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## DIFFERENTIAL ATTRACTION OF A PARASITOID TO DEAD HOST ANTS

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The red imported fire ant (RIFA), *Solenopsis invicta* Buren (Hymenoptera: Formicidae), is a major economic pest that has spread throughout the southern United States and beyond in the mere 60 years since its introduction to Mobile, Alabama (Vinson 1997). Efforts to control its spread without the use of non-specific and environmentally harmful pesticides (Banks 1990) has led researchers to explore every available option, including the use of a parasitoid fly as a biocontrol. A species-specific phorid fly parasitoid of the RIFA in its native South America, *Pseudacteon tricuspis*, has been introduced into areas infested with the RIFA in the southern United States, including sites around Austin, Texas, where this study was conducted (Gilbert & Patrock 2002).

In South America, many different species of *Pseudacteon* flies parasitize the RIFA (Disney 1994; Porter & Pesquero 2001), and these species differ in the context of their attraction to the ants. Some flies are more likely to be attracted to ants at their mound, as is the case with *P. tricuspis*, while others to ants foraging away from the mound (Orr et al. 1997). In the introduced populations in Austin, Texas, the flies have most commonly been seen attacking worker ants naturally at nuptial flight swarms, but have also been found at mound disturbances and at food baits with workers. The flies can also be attracted by presenting them with dead *S. invicta* workers; using freshly killed and crushed ants is a very effective method of attracting the flies.

*Pseudacteon tricuspis* flies are known to mate at the same place as they attack their hosts (Porter 1998). Although only females lay eggs on the ants, males will typically hover over the ants and often "harass" them; the male fly behavior is "harassment" in that they elicit an alarm response from the worker ants. While both sexes are attracted to the host ant, whether males arrive first, disturb the ants and attract females, females arrive first and attract males, or both males and females are equally likely to find their host ants, has not been reported.

In this study we investigated the relative attraction of the flies to two ant castes (workers and female reproductives), and documented the sex ratio of flies attracted. The sex ratio of the first fly to arrive was also noted in order to gain insight into whether fly sex is important in host location.

Given the flies' attraction to workers participating in nuptial flight swarms, and the role of ant sexuals in inducing nuptial flight worker behavior (Obin & Vander Meer 1994), we investigated the possible role of winged female sexuals (alates) in attracting the flies. Boxes that contained equal weights of either dead workers or alates (0.5 grams ants crushed in a mortar and pestle) were paired. The date of death (by freezing) and the colony of origin of both ant castes (workers and female sexuals) in each pairing were identical. The boxes in each pair were placed 1 meter apart in an area where *P. tricuspis* had been consistently recovered. If multiple pairs were used per trial, 15 minute observation period, the pairs were separated by 20 meters and the results for all pairs in the trial were pooled, thus making any conclusions more conservative; 1, 2, or 3 pairs were used per trial. Boxes were separated by 1 meter so that the flies would be able to detect both boxes and choose between the two, yet far enough away so that the choice they made would be distinct. Pairs of boxes were separated by 20 meters in order to increase the area over which flies were attracted; independence of pairs was not considered since the data over all pairs was pooled. Flies attracted to the ants in the boxes were aspirated, sexed, and released at the conclusion of each 15 minute trial. After their collection, females were confirmed to be *P. tricuspis* via their ovipositor, but males were only positively identified to family and behaviorally identified to species; low hovering over corpses or live ants by the males is sufficient to distinguish this species since no other phorids in the area have been previously attracted to *S. invicta*, whether live or dead (personal observation). Since our methods included sampling the flies with replacement, efforts were made to spatially and temporally segregate samples.

A follow-up experiment was performed pairing crushed alates with an equal weight of crushed crickets (control), using the same protocol described for the above experiment. This was done in order to assess the flies' ability to detect alates in the absence of workers.

A significantly greater number of *P. tricuspis* were collected at the worker boxes in comparison with the alate boxes (Mann-Whitney U-test,  $n = 12$  trials,  $U = 26.5$ ,  $p < 0.01$ ), 51 flies were col-

lected at the workers versus 23 at the alates. However, when alates were paired with crickets ( $n = 7$ ), only in one of the trials was a fly collected at the alates, none were collected at the crickets; at the conclusion of each trial the presence of flies was verified using dead crushed workers. No flies were ever observed trying to attack the ant cadavers. All trials were performed in areas where flies had been collected within the past 48 hours and during meteorological conditions within the active range of *P. tricuspsis*.

The sex ratio (female: male) of the first flies arriving at the boxes, the "discovering flies" (1:2.4,  $n = 17$ ), was similar to that of the total collected (1:2.2,  $n = 74$ ) ( $\chi^2 = 2.88$ ,  $p > 0.05$ , d.f. = 1).

This study shows that dead alates are attractive primarily in the context of nearby dead workers since alates alone proved to be only weakly attractive to *P. tricuspsis*. Dead workers on the other hand are very effective in attracting the flies. Fresh dead workers appear to be just as attractive, if not more so, as live workers (personal observation). It appears the workers are the primary source of long range cues that attract this fly to its host. Thus, using dead workers to assess fly presence is an effective tool for monitoring. This method is essential in drought-prone Texas because it can be employed independent of ant activity and density.

The similarity between the sex ratio of the discovering fly and that of all flies collected during the observation periods indicates that both sexes are equally likely to discover their hosts. Therefore, it is unlikely that either males or females attract the other to mate at the site of their host, but instead, it is the host that attracts both of them.

The use of odors of both dead and living workers as host orientation cues may account for the tendency of species like *P. tricuspsis* to be associated with mounds versus foraging trails (e.g., Orr et al 1997).

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#### SUMMARY

In a field study conducted in Austin, Texas, a greater number of *Pseudacteon tricuspsis*, a species-specific phorid fly parasitoid of the red imported fire ant (RIFA), were collected at worker corpses than alate corpses. Neither sex of fly discovered corpses more frequently than the other.

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