Grasshoppers and Armyworms

Tom Getts- UCCE

Outline

- Background
- Armyworms
- Grasshoppers

IPM

- Integrated Pest Management, or IPM, is a process you can use to solve pest problems while minimizing risks to people and the environment. IPM can be used to manage all kinds of pests anywhere - in urban, agricultural, and wildland or natural areas.

Step One

- Pest Identification!
  - Books, Internet, People
- Knowledge!
  - Lifecycle
  - Habitat
  - Damage potential
  - Help choose best management options…

Photo courtesy of: http://acmeexterminating.com/images/free_pest_id.jpg

Management

- Cultural
- Physical
- Biological
- Chemical

- Economics-thresholds

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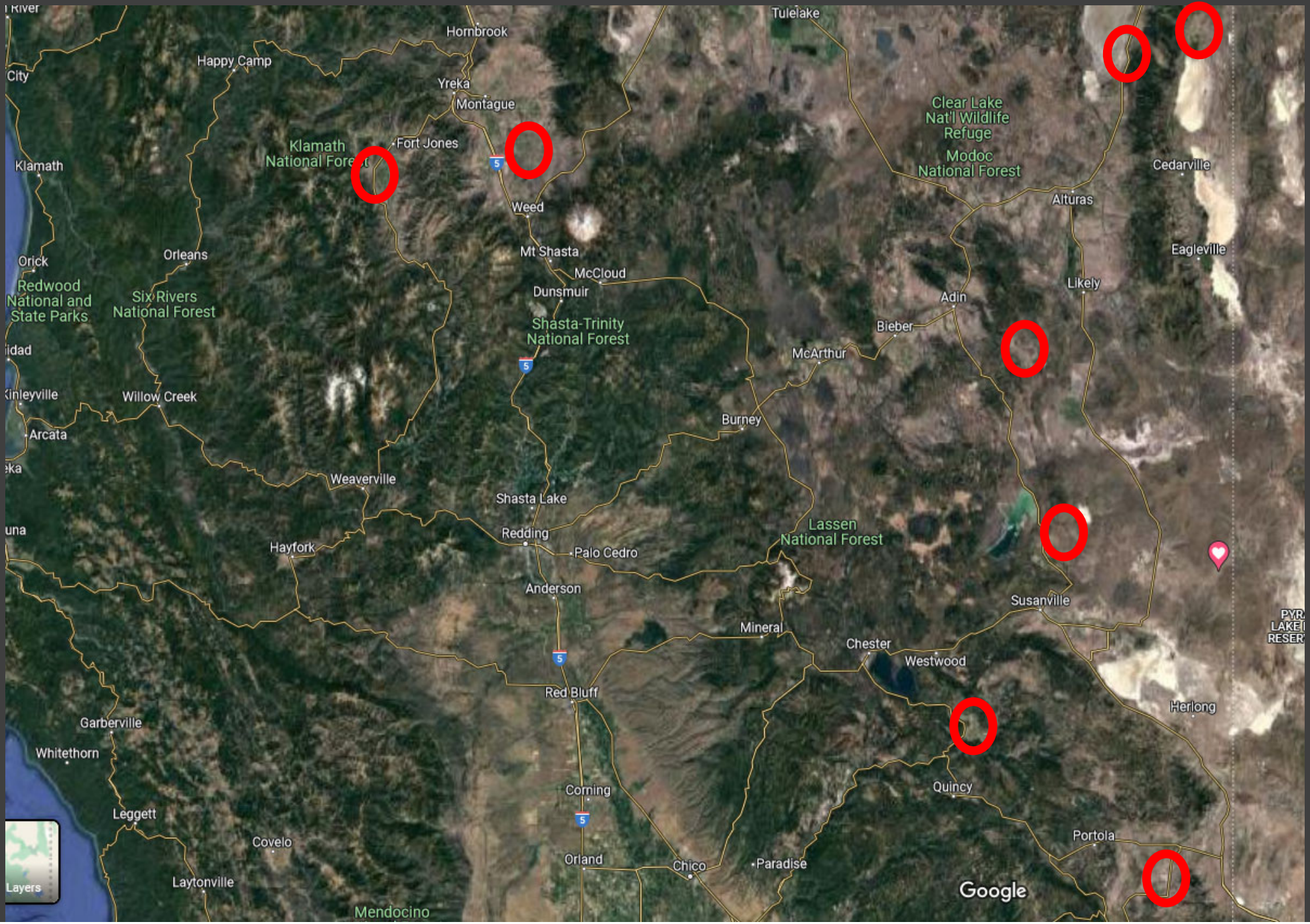
- Economics-thresholds

Where?


Tulelake
Hornbrook
Happy Camp
Yreka
Montague
Klamath National Forest
Fort Jones
Klamath
Clear Lake Nat'l Wildlife Refuge
Modoc National Forest
Cedarville
Alturas
Weed
Mt Shasta
Orick
Orleans
Redwood National and State Parks
Six Rivers National Forest
McCloud
Dunsmuir
Shasta-Trinity National Forest
Eagleville
Likely
Adin
Bieber
McArthur
Willow Creek
Arcata
Burney
Weaverville
Shasta Lake
Redding
Hayfork
Palo Cedro
Lassen National Forest
Anderson
Susanville
Mineral
Chester
Westwood
Red Bluff
Herlong
Garberville
Whitethorn
Corning
Quincy
Leggett
Covelo
Portola
Orland
Chico
Paradise
Laytonville
Mendocino
Layers
Google

Grasshoppers

- Over 200 species in California
- Huge legs!
- Easy to identify
- Sporadic pest, with boom and bust population dynamics

Clearwing Grasshoppers

Camnula pellucida

search fact sheets... GO

Species

Clearwinged grasshopper

Camnula pellucida (Scudder)

Subfamily Oedipodinae

Geographic range of Camnula pellucida (Scudder)

Identification

Adults of the clearwinged grasshopper are of medium size, yellow to brown, and possess mottled forewings and transparent hindwings (Fig. 8). The forewings have along their angles light stripes that in the resting grasshopper with closed wings converge near the middle. The male (Fig. 6) is noticeably smaller than the female (Fig. 7). First instar nymphs are strikingly colored cream, tan, and black (Fig. 1).

The nymphs (Fig. 1-5) are identifiable by their color patterns and external structures:

1. Head with lateral foveolae triangular (Fig. 9). Usually a dark bar crosses transversely across front of head under antennal sockets, across lower part of compound eyes, and onto sides of head.
2. Pronotum with median carina low but uniformly elevated; median carina entire (without notch) in early instars, notched once in front of middle in the older instars (Fig. 9). Pronotum with lateral carinae clearly defined (Fig. 9).
3. Hind tibia fuscous in first to third instar, fuscous or tan in fourth and fifth instars.

Fig. 1, first instar: BL 4.2-5.5 mm, FL 2.4-2.7 mm, AS 11-13

Fig. 2, second instar: BL 5-7.1 mm, FL

Distribution and habitat

The clearwinged grasshopper, *Camnula pellucida* (Scudder), is distributed widely in North America. It inhabits a variety of grasslands including the northern mixedgrass prairie, the bunchgrass prairie, and mountain meadows. A resident population lives in a mountain meadow at 10,800 feet in Colorado, just below timberline.

https://idtools.org/id/grasshoppers/factsheet.php?name=13164

Biology

- Eggs laid in pods during the fall (not in tilled fields)
- 1-4 pods/female
- 20 to 100 eggs per pod
- Top 2 inches soil
- Most overwinter as eggs, some as nymphs
- Hatch in spring
- 5 to 6 molts before maturity (30-40 days)
- Adults live 2-3 months
- One generation per year

Photo courtesy of: https://rstorage.filemobile.com/storage/6829995/15

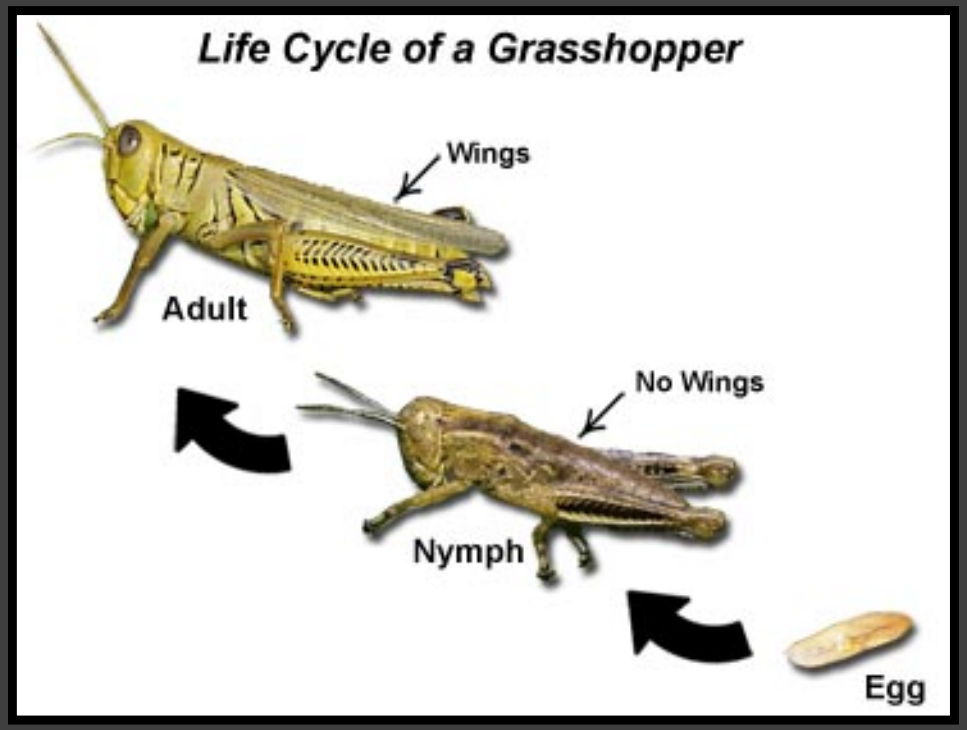


Photo courtesy of: https://targetstudy.com/nature/animals/grasshopper.html

Instar Sizes

General Sizes of Grasshopper Stages

Stage	Size
1st instar	1/4 inch
2nd instar	3/8 inch
3rd instar	1/2 inch
4th instar	3/4 inch
5th instar	1 inch
Adult	1.5 inches

Note: size is approximate, and depending on species, can vary by 1/4 to 1/2 inch.

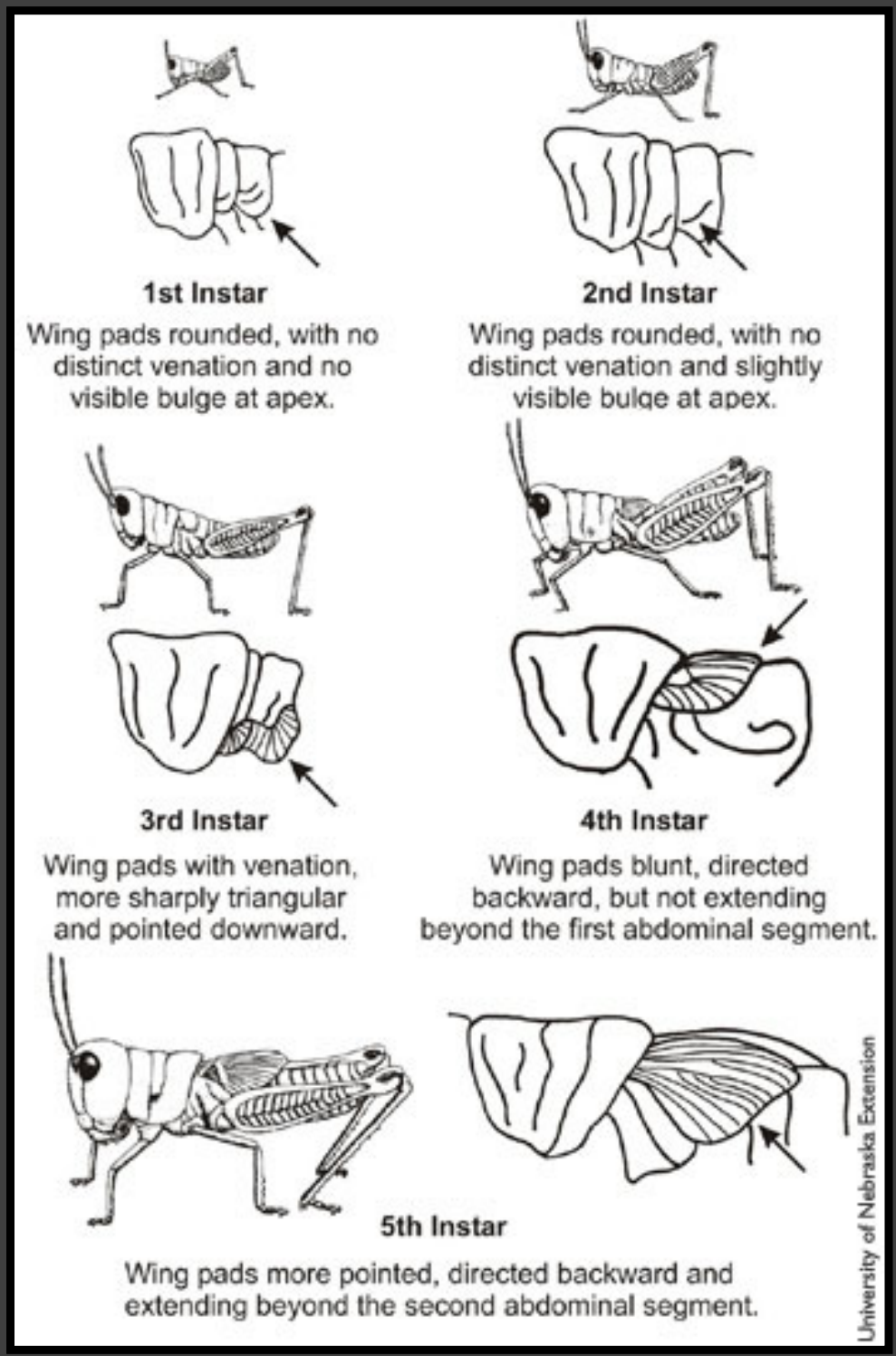


Chart Courtesy of Utah State

Photo Courtesy of: https://utahpests.usu.edu/ipm/agricultural/vegetable/grasshopper-control

Weather Impacts Populations

- Spring
  - Cold - decrease
  - Warm/Dry - increase
  - Wet - fungus
- Fall
  - Warm - more eggs
  - Cold - less eggs
  - Frost-
- Drought
  - Negatively impacts populations
  - Can cause movement
- Cold winters - no effect
- Various species impacted differently

Photo courtesy of:
http://www.weatherclipart.net/free_weather_clipart/clip_art_illustration_of_a_bright_sun_with_a_rain_cloud_hovering_over_0515-1011-0603-3308_SMU.jpg

Vegetation Consumed

- Some species
  - Grass specific
  - Broadleaf specific
  - Generalist
- Moist vegetation is more palatable
  - Readily move to find food

Photo courtesy of:http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=7743

Movement

- Nymphs will walk to more desirable vegetation
- Adults can fly 15 miles or more
- One source in Wyoming states swarms move over 60 miles
- Adults can “swarm”
- Typically starts in rangeland can move to cropland

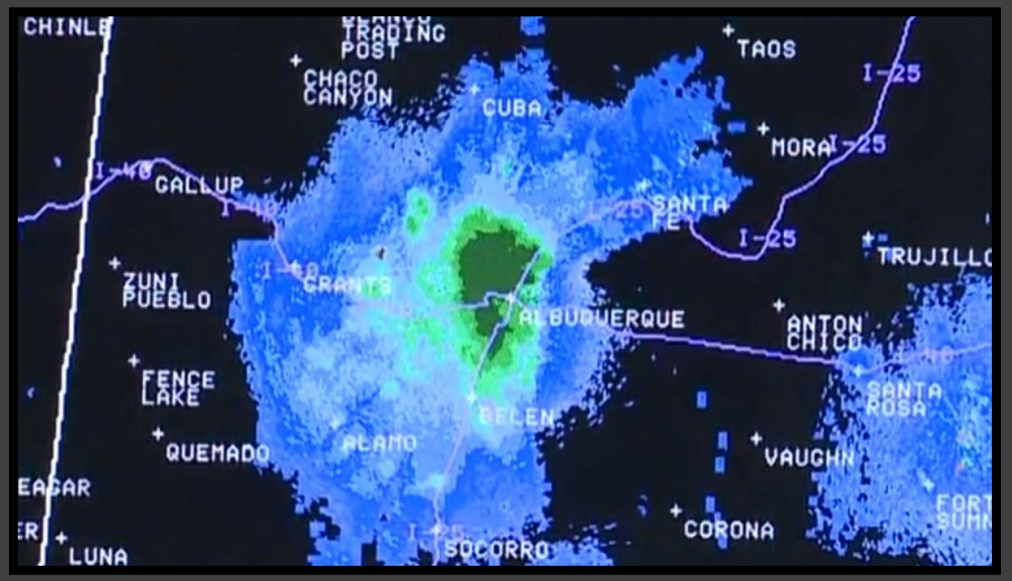


Photo courtesy of:
http://www.nydailynews.com/news/national/grasshopper-swarm-spotted-weather-radar-article-1.1812545

Damage

- Consume massive amounts of foliage
- Estimates - 30 to 250% of body weight per day
- Cows - 1.5-2.5% of their body weight
- 30 lb grasshoppers consume the same forage as a 600 lb steer

Photo courtesy of: http://entomology.k-state.edu/images/alfalfa-pests/grasshopper.tif

Management

- Area wide approach
- Coordinated effort
- Monitor
- UC IPM
  - Control on rangeland and field edges before move into crops!

Photo courtesy of: Evan McGlin and National Geographic

Extension Literature-

"Typically starts in rangeland can move to cropland"

- UC IPM
- Utah State
- Wyoming
- Western US….
- But do they?
  - Indian Valley-2019- to 2022
  - Goose lake???

Economic Thresholds Range

- Oregon Rangeland
  - 8 or more/square yard
  - USDA Aphis Standard before assistance
- California - no threshold
- Wyoming Rangeland
  - Less than 8/square yard - Not economic
  - 8-15/square yard - Potentially economic
  - 15-20/square yard - Economic
- Economic threshold vary by species, time, developmental stage, crop, cost, etc.

Economic Thresholds Nebraska

Table 1. Treatment guidelines based on number of grasshoppers (nymphs and adults) per square yard.

Grasshopper Population	Within Fields	Field Borders	Treatment necessary?
Non-economic	0-2	5-10	No
Light	3-7	11-20	Uncertain — depends on size, species, type of crop
Moderate	8-14	20-40	Probably
Abundant	15 or more	41 or more	Yes

Grasshopper Control

- Mechanical
  - Cultivation
    - Eggs do not persist in cultivated fields
  - Mowing
    - Eliminates food source
    - Double edge sword

Photo courtesy of: https://www.haugimp.com/

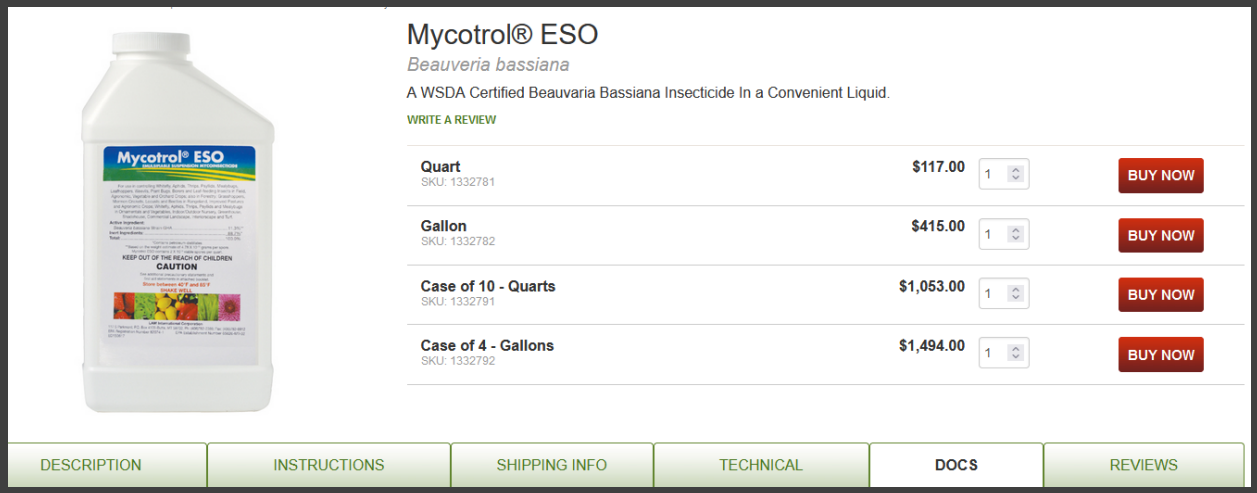
Grasshopper Control

- Biological
  - Birds, spiders, rodents, fungal pathogens (various species)
  - Nolo bait or Semaspore bait, etc.
    - Protazoa infect grasshoppers/Mormon crickets
    - Deformities, slows growth
    - Does not stop feeding immediately!
    - Needs reapplication

Photo courtesy of: https://vignette.wikia.nocookie.net/grasshoppers/images/6/62/Bird_Eating_Grasshopper.jpg/revision/latest?cb=20141205220809

Sprayable fungus

- *Beauveria bassiana*
  - 0.5-2QT./ACRE
  - Multiple applications may be needed
- *Metarhizium acridum*
  - No USA registration



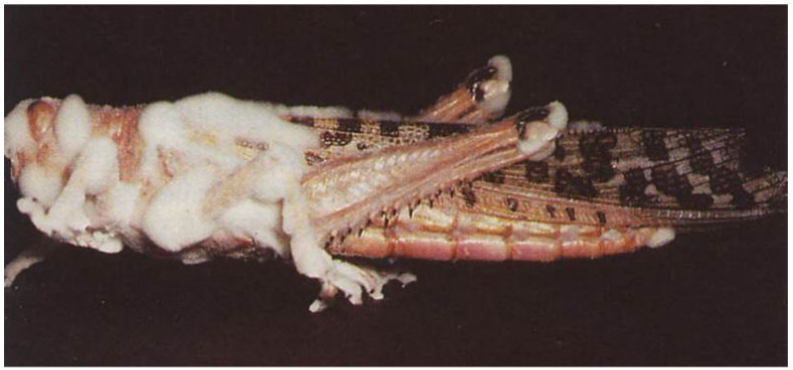


Photo 8. Adult locust infected with fungus *Beauveria basiana*. ©C. Lomer

http://www.uwyo.edu/uwexpstn/_files/global-perspectives/2013-fall-Latchininsky.pdf

Insecticidal Control Rangeland

- RAAT Treatments (Reduced Area-Agent Treatments)
  - Only treat part of acreage 35-80%
- Rangeland treatments
- Reduce cost of treated acreage
- Insects move from untreated to treated residual activity
- Provide haven for beneficial insects/food for birds
- UC IPM - treat young grasshoppers outside of crops

Wyoming Studies

- Products used in study
  - Carbaryl, Malathion, Dimilin
- Applications made to early instars!!
- Dimilin only effective on first three instars
- Blanket/Broadcast treatments
  - 85-99% grasshopper control
- RAAT Treatments
  - 75-90% grasshopper control
  - 50% of the cost
- Information courtesy of the University of Wyoming
  - Dr. Alex Latchininsky

Insecticides

- Generally much more effective on nymphs
- Dimilin only effective on first three instars - Timing!
- Pyrethroid better on adult grasshoppers
  - Not very selective
  - More non-target impacts

Photo courtesy of: The University of Wyoming

Buffer Zone with Baits

- Non-vegetated zone
  - 60 ft. zone
- Utilize carbaryl baits
- As hoppers migrate to fields eat the baits

Select Insecticides for Grasshoppers (product/acre)

Insecticide	Active	Chemical group	Alfalfa	Grasses	Rangeland
Sevin 4F	Carbraryl	1-A	NO	NO	1 pint
Malathion 57	Malathion	1-B	1.5-2 pints	1.5-2 pints	1.5-2 pints
Besige	chlorantraniliprole and lambda cyhalothrin	28+3	6-10 oz	6-10 oz	6-10 oz
Baythroid XL	cyfluthrin	3	2-2.8	2.6-2.8	2.6-2.8
Warrior 2	lambda cyhalothrin	3	1.28-1.92 oz	1.28-1.92 oz	1.28-1.92 oz
Mustang	zeta-cypermethrin	3A	3-4.3 oz	3-4.3 oz	3-4.3 oz
Dimilin 2l	diflubenzuron	15	NO	.75-1oz	.75-1oz
Prevathon	Chlorantraniliprole	28	8-20 oz	8-20 oz	-
Steward	Indoxacarb	22	6.7-11.3 oz	NO	NO

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Economics

- Prevathon- 9-23$ per acre
- Warrior/Lambda Cy- 1.25-2.5$ per acre
- Dimilin- 1.25-1.63$/acre (less if RATTS)

- ***More now- numbers from 2 years ago
- Price of hay is more now too…..

Grasshopper Case Study Modoc					
	2-Jul	9-Jul	2-Jul	9-Jul	
	Hopper Count/m		lb's/acre		ton's forage lower
Pasture Edge 1	12.25	12.5	1972	2180	-0.10
Pasture Edge 2	33.75	8.25	2316	907	0.70
Pasture Medium	26	14.5	3355	1550	0.90
Pasture Interior 2	0	61.5	4452	3171	0.64
Pasture Interior 2	1	10	4603	3153	0.72

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Past					
Past					
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Pasture Interior 2	0	61.5	4452	3171	0.64
Pasture Interior 2	1	10	4603	3153	0.72

$200-350/acre loss with current hay prices

Monitor!

- Catch them whole young
- Control outside of crops
- Looking- Late April-May
- Hatching Indian Valley May 23rd

Armyworms!

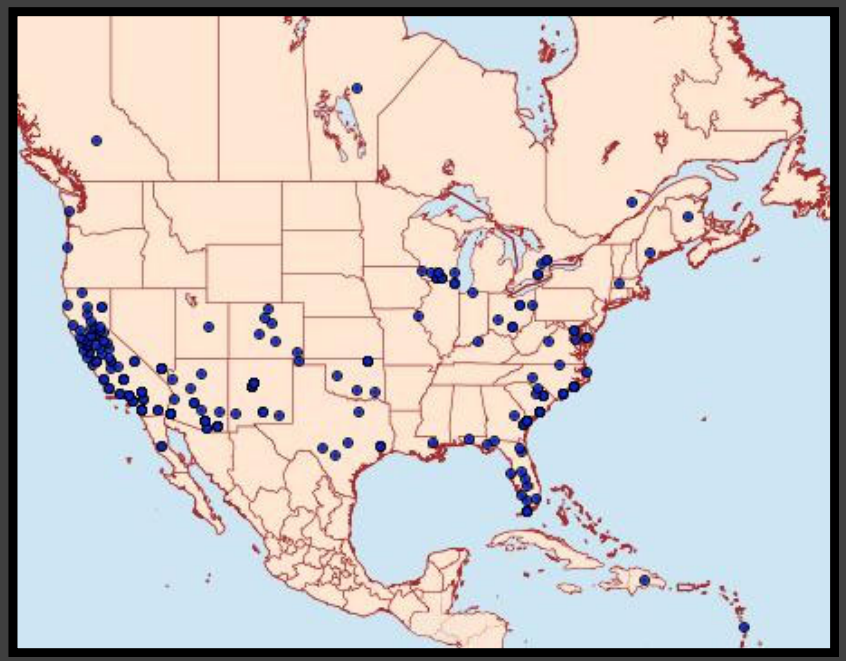
- Lepdopetera Species
- Beet armyworm
- Western yellow striped armyworm
- True armyworm
- Fall Armyworm?

Photos courtesy of: UC IPM

Beet Armyworm

- Native Southeast Asia
- Discovered US 1876
  - Throughout North America

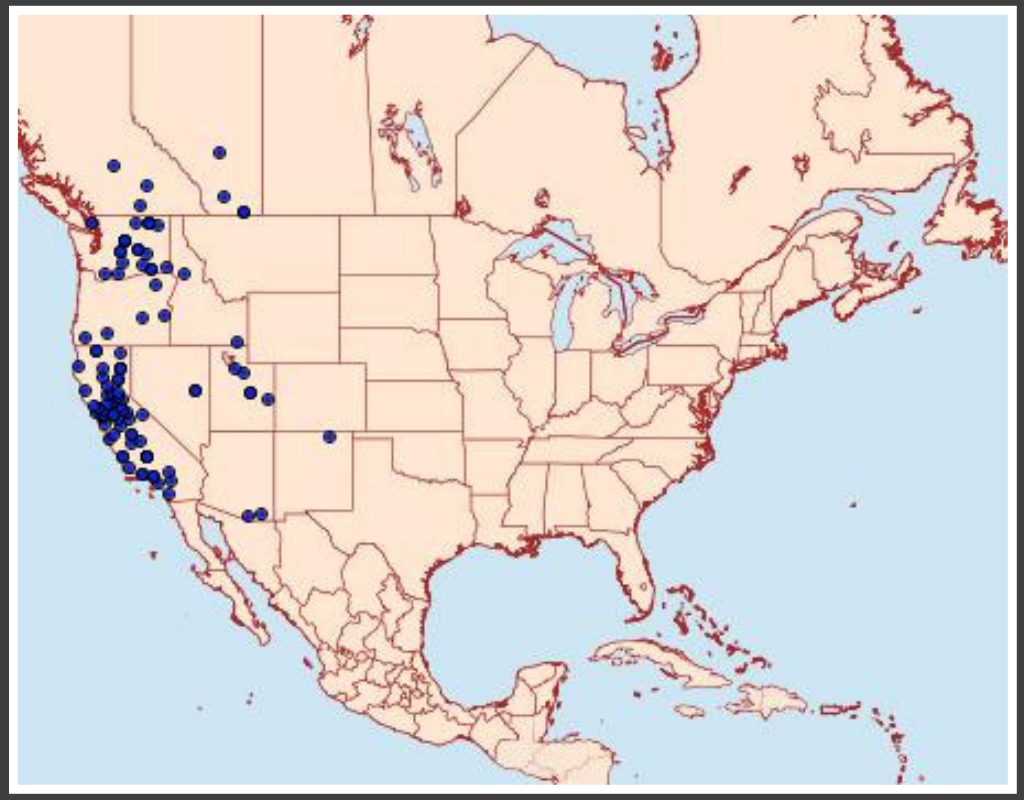
Image courtesy of: Byrain at https://bugguide.net/node/view/693747



Map courtesy of: http://mothphotographersgroup.msstate.edu/large_map.php?hodges=9665

Western Yellow Striped Armyworm

- Mainly Western US
- Native Species



Map courtesy of: Moth photographers group

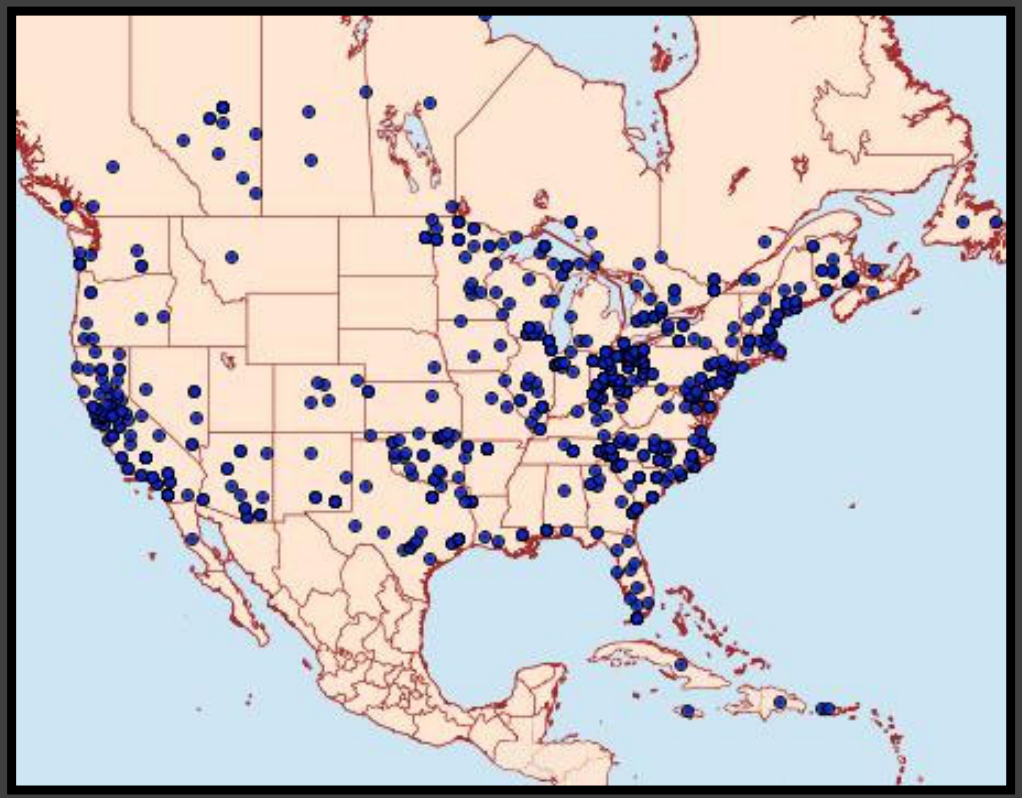
Image courtesy of : John Davis bugguide.net

Image courtesy of: Oregon State

True Armyworm

- All throughout world and North America

Image courtesy of: Clay Nichols bugguide.com



Map courtesy of Moth photographers group

Image courtesy of: Ilona L. bugguide.com

Fall Armyworm?

Image courtesy of: Carol wolf at the moths photographers group

Image courtesy of: Carol wolf at the moths photographers group

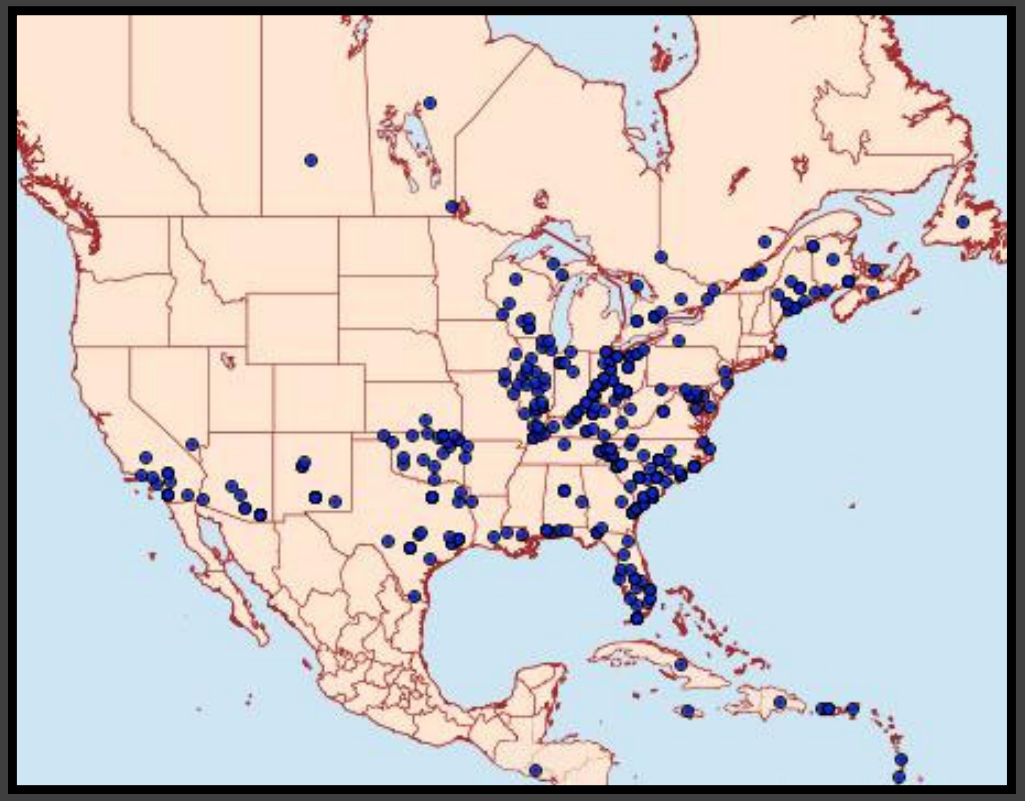


Image courtesy of: the moths photographers group

Image courtesy of: Ken Childs at the moths photographers group

Biology

- Moths - Nocturnal
- Lay eggs 20-400 in mass
- Up to 2,000 eggs per female
  - Beet armyworm and Western yellow striped upper side of leaf. Cottony covering.
  - True Armyworm - rolled in grass
- Typically hatch 1-2 weeks

Image courtesy of: Oregon State, and UC IPM

Image courtesy of: UC IPM

Biology continued

- Western Yellow Striped and Beet Armyworm
  - 2-3 weeks until mature
- True Armyworm
  - Typically 3-4 weeks until mature
- Central Valley
  - Up to 5 generations
- Intermountain Region
  - Only 2 maybe 3 generations

Photo courtesy of: UC IPM

Biology continued

- Appears in Intermountain Region July and August
- Second generation causes most damage
- Damage typically arises 2-3 weeks after second cutting
- Full life cycle can be from 4-6 weeks depending on temperature
- Generations can be concurrent!

Winter

- Do not overwinter in harsh climates
  - No definition of “harsh” climate in literature
  - Migrates in from warmer areas
  - Overwinters as pupa in soil

Damage

- Defoliation of the crop
- Skeletonize alfalfa leaves
  - Cause flagging in field
- Grass eaten often avoids midvein
- Voracious feeder

Damage

- Study looking at fall armyworm feeding
- 80% of total foliage consumed in last instar

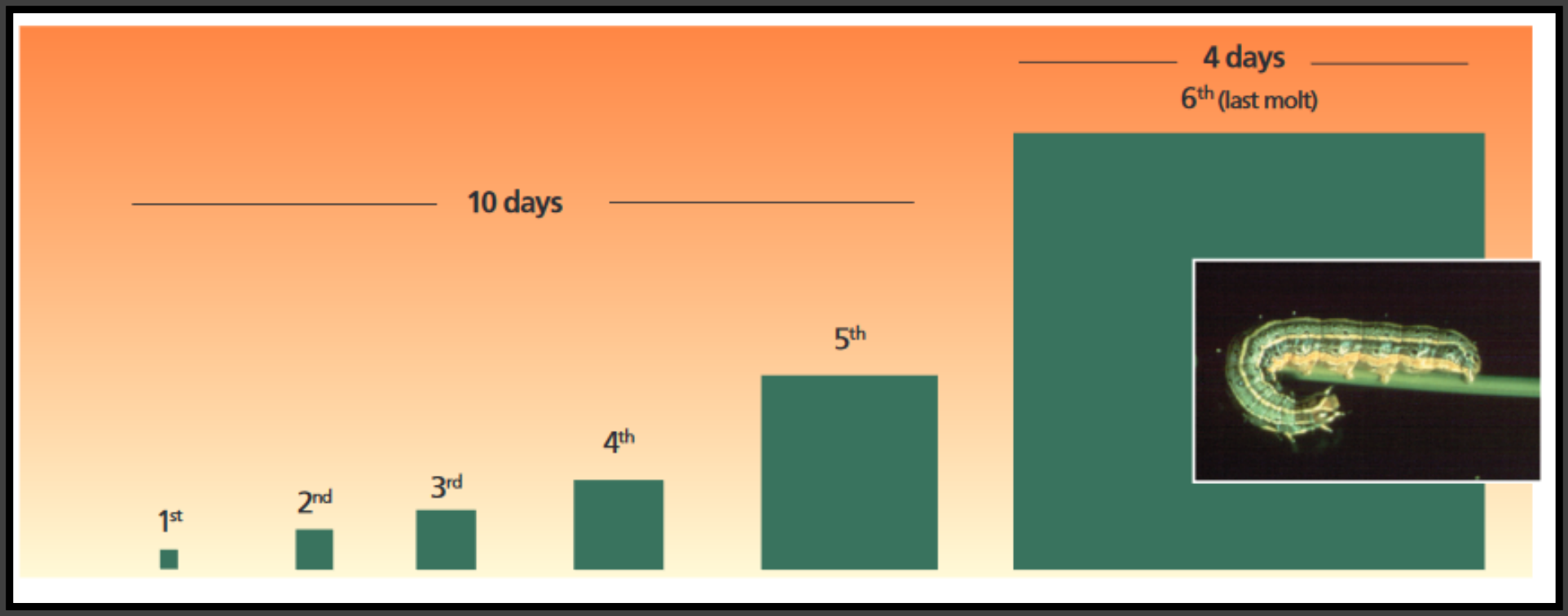


Figure courtesy of: Kathy L. Flanders Auburn University

Management

- Populations are cyclic
- Not a pest every year
- Not typically a large pest in the Intermountain Region
- Often controlled by natural predators!
- Warm winter, wet spring can lead to increased populations

Predators

- Big-eyed bugs
- Spiders
- Minute pirate bug
- Damsel bugs
- Lacewings

Image courtesy of: Southern Utah Entomology

Image courtesy of: Oregon State

Viruses

- Infected Armyworm

Photo Courtesy of: WSU

Parasites

- At least 10!
- Parasitic wasp (H*yposoter exigaue*)
- Often manages population
- Doesn't kill young instars….
- But kills larva before last instar

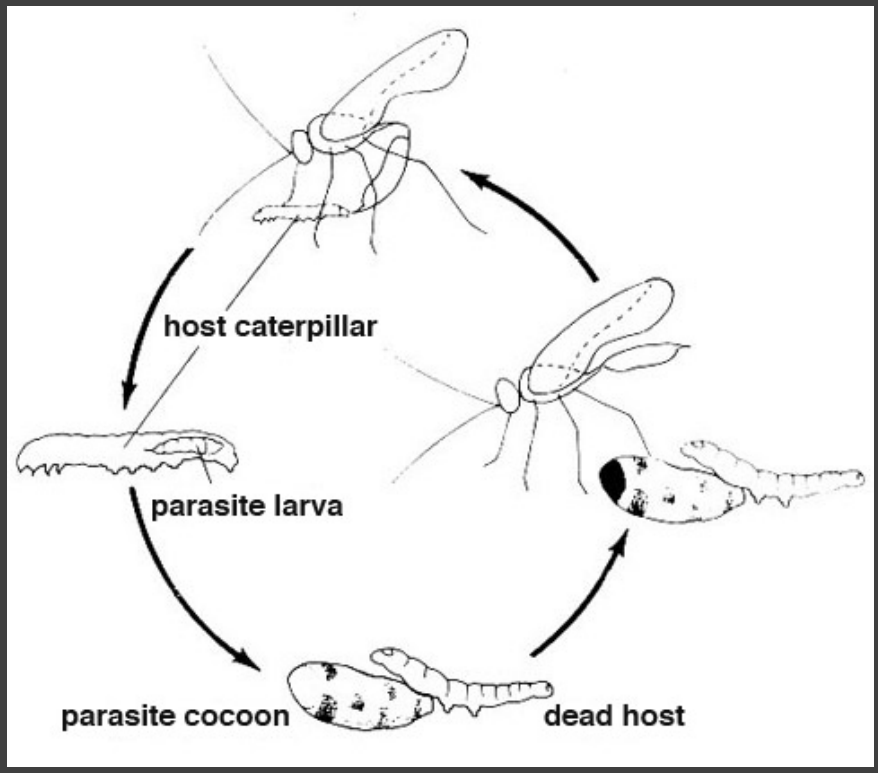


Image courtesy of: http://ipm.ucanr.edu/PMG/NE/hyposoter_exigua.html

Photo courtesy of: UC IPM

Management

- HIGH populations this year!
- Look for “frosting” on fields
- Look for birds
- Moths flying
- Ultraviolet/backlight traps
- And MONITOR!

Photo courtesy of UC IPM

Monitoring Pasture/Grass

- Ground Search!
  - Late July through fall
  - 15 sites/30 acres pasture
  - Every 5-7 days
  - Under grass, around crowns, in cracks
  - Economic threshold
    - Oregon State 5-10 /sq. ft.
    - Other states 2-4/sq. ft.
    - California no established threshold
    - Use judgment

Photo courtesy of: UC IPM

Monitoring Alfalfa

- Sweep 15 inch net
  2-3 times/week
  - 4 sections each field
  - 5 sweeps per section
- Evening and early mornings
- Identify
- Determine if parasitized!
- Threshold
  - 15 or more non-parasatized Armyworms longer ½ inch/sweep

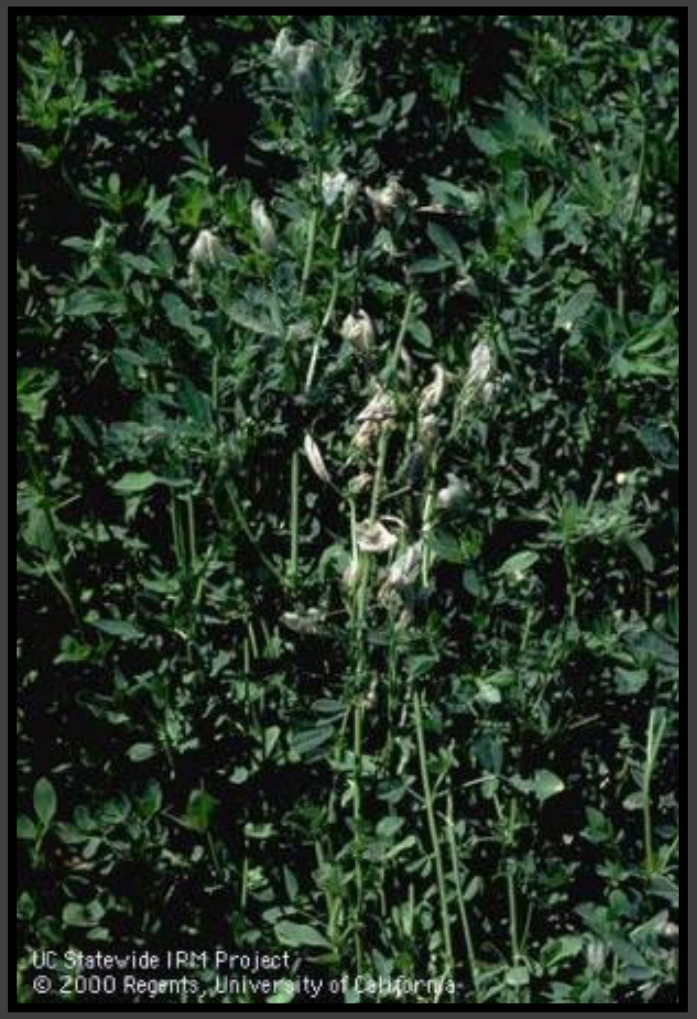


Photo courtesy of: UC IPM

Parasitized Video

- http://ipm.ucanr.edu/PMG/r1900711.html

Image courtesy of: UC IPM

Control options

- Cut the field
  - Creates inhospitable environment
  - If worms are large - may be problem after cutting
  - Under windrows feeding can occur
  - If threshold reached cut within 2 days or spray

Image courtesy of: Steve Orloff

Insecticide options

- Organic
- BT (bacillus thuringiensis)
  - Agree WG or Xentari DF
  - Apply to first two instars
    - Multiple applications may be needed
  - Does not harm beneficial insects

Photo courtesy of: UC IPM

Select Insecticides for Armyworms (product/acre)

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Sevin 4F	Carbaryl	1-A	1-1.5 Quarts	1-1.5 Quarts	NO
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Besiege	chlorantraniliprole and lambda cyhalothrin	28+3	6-10 oz	6-10 oz	6-10 oz
Baythroid XL	cyfluthrin	3	1.6-2.8 oz	1.6-1.9 oz	1.6-1.9 oz
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Mustang	zeta-cypermethrin	3A	3-4.3 oz	3-4.3 oz	3-4.3 oz
Dimilin 2L	diflubenzuron	15	NO	2oz	2oz
Intrepid 2F	Methoxyfenozide	18	4-8oz	4-8 oz	4-8 oz
Coragen	Chlorantraniliprole	28	3.5-7.5 oz	3.5-7.5 oz	3.5-7.5 oz
Steward	Indoxacarb	22	9.2-11.3 oz	NO	NO
Xentari	BT		.5-1.5 lb	.5-2 lb	.5-2 lb

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Baythroid XL	cyfluthrin	3	1.6-2.8 oz	1.6-1.9 oz	1.6-1.9 oz
Warrior 2	lambda cyhalothrin	3	1.28-1.92 oz	1.28-1.92 oz	1.28-1.92 oz
Mustang	zeta-cypermethrin	3A	3-4.3 oz	3-4.3 oz	3-4.3 oz
Dimilin 2L	diflubenzuron	15	NO	2oz	2oz
Intrepid 2F	Methoxyfenozide	18	4-8oz	4-8 oz	4-8 oz
Coragen	Chlorantraniliprole	28	3.5-7.5 oz	3.5-7.5 oz	3.5-7.5 oz
Steward	Indoxacarb	22	9.2-11.3 oz	NO	NO
Xentari	BT		.5-1.5 lb	.5-2 lb	.5-2 lb

Select Insecticides for Armyworms (product/acre)

Insecticide	Active	MOA Group	Alfalfa	Grasses	Rangeland
Sevin 4F	Carbaryl	1-A	1-1.5 Quarts	1-1.5 Quarts	NO
Malathion 57	Malathion	1-B	2 pints	2 piints	3 pints
Besiege	chlorantraniliprole and lambda cyhalothrin	28+3	6-10 oz	6-10 oz	6-10 oz
Baythroid XL	cyfluthrin	3	1.6-2.8 oz	1.6-1.9 oz	1.6-1.9 oz
Warrior 2	lambda cyhalothrin	3	1.28-1.92 oz	1.28-1.92 oz	1.28-1.92 oz
Mustang	zeta-cypermethrin	3A	3-4.3 oz	3-4.3 oz	3-4.3 oz
Dimilin 2L	diflubenzuron	15	NO	2oz	2oz
Intrepid 2F	Methoxyfenozide	18	4-8oz	4-8 oz	4-8 oz
Coragen	Chlorantraniliprole	28	3.5-7.5 oz	3.5-7.5 oz	3.5-7.5 oz
Steward	Indoxacarb	22	9.2-11.3 oz	NO	NO
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Dimilin 2L	diflubenzuron	15	NO	2oz	2oz
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Coragen	Chlorantraniliprole	28	3.5-7.5 oz	3.5-7.5 oz	3.5-7.5 oz
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