SEASONAL ACTIVITY OF SPECIES OF *Pseudacteon* (DIPTERA:PHORIDAE) PARASITOIDS OF FIRE ANTS (*Solenopsis saevissima*) (HYMENOPTERA: FORMICIDAE) IN BRAZIL

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ABSTRACT: The seasonal activity of the complex of species of the parasitoid phorid taxa *Pseudacteon* attacking colonies of the fire ant *Solenopsis saevissima* is documented. The seasonally most constant as well as the most abundant species were *P. tricuspis* and *P. litoralis*, with the remaining species (*P. obtusus*, *P. pradei*, *P. aduncus* and *P. wasmanni*) being much less abundant and consequently less seasonally constant. Because of the broad seasonality exhibited by the complex of these phorid parasites, their colonization success in areas of introduced populations of fire ants for biological control should not be limited by seasonal effects.

KEYWORDS: Parasitoid; ant; biological control; *Solenopsis*; *Pseudacteon*.

Introduction

The fire ant, *Solenopsis invicta* Buren has produced a number of ecological and economic problems since its accidental introduction into the USA and Puerto Rico from South America. Systematic surveys indicated that exotic North American populations are larger than those found in Brazil.[4] This difference in populations is probably related to the occurrence of polygyny and the absence of natural enemies in North American populations.[4] Of the potential natural enemies in South America, at least 17 species of *Pseudacteon* phorid parasitoids exist which probably parasitize fire ants.[2,7,8,9] The high species richness of parasitoid phorids and the behaviors exhibited by fire ants in their presence[1] suggest a long evolutionary history. These phorids probably do not regulate fire ant colony sizes directly through para-

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sitism, but indirectly through a reduction of foraging when these parasitoids are present, changing ant community patterns which favor other ant species.[1]

None of these parasitoids has been introduced into the United States or Puerto Rico, and only recently has their life-cycle and rearing been described.[5] One of the critical aspects to be considered for potential introduction against the imported fire ant, *S. invicta*, is seasonality. Species which occur throughout the year may be more likely to exert a stronger influence on fire ant populations than those which occur in limited periods throughout the year.[1] Here, we document the seasonal occurrence and fluctuations of abundance of the complex of species of *Pseudacteon* on the fire ant *Solenopsis saevissima* (Fr. Smith), closely related to *S. invicta*,[6] in sub-tropical Brazil.

Material and methods

Studies were conducted in Rio Claro, State of São Paulo, Brazil (23°S) due to the fact that 40% of all *Pseudacteon* species known occur there.[3] Colonies of *S. saevissima* were maintained in Petri plate observation nests, in teflon-coated plastic trays (35 x 40 x 5 cm). Two trays were taken to the field once a week to attract phorids. Trays were agitated to elicit activity of the ants and placed in the shade on a lawn 30 m apart. During a 3 h period, aspirator collections of all phorids present at trays were performed, alternating 10 min periods between trays. These data provide relative abundance. Observations were conducted from 6 am to 18 pm, the preferential period of phorid activity using these 3 h periods, such that at the end of the month the entire day was covered. No collections were performed during the months of November and December. Phorids were identified under a dissecting microscope, and then released after observations near the trays. In spite of their small size, females of *Pseudacteon* are relatively simple to identify based upon the characteristic form of the ovipositor.

Species constancy from sample to sample was calculated as its monthly incidence divided by the number of months we collected (n = 10). Additionally, seasonal fluctuations of relative abundance were measured using the B index.[10] The larger this index, the more extreme the relative abundance between months of collection. These indices were also correlated with relative abundance.

Results and discussion

Seven species of *Pseudacteon* occurred at colonies exposed in trays throughout the year, and collected individuals are deposited in the collection of H.G.F. *P. tricuspis* was the most abundant species (73% of all females collected) (Figure 1), followed by *P. litoralis* Borgmeier (17%), with the remaining five species (*P. obtusus* Borgmeier, *P. pradei* Borgmeier, *P. aduncus* Borgmeier and *P. wasmanni* Schmitz)

constituting the remaining 10% (n = 492). Additionally 679 males, whose taxonomy is uncertain due to the lack of description to place these with females, were also collected. Males probably occurred at traps in attempts to mate with females. All species showed a high degree of seasonal constancy (Figure 1), indicating that all probably are present throughout the year. The more constant species were also those that showed a higher degree of seasonality (B index) during the year (r = 0.886, P 0.004). No significant correlation was found with the relative abundance of species of *Pseudacteon* with the B index of seasonality (r = 0.585, P 0.13) (Figure 1).

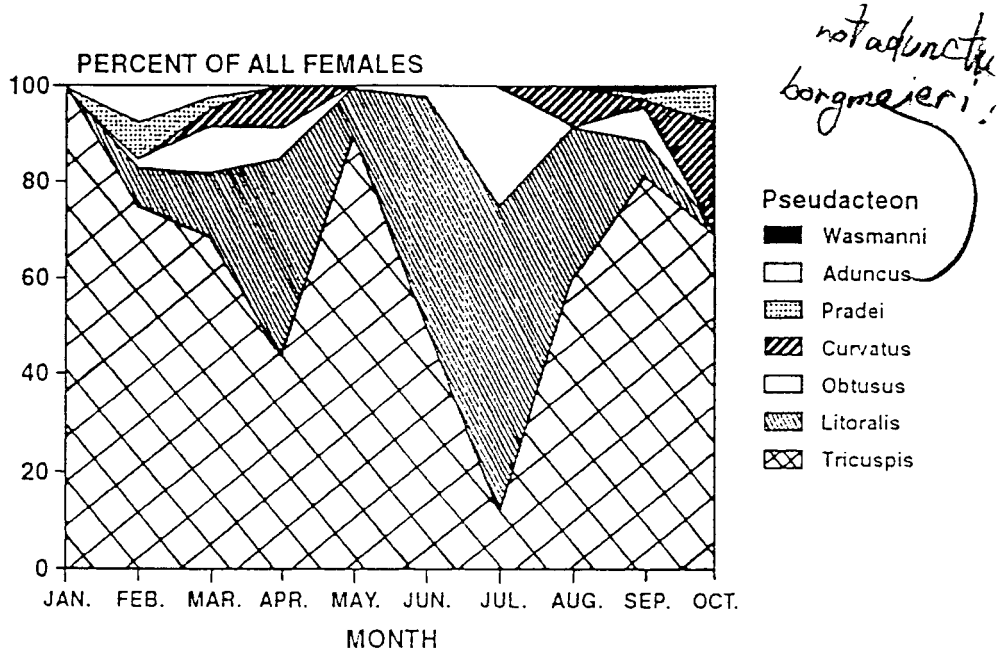

FIGURE 1 - The relative monthly abundance of species of *Pseudacteon* at field exposed laboratory colonies of *Solenopsis saevissima* in Rio Claro, SP, Brazil. Species sample sizes (n), the index of monthly constancy (c) and the B index of seasonality of Wolda,[12] were *P. tricuspis*, n = 361, c = 1.00, B = 5.08; *P. litoralis*, n = 94, c = 1.00, B = 6.41; *P. obtusus*, n = 19, c = 0.70, B = 3.61; *P. curvatus*, n = 13, c = 0.60, B = 4.56; *P. pradei*, n = 6, c = 0.40, B = 2.91; *P. aduncus*, n = 6, c = 0.2, B = 1.85; *P. wasmanni*, n = 1, c = 0.1, B = 1.00.

These observations suggest that probably all species occur throughout the year. However, those species which show are more constant, *P. tricuspis*, *P. litoralis*, and *P. obtusus*, also demonstrated higher population fluctuations. The remaining species demonstrated lower degrees of seasonality due to lower relative abundance. Peak populations of all species were found during the spring (August and September) in which the majority of the mating flights of *S. saevissima* occur.[3] Any of these three species should adapt well throughout the year to the same climatic

regime found in the areas of fire ant coverage in North America,[7] and could probably be introduced without problem due to their high degree of specificity.[5] These observations indicate that seasonal variations and occurrences should not limit the potential for their use in introduction programs in North America.

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FOWLER, H. G. et al. Atividade sazonal de espécies de *Pseudacteon* (Diptera: Phoridae), parasitóides de formigas lava-pés (*Solenopsis saevissima*) (Hymenoptera: Formicidae) no Brasil. *Científica (São Paulo)*, v.23, n.2, p.367-371, 1995.

- *RESUMO: Documenta-se a atividade sazonal do complexo de espécies da taxa parasítica de Pseudacteon atacando colônias da formiga lava-pés* Solenopsis saevissima. *As espécies com maior constância sazonal e também mais abundantes foram P. tricuspis e P. litoralis. As outras espécies (P. obtusus, P. pradei, P. aduncus e P. wasmanni) tiveram abundância menor e, consequentemente, demonstraram constância sazonal menor. Por causa da grande amplitude de sazonalidade presente no complexo de espécies destes forídeos, o sucesso de sua colonização em áreas de populações introduzidas de lava-pés para o controle biológico não seria limitado por efeitos sazonais.*

- *PALAVRAS-CHAVE: Parasitóide, formiga, controle biológico;* Solenopsis; Pseudacteon.

References

1 FOWLER, H. G., ROMAGNANO, L. F. T. di. Ecological bases for biological control. *Pesq. Agropec. Bras. (Brasília)*, v.27 (Edição Especial), p.5-14, 1992.

2 JOUVENAZ, D. P. Natural enemies of fire ants. *Fla. Entomol. (Winter Haven)*, v.66, p.111-21, 1983.

3 PESQUERO, M. A., CAMPIOLO, S., FOWLER, H. G. Phorids (Diptera: Phoridae) associated with mating swarms of *Solenopsis saevissima* (Hymenoptera: Formicidae). *Fla. Entomol. (Winter Haven)*, v.76, p.179-81, 1993.

4 PORTER, S. D., FOWLER, H. G., MAC KAY, W. P. Fire ant mound densities in the United States and Brazil (Hymenoptera: Formicidae). *J. Econ. Entomol. (Laham)*, v.85, p.1154-61, 1992.

5 PORTER, S. D. et al. Host specificity of *Pseudacteon* phorid flies which attack fire ants in South America. *Fla. Entomol. (Winter Haven)*, v.78, p.70-5, 1995.

6 TRAGER, J. C. A revision of the fire ants, *Solenopsis geminata* group (Hymenoptera: Formicidae: Myrmicinae). *J. N. Y. Entomol. Soc. (Lawrence)*, v.99, p.141-98, 1991.

7 WILLIAMS, D. F., BANKS, W. A. *Pseudacteon obtusus* (Diptera: Phoridae) attacking *Solenopsis invicta* (Hymenoptera: Formicidae) in Brazil. *Psyche (Cambridge)*, v.94, p.9-13, 1987.

8 WILLIAMS, D. F. et al. Fire ants attacked by phorid flies. *Fla. Entomol. (Winter Haven)*, v.56, p.259-62, 1973.

9 WILLIAMS, R. N., WHITCOMB, W. H. Parasites of fire ants in South America. *Proc. Tall Timbers Conf. Ecol. Anim. Control by Habitat Manage. (Tallahasse)*, v.5, p.49-59, 1974.

10 WOLDA, H. Seasonality parameters for insect populations. *Res. Popul. Ecol. (Kyoto)*, v.20, p.247-56, 1979.

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