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Fire Ants and their management

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The red imported fire ant, *Solenopsis invicta* (Buren), is an introduced species that arrived in Mobile, Alabama from South America around the 1920s. This species has had an enormous impact in the southeastern United States, and continues to spread into areas of North America with mild climates and adequate moisture and food.

The red imported fire ant reached Texas during the 1950s and has spread steadily across the state. The ants disperse naturally through mating flights, mass movement of colonies or by floating to new locations in flood water.

Fire ants can travel long distances when newly-mated queens land in cars, trucks or trains. Shipments of nursery stock or soil from an infested area may relocate entire colonies or nests (see Quarantine Regulations). More than half the counties in Texas are now infested with the red imported fire ant (see map page 2).

Fire Ant Identification

Four fire ant species are found in Texas. Three are native to the state. The tropical fire ant, *Solenopsis geminata* Fabricius, and the southern fire ant, *S. xyloni* McCook, are the most common native species. The desert fire ant, *S. aurea* Wheeler, is a rarely observed native species. The red imported fire ant causes the most concern and has largely replaced native fire ants in areas it infests.

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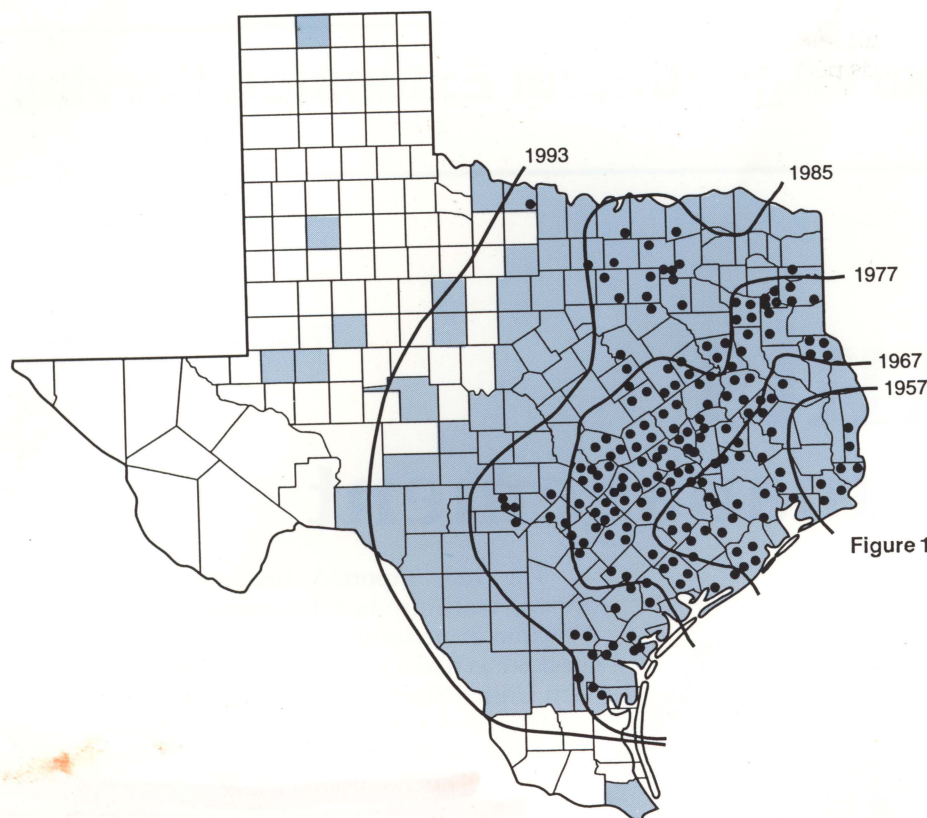


Figure 1. Historic red imported fire ant spread and currently infested (shaded) counties. Dots indicate confirmed presence of the multiple queen form. Not all infested counties are under quarantine.

Distinguishing between fire ant species is difficult; specimens preserved in alcohol can be identified by specialists contacted through the local county Extension office. However, the red imported fire ant does have some distinguishing characteristics. It usually builds mounds in open, sunny areas. **No openings are visible on the mound surface, since ants leave the mound through underground tunnels.** Unlike most ant species, fire ants readily run up objects such as sticks when the mound is disturbed. The red imported fire ant sting is painful, and afterwards the injected venom produces a unique white pustule.

Biology

Red imported fire ant colonies consist of the brood and several types (castes) of adults. These adults include winged males (distinguished from the females by their smaller heads and black bodies), red-brown winged females, one or more queens, and workers. Worker ants are wingless, sterile females and vary in size. Older workers forage or defend the nest while younger workers care for the developing brood. The brood is made up of cream-colored eggs, larvae and pupae of all the castes.

The winged forms, called reproductives, are the most prevalent in the spring and early summer. They live in the mound until embarking on a mating (nuptial) flight, which usually occurs in the afternoon soon after a rainy period. A mating flight can occur at any time of the year, but is most common from April through June. Males die soon after mating, while the fertilized queen alights to find a suitable nesting site, sheds her wings and begins digging a chamber in which to start a new colony. Winged forms

and queen ants do not forage for food, defend the mound or assist in colony maintenance.

A newly-mated queen lays a cluster of a dozen or so eggs. When they hatch 7 to 10 days later, the larvae are fed by the queen with body fluids or her eggs. Later on, a queen can lay up to 200 eggs per day and larvae receive food gathered by worker ants. Larvae develop 6 to 10 days before pupating. Adults emerge in 9 to 15 days. The average colony contains 100,000 to 500,000 workers, up to several hundred winged forms and queens. Queen ants can live 5 years or more.

New colonies do not produce a conspicuous mound for several months after the young queen begins egg laying. The red imported fire ant builds mounds in almost any type of soil, but prefers open, sunny areas such as pastures, parks, lawns, meadows and cultivated fields. The size of a mound depends upon soil characteristics and land disturbance, but mounds can reach 10 to 12 inches in height. Mounds are less well developed in very sandy soils. Often mounds are located in rotting logs, around stumps and trees, and occasionally under buildings.

Multiple Queen Colonies

In the 1980s multiple queen colonies of the red imported fire ant were detected. Prior to this discovery, it was thought that each fire ant mound contained only one mated queen and that ants were always territorial, competing with or eliminating other fire ant colonies nearby. This type of colony is called the "single queen" form. Multiple queen colonies, however, were found to contain more than one egg-laying queen. Furthermore, worker ants from a multiple queen colony move freely

from one mound to another. The result has been a ten-fold increase in the number of mounds per acre. Areas infested with single queen colonies contain 40 to 150 mounds per acre. In areas with multiple queen colonies, there may be 200 to 800 mounds per acre (see map page 2). This increased density of ants has aggravated the problems they cause, and their impact is being re-evaluated.

Medical Problems

The biggest problem associated with fire ants is their stinging and biting behavior. They can sting repeatedly and will defensively attack anything that disturbs their mounds or food sources. Because of this, people are often forced to alter outdoor activities when fire ants are present. Symptoms of a fire ant sting include burning and itching. Venom injected by the insect may cause a white pustule to form in a day or two. These pustules may leave permanent scars. Although the stings are not usually life threatening, multiple stings may lead to secondary infections. A few people are hypersensitive to the venom and may suffer chest pains or nausea, or lapse into a coma from even one sting. Relatively few deaths from fire ant stings have been documented as compared to deaths from bee and wasp stings.

Tips for avoiding medical emergencies and treating ant stings:

- Teach children and visitors about fire ants and their hazard.
- Wear protective clothing during outdoor activities. Wear shoes or boots and/or tuck pant legs into socks.
- Be prepared for an emergency by consulting with your doctor.
- If stung, treat with an approved insect bite remedy that deadens pain and provides protection against secondary infection, such as Sting-Kill® External Anesthetic containing benzocaine.
- Persons reacting severely to fire ant stings should see a physician immediately.
- Persons who are hypersensitive should see an allergist for treatment if it is possible they may come in contact with fire ants.

Integrated Fire Ant Management

Attempts to eradicate the red imported fire ant in the 1960s and 1970s used chemicals that destroyed native ant species. Because of this, eradication attempts may actually have aided the spread of fire ants. Native ants compete with red imported fire ants and prey on newly-mated queens. When native ants are eliminated, red imported fire ants can become well established in an area and prevent other ants from re-establishing colonies.

Today we believe that eradication is not technically, environmentally or economically feasible in fully

infested areas. Chemicals provide only temporary control of fire ants and must be reapplied periodically for as long as control is desired. Insecticides are not specific to the red imported fire ant. They may also eliminate native ants and other non-target organisms. No product is registered for use in all the sites where fire ants thrive. As a result, reinfestation is likely to occur if treatments are terminated; new populations may be larger than before treatment. Because of this, the decision to treat fire ants must be accompanied by a long-term commitment to continue periodic treatments. Chemical control can be expensive, and in commercial agriculture it must be justified economically.

In an urban environment and in areas of high use such as parks, the justification for fire ant control is more subjective. Individuals must decide when fire ants become intolerable and how much to invest in control efforts. These decisions are also influenced by the health risk fire ants pose and by the environmental impact of toxic chemicals.

An integrated approach to managing fire ants uses a combination of tactics over time, that is: 1) most effective; 2) least expensive; and 3) least harmful to the environment. Unlike eradication, the goal is to eliminate the problems caused by the red imported fire ant without necessarily eliminating them from the ecosystem. Reliance on chemical control alone is discouraged, although insecticides are currently the primary method of suppressing ants. Management programs must, of course, be site specific and justifiable.

Integrated management recognizes that the impact of the red imported fire ant is not always bad. Fire ants feed primarily on other insects and related arthropods, which reduces the need for insecticides in commercial agriculture. For example, in cotton fields fire ants help control boll weevils, fleahoppers, cotton bollworms, pink bollworms and tobacco budworms. In sugarcane they prey on sugarcane borers. In pecans they feed on pecan weevils and hickory shuckworms. In pastures they suppress lone star ticks, developing filth breeding flies (horn flies, house flies, etc.), horse flies and deer flies. Even in urban areas fire ants can be helpful. They feed on flea larvae, chinch bugs, cockroach eggs and other pests. (Problems with aphids, mealybugs and scale insects may be increased by fire ants, however.) The beneficial aspects of the fire ant can be exploited in management.

Quarantine Regulations

The Federal Fire Ant Quarantine, enacted May 6, 1958, is designed to prevent the spread of the fire ant from quarantined areas. Items such as hay, sod and ornamental plants must be inspected and/or treated with an insecticide before they are transported. Regulations are subject to change. Contact the Texas Department of Agriculture for current regulatory requirements and a list of quarantined counties (also see the quarantine information in the management sections for Ornamental Turf, Ornamental Plant Production and Pastureland and Rangeland).

Some Management Options for Fire Ant Problems

The following section lists treatment options for managing various kinds of fire ant problems. The methods and products mentioned here are described in detail later in this publication. Because many combinations of control options are available, there may be no single best method of control. The programs and options that follow are only suggestions, and are not intended to preclude other effective methods.

Lawns and Ornamental Turf

Fire ants infest lawns, school yards, athletic fields and parks. In these places they may pose a medical threat and affect human activity. Their mounds also detract from the aesthetic value of the landscape.

Treatment options:

Program 1: For small areas (usually 1 acre or less) of ornamental turf or where preservation of native ants is desired. This program selectively controls fire ants, but reinvasion should be expected. It requires more labor and monitoring than other programs.

1. Treat all unwanted fire ant mounds using the individual mound treatment of choice.
2. Selectively treat new or undesirable mounds as needed.

Program 2: For long-term ant suppression in ornamental turf and non-agricultural lands, including roadsides. This program is best suited to moderate size to larger areas and will not eliminate all ant activity. Suppression of ants occurs slowly (weeks to months) and the cost is moderate. This approach is not suggested for areas with large numbers of native ants and few fire ant mounds (15 to 20 per acre or fewer). For a thorough description see L-5070, "The Two-Step Method-Do-It-Yourself Fire Ant Control" (Texas Agricultural Extension Service).

1. Make an annual or semi-annual broadcast application of a bait-formulated insecticide (avermectin B1, fenoxycarb or hydramethylnon) in the spring and/or fall.
2. At least 2 days after broadcasting the bait, begin treating individual mounds in sensitive or high traffic areas as needed.

In areas with excessively high numbers of mounds per acre (200 or more), two applications of bait may be needed within several months to result in a satisfactory level of ant suppression, since not all mounds are affected by a single bait application. Reapply when ant presence justifies the cost of treatment.

If and when bait applications are terminated, fire ants can reinfest the area, sometimes with more mounds than were present initially. Mated queens may "seed" the treated area with new colonies and be unaffected by the earlier bait applications. Also, in low-lying, flood-prone areas baits may be less effective because ants move in and out of these areas often.

Program 3: To eliminate all mound building and foraging activity in ornamental turf. Effects of this program are more rapid and dramatic than with Program 2, but this program may be more expensive and requires more contact insecticide.

1. (Optional). Make an annual or semi-annual broadcast application of a bait-formulated insecticide in areas where there are many mounds (more than 20 per acre); or, individually treat fire ant mounds.
2. Routinely broadcast or spray a contact insecticide every 8 weeks or so when ants are detected. Heed the re-entry or treatment-to-harvest intervals specified on product labels.

Program combinations: The three programs described above can be used selectively in sites where different levels of fire ant suppression are justified or desired. On golf courses, for instance, Program 3 may be suitable for high use areas such as putting greens and tee boxes. In fairways and rough areas Program 2 may be sufficient

Commercial Turf

Treatment options:

Program 1: To treat sod to be shipped *within* the quarantined area use any of the programs listed for Lawns and Ornamental Turf.

Program 2: To treat turf to be shipped out of the quarantined area (modified from USDA APHIS Program Aid No. 1420, 1988, or USDA, APHIS PPQ Treatment Manual M301.81, revised Jan. 1985).

1. A Compliance Agreement and required shipping permits must be obtained from the Texas Department of Agriculture.
2. A broadcast application of chlorpyrifos granules (Dursban® 50W or Pageant® DF) must be made prior to harvest.

Homes and Structures

Fire ants from colonies close to homes and other structures sometimes forage indoors for food and moisture, particularly during the hot, dry summer months. Less frequently, entire colonies will nest in wall voids or rafters. Their presence is a nuisance and can threaten pets and sleeping or bed-ridden individuals. Colonies may also move into homes during flooding.

Treatment options:

1. If ants are entering the home or could enter the home from outside colonies, treat mounds near the home using one of the programs for Lawns and Ornamental Turf, and/or apply a residual insecticide containing chlorpyrifos or diazinon as an outside barrier around the base of the structure. Caulking cracks and crevices with a suitable sealant also may keep ants out.
2. If fire ants are foraging indoors, use a bait station product, such as MaxForce® Professional Insect Control™ Ant Killer Bait Station, as directed. This approach can be used to slowly eliminate the colonies from which the foraging ants come. (Bait-formulated insecticides, except for MaxForce®, are not registered for fire ants inside structures.) Or, spray ant trails or spot treat infested areas with products registered for this use (see Extension publication L-2061, "House Infesting Ants").
3. If colonies are located indoors follow foraging ant trails and treat colonies with dust or spray injected into the nesting area.

Electrical Equipment and Utility Housings

Like many ants, fire ants have an affinity for electrical fields. They build up in high numbers around contact points and can cause short circuits or interfere with switching mechanisms. Air conditioners, traffic boxes and other devices can be damaged. Fire ants often nest in housings around electrical and utility units. The ants move soil into these structures and chew on insulation and other soft materials.

Treatment program:

1. Eliminate colonies in and around casings and housings. Around water meter casings, immediate control can be obtained with injectible aerosols containing pyrethrins. Amdro® applied to mounds around the structure will provide control in about 1 week.
2. Clean out debris and nesting materials in the casing or housing.
3. Where possible, tightly seal all sensitive electrical components, such as circuit breakers, to prevent ants from entering.
4. Apply specifically labeled products to the housings (State® Fire Ant Killer with resmethrin, Rainbow Insect Control® containing chlorpyrifos, Sutton® JS 685 Powder containing synergized pyrethrins and silica gel or Elastrel™ insecticide with dichlorvos). Caution: Some insecticides can harm some types of circuitry, wiring or insulation.
5. (Optional). Carefully apply an insecticide barrier around the housing, making certain to avoid electric shock. Treat the area surrounding the installation using one of the ornamental turf programs.

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5. (Optional). Carefully apply an insecticide barrier around the housing, making certain to avoid electric shock. Treat the area surrounding the installation using one of the ornamental turf programs.

Home Gardens

Ants will occasionally feed on fruits and vegetables in home gardens. Fire ants tunnel into potatoes underground and feed on okra buds and developing pods, particularly during hot, dry weather. They can be a nuisance to gardeners during weeding and harvesting.

Treatment options:

1. Granular products containing carbaryl plus metaldehyde are registered to suppress ants foraging in gardens. Products containing diazinon or chlorpyrifos registered for use against soil insects in home gardens can be applied before planting. They also provide limited control of foraging ant activity.
2. Mounds can be shoveled out of the garden or treated with very hot water, taking care not to disturb or treat the garden plants (see Physical and Mechanical Methods Section).
3. Bait products are not registered for use in gardens, but they can be broadcast around the perimeter of the garden so that foraging ants will collect the bait and take it to the colony.
4. To prevent ants from entering the garden, apply a chemical barrier using diazinon or chlorpyrifos spray or granules around the garden.
5. Two plant-derived products (pyrethrins, rotenone) are registered for treating ants in vegetable gardens.

Compost Piles, Mulched Flower Beds, Pavement Cracks, etc.

Fire ants invade compost piles and mulched flower beds seeking heat and moisture. They also nest underneath cracked pavement, removing dirt from underneath sidewalks and roadways and aggravating structural problems. In these sites the location of the colony may be unknown or inaccessible, making treatment difficult.

Treatment options:

1. When the exact location of a colony is unknown, treat in the vicinity of greatest ant activity. Use the individual mound treatment rate of Amdro® to obtain control in about a week.

Field Crops and Commercial Vegetables

In cotton and sugarcane production, red imported fire ants are considered beneficial insects and no control is required. However, worker ants will feed on germinating seeds and seedlings of corn and sorghum during dry spring weather. They occasionally cause loss of stand. Fire ants also have been reported to feed on young watermelon, cucumber and sunflower plants, and have damaged peanut and soybean plantings.

Treatment options:

1. To prevent damage to corn and sorghum seedlings, treat the seed with lindane registered for soil insect control, or band an insecticide such as Lorsban® 15G over an open furrow at planting where there is a history of stand loss.
2. No products are registered specifically for fire ant control in watermelon, sunflower and other crops although some products containing pyrethrins (Prentox®, Exciter® and Fairfield American Pyrenone® Crop Spray) are generally labeled for ant control in these sites. Insecticides registered for other pests on these crops (and known to be toxic to fire ants) are occasionally used to temporarily suppress foraging ants when damage is observed and the crop is threatened (see Home Gardens section).

Ornamental Plant Production

Federal quarantine regulations mandate specific fire ant treatments of plants to be shipped to areas free of fire ants. Texas Floral and Nursery Law mandates that plants must be pest-free, but does not mandate formal treatment programs. In addition to products mentioned below others, including those containing acephate, carbaryl, diazinon and other products registered for treating fire ants around ornamental plants or in potting media, also may be suitable. The following treatment suggestions are for commercially produced ornamental plants to be shipped out of a quarantined area (modified from "Imported Fire Ants: A Guide for Nursery Operators," Program Aid No. 1420, USDA, APHIS, December 1988). In all cases the producer must obtain a Compliance Agreement from the Texas Department of Agriculture. Greenhouse-produced plants are exempt from quarantine regulations if the facilities are determined to be tightly closed by the nursery inspector.

Treatment options:

Program 1: Fire ant-free nursery program for containerized nursery stock. Effective August 1, 1990, use of granular chlorpyrifos (Dursban® 2.5G) as a potting and bench soil treatment is no longer approved as a stand alone treatment for fire ants. The following procedure is now required.

1. Treat all exposed soil surfaces (including sod and mulched areas) on property where plants are grown, potted, stored, handled, loaded, unloaded or sold. Use a broadcast bait such as Amdro® (hydramethylnon) or Logic® (fenoxycarb) at least once every 6 months, with the first application as early in spring as possible.
2. After broadcast treatments, treat individual mounds to eliminate remaining colonies.
3. Inspect the area for new mounds twice a month and treat any that appear.
4. Treat all potting media with bifenthrin (Talstar® 10WP EPA SLN No. TX-910013 or T&O).
5. Federal or state inspections of nurseries participating in this program will be conducted at least twice per year.
6. (Optional). Immerse stock in chlorpyrifos solution (Dursban® 2E, 4E or Turf Insecticide) or apply chlorpyrifos to the containers to the point of saturation (one time only).

Program 2: For balled and burlapped stock.

1. Immerse stock in chlorpyrifos (Dursban® 2E, 4E or Turf Insecticide), or drench stock twice daily for 3 consecutive days.

Program 3: For field-grown woody ornamentals, preharvest.

1. Broadcast bait (Logic®, Amdro®).
2. See Program 2.

Fruit and Nut Orchards, Vineyards and Blueberry Plants

Although fire ants are mostly a nuisance to field workers in these crops, their overall economic and ecological impact remains unknown. In pecan orchards, fire ants prey on pests such as pecan weevils and hickory shuckworms in fallen pecans, but they encourage aphids by preying on their natural enemies. The ants' nest building aerates the soil of the orchard floor, which is beneficial. But they will feed on the meat of cracked pecans and can damage irrigation systems. Ant mounds may interfere with some types of harvesting operations. Chemical control is warranted only if the cost of control is less than the potential economic loss ants may cause. In pick-your-own operations, the liability of ants attacking customers also should be considered.

Treatment options:

1. No products are registered specifically for fire ant control in bearing peach orchards, vineyards and blueberry plantings, although some products containing pyrethrins (Prentox[®], Exciter[™] and Fairfield American Pyrenone[®] Crop Spray) are generally labelled for ant control in these sites. Turf areas around such plantings can be treated using strategies listed for Lawns and Ornamental Turf. (Also see Field Crops and Commercial Vegetables.)
2. In pecan and citrus orchards, Lorsban[®] 4E, 50WP and 15G (chlorpyrifos) used to treat the orchard floor will temporarily suppress foraging ants. Rotate[®] 2.5G (bendiocarb) and Logic[®] (fenoxycarb) are registered for use in non-bearing fruit and nut orchards.

Apiaries

Fire ants invade bee hives and feed on developing bee larvae, occasionally destroying weak colonies. Use chemicals with care because the bees will be affected by insecticides.

Treatment options:

1. Treat areas around hives as described for Lawns and Ornamental Turf. (Bait formulations are the safest to use around hives; dust formulations should be avoided.)
2. Elevate the hives several inches on bricks or stones.
3. (Optional). The base of each hive can be carefully treated with a surface or paint application of diazinon or chlorpyrifos to produce a barrier. An insecticide also can be applied to the ground around the hives. (Apply insecticides late in the evening or early in the morning when bees are not active and prevent bees from contacting treated surfaces.)

Pastureland and Rangeland

Yield losses related to fire ants have not been documented in pastures. However, their tall, hardened mounds occasionally break or interfere with cutting and harvesting machinery. Colonies frequently move into bales of hay left in the field for extended periods. Calves are sometimes attacked shortly after birth. Fire ants sting the eyes of newborn calves, causing temporary blindness. They also sting soft tissues around the nostrils, udder and genitals. Sometimes the calves die. However, in most cases calves attacked by fire ants may have had other, more serious health problems. Consult your veterinarian for treatment if livestock are stung.

Treatment options:

Program 1: Chemical control for pastures. This program costs roughly \$10 or more per acre per year and may not provide a return on the investment.

1. Follow Program 2 in the Lawns and Ornamental Turf section, and use products registered for pastures (broadcast application of Amdro® and individual mound treatments with 75% acephate – Orthene® Turf and Ornamental Spray – or carbaryl products).
2. Where feasible, and particularly if summer calving is desired, designate a calving pasture and treat it as described above. This will ensure that calving can occur without the threat of fire ant attacks.

Program 2: Non-chemical fire ant management for pastures and cattle. These practices can reduce various problems caused by fire ants while maintaining a stable ant population that will help suppress lone star ticks, filth breeding flies and other pests, while also deterring the multiple queen form. (Use a combination of the following suggestions.)

1. Schedule the cow fertility program to ensure that calving occurs during cooler weather when fire ants are less active (soil temperature below 65 degrees F). This will reduce the probability of ant attacks.
2. (Optional). Use shallow discing or drag heavy objects such as railroad ties across pastures, particularly after rotating livestock out of a pasture, to temporarily flatten tall, hardened mounds (although this practice seldom eliminates fire ants) and scatter manure. Manure can breed fly larvae upon which fire ants feed.
3. Use disc-type (Kountz) cutters, designed and promoted to withstand the impact of fire ant mounds, to reduce equipment damage.
4. Use mechanized balers and bale movers, as used for round bales, to reduce human contact with bales which might be infested.
5. Store bales off the ground or in an area around which the ants have been treated.

Note: A quarantine is in effect which prohibits the shipment of hay from infested to uninfested counties without certificates. Call Texas Department of Agriculture personnel to certify that hay shipments are ant-free.

In addition to the products mentioned, Logic® (fenoxycarb) is now registered for use in horse pastures.

Poultry Houses, Barns and Feedlots

Red 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. In animal feeding stations, barns and feedlots, fire ants can cause similar problems.

Treatment options:

Program 1: For poultry farms. (Use a combination of the following suggestions.)

1. Remove food sources (trash, piled feed, broken eggs and dead chickens) and nesting sites (pieces of lumber, old equipment and manure piles).
2. Remove weeds and grass from around poultry houses with mowers or herbicides.
3. Treat litter with a registered product (carbaryl and others) if ants are nesting inside poultry houses. (Caution: Do not allow insecticides to come into contact with feed or water supplies; read the poultry section of labels for additional precautions.)
4. If fire ants are foraging inside the poultry house from outside, spray a barrier around the outside of the building with chlorpyrifos or diazinon, and/or use one of the Lawn and Ornamental Turf programs to control ants in the surrounding area. (Caution: Do not allow chickens access to fire ant bait or bait-treated areas.)

Program 2: For barns and feedlots.

1. The program for poultry houses can be adapted to barns, provided products used are labeled for treating animal premises. (See B-1306, "Suggestions for Managing External Parasites of Texas Livestock and Poultry," Texas Agricultural Extension Service.)
2. Barns and other structures may be treated as described for Homes and Structures, provided the treated areas are inaccessible to animals and registered products are used.

Wildlife Breeding Areas

Certain forms of wildlife are especially affected by ants during and soon after birth or hatching. The risk is greatest during the warm months. Fawns are vulnerable because they are born in June and because they instinctively remain motionless in their hiding places. Hatching quail and ground-nesting waterfowl chicks are also attacked. However, the impact of fire ants on area-wide populations of wildlife remains undocumented. In Texas, no endangered species has been reported lost because of fire ants. Fire ant control programs in wildlife areas are discouraged unless the benefits from such treatments have been documented. Many pesticides are toxic to non-target organisms (particularly to aquatic organisms) and may directly or indirectly affect game species if not used properly.

Treatment options:

1. Wildlife breeding areas are considered non-agricultural lands, and thus can be treated with products registered for this kind of site, as described for Lawns and Ornamental Turf.
2. Exotic game ranches are considered commercial agriculture areas. Breeding areas may be treated as described for Pastureland and Rangelands.

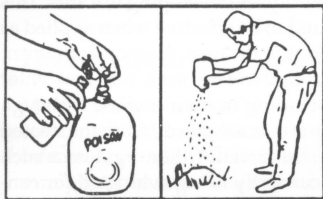
Control Techniques and Application Methods

Chemical Control

Chemical applications can be aimed at the foraging ants and/or at the entire colony. Techniques include *surface applications* using paints, sprays or dusts; *individual mound treatments* using drenches, granular products, dusts, aerosols or baits; and *broadcast applications* of insecticide liquids, granules or baits using granular applicators, high volume sprayers or electrical or mechanical spreaders. For a list of products see the table on p. 14.

Surface applications, spot treatments and barriers

Many products containing carbaryl, chlorpyrifos, diazinon, propoxur and resmethrin are labeled for indoor and/or outdoor use as spot treatments for ant trails and for ant colonies located in wall voids. These products are usually dusts or sprays, although several products contain chlorpyrifos mixed into a latex-based paint. Except when used to treat colonies located in wall voids, these products are intended only to reduce the number of foraging worker ants; the colony where ants are developing is not *directly* affected. These products can be used to produce barriers and protect items or areas from foraging worker ants. For a more detailed discussion of these methods refer to L-1783, "Carpenter Ants," and L-2061, "House Infesting Ants," available from the Texas Agricultural Extension Service.



Individual mound treatments

Mound drenches: Most fire ant control products are formulated as liquid concentrates, although a few are ready-to-use formulations.

These products may need to be diluted in the amount of water specified on the product's label. Be careful in handling the concentrate and avoid contact with it. Mix the proper amount in a gallon container, such as a sprinkler can, plainly marked "POISON." Do not use the container for any other purpose. Properly store or discard containers after use. Pour the solution on top of the undisturbed mound. Mound drenches generally do not kill ants immediately and may require several days to be effective.

Granular products: Several products contain insecticides formulated as granules to be applied to individual mounds at the rate specified on the product's label. To treat a single mound, measure the recommended amount in a measuring cup and sprinkle it on top of and

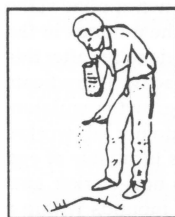
around the mound. Do not disturb the mound. When instructed, use a sprinkling can to water the mound gently to avoid disturbing the colony. Several days may be required before the entire colony has been killed.

Dusts: Some products, such as those containing 75% acephate, are specially labeled for dusting individual fire ant mounds. Distribute the recommended rates of the powder evenly over the mound. The colony should be eliminated within about 1 week. Acephate can also be mixed for use as a mound drench.



Injectable products: Products containing pyrethrins, tetramethrin or chlorpyrifos are manufactured in special aerosol containers to which an injection rod can be attached. The rod is inserted into the mound in a number of places, according to instructions on the label, and the pesticide is injected for a specified time into each mound. Smaller mounds may require less insecticide. Products containing pyrethrins immediately kill ants in the mound.

However, foraging workers outside the mound are not affected. These products are more expensive and time consuming to use, but tend to give faster results than mound drenches. Special equipment is required to apply PT® 270 Dursban® (chlorpyrifos) and Earthfire® (resmethrin).



Baits: These products contain pesticides formulated on a bait of processed corn grit coated with soybean oil. Baits can be applied around individual mounds or broadcast over larger areas at rates specified on the product labels. As individual mound treatments, bait products are slower acting and often more expensive than other methods. Several criteria must be met to achieve satisfactory results with these products:

1. Use *fresh* bait, preferably from an unopened container or one which has been tightly resealed and not stored for more than 2 years.
2. Apply when the ground and grass are dry and no rain is expected for the next 24 hours.
3. Apply when worker ants are actively foraging. This can be determined by leaving a small pile of the bait in the area to be treated. When ants are seen actively removing the bait 10 to 30 minutes later, you will know both that the bait is attractive and that ants are foraging. Foraging activity is reduced during cold periods (when soil temperature is 70 degrees F or lower).
4. Apply in late afternoon or early evening. During hot summer days, worker ants forage during the night and are inactive during the day.
5. Treat individual mounds by sprinkling the recommended amount of product around (up to 3 feet away) an undisturbed mound.

The time required for ants in treated mounds to die depends on the active ingredient used. Amdro® (hydamethylnon) usually eliminates ants in about a week. Fire Ant Ender™ and PT370 Ascend™ (avermectin) have some toxic effect on worker ants at high doses, but still require several weeks to achieve control. Ant activity in mounds treated with Logic® (fenoxycarb) may be seen for 5 weeks or longer following treatment as worker ants slowly age and die (also see the Broadcast Application section).

Bait stations: Max Force® (hydamethylnon), available from pest control operators, is registered for fire ant control indoors. The bait station is placed where foraging ants are observed. It may take several weeks to eliminate the colonies from which the ants are foraging.

Broadcast application

Contact insecticides: Several products are labeled for broadcast application. Granular formulations are applied with fertilizer spreaders and liquid formulations can be applied with a high volume

hydraulic sprayer. These materials must be thoroughly watered into the soil after application. Products containing carbaryl, chlorpyrifos, diazinon or isofenphos are long-acting, contact insecticides which primarily suppress foraging ant activity and prevent small mounds from becoming established. In some cases and through repeated use, these treatments can eliminate colonies.

Bait-formulated insecticides: For broadcast application, these products are applied at very low rates (1.0 to 1.5 pound of product per acre) and require special, properly calibrated application equipment (see the section on broadcast applicators). Applicators such as fertilizer spreaders with rotary-type agitators cannot be used because the oily bait tends to "cake up" during treatment. Furthermore, the bait loses attractiveness if applied as a mix with other materials such as fertilizer. Calibration of broadcast equipment is affected by bait particle size and oiliness. Calibration should be checked before application. Refer to the discussion of bait formulations in the section on individual mound treatments for product characteristics and the proper timing of application.

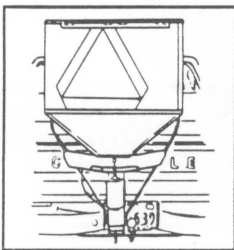
Bait products contain different active ingredients that work in unique ways. Amdro® (hydramethylnon) kills ants that ingest it by interfering with their ability to convert food into energy. When applied at the broadcast rate, ant activity in 80 to 90 percent of the mounds in the treated area will cease within about 5 weeks. Mounds active after this time may not have been affected by the bait. The active ingredients fenoxycarb and avermectin act primarily as insect growth regulators when applied at broadcast rates. These products do not kill worker ants or queens. Instead, they render most queens incapable of egg production and cause the brood to develop into non-worker ants (winged males and sterile females). Reduction of mounds within a treated area is slow, requiring several weeks to many months while worker ants die off. During this period, weakened mounds in the treated area apparently prevent colonization by newly-mated queen ants, providing an extended period of suppression which may last more than a year after treatment.

Broadcast applicators for baits



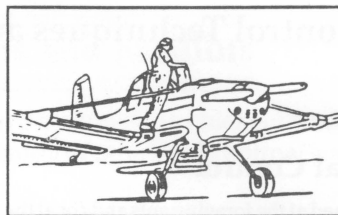
Manual spreaders: The least expensive applicators for treating small areas are hand-powered seed spreaders such as the Cyclone Seed Sower®, Ortho Whirlybird®, Republic or Scott's Hand-held Spreaders. These devices can be used with the operator either walking or riding on the back of a vehicle. The rate of application varies with characteristics of the bait, the setting of the flow outlet and the speed at which the applicator is moving. Thus, calibration is

necessary prior to each application. Some push-type applicators such as Spyker® model 24 and 44 also may be suitable, but some modification (attach fire ant plate) may be required to keep from applying too much material.



Electric spreaders: The Herd Model GT-77A®, Cyclone Spreader Model M-3® or similar applicators are preferred. These spreaders have vibrating opening plates and rotating spreading discs or fans. Swath width is either pre-set or can be adjusted with a rheostat. Applicators can be mounted on any vehicle that will maintain a low speed. Follow instructions provided with the equipment to calibrate the applicator.

Slight adjustments in the flow outlet setting and in bait characteristics (particle sizes) can cause bait flow to vary greatly. Do not use ground-driven or power take off-driven equipment.



Aerial application: Fire ants can be suppressed on privately owned land by applying baits by air. If applications are to be made by a commercial aerial applicator, the pilot is responsible for delivering the proper rate. To achieve the best results, some modifications

should be made to the single engine aircraft and application equipment. For a description of these modifications and calibration instructions, obtain instructions from the product manufacturers.

Non-chemical Control

Natural and biological control

A number of organisms kill newly-mated fire ant queens. These include dragonflies, other ants, some birds, lizards, spiders and toads. Animals that eat ants, such as armadillos, may disturb mounds and eat some workers, but are not really useful in control. Currently, the best method for the biological control of fire ants is the preservation and encouragement of native ant species such as the little black ant (*Monomorium minimum*) and others, that compete with the fire ant for territory and resources and attack queen ants. Broadcast applications of baits eliminate many native ants species and may encourage fire ant populations when their use is discontinued.

Some parasites and pathogens are known to attack ants. Several of these organisms have been marketed for fire ant control. One is a predatory mite that feeds on and paralyzes developing fire ants. This method of control has not been found to be effective when applied as directed, and is potentially hazardous to the user. A second organism is a parasitic nematode. These roundworms seek out and enter insects, paralyzing them and developing in their bodies. Although ants in treated mounds will temporarily move away from the treated mound, few colonies are actually eliminated. Other organisms such as parasitic fungi and insects are currently being evaluated for control. There is hope that natural enemies of the fire ant can be imported from South America and released in the United States to provide some fire ant suppression.

"Organic" insecticides

Only a few "organic" insecticides are currently available for fire ant control (see table page 14). Several botanical (plant derived) products containing nicotine sulfate, pyrethrins or rotenone have been formulated to drench individual mounds. Diatomaceous earth (D. E.), the crushed silica (SiO₂) containing shells of diatoms, will kill some ants, but ant activity in treated mounds is rarely eliminated. D. E. by itself is not a registered insecticide for fire ant control. Products containing synergized pyrethrins, alone or in formulations, perform better. Boric acid (B(OH)₃) is formulated in several baits for use indoors to control sweet-eating ants, not specifically fire ants. These products have not been shown to eliminate fire ant colonies. One product containing a boric acid bait (Bushwhacker® Fire Ant Killer) is registered for broadcast application in ornamental turf areas to control fire ants. In laboratory tests, this material temporarily eliminated larval development in treated colonies. However, scientifically acceptable field test data supporting this product's claims have not been produced.

Physical and mechanical methods

Fire ants can be suppressed by several mechanical methods. These may be appropriate in certain situations.

Boiling water is reported to be a fairly effective treatment for individual fire ant mounds. Approximately 3 gallons of hot water poured on each mound will eliminate about 60 percent of the mounds treated. Surviving mounds will need to be treated again. This method may work well in certain situations, but care must be taken not to pour hot water on desired plants and grass. Use care in handling large volumes of hot water to prevent serious burns.

A mound can be dug up and moved or dispersed. When disturbing mounds with implements, care must be taken to prevent fire ants from crawling up the handle of a shovel or out of a bucket. Talcum powder liberally dusted on tool handles or the inner surface of a bucket will deter most ants from crossing the dusted surfaces.

Colonies in mounds that are regularly disturbed or knocked down may move, but these methods do not eliminate the ants. Nor is it effective to shovel one mound on top of another in an attempt to force the ants to kill each other. Remember that the multiple queen form of the fire ant is tolerant of ants from neighboring mounds. Mixing colonies may encourage the multiple queen form.

To keep ants out of sensitive areas such as wood duck boxes and greenhouse benches, non-chemical barriers can be established with talcum powder and Teflon® or Teflon-like products (EnviroSafe™ Tape or Barrier Spray, Fluon®). These barriers generally lose their effectiveness in very humid or wet conditions. Tanglefoot®, a petroleum-based sticky material available as a gel or aerosol, may be effective temporarily, but loses effectiveness when the sticky material becomes coated with dust and other debris. Plates or wires that can be heated to roughly 140 degrees F can be used to form a barrier that ants will not cross. Similarly, electric wires positioned close together so that ants touching both wires are electrocuted can be used (see Control Devices section).

Home remedies

Many "home remedies" have been used or proposed. They are not recommended, but a discussion of some of them is presented here for information only. While these methods often *appear* to work, they rarely control ants. Usually the ant colony simply moves to a new location, or the queen and a few workers remain hidden underground.

Gasoline and other petroleum products have been widely used, and they do kill fire ant colonies. However, petroleum products are dangerously flammable, kill grass and plants around the treated mounds and can seriously pollute the soil.

Other home remedies include soap solutions, cleaning products or wood ashes soaked into the mound, all of which are believed to remove the protective oil coating from the ants. The use of battery acids, bleaches or ammonia products is extremely dangerous. All of these products are generally ineffective and potentially serious pollutants.

Another technique is the sprinkling of grits on fire ant mounds. The theory is that the ants will eat the grits, which will then swell and rupture the ants' stomachs. No scientific research supports this claim. In fact, only the last stage of the developing fire ant is known to ingest solid food. All other life stages feed only on liquids, sugary solutions or grease materials.

Substances released from crushed or grated citrus peels have been reported to be toxic to fire ants, as are other natural substances. However, until proper techniques for applying these naturally occurring chemicals have been developed they are likely to be ineffective.

Control devices

Devices that do not use insecticides do not require labeling by the Environmental Protection Agency, and are often marketed without being scientifically evaluated. The fact that a "control" device is on the market does not indicate that the device is effective. These products may kill some ants, but they are often incapable of eliminating a colony. Deceptive trade practices can be reported to the Federal Trade Commission.

Various mechanical and electrical products have been marketed for fire ant control. One device is designed to electrocute fire ant workers as they climb onto an electric grid inserted into the mound. It will kill many worker ants, but the queens and brood are unaffected. Other devices use explosive elements, microwaves, vibrating and sound-producing units designed to heat, repel and/or blow up mounds. Most of these devices are expensive, labor intensive, not scientifically validated and of questionable value for the control of fire ants.

SAFE AND EFFECTIVE USE OF INSECTICIDES

The user is always responsible for the effects of pesticide residues, as well as problems that could arise from drift or movement of the pesticide to neighboring areas. ALWAYS READ AND FOLLOW CAREFULLY THE INSTRUCTIONS ON THE CONTAINER LABEL.

Be sure to use the recommended amount of insecticide as specified on the product's label.

- 1 gallon = 4 quarts = 8 pints = 16 cups = 128 fluid ounces
- 1 fluid ounce = 2 tablespoons
- 1 tablespoon = 3 teaspoons
- 1 cup = 8 fluid ounces
- 1 pint = 2 cups

Proper disposal of left over pesticides and "empty" or used containers is an essential step in safe pesticide use. For additional information see Extension publication L-1088, "Disposal - Pesticide and Pesticide Containers."

POLICY STATEMENT FOR MAKING CHEMICAL CONTROL SUGGESTIONS

The Texas Agricultural Extension Service bases its suggestions for uses of pesticides on:

- Product effectiveness;
- Avoidance of residues in excess of allowable tolerances;
- Avoidance of toxicity to desirable vegetation and animals, and to humans; and
- Avoidance of adverse side effects upon beneficial predators and parasites, honeybees, fish and other wildlife, plants, animals and humans.

Suggested pesticides must be registered and labeled for use by the Environmental Protection Agency and the Texas Department of Agriculture. The status of pesticide label clearances is subject to change and may have changed since this publication was printed. County Extension agents and appropriate specialists are advised of changes as they occur.

PRODUCTS REGISTERED FOR ANT AND FIRE ANT CONTROL, 1989-1993

Below is a partial listing of insecticides registered for use to control "ants" and "red imported fire ants" (as indicated by *). Some products registered for control of ants may be ineffective for fire ant control as formulated or applied, although they can be legally used to try to control this ant species. This list is intended to provide an inventory of available control products and product information. There may be other products registered for ant or fire ant control not listed below. Mention of specific products is not intended as a recommendation for their use.

CODE KEY

* = LABEL CONTAINS SPECIFIC MENTION OF FIRE ANTS

Toxicity (TOX):

CAU = Caution, slightly toxic
 WAR = Warning, moderately toxic
 DAN = Danger, highly toxic

Availability (AVAIL):

GEN = Consumer-type retail, non-restricted use
 PCO = Pest control operator, agricultural, commercial only
 RES = Restricted use pesticide

Form (as supplied):

AERO = aerosol
 LIQU = liquid, emulsifiable concentrate or flowable
 DUST = dust
 W.P. = wettable powder
 M.E. = microencapsulated
 GRAN = granular
 BAIT = bait
 S.R. = slow release formulation

Site (abbreviations):

LAWN = lawns, recreational areas, ornamentals
 TURF = turf, commercial production

STRO = outdoor structural barrier spray
 HOUS = household, indoor
 INDO = indoor, commercial incl. food areas
 ORNA = ornamentals, commercial production
 PAST = pasture
 ORCH = non-bearing citrus and/or pecan orchards
 ELEC = electrical and utility units
 UTIL = utility equipment
 HPAS = horse pasture
 PECAN ORCH = pecan orchard floor treatment

Use:

SA = surface applications, spot or area treatments
 MD = individual mound treatments
 BT = bait stations
 PM = potting media mix treatment
 TB = T-band at-planting application
 AE = aerosol and fog generators, some total release
 FU = fumigant
 PT = paint, paint additive
 BB = broadcast application of bait
 DP = dispenser

CHEMICAL AND PRODUCT NAME	TOX	AVAIL	FORM	SITE(S)	USE
Accephate					
Orthene PCO Formula II	CAU	PCD	W.P.	INDO, STRO	SA
*Orthene Fire Ant Killer (75%)	CAU	GEN	DUST	LAWN	MD
*Orthene Turf and Ornamental Spray (75%)	CAU	GEN	DUST	LAWN, TURF, PAST	MD
*Ortho Systemic Insect Control (9.4%)	WAR	GEN	LIQU	LAWN	MD
Whitmire PT280	CAU	PCO	AERO	INDO	SA
Allethrin					
Black Flag House and Garden Insect Killer	WAR	GEN	AERO	LAWN, HOUS	SA
Black Flag House and Garden Formula D	CAU	GEN	AERO	LAWN, HOUS	SA
Black Flag Triple Active	CAU	GEN	AERO	HOUS	SA
d-Con Four\Gone Formula II	CAU	GEN	AERO	HOUS	AE
d-Con House and Garden Bug Killer	CAU	GEN	AERO	LAWN, HOUS	SA
d-Con Stay Away Outdoor Fogger	CAU	GEN	AERO	LAWN	SA, AE
Hot Shot Roach and Ant Killer	CAU	GEN	LIQU	HOUS	SA
Hot Shot Roach and Ant Killer Formula 111	CAU	GEN	AERO	HOUS	SA
Whitmire PT555 Allethrin Insect Fogger	CAU	PCO	AERO	INDO	SA
Arsenic					
Black Flag Antrol Ant Killer	DAN	GEN	BAIT	HOUS	BT
Terro Ant Killer	WAR	GEN	BAIT	HOUS	BT
Avermectin B1					
*Fire Ant Ender	CAU	GEN	BAIT	LAWN, TURF	BB, MD
*PT 370 Ascend	CAU	PCO	BAIT	LAWN, TURF	BB, MD
Bendiocarb					
*Dexa-Klor Dust	CAU	GEN	DUST	HOUS LAWN	SA MD
Ficam D (1%)	CAU	GEN	DUST	STRO, LAWN	SA
Ficam (29.45%) Plus + 3.06% pyrethrins	WAR	PCO	W.P.	LAWN, STRO, INDO	SA
*Ficam (76%)	WAR	RES	W.P.	LAWN	MD
Ficam (2%)	CAU	PCO	GRAN	LAWN, TURF, ORNA	SA
Green Light Roach & Ant Killer Powder	CAU	GEN	DUST	HOUS	SA
Green Light Ant Killer Dust (1%)	CAU	GEN	DUST	HOUS	SA
*Nor-Am Bendiocarb Homeowner Dust (1%)	CAU	GEN	DUST	LAWN, STRO, INDO LAWN	SA MD
*Rotate 2.5G	CAU	GEN	GRAN	ORCH	SA, MD
Turcam (2.5%)	CAU	RES	GRAN	LAWN, TURF, ORNA	SA
*Turcam (76%)	WAR	RES	W.P.	LAWN	MD

CHEMICAL AND PRODUCT NAME	TOX	AVAIL	FORM	SITE(S)	USE
Bifenthrin					
*Talstar T&O	CAU	PCO	GRAN	ORNA	PM
*Talstar 10WP	CAU	PCO	W.P.	ORNA	PM
Boric acid					
Borid	CAU	GEN	DUST	INDO	SA
Bushwacker (TM) Fire Ant Killer	CAU	GEN	BAIT	LAWN, ORNA	BB
TPC 300 Aerosol (20%)	WAR	GEN	AERO	STRO, INDO	SA
Drax ant kill-PF	CAU	GEN	BAIT	HOUS, INDO, STRO	BT
Carbaryl					
*Chipco Sevimol	CAU	PCO	LIQU	LAWN, TURF, ORNA	SA,MD
Drexel Carbaryl 80S	WAR	GEN	W.P.	LAWN, STRO	SA
Drexel Carbaryl 4L	CAU	GEN	LIQU	LAWN, STRO	SA
Drexel Carbaryl 2L	CAU	GEN	LIQU	LAWN, STRO, HOUS	SA
Green Light 10% Sevin Dust	CAU	GEN	DUST	LAWN, TURF	SA
Green Light 5% Sevin Dust	CAU	GEN	DUST	LAWN	SA
Green Light Liquid Flowable Sevin	CAU	GEN	LIQU	LAWN	SA
Martin's Vegetable Dust (+ 1% rotenone)	CAU	GEN	DUST	LAWN	SA
Martin's 50% Sevin Wettable Powder	CAU	GEN	W.P.	LAWN	SA
Martin's 10% Sevin Dust	CAU	GEN	DUST	LAWN	SA
Martin's Liquid Sevin	CAU	GEN	LIQU	LAWN, HOUS, STRO	SA
Ortho Bug-Geta Plus Snail, Slug & Insect Granules	CAU	GEN	GRAN	GARDEN	SA
Rigo Liquid Sevin	CAU	GEN	LIQU	LAWN, ORNA	SA
Savit 4F	CAU	PCO	LIQU	LAWN, ORNA	SA
Savit 80W	WAR	GEN	W.P.	LAWN, ORNA	SA
*Sevin 4F	CAU	PCO	LIQU	LAWN, ORNA, PAST	MD
*Sevin 50W	CAU	PCO	W.P.	LAWN, PAST	MD
*Sevin 80S	WAR	PCO	W.P.	LAWN, PAST	MD
*Sevin SL	CAU	PCO	LIQU	TURF, ORNA, PAST	MD
*Sevin XLR Plus	CAU	GEN	LIQU	LAWN, ORNA, PAST	MD
Chlorpyrifos					
*Black Flag Fire Ant Killer	CAU	GEN	LIQU	LAWN	MD
Black Flag Yard & Patio Spray	CAU	GEN	LIQU	LAWN	SA
Black Flag Super Spray	CAU	GEN	LIQU	HOUS	SA
*Cessco Instant Fire Ant Control	CAU	GEN	AERO	LAWN	MD
CIA APC	CAU	GEN	LIQU	HOUS, INDO, STRO	PT
CPF Insecticide 2D	WAR	GEN	LIQU	STRO	PT
*Drexel Chlorpyrifos 0.5G	CAU	GEN	GRAN	LAWN	SA
*Dursban 50W	WAR	PCO	W.P.	STRO, ORNA	SA
*Dursban 4E Turf Insecticide	WAR	PCO	LIQU	INDO	SA
*Dursban 50W, packets	WAR	PCO	W.P.	*TURF, STRO, *ORNA	SA
*Ford's Primacide Fire Ant Dust	CAU	GEN	DUST	LAWN	MD
*Ford's Ultra S.S.C.12-2.5	WAR	GEN	LIQU	STRO, INDO	SA
Green Light Roach and Ant Spray	CAU	GEN	LIQU	LAWN, HOUS	SA
Green Light Flea & Tick Granules	CAU	GEN	GRAN	LAWN, HOUS	SA
Green Light Indoor Flea and Tick Spray	CAU	GEN	LIQU	HOUS	SA
*Green Light Fire Ant Mound Drench	CAU	GEN	LIQU	LAWN	MD
*Green Light Fire Ant Killer	CAU	GEN	LIQU	LAWN, ORNA	MD
*Green Light Fire Ant Killer II	CAU	GEN	GRAN	LAWN	SA, MD
*Green Light Double Dursban	CAU	GEN	GRAN	LAWN, HOUS	MD
Green Light Dursban Granules	CAU	GEN	GRAN	LAWN	SA
Green Light Many Purpose Dursban Conct.	CAU	GEN	LIQU	LAWN, HOUS	SA
*Hyponex Fire Ant Extinguisher	CAU	GEN	AERO	LAWN	MD
Insecta Latex Paint	CAU	GEN	LIQU	INDO	PT
Killmaster II	CAU	PCO	LIQU, S.R.	INDO, STRO, UTIL	SA, PT
Lesco Fertilizer with Dursban	CAU	GEN	GRAN	LAWN	SA
*Lesco Lawn and Ornamental 4E Insecticide	WAR	PCO	LIQU	LAWN ORNA	SA, MD PM
Lesco Lawn and Ornamental Insecticide	CAU	PCO	LIQU	LAWN, INDO	SA
Lesco 2.23 Granular Insecticide	CAU	PCO	GRAN	TURF	SA
*Lorsban 4E Insecticide	WAR	GEN	LIQU	PECAN ORCH	SA
*Lorsban 15G	CAU	GEN	GRAN	CORN, SORGHUM PECAN ORCH	TB SA
*Lorsban 50W	WAR	GEN	W.P.	PECAN ORCH	SA
Martin's Dursban Pest Control	CAU	GEN	LIQU	HOUS	SA
Martin's Dursban 2 1/2% Granules	CAU	GEN	GRAN	LAWN	SA

CHEMICAL AND PRODUCT NAME	TOX	AVAIL	FORM	SITE(S)	USE
Martin's Dursban Lawn Spray	CAU	GEN	LIQU	LAWN	SA
Martin's Dursban Insecticide Granules	CAU	GEN	GRAN	LAWN	SA
Ortho Dursban Grub and Insect Control	CAU	GEN	GRAN	LAWN	SA
Ortho Home Pest Insect Control	CAU	GEN	LIQU	HOUS	SA
Ortho Ant, Roach, and Spider Killer	CAU	GEN	AERO	HOUS	SA
Ortho Outdoor Ant, Flea, and Cricket Spray	CAU	GEN	LIQU	STRO	SA
*Ortho Fire Ant Control	CAU	GEN	LIQU	LAWN	MD
*Ortho-Klor Ant Killer Dust	CAU	GEN	DUST	LAWN	MD
*Ortho-Klor Soil Insect and Termite Killer	WAR	GEN	LIQU	LAWN	MD
*Ortho-Klor Ant Killer Dust	CAU	GEN	DUST	LAWN	MD
Pageant DF	WAR	PCO	W.P.	TURF, ORNA	SA
Rainbow Insect Control	CAU	PCO	GRAN	ELEC	SA
Rid-a-Bug Brand pre-mixed	CAU	GEN	LIQU	HOUS	SA
*Rid-a-Bug Fire Ant Killer	CAU	GEN	LIQU	LAWN	MD
Rigo Lawn Granules	CAU	GEN	GRAN	LAWN	SA
Rigo Flea and Tick Granules	CAU	GEN	GRAN	LAWN	SA
*Rigo Lawn & Ornamental Spray	CAU	GEN	LIQU	LAWN, STRO LAWN, ORNA	SA MD
Rigo Ant Granules	CAU	GEN	GRAN	LAWN	SA
*Whitmire PT270 Dursban	WAR	PCO	LIQU	LAWN, INDO	SA, MD
Cyfluthrin					
Tempo 2	CAU	PCO	LIQU	STRO, ORNA	SA
Tempo 20WP	CAU	PCO	W.P.	STRO	SA
Cypermethrin					
Cynoff WP Insecticide	WAR	PCO	W.P.	STRO, INDO	SA
Demon (25% EC)	WAR	PCO	LIQU	STRO, INDO	SA
Demon (40% WP)	WAR	PCO	W.P.	STRO	SA
Ford's Viper Insecticide Concentrate	WAR	PCO	LIQU	STRO, INDO	SA
Diazinon (Not for use on golf courses or sod farms)					
Diazinon 4EC	WAR	PCO	LIQU	LAWN, INDO	SA
Diazinon, AG-4 Insecticide	WAR	GEN	LIQU	LAWN	SA
Diazinon DZN 2.0M.E.C.	DAN	PCO	M.E.	INDO	SA
Drexel D-264 4E	WAR	PCO	LIQU	LAWN	MD
				INDO	SA
Drexel Diazinon Insecticide	WAR	GEN	LIQU	LAWN	SA
Green Light Diazinon	CAU	GEN	LIQU	LAWN	SA
*Green Light Many Purpose Dust	CAU	GEN	LIQU	LAWN	SA
*Green Light Fire Ant Control	CAU	GEN	GRAN	LAWN	MD
*Green Light Diazinon 14% Granules	CAU	GEN	GRAN	LAWN	MD
*Green Light Diazinon 5% Granules	CAU	GEN	GRAN	LAWN	MD
Lesco 30-5-7 Fertilizer Plus Diazinon	CAU	GEN	GRAN	LAWN	SA
Martin's Ant Granules	CAU	GEN	GRAN	LAWN	SA, MD
*Martin's Fire Ant Killer	CAU	GEN	GRAN	LAWN	MD
Martin's Diazinon 12.5E Lawn and Garden	CAU	GEN	LIQU	LAWN	SA
Martin's Diazinon Household Insect Spray	CAU	GEN	LIQU	HOUS	SA
Martin's 5% Diazinon Granules	CAU	GEN	GRAN	LAWN	MD
Martin's Granular Lawn Insect Control	CAU	GEN	GRAN	LAWN	MD
Martin's Diazinon Ant and Roach Control	CAU	GEN	AERO	HOUS	SA
Mr. Scott's Do It Yourself Pest Control	CAU	GEN	LIQU	LAWN, HOUS	SA
Ortho Diazinon Granules	CAU	GEN	GRAN	STRO	SA
				LAWN	MD
*Ortho Diazinon Insect Spray	WAR	GEN	LIQU	LAWN, STRO	SA
*Ortho Fire Ant Killer	CAU	GEN	GRAN	LAWN	MD
Pennwalt Knox Out 2ME	CAU	GEN	M.E.	INDO	SA
*Rigo Diazinon 2E Insect Spray	CAU	GEN	LIQU	LAWN	MD
Spectracide Ant and Roach Control	CAU	GEN	AERO	HOUS	SA
Spectracide Crawling Insect Control Gran.	CAU	GEN	GRAN	LAWN	MD, SA, PM
Spectracide 6000 Lawn and Garden	CAU	GEN	GRAN	LAWN, STRO	SA
*Spectracide Lawn and Garden Insect Control	WAR	GEN	LIQU	LAWN	MD
Spectracide Professional Home Pest Control	CAU	GEN	AERO	HOUS	SA
T&O Diazinon 50WP Insecticide	WAR	RES	W.P.	LAWN	SA
T&O Diazinon 4EC Insecticide	WAR	RES	LIQU	LAWN	SA
Whitmire PT260 Diazinon	CAU	GEN	AERO	INDO	SA
Whitmire PT265 Knox Out 2FM	CAU	GEN	M.E.	INDO	SA
Whitmire PT265A Knox Out	CAU	GEN	AERO	INDO	SA

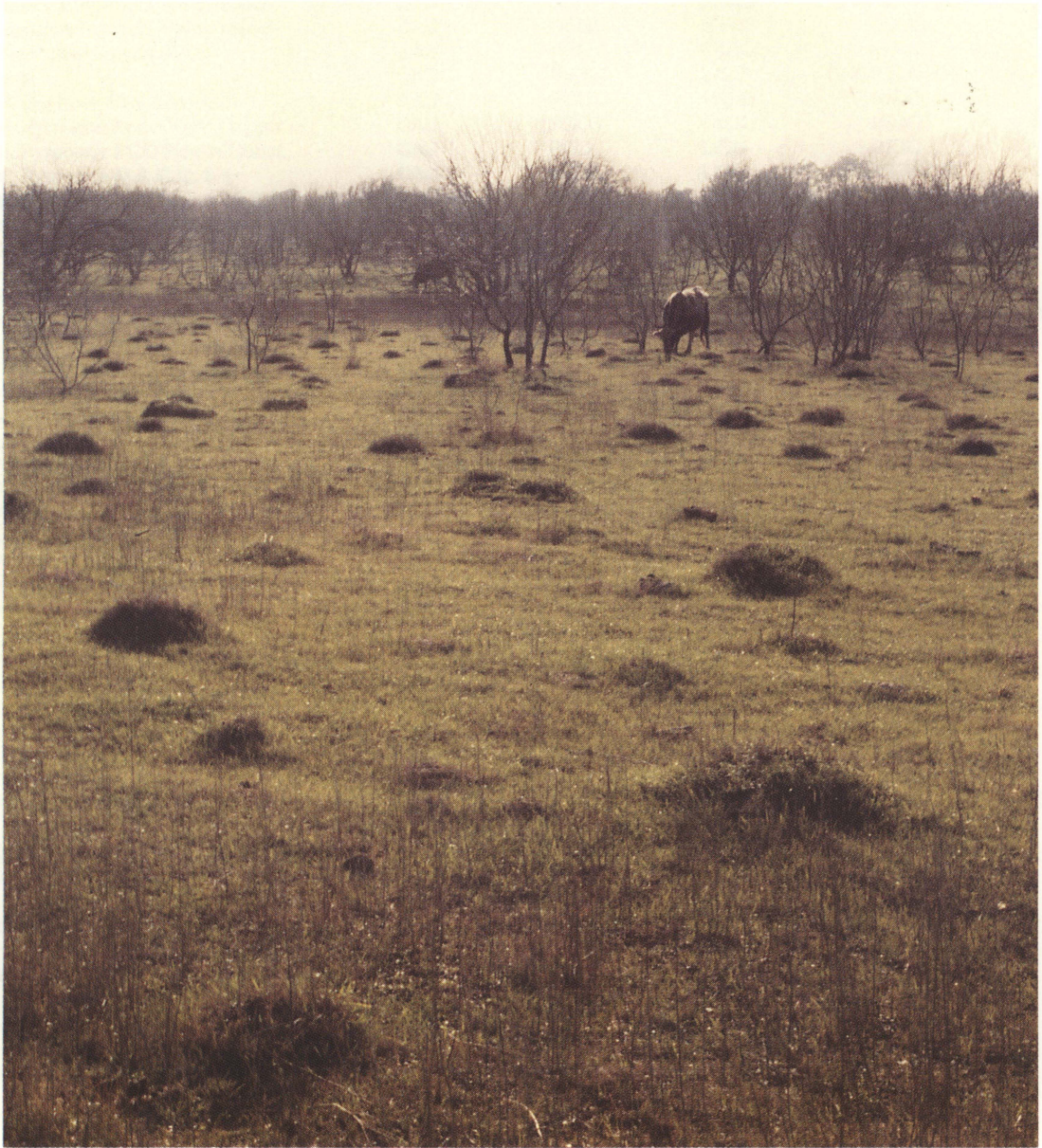
CHEMICAL AND PRODUCT NAME	TOX	AVAIL	FORM	SITE(S)	USE
Dichlorvos					
*Elastrel Insecticide	WAR	PCO	S.R.	ELEC, UTIL	DP
Es-fenvalerate					
Conquer Residual Insecticide Concentrate	WAR	PCO	LIQU	INDO, HOUS, STRO	SA
Fenoxycarb					
*Logic Fire Ant Bait	CAU	GEN	BAIT	LAWN, TURF, ORNA, ORCH, HPAS	BB, MD
*Award Brand of Logic Fire Ant Bait	CAU	GEN	BAIT	LAWN, TURF, ORNA	BB, MD
Fenthion					
Baytex 4	WAR	PCO	LIQU	INDO	SA
Fenvalerate					
Pest Control Products F-V-S Insect Fogger	CAU	GEN	AERO	INDO	AE
Pyrid	DAN	PCO	LIQU	STRO, INDO	SA
Fluvalinate					
Mavrick	CAU	PCO	LIQU	TURF	SA
Yardex	CAU	PCO	LIQU	TURF, ORNA	SA
Hydramethylnon					
*Amdro	CAU	GEN	BAIT	LAWN, TURF, PAST	SA, MD
*MaxForce Professional Insect Control	CAU	PCO	BAIT	INDO	BT
*Fertilome Truce Fire Ant Bait	CAU	GEN	BAIT	LAWN, TURF, PAST	BB, MD
Isazophos					
Triumph	WAR	RES	LIQU	LAWN	SA
Isofenphos					
*Oftanol 2 Insecticide (22% EC)	WAR	PCO	LIQU	TURF	SA, MD
*Oftanol (5%G)	WAR	PCO	GRAN	TURF	SA
Malathion					
Drexel Malathion 5EC Insecticide	WAR	GEN	LIQU	HOUS	SA
Nicotine sulfate					
*Natural Guard Nicotine Sulfate	DAN	GEN	LIQU	TURF	MD
Permethrin					
Flee (TM) Insecticide	CAU	PCO	LIQU	INDO, STRO	SA
Dragnet FT Termiticide	CAU	PCO	LIQU	STRO	SA, MD
Pounce 3.2EC	CAU	RES	LIQU	LUMBER, LOGS	SA
*Pramex EC	WAR	GEN	LIQU	LAWN	MD
Pramex Formula 1 Crawling Insect Spray	WAR	GEN	LIQU	INDO, STRO, LAWN	SA, MD
*Prentox Perm-X	WAR	GEN	LIQU	LAWN	MD
*Fertilome Quick-Kill Home, Garden, Pet Insect Concentrate	WAR	GEN	LIQU	INDO, LAWN	SA, MD
Propetamphos					
Safroin	WAR	RES	LIQU	INDO	SA
Propoxur					
Baygon 1.5	DAN	PCO	LIQU	INDO	SA
Baygon 2%	CAU	GEN	BAIT	STRO	BT
Baygon 70%	WAR	PCO	W.P.	STRO	SA
Black Flag Antrol Ant Traps	CAU	GEN	BAIT	HOUS	BT
Black Flag Antrol Ant Powder	CAU	GEN	DUST	HOUS	SA
Black Flag Antrol Ant Killer Spray	CAU	GEN	AERO	LAWN, HOUS	SA
Black Flag Dead Aim Ant and Roach Killer	CAU	GEN	AERO	HOUS	SA
Black Flag Pro. Power Ant and Roach Killer	CAU	GEN	AERO	HOUS	SA
Black Flag Liquid Ant and Roach Killer	CAU	GEN	LIQU	LAWN, HOUS	SA
d-Con Ant and Roach Killer	CAU	GEN	AERO	LAWN, HOUS	SA
Echols Roach, Ant, and Waterbug Killer	CAU	GEN	BAIT	LAWN, HOUS	BT
Fairfield Am., Multi-Purpose 70 WP	WAR	PCO	W.P.	LAWN, INDO	SA
Green Light Roach and Ant Killer	CAU	GEN	LIQU	HOUS	SA
Hot Shot Professional Strength Formula 311	CAU	GEN	AERO	HOUS	SA
Ortho Ant, Roach & Spider Killer	CAU	GEN	AERO	LAWN, HOUS	SA
Ortho Ant Killer Bait	CAU	GEN	BAIT	HOUS	BT
Rigo Insect Spray + .186% DDVP	WAR	GEN	AERO	HOUS	SA
Rigo Roach & Ant Killer + .186% DDVP	CAU	GEN	LIQU	HOUS	SA
Rigo Roach & Ant Spray + .816% DDVP	WAR	GEN	AERO	HOUS	SA
Pyrethrins					
Black Flag Institutional Ant & Roach Spray	CAU	GEN	AERO	HOUS	SA
Black Flag Automatic Room Fogger	CAU	GEN	AERO	HOUS	AE
Black Flag House and Garden Insect Killer	WAR	GEN	AERO	HOUS	SA
Purge CB-40,80	CAU	GEN	AERO	LAWN, HOUS	SA

CHEMICAL AND PRODUCT NAME	TOX	AVAIL	FORM	SITE(S)	USE
Cessco 5E Insecticide	CAU	PCO	AERO	INDO	SA
d-Con Professional Formula Ant & Roach	CAU	GEN	AERO	LAWN, HOUS	SA
d-Con Professional Formula Flying Insect	CAU	GEN	AERO	HOUS	SA
d-Con Double Power Roach & Ant	CAU	GEN	AERO	HOUS	SA
Prentox Exciter	CAU	GEN	LIQU	CROPS, ORNA	SA
Fairfield Am. Drione + 40% Silica Gel	CAU	PCO	AERO	INDO	SA
Fairfield Am. Pyrenone Food Plant Fogger	CAU	PCO	LIQU	INDO	SA, AE
Fairfield Am. Pyrenone PCO Roach Conct.	CAU	PCO	LIQU	INDO	SA
Fairfield Am. Pyrenone M.A.G.C. 5-1	CAU	PCO	LIQU	STRO, INDO	SA
Fairfield Am. Pyrenone M.A.G.C. 12.5-2.5	CAU	PCO	LIQU	LAWN, INDO	SA
Fairfield Am. Pyrenone Industrial Spray	CAU	PCO	LIQU	STRO, INDO	SA
Fairfield Am. Pyrenone Crop Spray	CAU	GEN	LIQU	ORNA, CROPS	SA
Flak 1	CAU	GEN	LIQU	STRO, INDO	SA
Organic Plus Pyrethrins/					
Diatomaceous Earth Insecticide	CAU	GEN	DUST	INDO, HOUS, LAWN	SA, MD
PET Chemical Total Release Aerosol	CAU	GEN	AERO	INDO	AE
Rigo Mist-R-Bug Fogger	CAU	GEN	AERO	HOUS	AE
Rigo House & Garden Pest Killer	CAU	GEN	AERO	HOUS	SA
Sutton JS685 Powder (with silica gel)	DAN	PCO	AERO	INDO	SA
TPC Pro-cide	CAU	GEN	AERO	INDO	SA
Whitmire PT150 Pyrethrum	CAU	PCO	AERO	INDO	SA
Whitmire, PT565 Pyrethrum	CAU	PCO	AERO	INDO	SA
Whitmire PT565 Plus Pyrethrum	CAU	PCO	AERO	INDO	SA
Whitmire Aerocide PT3-6-10 Pyrethrum	CAU	PCO	AERO	INDO	SA, AE
Whitmire PT170A X-clude	CAU	PCO	AERO	LAWN, INDO	SA
Whitmire PT170 X-clude	CAU	PCO	M.E.	INDO	SA
Whitmire PT575 Pyrethrum	CAU	PCO	AERO	INDO	AE
Resmethrin					
*Earthfire Vaporizing Fluid	CAU	GEN	LIQU	LAWN	MD
Ford's Ultra S.S.C. - 12-2.5	CAU	GEN	LIQU	STRO, INDO	SA
Hot Shot House & Garden Formula 711	CAU	GEN	AERO	LAWN, HOUS	SA
*Pratt Resmethrin EC 26 Insect Spray	WAR	GEN	LIQU	LAWN, STRO	SA
Rid-a-Bug Quick Kill	CAU	GEN	AERO	HOUS	SA
Vectrin 0.5% Insecticide	CAU	GEN	LIQU	INDO	SA
Whitmire PT550 Resmethrin	WAR	PCO	AERO	INDO	SA, AE
Rotenone					
*Noxfire Insecticide	WAR	GEN	LIQU	LAWN, GARDEN	MD
*Bonide Rotenone 5 Organic Insecticide	CAU	GEN	LIQU	LAWN	MD
S-bioallethrin					
Gold Crest Vectrin LO Insecticide	CAU	PCO	LIQU	HOUS, INDO	SA
Sumithrin					
Whitmire AeroCide PT120 Sumithrin	CAU	PCO	AERO	INDO	AE
Tetramethrin					
*Enforcer Fire Ant Killer	CAU	GEN	AERO	LAWN	MD
Ortho Household Insect Killer Formula II	CAU	GEN	AERO	HOUS	SA
Ortho Home & Garden Insect Killer	CAU	GEN	AERO	LAWN, HOUS	SA
Tralomethrin					
*Saga WP Insecticide	WAR	PCO	W.P.	INDO, STRO	SA
Trichlorfon					
Prentox Larva-Lur	CAU	GEN	LIQU	INDO, STRO	SA
Mixtures					
Misty Fire Ant Killer Concentrate containg resmethrin plus chlorpyrifos	CAU	GEN	LIQ	INDO, STRO, HOUS, LAWN, ORNA	SA

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