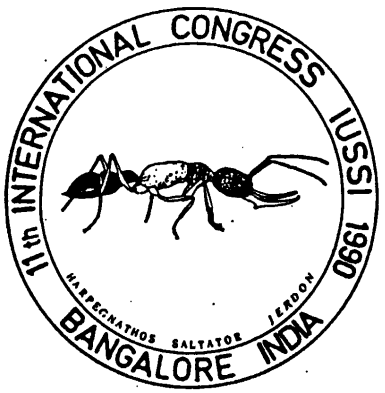
SOCIAL INSECTS AND THE ENVIRONMENT

PROCEEDINGS



Editors

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FUTURE CONTROL STRATEGIES : FIRE ANT PHEROMONES

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INTRODUCTION

The fire ant is an agricultural pest, but has received most notoriety because of its aggressive behavior and potent venom. About 1% of the population develop allergic reactions and it is estimated that one-third of the population in an infested area is stung at least once each year. The situation is compounded by its large numbers and the fact that the ant thrives wherever man disturbs the environment.

Baits were developed for fire ant control because they offered large scale treatment possibilities, as well as a method that required much less insecticide. Our laboratory has been instrumental in the discovery and development of several effective bait formulations. All of these baits have some affect on non-target organisms, especially other ants. One goal of our laboratory is to determine how pheromones produced by the fire ant can be used to develop more species-specific control methods.

FIRE ANT PHEROMONES

The following social insect behavioral responses are pheromone mediated (1) Alarm, (2) Attraction, (3) Recruitment to a new food source or nest site, (4) Trail following, (5) Brood care, (6) Assistance at molting, (7) Recognition of nestmates, (8) Caste regulation, (9) Control of competing reproductives, (10) Worker and sexual excitant during mating flights, and (11) The rendezvous of male and female sexual during mating flights [1]. We know very little about mating flight pheromones (sex pheromones, etc.) or caste regulation in fire ants. These are areas that have potential in control strategies but require basic research. Assistance at molting and brood care have been thought to be pheromonally controlled and a fire ant "brood pheromone" has been reported; however, the actual existence of brood pheromones is in doubt [2]. Fire ant nestmate recognition research has provided many benefits [3]; however, the associated chemical cues are not chemically discrete (derived from heritable and environmental sources) [3]. The possibility of disrupting the recognition process would be most favorable in polygyne populations, but research is lacking.

Much behavioral information has been accumulated about the control of competing reproductives in fire ant colonies. The fire ant queen produces a dealation inhibitory primer

pheromone that prevents dealation and ovariole development in coexisting female sexuals. Intriguingly, workers respond to greater than usual amounts of this pheromone by executing supernumery queens, until the pheromone level is sufficiently reduced [4]. Introduction of this pheromone into a colony could induce workers to execute their own queen. Evaluation of this hypothesis awaits the isolation, identification and synthesis of the active compound(s). Of similar interest is queen control over male and female alate production by influencing the behavior of worker toward male and female brood [5]. Chemical studies have not been done on this system.

Recruitment pheromones produced by the Dufour's gland elicit, depending on the situation, orientation, alarm, migration to a new nest site, or recruitment to a food source [6]. Artificial induction of these behaviors would result in disruption of the ant's social organization and perhaps aid in control. But the most obvious way to use pheromones is through the incorporation of worker attractant pheromones into baits. This would make the baits more efficient and species-specific. Two attractants have been chemically defined. (A) The attractant associated with recruitment has two components, but preliminary studies indicate that at greater than physiological levels a single component significantly attracts workers. We are currently attempting to make this compound available via synthesis. The queen also produces a worker attractant, which has been isolated and identified as a three component mixture (A, +B, -B, +C, and -C). Two compounds (B and C) are optically active; however, through comprehensive olfactometer bioassays we determined that significant attraction could be obtained with A in combination with ±B or even with ±B itself. Evaluation of the two attractant pheromones incorporated in bait particles is in progress.

There are many possible ways to use pheromones as adjuvants to fire ant control. It remains for us to keep our minds open and continue the basic research that will lay the ground work for the innovative pest ant control of the future.

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