Invertebrate Pest Management for Pacific Northwest Pastures

A.J. Dreves, N. Kaur. M.G. Bohle, D. Hannaway, G.C. Fisher and S.I. Rondon

Photo: Mylen Bohle, © Oregon State University
Figure 1. A pasture in the Pacific Northwest.

Introduction

A well-managed pasture (Figure 1) has several ecological and economic benefits. However, a variety of pests can diminish those benefits.

Several species of arthropods (insects, mites and garden symphylans), and gastropods (slugs) inhabit pastures of the Pacific Northwest of the United States. Newly planted pastures are more vulnerable to damage caused by invertebrate pests carried over from previous rotations if preventative measures such as tillage practices, adjustment of planting times, removal of infected plant material and healthy plant-management tactics are not followed. Infestations in established pastures occur when migrating pest populations attack from adjacent areas.

Either way, an invertebrate pest population can reduce a pasture's productivity and yield when damage exceeds an intolerable level generally referred to as an economic threshold level. Pest populations tend to fluctuate in nature and are heavily regulated by climate, food availability and ecosystem disturbance. Biological factors such as predators, parasites and entomopathogens also play an important role in pest population suppression (Figure 2, page 2).

An integrated pest management strategy can maintain pest populations below economically damaging levels. IPM is a holistic approach that relies on knowledge of pest biology and ecology and their interactions with and within systems. Weak links in the

Amy J. Dreves, Extension pest management specialist, University of the Virgin Islands; Navneet Kaur, Extension entomologist; Mylen Bohle, Extension agronomist; David Hannaway, Extension forage specialist; Glenn Fisher, emeritus Extension entomologist; and Silvia Rondon, Extension entomology specialist, all of Oregon State University.

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Photo: Amy Dreves, © Oregon State University
Figure 2. Parasitized pupa of true armyworm.

Photo: Amy Dreves, © Oregon State University
Figure 3. Researchers collect insect samples. Monitoring pests and beneficials are the cornerstone of pest management programs.

pest's biology provide windows of opportunity for the most effective control. Implementing effective IPM practices requires that you know:

- What to look for.
- When and how to scout for pests and their natural enemies.
- Where to find pests and recognize and locate their natural enemies (Figure 3).

This publication identifies common invertebrate pests and provides the ecological and control descriptions needed to develop successful pest-management programs.

Invertebrate pests of Northwest pastures

"*Your geographical region, forage varietal grown, surrounding vegetation, and agronomic management, largely determine the pest(s) you are likely to have in your pasture.*"

The following is a list of arthropod and gastropod pests that damage pastures in the PNW. Some are common pests; most are occasional pests. Not all will be present in your area.

Table 1. Pasture pests arranged by damage at crop development stage, geographical distribution, and when damage occurs

(Modified from *Insect, Mite, and Related Pests of Pacific Northwest Pastures*)**‡.**

Pest	Distribution[a]	Season of damage[b]
*At planting**		
Wireworms	W, E	Sp, F
Garden symphylan	W	Sp, F
Crane fly larvae (aka leather jackets)	W	W, Sp, F
Slugs	W	W, Sp, F
Black cutworm	W, E	Sp, Su
*Can also invade or develop to damaging levels anytime.		
Postemergence and established stands – primarily grasses and cereals		
Armyworms	W	Su, F
Sod webworms, different species	W, E	F, W, Sp

Pest	Distribution[a]	Season of damage[b]
Cutworms	W, E	Sp, Su, F
Mites	W, E	
Winter grain mite	E	W, Sp, F
Clover mite	E	late W, Sp
Banks grass mite (Timothy mite)	E	late Sp, Su
Aphids (several spp.)		
Greenbug		F
Russian wheat aphid	E	F, Sp
Bird-cherry oat aphid	W, E	F, Sp
Plant bugs		
Black grass bug	E	late Sp, Su
Chinch bug	E	Su, F
Other insects that can be problems in pastures		
Beetles		
White grubs	E	all year
Blister beetles	E	Su
Cereal leaf beetle	E	Sp (larva) F (adults)
Billbugs	W, E	Su
Grasshoppers, different species	E	Su
Western harvester ant	E	all year
Meadow spittlebug	W	Sp
Thrips	E (Timothy)	Su
Leafhoppers	E	late Sp, Su
Mealybugs	W (seldom), E	late W, Sp
Mosquitos	E	late Sp, Su
If there is alfalfa or clover in the pasture		
Alfalfa weevil	W (seldom) E	late Sp, Su
Alfalfa caterpillar	E	Su
Alfalfa & cabbage looper	W, E	Sp, early Su
Pea aphid	W, E	late W to Su
Alfalfa aphid	W, E	late W to Su

Pest	Distribution[a]	Season of damage[b]
Blue alfalfa aphid	E	late W to Su
Clover aphid	W, E	late Sp, Su
Spotted alfalfa aphid	E	Su
Blister beetles	E	Su
Clover leaf weevil	W, E	Sp, Su
Clover root curculio	W, E	Sp, Su
Clover root borer	W, E	Sp to W
Lesser clover leaf weevil	W, E	Sp, Su
Variegated cutworm	W, E	Sp, Su
Redbacked cutworm	E	late W, Sp
Army cutworm	E	late W, F
Bertha cutworm (western OR, WA)	W, E	Su
Clover cutworm	E	Su
Meadow spittlebug	W, E	Sp
Pea leaf weevil (seedling damage)	W, E	late W, Su, F
Slugs	W	W, Sp, F
Spider mites	E	late Sp, Su
Western spotted cucumber beetle	W	Sp
Thrips	E	Su

[a]W= West of Cascades; E= East of the Cascades
[b]Sp= Spring; Su= Summer; F= Fall; W= Winter
▯ https://www.extension.uidaho.edu/publishing/pdf/pnw/pnw0614.pdf

For chemical management of invertebrate pests on range and pastures, refer to *2020 PNW Insect Management Handbook.* Refer to the section on Pasture and Grass Hay Pests.

In all cases, follow the instructions on the pesticide label. Read the product label before making any pesticide applications. Applicators need to have in their possession current product labels and must use pesticides in a manner consistent with label directions, with the following exceptions.

It is legal to apply pesticides in any of the following ways:

1. More dilute than on the label.
2. At a lower rate than on the label.
3. Less frequently than on the label.
4. For pests not on the label, as long as the site or crop is listed and other restrictions are observed.

Photo: Silvia Rondon, © Oregon State University
Figure 4. Wireworm larvae.

In Oregon and Washington, public service entomologists or Extension agents possessing a current pesticide consulting license can make recommendations for controlling a pest not listed on the label.

Grass hay is NOT the same as alfalfa or clover hay for insecticide use. Many insecticides are labeled on alfalfa and its hay and fodder products. However, most of these insecticides are not labeled for use on grass and its hay and fodder products. Mixed legume and grass pasture or hays require a label listing pastures: mixed stands of grass and legume.

At planting

Growers have relied on tillage, increased seeding rates, and adjustment of seeding dates to increase a good stand. No-till practices tend to favor soil pest development. Wireworms, symphylans, slugs, crane flies and some cutworms may build sizeable populations, particularly if the previous year the field was a perennial grass, legume or native vegetation.

Soil preparation using conservation or minimal tillage practices in the late winter or early spring when wireworms and symphylans are in the top few inches of soil is generally the best timing for reducing populations of these pests that feed on seeds and seedlings. For all pests, timing is critical. Quick germination and vigorous seedling growth help to reduce pest damage. For instance, wireworms can live in the soil and damage the roots of plants for up to 4 years before they mature into adults known as click beetles. Fields infested with the garden symphylan will always be at risk in the west. Black cutworm larvae are often abundant in old pastures, legume/grass stands, canola, sugar beet crops, grass seed and legume hays, especially direct seeded (no-till). At least two species of crane flies infest grass pastures west of the Cascades, where they can cause stand loss in established pastures and new seedings. At least two species of slugs can seriously damage newly seeded pastures west of the Cascades. Billbugs sporadically cause economic damage in the east.

Wireworms

Description and life history

Wireworms are the larvae or immature stages of click beetles. Several species — dryland wireworm *(Ctenicera pruinina)*, Pacific Coast wireworm *(Limonius canus)* and sugar beet wireworm *(Limonius californicus)* — may be present. Wireworms are cylindrical, slender, hard-bodied, slow-moving and yellowish-orange larvae with brown heads (Figure 4). They vary from less than 1/4 inch to over an inch in length. Wireworms may live from two to

Photo: Silvia Rondon, © Oregon State University
Figure 5. Wireworm tunneling a crown.

Photo: Lynn Ketchum, © Oregon State University
Figure 6. A click beetle.

five years in the soil, damaging roots before maturing to adult click beetles. Wireworms move up and down the soil profile according to soil moisture and temperature. Therefore, larvae commonly damage pastures or grasses in late winter and spring and are often found tunneling into roots and crowns (Figure 5).

The adult beetles are narrow, brown to black, and usually 1/3- to 1/2-inch long (Figure 6). These are the only beetles that, when placed on their backs, will "spring" into the air with a distinct clicking sound to be right-side up. Adult wireworms usually emerge, mate and lay eggs from late spring through summer, depending on the species. Small white eggs are laid in clutches in the soil. Many species are attracted to grasses to lay eggs.

Damage

Wireworms feed on germinating seeds, roots and crowns of host plants that are numerous, including cereal, grass, legume and vegetable crops. The larvae destroy germinating seeds and feed externally on or tunnel into larger roots and crowns of plants. The larvae rasp, and shred plants below the soil line. This results in seedling stands with spotty emergence, and stunted growth (Figure 7). Infested grass and cereal seedlings are stunted and die slowly, progressing in color from green to yellow

Photo: Arash Rashed, © University of Idaho.
Figure 7. Damage caused by wireworms.

to chlorotic white. Wireworms do not cut stems from crowns like cutworms do. Click beetles do not damage pastures, but when present in large numbers can be an indication of a potential problem from their wireworm offspring.

Detection and scouting

Previous crop history of wireworm damage is about the most reliable predictor of damage to new pastures. Low densities of wireworms cause substantial damage, and these damaged areas are usually patchy throughout the field or are restricted to shallow, sandy areas and ridges in fields. Detect wireworms in damaged areas by digging and screening soil. If soil is dry, the wireworms will be as deep as the soil moisture line.

Sampling with baits. In the spring, when soil moisture is abundant and temperatures are mild, wireworm larvae are close to the soil surface and may come to baits buried in the soil. Oatmeal soaked in water for a day can be buried in the soil 3–6 inches below the surface and marked with flags in numerous places in fields suspected of having wireworms. Inspect bait stations 5–10 days later, depending on soil temperatures and moisture. Stations with one or more wireworms can be indicative of potential damage.

Management

Wireworm management is difficult. Seed treatments and preplant, soil-incorporated insecticides alone and in combination are used to manage wireworms in other crops. Because products may not be available for use in establishing grass and mixed legume or grass pastures, precede pasture establishment when possible with a crop such as field corn, for which wireworm insecticides are labeled. Otherwise, seasonal plowing (late winter through spring) when larvae are near soil surface will crush larvae and expose them to predation by birds. Increased seeding rates may help compensate for seeds and seedlings lost to light wireworm infestations.

For more information on wireworms, refer to *Wireworms: A Pest of Monumental Proportions* (EM 9166, https://catalog.extension.oregonstate.edu/em9166) and *Wireworm: Biology and Nonchemical Management in Potatoes in the Pacific Northwest* (PNW 607, https://catalog.extension.oregonstate.edu/pnw607).

Garden Symphylan

Description and life history

Garden symphylans (*Scutigerella immaculata*) are not members of the class Insecta (insects) but members of the class Symphyla. Species of this class are common soil arthropods worldwide. Symphylans are small, whitish “centipede-like” creatures that, when fully grown, are only about 1/4-inch long (Figure 8). They emerge from eggs with

Photo: Ken Gray Collection, © Oregon State University
Figure 8. Symphylan adult.

Photo: Amy Dreves, © Oregon State University
Figure 9. Damage to roots caused by symphylan.

six pairs of legs and at each molt gain another pair until maturity (12 pairs of legs total). Symphylans are fast-moving with a rapidly vibrating antenna. They can live for as long as a year under the right conditions. There are two reproductive periods — late spring and fall. Populations develop rapidly. Soil infested with symphylans typically remains infested as long as crop and noncrop plants are present.

Damage

Symphylans feed on germinating seeds, rootlets and small root hairs of plants (Figure 9). This results in poor germination (field skips) and short, deformed and stubby roots that produce small, stunted and unproductive plants. Root damage may also render plants more susceptible to some soil-borne plant pathogens.

Detection and scouting

Knowledge of past infestations and damage to crops in a field is important because these areas within a field tend to be present year after year. Ridges and slopes in the field are preferred to low, wet areas that have standing water during part of the year. Soil sampling with a shovel helps determine population density of symphylans. When sampling injured plants to determine if symphylans are the cause of a problem, dig down as deep as 12 inches and screen or break apart soil over a black background. Break the soil clods and clumps apart to see and record symphylans present.

Bait stations. In late spring, bait stations can provide information on symphylan infestations. Bait stations are faster to monitor than soil samples but are more variable and more sensitive to factors such as soil moisture, temperature and the presence of host vegetation. Use them from April through June. To make a bait station, scrape away vegetation or top 1/3-inch of soil in a 6-by-6-inch area. Moisten soil with water if it is dry (symphylans avoid dry soil). Slice in half a fresh potato (any variety works) and place it sliced side down on the soil surface and cover it with a plastic pot to keep it dark and moist. Place from 10 to 30 of these stations throughout the field or where symphylans are thought to occur. One to three days after placement, lift the bait and

count the garden symphylans on the soil and then the garden symphylans on the bait. Make a map and record numbers of symphylans found by location. During warm weather, check April–June baits one to two days after placement. This is because the potato dries out faster and dry, suberized potatoes attract fewer symphylans. Counts also decrease if baits are left out for multiple days. In cooler conditions, baits are commonly left out for three to five days. Baiting works best if used prior to tillage or about three weeks after tillage, when the soil has stabilized. More than five symphylans per bait usually indicate problems will be encountered in stand establishment.

Photo: Silvia Rondon, © Oregon State University
Figure 10. Slugs.

Management

Tillage is probably the oldest management tactic, and it is still one of the most effective. Tillage crushes symphylans, exposes them to extreme environmental conditions and destroys the cracks, tunnels and worm holes symphylans use to travel to seeds and seedlings. A firm seedbed makes it difficult for symphylans to reach newly seeded plants. The few effective insecticides that control symphylans are not labeled for use on pastures. Increasing seeding rates and seeding during optimal weather for germination and seedling growth help establish stands in infested soils.

Slugs

Description and life history

Slugs are common pests of grasses in western Oregon and Washington. Gray garden slug (*Deroceras reticulatum*) (Figure 10), and the banded Arion (*Arion circumscriptus*) are the most common species in the west. *D. reticulatum* was first reported east of the Cascades affecting potatoes in a storage facility in 2018. Typically, slugs feed below ground by day and above ground during cool weather, when there are conditions of low light, light rain or high humidity, particularly in the fall, winter and spring months (summer damage also occurs on irrigated pastures).

When temperatures cool in September and rains return to western Oregon and Washington, slugs become active. Reduced day-length, cool temperatures and rain activate the slugs that over-summered in the dry soil. They begin feeding again, mate and lay eggs. Small clutches of 2–10 eggs are deposited under organic matter or in soil cavities. Depending on species, each slug is capable of producing over 250 eggs over a two-or three-month period. Eggs deposited by mid-October usually hatch within a few weeks of being laid. Eggs deposited after mid-October usually hatch the following March and April. From one to two generations occur per year in pastureland. Two generations are typical in irrigated pastures or when an excessive amount of spring and early summer precipitation occur.

Damage

Slugs feed on seeds of cereals and corn, as well as on new roots and top growth of pasture plants. Slugs can be a significant factor when trying to establish pastures in western Oregon and Washington. Reduced tillage programs have probably been the most critical factor in increasing slug problems in agriculture. Tillage crushes slugs. Tillage also buries eggs and actively feeding slugs, which may die or be delayed in reaching and

feeding on seedlings of new plantings until significant crop growth has occurred. Tillage destroys the soil structure and the avenues of movement used by slugs (tunnels created by worms, voles, gophers, natural openings, cracks and crevices in the soil), further delaying their feeding on a new crop. Most problems with slugs occur when direct seeding into the ground that was previously in a perennial grass and infested with slugs. The more organic matter and surface residue present, the higher the slug populations encountered.

Slugs destroy seeds of cereals and seedlings of grasses, cereals and legumes. Damage and seedling stand loss occurs at around five slugs per square foot. Slugs also feed on established grasses and legume forages, impacting production and yield when populations exceed 10 or more per square foot. The expense of reseeding, bait cost and necessity of increased weed control can be substantial.

Detection and scouting

Prior to establishing a pasture, determine the slug population present. This can best be done by previous field history or by attracting slugs to bait stations before, at or just after planting. Bait stations work when slugs are active in the fall through spring months as long as the soil surface is wet and moist. A bait station is made by scraping a small area of the soil free of vegetation, placing three pellets of a commercial, metaldehyde-containing cereal bran-based bait on the soil in the late afternoon, and inspecting bait stations for slugs early the next morning. Record numbers of slugs attracted to the bait stations and create a field map. Sites where slugs number more than five will likely sustain substantial damage from slugs. Another method is to use 18-by-18-inch slug shelters (mats or blankets) to record relative slug activity.

Management

Commercial metaldehyde and iron phosphate baits are effective in reducing damage from slugs. Tillage prior to seeding a pasture in combination with slug bait applications provide the best strategy for suppression of slugs. Apply baits at planting and after plant emergence as needed.

Crane Flies (aka leatherjackets)

Description and life history

These pests primarily occur west of the Cascades, but they have also caused damage to crops in the Columbia Basin. Crane flies (Figure 11) are the adult stages of the leather jackets (Figure 12, page 11). Despite the big size of the flies, they do not feed since they do not have mouthparts but are responsible for reproduction and dispersal. The flies resemble giant gray to brown mosquitoes, reaching almost 1½ inches long. The front wing margins of the pest species are considerably thickened and leathery compared to nonpest species. Leatherjackets are the immature stages (larvae) that feed on both roots and above-ground parts of plants. Leather jackets are about 1 1/2- inches when

Photo: Silvia Rondon, © Oregon State University
Figure 11. Adult crane flies.

Photo: Amy Dreves, © Oregon State University
Figure 12. Leather jackets.

Photo: Amy Dreves, © Oregon State University
Figure 13. Crane fly larva rear end projections.

full grown, legless, translucent "dirty-gray" in color and are recognized by their distinct projections on the rear ends (Figure 13).

Two species are pests in western Oregon and Washington — *Tipula paludosa* and *Tipula oleracea*. *Tipula paludosa* has one generation a year. Adults emerge in late August and September. They mate immediately and within a day the females begin laying up to 200 eggs per female over a four- to seven-day period. These eggs hatch in a couple of weeks when exposed to sufficient moisture in the form of dew, rain or irrigation. The larvae feed on roots and crowns of grasses from late September through the following May. At this time, the larvae cease feeding and become dormant until they pupate in late July and August. *T. oleracea* has two generations per year; one occurs in the fall. These larvae, however, develop to maturity and produce crane flies that fly in late March and April. They mate and lay eggs that hatch in a couple of weeks. These larvae feed through the late spring and summer on host plants.

Damage

Feeding by the larvae can severely thin both seedling stands and established grass/legume pastures (Figure 14). Small leatherjackets feed below the soil surface on the roots and crowns of host plants. Larger larvae also migrate above ground at night to shred leaf tissue and clip stems of host plants. The larvae also damage turf, lawns and home garden vegetables. Seedling stands have been injured when more than five larvae per square foot are present. Established pastures can withstand higher numbers, with injury occurring at more than 10 larvae per square foot, depending on the health and vigor of the plants.

Detection and scouting

Both new seedings and established stands are at risk from this pest in western Oregon and Washington. Inspect weak areas by pulling back the grass, which separates readily from the crown when heavily infested with these pests. Early detection is vital if chemical control will be applied. Look for small leatherjackets in October and early November and again in May and June (*T. oleracea*) throughout the pasture, particularly the upwind side. Sample crowns and soil around plants to a depth of 2

Photo: Amy Dreves, © Oregon State University
Figure 14. Damage caused by leather jackets.

inches. Screen the soil over a white background and record numbers of larvae in soil samples.

Management

Seedling stands and older, weaker pastures are at risk from this pest. Well-fertilized and -irrigated pastures can often tolerate greater than 10 larvae per square foot without much damage. Birds are great natural predators of crane flies. Insecticides, when labeled, generally provide adequate control when applied to the young larvae.

Black Cutworm

Description and life history

Black cutworm (*Agrotis ipsilon*) occurs in many crops and pastureland throughout the western states. The moths are brownish-gray with dark spots and a light, silvery band on each front wing. The wingspan is about 1.4 inches (Figure 15). Moths usually emerge from pupae in the soil in April and early May. They mate, and in a couple of days, females begin laying eggs on the soil around host plants. The eggs are scattered over the lower, damper areas of grass and legume pastures as well as many other crops. Flight and egg-laying usually continue through May. Eggs hatch in seven to 10 days. The larvae feed for a few weeks. The second flight of adults occurs in the summer. Larvae from this generation can be found from August through early spring. Larvae are about 1.2–1.6 inches long when mature (Figure 16a and 16b). They are gray with a lighter brownish stripe down the back. The head is dark brown or black. Small larvae feed on the foliage for a few days before molting and moving down into the soil. Larvae feed beneath the soil surface by day and above ground at night for four to six weeks until they pupate.

Damage

Large numbers of cutworms can destroy seedling stands and reduce older stands, allowing weed encroachment. Black cutworm larvae feed underground on roots and crowns by day. At night they feed at the soil surface, cutting through leaves and stems of plants (Figure 17) and leaving them to wilt.

Detection and scouting

Wilted and cut plants and leaves are visible indicators of feeding injury. Therefore, scouting must be done for larvae presence during the spring and fall months. Weak pastures and new stands are most susceptible to damage

Photo: Tiziana Oppedisano
Figure 15. An adult cutworm.

Photo: Silvia Rondon, © Oregon State University
Figure 16a. Cutworm larvae typically form a ‘C’ shape when disturbed.

Photo: Silvia Rondon, © Oregon State University
Figure 16b. A closeup of the head of a cutworm larva.

Photo: Silvia Rondon, © Oregon State University
Figure 17. Damage caused by cutworm.

from this pest. Inspect fields for wilted and clipped plants. The larvae are usually found under surface debris or in the soil at the moisture line. Screen soil around the roots and carefully look for the larvae. Cracked corn soaked overnight and placed under shelters of wood will attract and hold medium- to large-sized larvae. Cereal bran-based baits with carbaryl attract and kill black cutworm and can be used in bait stations to monitor the larvae.

Management

When damaging numbers of larvae occur in an established hay pasture, either consider harvesting the hay crop a little earlier than planned or apply an insecticide registered for cutworm control.

Pests in Established Pastures

Some pests may migrate by flying or crawling into a pasture from adjacent areas carried by wind, water, farm machinery or seed stock. The composition of the pasture partly determines the pests you will have. Legumes generally have different pests than cereal or grass pastures.

Armyworm and cutworms

Moths whose immature stages are referred to as "worms" or "caterpillars," armyworms or cutworms may occasionally defoliate pasture grasses. Outbreaks of these pests are sporadic, occurring every few years. Sometimes these outbreaks are regional and persist over successive seasons before biological controls and other factors suppress them. There are five stages of development: moth, egg, larva, pupa and adult moth form.

Difference between cutworms and armyworms. Cutworms, such as the red backed cutworm and black cutworm, typically feed underground by day in sandier soils. At night, they feed at and above the soil surface on plant foliage. Armyworms typically feed above ground on foliage only at night (or on days of low light intensity), and hide in and on the soil under leaf litter by day (e.g., armyworm, *Mythymna unipuncta*, and army cutworm, *Euxoa auxillaris*). Armyworms build to such large populations that they can defoliate acres of grasses and cereals prior to migrating. Armyworm is usually a late summer or fall pest, while Army cutworms can be both an early season and fall pest.

The glassy cutworm — *Chrymoides devastator* (west of Cascades), and *Protagrotis obscura* (east of the Cascades, with no common name) — infest grasses and seldom feed above ground. Consequently, insecticides are seldom effective for their control (even when chemigated in all but the sandiest of soils).

Armyworm

Description and life history

The armyworm moth is about 1 inch long, has a wingspan of about 1 1/2 inches and is tan to grayish brown. Each of its uniformly light-brown forewings has a single tiny white dot in the center (Figure 18). These moths fly at night in summer and fall. They are often seen around porch lights and outbuildings in the evenings. Beginning in late June, moths lay eggs on host plants. Moths are long-lived and can deposit up to 2,000 eggs in masses of 20–80 eggs. The eggs are lined tightly next to one another near the midrib vein of cereals and grasses. The eggs hatch in 8–12 days. Armyworm larvae are quite uniform in color and markings, characterized by brown and black lines

Photo: Amy Dreves, © Oregon State University
Figure 18. An armyworm moth.

Photo: Amy Dreves, © Oregon State University
Figure 19. Armyworm larva.

Photo: Amy Dreves, © Oregon State University
Figure 20. Armyworm pupa.

running the length of the body (Figure 19). Each larva feeds over a 40- to 60-day period. When mature, the larvae cease feeding and burrow into the soil to form a reddish-brown torpedo-like pupa (Figure 20) from which the moth eventually develops and emerges.

Damage

On grasses and small grains, the larvae feed from dusk to dawn and on overcast days. They feed voraciously on foliage, eventually consuming all but the toughest stems and leaf veins. They burrow into the stalks of corn, feeding on this host even in the daytime. Larger larvae may clip leaf veins and seed stalks of grasses. Late summer and fall infestations are first found on ridges and the taller plants in and around fields. In the Willamette Valley, field corn, tall fescue grown for seed and cereal cover crops are favored hosts. This pest seems to prefer reed canary grass pastures over other grass types in southwestern Oregon, but economic damage can occur on most mixed-grass pastures.

Detection and scouting

Infestations often go unnoticed until extensive plant damage is observed. Knowing when to expect the first signs of damage from this pest is crucial for management. Scouting pastures for young larvae is an essential first step in designing a management strategy. Begin scouting in July (varies according to geographical location) to determine the presence of the pest. Look for the moths at lights at night. Later on, check for the larvae in the grass along fence lines by parting grasses and uncovering soil litter. Look for curled up armyworms on the soil surface and in cracks. Or, using a heavy-duty sweep net, take 10 straight-line, 180-degree sweeps in 10–15 different locations throughout a field. Sweep deep into the grass, vigorously covering a 5-foot swath, then count the number of armyworm larvae.

Management

Applied chemical control may be necessary when 25–50 larvae are averaged per straight-line sweep through the field or if an average of four or five larvae are found per square foot of pasture. If chemical control is selected, apply an insecticide when the larvae are less than ½-inch since they are most susceptible to control and little defoliation has occurred up to this point. Tachinid flies heavily parasitize armyworm larvae and often cause armyworm populations to collapse over large areas after a season or two.

Photo: Jim Moore, BugGuide.net
Figure 21. an army cutworm moth.

Army Cutworm

Description and life history

Cutworm moth has a wingspan of about 1 1/2 inches. Wing color varies, although the underlying patterns on wings remain the same (Figure 21). In late August through October, females scatter eggs on bare areas of overgrazed pastures, stressed and grassy areas, or newly

Photo: Joseph Berger, Bugwood.org
Figure 22. Army cuitworm larva.

sown ground. A female may lay more than 1,000 eggs throughout a large field. Irrigation or rainfall stimulates hatch. Larvae are pale gray-brown, and splotched with white marks (Figure 22). Lighter bands run the length of the body and sides. Full-grown larvae are 1½ inches. Larvae can feed through the fall, winter (if temperatures are above freezing), and spring. Larvae pupate in spring and adults emerge in late spring through summer.

Damage

Larvae are climbing cutworms and feed at night or on cloudy days. They usually rest in the soil by day. The preferred hosts are grasses, wheat, alfalfa, canola and mustard, but they also occur on many weeds and most all field crops (such as sugar beet, field corn and barley) in outbreak years. In fall and spring, when green plant material is sparse, larvae migrate over fields defoliating plants in their path.

Detection and scouting

Be suspicious if pastures do not "green up" in the fall or spring. Look closely at grasses and alfalfa for feeding damage on leaves and clipping of stems at the soil line. Confirm the presence of larvae by sifting through surface debris and soil to the moisture line. New seedings of wheat and alfalfa can be damaged with as few as two larvae per square foot. Older stands and grass pastures require greater numbers for economic damage, but consider other field stresses present as well. Many armyworms and cutworms feed on foliage at night. Sweeping foliage of pastures about an hour after sunset will indicate the magnitude of the infestation. During armyworm outbreaks, we have found as many as 20–30 larvae per sweep in grass pastures. The presence of crows, starlings and other flocking birds in fields can indicate the presence of armyworms and cutworms.

Management

As with other species, weather and parasitic wasps and flies usually regulate cutworms and armyworms. Mild winters promote larval survival. Later than normal spring precipitation encourages noncrop hosts and promotes larval build-up. When sampling for armyworms and cutworms, look closely for white eggs of parasitic Tachinid flies on the backs of larvae. If greater than 25% of the larvae have eggs, the armyworm populations usually crash by the end of the larval development period. However, current season damage to crops may still occur before the parasitized larvae die. For effective control of cutworm, insecticides need to be applied to small larvae of less than 1/2 inch.

Black cutworm

Discussed earlier in the section on pests that may be present at planting.

Mites: Winter Grain, Clover and Banks Grass Mite

Three species of mites may injure and cause economic damage to grass and cereal forages. All mites feed with stylet-like mouthparts that pierce and desiccate epidermal plant cells. Large populations of mites turn leaves from a normal green to various stages of yellowing, browning, whitening and silvering. Webbing on leaves is only produced by Banks grass mite and two-spotted spider mite. Large populations of these three species develop readily on timothy and orchardgrass.

Winter Grain Mite

Description and life history

Winter grain mite (*Penthaleus major,* Figure 23) is brilliant blue with reddish-orange legs. It is a cool-season mite that does not produce silk webbing on the undersides of leaves as do two-spotted spider mites and Banks grass mites. This mite feeds on grasses and cereals from late September through April. WGM passes the hot, dry summer months as an orange-colored egg in the soil or on a host plant at or slightly below the soil level. Eggs hatch in late summer (September–October). The immature mites feed and develop through the fall and winter. These adults continue to feed and produce a second generation that matures from March through early May. These mites lay the eggs that over-summer in the pasture. There are usually two generations a year.

Photo: Ken Gray Collection, © Oregon State University
Figure 23. Winter grain mite.

WGM feeds above ground on leaves of grass only at night or during overcast, relatively calm days when temperatures exceed 40 degrees. They can be quite active in the winter and cause much unseen injury to grasses under the insulation of snow. Although WGM can infest many crops, it is more common on grasses and cereals than legumes and some vegetable seed crops in the Northwest. Fall generation mites reach peak populations in the late fall and early winter. Winter generation mites peak in late winter and early spring.

Damage

Winter grain mite and clover mite are cool-season mites, meaning field populations are greatest during cooler months (fall through spring). Populations build in October. You can see most damage (Figure 24) to grass pastures from late February through May. Grass pastures do not green up in the spring.

Photo: Ken Gray Collection, © OSU
Figure 24. Winter grain mite damage.

Detection and scouting

Inspect potentially damaged plants from late October through April for mites. Late winter through May, damaged plants viewed from a distance are noticeably chlorotic and grow poorly. Mites are most easily seen in the early morning or on overcast days or at night on the foliage. Hundreds of mites can occur on single plants. On a bright day, pull individual plants with some soil around the crown and shake over a white pan or white paper. Use a hand lens and look for mites against the white surface.

Photo: Ken Gray Collection, © Oregon State University
Figure 25. Clover mite.

Management

Field burning has been a promising management option. When populations of WGM cause noticeable discoloration of pasture grass in the fall and winter months, insecticides control the mite and mitigate its damage. Organophosphate and pyrethroid insecticides are used to manage this mite. Apply sprays either in the fall to reduce winter populations or in mid-winter. See clover mite section below for a discussion on field burns to manage mites.

Clover mite

Description and life history

Clover mite, *Bryobia praetiosa*, (Figure 25) is smaller than the head of a pin and varies from light to dark brown on grasses. Like winter grain mite, clover mite is a cool-season mite that does not produce webbing on plants. This mite and its damage occur from late February through April in grass pastures in central Oregon and Idaho. These mites are smaller than WGM. They are light brown with very long front legs, 3 times longer than the other three pair! Use a 16-power hand lens or microscope to verify species. The life cycle, behavior and damage caused by this mite are not well understood. Two or more generations may occur while mites are active in pastures.

Damage

These mites damage grasses in the same manner as winter grain mite. In central Oregon, it has primarily been reported from orchardgrass pastures. As the mites feed, they puncture the epidermal cells with their stylets (Figure 26). This stunts plant growth and gives a silver-gray cast to otherwise chlorotic plants. Severe infestations have killed crowns of orchard grass.

Photo: Ken Gray Collection, © Oregon State University
Figure 26. Clover mite damage.

Detection and scouting

See description for winter grain mite.

Photo: F.C. Schweisin, Bugwood.org
Figure 27. Banks grass mite.

Management

Naturally occurring biological controls for this mite are poorly understood. To date, insecticide trials have not identified promising products to control this pest. Field burns do not consistently lower populations of this mite. Occasionally field burns can weaken or kill crowns of grasses under stress. If large numbers of mites survive a field burn or are windblown in from nearby areas, they colonize and build on the weakened regrowth from surviving crowns.

Banks Grass Mite

Description and life history

Banks grass mite, *Oligonychus pratensis*, (Figure 27) is a common mite species in many western states. In the Midwest, it is a serious pest of corn. In the northwest, it can damage drought-stressed turf. This mite and its damage resemble the two-spotted spider mite. Common in timothy grass, this mite has been most problematic in Nevada and Washington. Overwintering mites in the soil and crowns of plants colonize timothy in the spring when temperatures rise. They produce silk webbing on leaves and develop large colonies with multiple (5–7) generations during spring and summer. Hot temperatures and dry, dusty conditions exacerbate problems from these mites.

Damage

Banks grass mite is more destructive to turf than other turfgrass mites. These mites rasp and puncture epidermal cells of plants and feed on the fluid. The plants become yellowish, silver and bronze. In the early stages of feeding injury, there is small, white flecking (stippling) similar to that of other mites (Figure 28). Under hot, dry and droughty conditions, severe injury progresses rapidly. This mite can kill timothy crowns. Dying and dead grass appears brownish-yellow, and the blades are stiff.

Photo: Samuel Abbott, © Utah State University
Figure 28. Grass mite damage.

Banks grass mite is a hot weather mite, unlike the other two species discussed. Banks grass mites overwinter as fertilized adult females. These mites are

dormant during the winter months when the other two mites are active. Banks grass mite overwinters in the soil near the bases of the timothy plants. These overwintering mites are orange. When the weather warms in early spring, the mites resume feeding and lay eggs. With favorable conditions, the life cycle can be completed in 8–25 days. Continuous, overlapping generations are produced throughout the growing season. Banks grass mites spend much of the time feeding and resting at the base of the grass plant. This makes them somewhat difficult to detect and inhibits effective control.

Detection and scouting

Look for field symptoms described above just as they are beginning to develop in late spring. Inspect field margins, ridges and shallow, dusty and stressed field areas for first signs of infestations. Use a 10-power hand lens and cover field thoroughly through the season, particularly during dry, hot spells.

Management

Banks grass mite is a difficult species to control with pesticides. Currently, labeled products for use on grass pasture and hay crops are less than effective. Under conditions of drought, control of the mite is often unsatisfactory. Some predatory mites may offer limited control.

Aphids, Leafhoppers, Mealybugs

These are all insects that feed with piercing-sucking mouthparts. Large populations of aphids, mealybugs, and leafhoppers can develop in grass pastures during the spring (and fall – aphids). These pests can stunt, yellow, and even kill grasses and cereals. They excrete copious amounts of honeydew (a sugary exudates) that drops on, sticks to, and causes "burning" of leaves. The honeydew also provides a substrate for a black, sooty mold to grow. Both the burning and sooty mold interfere with photosynthesis.

Aphids

Many species of aphids colonize grasses and cereals in pastures. However, those occurring on legumes do not occur on grasses and cereals. Those on cereals or grasses do not occur on legumes. On grasses, aphids can build large populations that set back growth. Some aphids colonizing grasses are vectors of barley yellow dwarf virus (BYDV). BYDV infection probably reduces forage yield and quality.

The aphids colonizing alfalfa and clover are different species but can cause problems in the spring when large populations of clover aphid, pea aphid, alfalfa aphid, cow pea aphid or blue alfalfa aphid build rapidly.

Description and life history

Many species of aphids can occur in grass and cereal pastures. Bird-cherry oat aphid, *Rhopalosiphum padi* (Figure 29), and Russian wheat aphid, *Diuraphis noxia*, (Figure 30) are discussed. Aphids are small, yellow-to-green insects seldom larger than a number-two

Photo: Amy Dreves, © Oregon State University
Figure 29. Bird cherry oat aphid and a white oblong egg laid by a beneficial hover fly, whose larvae feeds on aphids.

Photo: Frank Pearis, © Colorado State University and Bugwood.org
Figure 30. Russian wheat aphid.

pencil lead. They have piercing-sucking mouthparts, may have wings or can be wingless. Look for the dorsal pair of cornicles or "tail pipes" at the rear end of an aphid to distinguish aphids from other insects. Aphids may overwinter in pastures during mild winters, or in the spring they may fly from other hosts into pastures (often in great numbers). Winged aphids migrating into grasses give birth to young, wingless aphids. These aphids mature in a week or two and begin laying more aphids. These aphids are all females and within weeks, large populations may be present in a field. Multiple generations occur. When populations become quite large, winged aphids (Figure 31) are produced on the grass. These aphids disperse from the field to colonize other areas and host plants.

Damage

Aphids suck sap from the leaves of grasses and cereals. They also vector diseases (bird-cherry oat aphid and barley yellow dwarf virus) or inject toxins into plants during feeding that stunt, distort or kill (Russian wheat aphid/greenbug). Large populations can dry up spring regrowth or new seedings rapidly. Plants wilt and are covered in sticky, syrupy honeydew secreted by the aphids. Russian wheat aphid stunts grasses and cereals, turning the leaves yellowish red and causing the leaf margins to roll and curl upwards, often enclosing the aphids!

Detection and scouting

Inspect fields early in the spring at regrowth. Carefully inspect crowns and leaf sheaths of grasses and cereals at and just below ground level for aphids that overwintered in the pasture. These aphids move up on the undersides of leaves in a few weeks and build rapidly. In April, May and June, check plants for winged aphids that have migrated into fields. Windward sides of fields usually are colonized first.

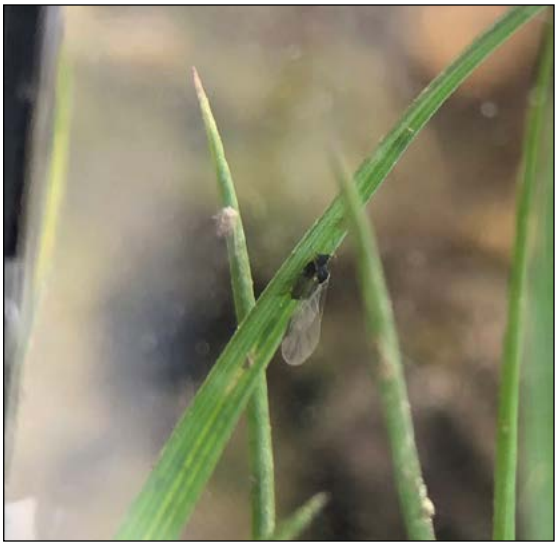

Photo: Navneet Kaur, © Oregon State University
Figure 31. A winged aphid.

Photo: Amy Dreves, © Oregon State University
Figure 32. Lady bird beetle larva.

Photo: Silvia Rondon, © Oregon State University
Figure 33. Parasitized aphids.

Photo: University of California
Figure 34. Fungal growth on an aphid.

Management

Insecticides provide a quick fix if aphid populations continue to rise in the spring.

Weather in the form of hot, dry spells, driving rains, or onset of extremely cold temperatures can have devastating effects on aphids. Biological control such as ladybird beetles (Figure 32), hover flies, as well as small parasitoid wasps (Figure 33), and fungal diseases (Figure 34) can sometimes reduce aphid populations to insignificant levels. Note that effective, naturally occurring biological controls often lag a little too far behind a surging aphid population to provide timely control. Insecticides are occasionally relied on to bring aphid populations under control.

Leafhoppers

In western states, large populations of adult leafhoppers (Figure 35) in grass and mixed legume/grass pastures are usually transient. In the spring, some species migrate hundreds of miles from southern regions to northern host plants. Large populations of winged leafhoppers may suddenly occur in the spring. Be aware that they may remain for only a few days before moving on. They may not reproduce in the pasture and may not cause injury other than some white stippling to leaves before they move on. Some species may vector pathogens.

Description and life history

Most leafhoppers seen in pastures are small (1/4 inch) with membranous wings held roof-like over their abdomens. Antennae are short, bristle-like. Mouthparts arise from the base of the head near the front legs. Depending on species, they may have four to five nymphal stages (Figure 36). Leafhoppers feed with piercing sucking mouthparts on the undersides of leaves seeking the xylem tissue.

Photo: Silvia Rondon, © Oregon State University
Figure 35. An adult leafhopper.

Photo: L. Pundt, © University of Connecticut
Figure 36. A leafhopper nymph.

Photo: University of California
Figure 37. Leafhopper damage.

Photo: L. Pundt, © Purdue University
Figure 38. Hopper burn on alfalfa.

Mechanical feeding injury is from insertion of their stylet-like mouthparts into leaf tissue, which punctures cells. Leaf injury appears as many, small (1/8-inch) circular, chlorotic spots randomly on plant leaves (Figure 37). In the eastern states, potato leafhopper causes "hopper burn" of alfalfa (Figure 38). This species also causes reduced stem height and yellowing of alfalfa leaves. Hopper burn has not been a problem in the PNW on legume or grass pastures.

Detection and scouting

Look for small, narrow-shaped, white to light green fly-like insects flying from foliage as you walk through pastures. Sweep net is best for collecting leafhoppers from foliage.

Management

Measures are usually not necessary in grass and mixed grass-legume pastures.

Mealybugs

Description and life history

Mealybugs are related to aphids and are about the same size. They feed with piercing-sucking mouthparts on grasses and cereals. They are covered with fine white waxy secretions that make these insects appear as tiny cotton puffs (Figure 39 and 40). They feed on and around the crowns of plants (Figure 41). They may colonize the lower

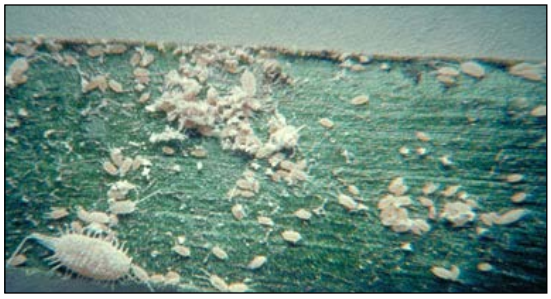

Photo: John Weidhass, Bugwood.org
Figure 39. Mealybug on grass.

Photo: John French, Bugwood.org
Figure 40. Mealybugs and wax.

Photo: Juan Manuel Alvarez, Bugwood.org
Figure 41. Mealybug damage.

Photo: David Shetlar, © The Ohio State University
Figure 42. Cinch bug egg, nymphs and adults.

leaves and even below-ground portions of the plant. In Oregon, one or two species of mealybugs are occasionally found on grasses and cereals in the spring. Like aphids, mealybugs complete multiple generations on their hosts. Females are wingless; males are winged. Short and long-range dispersal is by wind, animals and machinery.

Damage

Mealybugs are often occasional pests infesting grass grown for seed, grass pastures, and cereals. Grasses and cereals infested with mealybugs appear stunted and yellow. Often honeydew is present on the leaves.

Detection and scouting

Look for the symptoms described above in late winter and spring. Carefully inspect crowns, leaf sheaths and roots for wax, honeydew and live mealybugs.

Management

Insecticides have been used on timothy grass hay in some producing areas. In general, though, insecticides have not been effective in controlling them and are not recommended at this time in pastures.

Chinch Bugs

Description and life history

The chinch bug is best known for its damage to cereal grains in the Midwest. It may occasionally cause damage to grasses and cereals in pastures. Adults are small (1/10 to 3/16-inch depending on the sex and species), slender, dark brown to black with legs and antennal base reddish to yellow-brown and wings that are white and held tightly on the abdomen (Figure 42). Some forms have greatly shortened wings that only reach part-way down the abdomen. Nymphs (immature forms) are pale to dark brown with reddish abdomens (Figure 42). Eggs are less than 1/25-inch long, white when laid and turning to dark orange/red prior to hatching 10–30 days after deposited. Eggs are laid on plants and in soil. Adults and nymphs usually overwinter in fields or field edges, becoming active in late winter and spring. Females lay up to 200 eggs over a two to three-week period. The immature stages that hatch from these eggs feed for one to three months, depending on temperatures, before maturing and producing a second-generation over the summer. Chinch bug adults crawl from plant to plant and disperse throughout a field.

Photo: John French, Bugwood.org
Figure 43. Damage caused by chinch bugs.

Damage

The chinch bug and possibly related species infest turf grasses and lawns in parts of the Pacific Northwest. Feeding with piercing sucking mouthparts, large populations rapidly cause young and water-stressed plants to wither and dry rapidly (Figure 43). Plant death can occur, often rapidly, when populations are

quite heavy. Wheat, grasses, barley, corn and oats are hosts for this pest. Pasture grasses are occasionally damaged.

Detection and scouting

Damage is usually noticeable on plants beginning in May. The adults may be found in and around the crowns of plants in April. Sample crowns of plants by taking a 4-inch diameter core through the crown at several sites in a field. Screen samples and count numbers of chinch bugs present. Another method is the flotation technique. Remove both ends of a 2-pound metal coffee can, press it firmly into the ground and fill the can with water. Chinch bugs will float to the surface).

Management

Historically, infested grain fields have been plowed after harvest to reduce the overwintering forms. Field burning and clean field margins also reduce numbers that overwinter. A naturally occurring fungus, *Beauveria*, has been reported to reduce populations of this pest naturally. Insecticides (where labeled) are used effectively to reduce immediate problems.

Black Grass Bugs

Several species of "black grass bugs" occur in the western U.S. The most commonly referenced in literature is probably *Labops hesperius* (Figure 44). Other species of *Irbisia* (Figure 45) occasionally damage cereals and grasses. Black grass bugs are about 1/4-inch long. *L. hesperius* has buff coloration on the outer margins of the wing covers. Note that the wings of *Labops* adults do not extend to the tip of the abdomen. The wings of *Irbisia* adults, which are membranous at the ends, extend to the tip of the abdomen. Immature stages are similar in appearance to the adults but smaller and wingless.

Photo: Lynette Elliot, Bugguide.net
Figure 44. A *Labaps* adult.

Photo: Frank Peairs, Colorado State University
Figure 45. An *Irbisia* adult.

Description and life history

This black grass bug can reach 1/4 to 3/8 inches in length when mature. It is gray-black and, as an adult, has light-colored outer margins of the wings. Immature stages are similar to adults, but smaller in size. Both adult and immature stages have mouthparts that pierce plant tissue and suck out plant juices.

Black grass bugs feed on and can damage many grass species. They particularly favor wheatgrass. Some favored hosts are crested, intermediate, and slender wheatgrass, as well as Kentucky bluegrass, orchard grass, smooth brome and mountain brome.

Black grass bugs overwinter as eggs in grass stems. Eggs hatch in the spring as grass plants begin to grow. Egg hatch occurs early in the spring at lower elevations, and progressively later at higher elevations. One generation of black-grass bugs is produced each year. Nymphs feed and molt five times before becoming adults. It usually takes four to five weeks from egg hatch to the appearance of adult insects. Bug numbers begin to decline about four weeks after adults appear as they lay eggs and then die. The time span of the population is regulated by temperature, with adults maturing more quickly at higher temperatures. Most females in a population do not have fully developed wings. Therefore, they do not readily disperse and colonize new areas.

Damage

Photo: Whitney Cranshaw, © Colorado State University
Figure 46. Black grass bug damage.

Black grass bugs are more problems of unirrigated range grasses. Irrigated pastures in the PNW are occasionally damaged. On range grasses, BGBs damage plants in the spring by piercing and sucking the contents of cells. Within seconds of feeding, a whitish spot appears at the site from the destruction or removal of chlorophyll (Figure 46). The bugs begin feeding at the leaf tip and proceed downwards, feeding with the head pointing down. Most feeding is done on the upper surface of the leaf. Damaged leaves may appear straw-colored, as if they have been damaged by frost. Certain amounts of damage to the leaves seem to repel cattle or make the grass unpalatable. Heavy infestations may prevent seed formation, and black grass bugs often are pests of grass seed production fields.

Damage is most severe in drought years. Summer rainfall greatly reduces the effect of damage from this pest by promoting growth of plants after *Labops* activity has ceased in late June. Lack of summer rainfall coupled with *Labops* damage can result in sparse summer pastures with low feed value. Without normal precipitation that winter, more than 100 *Labops* per square foot can reduce the nutritive value of forage from 20% to 50% the following season.

Detection and scouting

Look for damage and the insects in April and May. Monitor populations early in the same manner as for chinch bugs. If numbers per square feet exceed 50 bugs, expect damage.

Management

Eggs overwinter in grass stems. Therefore, timely grazing or open field burns of dead grass in the fall destroy black grass bug eggs and may eliminate the need for insecticidal control. Graze wheat grass heavily for a short time in the late fall or early spring of each year. Wheatgrass pastures with a lot of plant material in the fall are not fully utilized by grazing or haying. These pastures provide egg-laying sites, winter protection and habitats that favor black grass bug survival. Mowing and removal of hay in late summer or fall may help reduce the number of overwintering eggs.

Because *Labops* prefer to lay eggs in the upper node of stems, and very few are laid in stubble and broken straw, grazing or taking a hay crop in the spring removes egg-laying sites. Rangeland with bulbous or Sandberg bluegrass present in wheatgrass provides egg-laying sites for this pest and can lead to population build-up. Rotational grazing (one year on, one year off) probably increases this pest by providing an abundance of stems for egg laying.

It is important to identify an infestation of black grass bugs early in the spring if chemical controls will be applied to prevent damage. Note that insecticides will kill the adults and nymphs of these bugs but will have no effect on eggs laid in grass stems. If sufficient eggs survive the winter, then a reinfestation may occur in the next growing season.

Meadow Spittlebug

Description and life history

Spittle masses (Figure 47) on plants are unmistakable, and each mass will have one to three small, yellow, wedge-shaped nymphs of this pest. The eggs overwinter in stems and straw. Eggs hatch in late March and April. Nymphs feed positioned upside down on

plant stems with piercing-sucking mouthparts. As they feed, copious amounts of foam are released from glands near the end of the abdomen, which flows forward and over the bugs. They feed on the host plant from within the spittle mass for about eight weeks. They then molt to adults, which appear in late May and June. The adults resemble large, stocky, brown leafhoppers. When disturbed, they can jump long distances. There is one generation produced per year.

Photo: Navneet Kaur, © Oregon State University
Figure 47. Spittle bug nymph in spit mass.

Damage

Spittlebugs feed on the xylem of plants with piercing-sucking mouthparts that mechanically injure plant cells. They also inject a toxin into the plants with their saliva as they feed. This can significantly stunt individual stems and plants with large numbers of spittlebugs, sucking plant juices.

Detection and scouting

Spittle masses are quite diagnostic.

Management

Seldom necessary in pastures because grazing and haying activities usually remove the straw stems needed by the adults to deposit eggs within.

Blister Beetles

Description and life history

There are many species of blister beetles, including the gray, striped, spotted and black blister beetles (Figures 48–51) that are pests of pastures. Like most blister beetles,

Photo: Clemson University
Figure 48. Striped blister beetle.

Photo: Clemson University
Figure 49. Margined blister beetle.

Photo: Joseph Berger, Bugwood.org
Figure 50. Black blister beetle.

Photo: Ward Upham, © Kansas State University
Figure 51. Gray blister beetle.

the adult is elongated and slender in form, the thorax is narrower than the head and abdomen, and the legs and antennae are moderately long. Blister beetles contain a blistering substance in their hemolymph (insect blood) called cantharidin. It is highly toxic when ingested by horses and livestock. These beetles are gregarious and typically are not seen until after the first cutting of hay and later in fall before the last alfalfa cutting.

The eggs are deposited in the soil within a tubular chamber at a depth of 1–1.5 inches, normally in clusters of 100–200 eggs, up to 3,000 eggs during their approximately one-month life span. The female covers the eggs after oviposition. Eggs can be found from summer through September.

Larvae initially have long legs and are whitish in color. As they develop and change instars (larval stages), the legs reduce in size and color changes to reddish-brown. Larvae may be generalist predators and feed on grasshopper eggs. The later instar larvae may overwinter, followed by pupation in the spring. The darkened pupal stage is found in the soil and resembles the adult beetle in form, though the wings and legs are tightly drawn together. Pupae are found in May–August.

The adults are elongated and slender and measure 0.3–1 inch in length. Color varies depending on species. The wing covers are long and have small punctures with very short hairs.

Damage

The concern to alfalfa growers is blister beetle poisoning to horses and other livestock. This occurs when beetles are bailed with the hay crop. The blistering agent that the beetle produces can severely irritate the mouths and lining of the stomachs of horses. Even a few beetles ingested can cause colic, low blood calcium and magnesium, or death to a horse.

Other plants that serve as hosts of these beetles are pigweed, goldenrod, goathead and puncturevine.

Detection and scouting

Inspect fields for adult presence before hay cuttings to determine locality and evaluate the severity of beetle populations in the field. Blister beetles are gregarious, which makes it easier to monitor for them. Look on weeds in bloom in the pasture. They often congregate in groups on flowers.

Management

Avoid harvesting areas if high levels of beetles are seen. Split open bales and inspect hay for beetle parts before feeding. Feeding horses first-cutting hay before beetles are active in mid- and late-summer lessens the risk of beetle poisoning. Spot treatments in the field may be used if needed. Dead beetles that are baled with dry forage can also pose severe health consequences on livestock.

Photo: Joseph Berger, Bugwood.org
Figure 52. Grasshopper nymph.

Grasshoppers

Description and life history

There are several troublesome grasshoppers (Figures 52 and 53) that may damage pastures, hay, legume seed and forage crops, including differential grasshopper, *Melanoplus differentialis*, red-legged grasshopper, *Melanoplus femurrubrum*, two-striped grasshopper, *Melanoplus bivittatus*, migratory grasshopper, *Melanoplus sanguinipes*,

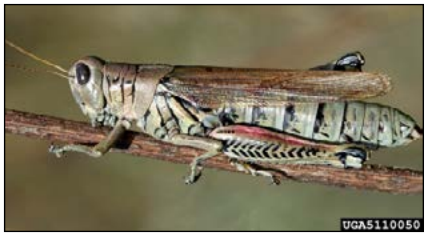

Photo: David Cappaert, Bugwood.org
Figure 53. An adult grasshopper.

and the clearwing grasshopper, *Camnula pellucida*, all in the family of Acrididae (order: Orthoptera). The differential grasshopper is brownish-yellow or olive green with contrasting black markings. On the hind femur, these markings resemble chevrons. The red-legged grasshopper has a reddish-brown back, a yellow belly and red hind legs. The two striped grasshopper is greenish-yellow with contrasting black or brown markings and has two light color stripes that run from the head to the end of the wings. The migratory grasshopper is gray with mottled yellow to grayish brown. Clearwinged grasshoppers are light yellowish-brown with two pale stripes along the forewing.

In the late fall, females deposit oval, elongated or curved protective pods of eggs (25–300) in the soil. The eggs overwinter and hatch into small nymphs (with shortened wings) in the spring. They feed, molt several times, and grow into full grown adults after 35–50 days, depending on species and temperature. Full-grown grasshoppers range in length from 0.74–1.3 inches. Most economically important grasshopper species complete one to two generations each year.

Damage

Grasshoppers are general feeders and devour leaves, buds, flowers and seed heads. They move into pasture fields from uncultivated or abandoned land and roadside ditches, particularly during the hot and dry season. They consume foliage of clover, grasses, small grains and alfalfa. They can be especially destructive to young seedlings in the fall.

Detection and scouting

Use a sweep net or visually monitor in the early spring for young grasshoppers when they are hatching from their breeding ground.

Management

Tillage of egg beds in the fall buries and crushes egg pods. Treat field edges or areas of the outbreak with registered chemicals. Treat the barriers between grasshopper breeding ground and pasture, hay or forage crop.

Harvester ants

Description and life history

Harvester ants are large red or black ants. There are many species, and they rank next to grasshoppers in terms of rangeland damage. These ants are primarily pests of rangeland. They prefer unirrigated land and, as such, are not serious pasture pests. The name is given to them because they collect seeds from the immediate area around their mound or nest and take them to the nest for food (Figures 54–56). Harvester ants can create nests reaching a foot in height and 30 feet in diameter. The ants are so efficient at

Photo: Andrew Watley
Figure 54. An ant carries a large load to the nest.

Photo: Whitney Cranshaw, Colorado State University
Figure 55. An ant nest.

collecting seeds that eventually the ant colonies clear the area as far as 50 feet around the mound of all vegetation.

Photo: Gerald Holmes, © Oregon State University
Figure 56. An ant colony.

Harvester ants pass through four life stages. These are the egg, larva, pupa and adult. The first three stages remain underground in the nest. New colonies are established by mated queens from late May through early fall. After mating, the queen sheds her wings and digs a burrow several inches deep in the soil. The first brood is composed entirely of worker females. This brood forages, enlarges the colony, cares for the young, and protects the mound. The workers move the eggs to newly constructed chambers, which are stocked with seeds and insect parts as a food source. Colonies survive 15 to 20 years and may consist of as many as 60 chambers.

Damage

Harvester ants can bite and sting animals and people, but their significance as pests of rangeland is their ability to compete with range animals for food, and they are quite efficient! Damage seems to be more intense in short or mid-grass prairie than on the more arid sagebrush shrub range. Researchers have analyzed the effects of grazing pressure on the abundance of ant mounds for long periods of time (10–30 years). There appeared to be no difference in light or moderately grazed pasture, but mound numbers increased dramatically on the overgrazed range.

Management

Grazing management can slow the increase of new mounds. As with grasshoppers, the overgrazed range suffers the greatest loss from harvester ants. There are insecticides registered for mound treatment, but their use requires considerable time and effort. Because these ants can inhabit thousands of contiguous acres of range, control activities are most effective when done on a cooperative area basis, as with grasshoppers. Individual efforts can be short-lived.

Silky Ant

The silky ant, *Formica fusca*, (Figure 57) is recognized by the characteristic mounds (Figure 58) that they build to maintain their colony on heavy and wet pastures and flooded areas of western Washington and Oregon. The ant is large and somewhat resembles the harvester

Photo: Jim Moore, BugGuide.Net
Figure 57. A silky ant forager.

Photo: U.S. Forest Service
Figure 58. A mound of silky ant.

ants, but they are not pests of range east of the Cascades. Their nests are conical, crater-shaped or cylindrical.

These soil structures are quite durable and may be 2 feet tall and from 2–3 feet in diameter. Their nests are common on silt loam soils like the Dayton series, which shows distinct mottling at 2–3 inches and is a sign of poor drainage. These mounds are seen in pastures where standing water persists in the winter and early spring.

Unlike harvester ants, these ants do not strip the nearby ground of vegetation. But, because grass grows all over the mounds and effectively hides the solid soil structure, they can be a hazard when operating machinery.

They are not particularly aggressive, and the mounds can be destroyed by spot spraying a registered insecticide and by knocking down the mounds when they are visible in the winter.

Summary

- Arthropods (insects, mites and garden symphylans), and gastropods (slugs) inhabit pastures, but only a few can reach pest status.
- Watch your field regularly with visual inspection or traps to detect early the appearance of these pests to prevent infestation and damage.
- Proper identification of pests is a prerequisite to handling problems effectively
- IPM seeks to reduce pest numbers below economically damaging levels rather than eliminate infestations. Keeping fields entirely pest-free is not necessary, desirable or possible.
- Populations of all pests are naturally suppressed by abiotic and biotic factors.
- As insect expert Carl Huffaker once noted, “When you kill the natural enemies of a pest, you inherit all of their work!”
- Conserving and favoring the natural balance in the ecosystems can reduce the long-term cost of control.
- Use less broad-spectrum pesticides and only when economic thresholds are met.
- Choose least-disruptive control options to reduce secondary pest outbreaks.
- Repetitive use of the same pesticide families can result in pesticide resistance.

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