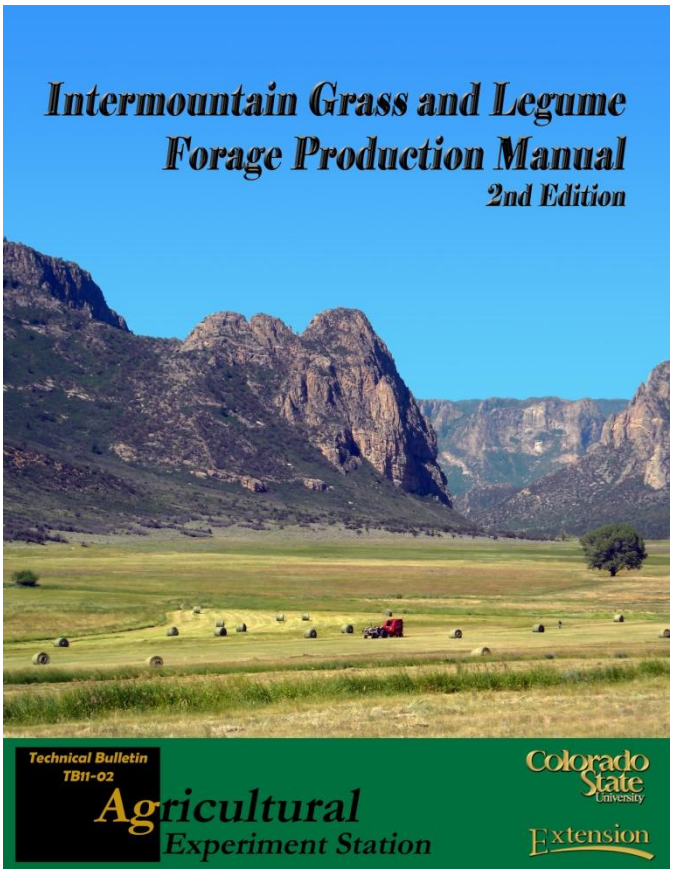


Compiled and Edited by

Calvin H. Pearson
Colorado State University
Western Colorado Research Center at Fruita
1910 L Road
Fruita, CO 81521

Joe E. Brummer
Colorado State University
Soil and Crop Sciences
Fort Collins, CO 80523

Bob Hammon
Melissa L. Franklin
Colorado State University
Tri River Area Extension
2775 Highway 50
Grand Junction, CO 81502

June 2011

Section I

Irrigated Pasture/Mountain Meadows

Chapter 4

Pest Management

Bob Hammon

Introduction

Weeds, insects, and diseases can all affect yield and quality of forage in pastures and hay fields (Pasture is discussed throughout this chapter, but all discussion applies to hay fields as well). However, their impact is typically minimal in well managed pastures. Management of weeds, insects and diseases is somewhat interconnected. Weed management is largely dependent upon maintaining a healthy, uniform stand of desirable forage grass and forb species. If insects, diseases, or poor management are allowed to affect plant stand or vigor, a weedy pasture is a likely result. Plants weakened by insect attack are more susceptible to diseases, and those weakened by disease are more easily damaged by insects (Fig. 1).

Fig. 1. Well managed pastures outcompete annual weeds and have healthy populations of beneficial insects which help them tolerate damage from insect pests and diseases.

The first step in any pest management program is to grow a healthy crop through proper fertilization, irrigation and harvest practices. Pastures that are weakened by mismanagement of one or more factors will be more severely affected by a given pest infestation than properly managed pastures.

Some common insect and disease problems encountered in pastures in the Intermountain West are discussed here. Insecticides are rarely needed in pastures, although grasshoppers and several species of caterpillars can reach damaging levels occasionally. These insects can attack and damage the healthiest of pastures.

Reference to specific pesticides is avoided in this publication since new products appear and older products are pulled from the marketplace on a regular basis. Please visit the High Plains IPM web site for an up-to-date listing of pesticides labeled for use on pasture pests.

Insect Pest Management

Irrigated pastures harbor many types of insects, most of which are not harmful. Pastures are typically dominated by insects that are beneficial predators or parasites of other insects, or ones that play a role in decomposing organic matter. Insects such as lady beetles, minute pirate bugs, damsel bugs, big eyed bugs and ground beetles prey on pests such as aphids, thrips, and caterpillars. Parasitic wasps and flies also help keep many of these pest insects in check. Indiscriminate pesticide use can harm beneficial insect populations and create greater problems in the long term. Learn to identify beneficial insects; they are the grower's friend.

Pests occasionally reach destructive levels and may need to be controlled to avoid loss of forage. These populations can develop within a field or they can move in from surrounding areas. Management options might be as inexpensive as harvesting early or as expensive as chemical control. Control options depend on pest species and population level, crop growth stage, and timeliness of discovery of the infestation. It is important to be familiar with common insect pests and to monitor the pasture to assure they are not in damaging numbers. The most common pests of pastures are discussed in this publication. Other insects such as black grass bugs, Banks grass mites, range caterpillars, and false chinch bugs can attack pastures. Collect specimens and get them properly identified if you are dealing with a pest you are not sure of.

Grasshoppers

Grasshoppers can devastate irrigated pastures when outbreaks occur. They can also be pests of rangeland, field crops, and small acreage, often with significant economic loss to producers. Because of their mobility, adult grasshoppers that attack a pasture may have developed from egg beds that are some distance away. Successful grasshopper control must be conducted when insects are in early growth stages. Effective control programs are often conducted over a large area, hundreds to thousands, or tens of thousands of acres. These programs often require planning and cooperation between landowners, agencies, pesticide applicators, and project coordinators.

Two excellent sources of internet-based information on grasshopper biology and control are Grasshoppers of Wyoming and the West, and Grasshoppers: Their Biology, Identification and Management. Either can be found by entering their name into an internet search engine.

Several hundred species of grasshoppers occur in the west, of which about 40 species can be agricultural pests. At least 90% of grasshopper damage to croplands is caused by only five species. Grasshopper species have different feeding preferences, but in general, most types eat a variety of plants. The life history of grasshoppers varies, but a generalized account is presented here.

A few types of grasshoppers overwinter as partially grown nymphs, but most spend the winter as eggs. Winged grasshoppers that are present in mid to late spring are species that overwinter as nymphs. These species are not usually present in large enough numbers to be significant pests. Most grasshoppers overwinter as eggs which are laid in pods in the soil during late summer and fall. Pods contain 4 to 40 eggs. Some grasshoppers lay eggs in open soil, others in idle land that has grown up to weeds. Still other species prefer sod to lay eggs. Sometimes eggs are deposited in beds, where the density is very high. Roadsides, waste areas, fencerows, and equipment lots are typical egg laying areas for many pest grasshoppers (Fig. 2).

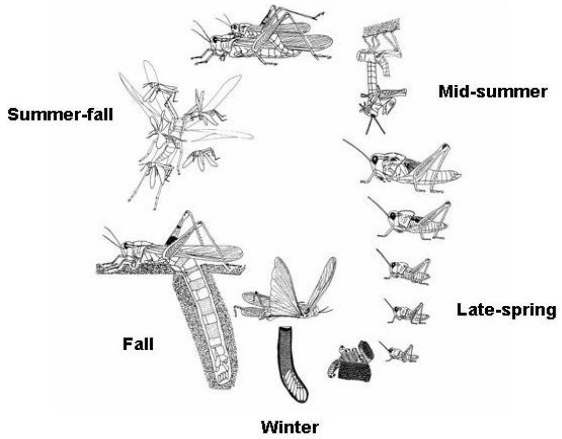


Fig. 2. Grasshoppers go through incomplete metamorphosis, usually with five immature stages before becoming winged adults. (Modified from Latchininsky et al., 2002.)

Egg pods are resistant to moisture and cold if the ground is not disturbed. The total number of eggs laid by a female varies with species and weather conditions, but typically ranges from 40 to 400. A warm, frost free fall allows for the maximum number of eggs to be laid. Grasshopper eggs begin hatching in the spring when soil temperatures warm to above 60°F for a period of time, but egg hatch can be spread out over time. Grasshopper egg hatch may begin in late April at lower elevations and early June at higher elevations (Fig. 3).

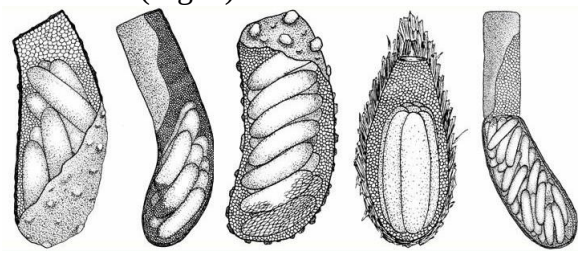


Fig. 3. Grasshopper egg pods are laid in the soil. Each species of grasshopper lays a very distinct pod and egg shape. From Latchininsky et al., 2002.

The major factors that keep grasshopper populations in check are unfavorable weather conditions, lack of food, disease, and natural enemies. Outbreaks are usually preceded by several years of gradual increase in numbers followed by a year with unusually favorable conditions. It is during these outbreak years that damage potential is the greatest, and control measures may be necessary to avert economic loss to pastures. Outbreaks can last several years, until environmental conditions or human intervention cause a break in the cycle.

The usual pattern of annual grasshopper population appearance is for early stages to occur in weedy areas of roadsides, fencerows, irrigation ditches, and other non crop areas. When these hosts die down or get eaten, grasshoppers move in search of other food sources, such as pastures and cropland. A green field surrounded by dry, brown vegetation is a perfect target for moving grasshoppers. Once they find a green field they initially move into the margins, spreading throughout the field as conditions permit.

Grasshoppers become more difficult and expensive to control as nymphs move away from the egg beds. Newly hatched grasshoppers in weedy areas and roadsides are concentrated in a relatively small area. They can be controlled there with low rates of insecticides applied to comparatively few acres. Once they reach field margins they are larger in size and more spread out, and require higher insecticide rates applied to a greater area for acceptable control. Once they have spread across an entire field crop damage may have already occurred and control is at its most expensive and least effective point.

Cultural practices applied to grasshopper egg beds may help in controlling infestations before they hatch. Once egg laying sites are identified tillage can destroy the pods. Deep plowing is most effective, but even shallow cultivation may help to destroy many egg pods by exposing them to the elements. Reducing weedy field margins, such as fence rows and roadsides will help keep down grasshopper numbers since these areas are favored habitats for egg laying and early nymphal feeding (Fig. 4).

Many economic thresholds for grasshopper control decisions have been devel-

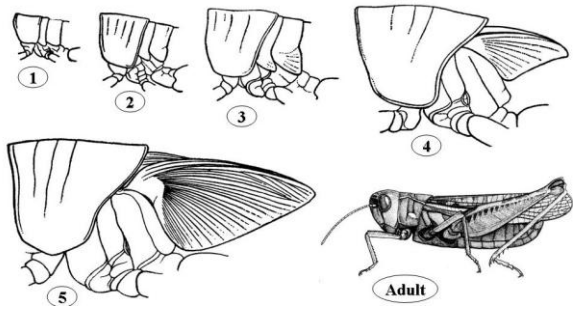


Fig. 4. Identifying grasshopper growth stages can be very important in control decisions. With most species, the development of wing pads is used to determine the grasshopper age class. Modified from Latchininsky et al., 2002.

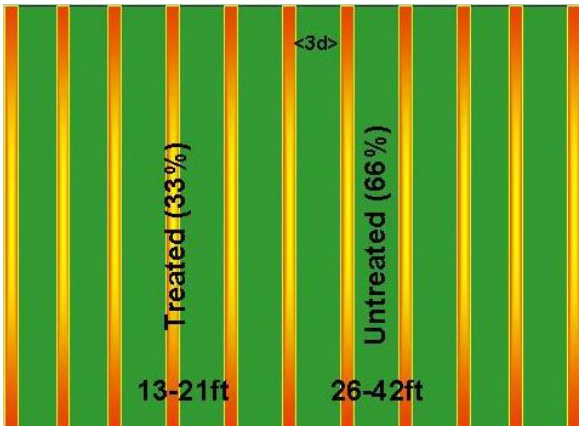
oped, usually expressed in terms of grasshoppers per square yard. Many of these figures were developed for rangeland conditions and they may not apply to irrigated pastures. A dilemma with determining the need for grasshopper control exists when damage from late instar and adult grasshoppers is observed at a time when control is difficult or impossible. While rescue treatments with insecticides may be justified at times, in many instances it is time to start thinking about the next year's grasshopper control plans.

The science of grasshopper control has evolved over the past several decades from large scale programs that sprayed all of the land within a treatment area, to a program that treated strips within the treatment area with a reduced rate of insecticide. The goal of Reduced Agent Area Treatment programs (RAATS) is to reduce grasshopper numbers below economic threshold levels, while reducing non target impacts and keeping treatment costs low. RAATS treatments are proven effective and can be applied by backpack, ATV, boom sprayers, or by air.

RAATS spray programs are based on the fact that small grasshoppers move a short distance, up to 10 ft per day. If an insecticide with residual is applied to a strip into which the grasshopper will move before that residual wears off, control is achieved. The width of treated and untreated strips varies with grasshopper population, the insecticide used, and application equipment. If an ATV sprayer is used on a pasture, as little as 25% to 33% of the ground needs to be treated. A 33% treatment RAATS would spray a 10 foot strip, leaving 20 feet between strips. The unsprayed areas are a haven for beneficial insects which would have been harmed if 100% coverage was used (Fig. 5).

Carbaryl (Sevin) and diflurobenzuron (Dimilin) are the most commonly used insecticide active ingredients in RAATS programs. Dimilin is most effective against early instar grasshoppers. It has no activity against adults. Both ingredients give excellent residual, are safe for applicators and wildlife, and are relatively inexpensive. Please visit http://highplainsipm.org for a complete list of insecticides registered for grasshopper control.

Fig. 5. RAATS programs treat strips of vegetation to save money and minimize non-target impacts. This diagram shows a typical ATV applied RAATS layout which treats only 33% of the land. (Courtesy of Latchininsky & Schell, University of WY)



Several baits are also used for grasshopper control. Baits use a grasshopper food such as wheat bran or apple pumice as an attractant and carrier for an insecticide. Most commercial baits are formulated with carbaryl as active ingredient. Nolobait is a biological product formulated with *Nosema locustae* as the active ingredient. It is slow acting and may provide some long term impact on grasshopper populations. Baits are usually used in areas where foliar sprays are unacceptable. They can be used in barrier

treatments to prevent movement into pastures. Carbaryl based baits are available in 2% and 5% active ingredient formulations, but the amount of product applied is more important than the concentration of insecticide.

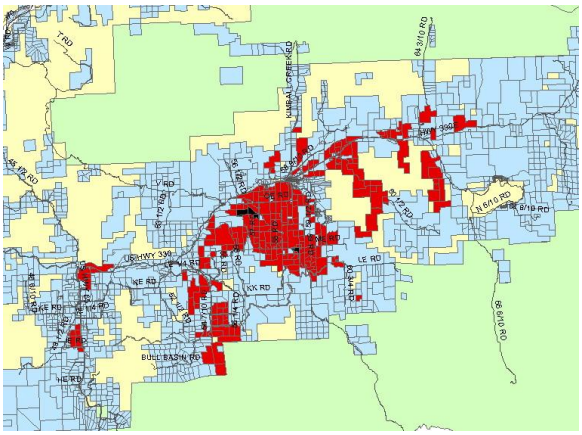
Baits tend to be more expensive than foliar sprays and must be reapplied after rain. Not all grasshopper species take baits, so control may be selective when there is a grasshopper species mix. They can take specialized application equipment when used over a large area. However, baits certainly deserve consideration in many grasshopper control projects.

Baits are more environmentally friendly than many sprays, especially those that do not use the RAATS approach. They can significantly reduce non-target impacts. New bran and apple pumice based carriers have increased the spectrum of grasshopper species that are attracted to bait. Newer products are formulated to flow easily through spreaders, allowing the use of fertilizer applicators in some cases. Most baits are safe enough to allow hand spreading with a gloved hand for small scale applications.

Area wide grasshopper treatment programs treat large areas to control grasshopper populations. These programs treat hundreds to thousands or tens of thousands of acres, controlling small grasshoppers before they have a chance to move from their egg beds. Area wide grasshopper control programs take considerable coordination between landowners. Planning must begin months before sprays are applied. They usually are based on aerial application of insecticide in RAATS coverage and can be done quite inexpensively on a per acre basis. Area wide programs, when done in a timely manner, can suppress grasshopper populations for many years from a single insecticide application. They are the most efficient and cost effective, on a per acre basis, method of grasshopper control. Area wide programs must involve a program coordinator, often a county Extension Agent. If there is a wide spread grasshopper outbreak, contact your local Extension Office to determine what treatment options exist (Fig. 6).

Two excellent resources on grasshopper biology and control are available online. One is the USDA/ARS site, Grasshoppers: Their Biology, Identification, and Management, and Grasshoppers of Wyoming and the West.

Fig. 6. This map shows a 20,000 acre area wide grasshopper treatment program done in Mesa County CO in 2004. More than 100 landowners cooperated to get long term relief from grasshoppers at a very reasonable price. The RAATS program used Dimilin insecticide which minimized environmental impacts.



White Grubs

White grubs are hidden pests of irrigated pastures. They feed underground on plant roots where they can't be seen. It is only when they reach destructive population levels that they are noticed. White grubs are present in most pastures, although they only reach damaging numbers occasionally.

White grubs are the larvae of June beetles, a type of scarab beetle. There are many species of destructive white grubs with a diversity of life histories. All species feed underground, some on plant roots and others on organic matter. The organic matter feeders help break down plant and animal residues and are beneficial in soil development.

The root feeders are plant pests. Because of the underground feeding habit, much white grub damage goes undiagnosed as insect injury. Damage usually appears as areas of dead plants which may be easily pulled from the ground. When sod forming grasses are attacked, enough roots may be eaten to allow the sod to be peeled back and rolled like a carpet. Examination of the soil under the plants will reveal C-shaped creamy-white colored beetle grubs with distinct head capsules and six fully developed legs.

Fig. 7. White grubs have a distinct head, six true

Mature larvae of the larger species may reach a length of 1 to 1.5 inches (Fig. 7).

About 200 species of white grubs occur in North America, of which a significant number occur in the Intermountain West. Some species complete their life cycle in a single year while others may take up to four years to complete their cycle. Two or three year life cycles are common for species that infest pastures.

The winter is spent in the soil as either an adult or larvae, depending on species. In the spring or summer adults emerge from the soil. Adults are usually active at night and are often attracted to lights. They feed on the leaves of trees or other plants. They return to the soil during the daytime and it is there that mated females lay pearly white eggs from one to several inches below the soil surface. Eggs are generally laid in grasses and grassy weeds. Eggs hatch in 2 or 3 weeks, and the young grubs feed on roots until early fall. They then work their way down through the soil, usually to a point below the frost line. White grubs have been found as deep as 5 feet below the soil surface. Grubs move back upward and begin feeding on plant roots when soils warm in the spring. Feeding continues throughout the season, and the grub moves back to deeper overwintering depths with the onset of cool fall weather. Pupation takes place during the early summer, but adults do not emerge from the soil until the following spring (Fig. 8).

The most important factor in management of white grub populations is maintaining a vigorous, healthy crop. Pastures that are properly irrigated, fertilized, and harvested are not as attractive as egg laying sites and can withstand white grub feeding better than pastures that are under stress. Once grub damage is diagnosed, chances are that the larvae are large and control is nearly impossible.

Chemical control of white grubs is difficult at best. Few insecticides are labeled for use against grubs in pastures. Insecticides that are used must be able to reach insects that are in the soil. The best control is achieved when the majority of the grubs are small and in the top few inches of soil, so timing is critical. Some species of white grubs are more easily controlled by insecticides targeting the egg laying adults. This requires scouting for adults on a regular basis, and anticipation of the problem. Since there are many species of white grubs and a diversity of life histories, identification to

Fig. 9. Grass cover in these pastures should have been several inches high in May 2003, but 20 or more army cutworms per square foot kept it mowed down to bare soil.

species level may be important in the design of a management program.

Armyworms and Cutworms

Cutworms, especially army cutworm (*Euxoa auxiliaris*) and true armyworm (*Pseudaletia unipuncta*), can be pests of grass pastures throughout the Intermountain West. They are present in low numbers in most years but when conditions are right, populations can explode and pastures can be damaged. When outbreaks occur, worms can consume all of the foliage in a pasture, seemingly overnight. When the foliage is consumed they move in mass migrations, giving them their name (Fig. 9).

Army cutworms are native to western North America. They have an interesting life history. The moths migrate to mountainous areas during the summer where they go into a diapause stage. They "wake up" from diapause in the fall and return to lower elevations to lay eggs. Eggs are laid in open soils that are loose enough for them to push their abdomen into. The eggs hatch in the late fall or early winter and young larvae feed on grasses or broadleaf plants before they go into diapause during the winter.

When there is a mild winter, larvae continue to feed on warm days. Damage can occur in infested areas during January and February when this happens. A huge army cutworm outbreak occurred during the winter of 2002/03. There were a lot of moths that emerged and oversummered in 2002; many eggs were laid that fall. The eggs hatched in October and November and the larvae fed on green cool-season plants, especially cheatgrass. When the warm weather persisted, the larvae continued to feed on rangeland, wheat, roadsides and pastures. In some areas, as larvae matured in January and February, large bands of mature larvae moved across roads making them very visible. Populations as high as 50 or more larvae per square foot could be found in some fields and pastures (Fig. 10).

Fig. 10. Army cutworm can be present in huge numbers during outbreak years.

In a more typical year, army cutworm damage appears as the grasses begin to grow in the spring. If a pasture does not green up as expected, check for brownish caterpillars hidden under debris or buried in loose soil.

If larvae are easily found, more than several per square foot and grasses in the pasture show feeding damage, treatment with an insecticide may be justified. Intensive grazing has been shown to reduce army cutworm damage in wheat and a similar approach may be an option in established pastures.

Army cutworm populations are kept in check by a variety of factors. Climate and precipitation play a role in keeping host plants healthy, especially in the late fall, winter, and early spring. Birds eat a lot of larvae and a variety of parasitic and predatory insects prey on them also. There can be a lot of mortality of moths as they migrate, sometimes hundreds of miles to and from their oversummering sites in the mountains. Bears even play a role as natural enemy when they feed on oversummering moths. These natural enemies and environmental controls are a major reason that army cutworm outbreaks are not more common.

Armyworms are widely distributed native insects in North America. They get their name when large congregations of worms move from an area when food supplies are exhausted. Armyworm larvae feed at night, hiding under clods or in crop residue during the daytime.

Armyworm larvae are dark green to brown in color, and mature caterpillars may reach two inches in length. They have white and dark stripes on the sides and middle of the abdomen, running the entire length of the body. Adult armyworms are brown moths with about a 1 inch wingspan. They are easily identified by a distinctive white spot in the center of the forewing.

True armyworms have a very different life history than army cutworms. Armyworms can have two or three generations per year after spending the winter as a partially grown larva. Overwintering larvae feed in the spring and then pupate in the soil before emerging as first generation moths in mid spring. Moths can lay up to 500 eggs, so populations can increase rapidly between generations.

Armyworm outbreaks usually start in dense grass cover. Weedy grasses such as crabgrass, sandbur, and barnyardgrass are often starting points for outbreaks, but they can also get started in many perennial grasses. Armyworms prefer to feed on grasses, but will eat many broadleaf species if they have no choice.

There are many natural enemies of armyworm larvae. Parasitic wasps and flies may become abundant enough to cause populations to collapse suddenly. Eggs and pupae of these parasites are easily seen in the field when they are present. Some species of parasites do not kill armyworm larvae until they are ready to pupate. Birds feed on armyworm larvae and the presence of flocks of birds in pastures is often indicative of armyworm or other insect activity (Fig. 11).

Fig. 11. The white egg on this armyworm larva was laid by a parasitic fly. The fly larvae that hatch from the egg will eventually kill the caterpillar. The whitish cocoons are all that is left of an armyworm that was killed by a parasitic wasp.

Control decisions must be made before significant damage occurs. Unfortunately, the vast majority of feeding occurs in the final two instars of the larval life, and damage can appear seemingly overnight. This coupled with the nocturnal feeding habits and the habit of hiding during the daytime in the soil, cracks, and under detritus or clods

makes scouting difficult. The key to scouting for infestations of later instar larvae is to look for feeding on the edges of grass leaves. The presence of a ragged edge on grass leaves usually indicates armyworm feeding. A check of the soil around symptomatic plants should turn up larvae.

Harvester Ants

Western harvester ants (*Pogonomyrmex occidentalis*) and other ant species are present in many established pastures throughout the West. The amount of damage they do can be significant, although it often goes unnoticed. Harvester ants are foragers that destroy vegetation around their mounds, and collect and eat seeds of grasses and broadleaf plants. Their mounds may interfere with efficient harvest of hay and damage harvest equipment.

Harvester ant colonies are located underground, reaching depths of six to eight feet. The entrance to colonies is located on the conical shaped mounds. An active nest may live 15 to 20 years if left uncontrolled. As many as 8,000 to 10,000 worker ants may live in a colony. Ants are active on the soil surface during the summer months. Usually no more than half of the ants living in a colony are active above ground at any time.

New colonies are formed during the late summer when winged males and females emerge from the colonies, mate and disperse. Wings fall off of the mated females and they turn into a queen that forms a new colony. She digs a brood chamber below the soil surface, lays eggs, and then goes into a diapause stage to spend the winter. The eggs hatch in the spring, and develop into worker ants which forage for food to feed the new colony.

Control of harvester ants must be aimed at destroying the queen. Killing only the ants above ground will do little to control the colony. Several insecticides are labeled for ant control in pastures. Refer to the label of specific insecticides for details of ant control. Vegetation that was removed by ants around anthills will slowly return, especially if rhizomatous grasses are present.

Individual ant mounds can be treated with insecticide drenches. Many formulations of carbaryl are labeled for this use in pastures. Some fire ant baits have been used successfully in southern states to control ants in pastures. Registrations vary by state, so be sure to check to see if a product is labeled for use in your state before using them. Always read and follow label directions when using any pesticide.