Alfalfa Production in Montana

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Montana State University, Miles City, MT
Outline

• Establishment
• Fall forage management
• Renovation
• Common pests
  – Weeds
  – Weevil
Alfalfa

- Average lifespan approximately 5 years
  - Much longer in MT
- Creates a “stability” not common among other types of agricultural crops
- Harvesting drastically alters microclimate in very short period of time
  - Usually every 20-45 d
Managing for nutrients

- Soil testing
  - Can “cater” to needs of pasture
- Forage can’t grow without necessary nutrients
- Apply according to recommendations
Managing for nutrients

• N, P, K the most limiting nutrients
  – Avoid over-fertilization of N at establishment
  – Can decrease nodulation

• pH
  – Can affect nutrient availability

• S also critical
Table 4. Pounds of nutrient removed per ton of alfalfa produced, dry matter basis.

<table>
<thead>
<tr>
<th>nutrient</th>
<th>dry matter removed (lb/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>phosphorus (P)</td>
<td>6</td>
</tr>
<tr>
<td>phosphate (P₂O₅)</td>
<td>14</td>
</tr>
<tr>
<td>potassium (K)</td>
<td>48</td>
</tr>
<tr>
<td>potash (K₂O)</td>
<td>58</td>
</tr>
<tr>
<td>calcium (Ca)</td>
<td>30</td>
</tr>
<tr>
<td>magnesium (Mg)</td>
<td>6</td>
</tr>
<tr>
<td>sulfur (S)</td>
<td>6</td>
</tr>
<tr>
<td>boron (B)</td>
<td>0.08</td>
</tr>
<tr>
<td>manganese (Mn)</td>
<td>0.12</td>
</tr>
<tr>
<td>iron (Fe)</td>
<td>0.33</td>
</tr>
<tr>
<td>zinc (Zn)</td>
<td>0.05</td>
</tr>
<tr>
<td>copper (Cu)</td>
<td>0.01</td>
</tr>
<tr>
<td>molybdenum (Mo)</td>
<td>0.002</td>
</tr>
</tbody>
</table>
## Sulfur Impacts

### Table 2

2015 Evaluation of dryland alfalfa response to spring topdress applied fertilizer formulations.

Central Agricultural Research Center, Moccasin, Montana

<table>
<thead>
<tr>
<th>Product-element</th>
<th>Application Rate(^1/) lbs/acre</th>
<th>Id code</th>
<th>Plant Ht cm</th>
<th>Yield Dry Mat. t/a</th>
<th>Protein %</th>
<th>Protein %</th>
<th>ADF %</th>
<th>NDF %</th>
<th>Fat %</th>
<th>Ash %</th>
<th>Lignin %</th>
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</thead>
<tbody>
<tr>
<td>Check + K</td>
<td>21.7 + 20 + 20 + 20</td>
<td>14FF01</td>
<td>45</td>
<td>1.54</td>
<td>23.5</td>
<td>0.6</td>
<td>25.8</td>
<td>30.6</td>
<td>1.8</td>
<td>10.5</td>
<td>3.5</td>
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<tr>
<td>P effect</td>
<td>21.7 + 00 + 20 + 20</td>
<td>14FF02</td>
<td>49</td>
<td>1.43</td>
<td>23.1</td>
<td>0.5</td>
<td>25.6</td>
<td>31.0</td>
<td>1.8</td>
<td>10.2</td>
<td>3.3</td>
</tr>
<tr>
<td>S effect</td>
<td>21.7 + 20 + 20 + 00</td>
<td>14FF03</td>
<td>44</td>
<td>0.48</td>
<td>19.8</td>
<td>0.4</td>
<td>23.1</td>
<td>32.6</td>
<td>1.8</td>
<td>9.2</td>
<td>2.0</td>
</tr>
<tr>
<td>K effect</td>
<td>21.7 + 20 + 00 + 20</td>
<td>14FF04</td>
<td>44</td>
<td>1.48</td>
<td>23.8</td>
<td>0.6</td>
<td>25.6</td>
<td>30.3</td>
<td>1.8</td>
<td>10.1</td>
<td>3.5</td>
</tr>
<tr>
<td>no fert</td>
<td>0 + 0 + 0 + 0</td>
<td>14FF16</td>
<td>31</td>
<td>0.34</td>
<td>19.4</td>
<td>0.4</td>
<td>24.7</td>
<td>32.7</td>
<td>1.8</td>
<td>8.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

\(^1/\) Application rates are based on the expected yield of alfalfa.
Table 5. Sufficiency levels of nutrients, top 6 inches of alfalfa at first flower.

<table>
<thead>
<tr>
<th>nutrient</th>
<th>low</th>
<th>sufficient</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitrogen</td>
<td>&lt;2.50</td>
<td>2.50–4.00</td>
<td>&gt;4.00</td>
</tr>
<tr>
<td>phosphorus</td>
<td>&lt;0.25</td>
<td>0.25–0.45</td>
<td>&gt;0.45</td>
</tr>
<tr>
<td>potassium</td>
<td>&lt;2.25</td>
<td>2.25–3.40</td>
<td>&gt;3.40</td>
</tr>
<tr>
<td>calcium</td>
<td>&lt;0.70</td>
<td>0.70–2.50</td>
<td>&gt;2.50</td>
</tr>
<tr>
<td>magnesium</td>
<td>&lt;0.25</td>
<td>0.25–0.70</td>
<td>&gt;0.70</td>
</tr>
<tr>
<td>sulfur</td>
<td>&lt;0.25</td>
<td>0.25–0.50</td>
<td>&gt;0.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>boron</td>
</tr>
<tr>
<td>manganese</td>
</tr>
<tr>
<td>iron</td>
</tr>
<tr>
<td>zinc</td>
</tr>
<tr>
<td>copper</td>
</tr>
<tr>
<td>molybdenum</td>
</tr>
</tbody>
</table>

Both graphs from Alfalfa Management Guide.
Legume inoculation

• All need to be inoculated prior to planting
  – Alfalfa- *Rhizobium meliloti*
  – Sainfoin- *Rhizobium spp.*
  – Clover- *Rhizobium trifolii*

• Can be affected by nitrogen fertilization
  – Avoid over-fertilization
Management

- Likes deep soils with adequate drainage
- Likes soil pH between 6.5 – 7
  - Can also thrive at higher pH
- Seeding rate
  - Irrigated- 8 pounds PLS
  - Dryland- 5-6 pounds PLS
- Plant at ¼- ½ "
- Companion/ nurse crop
Figure 4. First-cutting alfalfa yield relative to soil pH.

Management

• Likes deep soils with adequate drainage
• Likes soil pH between 6.5 – 7
  – Can also thrive at higher pH
• Seeding rate
  – Irrigated- 8 pounds PLS
  – Dryland- 5-6 pounds PLS
• Plant at ¼- ½ “
• Companion/ nurse crop
Figure 11. Alfalfa emergence from various seeding depths.

Source: Sund et al., University of Wisconsin, 1966.
Management

• Likes deep soils with adequate drainage
• Likes soil pH between 6.5 – 7
  – Can also thrive at higher pH
• Seeding rate
  – Irrigated- 8 pounds PLS
  – Dryland- 5-6 pounds PLS
• Plant at ¼- ½ “
• Companion/ nurse crop
## The Effect of a Companion Crop on Alfalfa Yields

<table>
<thead>
<tr>
<th>Companion Crop</th>
<th>Hay yield by years (% of check)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>140*</td>
</tr>
<tr>
<td>None + Eptam (check)</td>
<td>100</td>
</tr>
<tr>
<td>Barley—6 inch rows**</td>
<td>0</td>
</tr>
<tr>
<td>Barley—18 inch rows**</td>
<td>0</td>
</tr>
<tr>
<td>Wheat—6 inch rows**</td>
<td>0</td>
</tr>
<tr>
<td>Wheat—18 inch rows**</td>
<td>0</td>
</tr>
</tbody>
</table>

Management

• What about varieties?
• Does that matter?
Variety Trial Information

Forage Extension Program - Alfalfa Varieties

Information about alfalfa varieties.

- Round Up Ready Alfalfa
- 2014 Alfalfa Varieties
- 2011 Alfalfa Varieties
- Alfalfa Variety Selection
- Wintertime Survival, Fall Dormancy & Pest Resistance Ratings for Alfalfa Varieties
- Alfalfa Establishment — Establishing a Successful Alfalfa Crop
- Roundup Ready Alfalfa — An Emerging Technology
- North Central Region Alfalfa Management Guide

For information on the Forage Extension Program, please contact Dr. Emily Glunk at 406-994-5688 or Emily.glunk@montana.edu

http://animalrangeextension.montana.edu/forage/alfalfa-varieties.html
Figure 1. Average Potential Benefit (APBy) and Maximum Potential Benefit (MPBy) in tons per acre per year in the Washington State Alfalfa Variety Trials from 1990 to 2013.
Figure 3. Average Potential Benefit (APBea) and Maximum Potential Benefit (MPBea) in dollars per acre per year in the Washington State Alfalfa Variety Trials from 1990 to 2013.
- Could result in a .35 T/acre/year difference!

- At current prices ($150/T for large rounds), this would mean:
  - $52.5/acre/year loss
  - Can add up quick with many acres
  - 100 acres = $5,250 in one year
Outline

• Establishment
• Fall forage management
• Renovation
• Common pests
  – Weeds
  – Weevil
Fall Harvest Management

• Fall harvest critical to spring regrowth
  – Ensure last harvest at least 45 days before first killing frost
  – Harvest after several days of killing frost
Alfalfa renovation

- New stands >20 plants/ sq ft
- Established irrigated stands should have >3-4 plants/ sq ft
  - Dryland- 3 plants/ sq. ft

Figure 12. Stand density during first 12 months (seeded at 12 lb/acre).

Figure 18. Alfalfa stem count and yield potential.
Renovation

- Alfalfa has an autotoxic compound
Source: Cosgrove et al., University of Wisconsin-River Falls, 1996.
Outline

• Establishment
• Fall forage management
• Renovation
• Common pests
  – Weeds
  – Weevil
Alfalfa Pests

• Can’t cover everything in time left
• Important to consider IPM- *Integrated* Pest Management
  – Identify
  – Evaluate
  – Control
  – Re-evaluate
Weeds

• Make sure you know what you are dealing with!
• Timing is important
# Impact of Weeds on Forage Quality

<table>
<thead>
<tr>
<th></th>
<th>Serious</th>
<th>Moderate</th>
<th>Slight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual weeds</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Foxtail</td>
<td></td>
<td>Green Foxtail</td>
<td>Common Ragweed</td>
</tr>
<tr>
<td>Giant Foxtail</td>
<td></td>
<td>Velvetleaf</td>
<td>Pigweed species</td>
</tr>
<tr>
<td>Giant Ragweed</td>
<td></td>
<td>Shepherds’s Purse</td>
<td></td>
</tr>
<tr>
<td>Smartweeds</td>
<td></td>
<td>Pennycress</td>
<td></td>
</tr>
<tr>
<td>Cocklebur</td>
<td></td>
<td>Lambsquarters</td>
<td></td>
</tr>
<tr>
<td>Nightshades</td>
<td></td>
<td>Wild mustard</td>
<td></td>
</tr>
<tr>
<td><strong>Perennial weeds</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curly Dock</td>
<td></td>
<td>Canada thistle</td>
<td>Dandelion</td>
</tr>
<tr>
<td>Hoary Alyssum</td>
<td></td>
<td>Quackgrass</td>
<td>White Cockle</td>
</tr>
<tr>
<td>Yellow Rocket</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What can we do?

• #1 thing is to have a healthy stand
• Adequate soil fertility management plan
• Seed at appropriate time and seeding rate
• Variety selection
• Control for other pests
  – Diseases and insects
• Harvest management
Stand establishment

• Preplant:
  – Roundup- low residual activity
  – Eptam (EPTC)- annual and perennial grass and broadleaf weeds
  – Benefin/ Balan- annual grasses and broadleaf weeds

Photo source: Getts et al. What to do with those tough to control perennial weeds in established alfalfa? UC Cooperative Extension.
Stand establishment

• Postemergence:
  – Buctril- broadleaf
  – Butyrac- 60 PHI/ PGI-broadleaf
  – Poast- grass control
  – Pursuit- 30 day PHI/ PGI-alfalfa at least 2\textsuperscript{nd} trifoliate
  – Select- 15 day PHI/ PGI
  – Raptor- broadleaf and grassy
Established stands

- Broadleaf weeds are not necessarily low in forage quality, in vegetative stage...
- But decline in quality very quickly
- Don’t generally decrease yield
  - But larger portion of yield is composed of weeds
- Improve forage quality by controlling weeds
- Evaluate overall health of stand- does it justify weed control?
Roundup Ready Alfalfa

• Take care in timing of glyphosate application

• If spraying in spring and risk of frost, consider delaying spray
  – Can reduce yields in first harvest
  – Up to .8 T/ ac
  – Second harvest stand is recovered

• Apply <2”
  – Most damage seen at 6-8” height

Photo source: Orloff et al. 2016. Roundup Ready alfalfa: avoiding injury while maximizing weed control
Alfalfa Weevil

Photo from utahpests.usu.edu

Photo from agriculturewire.com
Alfalfa Weevil

- Annual pest occurring in alfalfa
- Most destructive insect of alfalfa hay in intermountain west
- Both larvae and adults will feed on plant
  - Larval stage is most damaging
- Cold regions, likely that overwintering occurs outside field
- Adults become active around 48 F
  - Begin laying eggs soon after
Figure 4. Life cycle of the alfalfa weevil

- **Winter**: Overwintering adults emerge May – June
- **Spring**: Overwintering adults emerge May – June
- **Summer**: Larva feeds for 2 to 3 weeks
- **Summer – Fall**: Summer dormancy of adults and then overwintering
- **Adult**: 1 year
- **Pupa (in cocoon)**: 1 to 2 weeks
- **Egg**: 1 to 2 weeks
Table 1. Approximate degree day (DD) requirements for alfalfa weevil development using 48 F as the base developmental temperature.

<table>
<thead>
<tr>
<th>Life Stage</th>
<th>DD Required to Complete Life Stage</th>
<th>Accumulated DD</th>
<th>Typical Feeding Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg hatch begins</td>
<td>300</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>1st instar development</td>
<td>71</td>
<td>371</td>
<td>Light</td>
</tr>
<tr>
<td>2nd instar development</td>
<td>67</td>
<td>438</td>
<td>Light</td>
</tr>
<tr>
<td>3rd instar development</td>
<td>66</td>
<td>504</td>
<td>Heavy</td>
</tr>
<tr>
<td>4th instar development</td>
<td>91</td>
<td>595</td>
<td>Heavy</td>
</tr>
<tr>
<td>Pupation</td>
<td>219</td>
<td>814</td>
<td></td>
</tr>
<tr>
<td>Adult emergence</td>
<td>—</td>
<td>&gt;814</td>
<td></td>
</tr>
</tbody>
</table>

From NDSU Integrated Pest Management of Alfalfa Weevil in ND
Alfalfa Weevil Damage

• Initial damage not always clearly visible
• Unfold overlapping foliage of stem terminals
• Heavily damaged stands have grayish or frostlike appearance
• Reduce hay quality
  – Potential damage to regrowth
Weevil Scouting- Stem method

- Sample randomly throughout a field
- Select >30 stems at each site and cut off at base
- Invert stems into bucket and beat vigorously
- Weevil density = \frac{\text{number of larvae collected}}{\text{number of stems cut}}
- Also helps to know plant height
Table 2. Recommended economic thresholds for third- and fourth-instar alfalfa weevil larvae in North Dakota prior to the first cutting.

<table>
<thead>
<tr>
<th>Plant Growth Stage</th>
<th>Treatment Cost</th>
<th>Crop Value ($/ton)</th>
<th>Management Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Height)</td>
<td></td>
<td>$50</td>
<td>$75</td>
</tr>
<tr>
<td>50% bud or greater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early bud (&gt;20 Inches)</td>
<td>$7/acre</td>
<td>4.0</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>$8/acre</td>
<td>4.6</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>$9/acre</td>
<td>5.2</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>$10/acre</td>
<td>5.8</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>$11/acre</td>
<td>6.3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>$12/acre</td>
<td>6.9</td>
<td>4.6</td>
</tr>
<tr>
<td>Late vegetative</td>
<td>$7/acre</td>
<td>3.8</td>
<td>2.4</td>
</tr>
<tr>
<td>(16 to 20 Inches)</td>
<td>$8/acre</td>
<td>4.4</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>$9/acre</td>
<td>4.9</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>$10/acre</td>
<td>5.5</td>
<td>3.6</td>
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<td></td>
<td>$11/acre</td>
<td>6.1</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>$12/acre</td>
<td>6.7</td>
<td>4.4</td>
</tr>
<tr>
<td>Midvegetative</td>
<td>$7/acre</td>
<td>3.6</td>
<td>2.2</td>
</tr>
<tr>
<td>(10 to 15 Inches)</td>
<td>$8/acre</td>
<td>4.1</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>$9/acre</td>
<td>4.7</td>
<td>3.0</td>
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<td>$10/acre</td>
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<td></td>
<td>$11/acre</td>
<td>5.9</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>$12/acre</td>
<td>6.4</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Weevil Scouting-
“Ball cap” method

- Sweep net
  - 20 “sweeps” per sample
  - At least 3 samples per field
    - Depends on size of field
    - Average larvae/sweep
  - >20 per 180 sweep, then treat
Alfalfa Weevil Management

• Cultural control
  – Often, most economical treatment is early cutting
    • Early cutting can reduce larvae populations due to desiccation from sun and wind
    • Disrupts food supply
    • May still need a chemical treatment
  • Bale windrowed alfalfa as soon as possible
  • Maintain stand health
Alfalfa Weevil Management

Goosey et al., 2004. Evaluation of alfalfa weevil densities and regrowth characteristics of alfalfa grazed by sheep in winter and spring.

Fig. 3. Results of larval alfalfa weevil sweep net samples taken across four dates during 2003 in sheep grazed and non-grazed plots where error bars represent the SEM.

Fig. 4. Results of larval alfalfa weevil sweep net samples taken across four dates during sheep grazed and non-grazed plots where error bars represent the SEM.
Fig. 1. Comparison of mean alfalfa stem heights across four sampling dates during 2002 in sheep grazed and non-grazed plots where error bars represent the SEM.

Fig. 2. Comparison of mean alfalfa stem heights across four sampling dates during 2003 in sheep grazed and non-grazed plots where error bars represent the SEM.
Alfalfa Weevil Management

- Host-resistant varieties (?)
  - Usually have increased branching
  - Larger terminal buds
  - Weevlecheck, Perry, Arc, Team, Liberty
Alfalfa Weevil Management

• Biological control
  – Parasitic wasps- *Anapheus luna, Bathyplectes anurus, B. curculionis, Oomyzus incertus*
    • *B. curculonis* average parasitism rate of 37.2 in ND/MT
      – Appears to be most effective in MT??
    – Fungal pathogen- *Zoophthora phythtophaga*
      • Only effective in warm, moist environments
Alfalfa Weevil Management

• Chemical control
  – Decision based on cutting or grazing crop
  – *Use scouting evaluation results*
  – Pollinator safety
    • Apply early morning or late evening
  – Follow all label instructions
  – Pre-harvest/ Pre-grazing interval extremely important
Table 3. Insecticides registered for control of alfalfa weevil in alfalfa in North Dakota (by active ingredient).

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Example Trade Name(s)</th>
<th>Chemical Class</th>
<th>IRAC Group</th>
<th>Product Rate per Acre</th>
<th>Preharvest Interval</th>
<th>Pre-grazing Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>beta-cyfluthrin</td>
<td>Baythroid XL</td>
<td>P</td>
<td>3A</td>
<td>1.6-2.8 fl oz</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>Sevin 4F, Sevin XLR Plus</td>
<td>C</td>
<td>1A</td>
<td>1.5 quarts</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Chlorantraniliprole + lambda-cyhalothrin</td>
<td>Besiege</td>
<td>D + P</td>
<td>28 + 3A</td>
<td>6.0-9.0 fl oz</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>Lorsban 4E, Lorsban Advanced, Nufos 4E</td>
<td>OP</td>
<td>1B</td>
<td>1-2 pints</td>
<td>1 pint = 14</td>
<td>1 pint = 14</td>
</tr>
<tr>
<td>Chlorpyrifos + lambda-cyhalothrin</td>
<td>Cobalt Advanced</td>
<td>OP + P</td>
<td>1B + 3A</td>
<td>16-38 fl oz</td>
<td>13-26 fl oz = 14</td>
<td>13-26 fl oz = 14</td>
</tr>
<tr>
<td>Chlorpyrifos + zeta-cypermethrin</td>
<td>Stallion</td>
<td>OP + P</td>
<td>1B + 3A</td>
<td>9.25-11.75 fl oz</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>Renounce 20 WP</td>
<td>P</td>
<td>3A</td>
<td>2.0-3.5 oz</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>Tombstone Helios</td>
<td>P</td>
<td>3A</td>
<td>1.6-2.8 fl oz</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Dimethoate</td>
<td>Dimethoate 4E</td>
<td>OP</td>
<td>1B</td>
<td>0.5-1 pint</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Gamma-cyhalothrin</td>
<td>Declare</td>
<td>P</td>
<td>3A</td>
<td>1.02-1.54 fl oz</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Gamma-cyhalothrin</td>
<td>Proaxis</td>
<td>P</td>
<td>3A</td>
<td>2.56-3.84 fl oz</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Indoxacarb</td>
<td>Steward EC</td>
<td>None</td>
<td>22A</td>
<td>6.7-11.3 fl oz</td>
<td>7</td>
<td>Not listed</td>
</tr>
<tr>
<td>Lambda-cyhalothrin</td>
<td>Warrior II</td>
<td>P</td>
<td>3A</td>
<td>1.28-1.92 fl oz</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Lambda-cyhalothrin</td>
<td>Grizzly Z, Silencer</td>
<td>P</td>
<td>3A</td>
<td>2.56-3.84 fl oz</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Malathion</td>
<td>Malathion 57EC</td>
<td>OP</td>
<td>1B</td>
<td>1.5-2 pints</td>
<td>0</td>
<td>Not listed</td>
</tr>
<tr>
<td>Malathion</td>
<td>Fyfanon ULV</td>
<td>OP</td>
<td>1B</td>
<td>8 fl oz</td>
<td>0</td>
<td>Not listed</td>
</tr>
<tr>
<td>Methomyl</td>
<td>Lannate LV</td>
<td>C</td>
<td>1A</td>
<td>3 pints</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Permethrin</td>
<td>Arctic 3.2EC</td>
<td>P</td>
<td>3A</td>
<td>4.0-8.0 fl oz</td>
<td>14</td>
<td>Not listed</td>
</tr>
<tr>
<td>Phosmet</td>
<td>Imidan 70W</td>
<td>OP</td>
<td>1B</td>
<td>1.33 pounds</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Zeta-cypermethrin</td>
<td>Mustang Max</td>
<td>P</td>
<td>3A</td>
<td>2.24-4.0 fl oz</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Due to potential bee injury, do not apply to alfalfa grown for seed.
2 Not effective against adult alfalfa weevils.
3 Do not apply when alfalfa is in bloom.
4 Suppression only.

Chemical Class Abbreviations: C = carbamates; D = diamides; OP = organophosphates; P = pyrethroids.
IRAC Group Modes of Action: 1A, 1B = acetyl cholinesterase inhibitors; 3A = sodium channel modulators; 22A = voltage-dependent sodium channel blockers; 28 = ryanodine receptor modulators.
Current Research in Montana
1) Validating the degree-day model in Montana

County locations surveyed for alfalfa weevil larvae using the bucket-sampling method in 2017, for head capsule measurements to determine instar stage.
Fig. 4. Actual occurrence of 1st to 4th instar larvae in 6 different MT counties compared to their predicted abundance by the degree-day model. The proportion (%) of each instar sampled in the field is indicated by the y-axis and the predicted peak occurrence by the degree-day model is illustrated in red font along the x-axis: H, egg hatch, 310 DD; I – IV, 1st to 4th instars, 350, 425, 500 and 580 DD respectively; and A, adult pupation, 850DD (Brewer et al. 2008; Brewer and Hoff 2002). Red arrows point out peak occurrence of second (II) instar larvae predicted by the degree-day model.
Other Resources

• “Establishing a Successful Alfalfa Crop” Montana State University MontGuide. MT200504Ag.

• “Alfalfa Weevil” Montana State University MontGuide. MT 9602.

• Forage Extension Program Website. http://animalrangeextension.montana.edu/forage/
Questions?

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