product</th>
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<tbody>
<tr>
<td></td>
<td>1 A</td>
<td>Lannate</td>
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<tr>
<td></td>
<td>3 A</td>
<td>Baythroid XL</td>
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<tr>
<td></td>
<td>3 A</td>
<td>Silencer, Warrior</td>
</tr>
<tr>
<td></td>
<td>3 A</td>
<td>various pyrethrins</td>
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<tr>
<td></td>
<td>5</td>
<td>Radiant SC</td>
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<td></td>
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## IPM Options – Insecticides: **WHEAT only**

### IRAC Site of Action

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<th>Group #</th>
<th>Product</th>
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<tr>
<td>1 B</td>
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<tr>
<td>3 A</td>
<td>Tombstone</td>
</tr>
<tr>
<td>3 A</td>
<td>Proaxis</td>
</tr>
<tr>
<td>3 A</td>
<td><strong>Mustang Max</strong> (and triticale)</td>
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<tr>
<td>1 B + 3 A</td>
<td>Cobalt</td>
</tr>
<tr>
<td>1 B + 3 A</td>
<td>Stallion</td>
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</table>
IPM Options – Insecticides: Barley only

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<th>IRAC Site of Action</th>
<th>Product</th>
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<tbody>
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<td>Group #</td>
<td></td>
</tr>
<tr>
<td>3 A + 4 A</td>
<td>Endigo ZC</td>
</tr>
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</table>

Insecticide Resistance Management - CLB

- Rotate site of action groups, avoid consecutive use of same group
- Tank mixtures /pre-mixes with different site of action group #
- One application typically will control CLB infestation – Timing is Key!
- Monitor treated CLB populations for efficacy
Insecticide Resistance Management - CLB

Rotate site of action groups
  • avoid consecutive use of same group

Tank mixtures /pre-mixes with different sites of action
  • Must be registered for intended use!

Timing is Key!
  • Typically, only one well-timed application is needed for CLB control

Monitor treated CLB populations for efficacy

Using IPM tactics help prevent resistance development
IPM Options – Insecticides: Small Grains

Note: new requirements for \textit{pyrethroid} products in “Precautionary Statements” section of label.

Buffer Zones

• 10 ft vegetative filter strip between field edge and down gradient aquatic habitat…plus…

• 25 ft no spray buffer zone…..plus……

Spray Drift Prevention Requirements

• Droplet size medium or coarser (ASAE S572 standards)

• Measure wind speed prior to application (adjacent to site prior to application, upwind side)

• More on label
IPM Options – Cultural Control Tactics

Sound agronomic practices that favor well-established stands

• Vigorous, well-tillered, non-stressed plants
• Tolerate damage from CLB infestations below threshold levels

CLB-resistant varieties not identified yet in PNW

• Resistance mechanism = leaf hairiness

Oat trap crop management tactic

• CLB adults prefer small, young oat plants for egg-laying
• Seeding oat border strips 2 weeks after spring wheat effective (Roberts et al. 2010)
• Untreated oats provide refuge for introduced and natural predators
IPM Options – Oat Trap Crop Tactic

Winter wheat field

Spring oat strip (seeded approx 14 days after spring wheat)

Spring wheat field

CLB adults move from winter to spring planted cereals during season.
IPM Options – Biological Control Tactics

No natural predators when CLB first arrive in new area
  • Insecticides first line of defense

Introduced CLB-specific parasitoid wasps have been used over the last 40+ years
  • Successful example of “classic” biological control
  • Natural enemies are imported and released in a new region for permanent establishment

Once established, help maintain CLB populations below economic threshold levels w/o insecticides
Oregon CLB Bio-control Project
ODA, USDA-APHIS and OSU
Adults lay eggs in CLB larva. *T. julis* larva develop within the host while the CLB-larva continues to feed on the crop until pupation. *T. julis* over-winters in the ground within the CLB pupa & earthen cell.
T. julis larvae recovered from CLB larva

Mike Cooper,
Idaho State Department of Agriculture
Cereal leaf beetle and larval parasitoid wasp (*T. julis*) distribution in Oregon - 2010

ODA IPPM Annual Survey = 24 infested counties in 2012
First parasitoid wasp releases

Many fields 75% + parasitized

A few fields 50-75% parasitized

90% + parasitism rates!
Untreated areas within treated fields and near field borders promote survival of introduced parasitoids and natural predators.
Closing Comments

CLB IPM has proven very effective in established areas
• Occasional “hot-spots” do occur
• Since 2007, less than 1000 acres in NE OR have needed CLB control

Monitor CLB populations levels then consider......
• Does it meet/exceed the economic threshold level?
• What percentage of the population are eggs?
• Do small larvae make up the majority of the population?
• Are the CLB larva parasitized? If so, at what level?

CLB larva samples can be tested by contacting the OSU Plant Clinic (737-3472)

If control necessary, leave untreated area within field to serve as refuge for *T. julis*
IPM Resources

Insecticide Resistance Action Committee –
http://www.irac-online.org/

OSU - IPPC
http://www.ipmnet.org/

Western Region IPM Center
www.wripmc.org
Any Questions? Thanks!