A Parasitic Fly that Kills Mole Crickets: Its Use in States North of Florida.

University of Florida
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Objectives:

1. *To explore farther south in South America (colder climates) to obtain stocks of the fly Ormia depleta, a natural enemy of the mole cricket.*
2. *To culture the captured South American flies in our laboratory and supply them to collaborators in other states for release.*

Scapteriscus mole crickets, all of South American origin, are the most damaging insect pests of southern turf. Because of the economic importance of turf in the South, they are the most important pests of turf in the USA. In the 1980s, three classical biological control agents were introduced from South America into Florida to control mole cricket pests. One of these agents is the parasitic fly *Ormia depleta*. Classical biological control does not aim to produce a marketable product -- instead, it aims to introduce and release a biological control agent that will provide permanent free area-wide biological control of the target pest. The cost of classical biological control is all subsumed under the heading "research. "

A tropical stock of *Ormia depleta* was imported from Piracicaba, Brazil (23°S) in 1987. It was first released in Alachua County, Florida, in April 1988, by the University of Florida mole cricket research program (at that time funded by a State of Florida appropriation). In 1989 through1991, further laboratory rearing of the fly was supported by 28 Florida golf courses (sponsored by the Florida Turfgrass Association). In that project, about 10,000 flies were reared and released in all areas of Florida. In summer 1992, a survey showed that the fly had established populations widely in central and southern Florida. By the end of 1994, the fly was found to occupy 38 counties of peninsular Florida, as far north as Alachua County. It contributed to control of pest mole crickets on Florida golf courses (see Florida Turf Digest 11(1): 21-24). Research on the fly then almost ceased for lack of funding. Nevertheless, "starter stocks" of the fly were provided to and released by collaborators in Alabama, Georgia, and North Carolina, but there was no evidence these became established.

Evidence for effect *of Ormia depleta.* Evidence presented (of suppression of pest mole cricket populations by *Ormia depleta*) in Florida Turf Digest 11(1): 21-24 is statistically significant for golf courses. Furthermore, each female fly is capable of producing several hundred larvae, each of which is capable of killing a mole cricket. Thus, the 1400 to 1800 adult female flies trapped each year at the University of Florida Gulf Coast Research Station (Bradenton) represent tremendous local killing power. If such numbers of flies are widespread in numerous localities in central and southern Florida, then very large numbers of mole crickets must die consequently. Unfortunately, the University of Florida

mole cricket research program now has no other permanent trapping stations in central and southern Florida because operators relocated. However, we can use temporary traps to show presence of *Ormia depleta* on any night. Golf course managers in general have been less than enthusiastic about *Ormia depleta*: they cannot see it because it is nocturnal, and they cannot readily assess the benefit it provides. Only one Florida golf course superintendent, was provided with traps for *Ormia depleta,* and he became convinced of the fly's efficacy. This fly seems to be totally host-specific, harmless to non-target organisms. Furthermore, it seems to be self-sustaining: it was introduced in 1988 and remains established in the area of peninsular Florida to which it is adapted, so there is no point in releasing more flies in that area.

Hypothesis. The current northern limit of *Ormia depleta is* in Alachua County, and the fly has been shown to be present in all the other counties at the same latitude and farther south, but no farther north. Furthermore, occupation of this northern layer of counties seems to be seasonal -in the fall -- requiring colonization each year from farther south. The stock of the fly that was released came from Piracicaba (at 23°S) which is in a tropical zone, whereas Alachua County is at 29°30'N, which is in a temperate zone. Thus, a cold-hardy strain of the fly, from farther south in South America (cooler climate), might be better adapted to persist in northern Florida and states to the north in the winter.

Fly larvae develop in pest mole crickets, and develop more slowly at cooler temperatures. Fly pupae develop in the soil and develop more slowly at cooler temperatures. Fly pupae may even be able to spend the entire winter in a dormant state (called diapause) in the soil. Diapause is known in many insect species, but perhaps a more familiar example is from vertebrate animals: in the northern USA, bears hibernate. Perhaps in cooler parts of South America the fly may have populations that can diapause. Therefore, we looked at the capabilities of *Ormia depleta* flies from at least 29°S in South America

The New Stock of Flies. Armed with the thoughts above, practical knowledge of mole crickets, and funds from USGA, Will Hudson (University of Georgia) and I flew to Porto Alegre, Brazil, then journeyed by road to Pelotas (almost 32°S), in November 1998. We had the necessary importation permit for *Ormia depleta* from USDA/APHIS and we were finally able to obtain a Brazilian collection and export permit.

The new stock of flies collected from Brazil is called Osorio, which is the name of a small town at nearly 30°S latitude near the collection area. The original stock imported into Florida was from Piricicaba at 23°S -- that latitude is well over 500 miles north of the latitude of Osorio. Development and survival of the fly larvae in mole crickets in my laboratory was excellent -- almost 600 adult flies were obtained. Then came the new problem: only four of the roughly 300 female flies became gravid (pregnant). The others died without progeny. We had used the same methods for them that we had used successfully over more than 10 years for the earlier (Piracicaba) stock. How could we ever provide enough gravid flies for releases in other southern states when we could (only just) obtain enough gravid female flies to continue the laboratory colony? This new (Osorio) stock was surely different, but not in a way we had foreseen.

As we reared the Osorio stock, generation after generation, the proportion of gravid females gradually increased. After all, any female that did not mate failed to pass on its genes to the next generation. Therefore, there was strong selection pressure. After a few generations, we even were able to supply a few token gravid females flies to Will Hudson (Georgia) and Seth Johnson (Louisiana) for releases in those states. However, we are still

very short of being able to provide 100 gravid female flies per generation for release in one of the other southern states. We are slowly getting there, but the cost is high. At each generation of flies, we use about 200 laboratory-reared mole crickets, at a cost of roughly $1000 in labor. Thus far, we have reared 8 generations of flies. We are now getting about 10 percent gravid female flies per generation, far better than the initial 1.3 percent, but not nearly high enough.

Summary and Plans. We have a new stock of *Ormia deplete* flies in culture from 30°S in southern Brazil. This new stock of flies is called Osorio after the name of the town from which they were collected. Established in February 1999, it has been through eight laboratory generations. We now have permits for release of the Osorio stock of flies in southern states, so the flies are no longer in quarantine and their care is easier. A graduate student (Hector Cabrera) working with us has begun a behavioral comparison of the Osorio stock with the old (Piracicaba) stock, which we no longer routinely maintain in culture. Release of the Osorio stock in other southern states has been delayed because of the low proportion of the Osorio stock becoming gravid in each laboratory generation. The proportion of flies becoming gravid in each generation has increased eight fold since the initial importation. However, if we cannot increase it substantially more, we will resort to the method used in 1987 through 1992 for releasing the original stock of flies in Florida. This method placed fly pupae (not adults) in the field, and let the adult flies emerge and find mates in the field (instead of releasing gravid female flies ready to attack mole crickets). After all, the original method was successful in establishing populations in Florida.