



Texas Imported Fire Ant Research and Management Project

Final Progress Report - October 2001

Ecology Program: Development of targeted, environmentally safe, substance delivery protocols (SDP) for novel chemical and biological products directed to imported fire ant management based on surface activity and foraging ecology of imported fire ants (Monogyne and Polygyne) and competitive native ant species.

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Relevance/Implication of Project:

Much of the activity of a fire ant colony occurs at the surface. This is where resources are gathered, where interactions between the fire ants and their competitors occur, and where most diseases, parasites, and predators are encountered. Further, the effectiveness of baits, barriers and certain cultural approaches to management are dependent on an interaction between the worker ant and the management approach being applied. Baits, which comprise one of the major current approaches to management, can be formulated and applied in a variety of ways. As new products come available, bait formulations may require a change which would impact the baits interactions with the ant.

In order to develop more effective fire ant management techniques, we must have a better understanding of the foraging, gathering, distribution, recruitment and defensive strategies of the workers in both monogyne and polygyne populations. We must also determine the source of resources the IFAs are using, determine who are the losers in competition for these resources and who besides the IFA benefits? How are these resources redistributed and does this redistribution favor the IFA? Can we interfere with this distribution? We propose to develop substance delivery protocols (SDP) that will allow us to make improved recommendations on when and where to apply control substances to achieve maximum impact on the IFA, thereby reducing costs and increasing benefits. a sound SDP will also aid in environmental protection by decreasing the amount of control substances which must be introduced into the environment per amount of control achieved and thus reducing potential collateral damage to non target organisms such as important competitive ant species. A sound SDP will also provide the information needed to develop other delivery systems as dictated by the nature of the management products that become available. This will be particularly important for certain biological control agents that will require delivery through an augmentation approach to management.

Summary of proposed work to be Done:

In order to know how to best disseminate biological agents will depend on a working knowledge of both the foraging strategies and the movement of resources into the various parts of monogyne and polygyne colonies. This information is important to: (1) improve the baits impact on the IFA, (2) reduce the impact of baits on the native competitors, and (3) develop baits that can be useful in inoculating IFA colonies with select bio-control agents (example, *Beauveria*). This also involves understanding the impact of the IFA on other organisms through their impact on the distribution and abundance of resources.

Lastly, we need to identify and characterize the ant fauna, educate the public as to the importance of competitors and the recognition of diseased populations, and develop methods to archive the biological samples and information. The present research is focused on the following objectives:

I. Determining how aspects of the spatial environment affect differences in the abundance and distribution of imported fire ants and native ants. We proposed to characterize the major habitat types found in Burleson and Brazos counties (as representative of Southeastern Texas) and quantify densities of imported fire ants mounds, gynes and determine forager activity in each of the habitat types in relation to spatial elements of resources (e.g., water) or habitat boundaries. We also proposed to characterize and quantify the native ant fauna for each habitat type. These goals are an extension of the methods and goals of the project funded during the first biennium “Geographic distribution and abundance of Fire Ants: A GIS/Landscape ecology approach to suppression and prevention.”

Results

In connection with the Geographic distribution and abundance project we focused on ant densities and species along ecotones. We identified the ants and found that ant diversity was high at the junction of most ecotones regardless of the types of habitat that flanked the ecotone. This research has been prepared for publication.

We have also examined the diversity of ants in the adjacent habitats. Here the diversity is much lower and greatly influenced by the nature of the habitat. The more disturbed the habitat, the fewer species. This research is also being prepared for publication.

II. To determine how environmental factors affecting surface activity and foraging behavior differ between imported fire ants and competitive native ant species. We proposed to determine the activity patterns for both the imported fire ant and the more important competitive native ants. We wanted to know how they coexist in mixed situations and we wanted to determine if the activity patterns differ when the mix differs. We also wanted to know if there is a foraging activity that is characteristic for each species. If so, we could improve the timing of bait application to reduce the impact on native species.

Results:

We examined the foraging activity of native and the Imported Fire Ant in an undisturbed meadow. This was chosen because there were a number of native ants, as well as, the Imported Fire Ant present. Further the fire ant colonies were scattered. In this setting the foraging pattern of the various species were examined throughout the day. We found that there are periods where the Imported Fire Ant does not actively forage while several of the native ants do. These results suggest there are times when a bait could be applied to reduce the impact on native ants. This research is “in press”. We have expanded on these studies and have developed a general model

of ant foraging time that is based on surface temperatures that appears to be predictive. We are further evaluating this possibility.

III. Determine the competitive interactions and the foraging biology of the Imported Fire Ant in the natural environment.

We Proposed to determine the relative abundance of imported fire ants and native ant species in habitats suitable for fire ants (meadows, pastures) and determine whether there are differences in the frequency of imported fire ants versus native ant species according to habitat type.

Results

We have not completed this part of the project, in part because we became aware of another fire ant activity that appeared to be more important and could influence the type of data we might collect. We discovered that the fire ant tends legless mealy bugs in large numbers. They even build enclosures for them and move them out of danger. The relationship is common throughout much of the fire ant range. It also appears that it is the fire ant that makes use of these insects as a source of food, primarily carbohydrates. Further, much of this activity is underground and therefore the worker ants are not as susceptible to attack by phorid flies. This research has tentatively been accepted pending a few minor corrections.

IV. Determine how food (energy) moves among nests within polygyne fire ant populations.

Using mass-marking and recapture techniques and food labeling technology, we proposed to track individual fire ants and food type movements among polygyne fire ant mounds. This information will lead to improved control substance placement strategies that will allow us to estimate the amount of material or pathogen/parasite numbers required for effective management of polygyne versus monogyne fire ant populations.

Results

We have examined resource movement and allocation in multiple queen-polygyne colonies in the field. This was initiated to determine how resources (and poisons) are moved into polygyne colonies and to determine how much sharing of resources is taking place. The results, although not yet completely analyzed, indicates that sharing occurs, but this sharing, particularly at the surface is much less than expected. The results suggest that on the soil surface that a mound tends to dominate a certain resources. However this is dependent of satiation of the dominant colony. However, underground these resources appear to be shared more. Further, there appears to be some indication that some colonies pull in more resources than others. This research is still ongoing.

V. Determine which extrinsic environmental factors (time of day, time of year, temperature, cloud cover and solar radiation) affect surface activity and foraging behavior of the imported fire ant and native ants.

We proposed to determine in the field how the time of day, temperature, season and other factors, affect surface activity of imported fire ants and coexisting native ants. Similar studies were proposed to elucidate the foraging biology of the Imported Fire Ant but using a simulated field environment where we could control the resources and the environmental conditions. This would allow us to determine the effect of temperature, light and humidity on foraging activity as well as the effects of starvation, competition, and diseases. In addition we could determine if scouts locate resources by odor, does site fidelity exist among scouts, if a scout louses a trail do they use external navigation cues and what are they. What percent of a colony forages or recruits to different resources, what effects does the colonies age, or physiological state have on these activities.

Results

We have developed a procedure that has allowed us to conduct simulated field studies and we have been able to regulate the environmental conditions so that meaningful data can be collected. Using these facilities and using several different experimental designs we have examined and described several different foraging situations that are dependent on resource distance and satiation levels. We have examined changes in foraging behavior as a result of differences in the distance to a resource, type of resource, amount of resource, and distribution of the resource. We have also examined the movement and cost of the movement of resources, primarily carbohydrates, into colonies. Much of this research is being written up as part of a dissertation.