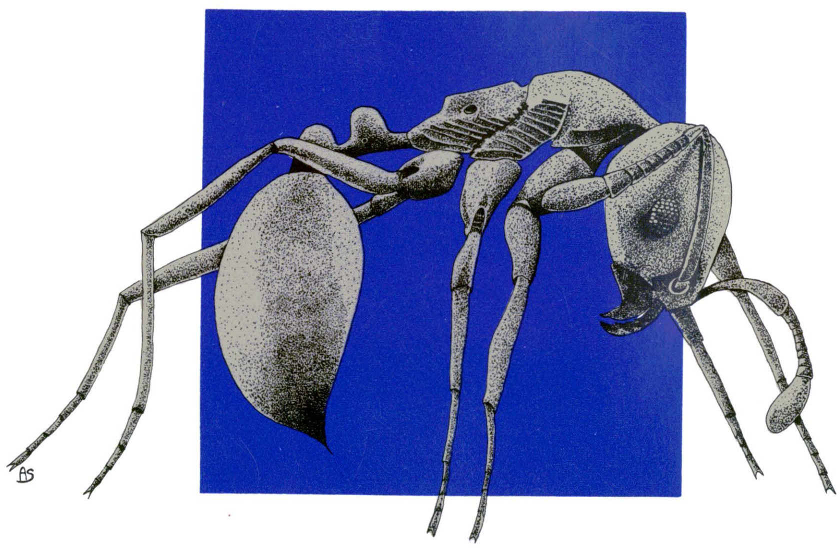
IMPORTED FIRE ANTS:
LIFE HISTORY AND IMPACT



TEXAS DEPARTMENT OF
AGRICULTURE

IMPORTED FIRE ANTS:
LIFE HISTORY AND IMPACT

S. BRADLEIGH VINSON AND A. ANN SORENSEN

DEPARTMENT OF ENTOMOLOGY
TEXAS A&M UNIVERSITY
COLLEGE STATION, TEXAS 77843
—AND—
AGRICULTURAL & ENVIRONMENTAL SCIENCES
TEXAS DEPARTMENT OF AGRICULTURE
P. O. BOX 12847
AUSTIN, TEXAS 78711

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The Imported Fire Ant is small in size, but it has presented much of Texas with a big problem. The Texas Department of Agriculture has put together a comprehensive, realistic program aimed at controlling this pest. The program features specially trained TDA inspectors working hand in hand with homeowners, farmers, ranchers, school and park personnel, county extension agents and others having trouble in the infested parts of the state.

In addition to getting the right information out on the proper treatment procedures, it's important to learn all we can about the life history and biological nature of the Imported Fire Ant. By studying the ant, we learn how and where it lives, what it eats, how it reproduces and how it survives in various geographic locations. All of this information may eventually give us some clues on how to counteract the Imported Fire Ant with natural predators or other means of control.

This booklet, produced with the help of Drs. Ann Sorensen of TDA and Brad Vinson of Texas A&M, is designed for those people wanting to know more about the Imported Fire Ant than the fact it provides a very painful sting.

Jim Hightower

JIM HIGHTOWER

TABLE OF CONTENTS

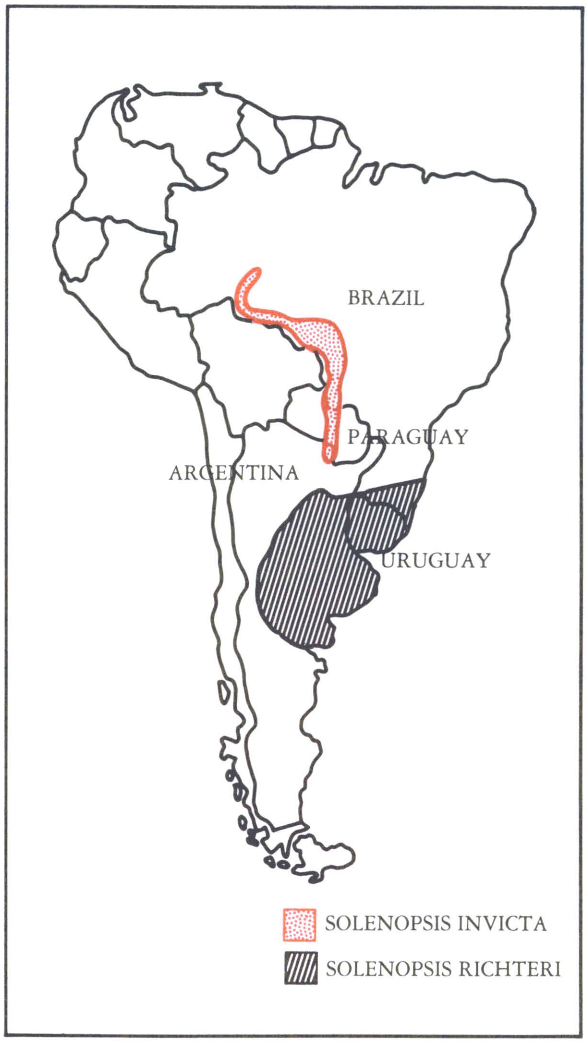


Fig. 1, above. The homeland of the two imported species of fire ants is South America. The black imported fire ant, ***Solenopsis richteri,*** *originated in southernmost Brazil (Rio Grande do Sul), Uruguay and Argentina. The red imported fire ant,* ***S. invicta,*** *comes from the state of Mato Grosso in Brazil. There it lives on the large flood plain formed by the headwaters of the Paraguay River and its tributaries. It is the red imported fire ant that causes most of our problems here in the U.S.*

THE IMPORTED FIRE ANT

The imported fire ant is a difficult problem throughout most of the Southern states, including a good chunk of Texas. In fact, the imported fire ant presents a Texas-sized problem because of its fiery sting. Research continues on the best methods of controlling the imported fire ant, although it should be emphasized that no one is thinking any longer in terms of eradicating the problem. The key word is "control."

It should also be emphasized that while the imported fire ant is a persistent and sometimes painful pest, it can also serve some useful purposes. It is clear that the ant presents many more problems than solutions, but it does feed on boll weevils, ticks and cockroaches among other things. Nevertheless, the ants can prevent people from enjoying their own backyards, damage crops, pose a threat to pets, and invade homes to threaten the elderly and small children. They are also attracted to electrical equipment, causing power outages. Clearly, the imported fire ant has achieved a status that deserves our ongoing efforts to bring it under control.

The following report summarizes what we've learned about the fire ant since its arrival here in the United States from Brazil in the 1940s.

THE SPREAD OF THE IMPORTED FIRE ANT

The imported fire ant (IFA) (Fig. 34) came to the United States from South America. There were probably two separate accidental introductions. The first introduction occurred in Mobile, Alabama, in about 1918 and resulted in the arrival of the black IFA which came from the mouth of the Parana and Uruguay rivers in Argentina and Uruguay (Fig. 1). How this fire ant got to the United States from

South America is not known, but ships transporting products like copra (coconut) to Mobile for processing and refining may have been responsible. Once in Mobile, the black IFA slowly spread into the local area.

In the 1940s the IFA suddenly showed up in five new states (Mississippi, Louisiana, Florida, Georgia and South Carolina). Most of the spread was due to a different ant which we now know as the red IFA. The red IFA was probably introduced into the Mobile area in the 1930s along with cargo from South America, perhaps in the dirt that was being used as ship ballast. The red IFA appears to have come from the headwaters of the Paraguay River located in Northern Argentina, Paraguay and Southern Brazil, a broad flood plain known as the Pantanal (Fig. 1).

The spread of the red IFA in the 1940s was largely due to the transport of sod and nursery root stock infested with IFA from the Alabama Gulf Coast to other areas of the South (Fig. 2). This inadvertent movement of ants was recognized in the 1950s, and the U.S. Department of Agriculture instituted regulations to monitor the shipment of sod and root stock. However, the IFA had already spread to eight Southern states.

Much of the information concerning the source, introduction and early movement of the IFA was unraveled in 1970 when a researcher at the University of Florida realized that two species of imported fire ants had been introduced into the U.S. Although the black IFA was the first species introduced, today it is found only in northeast Mississippi and northwest Alabama.

The red IFA has continued to spread, first entering Texas in 1956. This population was destroyed, but the ants reentered Texas in 1957 (Fig. 2). By 1985 the ants had infested about 250 million acres in much of Florida, South Carolina, Georgia, Alabama, Louisiana and Mississippi, and had invaded parts of North Carolina, Tennessee, Arkansas, Oklahoma and over a third of Texas. As the red IFA has spread, it has replaced the black IFA on the Gulf Coast of Alabama and displaced native fire ants (see Appendix) from many areas of their range. In 1977 the red IFA was discovered in Puerto Rico. It apparently entered the island during the construction of oil refineries on equipment brought in from the Southern United States. It now infests one third of the island.

The red IFA continues to spread primarily in Texas where, from 1957 to 1982, it moved west at the rate of 20—30 miles per year. While its spread has slowed as it has encountered the drier parts of West Texas, the ant is still moving westward. It is expected to move into irrigated areas and along permanent lakes and rivers of West Texas, New Mexico and Arizona.

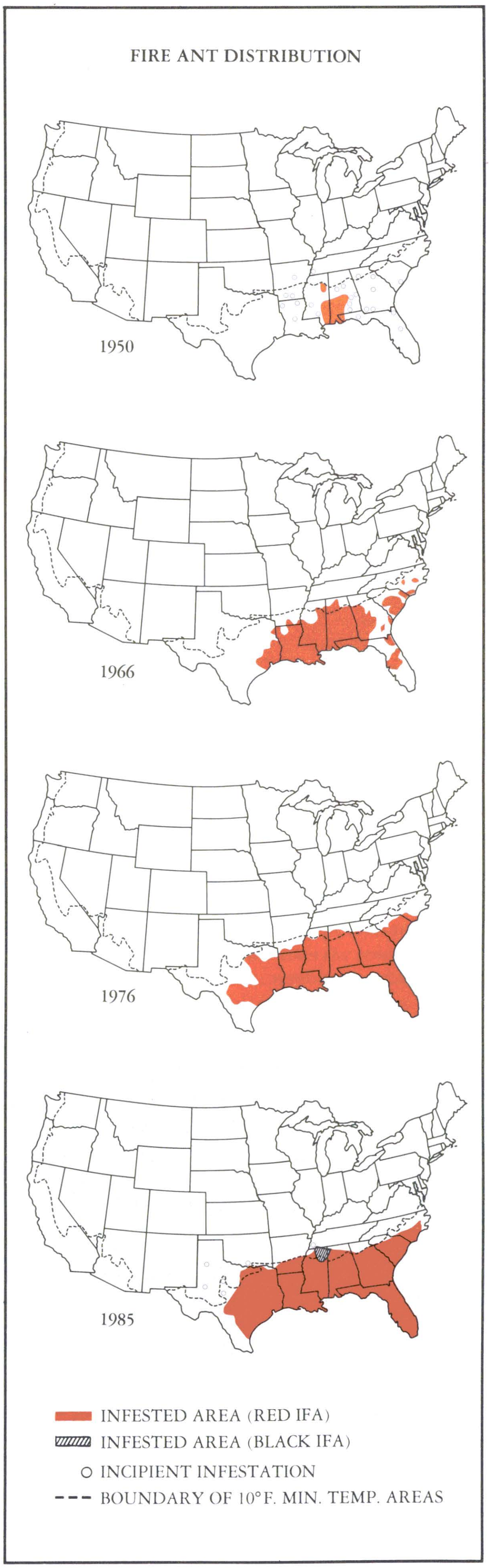


Fig. 2, right. The red imported fire ant has rapidly spread across the Southern United States. The ant first appeared in Mobile, Alabama, in 1918, apparently coming in on ship cargo from South America. By 1940, the ant had infested five Southern states. It was being rapidly spread by shipments of fire ant-infested sod and nursery stock. This inadvertent movement was slowed in the 1950s by regulations imposed by the USDA, but in 1956, the fire ant entered Texas. It presently inhabits 250 million acres in eleven Southern states and also infests part of Puerto Rico.

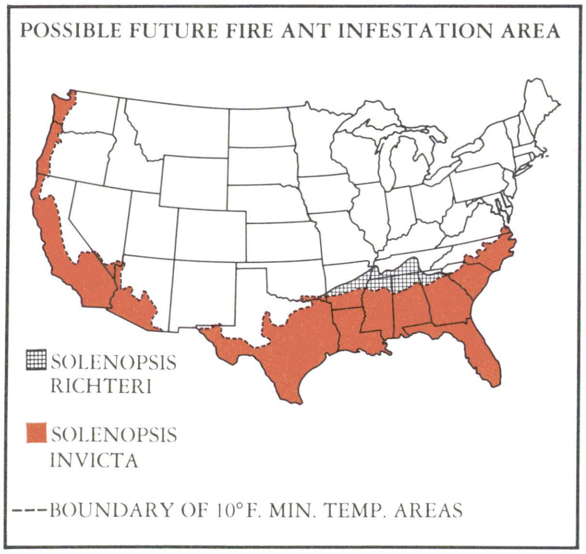


*Fig. 3, above. Based on what is known about the temperature and moisture requirements of the imported fire ant, they may infest a large part of the United States in the future. The black imported fire ant, **S. richteri**, is not expected to greatly expand its range. The red imported fire ant, **S. invicta**, is expected to eventually occupy nearly one-fourth of the United States.*

The red IFA has been moving slowly north through Georgia, and while it invaded southeast North Carolina some years ago, its northeastern movement has been less than expected (Fig. 2). The fire ant cannot withstand long periods of dry or cold conditions. However, it can withstand frost for short periods.

Based on present information, the red IFA is expected to eventually occupy nearly one fourth of the United States wherever average minimum yearly temperatures are greater than 10° F. (Fig. 3). It will be patchily located in those areas receiving less than 10 inches of rain per year.

The red IFA is presently spreading by four methods. These include (1) transport of colonies or mated queens in nursery root stock and sod or in soil used during construction; (2) during natural mating flights, reproductive forms leave the nest, mate in the air and then fly or are blown into new areas; (3) the mated queens may land in trucks, train beds or in other open containers that are moved from place to place; and (4) after being flooded from their mounds by heavy rains, colonies form rafts that float to new locations (Fig. 4).

HOW DOES AN IMPORTED FIRE ANT COLONY BEGIN?

Colonies are individually established by newly-mated queens following a mating flight. When large numbers of newly-mated queens land in the same area they may form small groups that cooperatively begin a new colony. This cooperation may be beneficial to the ants because, as a group, the queens are then better able to defend themselves against competitors and predators. However, once the colony is established, the workers kill all but one of the queens (there may be exceptions to queen killing by workers in multiple-queen colonies, which are discussed later). During the warmer months, mature colonies (a year or so old) produce large numbers of winged male and female ants. These are referred to as reproductives, sexuals or alates, a word meaning "winged form." The winged female is about 3/8-inch long, brownish-red in color and has a head just slightly smaller than her thorax (Fig. 5a). The winged male is black in color and slightly smaller than the female, but his head is distinctly smaller than his thorax (Fig. 5b).

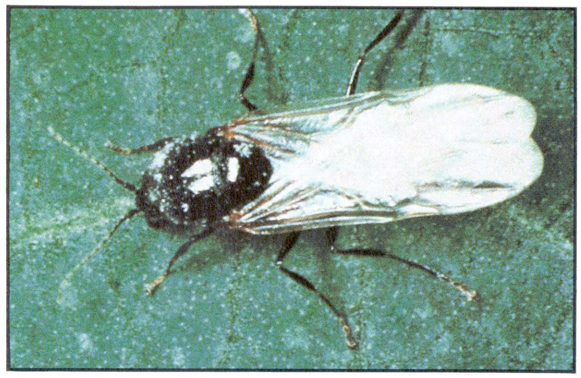
A mature colony can produce as many as 4,500 alates during the year, with six to eight mating flights occurring between the spring and fall seasons. As many as 97,000 queens are produced per acre each year in infested land in the Southern United States. Reproductives mature and accumulate in the colony and only start a mating flight under certain weather conditions. Such flights usually begin around 10:00 in the morning one or two days following a rain, if that day is warm (above 75° F.), not too windy and generally sunny. Usually the males

Fig. 4, above. One of the ways in which imported fire ants can spread is by the flooding of their mounds following heavy rains. The fire ants float on top of water, forming rafts to protect the larvae (immature ants) and queen. They then float to new locations where they reestablish a mound in drier soil. Fire ants can survive long periods of submersion under water, reviving once the water is removed.

leave the mound first, climbing onto small objects and flying off. Females emerge an hour or so later and join the males in the air. During this period IFA mounds are very active with workers running over and around the mounds. Although mating flights can take place in any month of the year in Texas, the best conditions for successful colony establishment occur between April and September.

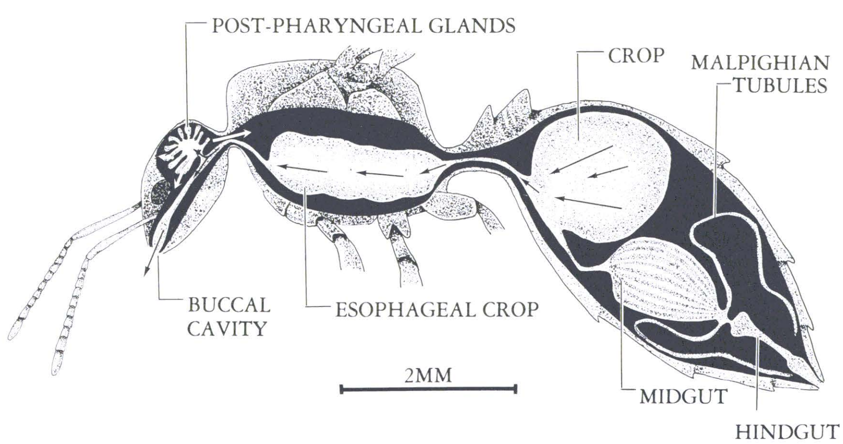
We know very little about the mating habits once flight has begun. Mating probably takes place 300 to 800 feet in the air. After mating, males drop to the ground and die. Females continue to fly and seek reflective or moist areas on which to land. Newly-mated queens can fly as far as 12 miles from their mother colony, but most land between 1/4—1 mile away. Often during the warmer months large numbers of newly-mated queens can be found in swimming pools where they have landed following a mating flight. While this indicates that a mating flight has occurred and that the area may experience increased problems with IFA colonies in the future, the queens themselves are harmless since they never sting. If they land on more suitable sites, they remove their wings and dig a small burrow in the soil, usually under a leaf, rock or in a small crevice. They excavate a small chamber at the end of the burrow and seal it up to prevent the entrance of unwanted guests. It is during and immediately after a mating flight that the fire ant is most vulnerable to predators. During the mating flight, large numbers are eaten by dragonflies and some birds. Many are attracted to bodies of water, such as swimming pools, where they land and drown, or they land in ponds where they are eaten by fish. In fact, a fish may eat so many ants that the sheer number of fire ants consumed kills the fish. Once on the ground they may be consumed by predatory ground beetles, earwigs or spiders. If the queens should land in an area already infested with fire ants, they are killed by workers from established colonies. In areas where fire ants do not occur, the queens may be killed by other ants, generally underground species. Mortality of newly-mated queens may be as high as 90—99% during the mating flight and colony-founding period.

FEMALE ALATE



MALE ALATE

Fig. 5a and 5b, above. Fire ant colonies periodically produce reproductive forms during the warmer months. They mate in the air, and the female drops to the ground, removes her wings and starts a new colony. The male dies shrotly after mating. The winged female (top, 5a) is about 3/8-inch long and brownish-red in color. The winged male (bottom, 5b) is black in color, slightly smaller than the female, and his head is reduced in size. The reproductive forms are also called sexuals or alates, a word meaning "winged form."



ALIMENTARY TRACT OF IMPORTED FIRE ANT QUEEN

Fig. 6, left. The newly-mated fire ant queen begins a colony by herself. Since she doesn't leave her burrow to find food, she must feed the developing larvae from her own body's resources. Oils are stored in her crop before she flies and are regurgitated to the larvae. In addition, her wing muscles degenerate and supply nutrients, and she lays infertile eggs (trophic eggs) which she feeds to the larvae. Drawing by A. A. Sorensen.

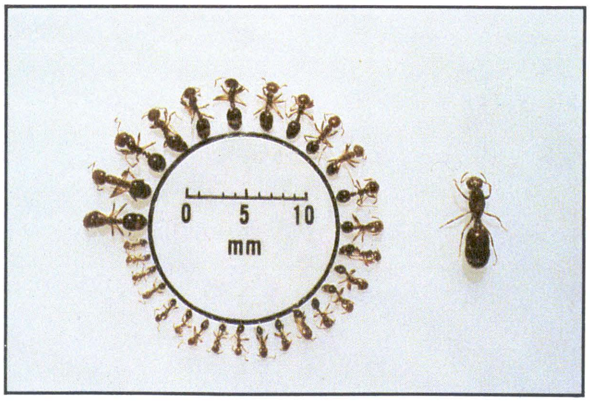
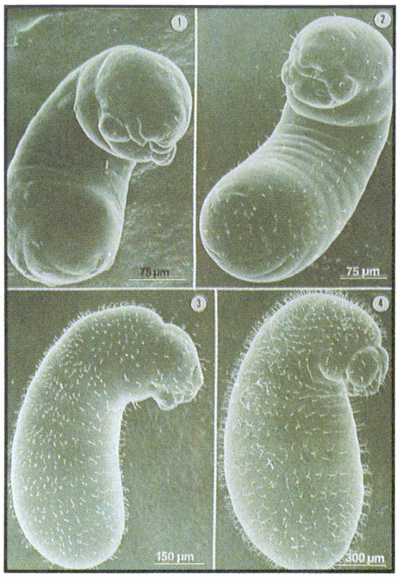


Fig. 7, above. Mature fire ant colonies contain a whole spectrum of different worker sizes. The largest workers are called majors, the medium-sized workers, medias, and the smallest workers, minors. The majority of workers are minors. Although size can be important in determining what kind of food a worker retrieves, the age of the worker largely determines which tasks the worker will perform. All workers are sterile females. A queen is shown on the right. Illustration provided by S. D. Porter.



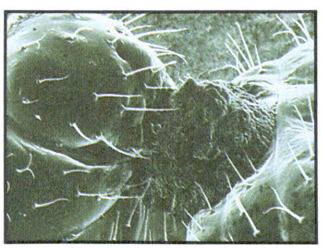


Fig. 8a and 8b, above. Fire ant larvae have four stages of growth called instars (top, 8a). Only the last instar can digest solid food. The first three instars are exclusively fed liquids. The fourth instar larva has a small depression in front of its mouth called the "food basket" (bottom, 8b). Solid foods are placed in this depression by the workers. The larva then regurgitates enzymes that digest and reduce the food to a liquid that can easily be sucked up by the workers.

If the newly-mated queen survives all of these dangers, she will begin a new colony. Within 24 hours the queen begins laying eggs. The first cluster contains 10 to 15 eggs, which hatch in about 8—10 days. By the time these have hatched, she has laid from 75 to 125 more eggs. She then stops laying until the first brood of workers is reared in about two weeks to a month. Later batches of eggs are cared for entirely by the workers. When the first eggs hatch, the queen feeds the young larvae with oils regurgitated from her crop (or stomach), secretions from her salivary glands and infertile eggs (called trophic eggs) which she lays (Fig. 6). The queen's wing muscles, which are no longer needed, break down and supply nutrients for the secretions and trophic eggs which she produces.

The queen does not generally seek food and must successfully rear these first few workers if the colony is to survive. These workers are very small due to the limited amount of food provided by the queen. They are called "minims." Minims open the small burrow made by the queen, locate food, feed the queen and new larvae, and begin construction of the new mound. Within a month, slightly larger workers are produced daily, and the mound begins to grow. Within six months the mound will contain several thousand ants and is readily visible in the field. Such colonies may contain a few large workers (major workers), some medium-sized workers (media workers) and many small workers that are slightly larger than minim workers (minor workers) (Fig. 7). The largest workers in a fire ant colony may weigh up to 10 times as much as the smallest workers. These three types of workers are sterile females that carry out all the tasks of colony life except egg production, which is exclusively a function of the queen. A queen in a large colony is capable of producing her own weight in eggs every day (1,500 or more). A typical mature fire ant colony will contain 80,000 workers, but some mounds contain as many as 240,000 workers.

LIFE IN THE COLONY

While fire ants may be serious pests, an observer cannot help but be impressed with the complexity and order of social insect life. The larvae that hatch from the eggs are fed liquid food provided by the workers who regurgitate the food from their crops (Fig. 11). Larvae have four stages of growth called instars (Fig. 8a). The fourth stage, in addition to receiving liquid food, is also fed bits of solid food brought in by workers. This solid food is placed in a small depression just in front of the larva's mouth (the "food basket") (Fig. 8b). The larvae regurgitate enzymes that digest this food, which is then sucked up. The digested food is regurgitated to adult ants who are not able to digest protein foods by themselves. Some of this digested protein is fed to the queen who needs it for egg production. The protein cycle, in effect, allows a fire ant colony to rapidly respond to food supplies (Fig. 9). As proteins in the form of other insects are brought into a colony, larvae are fed first, and they regurgitate digested proteins or amino acids to workers who feed them to the queen. These amino acids stimulate egg production. As long as there is sufficient food, egg production is maximized. However, if the food supply becomes limited, the larvae regurgitate less, thus reducing the amount of amino acids received by the queen. This results in decreased egg production. If food shortages become serious, workers may even cannibalize some of the larvae, thus reducing the food needs of the colony.

If food is abundantly available during spring through fall, eggs are laid and hatch in 7—10 days into legless, grublike larvae, which are dirty white in color and sparsely covered with recurved hairs. They are dependent on other members of the colony for their care and cannot even move about unassisted. The larva is a stage specialized for feeding and growing, and almost all growth occurs during this period. As in all insects, growth is accomplished by a periodic molting or shedding of the larval skin (cuticle) which allows the larva to expand. Larvae molt three times over a 6—12 day period. On the final fourth molt the larvae enter the pupal stage. For the first time adult structures, such as legs, become apparent. The pupae are shiny white and resemble adult workers in shape. This transitional stage between larva and adult lasts 9—16 days as larval tissues break down and reform to create adult structures. In insects in general, the adult stage is specialized for reproduction and dispersal. With ants, only a few adult individuals are capable of reproduction (queens and males), and the remainder are sterile workers. Newly emerged adults are light in color and are called "callows." They darken within a few days. These younger ants spend several days to weeks with the larvae and act as "nurses." The nurses take care of the eggs, larvae, pupae and the queen. They feed, clean and groom the larvae and queen and help larvae shed their cuticles as they grow and develop. The life span of a worker depends on its size. Minor workers live 30—60 days, medias 60—90 days, and majors 90—180 days or longer. Queens live 2—6 years.

As the nurses age they become "reserves." Reserves help feed and groom the larvae, defend the colony, build and maintain the mound and are recruited to bring back food discovered by the oldest ants, the "foragers." The foragers hunt for the food needed by the colony. Only 10—20% of the workers are foragers, and they are responsible for bringing back enough food to feed the remaining 80—90% of the colony. If a large food source is discovered, the forager lays a chemical trail on the ground (Fig. 10). The chemical comes from a small gland near the sting (Fig. 20). When the forager returns to the colony, it communicates its find by feeding the reserve workers it encounters some of the food it has discovered. Reserves then follow the chemical trail back to the food's source. Through this recruitment system, the ants can find food, return to the colony and rapidly send out legions of other workers to obtain the food before any competitors can reach it.

While adult ants can chew and cut with their mandibles, they can only swallow liquids, which they store in their crops (Fig. 11). In the field, adult ants drink liquid food they encounter and carry it back in their crop. Solid food chunks are chewed up into manageable sizes, picked up in their mandibles and carried back to the colony. Chunks are then cut up into appropriately small sizes, passed from reserves to nurses and finally to the larger larvae which digest them outside their bodies with powerful enzymes that they secrete (Fig. 9).

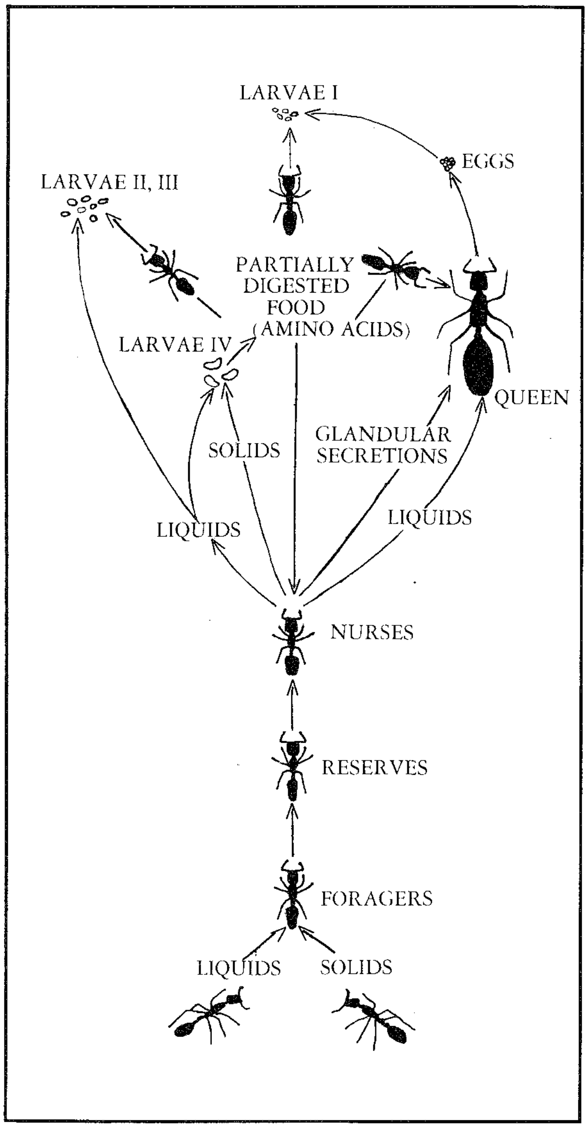


Fig. 9, above. Food, mostly in the form of other insects, is continually being brought into the fire ant mound. Only the fourth instar larvae can digest solid food, so it is carried directly to them. They break it down into liquid form, making it available to all of the other colony members. As long as the queen receives these liquids, she continues to produce eggs. When food supplies are scarce, the workers will cannibalize the larvae rather than allow the queen to starve. Illustration by A. A. Sorensen.

Fig. 10, right. When a fire ant worker encounters a rich food source, it lays a trail of chemical back to the mound that other workers can then follow. It does this by wiping its sting along the ground. The chemical, known as a trail pheromone, is produced in a small gland (Dufour's gland) attached to the sting. Other workers follow this trail by waving their antennae over the ground. Their antennae have special scent receptors that detect the presence of the chemical. The trail is constantly reinforced by excited food-laden workers returning from the food source. Drawing by A. A. Sorensen.

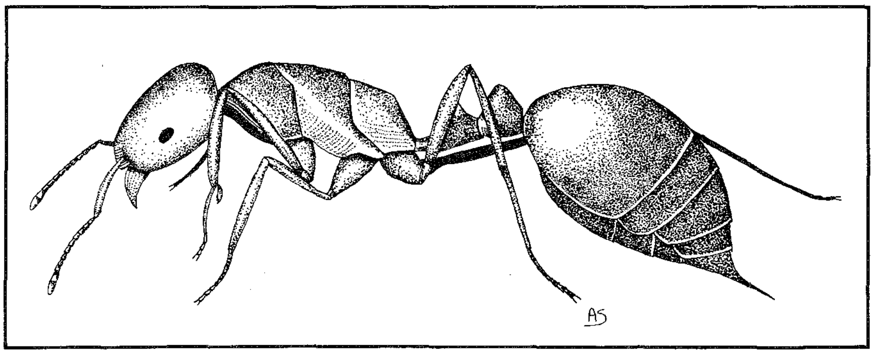
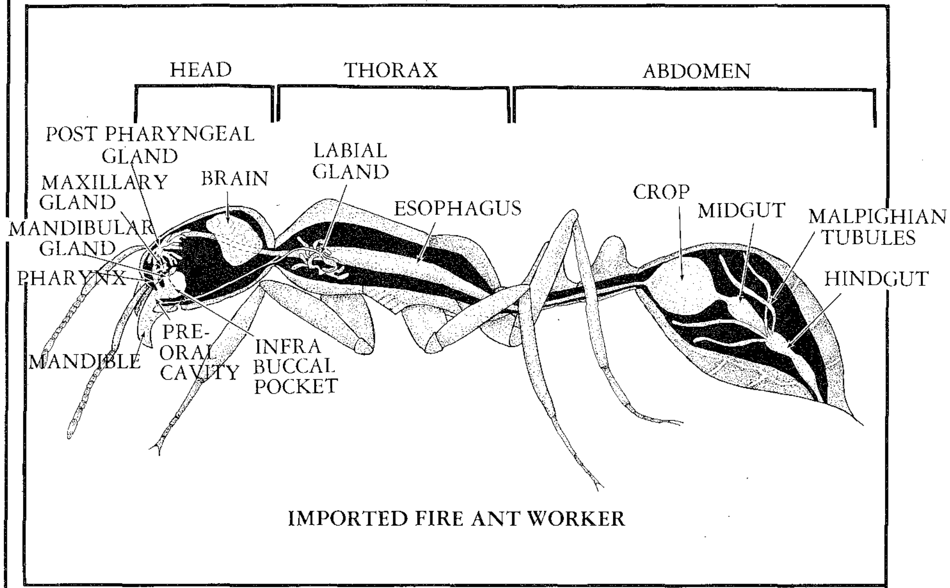


Fig. 11, right. Fire ant workers have an enlarged stomach, called a crop, which allows them to carry and store liquid foods. The workers can carry solid foods in their mandibles, but they cannot digest them. They have an elaborate screening system in their throats which prevents them from swallowing even very fine particles. Particulate matter which is screened out in this manner is stored in the infra buccal pocket and later ejected. Drawing by A. A. Sorensen.



As food is dissolved, larvae drink the liquid portions. In addition, workers may drink some of this digested liquid or solicit the liquid food already swallowed from the larvae. It is the workers that blend and store the food. When a worker encounters another colony member, they touch head to head. In some unknown way, each ant can tell if it has more or less food than another ant. If it has less, it begs to be fed, and the better-fed ant feeds it. In this way liquids are passed from one worker to another and to queens, larvae and the rest of the colony.

This transfer of food by social feeding is known as trophallaxis. It is a unique way to pass information in the form of chemical messages to all members of a colony. Insects often communicate by the use of chemicals. In the case of social insects like ants, what better way to spread messages to the many thousands of workers than through the use of food. While almost any member of a colony can add chemicals to the food (and may), the queen, because of her central importance, is believed to be the most important member of the colony to do so.

Actually, most ant behavior is mediated by chemicals. These chemical messages are referred to as pheromones, and some of the behaviors pheromones elicit are the following:

(1) Alarm responses are caused by the release of chemicals from workers that have been disturbed or injured. In addition to the release

of chemicals, alarm can also be spread by vibration. (2) Attraction to other workers is usually a response to chemicals, although movement may also be important. (3) Recruitment to a new food source or nest site is mediated by pheromones. Workers mainly follow a trail of chemical laid down by other workers (Fig. 10), although some visual landmarks are also used. (4) Grooming, including assistance at molting, is mediated by chemicals and by touch. For example, larvae produce pheromones which stimulate workers to groom, feed and carry them to favorable locations in the nest. (5) Trophallaxis (exchange of liquid food), as mentioned previously, can result in the transfer of chemical messages. Exchange of solid food particles can also result in the transfer of chemical messages. (6) Group interactions increase the exchange of pheromones. Social insects often need the presence of others of their kind to behave normally, probably due to the need for continual chemical stimulation. (7) Recognition of nestmates or castes may be mediated by chemicals and by touch. For example, the queen produces a chemical which identifies her as a queen and stimulates workers to groom her, feed her and take away any eggs she may lay. (8) Chemicals produced by the queen may determine whether a larva will develop into a worker or a new queen. (9) The queen also prevents new reproductives in the mound from laying eggs by producing an inhibitory chemical. (10) Workers recognize dead ants by chemicals that are released within 1 hour after death and respond by removing the dead worker from the nest.

Workers are constantly attracted to and lick the queen, where they presumably pick up the chemical messages she produces (Fig. 12). Through this licking, these messages enter the food chain and within hours have been spread throughout the colony.

The queen controls a colony through both the secretion of chemical messages and the production of replacement workers or reproductives. Because of her importance she is very effectively shielded from her environment by her workers. Such protection makes our efforts to control social insects difficult. All liquid foods are first consumed by workers; thus, fast-acting poisons kill the expendable workers, thereby protecting the larvae and queen. Solid toxic foods are fed directly to the larvae, killing them and reducing their effect on the queen. Small microorganisms and granular poisons are filtered out by elaborate screening systems in the workers' mouths that allow only liquids to pass through. The nurses surround the queen, and any kind of disturbance sends the queen and nurses to deep parts of the mound. Even if thousands of workers and larvae are killed, as long as a couple of workers or pupae survive along with the queen, the colony can survive.

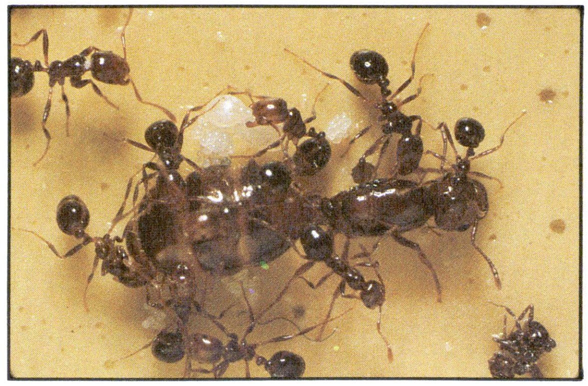


Fig. 12, above. The queen controls her colony both by secreting chemicals that can control the behavior of her workers and by producing replacement workers or reproductives. She is surrounded by workers that groom her, feed her and take away the eggs she lays.

WHAT DO FIRE ANTS EAT?

Fire ants are omnivorous and will feed on almost any type of animal or plant material. Generally they feed on other insects which they locate and sting. The sting paralyzes the insect, and the ant then consumes it at its leisure (Fig. 13). If the insect is very small, the ant

*Fig. 13, above. The imported fire ant is an effective predator and may even control certain key pests on crops. Here, the ants attack a corn earworm (**Heliothis zea**). The ants overwhelm their prey by stinging it, leaving the insect paralyzed. They can then bite and chew on the insect, carrying back the pieces to their mound.*

Fig. 14, above. Mature imported fire ant mounds can be very large, measuring as high as 1 1/2 feet and as wide as 1—2 feet. The size and shape of the mound depends largely on soil type. The drink can on top of the mound indicates the relative size of the mound.

can simply crush it with its powerful mandibles. Because ants are earthbound, they generally prey on insects that cannot rapidly escape them. Thus, they consume ticks, larvae of other insects, ground inhabiting insects and worms. The fire ant is also attracted to oil (a component of insects and seeds). This behavior was exploited by USDA in the development of an oil bait consisting of soybean oil formulated on a corn cob grit carrier. The oil acted both as a food and as an insecticide solvent. This combination of insecticide, oil and corn grit led to the present insecticide baits. However, oils and sugars are generally passed among workers rather than directly to the larvae and queen, thus delaying the movement of pesticides to them. This delay renders fast-acting insecticides useless, since the worker is killed before it can feed its nestmates.

THE FIRE ANT MOUND — A CASTLE IN THE GROUND

The mound begins as a small cell a few inches deep in the ground where the queen seals herself in to begin the colony. As workers are produced, they begin to tunnel into the surrounding soil, making many interconnected chambers. The soil removed during the formation of the chambers and tunnels is carried above ground where it is used to form many more chambers and tunnels.

A mature colony (a year or so old) consists of a mound (a conically-shaped dome of soil) that may be one to two feet in diameter and a foot to a foot and a half high (Fig. 14). The average mound is 15

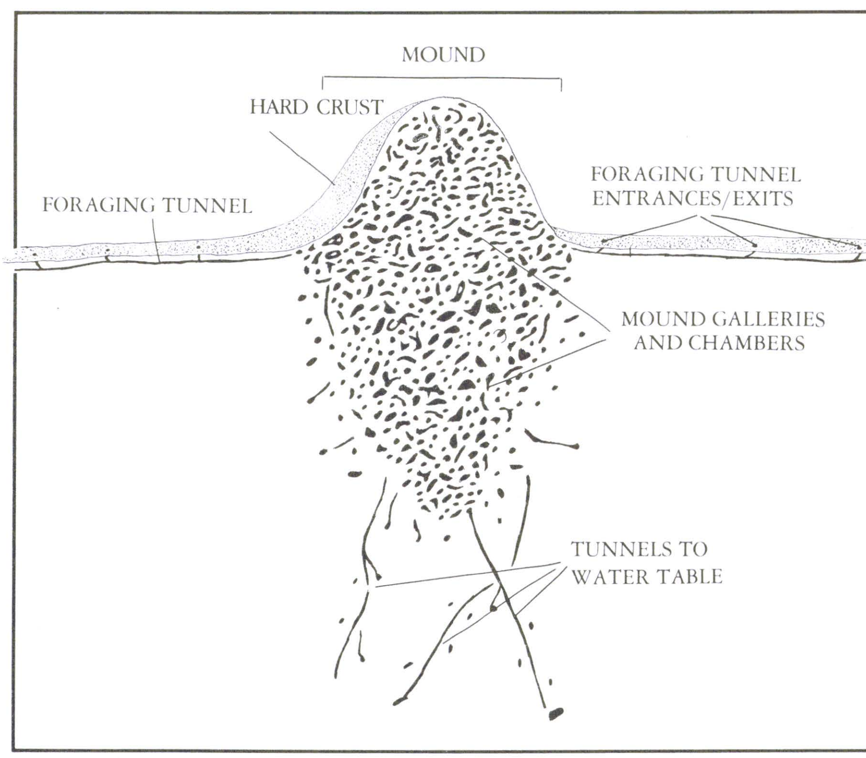


Fig. 15, right. The fire ant mound consists of a series of interlocking galleries, tunnels and chambers that extend downward into the ground. Galleries can extend anywhere from 1—3 feet into the soil, usually forming an inverted cone. Foraging tunnels just below the soil surface extend several yards out from the mound with periodic exits from which workers emerge to search for food on the soil surface.
Drawing by A. A. Sorensen.

inches in diameter and 10 inches in height. In low marshy terrain, mounds may be three or more feet high and up to 3—3 1/2 feet in diameter. During the hot dry months of summer, the ants do not maintain their mounds, and they may be easily overlooked. However, as soon as rains and cooler weather return, the mounds are reworked and become quite noticeable. The mound surface usually has a slight crust that protects it. The inside of the mound is filled with tunnels and chambers (Fig. 15). These chambers form a cone which extends 1—3 feet into the ground. Some of the tunnels may extend down five feet or more depending on the water table. Most mounds have no visible entrances or exits except during mating flights. At these times, the workers open numerous holes on top of the mound. They promptly close the holes after use. The workers leave and return to the mound in lateral tunnels just under the soil surface that radiate out from the mound. These shallow tunnels are 1—4 inches underground and may extend many yards from the mound. They may branch, and at points along their length are openings that lead to the surface from which the ants emerge to forage. Openings have been found as far as 132 feet away from the mound.

Mound size and shape depend, in part, on the soil type. In sandy soils, mounds are less well-developed, while in clay soils they may become quite large. In Texas, where summer droughts sometimes cause the clay soil to form large, deep cracks, ants may move into these natural tunnels and not form a mound. In lawns that are frequently mowed, the mound is often flattened because the top is continually removed during mowing.

Fire ants readily defend their mound from intruders. Any disturbance of the mound, which includes the surface tunnels located several yards away, results in hundreds of workers rushing out in all directions, usually attacking anything that moves. The worker ants are sensitive to vibrations, which seem to stimulate them to attack. When a worker uses its sting, it releases a chemical which alerts other workers and incites them to sting as well. Each worker can sting repeatedly, leading to multiple stings in a short period of time.

Although the ants readily defend their mound from intruders, the mound is not permanent. If the mound is disturbed, the ants often move and build a new one several feet to many yards away. Sometimes the ants move for no apparent reason. At other times, they move due to unfavorable conditions, such as too much shade or the presence of pesticides. However, some mounds may be repeatedly disturbed (such as mowing over them) without causing the ants to move. Thus it is hard to predict when and if the ants will move.

While a fire ant mound is elaborate, the ants cannot regulate its temperature and humidity. Instead, they continually move the larve and queen to the most suitable location within the mound. Thus, in the early morning during summer, the larvae and queen are usually near the top, on the sunny side of the mound, to take advantage of the warm, humid conditions. As the sun dries out and heats up the mound, the larvae and queen are moved deeper into the mound. During periods of drought the ants may remain deep in the ground for long periods.

During cold weather, ants also seek deeper cover and become very sluggish. The younger ants can withstand short periods of freezing conditions. Workers can also survive being under water for long

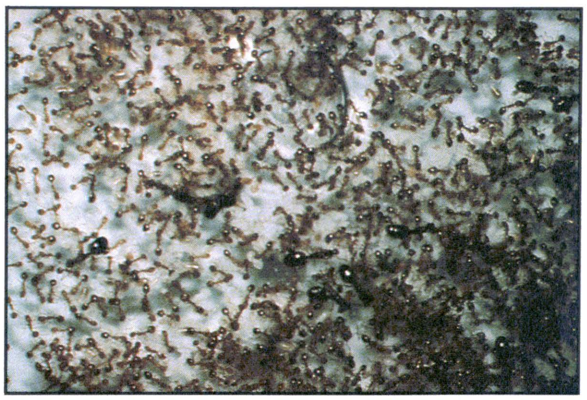


Fig. 16, above. Some fire ant colonies have more than one mated queen. These are called multiple-queen colonies, and they differ from the more common single-queen colonies in many aspects of their biology. They pose problems in our attempts to control the fire ant because their mounds are more densely spaced and all of their queens (normally 20—60) must be killed or the colony will survive.

Fig. 17, above. The major problem with the fire ant is that it stings and in doing so, injects a venom that causes blisters or allergic responses in people. The victim usually receives more than one sting because the ants can sting repeatedly.

periods; they appear to be inactive, only to revive after the water is removed. If water slowly invades a mound, the ants float out and form a raft of worker ants with the workers in the middle holding the larvae, eggs and queen safe and dry as the raft floats to new nest sites (see Fig. 4).

While mounds are important, they do not appear essential. As long as there is a small protected space that is dark and damp and a source of food and water, the ants may not form a mound but nest instead in walls of buildings, in logs, cracks, crevices in stone walls or under sidewalks.

MULTIPLE-QUEEN MOUNDS: A NEW THREAT?

Early studies of fire ant biology indicated that each of their colonies was controlled by a single queen. However, from 1973 on, reports began to appear of colonies with many queens (Fig. 16). In Mississippi, an extremely large colony, dubbed "queen city," was found to contain more than 3,000 queens. Multiple-queen colonies have also been found in limited areas in Florida, Louisiana, Georgia and Texas. They seem to be more common on the western edge of their range. Multiple-queen colonies differ from single-queen colonies in many important aspects of colony life: (1) their mounds are closer together (250 mounds/acre instead of 40 mounds/acre) and are more spread out in appearance; (2) their workers are much smaller, with very few large workers present, and they tend to be lighter in color; (3) the workers are less aggressive towards workers from neighboring mounds; (4) the queens lay fewer eggs and weigh less (although collectively more eggs are produced in a multiple-queen colony because

Fig. 18, left. To sting, the imported fire ant first takes hold of the skin with its mandibles to steady itself. This causes a pricking sensation. It then pushes in its sting and injects its venom. This produces a fiery, burning sensation. If not dislodged, the ant may continue to rotate around, stinging two or three more times and leaving a characteristic circular pattern of blisters.

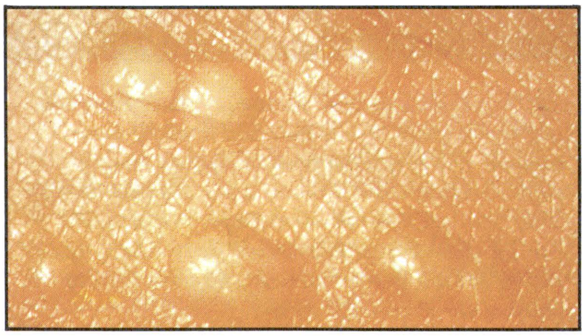


Fig. 19, left. Imported fire ant stings always form pustules. These blisters itch and can easily become infected if the skin is broken. They sometimes require medical attention and in many instances, leave a small brown scar that lasts for many months.

there are so many queens laying eggs at once); (5) the female reproductives they produce weigh less, and the males are often sterile; and finally, (6) fewer reproductive forms are produced by multiple-queen mounds. Although multiple-queen mounds represent only a fraction of the fire ant population overall, they are serious cause for concern. Their mounds are closer together so that areas are more heavily infested with fire ants. In addition, it is much harder to eliminate a multiple-queen mound because all of the queens (typically between 20—60 but sometimes 300 or more) must be killed, not just one.

PROBLEMS ASSOCIATED WITH THE IMPORTED FIRE ANT

The major problem with IFA is that the workers sting and inject a venom that causes blisters or allergic responses in people. Whether a person considers the IFA beneficial or damaging for the environment in general, these considerations are overshadowed by their impact on people.

For a variety of reasons the imported fire ants are frequently encountered by people. First, they defend their mounds from invaders. Large mounds may reach a foot or so in diameter and height, and thus are avoided by most people. However, stepping on a mound may be almost unavoidable in some areas where the number of mounds can reach from 50 to over 200 per acre depending on the location and the behavior of the ants in the area (single or multiple-queen colonies). Furthermore, some mounds are not easily seen or are hidden from view so that a person may step onto or lean against an object in contact with a mound without knowing it. Lastly, each mound has many lateral tunnels just beneath the soil surface that may lead from several feet to several yards from the mound with openings along the tunnel that the ants defend as part of their mound (Fig. 15). Thus, it is easy for people to inadvertently stand on one of these tunnels or lean against a fence post and have hundreds of ants rush out and climb onto them for 10 to 20 seconds before they realize it. Since each ant can sting many times, a person may receive many stings before the ants can be removed (Fig. 17).

When stinging, the worker attaches to its prey with its mandibles causing a pricking sensation and then it doubles under its abdomen and forces its sting into the tissue (Fig. 18). The sting hurts for a few minutes, then the area reddens, swells into a wheal and a pustule forms within a day (Fig. 19). The intense burning sensation which occurs when the venom is injected accounts for the popular name of "fire ant." These pustules may become infected and require medical attention. For most people, the pustule dries up in a week or so, but for some people the pustule may lead to a brown scar that may last for many months.

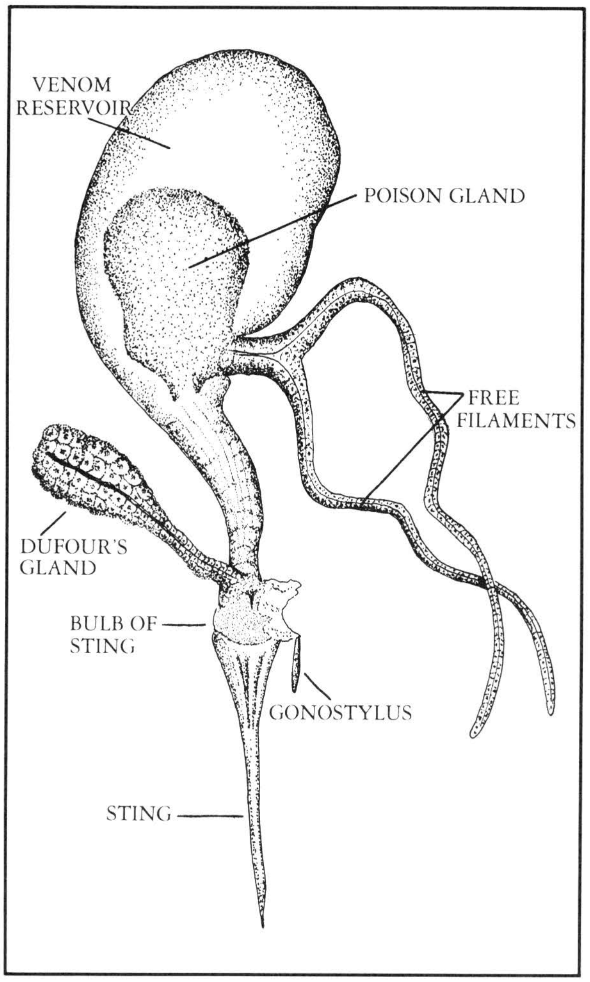
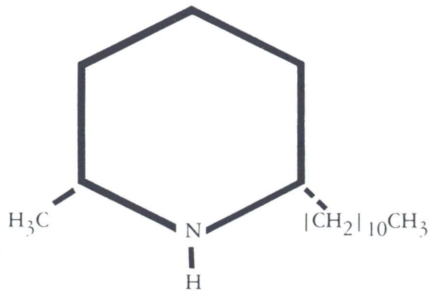


Fig. 20, above. The venom which the fire ant injects into its victim is produced in the poison gland. This gland is located inside of the venom reservoir which opens into the poison bulb at the base of the sting. The chemicals which are responsible for trail-following behavior by workers are produced in the Dufour's gland. Chemical trails are laid by workers as they drag their stings along the ground. Other workers can then follow these trails. Drawing by A. A. Sorensen.



PIPERIDINE ALKALOID
(SOLENOPSIN A)

Fig. 21, above. The major component of fire ant venom is an oily alkaloid called Solenopsin A. Alkaloids are toxic to cells and cause a pustule to form by killing cells in their vicinity. These dead cells then attract the body's defensive white cells, which accumulate at the venom site and form pus. Fire ant venom also contains some proteins which may produce allergic reactions in people sensitive to them.

Fig. 22, above. Farm and pasturelands may become heavily infested with fire ant mounds. Pastures with 30—50 mounds/acre are common in some areas. Along the western edge of the fire ant's range, where multiple-queen colonies occur, up to 250 mounds/acre may be present. Mounds can cause problems during harvesting, damaging equipment and making hand harvesting of a crop virtually impossible because of the numbers of ants produced.

The venom is produced in a gland which is connected to the sting (Fig. 20) and contains two major components. The oily alkaloids (Fig. 21) are toxic to cells and cause a pustule to form by killing cells at the site of the injection. These dead cells attract the body's defensive white blood cells, which accumulate at the venom site and form pus. If the skin is broken by scratching, bacteria may enter, and an infection can develop. The venom also contains a bit of protein (less than 10 percent) which has little or no effect on most people. Others are sensitive to these proteins, and a sting can lead to anaphylactic shock. The symptoms of shock include dizziness, nausea, sweating, swelling of the affected area, headache and shortness of breath. If any of these symptoms occur, the person requires immediate medical attention. Anaphylactic shock can lead to death. People who show symptoms indicating anaphylactic shock should seek advice from an allergist before entering known fire ant infested areas.

For those suffering just pain and the development of pustules, a simple solution of half bleach and half water applied immediately to the area can reduce the pain, itching and pustule formation. Speed of application is essential.

The presence of fire ants deters certain outdoor recreational activities, such as sitting on the ground, pulling weeds in a backyard garden, enjoying a picnic on the lawn, sitting on the grass near a lake, sitting around a camp fire and sitting or even standing on a stream bank to fish. Playgrounds, athletic fields and parks are either heavily treated to control fire ants or they are not used.

In the campsites of state and national parks in fire ant infested areas, it is difficult to put up a tent, let alone face the prospect of taking down a tent covered by angry fire ants. To ensure freedom from such difficulties, some people treat the area with chemicals. In time, the tent area is heavily contaminated with pesticides which, at the very least, endanger the wildlife the park was designed to protect.

The imported fire ant is one of only a few insects that are a problem to both rural and urban areas. In rural areas the imported fire ant is a threat to domestic animals. Animals, like man, are susceptible to anaphylactic shock, and their sensitivity can change with age and amount of exposure. Fire ants are quick to attack moving objects and are attracted to mucus surfaces. Young animals which are unable to escape may be blinded or killed.

Animals may try to avoid fire ant infested areas, causing other problems. For example, in poultry houses young chicks are reared in large numbers. Fire ants invade these chicken houses to feed on the insects that are attracted there. In doing so they cause the chicks to crowd into uninfested areas where they trample each other, resulting in large losses.

Fire ants also cause other economic losses. Mounds built in clay soils can bake in the hot summer sun and become as hard as rocks (Fig. 22). These hard mounds can damage farm machinery that encounter them (for example, the cutter bar of a hay mower, combine equipment or hay bailing equipment). In soybean fields, the farmer can either risk equipment damage or raise the cutter bar 6 to 10 inches to avoid the mounds and thus lose some of the crop.

Fire ants were not considered a pest of crops until recently. When the fire ant first invaded the Southeastern U.S. between the 1940s and 70s, most of our cropland was treated with residual (long-lasting) pesticides that may have kept ant populations at low levels. As these residual pesticides have been replaced with shorter-lived chemicals and with biological control techniques, fire ant populations have increased on agricultural lands. Ants feed on germinating seeds, thus causing serious damage to corn and soybeans. They feed on the buds and developing fruit of certain crops, such as beans, citrus, berries and okra (Fig. 23). They girdle young trees, particularly citrus and pecans. Damage to plants often increases during droughts, possibly because the ants are attempting to supplement their water needs. Lastly, the ants deter hand picking and harvesting of many crops.

In urban areas, fire ants cause additional problems. They nest under patio slabs, walks and roads, causing these structures to crack and collapse when the ants leave. The ants not only deter backyard activities (as discussed earlier), damage plants and threaten pets (similar to the rural problem), but they may also invade houses where they can threaten young children and the elderly. House invasion is often a problem following heavy rain. During floods, the ants seek high ground and have been found in houses, businesses and even under the rugs inside cars. A driver can lose control of a car if he is covered with stinging ants halfway down the street. In the home, the ants often move between the walls or under rugs and into other closed spaces. If moisture is present, such as found in a leaky bathroom pipe or drain in a wall, the ants may be content to remain in the house.

Ants also appear to be attracted to electrical equipment (Fig. 24). The reasons for this attraction to electricity are not yet clear. Nevertheless, the ants do crowd into electrical contacts causing them to short. This is a major problem with heat pumps and air conditioners located on concrete slabs. They can also short junction boxes, causing problems with telephone cables, electrical transformers and airport landing lights. They sometimes chew through electrical cable insulation, resulting in shorts in telephone lines, traffic lights, street and security lights.

Since the fire ant is attracted to moisture, it is occasionally a problem in drip irrigation lines, where the ants gnaw at the pipe and enlarge the drip holes. As the IFA moves into areas where drip irrigation predominates, this problem may increase.

The imported fire ant is often accidently transported along our major highways, thereby extending its range. Highway shoulders and rights of way are often ideal fire ant habitats. These areas represent open, disturbed land with an abundant food supply. The food comes from the trash tossed from cars and the wildlife, particularly insects, continually being hit by cars. Thus, infestations are often very heavy along the highways. This leads to an additional problem for accident victims who may end up on the side of the highway, unable to escape from ant attacks.

The effects of fire ants on wildlife are not well documented. However, fire ants reduce the number of other ant species in areas they have infested. Fire ants also have a major impact on ground nesting animals from insects to mice and birds. In some cases the ants may eliminate certain ground-inhabiting species from an area. The elimination of just a few soil insects may reduce the food supply of some animals which in turn affects the abundance of yet other animals. The altering of the food web in an area may have profound effects on animal abundance and diversity.

Fig. 23, above. Fire ants may be attracted to young seedlings and saplings where they can cause extensive damage by girdling stems and branches. They can also destroy buds and developing fruit. Here ants are shown feeding on citrus. Damage to plants often increases during droughts, possibly due to a search for an alternative source of water.

Fig. 24, above. Fire ants are attracted to electrical equipment for unknown reasons. They are a major problem for heat pumps, transformer boxes and air conditioners where they can short out electrical circuits. They can sometimes chew through electrical cable insulation, causing shorts in telephone lines and traffic lights.

Fig. 25, above. Imported fire ants can enhance populations of certain insect pests. They often tend plant-sucking insects such as aphids (shown here) and scales for their honeydew. They protect these insects from parasites and predators, thus allowing them to increase in number.

DO FIRE ANTS WEAR A BLACK OR WHITE HAT?

Fire ants feed on many things, and whether we consider them to be beneficial or a pest may depend upon our viewpoint. In fields of sugarcane, cotton or corn, where there are heavy losses from insects such as the sugarcane borer, boll weevil or corn earworm, fire ants may eliminate the problem (Fig. 13). Thus, we might consider them beneficial for these crops. We may also feel positive about the fire ant when it kills ticks or cockroaches. However, they may also kill beneficial insects, such as ladybug larvae that are important in the control of insect pests. Furthermore, the ant will tend and protect aphids that transmit various plant diseases (Fig. 25). Also, they may directly damage crops, attacking the buds, young fruit, roots or girdling the plant (Fig. 23). In these respects, one may label the fire ant a pest. Further, the ants attack invertebrates that inhabit the soil, thus reducing not only the diversity of an area, but also reducing food for other organisms. Fire ants may adversely affect ground-nesting birds and mammals such as mice, moles and rabbits. Whether this is considered beneficial or detrimental may again depend on your point of view.

HISTORICAL EFFORTS IN CONTROL

Although the IFA had invaded eight of the 11 presently infested states by 1950, the problems IFA caused were not immediately recognized. In 1949, Mississippi was the first state to appropriate funds ($15,000) to study the problem. At the same time, the state of Alabama made chlordane available to farmers. The U.S. Department of Agriculture also began studies on the IFA problem and issued its first report in 1954, two years after Louisiana had also made chlordane available to farmers.

Heptachlor was found to be more toxic and more stable than chlordane, and thus ants were controlled for a longer period of time. This chemical was applied as a granular formulation to the soil and killed any ant that came in contact with it over a period of many months. The result was good control.

The United States Congress was approached in 1957 by various state, local and private organizations to initiate action on the IFA problem. Later that year Congress appropriated $2,400,000 to begin an eradication program against the IFA, but the amount was far short of what was needed. The program began with the use of Heptachlor. However, over the next several years, funding varied to such an extent that program goals were virtually unattainable. During the same period, the amount of Heptachlor used in treatment was reduced from the original 1958 dose of 20 lb. of 10% Heptachlor (2 lb. active Heptachlor) per acre to two applications of 1/4 lb. active Heptachlor per acre by 1960.

Although the amount of Heptachlor was reduced, the environmental effects had not been considered. Heptachlor was not only killing ants, but also many other species of insects, invertebrates, birds and mammals. Further, residues began to accumulate in many animals. Texas, Florida and Alabama withdrew from the program in 1960 due to mounting environmental concerns. The effects on wildlife alarmed conservationists, and the IFA eradication program became a critical stimulus that led Rachel Carson to write the book "*Silent Spring*" (1962, Houghton Mifflin Co., NY) which resulted in public disenchantment concerning the widespread use of pesticides and led to the subsequent banning of Heptachlor.

Although about 20 million acres of land were treated with Heptachlor from 1957 to 1962, the IFA continued to spread from 80 million to over 100 million acres. The program, as conceived, appeared to be a poor one, the detrimental effects on wildlife being greater than the effect on the ant itself.

Mirex was discovered in 1961 and was utilized as a fire ant bait by U.S. Department of Agriculture researchers. It rapidly gained in popularity, becoming the standard control agent. Use of this pesticide began at the rate of 10 lb. of bait containing 0.15 oz. of Mirex per acre, but by 1966 the Mirex dose had been reduced to 1 1/4 lb. of bait containing 0.11 oz. of Mirex per acre with at least two applications recommended. Although dosages had been reduced, the program also suffered from inconsistent funding. From 1967 to 1969 a little over 36.1 million acres were treated with the Mirex bait while the ant continued to spread from 126 million to over 150 million acres. There were increasing concerns over the use of Mirex, and by 1969 the program ran into legal problems. Environmental problems were becoming more apparent, and what had been hailed as a "perfect pesticide" in the early '60s actually proved to be dangerous in subtle ways. While research continued to uncover more problems with the use of Mirex and legal difficulties mounted, Mirex was still used extensively until it was cancelled in 1978.

With the loss of Mirex, the hopes for an eradication program also failed. Experience with past programs now indicates that eradication of the IFA is not possible with any presently conceived techniques. The high rate of reproduction, extensive geographic infestation and difficulty in killing all of the mounds within an area make the IFA a very difficult insect to manage.

PRESENT CONTROL OF THE IMPORTED FIRE ANT

Many pesticides are currently being marketed for control of the IFA, and along with other control techniques, consumers have several options as to the control method they wish to use. There are two basic approaches to IFA control, each with its own advantages and disadvantages. While we provide a summary here, we recommend that

Fig. 26, above. ***Mound drenches:*** *Mound drenches are contact insecticides that must come directly in contact with the workers and queen(s) in order to kill them. A small amount of concentrated insecticide is diluted in water and either sprinkled or poured onto the mound. Care must be taken not to disturb the mound prior to drenching it. The queen will be taken deep into the mound if the ants are disturbed.*

Fig. 27, above. ***Surface dusts:*** *Surface dusts or granules are shaken over the mound and then watered into the soil. The dissolved granules must come directly in contact with the ants in order to kill them. If you disturb the mound in any way, the queen will be taken deep into the mound and the chemical will not reach her.*

Fig. 28, above. ***Injected toxicants:*** *Some insecticides can be pressurized and injected into the mound. Normally, the insecticide is injected into the mound in a number of places according to the directions. The chemical must come in contact with the workers and queen(s) in order to kill them.*

those who are interested in the latest control recommendations and practices obtain "Fire Ants and Their Control," B-1536, from the Texas Agricultural Extension Service.

The two basic approaches available for use against the IFA are either (1) individual mound treatments or (2) broadcast treatments:

(1) *Individual mound treatments* - There are several methods available for individual mound treatments. The main advantage of individual mound treatments is that there are more choices available, and when effective they usually kill a mound in a few hours to a few weeks depending on the approach. The major disadvantage is that each mound must be located and individually treated. This is labor intensive and thus can only be practical for small areas. In all cases some mounds may not be killed and may move to new locations. Some mounds cannot be found, or they are too young to be seen and thus are not treated. Reinfestation of the treated area from overlooked mounds may occur within 6 to 12 months, and retreatment may be required. There are seven different methods available.

(A) Mound drenches. The mound is flooded with a large volume of liquid which is toxic to ants. One choice is to simply pour several gallons of hot water over a mound. Insecticide drenches are mixed with several gallons of water and poured into a mound. Active ingredients include acephate, chlorpyrifos, pyrethrins and diazinon. Problems include inabililty to reach the queen who may be deep within the mound.

(B) Surface dusts. Insecticidal dusts or granular formulations are shaken over a mound and then watered into the soil. Dust treatments are very similar to mound drenches.

(C) Injected toxicants. Some insecticides are available that can be pressurized and injected into a mound. These are often more effective than mound drenches, but are more expensive. Equipment may be subject to leakage which can be dangerous to the handler, and injection may require more time than other methods. As with mound drenching, some queens may escape.

(D) Fumigants. Presently methyl chloroform is the only fumigant available. A few ounces are poured into each mound, but like the drenches, not all mounds will be destroyed. The material is toxic to plants.

(E) Baits. Only a few bait products are available. They may be used for individual mound treatments although they are primarily sold for broadcast treatments. For individual mound treatments, a small amount of bait is scattered around a mound. Baits are generally slower to act but are more effective than drenches, dusts or fumigants.

(F) Biological deterrents. Biological control approaches such as the use of mites or nematodes have promise, but their effectiveness has not been thoroughly examined. They are presently being used in a manner similar to a mound drench or dust. They have many of the same problems, although they have the advantage of being nonpollutants.

(G) Mechanical devices. Various mechanical and electrical devices are available, but their effectiveness has not been documented and the equipment is often expensive.

(2) *Broadcast treatment* - There are presently only a couple of products available for broadcast treatments. They are baits composed of soybean oil and a toxicant formulated on a corn grit carrier. The ants find and carry the grits into the mound where they feed the poisoned oil to their queen and nestmates. To be effective the toxicant must be slow acting or not too toxic to the foraging worker. The advantage of the broadcast baits is that they are less labor intensive since large areas can be quickly treated, and unseen and small mounds can also be controlled. However, they often do not give complete control because (a) some mounds are well fed and don't feed on the bait; (b) the bait fails to drop close enough to some colonies and they don't discover it; (c) the bait is light sensitive and does not remain effective very long; and (d) the baits are not specific to the fire ant, and competing ant species may remove the bait and subsequently die. This provides open ground for a reinvasion of the IFA which often reaches greater levels of infestation than before.

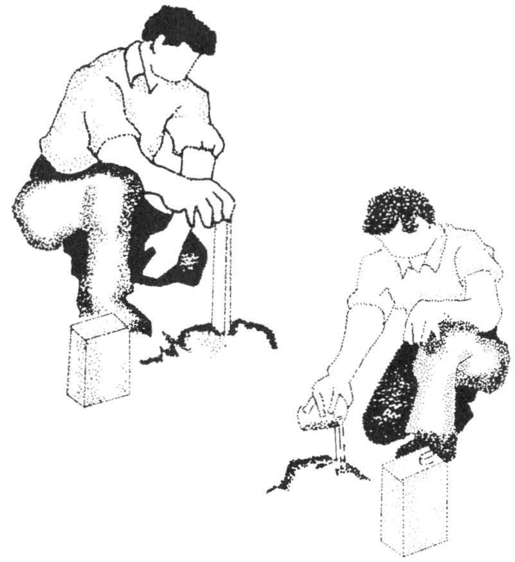


Fig. 29, above. ***Fumigants:*** *Methyl chloroform, the only fumigant currently available, is a liquid that rapidly turns into a gas when poured out of its container. Measure the recommended amount of liquid as specified on the label and pour it into holes poked into the top of the mound.*

Fig. 30, above. ***Baits:*** *Baits can be used for both individual mound treatments and for broadcast treatments. They consist of a mixture of corn cob grits, soybean oil and a toxicant. The ants find the grits when they are foraging for food, carry them back to their mound, and feed the poisoned oil to their queen and nestmates. Baits should be sprinkled uniformly around the mound about one to three feet away and not on the mound itself. Ants will only recognize the bait as food when they encounter it at some distance from the mound. They may confuse the bait with building material if they find it on top of their mound.*

ADDITIONAL READING

Hamman, Philip J., Bastiaan M. Drees and S. Bradleigh Vinson. 1986. "Fire Ants and Their Control." Texas Agricultural Extension Service Publication B-1536.

Lofgren, C. S. 1985. "The Economic Importance and Control of the Imported Fire Ant in the United States." In *The Economic Impact and Control of Social Insects.* (S. B. Vinson, Edit.). Praeger Press, N. Y.

Lofgren, C. S., W. A. Banks, and B. M. Glancey, 1975. *Biology and Control of Imported Fire Ants.* Ann. Rev. Entomology 20:1-30.

Sorensen, A. Ann and Mark Trostle. 1986. *Answers to Your Questions About Imported Fire Ants.* Texas Department of Agriculture.

Symposium on Imported Fire Ants. 1983. Florida Entomologist 66(1). 92-184.

Vinson, S. B. and L. Greenberg. 1985. "The Biology, Physiology and Ecology of the Imported Fire Ant." In *The Economic Impact and Control of Social Insects.* (S. B. Vinson, Edit.). Praeger Press, N. Y.

APPENDIX:
HOW TO IDENTIFY FIRE ANTS

HOW TO IDENTIFY FIRE ANTS

The fire ants comprise a large group of small reddish brown to black ants found in the warmer regions of the Americas. As a group, these ants belong to the genus *Solenopsis* (Fig. 31). Ants belonging to this genus can be recognized by their 10-segmented antennae topped by conspicuous two-segmented clubs, unarmed propodeum (no spines on the propodeum, although it does have a few hairs), a two-segmented pedicel (the petiole and postpetiole) and the presence of a sting which may be exposed. Worker ants vary in length from 1/8 to 1/4 inch.

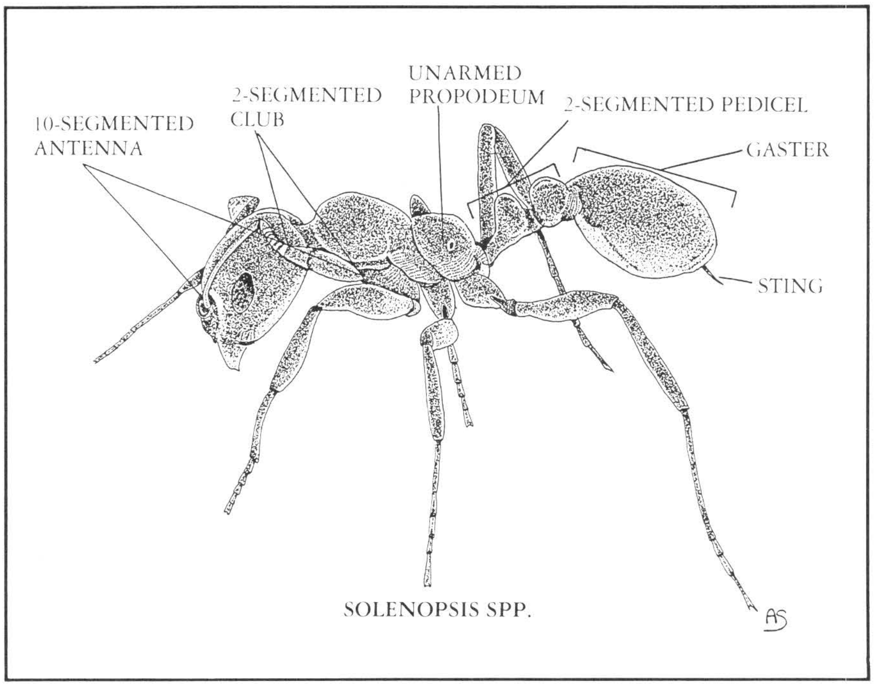


Fig. 31, right. Fire ants belong to the genus ***Solenopsis.*** *They all share the characteristics shown here: 10-segmented antennae with 2-segmented clubs, an unarmed or spineless propodeum, a 2-segmented pedicel and a conspicuous sting. They are reddish brown to black in color and 1/8-1/4 inch in length. Drawing by A. A. Sorensen.*

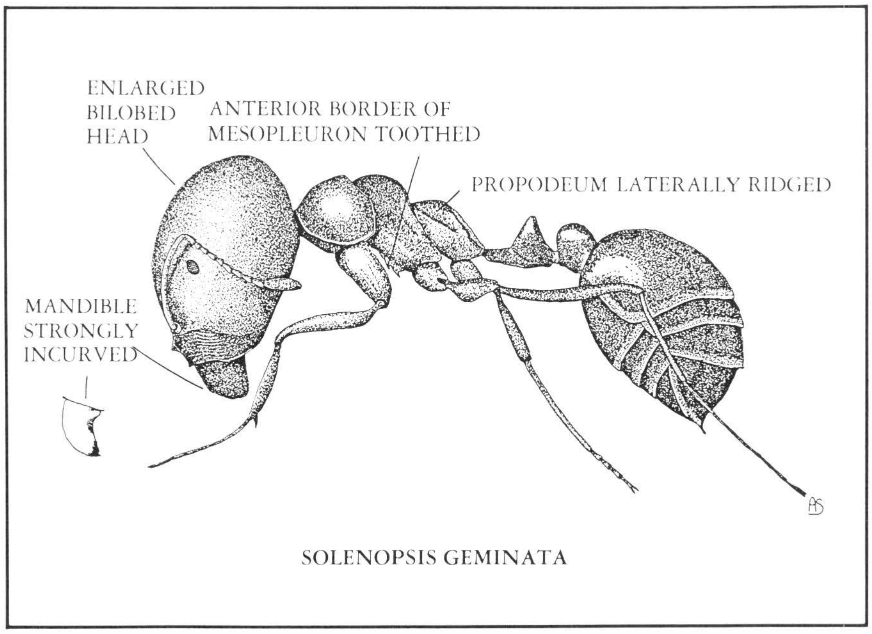


Fig. 32, right. The tropical fire ant, ***Solenopsis geminata,*** *is sometimes confused with the imported fire ant. Some of the larger worker ants in* ***S. geminata*** *colonies have enlarged bilobed heads as shown here. Both large and small workers have a laterally-ridged propodeum and a toothed mesopleuron. Their mandibles are strongly incurved. The tropical fire ant stings but does not leave a pustule. Drawing by A. A. Sorensen.*

There are several species or types of fire ants that are found in the United States from the Carolinas to California, including Puerto Rico and Hawaii. Two species are common in most areas and have been present in North America for centuries. They are referred to as the "native" fire ants. One native species is known as the tropical fire ant (*Solenopsis geminata* Fabricius) (Fig. 32). It differs from the imported fire ants in that some of its worker ants have enlarged heads. If a mound contains a few large ants with disproportionately large heads among its workers, the colony is composed of tropical fire ants. Other differences include the presence of a laterally-ridged propodeum, a toothed mesopleuron and strongly incurved mandibles.

The second native species is known as the southern fire ant (*Solenopsis xyloni* McCook) (Fig. 33). This species is generally difficult to distinguish from the imported species. The mound of the southern fire ant is often more flattened, but mound shape is not a reliable character.

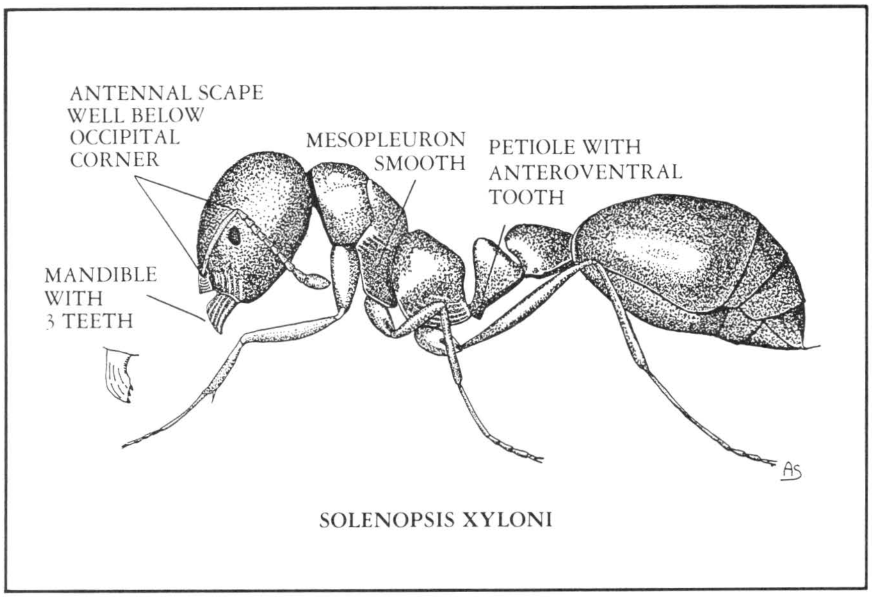


Fig. 33, left. The southern fire ant, ***Solenopsis xyloni,*** *closely resembles the imported fire ant. They differ in a few key characters as shown here: the mandibles have three teeth instead of four, the antennal scape stops well below the occipital corner of the head, the mesopleuron is smooth instead of rough, and there is an anteroventral tooth on the petiole. The southern fire ant stings but does not leave a pustule. Drawing by A. A. Sorensen.*

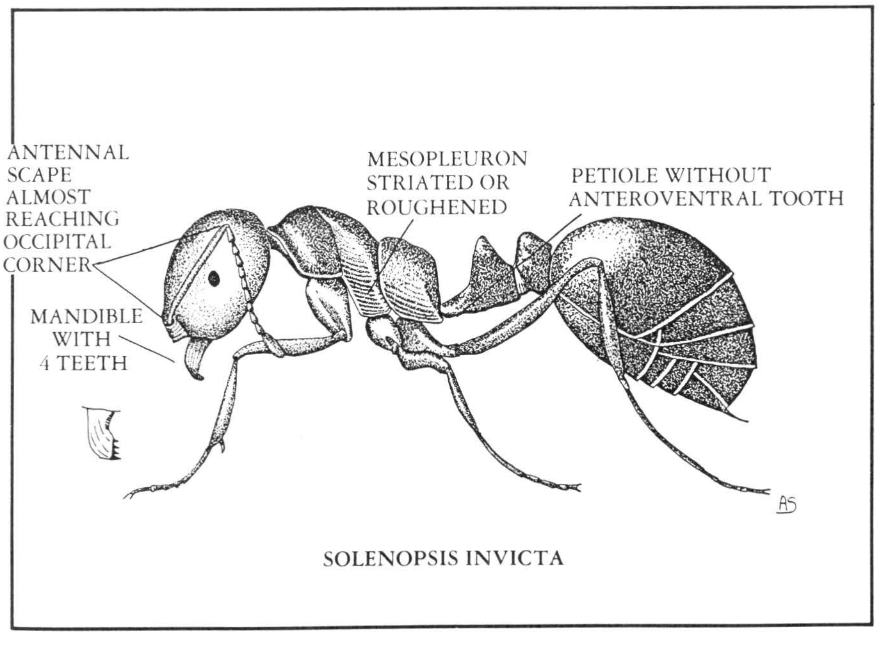


Fig. 34, left. The imported fire ant, ***Solenopsis invicta,*** *can be confused with other fire ants, but it differs in the key characters shown here: the mandibles have four teeth, the mesopleuron is striated or roughened, and the anteroventral edge of the petiole is smooth. When the imported fire ant stings, a characteristic pustule forms within a day. Drawing by A. A. Sorensen.*

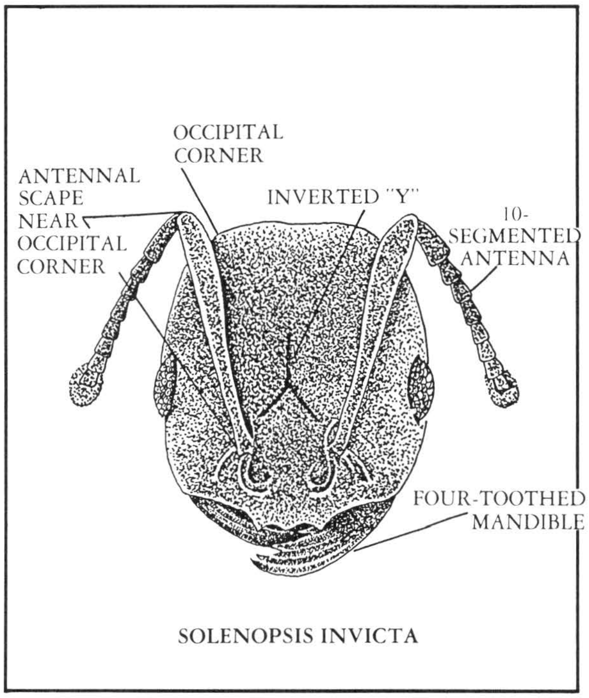


Fig. 35, above. A useful character that can sometimes be used to distinguish the imported fire ant from other native fire ants is the presence of an inverted "Y" shaped line on the front of the head between the eyes. Drawing by A. A. Sorensen.

The southern fire ant has only three teeth on its mandible (jaw), compared to four teeth for the imported fire ant (Fig. 34). The antennal scape fails to reach the occipital corner of the head of the southern fire ant by several proximal funicular segments, while the scape of the imported fire ant usually reaches to the occipital corner. The mesopleuron of the southern fire ant is generally smooth, while in the imported fire ant it is dull due to many small striations or ridges in the cuticle.

The desert fire ant (*Solenopsis aurea* Wheeler) is a rarely observed native species largely confined to the arid regions of the Southwest including West Texas. The mounds are small, often under rocks, and the golden-yellow ants are less aggressive than the other species.

Of the two imported species, the black imported fire ant (*Solenopsis richteri* Forel) is presently found only in northwest Alabama and northeast Mississippi. While taxonomic differences between the two imported species are difficult to describe, the black imported fire ant is generally darker and larger than the red imported fire ant, and its mounds are often bigger.

The red imported fire ant (*Solenopsis invicta* Buren) is the species of most concern, having spread from Alabama to eight Southern states during the 1940s and '50s. The key identifying characters are shown in Figs. 31, 34 and 35. While both the native and imported fire ants sting, only the red imported fire ant causes the formation of a pustule.

GLOSSARY

abdomen: the third or posterior division of the insect body; consists normally of nine or 10 apparent segments. In ants the globular or ovoid last seven or eight segments behind the pedicel is called the gaster.

alate: winged; in ants alates are winged reproductive forms, both male and female, that are periodically produced in a colony and released to fly, mate and found a new colony. Only the female founds the new colony. The male dies shortly after the mating flight. Alates are also called sexuals or reproductives.

alkaloid: a colorless, complex and bitter organic base containing nitrogen and oxygen. Examples include morphine and codeine. The major components of fire ant venom are alkaloids, unlike most stinging insects which utilize a venom rich in protein.

anaphylactic shock: an intense reaction caused by hypersensitivity to a foreign substance. Symptoms include nausea, vomiting, dizziness, perspiration, cyanosis, asthma and, in severe cases, may result in death.

antenna: *(pl. antennae)* a pair of segmented, flexible appendages located on the head, usually sensory in function.

beneficial insects: insects which are beneficial to man. These include predacious insects which kill and eat plant damaging insects and parasitic insects which develop inside other insects, killing them in the process.

callows: newly emerged ants whose exoskeleton is still relatively soft and lightly pigmented.

castes: any set of individuals in a colony that are morphologically distinct or belong to the same age group, or both, and perform specialized labor in the colony. Fire ants can be divided morphologically as reproductives (males and females), major workers, media workers and minor workers, or by age as nurses, reserves and foragers.

club: the very much enlarged distal (end) segments of the antenna.

crop: an insect's stomach; the dilated part of the alimentary canal which receives and holds food. Fire ants store liquids in their crops and later regurgitate them to other ants.

cuticle: the outer covering of an insect; its exoskeleton.

enzyme: a complex organic substance that is produced by living cells and catalyzes specific biochemical reactions. Digestive enzymes help speed up the digestion of different food substances.

food basket: a small depressed area near the mouth of a last-stage larva (4th instar); solid food is placed on this basket by workers and held firmly by forked hairs. The larva then regurgitates digestive enzymes onto the food and it slowly dissolves.

foragers: the oldest workers in a colony; foragers are responsible for locating food outside of the nest and recruiting other workers to help bring it back. They represent 10—20% of the workers in the colony.

funicular: referring to a part of an insect's antenna between the club (enlarged end of the antenna) and the ring-joints. The funiculus is all of the antenna, excluding the scape.

gaster: the hindmost body region of an ant.

instars: the period or stage between molts in the larva, numbered to designate the various periods. Fire ant larvae have four instars; only the last instar can digest solid food.

larva: *(pl. larvae)* the immature form of an insect; most of an insect's growth occurs during the larval period. Fire ant larvae are legless, grublike and white.

majors: the largest workers in an ant colony; majors are normally defined by their head width (>0.92mm). They live longer than any other workers in the colony.

mandibles: the first pair of mouthparts in insects; stout and tooth-like in chewing insects.

medias: medium-sized workers in an ant colony; medias are normally defined by their head width (between 0.73—0.92mm).

mesopleuron: in bees, wasps and ants, the piece below the insertion of the wings; the lateral surface of the mesothorax above the second leg.

minims: the first workers produced by a founding queen; minims are miniature workers that normally live only 20—30 days. They are only produced during the founding period.

minors: the smallest workers in an ant colony; minors are normally defined by their head width (<0.73mm).

molting: the periodic process of loosening and discarding the skin or cuticle, accompanied by the formation of a new cuticle. This process allows an insect to grow.

mound: a nest constructed out of soil; mounds can be quite elaborate, with many chambers and tunnels and usually project above the ground surface.

multiple-queen mounds: fire ant colonies which contain more than one egg-laying queen. These colonies normally contain 20—60 mated queens and are characterized by many small workers and high mound density.

nurses: the youngest workers in an ant colony responsible for grooming, feeding and transporting larvae.

occipital: of or pertaining to the occiput or the back part of the head.

omnivorous: feeding generally on animal or vegetable food or on both.

pedicel: the "waist"of an ant. It is made up of either one segment (the petiole) or two segments (the petiole plus the postpetiole). These segments connect the thorax to the abdomen.

petiole: the segment of the pedicel closest to the thorax.

pheromones: a chemical substance, usually a glandular secretion, which is used for communication within a species. One individual releases the material as a signal, and another responds after tasting or smelling it.

propodeum: the first segment of the abdomen which is fused to the thorax to form with it a single structure called the trunk.

proximal: that part of an appendage nearest the body.

pupal stage: the resting inactive instar or stage between the larva and the adult; during this stage the larval tissues break down and develop into the adult structures.

pustule: a small circumscribed elevation of the skin containing pus and having an inflamed base.

reserves: a group of workers in the colony that are between the careers of nursing and foraging. They are involved in nest maintenance tasks, relaying food within the colony, tending larvae and helping foragers carry back food.

scape: the first or basal segment(s) in antennae, sometimes greatly elongated.

single-queen mounds: fire ant colonies which contain only one egg-laying queen. These colonies are characterized by the presence of many large workers and widely spaced, nicely formed mounds.

thorax: the body region behind the head which bears legs and wings (if present). In ants this region should be properly referred to as the trunk, since it is actually composed of the thorax and propodeum.

trophallaxis: the exchange of alimentary liquid among colony members. Chemical messages are often passed along with the food as it is exchanged.

trophic egg: an egg, usually degenerate in form and inviable, which is fed to other members of the colony.

venom: poisonous matter secreted by some animals and transmitted to prey or an enemy by biting or stinging. Fire ants inject a venom through their sting.

wheal: a suddenly formed elevation of the skin surface which may burn and itch. A wheal appears almost immediately after a person is stung by an imported fire ant. Later a pustule forms as pus collects in response to the cells killed by the venom.

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