

TURFGRASS TRENDS

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ENTOMOLOGY

Red Imported Fire Ants Continue to Spread North and West

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S*olenopsis invicta* (Buren), the red imported fire ant, was accidentally brought into Mobile, AL in the ballast of ships from South America in the 1930s. Since its introduction, this species has spread throughout the southeastern United States and now continues to expand its northward and westward distribution into areas with mild climates and adequate moisture and food. The ants currently infest over 240 million acres and can be found throughout Puerto Rico, Florida, Georgia, Alabama, Mississippi and Louisiana and in portions of South Carolina, North Carolina, Tennessee, Arkansas, Oklahoma and Texas. In addition, infestations of the red imported fire ant were recently found in Fresno, Kern, and Orange Counties in California.

Fire ants disperse naturally through mating flights, through colony relocation over short distances or by floating to new locations in floodwater. Humans also assist in the distribution or movement into new locations through shipments of ant infested nursery stock, sod, soil, hay, pine straw or beehives. Despite quarantine efforts aimed at preventing the movement of fire ants, it is not uncommon to find that imported fire ants "jump ahead" of the natural distribution due to movement of infested products.



Large mound of the imported red fire ants.

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Friend or foe?

In some settings the red imported fire ant is considered a beneficial insect. The ants feed on just about anything, but their preferred source of food is other insects. In some agricultural settings they prey on very destructive insects. They also reduce the populations of many human and animal pests, such as ticks, fleas and flies.

Although fire ants can be considered to be beneficial insects in some settings, when looking at the "big picture," one must consider the numerous problems they create. Once fire ant mounds are exposed to environmental conditions, the above-ground portion of their mounds becomes very hardened and causes significant damage to turf and farm equipment. Damage to equipment results in lost time in labor as well as equipment repair costs. Adult ants often move into electrical housing units and chew away insulation from wiring. Fire ants cause numerous power outages or electrical shortages in air conditioners, irrigation control boxes, traffic lights and water pumps. In areas where heavy infestations occur (200-plus mounds per acre), fire ants have significant effects on populations of ground nesting birds, deer and other wildlife. Imported fire ants will also feed on seeds and young roots, causing significant plant loss in some agricultural cropping systems.

Although fire ants damage equipment, cause electrical problems and harm wildlife, the most significant problem associated with fire ants is their stinging behavior. The ants are very aggressive and will readily attack anything that disturbs their mound.

When a mound is disturbed, large numbers of worker ants come to the mound surface to defend the colony. An unsuspecting victim can be rapidly covered with ants. The ants anchor themselves with their mouthparts and then sting repeatedly. Venom injected through their sting causes a burning and itching sensation and often causes a white pustule to form. Although fire ant stings are not usually life threatening and are medically uncomplicated, a few people are hypersensitive to the venom and

may suffer chest pains, nausea or lapse into a coma from even one sting.

Look Inside an Ant Mound

Fire ant colonies consist of the brood (eggs, larvae and pupae) and adult ants. The various types (castes) of adult ants include winged males, winged females, one or more egg producing queens and workers. Within a colony, the worker ants vary a great deal in size, but they are all sterile, wingless females. Workers care for the queen and the brood, forage for food and defend the colony.

Winged adults and queens are responsible for dispersal and reproduction. The winged "reproductives" eventually leave the mound in large numbers to mate in the air. This mating or nuptial flight can take place any time of year, but usually occurs in the spring or early summer after a rainy period. Males die shortly after mating. The newly fertilized queen can fly for several miles before she falls to the ground, sheds her wings and begins digging a chamber in which to start a new colony.

The new queen lays a small cluster of eggs that hatch in seven to ten days. The queen initially provides nourishment to this first group of larvae, but later on, she lays up to 200 eggs per day and the care of the eggs and larvae is taken over by worker ants. The larvae develop for six to ten days before pupating. Adults emerge from the pupae in nine to 15 days. The average fire ant colony contains 100,000 to 500,000 workers and up to several hundred winged forms. Mounds may contain only one egg-laying queen (monogyne colony) or have multiple queens (polygyne colonies). Single queen colonies will not accept workers from other colonies and are defensive of their foraging territory. Populations of single queen colonies usually stabilize at 40 to 80 mounds per acre. Multiple queen colonies are more accepting of workers from other colonies and thus their populations often exceed 200-plus mounds per acre.

The mound of a new colony is not conspicuous until several months after the young queen begins egg laying. The size of

the mound depends upon soil characteristics and land disturbance. In heavy soils the upper portion of the mound is often conical and can reach a height of 12 to 18 inches, while in sandy soils the mounds are less well developed. The underground portion of the mound is a series of tunnels and chambers that may extend three to four feet deep.

Fire Ant Control Strategies

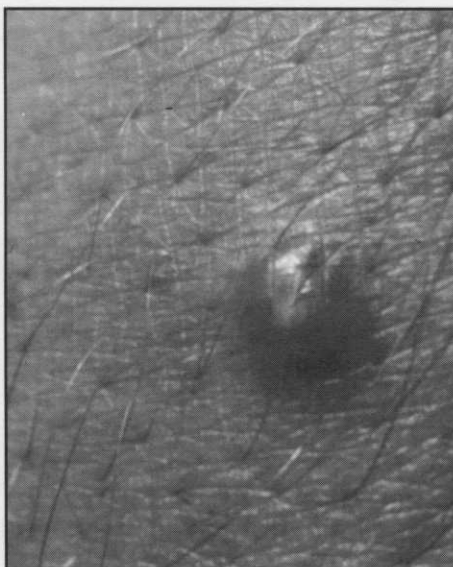
Total elimination of the red imported fire ant in fully infested areas is not technically, environmentally or economically feasible. Temporary control of fire ants can be achieved with the use of chemicals; however they must be periodically reapplied for as long as control is desired. If treatment is terminated, reinfestation is likely to occur as newly mated queens from surrounding areas reinvade the area. Furthermore, it is common for the newly repopulated levels to be larger than the population prior to the initial treatment!

The decision to treat fire ants, once taken, must be accompanied by a long-term commitment to continue periodic treatments. Because of this need for a long term commitment, it may be difficult to economically justify an ongoing control program in many agricultural settings. In high use areas such as parks, playgrounds, recreational turf areas and home lawns, justification for fire ant control programs is more subjective. One must decide when fire ants become intolerable and how much to invest in control efforts. These decisions are influenced by potential health risk due to the presence of fire ants and by the environmental impact of chemical applications.

Treating Individual Mounds

Common methods used to treat individual mounds include drenching each mound with a diluted liquid insecticide; application of granular insecticides to the top of each mound; injection of insecticide into each mound; or application of bait around each mound.

The treatment of individual mounds is a control technique that is best suited for use



Although fire ant stings are not usually life threatening, a few people are hypersensitive and may suffer chest pains, nausea or lapse into a coma.

in small areas where there are low populations of fire ants (less than 20 mounds per acre). Treating each mound requires more labor and monitoring than other treatment techniques and is not suggested for areas where fire ant populations are extremely heavy.

To be effective, it is important to time application of these insecticides to when the adult ants and their brood are located in the top portion of the mound. Mound treatment is most effective when applied in the spring or fall of the year or following periods of heavy rain. This technique of treatment selectively controls fire ants but reinvansion of the site by ants is often observed within three to six months.

Mound drenches: Most fire ant control products are formulated as liquid concentrates, although a few are ready-to-use formulations. These concentrated products may need to be diluted in the amount of water specified on the product's label so care should be taken in handling the concentrate to avoid contact. The solution is poured on top of and

Time insecticide applications when the adult ants and their brood are located in the top portion of the mound, usually in the spring or fall or following periods of heavy rain.

around the perimeter of an undisturbed mound. It is important to deliver the diluted insecticide to the mound in quantities large enough to reach the queen and the brood. On larger mounds, up to two gallons of diluted insecticide may be needed. Mound drenches generally do not kill ants immediately and may require several days to be effective.

Granular products: Several products containing insecticides have been formulated as granules to be applied to individual mounds at a specified rate. To treat a single mound, the recommended amount is sprinkled on top of and around the base of the mound without disturbing the mound. If instructed, water the granules into the mound without disturbing the colony. Several days may be required for the entire colony to be controlled.

Dusts: A few products, such as those containing the active ingredient acephate, are specially labeled for dusting individual fire ant mounds. The powder is distributed evenly at the recommended rate over the mound. Treated mounds should be eliminated within one week. Acephate can also be used 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. Although these products are more expensive and time consuming to use, they tend to give faster results than mound drenches. Injectable products also have the advantage of depositing the pesticide underground out of reach of people and pets.

Baits: These products contain pesticides formulated on bait of processed corn grits coated with soybean oil. Baits

can be applied around individual mounds or broadcast over larger areas at specified rates. As an individual mound treatments, bait products are slower acting and often more expensive than drenches, granular or injectable insecticides, but as an area treatment they offer the advantage of covering larger areas for moderately infected sites (greater than 20 mounds per acre).

Using baits as a broadcast application for infested areas prior to individual mound treatment can be an effective longer term treatment strategy. This approach is best suited for larger areas where fire ant populations exceed twenty mounds per acre and there is little or no concern for preserving native ant species. This combined program of area treatment followed by mound treatment provides long term ant suppression and minimizes the necessity of individual mound treatments.

Application methodology

Contact insecticides: Several control products are labeled for broadcast application. The granular formulations are usually applied with either broadcast or drop-type fertilizer spreaders and the liquid formulations can be applied with high volume hydraulic or individual backpack sprayers. Once applied, these contact control materials should be thoroughly watered into the soil.

Products containing carbaryl, chlorpyrifos, diazinon or isofenphos are longer acting, contact insecticides that primarily suppress foraging ant activity and can prevent small mounds from becoming established. In some cases and through repeated use, these treatments can eliminate colonies.

Bait-formulated insecticides: Bait products contain different active ingredients that work in unique ways.

Hydramethylnon kills ants that ingest it by interfering with the ants' ability to convert food into energy. When applied at the broadcast rate, approximately 80 percent of the mounds in the treated area will become inactive within about five weeks.

The active ingredients fenoxycarb, abamectin, pyriproxyfen or s-methoprene act 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 winged males and sterile females. Reduction of mounds within a treated area is slow, requiring several weeks to many months for the worker ants to die off. However, during this period, the weakened mounds in the treated area apparently prevent recolonization by newly mated queen ants, providing an extended period of suppression which may last up to a year after treatment.

The time required for ants in treated mounds to die depends on the active ingredient used. Hydramethylnon usually eliminates ants in about a week. Avermectin has some toxic effect on worker ants at high dose, but still requires several weeks to achieve control. Ant activity in mounds treated with fenoxycarb, pyriproxyfen or s-methoprene may be seen for five weeks or longer following treatment as worker ants slowly age and die.

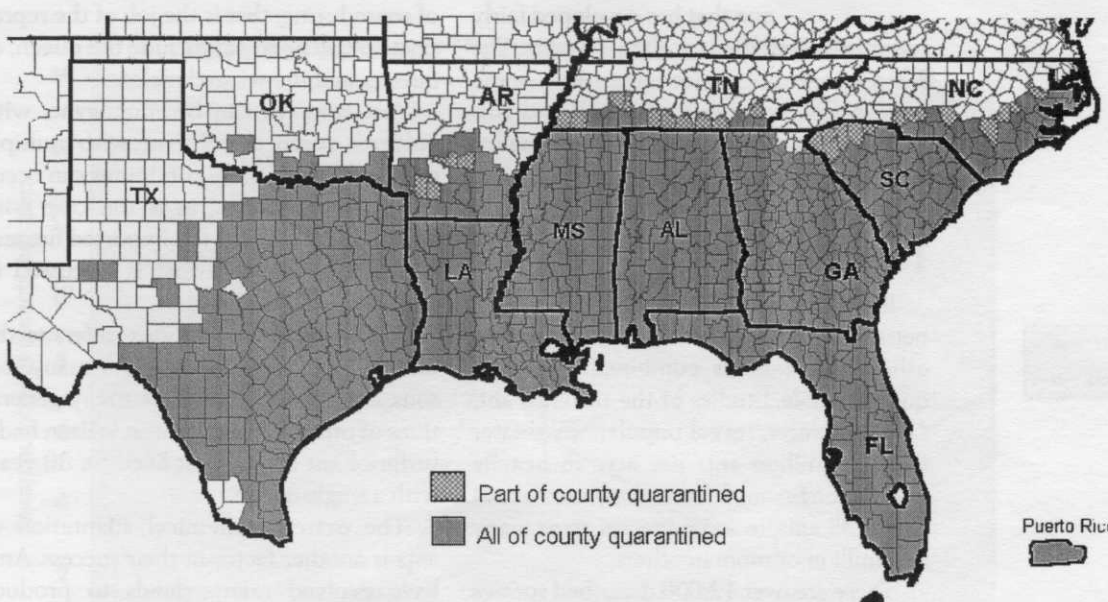
Conclusion

Managing imported fire ants requires a multifaceted strategy.

- Managers must decide if the current location of any mounds requires control efforts.
- Once a control decision is made, managers should quantify the level of infestation at the site.
- Areas of light infestation can be managed with individual mound treatment strategies.
- Moderate infestations can be managed with broadcast treatments.
- Heavier infestations can be managed with a combination of broadcast and mound treatments.
- Extensive site infestations in heavily infested regions of the country usually require some accommodation be made between human and ant activity, in addition to control measures, for satisfactory results to be obtained.

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Imported Fire Ant Quarantines



Restrictions are imposed on the movement of regulated articles from the quarantined (shaded) areas into or through unshaded areas.

Consult your State or Federal plant protection inspector or your county agent for assistance regarding exact areas under regulation and requirements for moving regulated articles. For detailed information see 7 CFR 301.81 for quarantine and regulations.

JUNE 14, 1998

The Turfgrass Ant

Lasius neoniger

By Sean F. Werle, University of Massachusetts, Amherst

What are ants? This question has almost as many answers as there are people who might consider it.

To your child, ants may be the industrious residents of an antfarm on a bookshelf or the fascinating combatants that engage in epic battles on the pavement of your driveway. To an ecologist, they are members of the insect family *Formicidae*, and are one of the most important cogs in the complex biological machinery that they study, exerting an effect on every other part of a given ecosystem.

If one is in the business of managing turf however, ants are more and more often becoming a problem that has to be dealt with. The pest status of ants is a phenomenon that has developed fairly recently, within the last 20 to 30 years. The reasons are not quite clear, but some hypotheses have been advanced and this article will address those ideas and also try to answer the question posed above.

The Ant World

It has been said that the combined number of ants on the Earth is greater than all other land animals combined, which is quite possible. Studies of the turfgrass ant, *Lasius neoniger*, reveal populations greater than 10 million ants per acre in heavily infested turf. A single ant colony can have as few as 35 ants, in some species, to as many as 1 million or more in others.

There are over 12,000 described species of ants; a large proportion of these are tropical, but there are many temperate and even arctic species. The state of Massachusetts is home to approximately 110 species of ants,

and this number is probably a good estimator of the diversity in any temperate area. Ant diversity will increase with decreasing latitude — the closer to the equator one looks, the more species of ants one can find.

Why Ants Succeed

The reasons for the evolutionary success of ants are numerous, but there are several that stand out. These are eusociality, chemical adaptation and general hardiness, probably in that order of importance.

Eusociality refers to the fact that ants are social insects, similar to some of the bees and wasps. E.O. Wilson defines eusocial insects as those that possess three traits: cooperative brood care, reproductive caste differentiation and overlapping generations.

All ants exhibit these traits. Immature ants are completely helpless and depend upon adult "worker" ants to care for and feed them. These worker ants are incapable of reproducing; that is the job of the reproductive castes, which include the queen, or queens, and the winged males.

Ant colonies can be monogyne, with only one queen, or polygyne, with multiple queens. Both of these conditions can occur in the same species, as is the case with *Solenopsis invicta*, the red imported fire ant, a notorious ant pest that is discussed in another article in this issue.

"Overlapping generations" refers to the fact that ant queens survive for many seasons, and thus can produce many generations of offspring in a lifetime. Wilson had a turfgrass ant colony that lived for 30 years with a single queen.

The extreme chemical adaptation of ants is another factor in their success. Ants have evolved many glands to produce chemicals that help the colony function. Some are used to raise an alarm in the case of danger from outside, some are for making trails that other ants can follow to a

The pest status of ants is a phenomenon that has developed fairly recently, within the last 20 to 30 years.

source of food or water and still others are antiseptic, keeping the colony free of infections caused by fungi or bacteria. This extreme chemical dependence has given ants a highly developed sensitivity to many chemical compounds and some studies have shown that they are capable of detecting and avoiding insecticide applications (Vittum and Werle, unpublished data).

The general hardiness of ants is quite remarkable. Some are able to survive immersion in water for as long as two weeks and others have been exposed to intense radiation with no ill effect. This toughness means that, for many species, an established colony is unassailable by other insects or animals.

Many ants can both bite and sting, and are very capable defenders of their colony. The tropical ant (*Paraponera clavata*), from Central and South America, is commonly known as the bullet ant because it is said that the sting of this ant is more painful than a gunshot wound, though the accuracy of this is debatable.

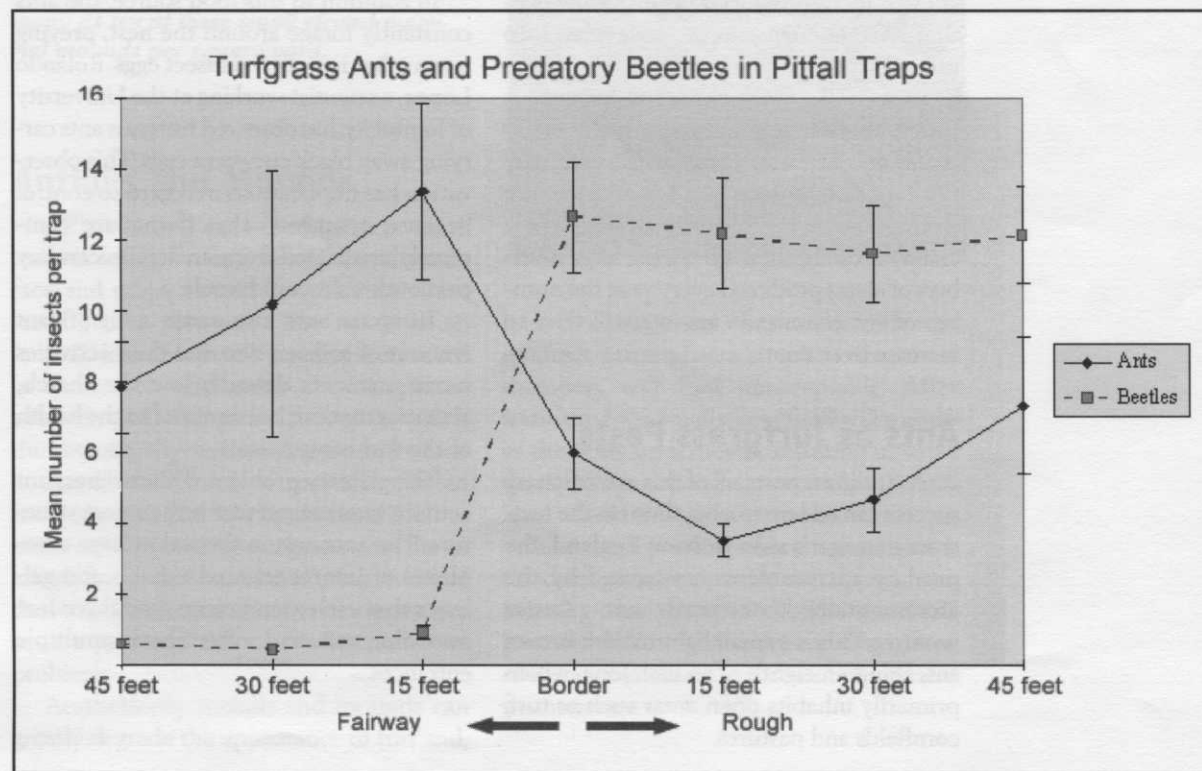
Colony Life Cycle

The life cycle of a colony is roughly similar for all ant species. In the turfgrass ant,

Lasius neoniger, the egg-laying queen spends most of the season laying fertilized eggs that will develop into female worker ants. These workers comprise the majority of the colony and are responsible for all of the food gathering, defense and brood care for the nest. Many ants share food within the colony through a process called trophalaxis where liquid food is regurgitated and passed between workers or from workers to the queen or the brood (larvae).

Late in the summer, the queen begins to lay fertilized eggs and also to feed some of her female larvae differently than normal worker larvae. The unfertilized eggs develop into winged male ants and the specially treated larvae develop into large winged females. These winged ants, called alates, build up in the nest and are prevented from leaving by the workers. Sometime near the end of August, some poorly understood signal causes the workers to allow the alates out of the nest and they take

Late in the summer, the queen begins to lay fertilized eggs. Once hatched, specially treated larvae develop into large winged females called Alates, who will become queens once they mate during a nuptial flight, usually in August.



The ants don't consume plant material, instead they tend small aphids which feed on the grass roots and produce a sugar-rich excretion, called honeydew, which the ants consume.

flight simultaneously across large regions. This is called the nuptial flight and it occurs once every year. During this flight the male and female ants mate and, after flying some distance, settle back to the ground.

The males have served their purpose at this point and are doomed, falling prey to other ants or insects or dying of starvation. The females, now mated and ready to establish new colonies, will fly in search of an open grassy area. Studies have shown that the queens will avoid entering wooded areas. Thus, if they began their flight on a golf course, they will likely remain somewhere on the course. Once they have found a suitable spot, they will chew off their wings, burrow into the ground and lay a small clutch of eggs.

These eggs develop into undersized workers called nanitics that immediately begin foraging. Once they have brought back enough food, the queen begins laying eggs that have enough energy to develop into normal workers.

Despite the ant's reputation for organization, this whole process is actually rarely successful. There are many dangers faced by the foundling queen and her tiny nanitic workers. But, when she does succeed, a new colony is established. Given the large numbers of alates produced every year, the number of ant colonies in an area will tend to increase over time.

Ants as Turfgrass Pests

As turfgrass pests, all of this evolutionary success can add up to a big thorn in the turfgrass manager's side. In New England, the primary ant problems are caused by the aforementioned turfgrass ant, *Lasius neoniger*. This is a small light to dark brown ant, about an eighth of an inch long, which primarily inhabits open areas such as turf, cornfields and pastures.

These ants need grasses in order to survive because a large part of their food is indirectly derived from the grass itself. The ants don't consume plant material; instead, they tend small aphids (*Anuraphis maidiradicis*, the corn root aphid), which feed on the grass roots and produce a sugar-rich excretion called honeydew which the ants consume. These aphids, in turn, are completely dependent on the ants.

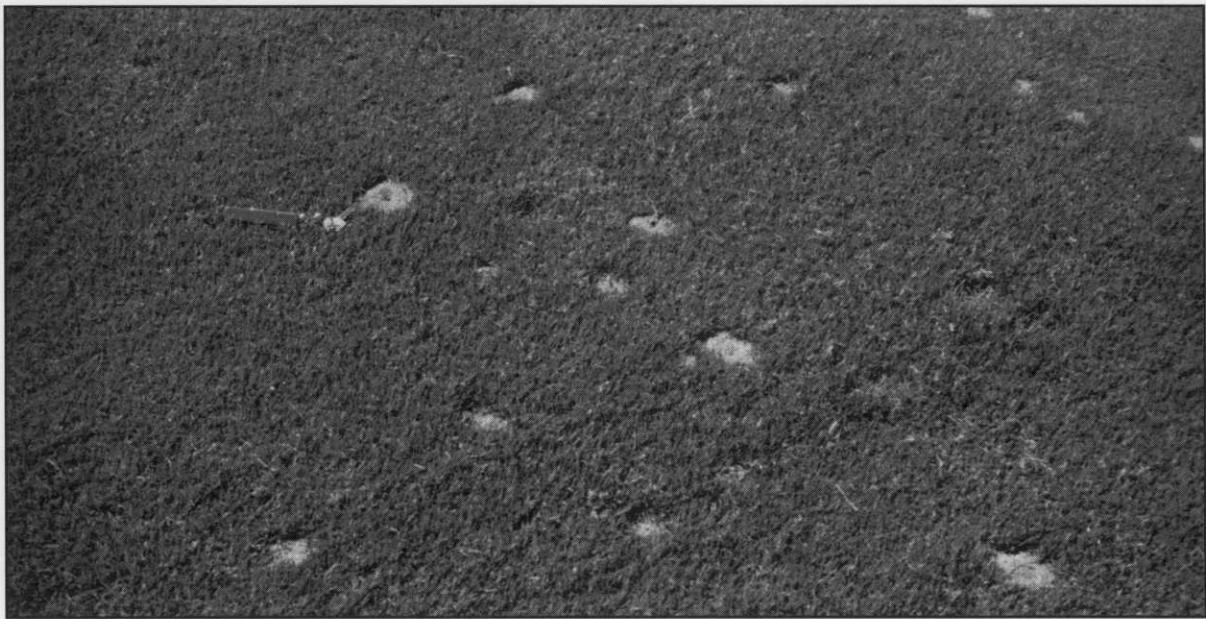
Metcalf described this relationship as follows: "This aphid is rarely found on roots except where attended by the ants and, if placed on the surface of the ground, is apparently helpless so far as finding a place to feed is concerned. An ant finding one of these aphids, however, immediately picks it up, carries it underground and places it on the roots of one of the aphid's food plants."

In the winter, the ants bring the eggs of the aphid down below the frost line and in the spring they place the newly hatched aphids back on the roots of the grass. The root zone of ant-infested turf often supports large populations of these aphids, though seldom enough to cause pathology in the plant.

In addition to this food source, the ants constantly forage around the nest, preying upon other insects and insect eggs. Rolando Lopez, a scientist working at the University of Kentucky, has observed turfgrass ants carrying away black cutworm eggs. This observation has implications in regard to control because it suggests that if ants are completely eradicated from an area, secondary pest outbreaks could result.

Turfgrass ants also cause a significant amount of soil aeration and their activities move nutrients down below the thatch; activities that can be beneficial to the health of the turf ecosystem.

The primary problem with turfgrass ant activity in managed turf is their nest structure. The ants nest in the soil in large complexes of interconnected tunnels and galleries that can extend more than three feet into the soil and often have multiple entrances.



The ants nest in the soil in large complexes of interconnected tunnels and galleries that can extend more than three feet into the soil and often have multiple entrances. All of the soil excavated to form these tunnels is brought to the surface. The result is an "anthill" like structure. It is not an ant mound in which the ants actually reside. In an infested area there can be as many as ten of these small ejected material mounds per square yard.

Anthills and Mounds

All of the soil excavated to form these tunnels and galleries is brought to the surface and piled around the entrance holes leading into the nest. The result is an "anthill" like structure. This term is enclosed in quotes to emphasize the distinction between an anthill or ant mound in which the ants actually reside, and an anthill which is simply composed of material ejected from beneath the soil by the ants such as those constructed by turfgrass ants. In an infested area there can be as many as ten of these small ejected material mounds per square yard and this causes a number of problems.

Aesthetically anthills and mounds can greatly degrade the appearance of turf and,



on golf course greens, they can detrimentally affect game play, a situation that most members will find unacceptable. After some time, the small piles of soil will smother the grass underneath, resulting in small dead patches that remain even after the ants have ceased using that entrance.

The most pressing concern, however, is the damage to equipment that results from mowing over the mounds. The small soil particles dull mower blades and clog rollers, causing a significant increase in equipment maintenance costs.

Why ants increase

Among a number of possible causes for the recent increase of ants as turf pests, the two that stand out are decreased mowing height and the loss of organochlorine insecticides. For many years, chlorinated organic compounds such as chlordane were used extensively in turf to control a number of pests, mainly scarab beetles. These com-

pounds are highly toxic to ants and thus ant populations were probably secondarily controlled by these applications. Since the use of these materials was discontinued in the 1970s, ants have possibly been released from this chemical constraint and thus are able to emerge as pests.

Another possibility is the "Stimpmeter factor." As golf courses have competed to increase green speed, mowing heights have steadily decreased. Turfgrass ants are seldom cited as home lawn pests and their presence is difficult to detect in a golf course rough. This is because the grass is mowed at a height that masks ant activity. On short-mowed fairways and greens, this masking is removed and ants that may have been present but undetected at a slightly higher mowing height are revealed as pests.

Controlling Turfgrass Ants

Lasius neoniger has proven difficult to control. Many insecticides are ineffective against them and, as mentioned before, they are capable of detecting applications and avoiding materials in some cases. Studies at Dr. Vittum's lab at the University of Massachusetts have revealed no material that is effective for more than a few weeks in controlling mound-building activity.

Some patterns have been seen that may be helpful, however. Since the ants spend the winter deep in the soil and move rapidly to the surface in the spring (early April in

western Massachusetts), timing of application can be an important factor in control. If an effective material is applied at this time, the colony will suffer a serious setback in its initiation of warm weather activity and this can delay the onset of turf management problems.

Another possible avenue of control is to adjust mowing height in order to mask ant activity. Fairways mowed at three quarters of an inch are unlikely to exhibit ant problems because the soil ejected from the nests will not reach above the grass. Often changes such as this are unacceptable to club memberships and so ants remain a difficult and expensive problem for the people in charge of managing turf.

Conclusion

It is appropriate to return to the question posed at the beginning: what are ants? Hopefully the point has been made that while ants are a serious problem in many turfgrass settings, they are beneficial in other ways also.

Understanding what ants are and how they fit into the local turf ecosystem (i.e., identifying and controlling food sources) is important for responsible ant management. However, if all your efforts prove fruitless, then the best long-term solution is probably for turf managers to find ways to coexist with the ants, using a combination of carefully timed pesticide applications and adjustments to fairway and greens mowing heights.

Think of it this way: With all of the myriad insects out there that eat grass, can insects that eat other insects be all that bad?

Sean F. Werle is a graduate student of Dr. Pat Vittum in the Department of Entomology at the University of Massachusetts, Amherst.

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