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HYMENOPTEROUS PARASITOIDS ASSOCIATED WITH APHIDS (HEMIPTERA: APHIDIDAE) IN THE WHEAT CROP IN CAMPO VERDE, MT, BRAZIL

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ABSTRACT: Mato Grosso is the Brazilian largest grain producer state but contributes a little towards overall production of wheat in the world. Some regions in this state are involved in the production of wheat and particularly, Campo Verde (MT) region has been able to cultivate this winter crop. This study was conducted under field conditions to evaluate the occurrence of natural enemies, more specifically parasitoids associated with aphid pests of great importance to wheat. Four yellow trays containing a preservation solution to capture parasitoids were installed in the experimental area of Assist Consultoria e Experimentação Agronômica from April to July 2014. Samples were collected weekly, and the solution was replaced after every collection. The collected material was taken to the laboratory where the counting and identification of insects was done at the species level. A total of 267 specimens of parasitoids were captured, belonging to six species *Aphidius* sp., *Lysiphlebus testaceipes*, *Praon gallicum*, *Praon volucre*, *Diaeretiella* sp., and *Ephedrus plagiator* (Braconidae: Aphidiinae). The most abundant species were *L. testaceipes* and *Aphidius* sp. The peak of population of all species was observed in May when the wheat was in the phenological stage of tillering, which favors the increase of the host (aphids), thereby increasing the number of parasitoids.
KEYWORDS: Aphids, Biological Control, Parasitism.

HIMENÓPTEROS PARASITOIDES ASSOCIADOS A PULGÕES (HEMIPTERA: APHIDIDAE) NA CULTURA DO TRIGO NO MUNICÍPIO DE CAMPO VERDE, MT

RESUMO: Mato Grosso é o maior produtor brasileiro de grãos, porém tem pequena participação na produção mundial de trigo. Algumas regiões desse Estado estão investindo na produção dessa cultura e o município de Campo Verde (MT) é região apta ao cultivo deste cereal de inverno. O presente trabalho foi conduzido com objetivo de avaliar a ocorrência de inimigos naturais, mais especificamente de parasitoides associados a pulgões, praga de grande importância para trigo. Foram instaladas quatro bandejas de cor amarela contendo solução conservante na área experimental da empresa Assist Consultoria e Experimentação Agronômica com a finalidade de captura dos parasitoides, de abril a julho de 2014. As coletas foram realizadas semanalmente, ocasião em que a solução era substituída. O material coletado foi levado ao laboratório, onde foi realizada a contagem dos insetos e identificação em nível de espécie. Foram capturados 267 exemplares de parasitoides pertencentes a seis espécies: *Aphidius* sp., *Lysiphlebus testaceipes*, *Praon gallicum*, *Praon volucre*, *Diaeretiella* sp. e *Ephedrus plagiator* (Braconidae: Aphidiinae). As espécies mais abundantes foram *L. testaceipes* e *Aphidius* sp. O pico populacional de todas as espécies ocorreu no mês de maio onde a cultura estava no estádio fenológico de afilhamento, o que favorece o aumento dos hospedeiros (pulgões), aumentando consequentemente o número de parasitoides.
PALAVRAS-CHAVE: Afídeos. Controle biológico. Parasitismo.

1 INTRODUCTION

Wheat is the second most important cereal worldwide produced, and has a significant role in the global agricultural economy. It is grown in the South, Southeast and Midwest Brazil, and its production receives systematic support of governmental agencies, since weather conditions are unfavorable to this culture. Currently, wheat cultivars have a wide edaphic climatic adaptation due to genetic improvements. Wheat has been grown in regions with desert type climate in some Middle Eastern countries and in regions with high rainfall, such as China and India (FAOSTAT, 2015).

Several pests attack wheat crop during its development, and aphids have being the most crucial. They are vectors of viruses, and the most critical phase of inoculation is from seedling to tillering stage. Damages can occur from plant emergence phase to the final phase of grain filling, causing even death of plant in severe attacks (GASSEN, 1984; SALVADORI; TONET, 2001).

There exists important agents of aphid population suppression, such as predators, entomo-pathogenic and parasitoids, the latter being considered the most specific and efficient (SALVADORI; TONET, 2001). Few studies have been conducted on the species of parasitoids associated with aphids in Brazilian wheat. Currently the integrated management of aphids in this crop comprises biological control and the judicious use of insecticides, and it is a reference in pest management in winter cereals (PEREIRA *et al*., 2010). In the 80s, a total of 14 species of hymenopterous parasitoids from Europe and the Middle East were introduced in Brazil. The species introduced were *Aphelinus asychis* (Walker, 1839) (Hymenoptera: Aphelinidae), *Aphidius ervices* (Haliday), *Aphidius rhopalosiphi* (Stefani, Perez, 1902), *Ephedrus plagiator* (Ness, 1811), *Praon gallicum* (Stary, 1971), and *Praon volucre* (Holiday, 1833) Hymenoptera: Braconidae), and *Lysiphlebus testaceipes* (Cresson, 1880) (Hymenoptera: Aphidiinae). Embrapa Wheat multiplied and released circa 3.8 million parasitoids in the Brazilian southern and mid-western (STOETZER, 2013), in the states of Rio Grande do Sul, Santa Catarina, Paraná e Mato Grosso do Sul. Survey of parasitoid species and their hosts is extremely important to promote integrated management programs in wheat crops. Due to lack of related studies in Mato Grosso State, the occurrence of natural enemies were evaluated, more specifically parasitoids associated with aphids in wheat in Campo Verde (MT).

2 MATERIAL AND METHDOS

The experiment was carried out in the experimental area of company Assist Consultoria e Experimentação Agronômica located 16 km from the city of Campo Verde, Mato Grosso, Brazil (15° 32' 56.9738" S; 55° 09' 45.3349" W; 718 m asl), 700 meters from the highway MT 251 which connects the cities of Campo Verde and Chapada dos Guimarães.

2.1 EXPERIMENTAL LAYOUT

The test was carried out on a soil prepared with NPK formulation (300kg/ha) on March 31 2014. The trial was laid out on April 4 2014 using cultivars BR18 and BRS 254, and part of the seed used, treated with Standak top. The experimental design was randomized block in split plot with four treatments and four replications. Treatments used were: T_1: Total Treatment (T_1: Standak top plus aerial application of insecticide (ENGEO Pleno fortnightly)); T_2: Seed treatment only (Standak top); T_3: Aerial application of Insecticides (Engeo Pleno) only when control level was reached; T_4: control (no seed treatment or aerial application insecticide).

The aerial applications of insecticide Engeo Pleno (40ml/ha) were used bi-weekly in the treatment T_1; whereas in case of treatment (T_3) insecticide was applied only when the level of control was reached.

The subplot consisted of 15 rows spaced at 0.17m and 8m in length, comprising a total area of 0.193 ha, with spacing of 2m between the subplots and each portion 4m apart from each other so that there was not any influence on the results.

Hundred seeds were planted per meter at a depth of 3 to 5 cm and were observed until the germination. In case of germination failure seeds were re-sown. A foliar application of N (urea, 50 kg/ha) was done fifteen days after seeding.

2.2 PLOTS AND SUBPLOTS

Each plot was divided into two subplots with two cultivars, BRS 254 and BR 18.

2.3 COLLECTION AND IDENTIFICATION OF PARASITOIDS

Parasitoids were collected weekly from April 14 to July 21, 2014 using four yellow aluminum trays (42,5cm x 30,8cm x 4,5cm) that contained a preservative solution, distributed equidistantly in the study area. The preservative solution (water, formaldehyde and detergent) was prepared in gallons (4% formaldehyde and 0,5% detergent). A mesh sieve (10 Mesh) was used for collections of parasitoid, and to remove impurities and larger insects. Thereafter, solution was sieved again through another mesh (5 Mesh) aiming to remove smaller insects; then parasitoids were transferred to vials containing 70% alcohol, and storaged under laboratory conditions for subsequent counting and identification.

Parasitoid species were identified with the help of specific key (PEREIRA & SALVADORI, 2005) to identify the main species with the aid of a magnifying glass and histological tweezers. After identification, the all species were counted and stored in the Entomology Laboratory, IFMT, *campus* São Vicente, Reference Center of Campo Verde.

3 RESULTS AND DISCUSSION

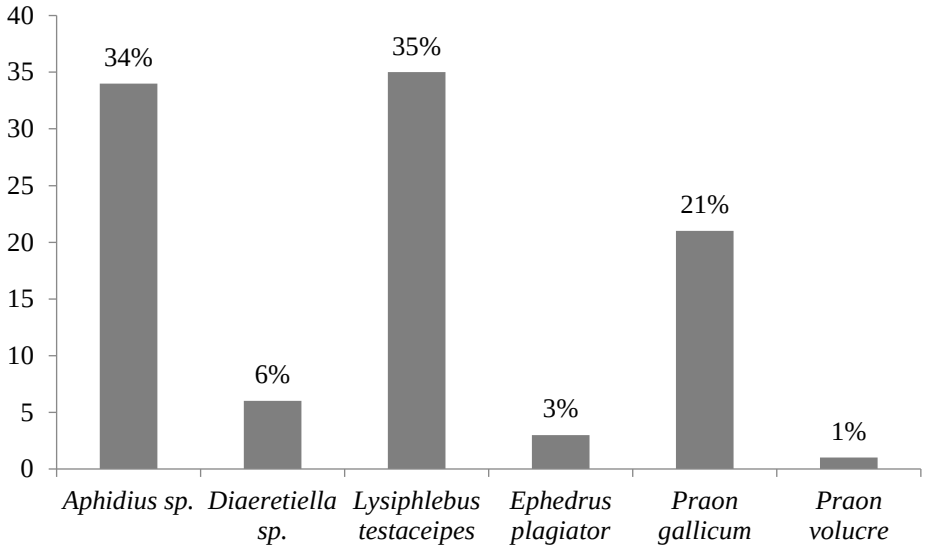
In the four months of surveys, 267 parasitoids specimens were collected (Hymenoptera: Braconidae: Aphidiinae). Six species of parasitoids were identified associated with wheat crop under field conditions (Table 1).

Table 1. Species of parasitoids (Hymenoptera: Braconidae) and number of specimens collected from April to July 2014 in Campo Verde, MT, Brazil.

Species of parasitoids	**Months of collection**				
	April	**May**	**June**	**July**	**Total**
***Aphidius* sp.**	3	55	29	4	**91**
***Diaeretiella* sp.**	0	11	4	0	**15**
Ephedrus plagiator	3	2	2	1	**8**
Lysiphlebus testaceipes	2	65	19	7	**93**
Praon gallicun	4	31	18	4	**57**
Praon volucre	0	0	3	0	**3**
Total	**12**	**164**	**75**	**16**	**267**

Lysiphlebus testaceipes (35%) was the most frequent parasitoid followed by *Aphidius* sp. (34%) in the studied area (FIGURE 1). Different crops in the vicinity of the experimental area such as corn, cotton, wheat, as well as the native vegetation might have influenced the occurrence of natural enemies.

Figure 1. Composition of parasitoid population (Hymenoptera: Braconidae) in wheat crop from April to July 2014 in Campo Verde, MT, Brazil.



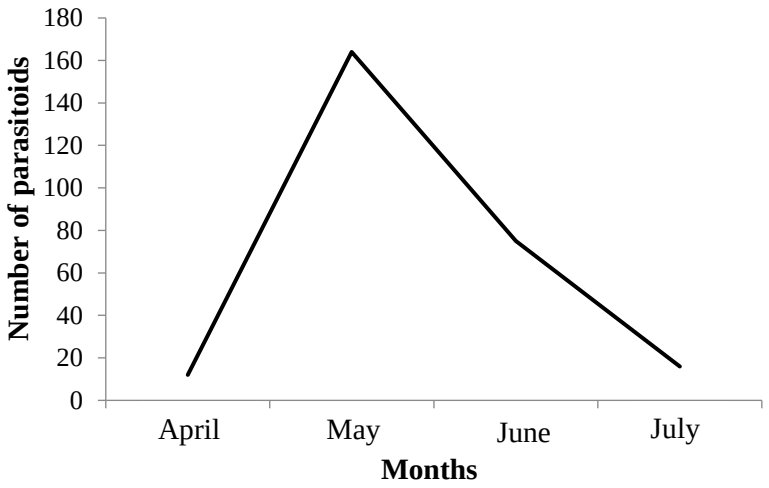
Lysiphlebus testaceipes is a Nearctic species with wide distribution in North, Central and South America. This species, along with *A. colemani* are the most abundant in South America parasitizing several species of aphids (STARY & CERMELI, 1989). These two braconid species have been reported in Brazil even before the biological control project was conducted by Embrapa Wheat (GASSEN, 1999). However, the introduction of these parasitoids was a success because these have adapted to climatic conditions in different Brazilian states, and in high population density when compared to native species.

During a survey Stary *et al*. (2007) mentioned the occurrence of *L. testaceipes* an aphid parasitoid in several Brazilian states (RJ, SP, MG, PE, PR and BA). To date, there is no recorded collection of this parasitoid in the State of Mato Grosso, as well as other species such as *Aphidius* sp. Zanini *et al*. (2006) studied ecological aspects of parasitoids for biological control of aphids in the West of Paraná, Brazil in wheat crops, and *A. colemani* was collected as a single species of parasitoid of *Sitobiun avenae* (Hemiptera: Aphididae) with efficiency of 95% of parasitism.

Tome *et al*. (2012) found similar composition of parasitoid species in the city of Passo Fundo (RS) such as found in this work, mainly *Aphidius colemani* (36.86%), *A. uzbekistanikus* (20.76%), *Praon gallicum* (16.53%), *A. rhopalosiphi* (13.14%), *A. picipes* (7.63%), *E. plagiator* (2.97%), *A. ervi* (1.69%) and *L. testaceipes* (0.42%) from July to October 2012. Even considering as native species, *L. testaceipes* was reported to be the parasitoid released in wheat producing areas in Rio Grande do Sul, Brazil (SALVADORI; SALLES, 2002). In another studies, conducted in Guarapuava (PR), during the winter seasons in 2011 and 2012 four species of parasitoids were collected: *Diaeretiella rapae*, *Aphelinus* spp *Aphidius* spp., and *L. testaceipes*, particullarly *D. rapae* and *Aphelinus* spp., being the predominant species in the two seasons (STOETZER, 2013).

The highest incidence of parasitoids occurred in May, indicating that the species collected have only one population peak (FIGURE 2). The peak of population can be attributed to the phenological stage of the wheat (tillering) where the seedlings are more susceptible to pests, especially aphids, thus increasing the population of parasitoids. Besides the abundance of their host, environmental factors must have some role on their population. All parasitoid species found had highest populations in May, except *P. volucre* and *E. plagiator*.

Figure 2. Population fluctuation of parasitoids (Hymenoptera: Braconidae) from April to July 2014 in Campo Verde, MT, Brazil.

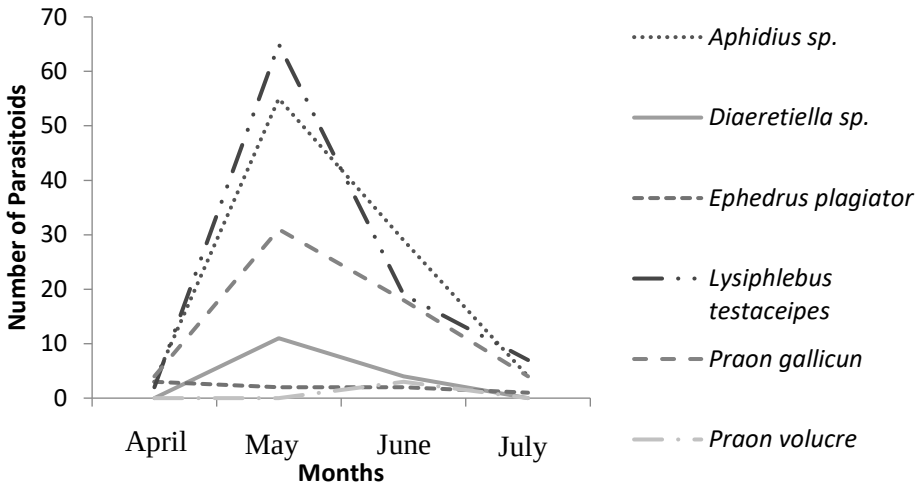


Samples carried out in other Brazilian wheat producing areas showed divergent results on the population peaks of parasitoids species. This may be mainly to the period of sowing of wheat crop, which differs greatly between regions with different soil types and climates. *A. colemani* presents peak population in August in the western Paraná (ZANINI *et al*., 2006). However, several authors agree that the population peak of parasitoids have been influenced by the population density of aphids, in addition to climatic factors; which in turn is influenced by the phenological stage of the crop (ZANINI *et al*., 2006).

Low capture rate of all species of parasitoids was observed in July. In this period where the culture was at the harvest time, and population density of aphids had a drastic reduction in number.

Aphidius sp., *L. testaceipes* and *P. gallicum* were the predominant species collected in any month of collection (FIGURE 3).

Figure 3. Population fluctuation of parasitoids collected from April to July 2014 in Campo Verde, MT, Brazil.



Lysiphlebus testaceipes and *Aphidius* sp. showed population peaks in May, and the former was the most dominant species. The results in this study demonstrated the dominance of one species of parasitoids over others throughout the studied period. Zanini *et al*. (2006) reported the possible dominance and alternancy of parasitoids *L*. *testaceipes* and *A*. *colemani* in Medianeira, PR. Stoetzer (2013) analysed two consecutive harvests and observed the predominance of the genus *Aphelinus* followed by the species *D*. *rapae* in 2011; however in *D*. *rapae* was the predominant species followed by the genus *Aphelinus* in 2012.

In the present study, although the occurrence of other natural enemies was not assessed, coccinellids, lacewings and syrphids were observed preying aphids in wheat under field conditions.

4 CONCLUSIONS

Aphidius sp., *Lysiphlebus testaceipes*, *Praon gallicum*, *P*. *volucre*, *Ephedrus plagiator* and *Diaeretiella* sp. occur naturally in Campo Verde (MT), and may contribute to biological control of wheat aphids under field conditions.

Aphidius sp. and *L*. *testaceipes* were the most common species found, and May was the most favorable month to highest population peaks of parasitoids.

There are no reports in the literature of other studies on parasitoids related to aphids in wheat crop in Mato Grosso; further studies are needed to promote integrated management of wheat pest in the city.

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