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Source: Entomologica Americana, 119(3) : 80-84

Published By: New York Entomological Society

URL: <https://doi.org/10.1664/12-RA-003.1>

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**PACHYSOMOIDES SP. (HYMENOPTERA: ICHNEUMONIDAE: CRYPTINAE)
PARASITIZING POLISTES VERSICOLOR (HYMENOPTERA: VESPIDAE) IN
VIÇOSA, MINAS GERAIS STATE, BRAZIL**

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Abstract—Parasitoids may have important role in the biological control of social wasps. The objective of the current study was to identify and to measure colonies of the social wasp *Polistes versicolor* Olivier, 1791 (Hymenoptera: Vespidae) that were attacked by parasitoids in the campus of the Federal University of Viçosa in Viçosa, Minas Gerais State, Brazil. The nest cell diameter, maximum and minimum width and height of the colony above the ground were recorded; in addition, the number of nest cells, pupae, larvae and eggs of parasitized colonies was determined in the laboratory from ten colonies of *P. versicolor* collected between April and May 2011. Parasitoid emergence was monitored on a daily basis. An individual of a non-described species of *Pachysomoides* (Hymenoptera: Ichneumonidae: Cryptinae) emerged from one *P. versicolor* colony collected from a plant of the sweet orange *Citrus sinensis* (L.) Osbeck (Rutaceae). This colony had a nest cells diameter of 0.50 mm, a maximum and minimum width of 5.50 mm and 3.40 mm, respectively, and it was 1.48 m above the ground. In total, 189 nest cells, 19 pupae, 27 larvae and 41 eggs were found in the colony. This is the first report of a parasitoid of the ichneumonid genus *Pachysomoides* from a colony of the wasp *P. versicolor* in Brazil.

Key words: biological control, colony, natural enemy, parasitism, social wasps.

Vespidae are important for the biological control of defoliating Lepidoptera in agricultural and forest crops, including *Chlosyne lacinia saundersii* Doubleday & Hewitson, 1849 (Lepidoptera: Nymphalidae) by *Polistes versicolor* Olivier, 1791 (Hymenoptera: Vespidae) (Prezoto et al., 2006) and *Diaphania nitidalis* Stoll, 1781 (Lepidoptera: Pyralidae) in Cucurbitaceae by *Polybia ignobilis* Haliday, 1836 (Hymenoptera: Vespidae) in Viçosa, Minas Gerais State (MGS), Brazil (Gonring et al., 2003). Social wasps are abundant in many environments, including plantations of hybrid *Eucalyptus urograndis* (*Eucalyptus grandis* W.Hill ex Maiden × *Eucalyptus urophylla* S. T. Blake) (Myrtaceae) in Juiz de Fora, MGS, Brazil (De Souza et al., 2011), riparian forests in Barroso, MGS, Brazil (de Souza et al., 2010) and urban areas (human impact) in Viçosa, MGS, Brazil

(Santos et al., 2009), but they may be parasitized in these environments.

Social wasps of the genus *Polistes* (Hymenoptera: Vespidae) are considered more resistant to natural enemies compared with solitary species of this group (Lorenzi and Thompson, 2011). In addition, isolated colonies can be more vulnerable to parasitism and less productive, because of the amount of time spent defending the colony versus a reduction in foraging effort (Clouse, 2001). Colonies of *Polistes dominulus* Christ, 1791 (Hymenoptera: Vespidae) that parasitized by *Baryscapus elasmii* Graham, 1986 and *Elasmus schmitti* Ruschka, 1920 (Hymenoptera: Eulophidae) in southern Ukraine were less productive and had lower number of individuals; in addition, the parasitized pupae were isolated by a thin wall of feces (Gumovsky et al., 2007).

Larvae, pupae and adults *Polistes* spp. are more vulnerable to predators and parasitoids compared to others species (de Souza et al., 2008). Wasp colonies can be invaded by natural enemies, such as Hymenoptera (Eulophidae and Ichneumonidae) and Diptera (Phoridae) parasitoids, and be attacked by predators, such as ants and birds (Clouse, 2001). *Polistes dominulus* was found to be parasitized, or preyed upon, by species of the orders Diptera, Hymenoptera, Lepidoptera and Strepsiptera in North America, Ukraine and Italy, respectively (Hughes et al., 2003; Rusina, 2008; Madden et al., 2010).

The primitively eusocial wasp *Mischocyttarus cassununga* Von Ihering, 1903 (Hymenoptera: Vespidae) is parasitized by *Pachysomoides* sp. (Hymenoptera: Ichneumonidae) and *Megaselia scalaris* Loew, 1866 (Diptera: Phoridae) in Viçosa, MGS, Brazil (Soares et al., 2006); individuals of *Pachysomoides fulvus* Cresson, 1864 (Hymenoptera: Ichneumonidae), *Chalcoela pegasalis* Walker, 1859 (Lepidoptera: Crambidae), *Elasmus polistis* Burks, 1971 (Hymenoptera: Eulophidae) and *Xenos peckii* Kirby, 1813 (Coleoptera: Stylopidae) parasitize the paper wasp *Polistes metricus* Say, 1831 (Hymenoptera: Vespidae) in northeast Georgia, USA (Hodges et al., 2003); and *Sulcopolistes atrimandibularis* Zimmermann, 1930 (Hymenoptera: Vespidae) parasitizes *Polistes biglumis* L., 1758 (Hymenoptera: Vespidae) in the French Alps (Schwammberger, 1998).

Parasitism by *Chalcoela iphitalis* Walker, 1859 (Lepidoptera: Pyralidae), *Dibrachys canvus* Walker, 1859 (Hymenoptera: Pteromalidae), *E. polistis* and *P. fulvus* on *Polistes exclamans* Viereck, 1906 (Hymenoptera: Vespidae) and *P. metricus* in Missouri, USA (Whiteman and Landwer, 2000) has also been reported. *Vespula germanica* F., 1793 and *Vespula vulgaris* L., 1758 (Hymenoptera: Vespidae) were both parasitized by *Sphecophaga vesparum* Curtis, 1828 (Hymenoptera: Ichneumonidae) (Beggs et al., 2008), and *Sphecophaga burra vesparum* Cresson, 1869 (Hymenoptera: Ichneumonidae) parasitized *Vespula* spp. (Hymenoptera: Vespidae), although this parasitoid was unable to establish successfully following its introduction to New Zealand (Beggs et al., 2002).

Polistes versicolor is a paper wasp native to Brazil (Gobbi et al., 1993). It prefers to build nests on human habitation, where they can be very unwelcome, although they are aggressive only if disturbed (Elisei et al., 2012). *Polistes versicolor*

may consume large numbers of caterpillars, which is what makes this species beneficial (Prezoto et al., 2010; Elisei et al., 2010). The objective of the current study is to identify a larval parasitoid of this species and to determine the size of parasitized colonies of *P. versicolor* in the campus of the Federal University of Viçosa (UFV) in Viçosa, MGS, Brazil.

METHODS

The study was conducted on sweet orange *Citrus sinensis* (L.) Osbeck (Rutaceae) plants growing on the UFV campus during April and May, 2011, when the average rainfall is 16 mm and 5 mm, and average temperature is 23°C and 20°C, respectively. Wasps were collected from colonies at a latitude of 20°45'S, longitude 42°51'W and altitude 651 m. The plants with the colonies were inspected daily between the hours of 08:00 to 10:00 A.M. (Santos et al., 2009).

Ten colonies of *P. versicolor*, in which the adults displayed agitated behavior (e.g., movement and beating of the wings) suggesting the presence of natural enemies (Soares et al., 2006), were collected. These colonies were brought to the Laboratory of Biological Control of Insects (LCBI) of UFV and housed in individual plastic cups (0.19 × 0.145 × 0.145 m) with a ventilation area of organza fabric in the lid (Silva-Filho et al., 2007). Nest cell diameter, and maximum and minimum width were measured, and the height of the colony from the ground was recorded before removal from the field. In addition, the total number of nest cells, pupae and larvae and the parasitism rate (total number of colonies parasitized) were recorded (da Silva et al., 2006).

Parasitoid emergence of parasitoids was recorded daily. Emerged parasitoids were placed in 70% alcohol and sent to the Department of Ecology and Evolutionary Biology, Federal University of São Carlos (UFSCar) in São Carlos, São Paulo State, Brazil, for identification using Kudo et al., 2013 by A. M. P. M. D. and deposited in the insect collection of the UFSCar.

RESULTS

A single parasitoid emerged during the study period that was identified as an un-described species of *Pachysomoides* (Hymenoptera: Ichneumonidae: Cryptinae). The *P. versicolor* colony parasitized by this *Pachysomoides* sp. had nest

Table 1. Social wasp species (Hymenoptera: Vespidae), parasitoid species, country where was found and citation.

Social wasp	Parasitoid	Country	Citation
<i>Mischocyttarus cassununga</i> Von Ihering, 1903	<i>Megaselia scalaris</i> Loew, 1866 (Diptera: Phoridae); <i>Pachysomoides</i> sp. (Hymenoptera: Ichneumonidae)	Viçosa, Minas Gerais State, Brazil	Soares et al., 2006
<i>Polistes</i> sp.	<i>Brachymeria</i> sp. (Hymenoptera: Chalcididae)	Central America	Makino, 1985
<i>P. exclamans</i> Viereck, 1906; <i>P. metricus</i> Say, 1831	<i>Chalcoela iphitalis</i> Walker, 1859 (Lepidoptera: Pyralidae); <i>Elasmus polistis</i> Burks, 1971 (Hymenoptera: Eulophidae); <i>Dibrachys canvus</i> Walker, 1859 (Hymenoptera: Pteromalidae); <i>P. fulvus</i> Cresson, 1864	Missouri, USA	Whiteman and Landwer, 2000
<i>P. lanio lanio</i> F., 1775	<i>Apanteles</i> sp. (Hymenoptera: Braconidae); <i>B. vesparum</i> Bouček, 1992; <i>Enicospilus</i> sp. (Hymenoptera: Ichneumonidae); <i>Exasticolus fuscicornis</i> Cameron, 1887 (Hymenoptera: Braconidae); <i>Michocharops penonatus</i> Cameron, 1911 (Hymenoptera: Ichneumonidae); <i>P. stupidus</i> Cresson, 1873	Between 2004 & 2006, Seropédica, Rio de Janeiro State, Brazil	Silva-Filho et al., 2007
<i>P. versicolor</i> Olivier, 1791	<i>B. vesparum</i> ; <i>P. iheringi</i> Brauns, 1979	Rio Grande do Sul, São Paulo and Pará States, Brazil	Bouček, 1992; de Santis, 1980

cells diameter of 0.50 mm, a maximum and minimum width of 5.50 mm and 3.40 mm, respectively, and it was found at 1.48 m above the soil. In total, 189 nest cells, 19 pupae, 27 larvae and 41 eggs were collected from this colony.

DISCUSSION

Although most Polistinae wasp species are found in the Neotropical region, mainly in Brazil, a limited number of South American parasitoids or parasites of these polistines are known and described only to the generic level (Kudo et al., 2013). This is the first report of parasitism by the ichneumonid genus *Pachysomoides* sp. in a *P. versicolor* colony in Brazil. Other larva parasitoid species have been recorded for *M. cassununga* and *Polistes* spp. in Brazil, Central America and EUA (Table 1).

The parasitized colony of *P. versicolor* was of typical size for that time of year (autumn) in this region (Prezoto et al., 2006), although the height above ground and host plant can vary among colonies of these insects (Alvarenga et al., 2010). In winter, individuals of *P. versicolor* form larger

colonies to protect against unfavorable temperatures in tropical Brazil. In the summer, new nests are built (Gobbi et al., 2006; Sinzato et al., 2011). Nests are built preferentially in riparian forests near natural corridors and moist areas. The frequency with which these nests are found in these areas is an indicator of the the degree of conservation of the environment (de Souza et al., 2010).

The emergence of a single parasitoid (low parasitism rate) from the *P. versicolor* colony in the appears to be typical current study is normal. It may indicate that there is no competition among individuals of this natural enemy within a single host colony or it avoids superparasitism (Silva-Filho et al., 2007). The finding that *Pachysomoides* sp. parasitism of a *P. versicolor* colony that contains pupae, larvae and eggs is consistent with other studies that show the parasitoids *C. pegasalis*, *P. fulvus* and *X. peckii* prefer to oviposit in colonies of *P. metricus* with immature individuals (Hodges et al., 2003). Furthermore, the temperatures between 15.7°C and 25.7°C appear optimal for social wasp colonies to be parasitized, because this may

increase the effectiveness of natural enemies (de Carvalho et al., 2005).

The *Pachysomoides* sp. isolated in this study belongs to the family Ichneumonidae, which contains other important natural enemies of social wasps, such as *S. vesparum*, which was introduced in New Zealand to control colonies of foreign wasps. This parasitoid dispersed at a rate of 2.37 km/yr, but with reduced establishment in some regions (Moller et al., 1991). In contrast, the parasitoid *S. burravesparum* failed to become established in New Zealand following its introduction to control *Vespula* spp. (Beggs et al., 2002). Ichneumonid parasitoids are abundant, persistent, are able adapt to local conditions and have the potential to be used in the biological control of social wasps (Silva-Filho et al., 2007). Nonetheless studies of parasitism of social wasp colonies by ichneumonid wasps are scarce, due to the rarity of such behavior or the difficulty of observing species of this family (Soares et al., 2006). Ichneumonidae can parasitize colonies of social wasps, even with adult wasps actively defending them (Soares et al., 2006).

This is the first report of a *P. vesicolor* colony being parasitized by an ichneumonid wasp of the genus *Pachysomoides*.

ACKNOWLEDGEMENTS

To the Brazilian agencies “Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq),” “Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)” and “Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG)” for financial support. The English corrections and editing this manuscript was done by Asia Science Editing of the Republic of Ireland.

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