UNIVERSITY OF MINNESOTA EXTENSION
Driven to Discover℠

Challenges with a resurgence of alfalfa weevil in the Midwest and guidance for adapting to a changing pest

Anthony Hanson, PhD
University of Minnesota Extension - Integrated Pest Management

MAKING A DIFFERENCE IN MINNESOTA: ENVIRONMENT + FOOD & AGRICULTURE + COMMUNITIES + FAMILIES + YOUTH

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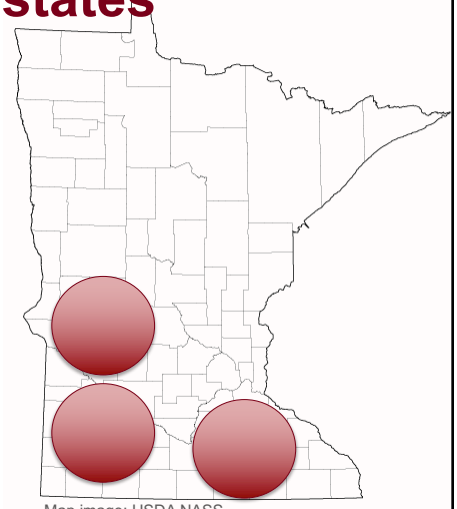
Alfalfa weevil in Minnesota and implications for other Midwest states

- ~ 650,000 acres of alfalfa in MN (USDA NASS)
  - Primarily dairy and beef
- Alfalfa weevil outbreaks prevalent since ~ 2020 in west central, southwest, and southeast counties.



Map image: USDA NASS

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Alfalfa weevil – *Hypera postica*

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Lookalikes – clover leaf weevil

- Alfalfa weevil – black head capsule
- Clover leaf weevil – brown head capsule

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Alfalfa insect integrated pest management (IPM)

- Keep control methods compatible (especially “free” ones)!
- “Insurance” insecticides might actually make your alfalfa insect problems worse because:
  - Insecticides kill beneficial insects.
  - Lost biological control could cause other insect problems to flare up.
  - Overuse can lead to insecticide-resistant insect populations
  - Extra input costs when not needed at the time

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Alfalfa weevil and skeletonized leaves

Alfalfa weevil larva: black head capsule w/ white stripe along body. Photo: A. Hanson

Larval feeding between leaf veins. Photo: J. Goplen.

Healthy (left) vs. heavy feeding (right) with reduced leaf mass and browning. (John L. Obermeyer, Purdue Extension Entomology).

- Historically one generation per year
- Usually only an issue for first cutting, possibly into second crop

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Clockwise from left: second instar, fourth instar, third instar, and first instar (John L. Obermeyer, Purdue Extension Entomology).

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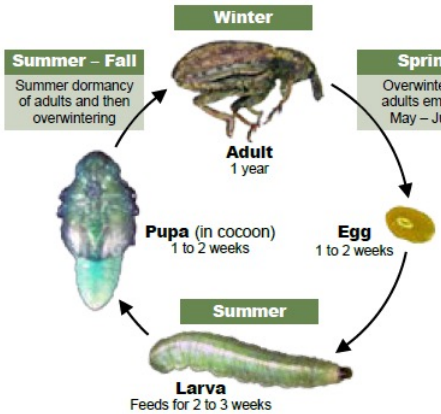
Life cycle



Alfalfa weevil life cycle (NDSU)

Alfalfa weevil adults are present in or near fields for most of the year, but not causing feeding damage or laying eggs until the next spring. **Do not count while scouting.**
Photo: Adam Sisson.

Alfalfa weevil eggs stem (Sue Blodgett, Iowa State University, Bugwood.org).

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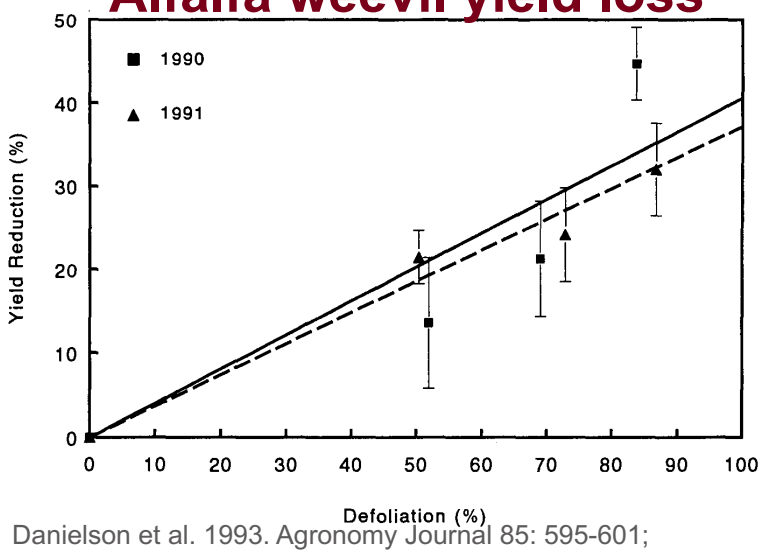
Alfalfa weevil yield loss



Danielson et al. 1993. Agronomy Journal 85: 595-601;
Hintz et al. 1976 J. Econ. Entomol. 69: 749-754

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Alfalfa Weevil Integrated Pest Management

- Insecticide – economic thresholds
- Cultural control – early mowing
- Biological control – parasitoid wasps and some fungi
- Host-plant resistance – not readily available
- Weather – at ***soil surface*** 13 F °causes 20-30% mortality, a few survive down to 1 F°

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Scouting alfalfa for weevils

- Sweep net to check if larvae are present.
- Cut 30 **stems** across the field at ground level.
- Record each plant's height and shake in a 5-gallon bucket to determine average **larvae** per stem in the field.
- Mow if at 16 inches or near early-bud stage.
  - Inspect stubble for larvae.

Alfalfa weevil larvae from stem sampling (Patrick Beauzay, NDSU).

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Problem fields in west-central MN

Left: Feeding damage under windrows that were not raked and baled quickly near Morris, MN. Right: Feeding and drought issues near Alexandria, MN in early July when larval feeding would have normally stopped. Photos: Anthony Hanson

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Strains and egg laying biology

- Invasive to North America in 1904, multiple introductions:
  - **Eastern** (eastern US, predominant in MN)
  - **Western** (Rockies)
  - **Egyptian** (southwest)
- Visual ID extremely difficult, requires DNA testing instead
- Nebraska research: Westerns moving east ~ 10 miles / year and peak 1-2 weeks later than easterns
- Compounds complications with resistance options if western strain creates an extended weevil season.

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Strain distribution 30+ years ago

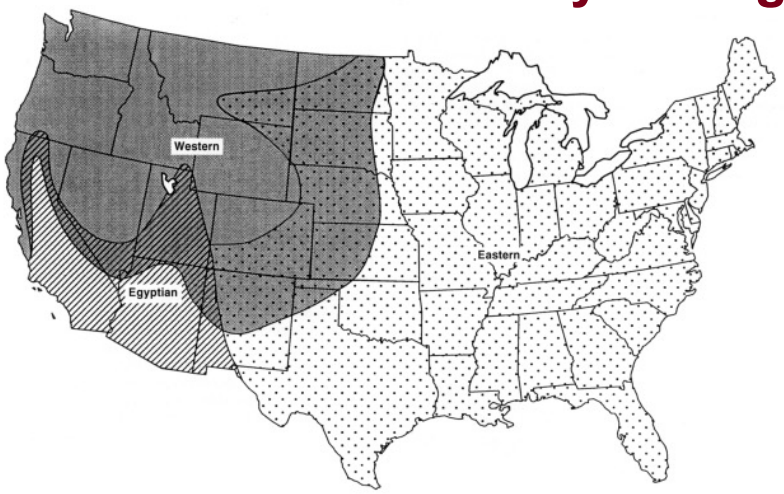

Fig. 1. Distribution of USA alfalfa weevil strains (adapted from D.C. Vacek, US Department of Agriculture, 1986, unpublished report; and Hsiao, 1996).

Radcliffe & Flanders 1998. Biological Control of Alfalfa Weevil in North America. Integrated Pest Management Reviews. Vol. 3, 225–242

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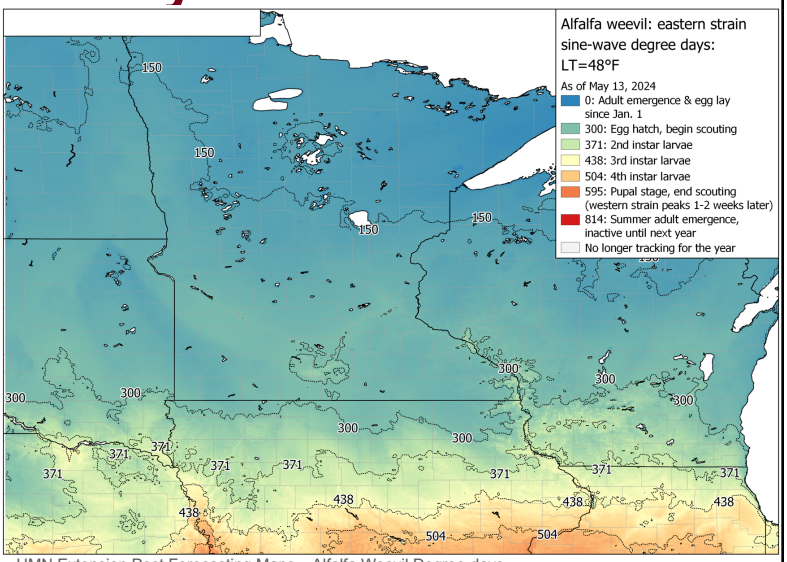
Strain distribution today?

- Strains have not been monitored in MN since 80-90s.
- Degree-day models are based on the eastern strain, not mixed populations.
- Scout for two population peaks



UMN Extension Pest Forecasting Maps – Alfalfa Weevil Degree-days

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Management tools – Early mowing

- Research from Wyoming shows early mowing can be just as effective as insecticide.
- Depends on specific farm needs
- Takes pressure off insecticides

ELSEVIER
Crop Protection
Available online 28 January 2025, 107134
In Press, Journal Pre-proof ? What's this?

Alfalfa harvest timing impacts on alfalfa weevil with agronomic and economic contexts

Judith S. Herreid [1 2], Brian Lee [3], M. Anowarul Islam [4], John Ritten [5], Randa Jabbour [1]

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Alfalfa weevil economic threshold

Stem height	Treatment cost/acre	Hay value ($/ton) $50	$75	$100	$125	$150	$175
		Average larvae per stem					
10-15 inches (mid-vegetative)	$7	3.6	2.2	1.5	1.1	0.9	0.7
	$8	4.1	2.6	1.8	1.4	1.1	0.8
	$9	4.7	3	2.1	1.6	1.2	1
	$10	5.3	3.4	2.4	1.8	1.4	1.2
	$11	5.9	3.7	2.7	2.1	1.6	1.3
	$12	6.4	4.1	3	2.3	1.8	1.5
16-20 inches (late vegetative)	$7	3.8	2.4	1.8	1.4	1.1	0.9
	$8	4.4	2.8	2.1	1.6	1.3	1.1
	$9	4.9	3.2	2.4	1.8	1.5	1.2
	$10	5.5	3.6	2.6	2.1	1.7	1.4
	$11	6.1	4	2.9	2.3	1.9	1.6
	$12	6.7	4.4	3.2	2.5	2.1	1.7
>20 inches (early bud)	$7	4	2.7	2	1.6	1.3	1.2
	$8	4.6	3.1	2.3	1.8	1.5	1.3
	$9	5.2	3.5	2.6	2.1	1.7	1.5
	$10	5.8	3.8	2.9	2.3	1.9	1.6
	$11	6.3	4.2	3.2	2.5	2.1	1.8
	$12	6.9	4.6	3.5	2.8	2.3	2

* if >50% of plants are at bud stage, more beneficial to mow

Control options

Insecticide treatment

Short pre-harvest interval (PHI) insecticide or mow

Mow early

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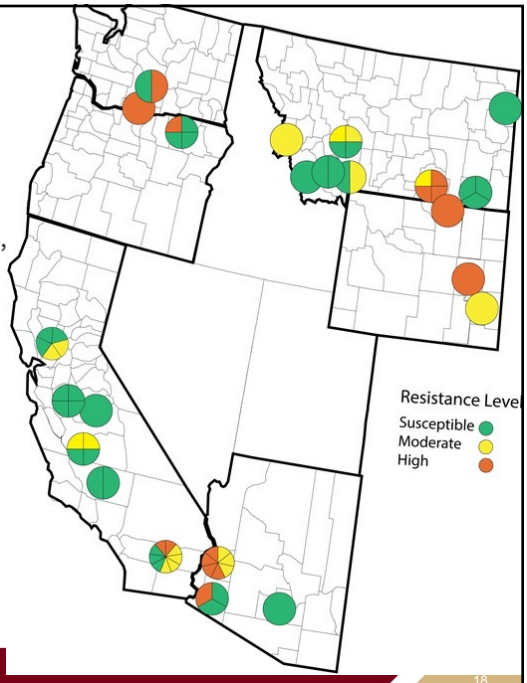
Alfalfa Weevil (Coleoptera: Curculionidae) Resistance to Lambda-cyhalothrin in the Western United States

E A Rodbell ✉, M L Hendrick, I M Grettenberger, K W Wanner

Journal of Economic Entomology, Volume 115, Issue 6, December 2022, 2029–2040, https://doi.org/10.1093/jee/toac156

- Not confirmed in MN yet – testing beginning with NDSU in 2025
- Pyrethroid failures may be for other reasons (e.g., applicator issues), but resistance is a major suspect.
- Avoid reusing pyrethroids if field has a history of issues with that class.



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Recent conversations on pyrethroid resistance

- Weevil spread?
  - Adult movement
  - Hay transport
- Scheduled or purposeful spraying for each crop (regardless of threshold)
- Repeated insecticide exposure targeting other insects

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Alfalfa Weevil Control

- Mowing and rake early
- Insecticides – current options

Group	Class	Active ingredient	Trade Names
1A	Carbamate	Methomyl	Lanate
		Carbaryl	Sevin
1B	Organophosphate	Malathion	Malathion
		Phosmet	Imidan
3A	Pyrethroid	Alpha-cypermethrin	
		Beta-cyfluthrin	
		Cyfluthrin	Warrior and generics,
		Gamma-cyhalothrin	Mustang-Maxx,
		Lambda-cyhalothrin	Baythroid, etc.
		Permethrin	
		Zeta-cypermethrin	
22	Oxadiazine	Indoxacarb	Steward

After cutting, can burn

~50% control

Likely pyrethroid resistance in MN, confirmed in western states.

Windrows can shelter remaining larvae not killed by mowing or exposure. Rake & bale quickly if populations are high.

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Check pre-harvest intervals and labels!

- Limits on how close to harvest insecticides can be applied, even for livestock consumption
- Some organophosphates cannot be applied 14-21 days before harvest
- Others no less than 7 days
- Some products (e.g., bifenthrin) only labeled for seed production

Photo: A. Hanson

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Stubble scouting

- If a large number of larvae survive mowing/baling, treatment may be worthwhile.
- Ground counts: 20 samples across the field (1 sq. ft. each)
- Threshold: 8+ larvae / sq. ft. (6+ on sandy soil)
- Consider scouting windrows first

Quadrat used for randomly sampling vegetation within a predetermined area made of PVP pipe. This is a quick (and cheap) way to make 1 sq. ft. sized squares you can throw into a field as a marker. Photo: University of Idaho.

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Other options – Chlorpyrifos (1B) in 2025, last call?

- Most products have updated labels with reduced number of food & feed uses approved by EPA
- **Products with old labeling** – After June 30, 2025, these may only be used for non-food purposes. Use of existing stock prohibited after this time.
- **Products with new labeling** – These may still be used for food purposes, provided they comply with updated EPA guidelines.

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Other options – Spinosad (organic) ~70%+ field efficacy

SPINOSAD	GROUP	5	INSECTICIDE

Entrust® SC

Naturalyte® Insect Control

A Naturalyte® insect control product formulated for control of lepidopterous larvae (worms or caterpillars), leafminers, thrips, and red imported fire ants.

Active Ingredient:
spinosad (a mixture of spinosyn A and spinosyn D) 22.5%
Other Ingredients 77.5%
Total 100.0%

ACCEPTED
02/14/2020

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Other options – Bt (*Bacillus thuringiensis*)?

Alfalfa weevil larvae

Alfalfa weevil parasitoid

Bacillus thuringiensis SDS-502

- Bt is quickly degraded by sunlight and rain
- Montana field trials: 55-60% control as a spray after 7 days
- Did not affect rates of parasitism by beneficial parasitoid wasps

Photo: Shrestha et al. 2018. Field efficacy of Bacillus thuringiensis galleriae strain SDS-502 for the management of alfalfa weevil and its impact on Bathyplectes spp. parasitization rate. Journal of Invertebrate Pathology 153 (2018) 6

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Natural enemies

- Alfalfa weevil isn't native; introduced in 1904
- Parasitoid wasps from native range introduced by USDA
- Suppress weevil populations, but very susceptible to insecticides
- No recent population surveys in MN or surrounding states

Adult *Bathyplectes anurus* , a parasitoid of alfalfa weevil larvae. Photo: USDA APHIS

Alfalfa weevil parasitoid cocoons of *Bathyplectes curculionis.* Photo: Pellissier et al. 2017. Journal of Integrated Pest Management.

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In the pipeline

Treatment/ formulation	Rate fl oz/acre	Avg no. of AW larvae per 10 stems 2 DAT	9 DAT	17 DAT	21 DAT
Untreated check		11.5a	18.2a	20.0a	8.25a
Plinazolin low	1.03	4.75abc	3.5b	2.0b	1.0b
Plinazolin med	1.54	2.5c	2.25b	0.75c	2.25ab
Plinazolin high	2.05	3.75bc	3.0b	1.0bc	1.25ab
Mustang Maxx	2.24	4.25abc	2.0b	1.25bc	1.0b
Harvanta 50SL	16.4	9.75ab	6.75b	6.75ab	8.25a

DAT = Days After Treatment, differing letter groupings indicate treatments with statistically different weevil counts for that date

JOURNAL ARTICLE

Effects of Selected Insecticides Against Alfalfa Weevil Infesting Alfalfa, 2022

Kyle Bekelja, Kelly McIntyre, Thomas Kuhar

Arthropod Management Tests, Volume 48, Issue 1, 2023, tsad006, https://doi.org/10.1093/amt/tsad006

Published: 11 February 2023

- Field trials in ***Virginia***, 2022
- Plinazolin (isocycloseram): a new group 30 insecticide pending EPA registration
- Mustang Maxx – group 3 pyrethroid
- Harvanta – group 28 less effective, not currently labeled for alfalfa

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Adapting insecticide recommendations

- Rotate group numbers (1 = OPs, 3 = pyrethroid, 22 = indoxacarb) between years
  - Avoid pyrethroids if resistance suspected in a field
  - **Do not apply the same group within 3 years**
- Steward, etc. (group 22) is the last good line of defense
  - Can't use repeatedly, will lose tool to resistance quicker
- Use high labeled rates, low rates = quicker resistance
- Treat early mowing like it's an insecticide treatment to give insecticide groups more buffer time.

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What about winter?

Photo: A. Hanson

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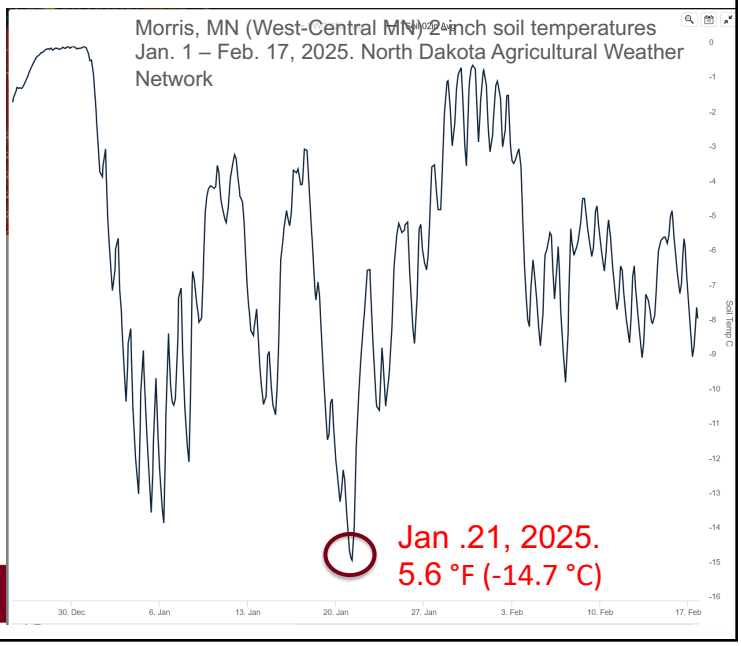
Weevils and Winter

- Overwinters as adults in leaf-litter and stubble (soil surface).
- Exposure to 13 °F (-10.5 °C) = 20-30% mortality.
- A few survive down to 1 °F (-17.2 °C)
- Coldest MN night was Jan. 21 (little snow cover)



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Be careful of marketing & untested products (or depths of the internet)

- Cinnamon oil: cinnamaldehyde, eugenol (clove oil), camphor oil, linalool and other components
  - Data from lab studies very sparse; no peer-reviewed data found for cinnamon oil + alfalfa weevil. Other insects: variable efficacy, but mostly not different than control treatments
- Botanicals promising for new insecticides, but there's a long ways between even an initial lab study vs. field efficacy.

Photo: USA Today

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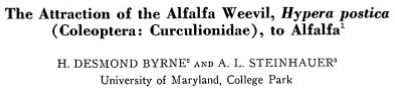
Be careful of marketing & untested products (or depths of the internet)

- Sugar sprays as insecticide?
- Many internet claims with no data that sound convincing (at first)

https://cropwatch.unl.edu/research-sugar-application-crops/

- Myth: sugar on leaves makes aphids/weevils diabetic and they die
  - Insects consume plants with varying sugar levels, aphids very adapted to high sugar
  - Sugar solution actually used to attract weevils to alfalfa (Byrne & Steinhauer 1966



The Attraction of the Alfalfa Weevil, *Hypera postica* (Coleoptera: Curculionidae), to Alfalfa[1]

H. DESMOND BYRNE[2] AND A. L. STEINHAUER[3]
University of Maryland, College Park

- Myth: Higher Brix (sugar) levels = insects avoid eating
  - Usually no correlation between Brix in insect population studies

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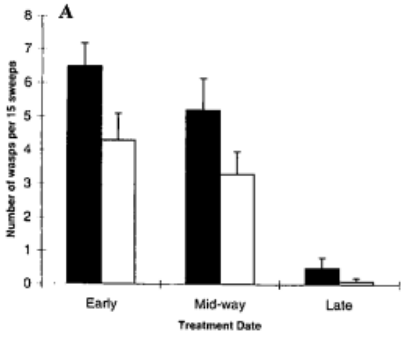
Sugar and alfalfa weevil

- Found one 1998 Utah study on alfalfa weevil and sugar sprays.
- Sugar is a food source attractive to parasitoids and predators.
- Weevil numbers did not differ between control and sugar plots.
  - No direct effect on weevils
  - Didn't increase beneficial populations enough for added control



BIOLOGICAL CONTROL

Effects of Sugar Spray and Aphid Honeydew on Field Populations of the Parasitoid *Bathyplectes curculionis* (Hymenoptera: Ichneumonidae)

HELEN S. JACOB AND EDWARD W. EVANS

Department of Biology, Utah State University, Logan, UT 84322-5305

Environ. Entomol. 27(6): 1563-1568 (1998)

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What can I do in 2026?

- Weevil strain issues with extended emergence?
  - Scout through all of May and June
- Management
  - Use early mowing in place of an insecticide as first line defense
  - Avoid pure-stand alfalfa
  - Use thresholds, avoid schedule sprays
  - Rotate insecticides: avoid the same group within 3 years
  - Avoid pyrethroids (group 3) if a field has history of issues

Photo: A. Hanson

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Potato leaf hopper

Empoasca fabae (Hemiptera: Cicadellidae)

Migratory, arrives from Gulf of Mexico on storm fronts

Multi-generational; population builds over growing season.

Mid to late-summer pest as populations build

Lays eggs in stems, but feeding causes damage.

Potato leaf hopper adult. A. Hanson

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Symptoms & damage

Hopper burn (V-shaped yellowing) and stunting.

Resistant plants

– Plants tolerate higher hopper populations

Foliar insecticides

– similar options as alfalfa weevil, resistance increasing concern!

Chlorosis (“hopperburn”) from potato leaf hopper feeding. A. Hanson

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Potato leaf hopper control tactics

- Resistant plants
  - Secretions from plant hairs
  - No yield drag in modern varieties
- Grass mixes
- Scouting – needing to treat is not common
  - Use sweep nets

Glandular hairs on resistant alfalfa (John Obermeyer, PSU)

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Potato leaf hopper economic threshold

	Cost of insecticide treatment / acre				
	$10	$12	$14	$16	$18
Height	Potato leaf hopper / sweep				
4	0.2	0.3	0.4	0.5	0.6
6	0.3	0.5	0.6	0.8	0.9
8	0.4	0.6	0.8	1	1.2
10	0.5	0.8	1	1.3	1.5
>10	1	1.6	2	2.6	3

Susceptible varieties

	Cost of insecticide treatment / acre				
	$10	$12	$14	$16	$18
Height	Potato leaf hopper / sweep				
4	2.1	3	4.1	5	6
6	3.2	4.6	6.2	7.6	9
8	4.2	6.1	8.2	10.1	12
10	5.3	7.6	10.3	12.6	15
>10	10.6	15.2	20.6	25.2	30

Resistant varieties

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Blister beetles in hay

- Highly toxic to horses
- Moderately toxic to cattle – moreso young calves and dairy
- Don't spray!
  - More dead beetles in hay
- Mow and give ample time for living beetles to move out of windrow

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Regional Alfalfa Survey

- Let us know what alfalfa insect issues you're having in survey below.
- This helps us find out how widespread alfalfa weevil issues are and justifies alfalfa funding.
- https://z.umn.edu/alfalfapestsurvey

Any mention of specific insecticide products or tradenames in this presentation is solely for educational purposes and is not an endorsement of any company or product.

Questions?

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