

Ecology and behavior of *Pachycoris torridus* (Hemiptera: Scutelleridae): new host plant, color polymorphism, maternal care and parasitism

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Abstract

The frequency of the different phenotypes, maternal care and parasitism in *Pachycoris torridus* (Hemiptera: Scutelleridae) on a new host plant, *Cnidoscopus pubescens* (Euphorbiaceae), was studied in an area of Atlantic Forest, in southeastern Brazil. Seven different phenotypes, three not previously recorded, were found among 54 adults. Females were only observed guarding eggs and first-instar nymphs. Unidentified species of Trichogrammatidae (Hymenoptera) and *Spalangia* sp. (Hymenoptera: Pteromalidae) were found parasitizing, eggs and nymphs of *P. torridus*, respectively.

Keywords: *Cnidoscopus pubescens*, maternal care, parasitism, phenotypic variation.

Introduction

Scutelleridae (Hemiptera) species are known for their wide intraspecific color variation (color polymorphism), usually sex-related. Normally, adult females are polychromatic while adult males are monochromatic. They often show a wide range of color patterns and this phenotypic variation can yield important consequences on their evolutionary ecology since different phenotypes can differ in their adaptive value. Paleari (1992, 1994) detected different diapause length, parasite preference, offspring production, and even survival among the different phenotypes of the scutellerid *Agonosoma flavolineatum*. Besides, color polymorphism may influence patterns of communication between sexes and, hence, mating probability within different phenotypes (Machado & Araújo, 2003).

Species of *Pachycoris* generally feed on Euphorbiaceae such as *Croton*, *Jatropha*, and *Cnidoscopus* and herbivory by these species has been reported to decrease host plant productivity (Grimm & Maes, 1997ab; Wink et al., 2000; Peredo, 2002). Egg masses are laid on leaves and early-instar nymphs are usually gregarious (Williams III, et al. 2001). While such aggregations are often related to defense (Aldrich, 1988), there may be other physiological traits that favor gregariousness, such as lower heat and moisture lost (Paleari, 1992). As early-instar nymphs are more susceptible to parasitism (Peredo, 2002), maternal care may have evolved as a strategy to maximize offspring survival.

Pachycoris torridus Scopoli 1772 is the most studied in the family Scutelleridae in Brazil (Silva et al., 1968), being more commonly found in South America and quite rarely in Mexico (Peredo, 2002). This species is very similar to the Mexican species, *P. kluggi*, causing confusion and resulting in the description of different varieties of *P. torridus* (Peredo, 2002). Otherwise, few studies were accomplished for *P. torridus*. Hussey (1934) described the guarding behavior of this species in Paraguay while Monte (1937) described various color patterns, and recently two other studies have been conducted in agrosystems in Brazil (see Sánchez-Soto & Nakano, 2002; Sánchez-Soto et al., 2004).

Casual observations on the occurrence of insect herbivores on the plant *Cnidoscopus pubescens* (Euphorbiaceae) in an Atlantic Forest in Brazil indicated the presence of large numbers of *P. torridus*. The goal of this study was to provide some ecological notes on the biology of *P. torridus* with special attention to color polymorphism frequency, maternal care and parasitism. *Pachycoris torridus* has been recorded on economic important plants in Brazil, but ecological and behavioral information about this species in natural habitats is still scarce. Therefore, this study provides new information on the natural history of *P. torridus* in the Brazilian Atlantic Forest.

Material and Methods

This study was performed on three different sampling periods of 2004 (March, May and November), in the Fazenda Bulcão, a 676 ha rehabilitation area of Atlantic Forest in the city of Aimorés, MG, southeastern Brazil. The studied area is a natural reserve located at Rio Doce's Valley, primarily covered by Atlantic Forest (one of the main biomes for biodiversity

conservation; Myers et al., 2000). The region is under accelerated degradation process, mainly by wood exploitation, agriculture and pasture activities. Observation and samples were taken in two adjacent areas: 19°32'41.5" S, 41°06'11.7" W, 345 m a.s.l., and 19°32'38.8" S, 41°05'57.3" W, 352 m a.s.l.

Adults of *P. torridus* feeding on *Cnidoscopus pubescens* (Euphorbiaceae) were sampled, separated into the different phenotypes and measured for adult total body length, width and offspring production. We also measured nymph length in an attempt to provide more data for future investigations. Whenever a female was found guarding eggs or nymphs, the whole leaf used was collected to evaluate the offspring number of each adult morph. The morph patterns of *P. torridus* were described according to Monte (1937) and Sánchez-Soto et al. (2004). Voucher species were deposited in the Museum of Zoology, University of Rio Janeiro (MZURJ).

Results and Discussion

New host plant

Though *Pachycoris* species often feed on Euphorbiaceae, *P. torridus* has been recorded on 12 phylogenetically unrelated host plant species of economic importance in Brazil [for a complete list see Sánchez-Soto & Nakano, (2002) and Sánchez-Soto et al., (2004)]. In Paraguay, Hussey (1934) described the occurrence of this species on *Sapium haemospermum* Müll. Arg. (Euphorbiaceae). Although there are many host records known for this species, the native host plant has not yet been recorded in Brazil. For the first time, we record the occurrence of *P. torridus* on *Cnidoscopus pubescens* (Euphorbiaceae), a species widely recognized for its poisonous thorns. In a single case, we observed a female guarding an egg mass on a leaf of the liana *Arrabidaea chica* (Bignoniaceae) probably as a result of a wrong oviposition, since this plant was adjacent a *C. pubescens* individual.

It is likely that *C. pubescens* is the native host plant of *P. torridus* because the other species of *Pachycoris* feed on Euphorbiaceae (Grimm & Maes, 1997ab; Wink et al., 2000; Williams III et al., 2001; Peredo, 2002) and individuals were found only in this plant despite the occurrence of other hundreds of plant species in the area, including species of *Manihot*,

Ricinus, and *Hevea*, among others. Besides, *Pachycoris* may have specific interactions with Euphorbiaceae species because some aposematic specialist bugs sequester from their host plant compounds that are toxic to their predators (Williams III et al., 2001). We observed *P. torridus* adults sucking *C. pubescens* leaves, fruits and inflorescences. Adults were found either feeding alone or in aggregations, while nymphs were only observed feeding in aggregations. Feeding behavior is an important aspect in the Scutelleridae species because it can help us to understand strategies of defense behavior. For instance, the abundance of arthropod natural enemies apparently has forced *P. stallii* to maintain this defense system despite feeding on a toxic host plant *Croton californicus* (Williams III et al., 2001).

Color polymorphism and new morphs

A sample of 54 adults yielded seven morphs (Fig. 1), among which three new phenotypes had not been previously recorded by Monte (1937) nor by Sánchez-Soto et al. (2004). Fig. 1A-C shows the patterns found in this study that correspond to patterns 4, 12, and 13 previously described by Monte (1937). Thirteen morphs were described by Monte (1937) while Sánchez-Soto et al. (2004) described four new spot morphs of pronotum and scutellum, denominated, respectively, 14 up to 17. The pattern 17 was also recorded in this study (photograph unavailable). We describe three new morphs following the numbering system suggested by Monte (1937):

Color pattern 18 - Brown, with two spots in the pronotum near the head. The scutellum has six spots; four on median region and two on laterals (Fig. 1D).

Color pattern 19 - Red, with two spots in the pronotum near the head. The scutellum has indications of two spots on the medium region (Fig. 1E).

Color pattern 20 - Brown, without spots (Fig. 1F).

Up to nine types of color within of pattern 13 (basic pattern), were found in aggregations of adults or isolates (Fig. 2A,B). The basic pattern represented the most abundant morph, with 88.9% of the individuals (48 with the basic pattern and six with the other patterns). Other morphs were found at low densities in aggregations or isolates (Fig. 2A-E).

Although we do not have data regarding the natural defensive behavior in *P. torridus*, we believe that aposematic

Table 1 - Number of eggs and offspring associated with coloration pattern of *Pachycoris torridus* (Hemiptera: Scutelleridae) in *Cnidoscopus pubescens* (Euphorbiaceae). Except the morph in second line that occurred in *Arrabidaea chica* (Bignoniaceae).

Color pattern	Morph number	Length (mm)	Width (mm)	Offspring/Stage
Pattern four	4	15,7	10,2	92/eggs
Basic pattern	13	14,6	9,6	75/eggs
Basic pattern	13	15,5	10,1	66/1-instar nymphs
Basic pattern	13	16,3	10,3	67/1-instar nymphs
Basic pattern	13	15,7	10,2	91/1-instar nymphs
Basic pattern	13	14,8	9,7	80/4-instar nymphs
Basic pattern	13	15,7	10,2	82/4-instar nymphs

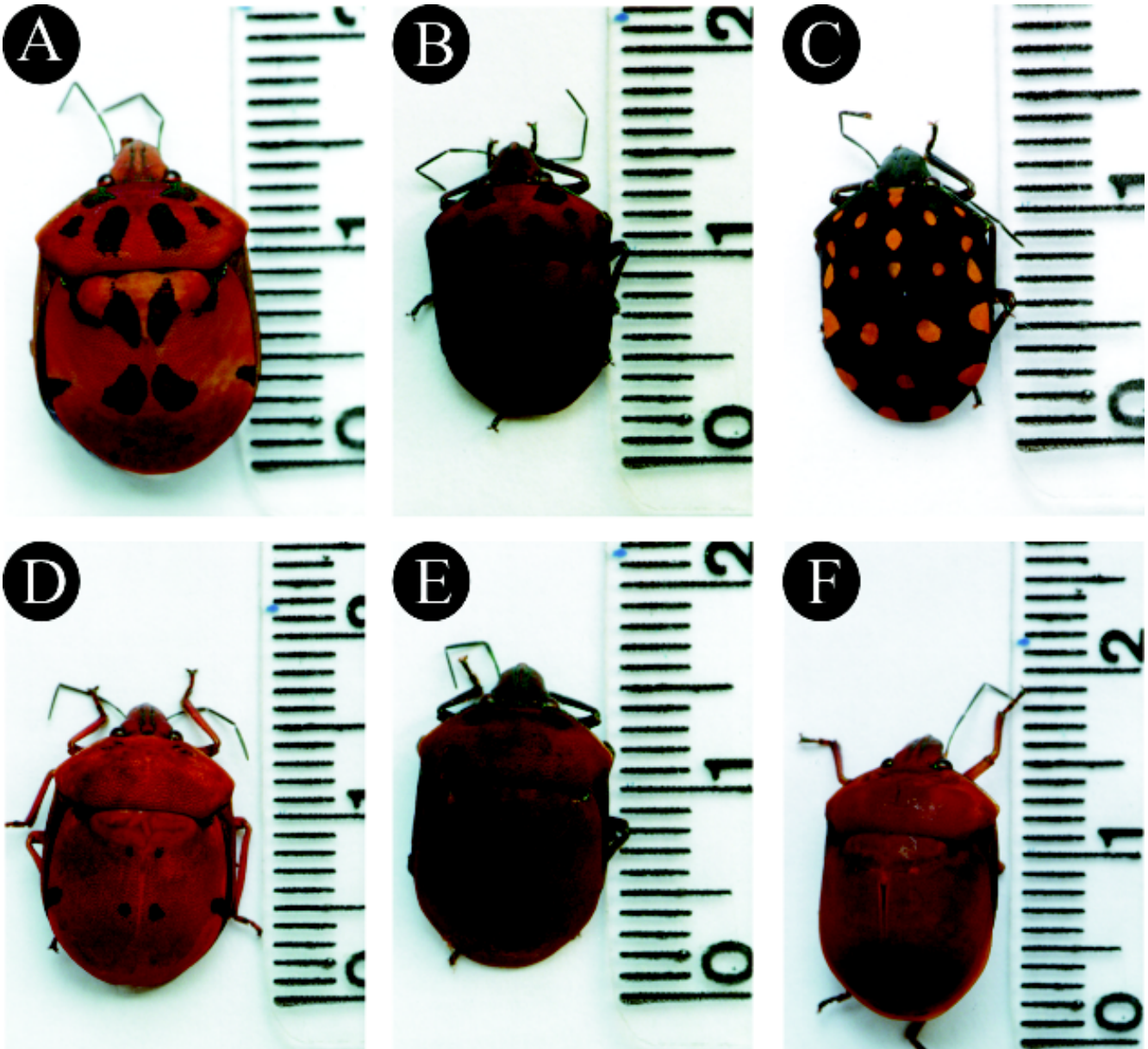


Figure 1 - Color patterns of *Pachycoris torridus* (Hemiptera: Scutelleridae) found in this study. The figures A-C correspond to patterns 4, 12 and 13 previously described by Monte (1937) and the figures D-F corresponds the three new phenotypes describe in this study.

behavior is likely to occur in this species. This question was addressed by many other studies in the genus *Pachycoris* (see Wink et al., 2000; Williams III et al., 2001).

Maternal care and parasitism

We observed two egg masses laid by *P. torridus* females (75 and 92 eggs, respectively (Tab. 1). Other Scutelleridae species, such as *Agonosoma flavolineatum*, oviposits an average of 14 eggs (Paleari, 1992), while *P. klugii* lays on average 81.4 eggs (Peredo, 2002). Thirty-three out of the 92 eggs of *P. torridus*

(35.8%) were parasitized by an unidentified species of Trichogrammatidae (Hymenoptera: Chalcidoidea). In the other egg mass only one egg was parasitized. Parasitized eggs showed a black or white color in contrast to healthy red eggs. They were located at the periphery of the egg mass indicating that the eggs in the center of the oviposition mass may be better protected by the mother (Fig. 2F). The parasitism rate observed by us was different to the data reported by Hussey (1934) (15% on *P. torridus*) but similar to that reported by Peredo (2002) (38% on *P. klugii*). Peredo (2002) reported that although *P. klugii* females also guard their eggs (a behavior similar to *P. torridus*; Fig. 2E)

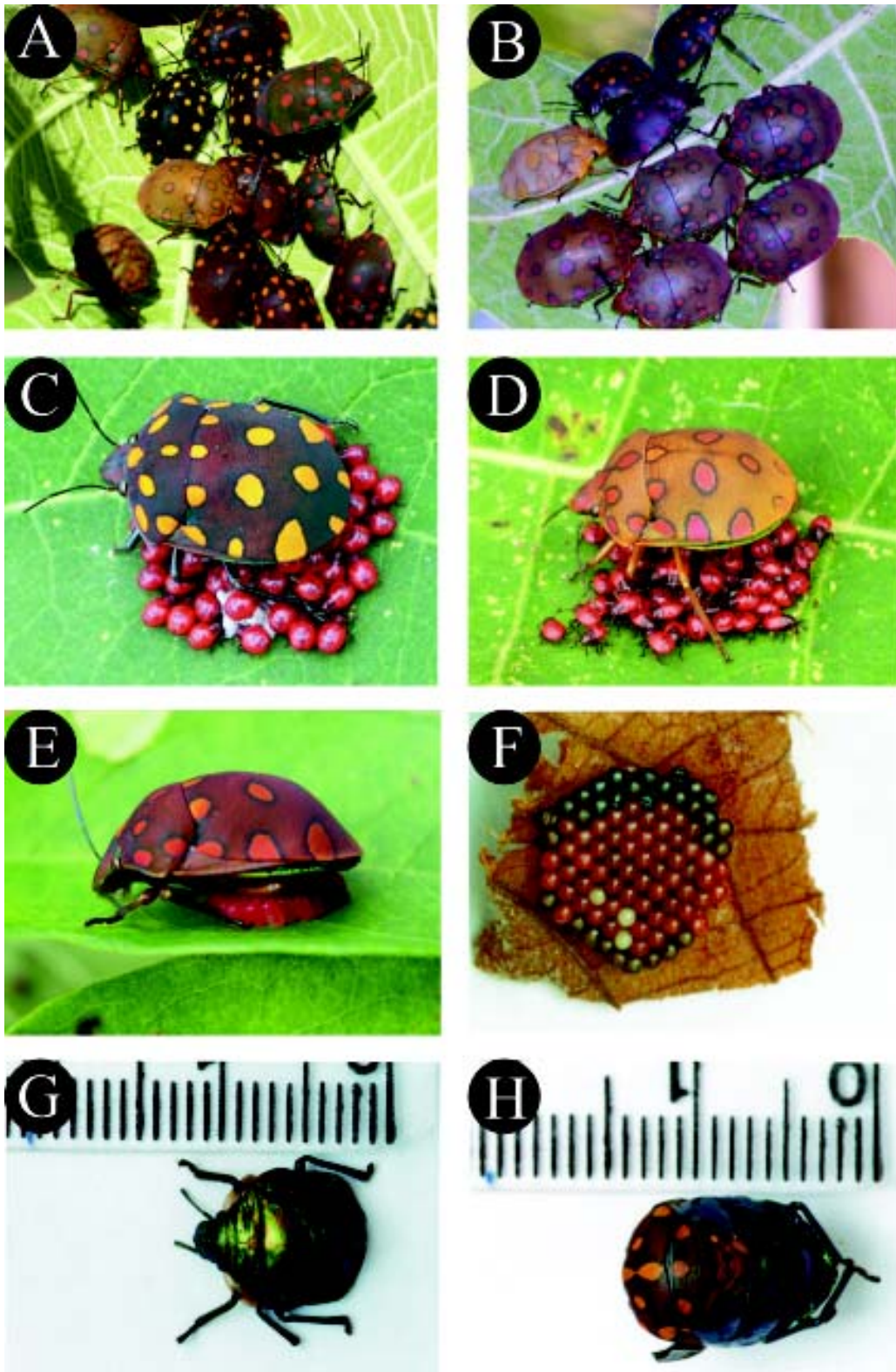


Figure 2 - A-B. Aggregation of individuals of *Pachycoris torridus* (Hemiptera: Scutelleridae). C-E. Maternal care in nymphs and egg mass. F. Egg mass with parasitized eggs (see black and white parasitized eggs and red healthy eggs). G. The four-instar nymph. H. Metamorphosis in an individual of *P. torridus*.

they were often parasitized by the wasp *Telenomus pachycoris* (L.) (Scelionidae). Future observations will address this issue with more detail.

We collected only two nymphal stages, first and fourth-instar, with an average of 72 and 81 individual for aggregation, respectively (Tab. 1). Maternal care was only observed for first-instar nymphs (2.70mm, n = 47; Fig. 2C-D), which were more than four times smaller than the fourth-instar nymphs (10.93mm, n = 39; Fig. 2G). An unidentified species of *Spalangia* (Hymenoptera: Pteromalidae: Spalanginae) emerged from four first-instar nymphs (8.5%). In other studies the tachinid fly, *Trichopoda pennipes*, parasitized adults of *P. klugii* (Peredo, 2002) and *A. flavolineatum* (Paleari, 1994). Otherwise, parasitism rate by the tachinid fly was very low in those species.

Several reports of maternal care on *Pachycoris* are available and it appears that adult females guard only eggs and early-instar nymphs (Grimm & Maes, 1997ab; Williams III et al., 2001; Peredo, 2002). After oviposition, females of *P. klugii* remain on the leaves and defend the first instars nymphs against predators with secretions from their stink glands (Wink et al., 2000). Paleari (1992) observed that gregariousness and maternal care in *A. flavolineatum* occur up to 3-instar nymphs and mortality increased in isolated last-stage nymphs. This could also be related to lack of maternal care, with increased parasitism and predation, or excessive moisture and heat lost. Hussey (1934) described the guarding behavior of *P. torridus* in Paraguay and like *P. klugii*, this record suggests that *P. torridus* is a subsocial species (Peredo, 2002).

Broad questions related to the behavior, ecology, evolution, and conservation of the *P. torridus* still awaits further investigations. For instance, i) does the frequency of different phenotypes change along time and what are the selective pressures ruling these changes?; ii) is there a correlation between subsocial behavior in *Pachycoris* species and restricted site feeding in Euphorbiaceae? Because of its abundance in the field and easiness to work with, the system *Pachycoris*-*Cnidocolus*-parasitoids offer an interesting scenario where the natural history of the genus and broad evolutionary questions can be addressed in detail.

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