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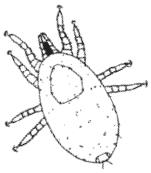
Poultry Pest Management



Poultry Pest Management

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The poultry industry contributes about $1.6 billion each year to the Texas economy, including the production of more than 627 million broilers and about 4.7 billion table eggs in 2005. In 2003, the U.S. Department of Agriculture ranked Texas sixth in the nation in broiler production and seventh in egg production.

One of the largest management problems facing poultry producers is pest control. Poultry operations can be infested by flies, mites, lice, bed bugs, fleas, beetles, red imported fire ants, chiggers and gnats. But by implementing integrated pest control measures, producers can minimize the damage from these pests.

For specific suggestions on products to consider for suppression of these pests, see Tables 1 and 2 (page 14).

Flies

The shift from many small farm flocks to fewer large poultry operations has greatly increased fly problems by creating concentrated breeding areas and large amounts of waste that are costly to be removed often. As more people move to rural areas, poultry producers face increasing pressures to reduce fly populations. Populations of manure-breeding flies may cause a public health nuisance, resulting in poor community relations and threats of litigation. To achieve an acceptable level of fly control, a dedicated effort is necessary.

Several kinds of flies are common in and around caged layer houses in Texas. Probably the most common flies are the house fly and the little house fly. About 95 percent of problems involve the house fly. Both of these fly species can move up to 20 miles from the site of development, but they normally fly no more than a mile or two from the initial source.

House flies, *Musca domestica*, are about 1/2 inch long. They breed in moist, decaying plant material, including refuse, spilled grains and spilled feed and in all kinds of manure. For this reason, house flies are more likely to be a problem around poultry houses where sanitation is poor. Adult house flies prefer sunlight and are very active, crawling over filth, people and food products.

This fly is the most important species because it can carry and spread human and poultry disease agents and leave fly specks on eggs. For example, the house fly is the intermediate host for the common tapeworm in chickens, and it has been implicated in the transmission of several viral and bacterial pathogens of people and animals.

The **little house fly**, *Fannia canicularis*, is somewhat smaller than the house fly, about 3/16 inch long. This fly prefers a less moist medium for breeding and reproduction than does the house fly. The little house fly chooses poultry manure over most other media for egg laying.

The adult fly also prefers shade and cooler temperatures and is often seen circling aimlessly under hanging objects in the poultry house, egg room and feed room. Large numbers of the flies may also hover in nearby garages, breezeways and homes, which offer shade and protection from wind.

Although the little house fly is less likely to crawl on people and food, it does spark complaints about fly problems from people living near poultry establishments, and it may surpass the house fly in its ability to cause nuisance to nearby homeowners.

The **black garbage fly**, *Hydrotea ignava*, is shiny bronze-black and slightly smaller than the house fly. The wings are held straight back. This fly tends to remain on its food source at night rather than resting on the ceiling or on outdoor vegetation, as does the house fly. The female fly does not seem to fly great distances, but it has been found about 5 miles from its breeding area.

Although black garbage fly larvae have been known to exterminate house fly populations, they should not be considered entirely beneficial because these flies also can build large

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populations on the farm and fly to nearby communities.

All stages are found throughout the year under suitable conditions, and they can tolerate cold weather. The life cycle is similar to that of the house fly.

Blow flies, sometimes known as green or blue bottle flies, are slightly larger than house flies and sometimes live in poultry houses. These flies may be green, blue or nearly black, which makes for easy identification.

Blow flies prefer to breed and reproduce in decaying animal and bird carcasses, dog manure, broken eggs and wet garbage. Generally, a good sanitation program and rapid mortality processing will hold these flies in check.

Other flies found on the poultry establishment include **soldier flies, small dung flies, fruit flies, and rat-tailed maggots**.

Fly biology

To control flies most effectively, at the lowest cost and with the least harm to the environment, it helps to understand their biological life cycle. All flies develop through four life stages: egg, larva, pupa and adult.

Most adult flies lay small, white, oval eggs on the breeding medium. Creamy white larvae (maggots) develop in the moist materials. Mature maggots crawl out of this material and move to a drier place for the pupal stage. The brown, seed-like pupae finally yield adult flies.

Development from egg to adult fly may take just 7 to 10 days under the ideal conditions often present in poultry manure pits.

Cultural control

The most effective way to control flies is by manure management. As many as 1,000 house flies can complete development in 1 pound of breeding material. Fresh poultry manure contains 75 to 80 percent moisture, which makes it ideal for fly breeding.

You can practically eliminate fly breeding in this material by reducing the moisture content to 30 percent or less. Drying manure is preferred because once dried it will occupy less space, usually has less odor and is more easily transported off site. Also, high-moisture manure often results in high black garbage fly populations.

Dry manure management

To prevent fly breeding, remove the manure often, at least twice a week. This breaks the breeding life cycle. It is important to scatter the manure in thin layers outdoors to kill the eggs and larvae by drying them. Avoid piles or clumps of manure.

You must have access to enough land so the manure can be spread thinly; this keeps excessive amounts of nutrients from building up in the soil. Spread it at an agronomic rate for your area.

If the manure is stored in-house, it must be dried to a 30 percent moisture level and be maintained at this level. Dry manure can be held for several years. Any practice that limits moisture in the droppings or aids in rapid drying is important for fly control.

Water management

To control flies, it is vital that you lower the water content of the manure. Follow these steps to minimize water content:

- Prevent leaks in water troughs or cups. Regulating water flow to an on/off cycle may help eliminate moisture problems. Assign an employee to walk the manure pit daily to check for leaks.
- Provide abundant cross-ventilation beneath the cages, especially during hot weather. Using 36-inch pit fans blowing across the manure can be very effective. Place a curtain above the manure every 100 feet to help keep the air moving over the manure. Adequate house ventilation is important at all times.
- If the water table in your area is high or if there is a danger of water running into the house from the outside, adjust the floor grade so that the house floor is higher than the outside surrounding ground. Direct surface water away from the building. Drain and fill all low areas around the houses.
- Prevent dysentery by keeping the water clean. If dysentery develops, use recommended antibiotics.
- Prevent excessively high house temperatures, which encourage the chickens to drink abnormal amounts of water.
- Practice good husbandry by restricting excess water consumption but not to the point of reducing egg lay.

- If your resources allow it, consider adopting a new housing system designed to dry the manure in the pits.

Sanitation

The most important aid in successful fly control is sanitation. Often, certain conditions in and around the poultry operation will encourage fly outbreaks. These must be eliminated.

To improve sanitation:

- Quickly remove and dispose of dead birds and broken eggs. Dispose of them far from the poultry premises by burning them in an incinerator or by using another approved management method.
- Immediately clean up and dispose of feed spills and manure spills, especially if they are wet.
- Clean out weed-choked water drainage ditches.
- Install proper eave troughs and downspouts on poultry houses to carry rainwater far from the buildings. Provide proper drainage in the poultry yards.
- Minimize the migration of flies from other fly-infested animal operations close to the poultry house.

Biological control

Entomologists encourage the use of biological control in poultry houses. If you are considering biological control for your operation, be sure to buy beneficial insects (also called "beneficials") that are adapted to the climate in your area and apply them as directed by the supplier. Neither the suppliers nor Texas Cooperative Extension guarantee success for implementation of biological control efforts, particularly when initiated after the appearance of high fly populations.

These beneficials are fly parasitoids, actually very tiny wasps, and are the naturally occurring enemies of manure-breeding flies. They kill flies in the pupal stage.

One species, *Spalangia nigroaenea*, is about the size of the head of a house fly (1/16 to 1/8 inch) and lives in the manure. An adult female wasp lays an egg on the fly pupa within the puparium (the hard, brown case containing the fly pupa). Then the developing wasp larva consumes the pupa and emerges as an adult.

These fly parasitoids are specific to flies and attack nothing else. They do not bite or sting people or birds and usually go unnoticed by those living near poultry operations. They self-propagate in the process of controlling pest flies.

However, mass releases are usually needed. Also, the wasp lays fewer eggs than does a fly over the same period, making it necessary to start with an initial wasp release and follow up with supplemental releases weekly. Release these wasps before and during the fly season until control is achieved. Under proper management, suppression occurs in 10 to 20 weeks.

Whenever you use beneficial insects, be very careful when applying insecticides. Minimize chemical sprays where these wasps are released. And never treat the entire manure surface with insecticides, except for cyromazine (Larvadex®); otherwise, the beneficial insects as well as the pest flies will be killed.

To use chemicals without killing all the beneficials, spot-treat the manure where the fly larvae are concentrated, and apply pesticides to fly-resting sites, such as walls and structural posts.

You can improve the chances of successful biological control with these wasps by following a strict sanitation program of manure management, water management and weed mowing. Keep the manure dry because wet manure promotes fly breeding and inhibits beneficial insect breeding.

Other beneficials in poultry manure include mites and beetles, according to *Pest Management Recommendations for Poultry*, a publication by Cornell University and Penn State Cooperative Extension. Mites and beetles are major predators in caged-layer operations.

The macrochelid mite, *Macrochelis muscaedomesticae*, is reddish brown and less than 1/16 inch long. It feeds on house fly eggs and first-instar (or first-stage) larvae. Found on the outside layer of manure, this mite can consume up to 20 house fly eggs a day.

Another mite, the uropodid mite, *Fuscuropoda vegetans*, feeds only on first-instar house fly larvae deeper in the manure. Both species occur naturally in most poultry facilities.

A hister beetle, *Carcinops pumilio*, is black and about 1/8 inch long. It feeds on house fly eggs and first-instar larvae. Common in both broiler and layer houses, it can consume 13 to 24 house fly eggs per day. Both adult and immature hister beetles live in the surface layers of manure.

Another hister beetle, *Gnathoncus nanus*, is present at lower numbers on poultry farms.

In Texas, the use of fly parasitoids for biological control may reduce the chemical residues for people, birds, eggs and the environment. However, to date, claims that wasps can provide long-term fly control have not always been backed by scientific research results.

Biological control methods are more effective if the manure is kept dry. Leave accumulations of poultry manure undisturbed over long periods to support large populations of native fly parasitoids and fly predators (beetles and mites). Be sure to encourage the native strains of beneficials already present in the dry manure to populate.

Remove manure only during the fly-free time of the year, minimize residual insecticide sprays (residual insecticides leave a residue that remains effective for some time after application) in the manure pits and use pyrethrin sprays as a first option for adult fly knockdown.

Mechanical control

Many types and styles of fly traps are available, including sticky fly strips, funnel-type traps and "fly zappers," which use black lights with electrically charged grids to kill the insects. Some traps are baited with a fly attractant material.

Traps appear to help as a preventive measure in tight, enclosed areas such as egg rooms where there is no breeding fly population and where good sanitation practices are followed. However, in areas of heavy fly populations, traps do not reduce fly numbers to satisfactory levels. When used, traps operate during the night, away from doors and windows.

One should judge a trap by the population of flies remaining in the area and not by the number of flies caught in the trap. Most entomologists believe that fly traps used alone are ineffective in controlling flies, especially in and around livestock and poultry operations.

In sensitive areas, a fan might be used to blow air through a screened doorway from the egg room or other work area into the main poultry house. Flies will not move against the wind into the egg room or other work area. Commercial electric-powered air curtain fans are available. However, certain state health department may require solid doors between the egg room or other main work areas and the main poultry house.

Surveillance

To make informed control decisions, it is important that you monitor the fly populations. Visual observations alone can be misleading. Historical observations may be helpful in determining when to apply control options such as manure removal or the release of beneficial arthropods.

Surveillance methods include moving tape counts, sticky fly tapes, fly speck counts, baited jug traps and larval sampling.

A **moving tape count** is the best surveillance method, requiring about 5 minutes each day walking on a 1,000-foot walk to catch 25 to 75 flies. Walking down and back in each house is cheap and easy.

Carry the sticky fly tape using the same walk pattern at the same time of day. If possible, do not turn on or use a light, as this encourages fly movement.

Sticky fly tapes that hang often tell nothing. Tapes in a chicken house fill up fast during the summer. However, they do enable you to determine the fly species infesting the operation.

Some operators hang sticky fly ribbons along the aisles. Each week they count the captured flies and replace the tapes. A weekly count of 100 flies per ribbon may indicate that fly control is required.

Ribbons may become ineffective after 2 to 3 days because of dust and fly covering. Tapes are messy to use, and location is important. These devices are a poor choice for a monitoring program.

Fly speck counts are an economical way to determine whether fly-control methods are needed. Fasten 3- by 5-inch white index cards flush against feed troughs, ceilings, braces or other fly-resting areas, and leave them for several days to a week. Label the back of each card with date and location in the facility.

Place the cards on the head rafters (ten cards per house) and count the fly specks on one side. Count the "fly specks" on a given date or over a period of time within a given house. Change the cards once a day or week, depending on the populations present. Fifty or more spots per card per week may indicate that fly-control measures are required.

Place new cards in the same position each week. Fly species cannot be determined from the spots.

Baited jug trap. More expensive than other sampling methods, baited jug traps can indicate changes in and need for control of house fly populations. This trap will not collect species as such as the lesser house fly because they are not attracted to the commercial baits available.

To make a jug trap, cut four access holes (2 to 6 inches in diameter) around the upper part of a plastic milk jug. Attach a wire to the jug and pour commercial fly bait (about 1 ounce) inside the jug bottom. For increased effectiveness, add the fly pheromone muscalure (Muscamone®). Hang the jug about 6 feet above the floor around the pit periphery.

Larval sampling. It is most important to walk the pits to determine "hot spots" where the manure appears flattened and wet and contains heavy populations of fly eggs and maggots. Always take a hoe or trowel to sample for larvae. Keep the pits walkable, clean and water free.

"Hot spots" usually appear where water has accumulated in the manure. Some producers carry knapsack sprayers to treat only the hot spots to halt excessive fly larval breeding. However, treating manure widely and excessively will kill the beneficial agents.

Chemical control

Consider insecticides (Table 1) to be supplements to sanitation, and direct your management measures to preventing fly breeding. Keep accurate records on the insecticides and dosage rates you use.

The first chemical option should be pyrethrins, which is not a residual. This material is highly effective for a short time; when used sparingly, it does minimal damage to the beneficial arthropod populations.

Resistance to insecticides

House fly resistance develops more quickly when pesticides are applied frequently or in heavy doses. Insects resistant to one insecticide can be cross-resistant to other insecticides of the same class or having a similar mode of action. **The only proven solution to resistance problems is to use insecticides conservatively (only when justified) and to rotate the use of different classes of insecticides.**

As a general rule to delay the development of resistance, apply pesticides only at the beginning of the fly season to limit fly numbers and then during the fly season as the numbers begin to increase again after the previous application.

Do not apply pesticides during the cooler months of the year when there are normally few flies or in any month when fly numbers are not increasing and are not near predetermined treatment thresholds.

Residual surface sprays

Residual surface sprays usually are the most effective and economical method for controlling potentially heavy populations of adult flies of any species present. Apply them to surfaces where the flies rest, such as poultry house framework, the ceiling, walls, trusses, wires supporting cages, electric light cords and other areas marked by fly specking. Also, treat outside the poultry house around openings and on shrubs and other plants where flies rest.

Use a power sprayer or good proportioned-type sprayer to apply coarse, low-pressure sprays to the point of runoff at pressures of 80 to 100 pounds per square inch. Depending on the insecticide used and the type of surface sprayed, treated areas may remain toxic for about 4 weeks. Avoid contaminating feed, water and eggs during spraying. Do not spray birds. Follow the label directions.

Portable mechanical foggers and misters

It is often impractical to treat large poultry houses with residual sprays. Portable, lightweight, mechanical fogging machines are convenient, efficient and labor-saving in caged bird operations to quickly reduce adult fly populations. These devices provide quick fly knockdown but have poor residual action.

A very effective application method that has little or no residual effect is to spray with a gasoline-powered side-pack (ultra-low volume, or ULV) aerosol generator, using micron-particle-size spray droplets. Space applications should fill the room with fog or mist. For maximum effectiveness, be sure to close the windows and doors.

Natural pyrethrins, used inside for adult fly control through a ULV machine, are easy to use at 1 percent pyrethrins plus 5 percent piperonylbutoxide (PBO). The ratio of 1:5 pyrethrin to PBO controls flies most effectively.

When using this equipment, adjust it to deliver aerosol droplets that are 30 microns or less, and apply 1 ounce of pyrethrins per 1,000 cubic feet of space. Direct the spray toward the upper areas of the room. Leave the room closed for at least 1 hour. Do not remain in the treated areas, and ventilate them before reentry. Repeat the application as needed.

To kill flies in open areas near buildings, use outdoor ground application equipment, preferably when the temperature is cool (75°F or less) and wind velocity is about 5 mph or less. Apply at the rate of 4 ounces per acre in 50-foot swaths. Allow the spray drift to penetrate dense foliage. Repeat the application as needed.

Baits

Baits are a supplement to residual and aerosol sprays. Place the baits outside the cages upstairs in the high-rise house or other areas where adult house flies tend to congregate. Apply a line of bait in areas where employees will not walk.

Baits falling into the pit may destroy beneficial parasites. These selective adulticides suppress low fly populations. Never apply baits where they could accidentally be eaten by the birds or mixed into feed.

Dry sugar baits of methomyl (Blue Sreak®, Fatal Attraction®, Improved Golden Malrin®) are effective. To reduce potential resistance, rotate the baits. Methomyl is a carbamate insecticide, whereas other baits, wet or dry, using dichlorvos (Vapona®) and tetrachlorvinphos, (Rabon®) mixed with sugar are organophosphate insecticides.

Newer baits are Quickbayt® and Elector®, and they contain imidacloprid and spinosad, respectively.

Resin strips and fly belts

Ready-to-use dichlorvos (Vapona®) 20 percent resin strips can be used at the rate of one strip per 1,000 cubic feet of enclosed area. You will need to replace the strips as they lose their effectiveness, about every 3 months.

Larvicides for maggot suppression

To control larvae, an insect growth regulator (IGR), cyromazine (Larvadex®) can be blended into a poultry feed ration. It may control manure-breeding flies in and around caged chicken operations or in slatted flooring in layer chicken operations and breeder chicken operations. Do not feed it to broiler poultry.

Larvadex® 1% Premix kills the fly larvae before adulthood and does not harm natural predators or parasites. Blend the Larvadex® 1% Premix into the feed at the rate of 1 pound Premix per ton of feed. Larvadex® will provide a high degree of fly control.

When using Larvadex®, you must follow a feeding program to prevent potential fly resistance. Resistant flies have developed in large poultry operations where label directions have not been followed. Never feed it continuously throughout the year.

First, monitor adult flies in and near the poultry house. When the population reaches a level to cause concern, spray or fog an adulticide, such as pyrethrins, to reduce the number of flies that might lay eggs. Spray for the adults for as long as possible before using cyromazine.

Then check the manure first at hot spots in the pits for maggot activity. If maggots are active, start Larvadex® in the ration. Feed Larvadex® continuously as directed for 4 to 6 weeks (a minimum of 4 weeks) and if little or no maggot activity is observed in the manure, discontinue Larvadex® feeding. This is usually enough time to break the fly population life cycle.

Continue monitoring the manure pits and if maggots become active again, repeat the procedure. Use baits, sprays or fogs as needed during and between Larvadex® feeding periods to control flies.

Do not spray the manure pits with contact insecticides or liquid cyromazine. During the winter or in periods of low fly pressure, do not use Larvadex®. Larvadex® use in poultry is limited to use as a feed-through in chickens only and may not be fed to any other poultry species. Avoid illegal residues: Larvadex®-treated feed must be removed from layers at least 3 days (72 hours) before slaughter. Manure from animals fed Larvadex® may be used as a soil fer-

tilizer supplement. Do not apply more than 3 tons of manure per acre per year. Do not apply it to small grain crops that will be harvested or grazed, or illegal residues may result.

Liquid spray

Larvadex® 2SL is a soluble concentrate, which when diluted with water according to the directions for use acts as a larvicide to control fly species developing in poultry manure and refuse. Larvadex® controls fly infestations by breaking the life cycle at the maggot stage.

Larvadex SL® is labeled for fly control in and around chicken layer and breeder operations only.

Do not apply this product so that it exposes workers or other people, either directly or through spray drift, except those knowingly involved in the application.

Boric acid

Residual control may be provided by an insecticide labeled for control of darkling beetles, hide beetles and flies, known as orthoboric acid (SafeCide®). It kills adult beetles and larvae by contact or ingestion.

Usually a quick-kill insecticide is used before applying SafeCide® to kill beetles away from the litter. Apply a 99 percent and/or 30 percent bait formulation directly to the manure.

For poultry houses where birds are grown on litter, remove the birds before applying the bait uniformly to the floor or to old litter by fertilizer or seed spreader. Use a rate of 1 to 2 pounds per 100 square feet, in bands along feeder lines.

Spread fresh litter at least 4 inches uniformly over all treated areas (the floor or old litter) then introduce the birds. Reapply after each grow-out, if needed.

To control beetle adults and larvae in poultry houses using SafeCide® IC, remove the birds before dry and wet applications. Use 1 to 2 pounds for each 100 square feet of treated surface for dry applications, dusting side walls, top plates, posts and framing.

For wet application, mix the dust at the rate of 1 to 2 pounds per three gallons of water to apply over 100 square feet of treated surface.

Other pests

Non-insect pests

Mites

The **northern fowl mite**, or feather mite, *Ornithonyssus sylviarum*, is a very important external parasite of poultry. Heavy populations of this mite can reduce egg production by 10 to 15 percent. The mites can also annoy egg handlers and other people.

Mites are often noticed first on the eggs. Check for mites first on the vent, then on the tail, back and legs of layers. Feathers become soiled from mite eggs, cast skins, dried blood from feeding and excrement.

The eight-legged adult is about $^{1}/_{26}$ inch long and dark red to black. The mite's entire life cycle—egg, larva, several nymph stages and adult—is completed on the bird and can be completed under ideal conditions within a week.

If you detect the mites early, you may need to treat only some of the caged layers. Each week, monitor at least 10 randomly selected birds from each cage row in the entire house. Mite populations will increase in cooler weather.

The **chicken mite**, *Dermanyssus gallinae*, sucks blood from poultry at night and remains secluded in cracks and crevices during the day. Poultry workers entering poultry houses at night may be readily bitten by these mites as well.

When the mites are numerous, weight gains and egg production can be reduced. These red and gray mites are difficult to see without a magnifying glass. The life cycle may be completed in 7 to 10 days during warm weather; they are inactive during cold weather.

Female **scaly-leg mites**, *Knemidocoptes mutans*, are small with round bodies and short, stubby legs. These mites must be magnified to be seen because they are only $^{1}/_{50}$- to $^{1}/_{100}$-inch long. Young mites are at first six-legged, then molt through two eight-legged nymphal stages.

The scaly-leg mite is distributed widely throughout the world, but its exact range in Texas is unknown. This mite attacks poultry, commonly chickens and turkeys. However, infestations of commercial poultry are uncommon, as these birds are typically young and

have not had contact with older birds that may be infested with these mites.

The scaly-leg mite also has been reported on pheasants, partridges, bullfinches, gold finches and many passerine (perching) birds. Researchers suspect that wild birds transmit the mites to domestic flocks.

Little is known about the life history and habits of this species. The females burrow under scales on the feet and legs of poultry and deposit eggs. They begin laying eggs soon after they burrow under the skin and continue to oviposit (lay eggs) for about 2 months.

The eggs hatch in about 5 days into six-legged larvae that soon molt into nymphs. The nymphs develop into mature males and immature females. The immature female becomes a mature egg-laying female shortly after it is fertilized. Complete development for an egg-laying female probably requires 10 to 14 days.

When the mites burrowing under the scales on the feet and legs of poultry, a powdery material accumulates and binds into a scab of serum discharge. Affected feet and legs usually have red blotches. Glands in the mouthparts of mites may secrete an irritating fluid that causes the discharge and blotches. Eventually, the feet and legs may be covered with these crusts or scabs. Mites remain beneath the crusts in small oval vesicles.

Irritation from mite infestation causes the poultry to pick at the crusty formations. As the formations extend over the feet and legs, they interfere with joint flexion and cause lameness. Severe infestations may cause loss of toes, loss of appetite, lowered egg production, emaciation and death.

The **depluming mite**, *Neocnemidocoptes laevis gallinae* var. *gallinae*, is similar to the scaly-leg mite but is smaller and more oval. Infestation occurs throughout the United States. Hosts include pigeons, pheasants, geese, canaries and chickens. Many wild birds have been infested with this species or with closely related, unidentified species.

Development stages include egg, larva, nymph, male adult, and immature and mature female adult. Little is known about the life history of this species, but researchers believe that the transformation from immature to mature female occurs after fertilization.

The fertilized female begins depositing eggs within a few hours after starting to burrow and continues at 2- or 3-day intervals for about two months. The eggs hatch in about 5 days. Development from egg to egg-laying female requires 10 to 14 days. Fewer than 10 percent of the eggs mature into adults.

The depluming mite burrows into the skin at the base of the feathers on the back, on top of the wings, around the vent and on the breast and thighs. It causes intensive itching, often resulting in feather pulling. The fowls may lose feathers over large areas of the body. The infestations are especially noticeable in spring and summer; they may disappear in autumn.

Insect pests

Lice

The **chicken body louse**, *Menacanthus stramineus*, can reduce egg production in caged layer hens. The skin of infected birds becomes irritated and red, and localized scabs and blood clots form. In addition to feeding on skin fragments, feathers and debris, these lice can attack young quill feathers, feeding on blood. Although the lice are naturally infected with the eastern encephalomyelitis virus, they are not considered an important vector (transporter of disease).

Adult chicken lice are yellowish, flat bodied and 1/16 inch long. They have chewing mouthparts.

Shaft lice, *Menopon gallinae*, are commonly collected from domestic and wild fowl. They have complete life cycles and require about 2 1/2 weeks to complete their development from egg to adult.

Wing lice, *Lipeurus caponis*, are similar to the lice species previously described. However, wing lice develop more slowly, requiring 35 days to grow from egg to adult stage. Treatments used for suppressing other lice will also work for wing lice.

Chicken head lice, *Cuclutogaster heterographus*, are primarily a pest on young birds. They occur on the base of the feathers on the animal's head and are transmitted through contact.

Bed bugs

The common bed bug, *Cimex lectularius*, occasionally attacks poultry. It hides in cracks within the housing during the day and feeds

mostly at night on blood while the host is asleep. Bed bugs cause small, hard, swollen, white welts that become inflamed and itch severely. They are rarely seen on poultry during daylight hours.

An infestation can sometimes be recognized by blood stains and dark spots of excreta on support structures. The adult is reddish brown, oval-shaped, flattened and about 1/4 to 5/8 inch long. There may be three or more generations per year.

There is no evidence that bed bugs spread disease. For more guidelines on suppressing bed bugs, see publication L-1742, *Bed Bugs*, which is available at the Texas Cooperative Extension Bookstore Web site at http://tcebookstore.org.

Fleas

Fleas are occasionally found in the poultry house. They are usually first noticed in the litter, where a wide range of hosts are attached, including rats, mice, chickens and people. Bites annoying egg handlers occur primarily on the ankles and legs, causing a swollen itchy spot.

The adult flea, an excellent jumper, passes through a complete life cycle consisting of egg, larva, pupa and adult. The life cycle varies from 2 weeks to 8 months, depending on temperature, humidity, food and species.

The most common flea found in Texas is the **cat flea**, *Ctenocephalides felis*. The adult is 1/16 to 1/8 inch long, dark reddish-brown, wingless and hard-bodied. It has three pairs of legs and is flattened vertically (like a bluegill fish).

The **sticktight** or **southern chicken flea**, *Echidnophaga gallinacean*, is found in the southern United States from South Carolina to California. It attacks poultry, cats, dogs, horses and people.

Adult males and females are found on the heads of fowl. The females remain attached by their mouthparts in the same spot as long as 2 or 3 weeks. During this time, eggs are laid, being thrown with considerable force from the female's vagina. The eggs hatch on the ground in 2 days to 2 weeks.

The slender white larvae feed on excreta of the adult fleas, filth in cracks or litter on the poultry house floor or on the ground in dry, protected places. After growing for 2 weeks to 1 month, they spin silken cocoons and molt to the pupal stage.

The adults attach to the host in about a week, and females feed for about 1 week before laying eggs. One to five eggs are laid at one time. The life cycle may be completed in 1 to 2 months. This pest thrives in dry, cool weather, and under these conditions adults may live for several months.

In the South and Southwest, fleas sometimes embed themselves in clusters about the face, eyes, ear lobes, comb and wattles of poultry so that they cannot be brushed off. Young fowls are often killed; egg production and growth are reduced because of the loss of blood and irritation caused by the bites.

For more information on flea control, see Texas Cooperative Extension publication E-433, *Controlling Fleas*, which is available at http://tcebookstore.org.

Beetles

The darkling beetle or **lesser mealworm**, *Alphitobius diaperinus*, is rapidly becoming more of a nuisance in poultry operations. Large populations of beetles sometimes migrate to nearby residential areas, especially after litter cleanout. Although the beetles can fly up to a mile, most crawl at night from litter disposed in fields neighboring homes.

Beetles are often associated with poultry feed, preferring grain and cereal products that are damp, moldy and slightly out of condition. Adults and larvae consume poultry feed in amounts costly to the producer. The larvae are known as lesser mealworms.

Control of this beetle has become increasingly important. Adult beetles and larvae act as reservoirs for many poultry and human pathogens and parasites. Researchers have found that this beetle has transmitted acute leucosis (Marek's disease) to chickens.

Marek's disease usually affects 3- and 4-month-old birds. The clinical signs include various degrees of paralysis, most easily observed in legs and wings, as well as droopy wings, gasping, loss of weight, pallor and sometimes diarrhea. Birds severely affected may be found lying on their sides with one leg stretched forward and the other held behind.

The disease affects both broiler and egg-laying poultry. Losses can reach 2 percent of the flock per day, with mortality at 30 percent of the flock within a few weeks.

This disease is highly contagious and has been shown to be airborne. Contamination may persist in the environment because the darkling beetle may serve as a reservoir for residual contamination.

Other diseases spread by this beetle include the causative agents of avian influenza, salmonella, fowl pox, coccidiosis, botulism and Newcastle disease. The beetle also spreads cecal worms and avian tapeworms.

In the poultry house, the darkling beetle can lay up to 800 eggs in litter during a 42-day period. Eggs develop into larvae in 4 to 7 days. The life cycle requires between 42 to 97 days, depending on temperature and other factors. Adult beetles live 3 months to a year. The adults are about ¼ inch long and black or very dark reddish brown.

The larvae are yellowish brown (wireworm-like) and up to ¾ inch long. They accumulate in the dark corners of manure or litter, especially under sacks, in bins or in places where feed is stored. Pupation occurs in the litter, soil and side walls of poultry houses. The larvae often migrate throughout the litter seeking pupation sites.

Adult chickens and chicks are more likely than turkeys to eat the beetles and their larvae. Rather than providing "extra protein" in the diet, consumption actually lowers feed conversion and rate of gain, according to research.

Mature larvae of the **hide beetle**, *Dermestes maculatus*, develop on chicken carcasses in the facility and have the habit of boring into various hard surfaces to pupate, preferring softwoods. Some may climb 24 to 36 feet and bore into wood posts, studs and rafters, seriously weakening and "honey-combing" these structures.

The larvae are especially troublesome in poultry houses, damaging yellow pine, foam insulation, sytrofoam air baffle boards, paneling, drywall and even PCP (Penta Ready) chemically treated wood, in some cases. Larvae emerge from the litter, climb the walls and bore into soft building material.

Hide beetles are larger than darkling beetles, about ⅓ inch long, dark brown on top, with a mostly white undersurface (belly). Each female lays about 135 eggs, which hatch in 12 or more days.

The larvae are thickly covered with long, brown hairs, grow to about ½ inch long and have two spines on top near the tail end, which curve forward. The life cycle requires 40 to 50 days.

Reasonable control has been achieved by applying tetrachlorvinphos (Rabon®) 50% WP in the dry form to building walls. Make treatments with an electrostatic duster to negatively charge the particles, which enables it to stick to the wall surface better.

The best time to treat for darkling and hide beetles is after manure removal. Treatments of caged-layer houses before manure removal will fail.

Red imported fire ants

The red imported fire ant, *Solenopsis invicta*, forms tall, hardened mounds in clay-type soil in and around poultry operations.

Imported fire ants can cause problems on poultry farms by attacking chickens and foraging on broken eggs. Fire ant stings cause blemishes that can reduce the quality of poultry. Their stings can cause medical problems or even death to some animals receiving multiple stings.

In animal feeding stations, barns and feedlots, fire ants can cause similar problems. Fire ants prey on a number of pest insects and arthropods, including many species of caterpillars, flea larvae, ticks and chiggers. They also prey on beneficial insects.

Ants defending mounds can sting and cause medical problems for workers. The ants have an affinity for electrical units, utility housings and structures, where they can cause equipment failures.

Like other ants, the fire ant is a social insect. Colonies of these ants reside under mounds of dirt that may exceed 18 inches tall. Imported fire ant mounds commonly occur in open, sunny areas in the landscape.

Winged reproductive male and female ants periodically leave the colonies on mating flights. Mated females (queens) can fly or be carried by winds for miles before landing and starting new colonies.

Development from egg to adult occurs in about 30 days, progressing though four larval stages and a pupal stage. In a mature colony, worker ants (sterile female ants that can sting) can number in the hundreds of thousands.

There are two forms of fire ant colonies: single queen (monogyne) and multiple queen (polygyne). Areas infested by the single-queen form may have 40 to 80 colonies per acre. Land infested by multiple-queen colonies can harbor 200 to 800 or more ant mounds per acre.

Worker ants from multiple-queen colonies are not territorial; they move freely from mound to mound. The opposite is true of workers from single-queen colonies.

The number of fire ant mounds can increase rapidly after agricultural lands are disturbed by mechanical operations or pesticide use. Because the ants can form a mass of floating bodies, flooding can temporarily move fire ants out of flood-prone areas and into sites that were not previously infested.

In the 1950s, the U.S. Department of Agriculture (USDA) developed a quarantine program for fire ants (see http://aphis.usda.gov). The quarantine is designed to minimize the spread of imported fire ants by requiring proper treatment and inspection of all nursery stock, turfgrass, hay and other articles, including chicken litter, shipped out of quarantined counties. For specific information on compliance with these quarantine regulations, contact the Texas Department of Agriculture.

Management

Management of fire ants for caged-layer houses differs from that for broiler houses.

Program 1: For caged-layer houses

Use a combination of the following suggestions:

1. On grounds surrounding the buildings, broadcast conventionally formulated bait products outside the poultry house. Products include abamectin (Clinch™), fenoxycarb (Award®), hydramethylnon (Amdro®), pyriproxifen (Distance®), s-methoprene (Extinguish™) or hydramethylnon plus methoprene (Extinguish™ Plus). Do not allow the chickens to have access to the fire ant bait or bait-treated areas. Pesticides available for this method are listed in Table 2.
2. If fire ants are foraging inside the poultry house from ant mounds located outdoors, spray a barrier around the outside of the building using products registered for that usage site, such as lambda-cyhalothrin.
3. Use mowers or herbicides to remove the weeds and grass from around poultry houses.
4. Remove food sources (trash, piled feed, broken eggs and dead chickens) and potential nesting sites (pieces of lumber, old equipment and manure piles).
5. If the ants are nesting inside poultry houses, treat indoor surfaces with a registered product. Note: Although some products such as permethrin (Y-Tex® GardStar®) are registered specifically for control of fire ants in poultry houses, other products, such as cyfluthrin (Countdown™), dichlorvos (Vapona® Concentrate Insecticide) and lambda-cyhalothrin (Grenade™ ER Premise Insecticide), are more generally registered for "crawling pests," including ants. Read the poultry section of the labels for additional precautions. Do not allow the insecticides to come into contact with feed or water supplies.

Program 2: Broiler houses

Program 1 for caged-layer facilities can be adapted to broiler houses, if the products used are registered for this site. Because broilers roam freely in the houses, you must take care to prevent the chickens from having contact with the insecticides by confining treatments to the outside of the broiler house (see Step 1 above).

For more information on managing fire ants, see Texas Cooperative Extension publications B-6043, *Managing Imported Fire Ants in Urban Areas*, L-5070, *The Texas Two-Step Method: Do-It-Yourself Fire Ant Control for Homes and Neighborhoods*, or SP-196, *Management of Imported Fire Ants in Cattle Production Systems*, all of which are available at http://tcebookstore.org.

Miscellaneous pests

Chiggers, Trombicula (Eutrombicula) splendens (Ewing), T. alfreddugesi (Oudemans), T. batatas (Linee)

Chiggers also are known as red bugs, jiggers, harvest mites and by other common names. More than 700 species are known, but only three or four are important parasites in the United States.

The adults usually are covered with dense, feathered hairs that give them a velvety appearance. They are often bright red with a figure-eight-shaped body.

The parasitic larvae are about 1/150 inch long, reddish or straw colored, and not as densely covered with hairs as the adult. The larvae are barely visible to the naked eye.

The most common and widespread species in the United States is *Trombicula alfreddugesi*. This species is found on a variety of hosts, including people, fowls, reptiles, amphibians and mammals.

The larvae are most abundant in the transitional areas between forests and grasslands and along the margins of swamps. They are active in the north from July to September, but they may be encountered throughout the year in southern semi-tropical areas of the U.S.

Trombicula splendens is not as widely distributed as *T. alfreddugesi*, but their ranges often overlap. *Trombicula spendens* occurs in eastern half of the United States but ranges into Texas and prefers more moist habitations than does the common chigger (*T. alfreddugesi*). Its seasonal pattern is also similar to *T. alfreddugesi*.

This species feeds on mammals, birds, reptiles and amphibians, but the most common natural hosts appear to be reptiles, especially snakes and turtles.

Another chigger, *Trombicula batatas*, exists primarily in tropical areas and ranges from the United States to Brazil. It prefers open, sunlit, grassy areas, especially where domestic animals are kept, but it is not abundant in jungles or wooded areas.

It attacks humans, domestic animals and poultry, but its preferred hosts seem to be ground-inhabiting birds.

The range of the chigger *Neoschongastia americana americana* (Hirst) extends across the southern states from the Carolinas to California. It is more abundant in areas with hard soils that crack open during hot, dry summers and in areas where rock outcroppings occur.

Populations begin to increase in late April or May, peak in June and decline in late July or August. There may be an increase in September or October, and by late October or November it disappears from the host.

Domestic hosts are turkeys and chickens. Wild hosts include quail, woodpeckers and other wild birds.

The life cycle of chiggers differs from that of other mites. Most chiggers undergo five developmental stages: egg, deutovum (the larva is enclosed in a membrane in addition to the eggshell); larval, nymphochrysalis (a quiescent, or inactive, stage that transforms to the nymph); nymphal, imago chrysalis (a quiescent stage that transforms into the adult); and the adult stage.

The eggs usually are deposited singly in the soil. After a 4- to 6-day incubation period, the eggs hatch into the deutovum, which remains in the eggshell fragments for about a week before the six-legged larva emerges. Larvae crawl around rapidly in search of a host and may survive 2 weeks or more without one.

The larval stage is the only parasitic stage in the chigger life cycle. The larva usually feeds only once. It most often completes feeding in 1 to 4 days, but in some instances may require up to a month. When feeding is complete, the larvae drop to the ground, burrow into upper layers of the soil and become inactive.

The nymph is larger and more hairy than the larva. It probably feeds on insect eggs and early stages of other arthropods. After about a week, nymphs enter a quiescent stage, and emerge as adults in another week.

The adults are larger, hairier and sexually mature. Adults are ready to deposit eggs within a week, and egg laying continues for several weeks, probably as long as favorable conditions exist. Under laboratory conditions, observers have counted as many as 4,764 eggs deposited from a single female within 23 days.

Neoschongastia americana americana is the most abundant external parasite on turkeys grown on ranges with rocky outcroppings or hard soils that crack during summer when they become dry. Chiggers feed in clusters on the thigh, breast and underside of wings, and around the vent. These clusters cause scabby lesions that require about 3 weeks to heal after the engorged chiggers leave the host.

Chiggers normally do not burrow into the skin or suck blood. When the chigger is firmly attached, it injects a digestive enzyme into the wound that liquefies host tissue. It sucks up the

partially digested, liquefied host tissue, leaving a tube called a "stylostome." The digestive enzyme that hydrolyzes the host's tissues is probably responsible for the severe irritation and raised bump that results from chigger "tubes."

For more information on chiggers, see Texas Cooperative Extension publication E-365, *Chiggers*, which is available at http://tcebookstore.org.

Gnats

Several kinds of gnats attack poultry, including black flies, buffalo gnats and turkey gnats. The most common is the turkey gnat, *Simulium* spp., a vector of leucocytozoan parasites that cause a malaria-like disease in turkeys and ducks.

The eggs are deposited on objects in or on the surface of flowing water, usually at the edge. The eggs must be kept wet or submerged to hatch into larvae, which occurs in 2 to 12 days. Larvae develop in water 1 to 6 weeks before transforming into pupae. Adults emerge after a 4- to 15-day pupal period.

For more information on gnats, see Texas Cooperative Extension publication UC-019, *Black Flies or Buffalo Gnats*, available at http://insects.tamu.edu/extension/bulletins/uc/uc-019.html.

Table 1. Insecticides for suppression of arthropod pests in poultry.

Pest	Material and formulation	Application and remarks
Mist sprays		
Chicken mites	carbaryl (Sevin) 50% WP	Repeat treatment in 4 weeks if needed. Ventilate while spraying.
Lice	80% S	Do not spray nests, eggs, feed or water.
Northern fowl mites (bird treatment)	4F (43% suspension)	Do not treat within 10 days of vaccination or other stress influence.
	trachlorvinphos and dichlorvos (Ravap) 2.7% EC	For cage birds, spray no less than 100 to 125 psi to the vent area from below (high pressure). For floor birds, spray lightly. Do not treat more often than every 14 days.
	tetrachlorvinphos (Rabon) 50% WP	For cage birds, spray no less than 100 to 125 psi to the vent area from below (high pressure). For floor birds, spray lightly. Do not treat more often than every 14 days.
Coarse sprays		
	carbaryl (Sevin) 50% WP	Repeat treatment in 4 weeks if needed. Ventilate while spraying.
	80% S	Do not spray nests, eggs feed or water. Do not treat within 10 days of vaccination or other stress influence.
	4F	
Dusts		
	carbaryl (Sevin)	Use rotary or other duster. Do not treat birds more often than once every 4 weeks. Do not treat nests, eggs, feed or water.
Dust boxes		
	carbaryl (Sevin) 5% dust	Mix dust evenly throughout top layer of box contents.
	tetrachlorvinphos	Mix dust evenly throughout top layer of box contents.

Table 1. Insecticides for suppression of arthropod pests in poultry. (continued)

Pest	Material and formulation	Application and remarks
Mist sprays		
Northern fowl mites (bird treatment)	permethrin (Insectrin X, Permectrin II) 10%	Aim spray at the vent area. Cover or remove feed and water. Can spray cages or nests. Do not treat more often than once every 2 weeks.
Coarse sprays		
Northern fowl mites	permethrin (Atroban, Expar) 11% EC (Insectrin) 5.7% EC (Permectrin) 25% WP	Pay particular attention to vent. One application should eliminate an infestation.
Dusts		
Lice Northern fowl mites (bird treatment)	permethrin (Insectrin GP, Permectrin) 0.25% Dust	Apply with shaker or hand duster. Treat vent area thoroughly.
Sprays		
Chicken mites Lice	permethrin (Permectrin) 25% WP	Spray ceilings, walls, empty cages or nests to runoff. Repeat in 7 to 10 weeks or as needed.
Northern fowl mites (house and litter treatment)	tetrachlorvinphos and dichlorvos (Ravap) 28.7% EC	Apply thoroughly to litter, walls, roosts, cracks and crevices.
	tetrachlorvinphos (Rabon) 50% WP	Apply thoroughly to litter, walls, roosts, cracks, crevices and interiors.
	carbaryl (Sevin) 50% WP	Do not treat poultry or game birds. Apply spray to wall, litter or roost surface.
	80% S 4F (43% suspension) XLR (56.6% suspension)	Force spray into cracks. Repeat as needed. Avoid contaminating nests, eggs, and feeding and watering troughs. Ventilate while spraying,

Table 1. Insecticides for suppression of arthropod pests in poultry. (continued)

Pest	Material and formulation	Application and remarks
Dusts		
Lice	carbaryl (Sevin) 5% Dust	Treat litter evenly and repeat in 28 days if needed. Do not contaminate feed and water.
Northern fowl mites	tetrachlorvinphos (Rabon) 50% WP 3% D	Treat litter thoroughly and evenly.
Roost paints		
Northern fowl mites	tetrachlorvinphos and dichlorvos (Ravap) 28.7% EC	Spray or treat by brush (thoroughly), especially cracks and crevices.
	tetrachlorvinphos (Rabon) 50% WP	Treat by brush (thoroughly), especially cracks and crevices.
Sprays		
Northern fowl mites Cockroaches Mosquitoes (house and litter treatment)	permethrin (Insectrin X, Permectrin II) 10%	Spray to the point of runoff. Cover birds, feed and water. Do not treat more often than once every 2 weeks.
Chicken mites	carbaryl (Sevin) 50% WP	Repeat treatment in 4 weeks as needed. Ventilate while spraying. Treat walls, bedding, litter and roost surfaces. Force spay into cracks and crevices.
	80% S	
	4F (43% suspension)	
	tetrachlorvinphos and (Ravap) 28.7% EC	For cage birds, spray no less than 100 to 125 psi to the vent area from below (high pressure). For floor birds, spray lightly. Do not treat more often than every 14 days.
	tetrachlorvinphos (Rabon) 50%WP	For cage birds, spray no less than 100 to 125 psi to the vent area from below (high pressure). For floor birds, spray lightly. Do not treat more often than every 14 days.
Bed bugs	carbaryl (Sevin) 50% WP	Thoroughly spray walls bedding, litter and roost surfaces. Force spray into cracks and crevices. Ventilate while spraying. Do not apply directly to poultry, nests or eggs. Repeat as needed.
	80% S	
	4F (43% suspension)	Ventilate while spraying litter surface. Repeat as needed.
	LXR (56.6% suspension)	Ventilate while spraying litter surface. Repeat as needed.

Table 1. Insecticides for suppression of arthropod pests in poultry. (continued)

Pest	Material and formulation	Application and remarks
	Dusts	
Darkling beetle (lesser mealworm)	carbaryl (Sevin) 5% Dust	Apply evenly to litter and repeat treatment in 28 days if needed. Do not treat feed, water, nests or eggs.
	Sprays	
Darkling beetle (lesser mealworm)	carbaryl (Sevin) 4F (43% Suspension)	Ventilate while spraying litter surface. Repeat as needed.
	XLR (56.6% Suspension)	Ventilate while spraying litter surface. Repeat as needed.
	tetrachlorvinphos (Rabon) 50% WP	Apply thoroughly to litter, walls, roosts, cracks, crevices and interiors.
	carbaryl (Sevin) 5% Dust	Do not treat more than once every 4 weeks. Do not apply to eggs or nests. Clean houses before treatment if mealworms are a great problem. Avoid excess grain in litter and moisture. Treat floor litter.
	cyfluthrin (Tempo) 20% WP	Apply Tempo 20 WP to litter, walls and center posts inside the house. Best control will be obtained when application is made shortly after bird removal because larvae and adults begin to burrow deeper into the litter as surface temperature begin to cool, making control more difficult. Use a properly calibrated air blast, boom or power hand gun sprayer to achieve full coverage. Treat only when no birds are present.
	tetrachlorvinphos (Rabon) 50% WP	Treat litter evenly and thoroughly.
	carbaryl (Sevin)	Spread evenly before new litter is applied or on top of built-up litter. Birds do not have to be removed during application. Optimum treatment is 10 to 14 days after birds are placed in the house. Repeat treatment 2 weeks later if needed. Follow label directions.
	Dusts	
Fleas	carbaryl (Sevin) 5%	Do not treat birds more often than once every four weeks. Do not treat eggs, feed or water.
	5%	Apply evenly to litter and repeat treatment in 28 days if needed. Do not treat feed, water, nests or eggs.
	10%	

Table 2. Insecticides for suppression of fire ants.

Ingredient	Trade name*	Registered site(s)
abamectin	PT370 Ascend	Turf, lawns, non-crop areas; indoors to crevices or voids or utilities
	Clinch	Citrus, barns, **poultry houses**
boric acid (Note: Scientific studies have yet to demonstrate the effectiveness of these products)	SafeCide®	**In poultry houses**
carbaryl	Sevin XLR Plus (other formulations include 4F, 50W, 80S, SL, 5% and 10% dust)	Pastures, rangeland, forested lands, wastelands, nursery stock, vegetable transplants (do not use on any food crop not listed on the label), foliage plants, bedding plants (do not use in greenhouses). Sevin 50W and 5% also registered for **poultry and premises**, although not specifically for control of fire ants.
cyfluthrin	Countdown	For control of crawling pests (including ants) in and around livestock premises (including poultry houses)
dichlorvos	Vapona Concentrate Insecticide	Indoor livestock premises and poultry houses
fenoxycarb	Award	Horse farms and horse pastures, nonbearing crops (apples, avocados, blueberries, citrus, nectarines, peaches, pecans, plums), noncropped and nongrazed areas on the farm, turfgrass; Around container-grown ornamental and nonbearing nursery stock and on sod farms; turfgrass areas
hydramethylnon	Amdro Pro Insecticide Bait	Turf, rangeland, pasture, noncropland as above
lambda-cyhalothrin	Grenade ER Premise Insecticide	In and around buildings housing livestock; for use as barrier and general surface treatment for ant control
permethrin	Y-Tex GardStar	In and around livestock premises including poultry houses to control ants
		Sprinkle 1 gal over mound and surrounding 4-ft-diameter area
pyriproxyfen	Distance Fire Ant Bait	Indoor and outdoor container and field grown ornamentals (commercial nurseries), ornamental tree farms, non-bearing nut, citrus and other tree fruits grown in nurseries, conifers, conifer nurseries, sod farms, industrial sites, uncultivated nonagricultural areas, nongrazed pastures and nongrazed rangeland
s-methoprene	Extinguish	Turfgrass and landscapes, parks, zoos, golf courses, roadsides, airports, cemeteries, perimeter areas of buildings, homes, sheds, electrical and phone boxes, pump houses and other associated areas, forestry sites, commercial nurseries including field-grown and container stock, school grounds, sports fields, pastures, rangeland, citrus groves, sod farms, cropland

*(All are registered, ®, or trade marked, ™, product names)

Restricted pesticides

Under Texas' Pesticide Law, certain pesticides are restricted and can be bought and used only by pesticide applicators and public operators who are licensed by the Texas Department of Agriculture.

Restrictions on the use of some of these pesticides require the applicator to notify the occupants of lands within 1,000 feet of the boundaries of the area to be treated at least 24 hours before the application is made. The applicator should also inform the occupants of precautions necessary for the safety of people and animals.

Licensing

Any person who applies a pesticide on public property must be licensed by the Texas Department of Agriculture or be a trained applicator working under the supervision of a licensed applicator. This is true even if the pesticide is not restricted.

Disclaimer

This publication contains pesticide considerations that are subject to change at any time. These suggestions are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used.

Because labels and product registrations change constantly, some of the products mentioned in this writing may no longer be legal by the time you read them. If information in this publication disagrees with the label, the information in this publication pertaining to the target subject matter must be disregarded. The label is the law.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The authors and The Texas A&M University System assume no liability resulting from the use of these guidelines.

For more information

Economic Impact of the Texas Poultry Industry (L-5214), by John B. Carey. Texas Cooperative Extension, 2004

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