Features - PCT News

[Ant Control] New Research Busts Old Myths

5/19/2009

A review of some recent research from Purdue University about carpenter ants.

Carpenter ants are among the top five pest ants in the U.S. and, in some states, the most frequently treated by pest management companies. In the Pacific Northwest and the northeastern U.S. these ants can be as destructive as subterranean termites. Carpenter ants nest in wood structures and prefer moist wood affected by fungal decay. However, they will also nest in sound wood and other non-wood construction materials, including foam and fiberglass insulation, drywall and particleboard.

Numerous conditions may promote infestations by carpenter ants (see Figure 1 on page 58) including proximity to forest, wood in contact with soil, vegetation in contact with structure, roof or gutter leaks and infested trees on property. Carpenter ants may invade a structure in one of two ways. The most common way is for a mature colony nesting outside to set up a satellite nest inside. This usually results in more ants visible on the inside and more damage, as satellite nests are started by mature colonies in need of expansion. Another way is for a newly produced queen (alate reproductive) to set up a new colony within the structure. This is rather unlikely as new queens usually establish colonies in the outdoor environment. This also results in little to no immediate damage to the structure because carpenter ant colonies grow slowly during the first two years and the colony may initially only have 10 to 20 workers.

REGIONAL DIFFEReNCES. Worldwide, there are more than 900 species of Camponotus species, of which 50 are found in the United States and Canada. The great majority are not pests and are highly beneficial helping to recycle decaying wood, serving as food for other animals, preying on forest pests and supporting forest ecosystems in a variety of intricate ways. Some species, however, have become leading structural pests.

In the United States there are approximately six major pest species of carpenter ants and two species clearly stand out as the most abundant and the most economically important. The black carpenter ant, Camponotus pennsylvanicus, is the principal structural pest in the North Atlantic states and the Midwest and the most common carpenter ant pest in the U.S. The workers are 6 to 13 millimeters long, dull black in color with pale yellow or light pubescence. Colonies may reach 10,000 to 15,000 individuals and the ants are primarily nocturnal, with two peaks of activity, one right after sunset and one right before sunrise. Foraging activity patterns are not set and may change in response to environmental conditions (e.g., temperature, humidity, light intensity) and colony demands for resources.

The western black carpenter ant, Camponotus modoc, is the most common pest species in the western United States and southwestern Canada. The workers are 6 to 13 millimeters long, dull black in color with short pubescence that is half the length of erect hairs. Colonies may be large, with up to 50,000 individuals.

Other, less economically important species include Camponotus vicinus in the Pacific Northwest, Camponotus floridianus in the southeastern states and Camponotus variegatus in Hawaii.

While in some cases careful species identification may not be necessary for successful control, it is important to consider that species differences may have significant implications for dealing with infestations. Colony size is one factor.

For example, colonies of C. vicinus may have more than 100,000 individuals, while colonies of C. pennsylvanicus only around 10,000. If baits are used, bait usage should be adjusted depending on colony size. Another consideration is daily activity patterns that may affect the likelihood of finding the nesting sites. For example, C. pennsylvanicus are mainly nocturnal, while C. floridianus are active day and night which should help with finding the nests. Species differences in nesting preferences will affect where the colonies may be found. Some species prefer to nest in wood (e.g., C. pennsylvanicus), while others may nest in soil beneath objects (e.g., C. floridianus). Finally, activity is highly affected by temperature and rainfall in some species (e.g. C. pennsylvanicus), but not others (e.g., C. modoc).

PURDUE RESEARCH. What follows is a review of some of the ongoing research at Purdue University:

Colony Spatial Structure. Mature carpenter ant colonies may be partitioned into parent and satellite nests (see Figure 2 on page 64). The nests are separated spatially, but connected socially by the exchange of workers, brood and food. The queen, eggs, early-instar larvae and workers are located in the parent nest, usually in a standing live or dead tree, rotting wood, or a wooden structure. Workers, mature larvae, pupae and winged reproductives are found in satellite nests, which are often excavated in drier, solid wood. Satellite nests can be numerous and often difficult to locate by visual observations alone. They may account for as much as 75 percent of structural infestations. The number of satellite nests per colony varies, as does their demographic composition.

Furthermore, the distribution and location of carpenter ant nests vary among species and habitat. To better understand the colony structure in black carpenter ants, Camponotus pennsylvanicus, we surveyed a large plot (more than 1 square mile) on the campus of Purdue University to estimate the abundance of carpenter ants. The habitat is a managed urban landscape and is typical of where pest management professionals might normally treat for carpenter ants. The area included numerous buildings, streets and landscaping with abundant trees and shrubs, park-like areas, lawns and mulched beds.

We inspected 1,150 trees and determined that 365 trees (32 percent) were colonized by carpenter ants. The ants nested in 24 different species of trees, with 35 percent of colonies nesting in oaks, 15 percent in maples and 10 percent each in locust and black walnut trees. However, this does not necessarily mean that carpenter ants prefer oaks and maples over other trees — these were the most abundant trees in our plot and carpenter ants nested in any and all tree species including conifers and hardwoods.

Approximately 8 percent of colonies were monodomous (one nest), indicating that carpenter ants rarely nest in a single location. Thus, when a nest is discovered in a structure, there is greater than 90 percent chance that there is at least one more nearby. The average number of trees per colony was 2.2 (range one to five). We counted the number of ants visible on the trees to estimate the number of workers that might be observed during an inspection. The counts were taken at night when the colonies are the most active. The counts ranged from five workers to more than 350 workers per tree with an average of 45 workers per tree. This indicates that colony size can vary greatly and active sites can easily be missed if foraging activity is low or if the inspection is performed during the day.

Previous research suggests that at any one time, only 1 to 3 percent of the ants are outside the nest foraging. Day activity was at least tenfold lower (or the ants were completely absent). We also measured the length of trails between trees to determine the extent of the colony's foraging range and foraging distance. The average distance between infested trees was 51 feet. Ten percent of the trails were under 25 feet, 50 percent between 25 and 50 feet and 40 percent over 50 feet. The shortest trail was only 2 feet and the longest more than 120 feet, indicating that additional nests may be located far from the infested structure. It is important to note that carpenter ants do not always take the shortest route between nests, but will often take the easiest. They prefer to use paths free of obstacles (e.g., will trail 50 feet over concrete, rather than trailing 25 feet over grass) and will use structural guidelines for navigation (e.g., sides of buildings, gutters, cables, etc.).

Spatial Structure &Elimination. Pest management professionals often hear that it is necessary to find and treat all carpenter ant nests to achieve complete control. While older chemistries may have required a complete treatment (and most likely some re-treatments), modern chemistries including fipronil, indoxacarb and thiamethoxam may not have the same requirement.

Full colony treatments have always posed a challenge due to the time it took to discover all the nests and the need to apply more insecticide. Furthermore, if two nests were discovered, it was unknown whether they belonged to the same colony or two different colonies, which would have resulted in two partial treatments. Our field research demonstrates that treating all nests is not necessary and complete control is frequently achieved by treating just one nest. We compared the efficacy of full and partial treatments using a gel formulation of indoxacarb applied to trees occupied by carpenter ants. In the full treatment, we treated all nests in each colony and in the partial treatment we only treated one nest, either parent or satellite. Each treatment was replicated 6 times. As could be expected, the full treatment worked substantially faster and gave complete control in 4 out of 6 colonies at 28 days after the treatment (average mortality 94 percent). The partial treatment, although slower, resulted in the same level of control and 4 out of 6 colonies were completely eliminated and the other two greatly reduced (average mortality 91 percent). All trees were inspected again the following season to make sure that the colonies were indeed completely eliminated, not just suppressed for the season.

Similar results were achieved with a thiamethoxam bait formulation. In another field study, liquid spray formulations of fipronil and indoxacarb were used as band treatments around infested trees. Again, partial treatments with either insecticide resulted in complete colony elimination and dead ants at the base of the untreated trees often revealed the location of satellite nests. These results show that partial treatments can be very effective and result in complete colony kill and that finding both the parent nest and the satellite nests(s) is not necessary for complete colony eradication. However, it is important to keep in mind that thoroughly inspecting and treating all nests is still the best and the fastest way to eliminate carpenter ants.

Worker Size & Speed of Kill. The toxic effects of insecticides largely depend on the dose and the size of the individual. For example, in humans the consequences of accidental insecticide poisoning depend on the dose ingested and body mass. We were interested whether a similar pattern holds true for ants. Specifically, we wanted to determine if higher doses of spray insecticides might be needed to kill carpenter ants relative to much smaller ants.

Conventional wisdom suggests that when treated with the same dose of the same insecticides, small ants should die faster than larger ants. To determine whether this holds true, we exposed nine urban pest ant species to residues of three spray insecticides commonly used for ant control (bifenthrin, chlorfenapyr and fipronil). The ants ranged from small (e.g., Pharaoh ants, thief ants), to medium (e.g., odorous house ants, Argentine ants), to large (e.g., black carpenter ants, field ants). We treated two substrates (sand or tile) with label rates of the insecticides and continuously exposed the ants to dry residues.

Contrary to our predictions, mortality did not appear to depend on worker size and no single species was consistently the most or the least susceptible to any particular insecticide. Despite their large size (on average, carpenter ant workers are 40X heavier than odorous house ant workers and 120X heavier than Pharaoh ant workers), carpenter ants clearly emerged as a highly susceptible species. Adjusted for worker body mass, carpenter ants were 60X more susceptible to fipronil and 50X more susceptible to bifenthrin relative to odorous house ants. Carpenter ants were also 100X more susceptible to fipronil, 85X more susceptible to bifenthrin and 45X more susceptible to chlorfenapyr relative to Pharaoh ants.

This shows that certain ant species are highly susceptible to the effects of insecticides, while other, often much smaller species are substantially less susceptible. Interestingly, the odorous house ant emerged as a tough-to-kill species and was consistently harder to kill than other larger or smaller species. Could this be why the odorous house ant is considered the No. 1 "callback pest ant" in many areas of the country? Further work needs to be done to determine how the biology and behavior of odorous house ants may help them survive exposure to insecticide treatments.

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