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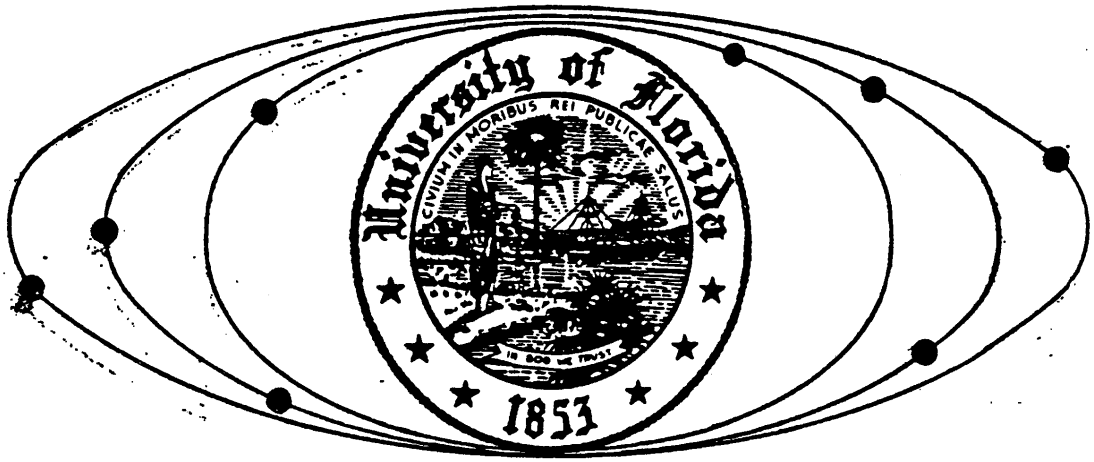

Host Institutions

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A DISCUSSION OF THE IMPORTED FIRE ANT IN THE UNITED STATES

David F. Williams
USDA, ARS, Insects Affecting Man and Animals Research Laboratory, Gainesville, Florida 32604

The major research effort on fire ants is located at our laboratory here in Gainesville, Florida at the Insects Affecting Man and Animals Research Laboratory of the USDA,ARS. Today I will speak on the history and biology of fire ants and briefly mention the role pheromones play in the fire ant's behavior.

Mr. William A. Banks will follow my presentation with a discussion on laboratory rearing methods, economic damage, and chemical control of the imported fire ant. Later this afternoon, Drs. Dan Wojcik and Don Jouvanez will discuss research on the ecology and biocontrol of the imported fire ants.

History and Biology

Five species of fire ants are found in the United States. There are 3 native species of fire ants, Solenopsis geminata, S. xyloni, and S. aurea. However, it is the 2 imported species the red imported fire ant, S. invicta, and the black imported fire ant, S. richteri, that have caused

the most problems in the U.S. S. richteri which was introduced into the U.S. at Mobile, Alabama around 1918 is now found only in a small area in northeastern Mississippi and northwestern Alabama. S. invicta also entered the U.S. at Mobile, AL but about 15-20 years later in the 1930's (Tschirley 1982). S. invicta has spread to 9 states and the island of Puerto Rico. This dramatic spread was due in part to the ant's high reproductive capability (3000 to 5000 queens per colony per year; Lofgren and Weidhaas 1972), and the movement of nursery stock throughout the southern U.S. By 1953, S. invicta had definitely established itself in many areas throughout the south and was thus free to spread to uninfested surrounding areas. In 1985, they occupied over 93 million hectares (Lofgren 1986). The future distribution of S. invicta is unknown but the potential exisits for it to spread westward to California and up both coastlines of the U.S.

Normally, colony-founding by imported fire ants begins when new queens from nuptial flights alight on the ground. Usually a colony is started by a single queen however, in some heavily infested areas, many dealated queens come together under pieces of debris such as paper, grass clippings, cans, and wood (Lofgren et al. 1975). Sometimes many queens are found in a single nest (Markin et al. 1972). These multiple queen colonies usually have a much greater number of workers that are smaller and more uniform in size than single queen colonies.

S. invicta founding queens usually produce over 100 eggs per day which hatch in about 8 to 10 days (Petralia and Vinson 1978). There are 4 larval instars. All of the larval instars are fed liquid foods and the 4th instar is also capable of feeding on solid food fed to it by the workers. Developmental time for all 4 larval stages ranges from 6 to 10 days while the pupal stage requires 7-8 days (Lofgren et al. 1975). The first workers (minims) are produced within about 27-37 days (Fincher and Lund 1967). After 4-5 months, the colony size numbers over 1000 minor workers and a few major workers. At this time, the minim workers no longer are present (Vinson and Greenberg 1986). Generally after 1 year, colonies average over 11,000 workers. A fully mature colony 2 1/2 to 3 years old may have over 230,000 workers (Vinson and Greenberg 1986).

Reproductives (winged males and females) begin to appear when the colony is only 6 months old. Mating flights generally occur throughout the year with peak activity during the summer months (May through August). The flights will usually occur within 1 to 2 days after a rain and take place in the afternoon 100 to 300 meters above ground (Lofgren et al. 1975). After mating, queens land, shed their wings, and begin to excavate a burrow for their nest site. Males will die within 24 hours after mating. The average number of alates produced per hectare per year in Florida was about 462,000 (Morrill 1974).

Although the primary diet of fire ants consists of insects and other small invertebrates (N.L. Wilson and Oliver 1969), they are omnivorous and opportunistic and may feed upon whatever plant or animal material they encounter (Lofgren et al. 1975). Fire ants are very efficient foragers for food. The workers collect food for the colony by foraging from the mound thruogh underground foraging tunnels that radiate 15 to 25 meters from the mound. These tunnels are 6 to 12mm below the soil surface (Lofgren et al. 1975). Exit holes to the soil surface occur at irregular intervals along these foraging tunnels. The worker ant exits through one of these holes to the surface and randomly forages the area until food is located. Once food is found, the foraging worker returns to the tunnel laying a trail with a pheromone. Additional workers are then recruited and thus a continuous trail of workers is established between the food and the nest.

Pheromones

Pheromones are very important in the organization and cohesiveness of the fire ant colony. These chemicals are involved in many behavioral responses and are used for individual and colony communication (Vander Meer 1983). Four pheromone systems have been examined in S. invicta (Blum 1980). These are the brood pheromones, trail pheromones, queen pheromones, and nestmate recogition pheromones. The brood pheromone is probably involved with

the grooming, licking, and antennation of brood by worker ants. If brood is scattered outside a nest, S. invicta workers rapidly pick them up and return them to a brood pile inside the nest (Glancey et al. 1970). Bigley and Vinson, (1975) using sexual prepupae, identified the major active component in the brood pheromone as triolein; however, Vander Meer (1983) criticized their work suggesting that other components were probably involved.

The trail pheromone was the first fire ant pheromone system to be investigated (Vander Meer 1983). Wilson (1959) discovered that the Dufour's gland was the source of the pheromone that elicited trail-following. The Dufour's gland and accompanying poison apparatus, which includes the poison sac, poison gland, and sting, were discribed by Callahan et al. (1959). Trails are laid when foraging workers apply the phermone from Dufour's gland through the sting to the ground. The trail consists of streaks made by the extension and withdrawal of the sting away from the surface substrate (Wilson 1962). Vander Meer et al. (1981) made a major breakthrough in trail pheromone chemistry by isolating and identifying several trail pheromone components from S. invicta.

The term queen pheromone is a term that encompasses several queen-related behavior responses (Vander Meer 1983). This pheromone is stored in the poison sac and causes responses by the workers towards their mother queen. The usual response is aggregation, antennation, grooming of the

queen, and the deposition of brood near her (Vander Meer 1983). Several researchers are continuing work on the multifunctional role of the queen pheromone system.

The final pheromone system is comprised of the nestmate recognition pheromones. There is a large amount of evidence that fire ants recognize odors of nestmates and often have specific territories on the ground where they forage (Wilson 1971, Wilson et al. 1971). Colony odors appear to consist of innate odors characteristic of a species and environmental odors absorbed onto the insects cuticle, which serve to distinguish colonies of the same species (Wilson 1971). Vander Meer (1983) showed that the cuticular hydrocarbon patterns of S. invicta, S. richteri, S. geminata, and S. xyloni were distinctive patterns of saturated and unsaturated paraffins. Further studies in the laboratory by Vander Meer (1983) indicated that S. invicta had a characteristic pattern of 5 major hydrocarbons which exisited not only in the adults but also in immatures. Thus, it appears that cuticular hydrocarbons are a very important part of nestmate recognition in the fire ant (Vander Meer 1983).

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