AGRICULTURAL ANIMAL PEST CONTROL

PESTICIDE APPLICATION
AND
SAFETY TRAINING
STUDY GUIDE

UTAH DEPARTMENT OF AGRICULTURE

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STUDY GUIDE FOR ANIMAL PESTS

The educational material in this study guide is practical information to prepare you to meet the written test requirements. It doesn't include all the things you need to know about this pest-control subject or your pest-control profession. It will, however, help you prepare for your test.

Contributors include the Utah Department of Agriculture and Utah State University Extension Service. This study guide is based on a similar one published by the Colorado Department of Agriculture. Materials for that guide were prepared by Colorado State University Extension Service. Other contributors include: Extension Service personnel of California, Illinois and Georgia, as well from materials furnished by Metro-Pest Management Consultants, Inc.

The information and recommendations contained in this study guide are based on data believed to be correct. However, no endorsement, guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Other topics that may be covered in your examinations include First Aid, Personal Protective Equipment (PPE), Protecting the Environment, Pesticide Movement, Groundwater, Endangered Species, Application Methods and Equipment, Equipment Calibration, Insecticide Use, Application, Area Measurements, and Weights and Measures. Information on these topics can be found in the following books:

1. **National Pesticide Applicator Certification Core Manual,** Published by the National Association of State Departments of Agriculture Research Foundation.

2. **The Workers Protection Standard for Agricultural Pesticides – How to Comply: What Employers Need to Know.** U.S. EPA, Revised September 2005, Publication EPA/735-B-05-002.

These books can be obtained from the Utah Department of Agriculture or Utah State University Extension Service. Please contact your local Utah Department of Agriculture Compliance Specialists or Utah State University extension agent.

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INTRODUCTION

Agricultural animals are attacked by mites and ticks, insects, and animal predators. These various parasites and predators are of great economic importance to Utah agriculture; they cause losses amounting to millions of dollars annually.

These pests affect animal productivity by: direct killing, spreading disease agents, causing loss of blood, causing physical damage to animals or animal products, reducing weight gains, reducing milk and egg production, and in a number of other related ways.

This study guide deals with some of the major pests of agricultural animals. It isn't intended as a complete text on this important subject.

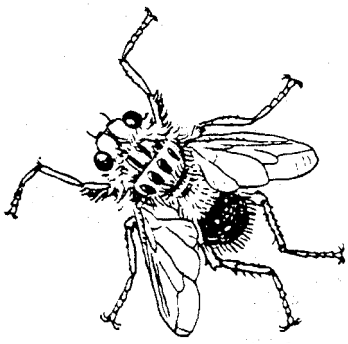
PESTS OF CATTLE

FLIES

Many of the important pests of agricultural animals are flies. The pest damage from a fly may range from a simple annoyance to painful biting and bloodsucking parasitism. Some of the important Utah species are discussed below.

HEEL FLY (Cattle grub)

There are two species of cattle grubs in Utah, the common cattle grub (*Hypoderma lineatum*) and the northern cattle grub (*Hypoderma bovis*). Habits of the two species are similar except that the northern grub's life cycle is a month or two behind the common grub.

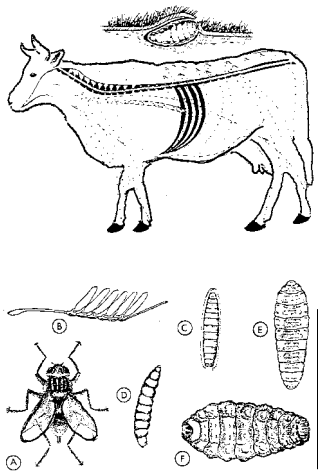


Heel fly (cattle grub)

As flies seek animals on which to deposit eggs, cattle become frightened and run. Cattle fail to graze normally during the warble-fly season because of gadding. They seek shade or water to stand in to avoid the flies. The failure to graze normally results in decreased milk production and subnormal weight gains. Further losses occur when cattle run through fences or into other objects. Slaughter losses result from the necessity to trim grubby areas from the carcass and from the decreased value of hides with grub holes.

The adult heel fly doesn't feed and only lives a short time, usually less than a week. The eggs are attached to the hairs of the host, preferably on the lower parts of the body (hence the term "heel fly"). The eggs hatch in three to six days, and the tiny larvae bore through the skin. The larvae then migrate in several directions in the body for about eight months in the connective tissues between the muscles.

Upon reaching the back, the larvae cut a breathing hole through the skin and remain in this position just beneath the skin for 35 to 90 days before becoming mature grubs. After becoming fully grown, the grubs squeeze through the breathing holes, drop to the ground, and pupate in loose soil or other debris.



Grub cycle

The heel or warble fly. A, adult female. B, eggs attached to hair. C, larva as seen in eggs. D, larva from gullet of cow. E, later stage of larva from beneath the hide of back. F, larva or warble at the stage when it leaves the back of cattle and falls to the ground.

After about four to five weeks, the adult heel flies emerge. There is only one generation per year. When planning to treat cattle that have come from out of state, remember that the timing of the life cycle varies in different parts of the country. Apply treatment after heel-fly season but not later than eight to 12 weeks before the anticipated first appearance of grubs in the back. Applications can also be made after all of the grubs have appeared in the back.

Control

There are a number of effective pesticides and methods of application to control heel flies. Nearly all of the pesticides are aimed at the immature stage, grub or warbles.

You must observe the following general precautions when using these products.

1. Don’t use systemic insecticides on lactating dairy animals, and observe withdrawal periods before slaughter or freshening strictly. No systemic insecticide should be used except in strict accord with the manufacturer's recommendations.

2. Don’t treat sick or stressed animals or calves under three months old, unless such treatment is on the label as an approved use.

3. Don’t apply in conjunction with oral drenches, phenothiazine medication, or other organic-phos-phate insecticides.

4. Don’t use in conjunction with pyrethrins, allethrins or synergists.

5. Take special note of warning statements on insecticide labels regarding rates, condition of animals to be treated, treatment in conjunction with other medication, and recommended time periods for treatment.

Various control methods are available for cattle grubs. These include: (1) feed additives, (2) sprays, (3) dips, (4) pour-ons, and (5) injectable avermectins. Use only in accordance with label directions for the given chemicals.

BLACK FLIES

There are many species in the black-fly family *Simultidae*, and they are among the smallest of the biting flies that attack livestock. They are often called buffalo gnats because of their "humped-back" appearance. Black fly may be a misnomer, because some species that attack livestock are often tan or yellowish in color.

There are four life stages of the black fly: egg, larva, pupa and adult. The duration of the life stages varies considerably with the different species. Several hundred eggs may be deposited on or in the water by the adult female. Larval and pupal black flies spend their lives in the running water of rivers, canals or streams. These aquatic stages are attached to objects such as stones, logs, and submerged vegetation. After emergence, adult flies are capable of moving great distances from their origin.

Female black flies are attracted in large swarms to the host animal. They fly about and get into the nose, eyes, ears and mouth. They feed either on exposed areas of skin or deep within the haircoat. They cut the skin and suck oozing blood. Strong anti-coagulants in their saliva prevent coagulation of the blood for some time after the bite. A large, painful welt may develop at the site of the bite.

Significant losses in weight gains and milk production have been reported during black-fly outbreaks.

HORN FLIES

Horn flies are about half the size of common house flies. They get their name because they sometimes gather in great numbers around the base of the horns of cattle, but they also feed on the backs, shoulders, withers and bellies.

Horn flies are bloodsuckers with piercing, sucking mouthparts. They are known to feed 20 to 30 times per day.

Populations of several thousand may be present on one animal. When large numbers of flies are on cattle, the cattle bunch and spend most of the time fighting flies. They will stand in water or seek shade trying to get relief. Studies have shown that yearling cattle free from horn flies gain from 15 to 50 pounds more than heavily infested animals during the grazing season.

Milk production on dairy cattle pastured during the day and infested with horn flies may decrease as much as 20 percent. However, the horn fly is most important on pasture and range cattle. Horn flies stay on cattle most of the time, crawling and feeding among the hairs on the back, sides or belly. The eggs are very small and are white or dark brown. The larvae are typical small fly maggots, and the pupae are small, brown, seedlike cases.

Horn flies overwinter in Utah as pupae in or beneath cattle droppings. In late April or May, adults emerge and begin the season life cycle. The female deposits eggs in fresh cattle-droppings. The larvae complete development in the manure, then they may move below the droppings into the soil to pupate.

The complete life cycle, egg to adult, may be completed in ten to 20 days during hot weather. Under favorable conditions, many generations are produced in a single season.

Control

Adult horn flies spend most of their time resting on the bodies of animals during the day as well as at night, feeding at intermittent intervals. Due to this habit, horn flies are easily controlled by using any of several methods of residual application applied to the backs of cattle. Horn-fly problems are limited to pasture and range situations; they are not of significant consequence in feedlot operations.

Begin treatment in about May when fly counts reach 25 to 50 per animal, and continue treatments at specified intervals during the fly season.

Sprays are effective in controlling horn flies. However, their use requires frequent application and thus relatively high labor cost in working the animals.

Backrubbers offer a convenient method to control horn flies and will also help control face flies when the pesticide comes in contact with the animal's face.

Dust bags provide excellent control of horn flies where properly installed and maintained. Buy ready-to-use bags and suspend near, but not directly over, mineral or salting stations, in alleyways, in loafing pens, or in holding sheds. Protect the bags from weather by placing them under shelter. Suspend them where they will hang four to six inches below the top line of the cattle.

Feed additives kill the larval horn flies in the feces.

Insecticide-impregnated ear tags from different pesticide families should be used annually to avoid pesticide resistance.

Label information will indicate amounts, restrictions and warnings for use of insecticides on animals. Don't use an insecticide that doesn't contain label information for animal use.

FACE FLY

The face fly, *Musca autumnalis*, is an important, non-biting, nuisance-type fly affecting mostly cattle. The insect looks very much like the house fly. In fact, it's very hard to tell the adults apart in the field.

Their persistence and habit of congregating around the eyes and nose of animals helps distinguish face flies from house flies in the field. Face-fly larvae (maggots) are yellowish, and the puparia are white. In the case of house flies, their larvae are mostly white, and the puparia are red-brown.

They swarm around the head of an animal, lighting in and around the nostrils, muzzle and eyes. They cause profuse tear formation. Face flies feed on the mucous of eyes, nose and mouth and on the blood oozing from insect bites or open cuts. Irritation resulting from face-fly infestations may cause cattle to huddle or seek shade and refuse feed. The protective and evasive actions of cattle in attempts to avoid the annoyance of the flies undoubtedly reduces milk flow or weight gain.

The face fly is a strong flier and can travel several miles. Individual face flies don't remain with cattle at all times and usually don't enter darkened barns or stables. The adult face fly passes the winter in the adult stage within shelters. They may be a household pest in the spring, when the flies emerge from their indoor hibernation quarters.

The flies are present in the field throughout the summer. Peak population occurs in late July or August. The flies are most prevalent along waterways, areas of 30 inches or more of rainfall, canyons where the canyon floors have trees and shaded vegetation, and on irrigated pastures. The open ranges with sparse vegetation apparently allow the manure to dry out before the fly larvae have completed development.

Control

The achievement of adequate face fly control is difficult at best. Two factors contribute to this difficulty: (1) The flies congregate on the face of the animal, a hard place to treat, and (2) Face flies spend a good deal of time away from the animal, so residual activity of an insecticide may be lost before the fly contacts it.

The best control has been obtained where treatment stations were built and animals were forced to contact an insecticide (dust or oil) with their faces on a daily basis, or where animals were hand-treated daily with a dust or spray. Insecticide control measures recommended in Utah include dust or oiler self-treatment devices, sprays, and feed additives.

Dust bags and oilers can be used with considerable success if special attention is paid to placing and maintaining these devices. They must be placed so that cattle and calves are forced to pass under them in order to obtain water, salt or feed or to enter loafing areas.

Feed additives containing insecticides and growth regulators help with control**.**

Insecticide-impregnated ear tags using two tags per animal have resulted in 70- to 80-percent reductions.

STABLE FLY

The stable fly is about the size of a house fly but is dark gray, and the abdomen has dark, irregular spots on it. The proboscises (mouthparts) protrude bayonet-like in front of the head. The larvae are typical whitish fly maggots. The pupae are chestnut brown and are one-fourth inch long.

The complete life cycle of the fly from egg to adult averages about 24 days in Utah in hot weather. The female fly deposits eggs in spoiled or fermenting organic matter mixed with animal manure and dirt. The most common breeding sites are in feedlots or dairy lots.

These breeding sites are common around feed bunks; along the edges of feeding aprons; under fences; and along stacks of hay, alfalfa or straw. Each female fly lives about 20 to 30 days and lays 200 to 400 eggs during her lifetime. In warmer areas, the stable fly may breed all year.

Economic importance

Stable flies are the most important insect pest on feeder and dairy cattle in the summer in Utah. They feed by piercing the skin and sucking blood. Stable flies stay on the animal long enough to get a blood meal, then they seek a shaded place on a fence, barn wall, feed bunk or vegetation to digest it.

The bite of the fly is painful, and cattle try to dislodge flies by foot-stamping, by tail-switching, and by throwing their heads down toward their front legs. When flies are abundant, cattle either bunch, with each animal trying to get to the center of the group, or seek water to stand in to avoid the fly harassment. Heavy fly populations may cause cattle to go off feed and add to the danger when the weather-safety index is critical. Weight-gain depressions of 0.25 pound per day and milk-production decreases of 30 to 40 percent have been recorded.

Control

Sanitation should be the first step in a control program. In a feedlot or dairy operation, manure should be removed or mounded. Clean around feed bunks and feed aprons, under fences and gates, around water systems, and at the edges of the mounds.

Clean sick pens and feed storage areas regularly. Even small breeding areas support very high numbers of flies. If sanitation isn't practiced to a certain degree, chemical control may be unsuccessful.

There are three methods of insecticide fly control. The method of choice will depend to some extent on the type of livestock operation.

1. **Residual sprays**: Stable flies rest on shady surfaces such as fences, feed bunks, buildings and vegetation surrounding cattle lots after the temperature reaches 80 degrees F. These surfaces can be treated with residual sprays; flies rest on the treated surfaces and absorb the insecticide. Residual insecticides should be effective for ten to 21 days, unless washed off by rain or broken down by high temperatures or bright sunlight. Three to six applications during the fly season should be adequate. The residual-spray method is best adapted to dairies or smaller feedlots where fly resting-areas are not too extensive. Apply residual sprays to the point of runoff, but don’t allow puddles to form, and don’t contaminate feed or water.

2. **Area sprays**: Area sprays are considered short-residual knockdown insecticides. They should be applied on areas where flies are concentrated, because they kill only the flies they contact. The sprays are used as low-concentrate fine mists. Area sprays are the most efficient when fly activity is low and when they are collected in swarms. These times would be early morning, late evening, or during the hottest part of the day when flies are resting in shady areas. This method is probably best adaptable where pens and resting areas are too extensive for the use of residual sprays. The area sprays may have to be applied two or three times a week. The residual and area spray methods can be combined. An area spray could be used to knock down existing adult populations. After about a week (the time needed for newly emerging females to begin to deposit eggs), a residual treatment could be applied.

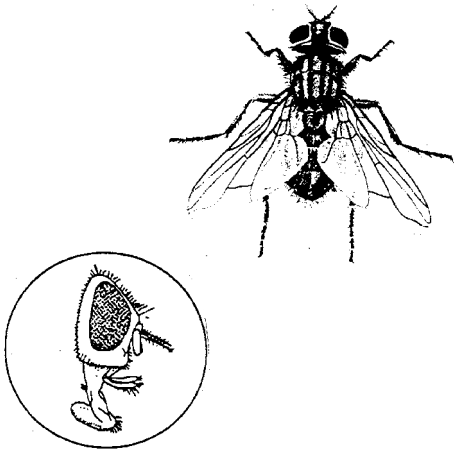
These methods could be alternated as needed throughout the fly season.

3. **Animal or wet sprays**: Sprays applied directly to cattle for control of stable flies generally need to be applied at four- to seven-day intervals, because wet vegetation (from dew or rain) washes the insecticide off the legs of pasture cattle. (Some products have longer treatment intervals.) This method may be the only feasible one where cattle come to lots to water once or twice per day, then return to pasture. Stable flies breed around the lots, attack the cattle, then follow them back to the pastures. Sometimes pens that have served as winter feeding facilities will provide breeding areas for flies. When the flies emerge, they move to cattle in nearby pastures to feed, then back to the lots to deposit eggs. In either situation, a cleanup of the lots may be the best control. If wet sprays are to be used, spray the legs, flanks and underlines of the cattle (about one-half to one gallon of diluted spray per mature animal, less for a calf).

Applying insecticides to breeding areas is generally not recommended. The acidity of the material in the breeding areas breaks down the insecticides too rapidly, there is a danger of animal or crop contamination, fly insecticide-resistance tends to increase, and sanitation (the prime method of fly control) tends to be ignored.

HOUSE FLIES

House flies are about the same size as stable flies. They develop in manure or other areas of high organic matter that remain moist for several days. House flies cannot bite because they have sponging mouthparts. The underside of the abdomen is white to yellow rather than the gray color of stable flies.



The adult house fly and enlarged, side-view of head and sponging-type mouthparts.

House flies are not directly injurious to livestock but are annoying to the animals and are responsible for high bacteria counts. They are a nuisance to the homeowner. The tremendous numbers produced around feedlots may create a fly problem for several miles around.

The development stage of house flies requires eight to 20 days, depending on the conditions. Two or more generations per month may be produced during warm weather. Populations increase in the spring and summer, then reach the maximum in late summer or early fall.

They are of principal importance around feedlots and in hog and poultry operations, but are of minor importance under range situations.

Control

Sanitation is of major importance. Remove manure once a week, if possible. Use of residual sprays will help reduce the fly population for a short time, although this method in general appears to be gradually decreasing in effectiveness.

Sprays: Apply to ceiling and walls, using one to two gallons per 1,000 square feet. Cover feed and water, and keep animals out during spraying operations.

Baits: Baits are sometimes useful in supplementing other fly-control measures. They may be applied as dry or wet mixtures to floors, window sills, and other areas where flies congregate. In general, apply baits daily for a week and as needed thereafter. You may prepare your own bait or use a commercially prepared mixture.

Feed-through insecticides: This approach to fly control is being used in Utah. The effectiveness and feasibility of this approach depend mainly on individual circumstances.

These materials function by passing through the animal's digestive system to kill fly larvae in the manure. The method's performance in the laboratory is generally excellent, but in order for it to work in the field, cattle must ingest the proper amount of larvicide daily in order to prevent fly development in the manure.

A very careful sanitation program must be conducted in and around cattle lots to prevent breeding in untreated media. Since adult flies are not controlled, more traditional methods may be necessary. The species of fly involved must be considered, along with the ease and economy of control by other methods.

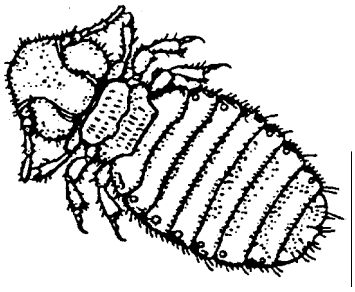
Bio-control: Parasitic wasps can be used to kill the fly larvae.

LICE

Lice are considered by many to be the most serious insect pests of livestock in North America. Livestock producers' losses to lice are estimated to be many millions of dollars per year. Heavy louse populations result in lowered milk production, loss of flesh, stunted growth, general unthriftiness, and anemia. "Chronic" or "carrier" cows may abort due to louse-induced anemia. During severe winters, louse- infested animals are more susceptible to respiratory diseases.

Fall calves, yearlings, older unthrifty cattle, and early spring calves usually have the heaviest infestations. Heavily infested cattle are usually in poor physical condition, with rough, patchy haircoats that have a dirty appearance.

Older animals may be "chronic" or "carrier" animals that, despite repeated insecticide treatments, continue to carry heavy populations of lice. These animals are instrumental in reinfecting entire herds each year.



Cattle biting louse

Heavy cattle-lice infestations are easy to recognize. Bluish-colored patches may appear on the head, neck, brisket and shoulders of cattle. Lice may be seen climbing about on the host's facial hairs. Cattle scratch and rub against objects and remove hair in an attempt to relieve itching.

All of these signs may mean that the lice have reached serious levels and will cause a substantial monetary loss, unless they are controlled. Four different species of lice are important parasites of cattle in temperate areas of the United States.

The three common sucking lice species are:

- The short-nosed cattle louse
- The long-nosed cattle louse
- The little blue cattle louse

The only biting louse species is:

- The cattle-biting or chewing louse

All four lice species have similar life cycles. The eggs are glued to hairs and, in a severe infestation, are very noticeable. The duration of the egg stage varies, but usually eggs hatch after one to two weeks. The nymphal lice look very much smaller. There are three nymphal instars, which last between two to three weeks before maturing to adulthood. Adults may live about two weeks, producing one to two eggs per day. Infestations decline during summer and become more severe during cold weather.

Short and long-nosed lice

Control

Control of lice depends on early inspection and thorough treatment. Choose a warm fall day, and apply an insecticide with a sprayer producing 200 to 250 pounds per square inch of pressure. Backrubbers and dust bags often help reduce lice infestations.

Several insecticides are available in pour-on formulations. Pour-on treatments are preferred over sprays in midwinter (January and February), because they can be applied without wetting the animals during periods of cold weather. Injectables are effective for bloodsucking lice.

TICKS

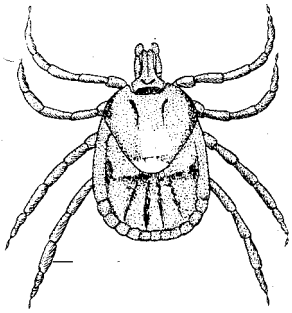
Livestock often become infested with ticks. Ticks are not insects and don't resemble them. Ticks, as well as mites, are more closely related to spiders, scorpions, etc.

Ticks have four developmental stages: egg, larva, nymph and adult. The larvae, nymphs and adults can be differentiated according to size. Larval ticks possess six legs, whereas adults and nymphs have eight.

Ticks are obligatory parasites and require blood meals in order to develop. The tick feeds by driving its mouthparts into the skin of the host. The feeding of ticks produces wounds and removes large quantities of blood.

ROCKY MOUNTAIN WOOD TICK

The Rocky Mountain wood tick, *Dermacentor andersoni*, attacks most domesticated animals and is a significant pest. In addition, toxins secreted by the female tick can paralyze many animals, including cattle, man, sheep and horses.



Hard Tick
Dermoacentor sp.

Rocky Mountain wood ticks may cause tick paralysis in livestock by the feeding of females and their injection of a toxin into the bloodstream of the host. First symptoms in afflicted animals are weakness and staggers. In a few hours, they are incapable of standing, and finally death ensues. Animals can be saved by removing the offending ticks. Recovery may be rapid (within an hour), or it may take a couple of days. When recovery doesn't occur within this time, it's an indication that some ticks may have been overlooked during the removal.

Control

Thorough coverage by a spray or dip is necessary to control the Rocky Mountain wood tick. Several different insecticides are approved for this purpose.

SPINOSE EAR TICK

The spinose ear tick inhabits the ears of cattle, but only in the larval and nympha stages. The adults live on the ground, away from the host. They cause injury by puncturing the skin within the ear and sucking blood. Wounds may become infested, causing a condition known as "ear canker." Sometimes tick infestations become severe enough to completely close the ear passage.

Control

For control of the spinose ear tick, approved dust or oil solution formulations must be applied into the ears of infected animals, or insecticide-impregnated ear tags may be used.

MITES

SCABIES (Cattle mange)

The term "scabies" and mange are often used interchangeably, but they are defined by the U.S. Department of Agriculture (USDA) in the following way:

Mange is any skin condition of man or animals associated with a mite; scabies is an especially serious, debilitating, reportable mange condition. The causative organisms, mites, are tiny arachnids related to ticks and spiders.

Three varieties of mite infestation are grouped together under the term scabies: (1) psoroptic or common scabies, (2) sarcoptic scabies, and (3) chorioptic scabies. When scabies mites are detected, the infested cattle are required by law to be quarantined and treated.

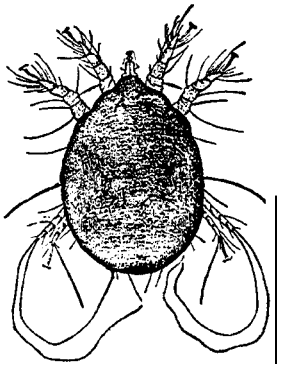
Scabies has been known since ancient times in man as well as in animals. Cattle scabies is a universal parasitism; infestations have been and are today reported from all areas of the world.

In the U.S., the disease constituted a serious threat to the cattle industry, especially on the open ranges of the West, before the turn of the century. The last outbreak in Utah was in 1986. We are currently free of scabies.

The annual cost of scabies to the cattle industry and to the nation is a controversial matter, subject to interpretation. In 1973, for example, an outbreak of cattle scabies involved 53 ranches and feedlots, all in the Southwest. During that outbreak, nearly 40 million inspections of individual cattle were conducted, and some 2.7 million head of cattle were dipped, either once or twice. Inspectors' salaries and travel costs amounted to 3.5 million dollars that year. Adding all direct costs and intangible losses associated with this enormous operation, USDA economists estimated that 40 million dollars was spent on or lost as a result of cattle scabies.

SCABIES MITES OF CATTLE

Psoroptic scabies: Scabies has come to mean psoroptic scab, common scabies, or its equivalent in most livestock during the past half-century. It's caused by *Psoroptes ovis*, a parasite that spreads quickly and easily among cattle of all ages, classes and conditions.



The sheep scab mite (Psoroptes ovis), female. Greatly magnified.

Some external parasites, like many kinds of lice, are said to be "host-specific"; that is, they parasitize only a single species of host and cannot survive on any other.

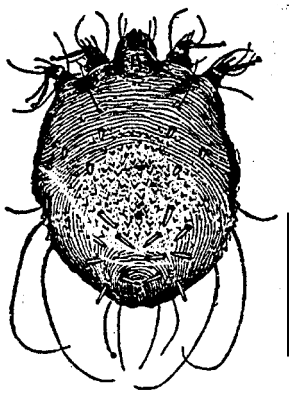
Psoroptes ovis is host-specific to a degree; it lives only on sheep (that it prefers to other animals), on cattle, on horses, and on the American bighorn sheep. The entire life cycle, from egg to egg, is spent on the host.

Psoroptic scabies is by far the most injurious form of cattle scabies and requires immediate quarantine and control measures when found.

Sarcoptic mite

Sarcoptic scabies. Another form of scabies is caused by the sarcoptic mite, *Sarcoptic scabiei.* This parasite isn't specific only to barnyard animals, where it's seen on swine, horses, cattle and sheep, but it may also be found on household pets, wild carnivores, monkeys and man. It's truly a cosmopolitan parasite of mammals. Oddly enough, it has never been isolated from sheep in the U.S. Sarcoptic mites are known to transfer from one species of host to another, as from cattle or swine to humans, but according to some scientists, the secondary infestations are only temporary.

In establishing themselves on cattle, sarcoptic mites usually congregate where the hair is thin and the skin tender. The first lesions are often found above the scrotum or udder and on the inner surface of the thighs. If the disease isn't checked, infestations may cover the entire body. Affected areas lose hair and become covered with heavy crusts or scabs. New generations of mites require about two weeks to complete the cycle from egg to egg.

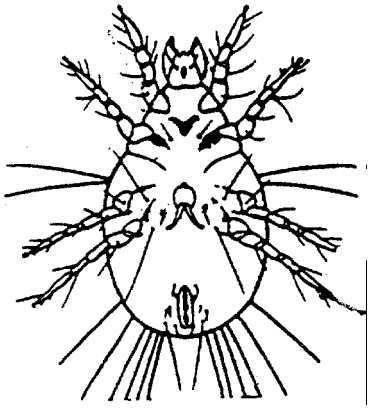


The mange or itch mite, (Sarcoptic scabiei), female.

Sarcoptic, like psoroptic, scabies is a disease subject to quarantine and control measures wherever found.

Chorioptic mite

The third scabies mite of cattle is *Chorioptes bovis*. In some literature, especially of the l9th century, it's the mite that causes "leg mange" or "foot mange." Like psoroptic mites, chorioptic mites have rather strong host preferences. They are normally found on only four host species: the cow, horse, goat and sheep.



Chorioptic scabies (Chorioptes bovis)

In some species, the feet and lower hind legs are important sites of infestation. *Chorioptes bovis* lives in colonies on the surface of the skin. It's the most common type of mange in cattle. The skin lesions usually develop in the tail region and spread to other parts of the body. If the lesions start on the feet or legs, it's called leg mange.

Other sites to find lesions are on the scrotum and udder, under the flanks, and on the legs. Chorioptic scabies is considered a "reportable" disease in some states, and its existence is brought to the attention of the state veterinarian. Imposition of quarantine and control measures are usually left to the discretion of state animal-health agencies.

Spread of the mites from host to host

All of the scabies mites are one-host parasites; they normally live, mate, deposit eggs, and die on the same host. Some, however, drop off or are rubbed off the skin and haircoat of the infested host and establish themselves on a new host. In this elementary way, all of the forms of scabies become highly contagious diseases, and extreme care must be exercised to prevent dissemination. Cattle scabies may be borne from farm to farm on newly purchased stock and through the medium of infested cars, trucks and enclosures.

CONTROL OF CATTLE SCABIES

Because scabies infestations are considered contagious diseases, their existence must be reported to appropriate federal and state agencies. Reporting sarcoptic and psoroptic or common scabies is mandatory, but as noted earlier, attitudes concerning chorioptic scabies are elastic. In any event, when the disease is reported, scabies control measures must be supervised by federal- or state-designated officers.

At the present time, only three chemical compounds are recognized as suitable scabicides, which is, drugs officially permitted for use under imposed quarantine restrictions and on cattle destined for interstate movement. These scabicides are water suspensions of the organic phosphate compounds coumaphos and phosmet and the injectable drug avermectin.

When coumaphos is used, all animals, infested or merely exposed to diseased cattle, must be treated twice. Cattle treated with this scabicide may be designated for immediate slaughter; no withholding period is required.

State and federal animal-health agencies cooperate very closely and effectively in the detection, quarantine and control of scabies. When scabies-infested individual animals or herds remain within state confines, only the office of the state veterinarian concerned is responsible for the necessary regulatory procedures. On the other hand, when two or more states are involved in a scabies outbreak, when infested animals are moved across any state boundaries, or when livestock are brought into the U.S. from outside the country, the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture determines the course of action to be followed. In the last event, very precise statutes, as elaborated in the Code of Federal Regulations, must be observed.

PESTS OF SHEEP

A number of insects and related pests are problems to sheep producers in Utah. The following information highlights some of the important organisms.

FLIES

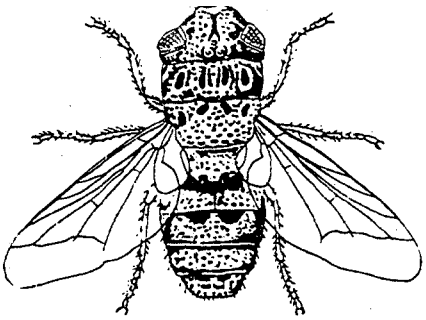
Several of the important pest flies to sheep have been discussed in the cattle pest section, for instance:

- Black flies
- Stable flies
- Horn flies
- House flies

Some other important fly pests of sheep are:

SHEEP BOT FLIES

The sheep bot fly, *Oestrus ovis*, is a common pest of sheep and goats. The persistence of the adult flies in depositing larvae in the nostrils excites the animals and interferes with handling and grazing.



12 mm in length grayish brown

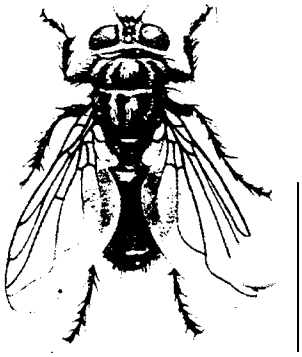
The larval stages of the fly, known as head grubs, live as parasites within the nasal passages and frontal sinuses. They may irritate membranes lining the nasal cavities and predispose the sheep to bacterial infection. The resultant nasal discharge leads to the term "snotty nose."

Control

There are several drugs that may be used to control the larval stage: ruelene given orally, rafoxanide given orally, trichlorfon given orally or injected, nitroxynil injected, and avermectin given orally or injected.

BLOW FLIES (Wool maggots)

The larvae of many species of blow fly have been reported to invade wounds of livestock. Several species, however, don't necessarily require a wound in order to parasitize sheep. The larvae of these flies are called wool maggots or fleece worms.



Black blow fly

The adult flies are often about the same size as the house fly and dark bluish-green in color, with a metallic luster. The larvae look like typical fly maggots.

The factors surrounding strike or egg-laying are not completely known, however, several predisposing causes have been reported. The primary cause for strike is bacterial activity in the wool, which can be stimulated by contamination with urine, feces, sweat, or an existing maggot infestation. Maggots may live in the fleece, or they may attack the skin and produce lesions. The lesions and the maggots irritate the animals. The sheep become restless, stamp their feet, constantly wag their tails, and bite at the site of the trouble. They don't feed properly, and their condition deteriorates. Death may occur within a few days.

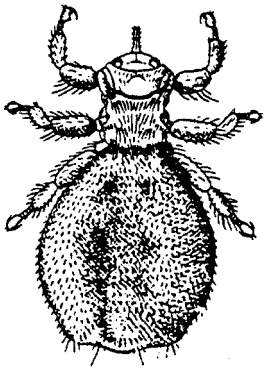
Control

Much can be done to avoid maggot infestation of animals through flock management. Soiling of fleece should be avoided, but if the breech area becomes saturated with urine and feces during the blowfly season, wool should be clipped from the crotch area.

In order to avoid wounds that may become maggot-infested, sheep should be handled gently and with safe chutes and corrals. Lambing and shearing early in the spring, prior to the blowfly season, are advisable. Insecticides are used for prevention as well as control. Preventive dips or sprays may be applied if animals scour during the warm months. Wounds may also be treated. Infested animals may be dipped or sprayed with dilute insecticide. If only a few animals become infested, spot treatment of the infested site is a possibility.

SHEEP KED

The sheep ked, *Melophagus ovinus*, is a common pest of sheep. It's a wingless fly that has a tick-like appearance. Two stages of the insect may be seen on sheep, the adult and the pupa. Both stages are most commonly found on the underside of the host, although they are not restricted to that area.



Sheep ked or Sheep-tick

The sheep ked is a blood-feeder, and it crawls rapidly through the fleece of the host animal. Damage results from bites of the ked, causing irritation to the sheep, and lesions caused by the insects' feeding. These reduce the grade and value of the sheepskin. The excrement of the keds causes permanent discoloration of the fleece.

The entire life of a sheep ked is spent in the fleece of the host. Adult keds spread from one host to the next by direct contact. This is how keds transfer from ewes to newborn lambs.

Ked populations build up during the autumn and winter months and reach peak numbers in January and February, then decline to lower numbers that are carried over the summer.

Control

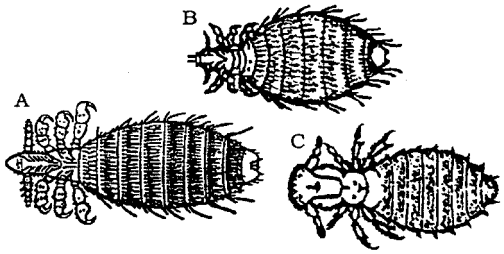
Several methods of control are available for sheep keds. Each has its advantages and disadvantages, depending on the particular sheep management program. Most often, sheep are successfully treated in the spring after shearing, which is a means of control. All sheep in the flock must be treated, and all animals introduced into a flock should be treated in order to prevent reinfestation. Methods of application for sheep-ked control include dipping, high-pressure spray, low-pressure spray (including sprinkler can), pour-on, power-dusting, and hand-dusting.

LICE

SHEEP LICE

Several species of lice can infest sheep. These include one species of chewing louse (the sheep-biting louse) and several species of sucking lice. The sheep-biting louse, the sheep-foot louse (a sucking louse), and the bloodsucking body louse will be discussed here.

The sheep-biting louse, *Bovicola ovis*, is a small species with a pale abdomen, darker thorax, and reddish head. The sheep-foot louse, *Linognathus pedalis*, is up to two millimeters long, has a short head, nearly as wide as it's long, and has an abdomen thickly covered with long, slender bristles. The blood-sucking body louse, *Haematopinus ovillus*, is larger but similar in shape.



A) The sucking body louse of sheep, Haematopinus ovillus.
B) The sheep sucking foot louse, Linognathus pedalis.
C) The sheep biting louse, Bovicola ovis.

The adult, nymphs, and egg stages all appear on the host. The three nympha stages resemble the adult lice in general appearance, however, they are smaller in size. The eggs, which are quite small in size, are glued to wool fibers and hairs.

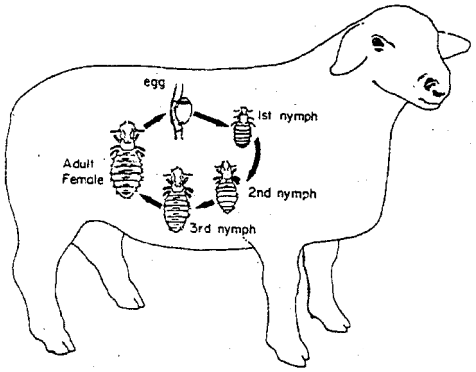
The sheep-biting louse and sheep-foot louse demonstrate a pronounced seasonal fluctuation in populations, numbers being greatest in winter and early spring and lowest in summer. Lice are spread by contact between sheep. The sheep-foot louse can also be acquired from an infested pasture.

The sheep-biting louse is usually most abundant on older sheep and sheep in poor condition. Their preferred

location is near the skin along the back and the upper sides.

In heavy infestations, lice may be found anywhere on the body. Biting lice feed on the skin scurf. They cause intense irritation that sheep relieve by biting and pulling the wool and by rubbing against objects. The fleece of heavily infested sheep becomes ragged and torn.

The sheep-foot louse is a sucking louse that feeds on blood. Usually this louse isn't considered very injurious,



Life cycle of the Sheep biting louse

since feeding occurs on the hairier parts of the sheep's body, and the animal exhibits little discomfort. In severe infestations, though, it may cause some lameness.

Generally, lambs and younger sheep are more heavily infested by the sheep-foot louse than are older animals. Light infestations commonly occur as small colonies of lice around the accessory digits. From this location, they may spread down to the feet and up the shank. In heavy infestations, they also infest the scrotum and sometimes the belly of the rams.

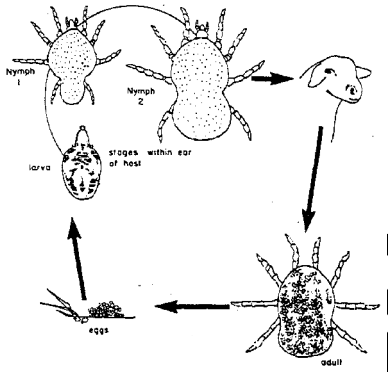
The bloodsucking body louse robs the host of nutrition and stains the wool with small, brown fecal spots. The sucking body louse also may infest the belly and scrotum of rams and spreads during breeding.

The bloodsucking body louse, sheep-biting louse, sheep-foot louse and other species that occur on sheep may be controlled by the use of an insecticide dip or high-pressure spray, various pour-on formulations, and the injectable avermectins.

TICKS

The Rocky Mountain wood tick and the spinose ear tick discussed in the cattle section can also be serious problems of sheep.

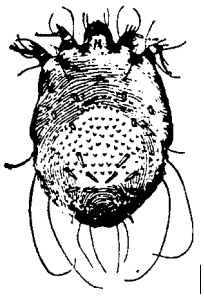
Control methods are similar to those discussed in the cattle section.



Life cycle of the Spinose ear tick

MANGE MITES

Several different mite species produce a contagious disease of the skin of domestic animals known as mange. The types of mange -- sarcoptic mange, psoroptic mange, and chorioptic mange -- are named after the mites causing them -- sarcoptic, psoroptic and chorioptic mites. For diagnosis, mites are scraped from an infected area of the host animal. Microscopic examination is necessary for positive identification of the type of mange present, because mites are barely visible to the naked eye.



Sarcoptic mite

All stages live only on the host animal and spread by contact between animals or with contaminated equipment.

SARCOPTIC MANGE

Sarcoptic mange is rare in sheep. Adult sarcoptic mites burrow within the skin of the host and cause severe irritation. Eggs are laid within the burrows.

Development of the mite from egg to reproductive adult takes about two weeks. This form of mange occurs only on the non-wooly skin. Lesions usually first appear on the head and face.

PSOROPTIC MANGE

Psoroptic mange of sheep is also called sheep scab. It's caused by *Psoroptes ovis*. It's a notifiable and quarantin-able disease and, when suspected, should be reported immediately to regulatory officials.

Psoroptic mites don't burrow in the skin of the host. Instead, by pricking the skin to feed, they cause serum to ooze from the wounds. Accumulation of serum causes the formation of scabs. It occurs almost exclusively on the wooled parts of the body, where it produces large, crusted lesions. Psoroptic infestations eventually may involve large areas of skin. The coat of the sheep becomes ragged, and "tags" of wool are torn out or rubbed away by the sheep. *Psoroptes ovis* causes severe weakness and extensive loss of wool. In severe cases, animal deaths are not uncommon.

The life cycle requires about two weeks, and the infestation can build rapidly. Psoroptic mites occur abundantly under the scabs. Infested sheep rub and scratch because of the severe irritation, and this results in rapid spread of the disease to other animals.

CHORIOPTIC MANGE

This form of mange is probably the most widespread in sheep in the U.S. Chorioptic mites live on the surface of the skin and feed on scurf and skin secretions. Although the mite sometimes causes considerable irritation to the host, the only noticeable skin lesions occur on the scrotum of rams. Infested sheep may often be observed biting or licking their lower legs and feet.

It's also known as leg or foot mange. The areas of the body on which this mite is found are those pestered areas of the legs, face and scrotum having no wool. Little damage results to the fleece, and little weight is lost by fattening lambs.

Control

Dipping or injections of the avermectins are the preferred method of treatment for mange control in sheep. An infestation of psoroptic mite, sheep scabies, calls for a control program supervised by state and federal regulatory officials.

PESTS OF HORSES

Like other farm animals, horses, mules and donkeys share some of the same pests. Those flies, mites and ticks not already covered elsewhere in this study guide will be discussed in this section.

FLIES

Flies, both the bloodsucking and nuisance types, are major pests annoying horses. See the cattle section for a discussion of many fly pests of agricultural animals.

Control

Horse flies are harder to control than most of the bloodsucking flies. Many compounds will kill them, but because of the flies' intermittent feeding, they may not be exposed to a lethal dose of pesticide.

BOT FLIES

There are three species of bot flies in the U.S. They are the throat bot fly, the nose bot fly, and the common bot fly. The adult female attaches her eggs to the hair of the horse. Each species has a particular site of preference where the eggs are laid. When the eggs hatch, the larvae enter the mouth and penetrate the mucosal lining and the tongue. After a period of development, they migrate to the stomach, where they

attach into the stomach lining and feed. This activity often causes unthriftiness, colic, and other problems.

As the larvae reach the latter stages of their development, they release their attachment and are excreted in feces. They burrow under loose debris in the soil, where they pupate and develop into adult flies.

Horse bots cause injury in several ways. Since the mouthparts of the adult flies are non-functional, they cannot bite. However, the egg-laying habits of flies annoy or frighten the horses and cause them to mill or run, thus interfering with work and grazing. Because of this annoyance, horses may lose weight and vitality. Also, young larvae, or bots, penetrate and irritate sub-mucosal tissues of the inner lip, mouth and tongue and induce horses to rub their mouths on hard objects, causing additional sores. Older larvae attach to the lining of the stomach and intestines, removing nutrients and causing inflammation. Heavy infestations hinder passage of food through the alimentary canal and impair digestion of food.

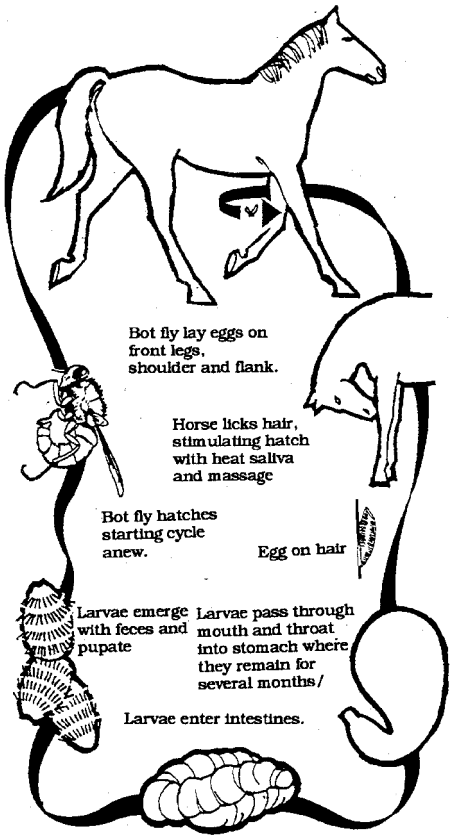
COMMON HORSE BOT FLY

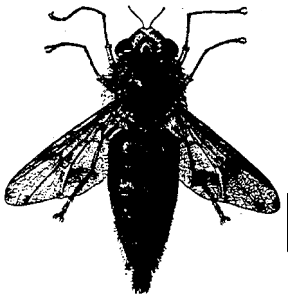
Female common horse bot flies may lay up to 1,000 eggs. The eggs are usually attached to the hairs of the forelegs or in other places the horse can reach with its mouth. After a five-day incubation period, heat caused by licking of the horse stimulates the eggs to hatch. Young larvae are taken into the mouth, where they burrow into the mucous membrane of the tongue. After three or four weeks there, the larvae pass to the stomach, where they attach to the lining and pass their lives as second and third larval stages. The larvae remain in the stomach for ten months, until the following spring, when they pass out with the feces. Pupation takes place in loose soil or ground litter. The pupal period lasts from three to five weeks. Individual adult flies may live for about three weeks. Larvae continue to drop from the host over a long period of time, and flies can be found annoying horses from late summer into early fall.

NOSE BOT FLY

The eggs of the nose bot fly, which are laid mainly in the hairs of the upper lip, require an incubation period of about two days. Moisture provided by licking may be necessary for hatching. The larvae penetrate the lips and migrate into the tissue of the mouth. This species moves to and attaches to the stomach and small intestine in the second and early third larval stages. Unlike the other species, it then detaches and reattaches in large numbers in the rectum, very close to the anus, before dropping out with the feces.

The life cycle below of the nose bot fly is similar to that of the other horse bot flies.





Horse bot fly

WINTER TICK

The winter tick is a frequent and widespread pest of horses. Preferred hosts are horses, moose and elk. Young animals are especially vulnerable to attack and may be killed by heavy infestations.

This tick is a pest in the fall, winter, and early spring. The larval or seed ticks, which are similar to the adults except for smaller size and possessing six legs, spend the summer in clusters on the ground.

When the cool weather of fall approaches, the larval ticks become active and seek a host. The tick remains on and feeds on the blood of the same host throughout its life. For this reason, the winter tick is called a "one- host tick." The mated, fully blood-engorged female tick drops off the host in early spring. Egg-laying takes place on the ground later in the spring. For information about the Rocky Mountain wood tick and the spinose ear tick, refer to the cattle section.

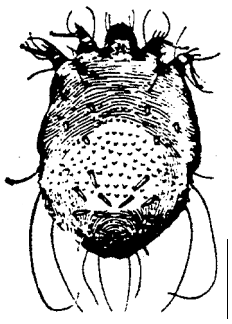
Control

If ticks become attached, the simplest method of removing them is by a slow, steady pull that won't break off the mouthparts and leave them in the wound.

An antiseptic should be applied to tick bites, the same as to other open wounds. Thorough coverage of an infested animal is necessary for insecticidal control of the winter tick and the Rocky Mountain wood tick. Several different insecticides are approved for this purpose. Application may be by means of spray, dip or hand-washing. For control of the spinose ear tick, dust- or oil-solution formulations must be applied directly into the ears of infected animals.

MANGE MITES

Several different mite species produce a contagious disease of the skin of various domestic animals known as mange. The type of mange -- sarcoptic mange, psoroptic mange, or chorioptic mange of horses -- is named after the mite causing it -- *Sarcoptes scabobel*, *Psoroptes ovis* and *Chorioptes bovis*.



Mange mite

Specific identification should be made by a trained individual.

The symptoms of the disease are quite obvious, however, and may consist of blisters and small bumps on the skin, swelling and inflammation of the skin, scabs that consist of serum and scurf, and, in advanced cases, a dry, leathery skin condition.

Mange is highly contagious. Mange mites are transmitted by contact with infected animals or equipment. Populations are generally greatest in the winter, when haircoats are long and horses are crowded together.

For a more detailed discussion about the biology and control of mange mites, see the section on cattle pests.

PESTS OF SWINE

FLIES

Most flies that are pests of cattle are also pests of swine. Refer to descriptions and control recommendations in the cattle section.

HOG LICE

The presence of hog lice may be indicated by excessive scratching and rubbing. This causes reddening and thickening of skin and results in reduced weight, especially in young pigs. Heavy infestations may cause death. The life cycle is the same as that of cattle lice.

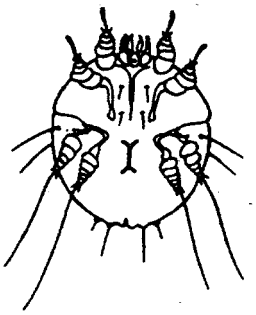
Hog louse
Order Anoplura
Length, 3/8 inch
Bloodsucking pest of hogs.

Control

A number of sprays and dips may be used. In addition, the granular formulation of Ronnel may be used in the bedding for small pigs. Dust formulations may also be used on young and mature pigs.

HOG MANGE

Since mange spreads rapidly, especially in winter, treat the entire herd when any individual shows mange.



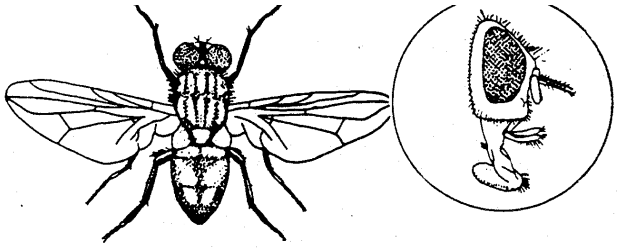
Hog mange

Routine treatment will help prevent an outbreak. Such a program requires: treatment of pigs at weaning, sows a month before farrowing, boars prior to the breeding season, as well as all feeder pigs and other hogs in the fall before placing them with other hogs.

PESTS OF POULTRY

FLIES

Many types of domestic flies are pests on poultry ranches. The house fly is the most common problem. Some flies may transmit disease to poultry. Adults that disperse into the surrounding environment are a nuisance to many people and may transmit human and animal diseases.



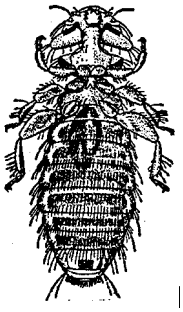
Adult house fly and enlarged side-view of head and sponging type mouthparts

Control

Good sanitation is important for successful fly control. Follow the recommendations in the cattle section for house- and stable-fly control.

LICE

Chewing lice infest poultry. They spend their entire life on the host. Louse transmission is by direct contact with infested birds. The lice live on the host year-round, but they are most abundant during the summer. The most



Chicken body louse. Menacanthusstramineus, female, underside.

common and economically important louse to chickens and turkeys is the chicken body louse. It feeds on dry skin scales, feathers, scabs, and blood it gets by puncturing soft quills near their base.

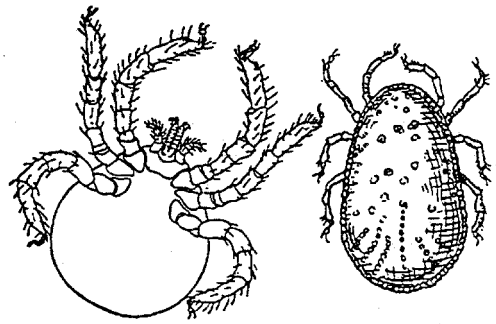
Infested birds become restless and damage themselves by pecking at body areas. Weight gain and egg production may decrease.

Control

Insecticides can be applied by dusting or spraying the bird or by providing self-treatment devices, such as dust boxes.

FOWL TICKS

Although several species of ticks may infest poultry, the most prevalent is the fowl tick. The fowl tick causes about the same kind of damage as poultry mites. All forms (larvae, nymphs and adults) attach to the skin, where they suck blood and cause skin irritation. Loss of blood in chicks can be great enough to cause death. Older birds become anemic, and they lose production.



Fowl tick or Bluebug
Order Acarina
Length, ½ inch
Adult, nymph suck blood from domestic fowl, most at night; found in roost cracks during day.

These ticks feed at night and hide in cracks in roosts, floors, walls, nests and cages during the day.

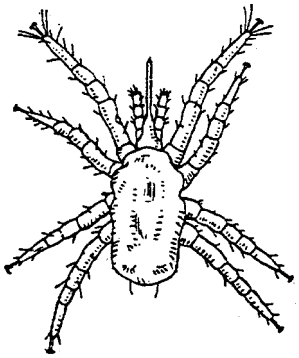
The ticks feeding may cause the birds to be restless while roosting. Red spots may be seen on the skin where ticks have fed.

Control

Control is gained by cleaning the poultry houses, spraying pesticide in the poultry houses, and by spraying or dusting the birds.

CHICKEN (RED) MITE

The most common mite in poultry is the chicken or red mite, which feeds on blood during the night and hides in cracks of the house during the day. Another common mite is the northern fowl mite, which spends all of its life on the bird.



Chicken mite
Order Acarina
Length, 1/30 inch
Unfed nymph; adult, nymph troublesome poultry pests; lays eggs in cracks of roosts, nests.

Infested birds develop skin irritation and anemia. If not controlled, dense mite populations may reduce weight gains and egg production or cause death.

Mite infestations are transferred from bird to bird. They sometimes are a result of invasion of poultry houses by wild birds. Other means are infested feathers, poultry-handling equipment and flats; manure; and workers' and poultry feet.

Control

Control the chicken (red) mite by spraying pesticide into the cracks and crevices of the poultry house. For control of northern fowl mites, spray the pesticide directly on the birds. Retreatment may be required for effective control.

CHIGGERS AND FLEAS

Chiggers and sticktight fleas can be a problem on turkeys and chickens that are on the ground.

Control

Apply pesticides to the ground as sprays or dusts. Repeated applications may be necessary.

ANIMAL PREDATORS

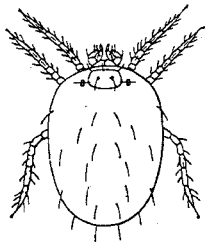
A variety of large and small predators can attack livestock and poultry. Some of the more noted ones are coyotes, skunks, weasels, foxes and others.

Livestock and poultry may be injured or killed under the following conditions:

- **!** By direct predator attack.
- **!** As a result of stampeding when frightened by a predator.
- **!** By predator-transmitted diseases.

Control

Predator controls consist mainly of trapping, shooting, poisoning, and correct livestock and poultry management. Control of some species and certain control methods are regulated by state and federal laws. You must know and follow appropriate regulations. Be sure you correctly identify the predator causing damage.



Chigger
Order Acarina
Length, 1/50 inch
Orange-yellow, feeds on flea
man and many animals;
lives in grass and poultry,
underbrush
stays
periods.

Sticktight flea
Order Siphonaptera
Length 1/4 inch
Southern chicken
found in dense masses
around head of
sometimes animals;
on host for long

PESTICIDE SAFETY AND USE

The management of livestock pests is important to the modern livestock producer. Choosing the proper preventive and control practices contributes to efficient livestock and poultry production and provides wholesome products to the consumer.

PESTICIDE TOXICITY

Pesticides can protect animals from pests, but they may be toxic to the animals being treated as well as to the pests. Apply them correctly to prevent adverse effects. Animals may be sensitive to certain pesticides.

Poisoning signs usually include excessive:

- **!** Salivation
- **!** Defecation

- ! Urination
- ! Muscle-twitching

DON'T treat animals that are under stress. Be careful not to overdose young or smaller animals. When planning a pesticide application, choose the pesticide that has the least risk of adverse effects and that will give good control.

RESTRICTIONS/WARNINGS

1. Before applying any livestock insecticide, read the label until you completely understand it. Then follow the directions on the label.
2. Note and obey treatment-slaughter intervals for each insecticide to avoid illegal residues.
3. For each insecticide, note and follow treatment restrictions concerning application on young, sick or stressed animals and poultry, or treatment in conjunction with other medications.
4. Note and follow treatment-cutoff periods.
5. Be aware that these insecticides are poisonous; they can be fatal if swallowed and harmful if inhaled or absorbed through the skin. Avoid skin contact. Don't contaminate food, feeds or water. If they are spilled on skin, wash immediately with soap and water. If symptoms of poisoning develop, see a physician immediately.
6. Keep insecticides away from children and pets. Store in original container in locked storage area.

INSECTICIDE USE

PRECAUTIONS

Insecticides must be handled with care, because most are toxic to humans and animals as well as to insects. When it becomes necessary to use an insecticide, you should be read and understand the label of the appropriate formulation. Be sure the formulation is approved for your intended use. Some insecticide formulations are for crop use only and not for use on livestock.

Before using the insecticide, thoroughly familiarize yourself with safe handling procedures; symptoms of poisoning, if any; and what to do in case of an accident.

Apply the insecticide in a manner consistent with directions on the insecticide label. If the compound isn't ready to use, then it must be diluted to give the correct concentration. Prepare only as much dilute material as you need at one time.

Observe label precautions regarding treatment of animals that, for reasons of health, age, condition or breed, may be adversely affected by the treatment. Also, observe precautions concerning use in conjunction with other insecticides or with medications.

Observe the required time interval between treatment and slaughter of animals. The purpose of this waiting period is to avoid residue levels that may exceed established tolerances.

INSECTICIDE FORMULATIONS

Several different kinds of insecticides formulations are available. Some, such as dusts or oil solutions, are ready to use directly from the original container, while others, such as wettable powders (WP) and emulsifiable concentrates (EC), must be diluted before application. Wettable powders are dry concentrates that are formulated with wetting agents so they will disperse in water. Agitation of the diluted material is necessary to keep the insecticide in suspension. Emulsifiable-concentrate insecticides also contain a high percentage of active ingredient and must be diluted prior to use.

PREPARATION OF CORRECT INSECTICIDE CONCENTRATION

Preparation of the correct concentration of insecticide is essential for successful control. Errors in determining the quantity of the insecticide concentrate that must be mixed with water or oil can result in the use of excess

toxicant that is costly and it may also lead to toxicity or residue problems. The concentration of insecticide in wettable powders or emulsifiable concentrates is expressed on the label.

The concentration of a wettable powder expressed as a percentage -- for example, 25 percent malathion wettable powder. The concentration of an emulsified concentrate may be expressed as percent active ingredient or pounds of active ingredient per gallon of concentrate. For example, 11.6 percent Co-Ralc emulsifiable concentrate contains one pound of coumaphos per gallon.

The problem of determining the quantity of wettable powder or emulsifiable concentrate that will be needed to prepare a certain volume of dilute spray or dip liquid can be solved rather easily with the help of either a dilution table or a formula, as presented below.

FORMULAS

Emulsifiable concentrate: Two different formulas can be used to determine the amount of emulsifiable concentrate needed to prepare a spray or dip containing a given percentage of active ingredient.

In the first, the concentration is expressed as pounds of active ingredient per gallon. In the second, the concentration is expressed as percent active ingredient.

$$\frac{\text{Gal. spray wanted} \times \text{\% active ingredient wanted} \times (8.3)}{\text{lb. active ingredient/gal. of concentrate} \times (100)}$$

OR

$$\frac{\text{\% active ingredient in concentrate}}{\text{\% active ingredient wanted}} = \text{Number of parts of finished spray that must contain one part of the concentrate}$$

For example:

How many gallons of 11.6 percent coumaphos (1 lb./gal.) of emulsifiable concentrate are needed to make 100 gallons of spray containing 0.25 percent coumaphos?

Using 1 lb. active ingredient/gal.:

$$\frac{(100) \times (0.25) \times (8.3)}{(1) \times (100)} = 2 \text{ gal.}$$

OR

Using 11.6 percent active ingredient:

$$\frac{11.6\%}{0.25\%} = 46.4$$

The dilution is one part 11.6 percent coumaphos in 46 parts of finished spray or dip. This would be equivalent to 1 gallon of 11.6 percent coumaphos to 46 gallons of water.

Wettable powders: The following formula is used to determine the number of pounds of wettable powder needed to prepare a spray or dip containing a given percentage of active ingredient.

$$\frac{\text{Gal. spray wanted} \times \text{\% active ingredient wanted} \times (8.3)}{\text{(\% active ingredient in WP)}}$$

For example:

How many pounds of coumaphos 25 percent wettable powder are needed to make 100 gallons of spray containing 0.03% coumaphos?

$$\frac{(100) \times (0.03) \times (8.3)}{25} = 1 \text{ lb.}$$

ANIMAL SYSTEMIC INSECTICIDES

Some of the organophosphate insecticides that are used to control pests of beef cattle are systemically active.

That is, they are absorbed and transported through the animal's body by its circulatory system. These compounds can be used for the control of several internal and external insect pests. These are not the same as "plant-systemic" insecticides and must not be confused with them.

METHODS OF INSECTICIDE APPLICATION

Application techniques commonly used in the control of several different pests are discussed here. More specific information is presented later, along with the individual pests. The purpose is to familiarize the reader with common application techniques and terminology.

DILUTE SPRAY

This is a common method for applying diluted insecticides to livestock. Liquid insecticide is applied by means of a livestock sprayer. The use of high pressure, about 350 pounds per square inch (p.s.i.), is important in the use of systemic-type insecticides because wetting of the skin is necessary. Lower pressures of 100 p.s.i. or less may be used to control those pests where merely wetting of the haircoat is necessary. Several animals may be sprayed at a time by working them back and forth in a small pen.

A spray gun that permits a variable spray pattern is useful. A narrow spray-stream may be necessary under windy conditions or to penetrate a dense haircoat. It’s important to calibrate the sprayer. Determine the delivery in gallons per minute for the particular disc in the spray gun (usually a number 4, 5 or 6) and the pressure.

The amount of spray per animal will vary with size of animal and thickness of haircoat due to time of year. For thorough coverage of cattle in the winter, 1-1/2 to three gallons of spray per cow and one to two gallons per calf may be required.

MIST SPRAY

An electric or hand-operated "mister" may be used to apply small amounts of relatively concentrated insecticide spray to an animal. A large nozzle opening is desirable for a coarse spray that will adhere to the haircoat of an animal. Mist applicators are also used for application of space sprays as discussed below.

COMPRESSED-AIR SPRAY

An easy method of spraying a few animals is with a hand-powered compressed-air sprayer. These sprayers make little noise and don’t frighten animals.

They are also handy for spot-treatment of surfaces such as walls and posts where flies tend to concentrate.

RESIDUAL WALL SPRAY

Wall sprays are applied at low pressure, such as 80 p.s.i., to produce a coarse spray. The spray may be applied to fences, ceilings, and inside and outside walls of buildings. Usually animals should be removed from buildings before spraying, and one should avoid spraying feed and water.

SPACE SPRAYS OR AEROSOLS

This is a method for quickly clearing spaces of flying insects. A machine is used that produces a fine, direct mist or fog that remains suspended in the air for several hours. Usually the application is most effective indoors and must be repeated daily.

DIP VATS

Dipping is an excellent method for getting thorough coverage. Two popular types of dip vats are the swim vat and the cage vat. The dip-vat method requires a relatively large initial expenditure for construction and materials as well as chemicals. However, there is no faster or more thorough way of treating large numbers of animals. Use of a community dip vat is a good way to reduce the cost to individual ranchers.

The dip vat may be located near a convenient water source, but care should be taken to avoid a location where contamination of streams, ponds, or other water sources might occur.

Prior to filling, a dip vat should be cleaned thoroughly. All liquid, as well as solid material on the bottom of the vat, should be removed and properly discarded. Check with regulatory or extension personnel for current regulations concerning proper disposal.

The vat should be filled or charged immediately prior to dipping. The volume of the vat should be figured before charging. This can be determined by pouring water into the vat from a measured drum or tank, by metering the water into the vat, or -- if the dimensions of the vat are known -- calculating the volume.

Both emulsifiable-concentrate and wettable-powder formulations should be suspended in water in a pre-mix tank before being added to the water in the vat. If a vat is to be replenished during dipping, it's advisable to situate a tank or drum adjacent to the vat. It should empty directly into the vat. This container can also be used in preparing the initial charge.

After filling or recharging the vat, the contents should be mixed thoroughly. Also, provisions must be made for mechanical agitation of the vat to insure complete resuspension of the contents after periods of non-use. Compressed air or plunger-boards may be used for this purpose. A plunger-board is a board about 18 inches square with one-inch holes drilled on three- inch centers. An up-and-down plunger action with this mechanism for about 15 minutes will sufficiently agitate the contents of most vats.

BACKRUBBER

The backrubber is an inexpensive and effective self-treatment device for cattle. It consists of a 15- to 20-foot length of cable, chain, or heavy wire around which several layers of burlap are wrapped. The backrubber is then suspended between two posts so it sags to about 18 to 24 inches from the ground at the center.

The backrubber is placed in an area where cattle loaf, for example, near water or a salt lick. The selected insecticide should be mixed with No. 2 diesel fuel, furnace oil, or a commercial preparation, then applied to the burlap at the rate of one gallon for each 20 linear feet. The backrubber should be recharged often to keep it moist and effective.

POUR-ON

The pour-on is a quick and simple method of applying insecticides to cattle. The method was originally developed for application of animal systemics for grub control. Now it's used with some non-systemic insecticides also. The pour-on solution, either an oil solution or a water emulsion, is poured evenly from a calibrated dipper along the animal's back so that none of the liquid drips off.

Usually, the application rate is between one-half and one ounce per hundred pounds of body weight. Some newer formulations, designed for cattle grub or lice control, are applied in even smaller volumes and require special application devices.

DUST

A small number of animals may be individually treated with insecticide dust. The dust may be applied by shaker can or other means, then worked into the haircoat.

DUST BAGS

Dust bags are heavy (ten-ounce cloth) burlap sacks that are filled with an approved insecticide dust and suspended below backline height in outdoor areas where cattle are likely to pass. When an animal bumps or rubs against the bag, a small quantity of dust sifts through the fabric.

Ready-made dust bags can be bought. These generally consist of a grommeted burlap sack with a plastic hood to protect the bag from rain. A much less expensive way is to buy heavy burlap sacks and insecticide dust separately.

Stop! All pesticides can be harmful to health and the environment if misused. Read the label carefully and use only as directed.

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1. Dilution tables: To prepare a spray with a desired percentage of active material, only the formulation need be known to use the table. The top figure in each box represents the amount of pesticide formulation for each gallon of water, and the bottom figure in each box represents the amount of pesticide formulation for each 100 gallons of water.

As an example, a 0.25 percent concentration of coumaphos (Co-Ral) is recommended for cattle-grub control. To make a 0.25 percent spray using a 25 percent wettable powder (WP), mix eight pounds of coumaphos in 100 gallons of water. For the same percentage in one gallon of water, use 12 teaspoons.

CHOOSING A PESTICIDE

Since the approved use of pesticides is subject to change, only general information about commonly used pesticides are given in this study guide.

REMEMBER:

- **!** Before you select a pesticide, get a positive identification of your target pest(s).
- **!** Before you buy the pesticide, read the label to be sure it's the correct chemical for your problem.
- **!** Before you get to involved, be sure of your information. Contact such people as the USU Extension Service or the Utah Department of Agriculture and Food for professional advice.

THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA) was passed by Congress to protect certain plants and wildlife that are in danger of becoming extinct. This act requires EPA to ensure that these species are protected from pesticides.

Formulation of the Utah Threatened and Endangered Species/Pesticides Plan is a cooperative effort between federal, state, and private agencies and producers/user groups, and is a basis for continuing future efforts to protect threatened and endangered species from pesticides whenever possible. Furthermore, this plan provides agencies direction for management policies, regulations, enforcement and implementation of threatened and endangered species/pesticide strategies.

EPA has therefore launched a major new initiative known as the Endangered Species Labeling Project. The aim is to remove or reduce the threat to threatened and endangered species from pesticide poisoning. EPA has the responsibility to protect wildlife and the environment against hazards posed by pesticides. The ESA is administered by the U.S. Fish and Wildlife Service (FWS) in the U.S. Department of Interior. The Fish and Wildlife Service will determine jeopardy to threatened and endangered species and report to EPA. EPA and FWS will work cooperatively to ensure that there is consistency in their responses to pesticide users and to provide necessary information. The Utah Department of Agriculture and Food is acting under the direction and authority of EPA to carry out the ESA as it relates to the use of pesticides in Utah.

Maps will show the boundaries of all threatened and endangered species habitats in affected counties. The maps identify exactly where, in listed counties, use of active ingredients in certain pesticides is limited or prohibited. Product labels will be updated as necessary. The updated labels will reflect any additions or deletions to the project. Because EPA's approach to the protection of threatened and endangered species was in the proposal phase at the time this guide was published, any and all of the above information on threatened and endangered species is subject to change and may not be valid.

WORKER PROTECTION STANDARDS

This final rule, which was proposed in 1988 and that substantially revised standards first established in 1974, affects 3.9 million people whose jobs involve exposure to agricultural pesticides used on plants; people employed on the nation’s farms; and in forests, nurseries and greenhouses. The standard reduces pesticide risks to agricultural workers and pesticide handlers. The standard is enforceable on all pesticides with the Worker Protection Standard labeling. The provisions became fully enforceable in January 1995.

Agricultural workers in Utah now have a far greater opportunity to protect themselves, their families and others. These workers will know, often for the first time, when they are working in the presence of toxic pesticides, understand the nature of the risks these chemicals present, and get basic safety instructions.

Among the provisions of the rule are requirements that employers provide handlers and workers with ample water, soap and towels for washing and decontamination and that emergency transportation be made available in the event of a pesticide poisoning or injury. The rule also establishes restricted-entry intervals -- specific time periods when worker entry is restricted following pesticide application -- and requires personal protection equipment (PPE) for all pesticides used on farms or in forests, greenhouses and nurseries. Some pesticide products already carry restricted re-entry intervals and personal protection equipment requirements; this rule raised the level of protection and requirements for all products.

Other major provisions require that employers inform workers and handlers about pesticide hazards through safety training, which handlers have easy access to pesticide-label safety information, and that a listing of pesticide treatments is centrally located at the agricultural facility. Finally, handlers are prohibited from applying a pesticide in a way that could expose workers or other people.

GROUNDWATER CONTAMINATION BY PESTICIDES

Utah has implemented a comprehensive and coordinated approach to protect groundwater from pesticide contamination.

Formulation of the Groundwater/Pesticide State Management Plan is a cooperative effort between federal, state, and private agencies and producers/user groups; it provides a basis for continuing future efforts to protect groundwater from contamination whenever possible. Furthermore, this plan provides agencies with direction for management policies, regulations, enforcement and implementation of groundwater strategies.

While it's recognized that the responsible and wise use of pesticides can have a positive economic impact, yield a higher quality of crops, enhance outdoor activities, and give relief from annoying pests, the Utah Department of Agriculture and Food is authorized by the U.S. Environmental Protection Agency (EPA) to enforce the protection of groundwater from pesticides. Product labels will be updated as necessary.

The Utah Department of Agriculture and Food, in concert with cooperating agencies and entities, admonishes strict compliance with all pesticide labels, handling procedures and usage to protect groundwater in the state.

Groundwater can be affected by what we do to our land. Prevention of groundwater contamination is important, because once the water is polluted, it's very hard and costly to clean up. In some instances, it's impossible, especially if it's deep underground. City and urban areas especially contribute to pollution because water runoff that contains pesticides runs into drainage tunnels, then into a river or an underground stream that drains into the river. For more complete information about what groundwater is and where it comes from, read the study manual "Applying Pesticides Correctly."

Shallow aquifers or water tables are more susceptible to contamination than deeper aquifers. Sandy soils allow more pollution than clay or organic soils, because clays and organic matter absorb many of the contaminants.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, establishes a policy for determining the acceptability of a pesticide use or the continuation of that use, according to a risk/benefit assessment. As long as benefits outweigh adverse effects, a pesticide can be registered by the EPA. Although the intent of a pesticide application is to apply the pesticide to the target or pest, part of the pesticide will fall on the area around the target or pest. Rain or irrigation water then can pick up the part that isn't degraded or broken down and carry it to the groundwater via leaching.

The major factors that influence the amount of contamination that can get into water are the chemicals' persistence in soil, retention time or time it remains in the soil, the soil type, the time and frequency of the application(s), soil moisture, placement of the pesticide, and the ability of the chemical to persist once in the aquatic environment. Each of these factors will influence the amount of pesticide that can leave the root zone or soil surface and percolate to groundwater.

Although some pesticides may have a high absorption quality, when they are applied to sandy soil, they will still migrate to the water table because there are no fine clay particles or organic matter to hold them. The management and use of pesticides is up to the individual applicator and/or land owner as to whether safe practices are used. Water is one of our most valuable resources; we must keep it as pure as possible.

CALIBRATION INFORMATION

Conversion:

Units

One acre = 43,560 square feet	Example: ½ acre = 21,780 square feet
One mile = 5,280 feet	Example: ¼ mile = 1320 feet
One gallon = 128 fluid ounces	Example: ½ gallon = 64 fluid ounces
One quart = 2 pints = 4 cups = 32 fluid ounces	Example: 2 quarts = 64 fluid ounces
One pint = 2 cups = 16 fluid ounces	Example: ½ pint = 1 cup = 8 fluid ounces
One tablespoon = 3 teaspoons = 0.5 fluid ounces	Example: 2 tablespoons = 1 fluid ounce
One pound = 16 ounces	Example: ¼ pound = 4 ounces
One gallon = 231 cubic inches	Example: 2 gallons = 462 cubic inches

Weight

1 ounce = 28.35 grams
16 ounces = 1 pound = 453.59 grams
1 gallon water = 8.34 pounds = 3.785 liters = 3.78 kilograms

Liquid Measure

1 fluid ounce = 2 tablespoons = 29.573 milliliters
16 fluid ounces = 1 pint = 0.473 liters
2 pints = 1 quart = 0.946 liters
8 pints = 4 quarts = 1 gallon = 3.785 liters

Length

1 foot = 30.48 centimeters
3 feet = 1 yard = 0.9144 meters
16 1/2 feet = 1 rod = 5.029 meters
5280 feet = 320 rods = 1 mile = 1.6 kilometers

Area

1 square foot = 929.03 square centimeters
9 square feet = 1 square yard = 0.836 square meters
43560 square feet = 160 square rods = 1 acre = 0.405 hectares

Speed

1.466 feet per second = 88 feet per minute = 1 mph = 1.6 kilometers per hour (kph)

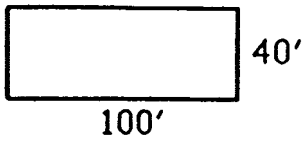
Volume

27 cubic feet = 1 cubic yard = 0.765 cubic meters
1 cubic foot = 7.5 gallons = 28.317 cubic decimeters

Area and Volume Calculations:

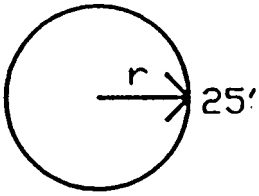
Area of Rectangular or Square Shapes

The area of a rectangle is found by multiplying the length (L) times the width (W).
(Length) x (Width) = Area
Example: (100 feet) x (40 feet) = 4000 square feet



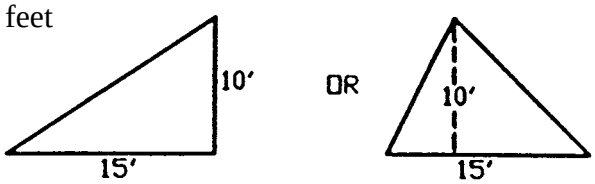
Area of Circles

The area of a circle is the radius (radius = one-half the diameter), times the radius, times 3.14.
(radius) x (radius) x (3.14) = Area
Example: (25 feet) x (25 feet) x (3.14) = 1962.5 square feet



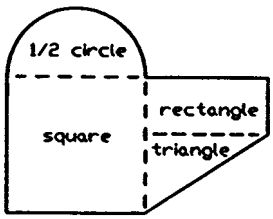
Area of Triangular Shapes

To find the area of a triangle, multiply ½ times the width of the triangle's base, times the height of the triangle.
(½) x (base width) x (height) = Area
Example: (½) x (15 feet) x (10 feet) = 75 square feet

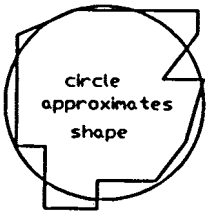


Area of Irregular Shapes

Irregularly shaped sites can often be reduced to a combination of rectangles, circles, and triangles. Calculate the area of each shape and add the values together to obtain the total area.
Example: Calculate the area of the rectangle, triangle, square, and one-half of a circle.

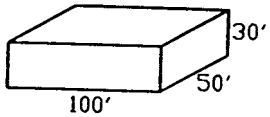


Another method is to convert the site into a circle. From a center point, measure the distance to the edge of the area in 10 or more increments. Average these measurements to find the radius, then calculate the area using the formula for a circle.
Example: Approximate the area by calculating the area of a similarly sized circle.



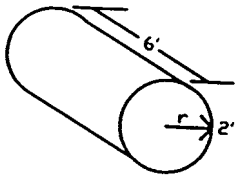
Volume of Cube and Box Shapes
The volume of a cube or box is found by multiplying the length, times the width, times the height.
(Length) x (Width) x (Height) = Volume

Example: (100 feet) x (50 feet) x (30 feet) = 150,000 cubic feet



Volume of Cylindrical Shapes
The volume of a cylinder is found by calculating the area of the round end (see formula for circle) and multiplying this area times the length or height.

Example: (radius) x (radius) x (3.14) = Area of Circle
(Area of Circle) x (Length) = Volume of Cylinder
(2 feet) x (2 feet) x (3.14) x (6 feet) = 75.36 cubic feet



Sprayer Calibration Formulas:

To Calculate Travel Speed in Miles Per Hour
The travel speed of a sprayer is determined by measuring the time (seconds) required to travel a know distance (such as 200 feet). Insert the values in the following formula to determine the miles per hour.

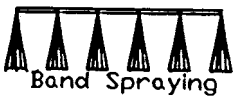
$$\frac{\text{Distance in Feet x 60}}{\text{Time in Seconds x 88}} = \text{Miles Per Hour}$$

Example: $\frac{\text{(200 feet) x (60)}}{\text{(30 seconds) x (88)}} = \frac{12{,}000}{2640} = 4.55$ mph

To Calculate the Gallons Per Minute Applied During Broadcast Spraying
The application rate in gallons per minute (GPM) for each nozzle is calculated by multiplying the gallons per acre (GPA), times the miles per hour (MPH), times the nozzle spacing in inches (W); then dividing the answer by 5940. For small adjustments in GPM sprayed, operating pressure is changed. For large adjustments in GPM sprayed, travel speed (miles per hour) is changed or nozzle size is changed.

$$\frac{\text{GPA x MPH x W}}{5940} = \text{GPM}$$

Example: $\frac{\text{(12 GPA) x (4.5 MPH) x (24”)}}{5940} = \frac{1296}{5940} = 0.22$ GPM



To Calculate the Gallons Per Minute Applied During Band Spraying
Broadcast spraying applies chemicals to the entire area. Band spraying reduces the amount of area and chemicals sprayed per acre. To use the above formulas for band sprayer applications, use the band width (measured in inches) rather than nozzle spacing for the “W” value.

Pesticide Mixing:

Terminology

The ***active ingredients*** of a pesticide are the chemicals in a formulation that control the target pests. The ***formulation*** is the pesticide product as sold, usually a mixture of concentrated active ingredients and an inert material. Restricted use pesticides are purchased in formulations requiring ***dilution prior to application***. Formulations are diluted with inert substances such as water. The ***percentage of active ingredients*** in a pesticide formulation directly affects dilution and application rates. Given two pesticides, A = 50% active ingredients, B = 100% active ingredients; twice as much pesticide A formulation is required to equal pesticide B formulation.

To Determine the Total Amount of Pesticide Formulation Required Per Tank

To calculate the total amount of pesticide formulation needed per spray tank, multiply the recommended dilution, ounces/pints/cups/teaspoons/tablespoons/etc. of pesticide per gallon of liquid, times the total number of gallons to be mixed in the sprayer. A full or partial tank of pesticide spray may be mixed.

(Dilution Per Gallon) x (Number of Gallons Mixed) = Required Amount of Pesticide Formulation Example: (3 ounces per gallon) x (75 gallons) = 225 ounces

Note: 1 gallon = 128 ounces; through unit conversion 225 ounces = 1.76 gallons

To Calculate the Amount of Pesticide Formulation Sprayed Per Acre

The calculate the total amount of pesticide formulation sprayed per acre is determined by multiplying the quantity of formulation (ounces/pounds/pints/cups/teaspoons/tablespoons/etc.) mixed per gallon of water, times the number of gallons sprayed per acre.

(Quantity of Formulation Per Gallon) x (Gallons Sprayed Per Acre) = Formulation Sprayed Per Acre

Example: (1/2 pound per gallon) x (12 gallons per acre) = 6 pounds per acre

To Calculate the Amount of Active Ingredients Sprayed Per Acre

To calculate the total amount of active ingredients (AI) applied per acre, multiply the amount (pounds, gallons, ounces, etc) of pesticide formulation required per acre, times the percentage of active ingredients in the formulation (100%, 75%, 50%, 25%, etc.), and divide the value by 100.

$$\frac{\text{(Amount of Formulation Required Per Acre) x (Percentage of AI)}}{100} = \text{Active Ingredients Per Acre}$$

Example: $\frac{\text{(4 pounds formulation sprayed per acre) x (75\% AI)}}{100}$ = 3 pounds of AI sprayed per acre

Note: 75 % = 0.75

To Calculate the Gallons of Pesticide Mixture Sprayed Per Acre

The calculate the total amount of pesticide mixture sprayed per acre is determined by dividing the number of gallons sprayed by the number of acres sprayed.

$$\frac{\text{Gallons Sprayed}}{\text{Acres Sprayed}} = \text{Gallons Sprayed Per Acre}$$

Example: $\frac{\text{200 Gallons Sprayed}}{\text{10 Acres Sprayed}}$ = 20 gallons of pesticide mixture sprayed per acre