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Ocorrência de pragas em plantas daninhas com diferentes manejos de cultura

Occurrence of pests in weeds with different crop managements

Ocurrencia de plagas en malezas con diferentes manejos de cultivos

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Resumo

As plantas daninhas podem constituir importantes hospedeiros para potenciais pragas das culturas. Assim, objetivou-se avaliar a ocorrência de pragas em plantas daninhas em três estratégias de manejo de culturas. O experimento foi conduzido na safra 2016/17. Cada manejo possuía uma área de 0,5 ha, utilizadas para avaliar pragas: (1) algodão/soja/*Urochloa decumbens*; (2) milheto/soja/milheto e (3) milheto/soja/*Crotalaria*. Os levantamentos de pragas foram realizados mensalmente em plantas daninhas durante o manejo da cultura da soja e nas coberturas em sucessão. Foram determinados os índices de diversidade, abundância, dominância, frequência e constância de Shannow-Weaner e flutuação da população. Quatorze espécies de pragas foram identificadas em associação com plantas daninhas nos três sistemas de rotação. A ordem Hemiptera teve o maior número de indivíduos coletados, seguida pela ordem Lepidoptera. A rotação milheto/soja/*Crotalaria* proporcionou o maior número de pragas e a rotação algodão/soja/*U. decumbens* apresentou o menor número de pragas. As pragas *Bemisia tabaci*, *Aphys gossypii* e *Daubulus maidis* apresentaram o maior número de indivíduos nas avaliações nos três manejos.

Palavras-chave: Entomofauna; *Glycine max*; Hospedeiros alternativos, Rotação de cultura.

Abstract

Weeds can be important hosts for potential crop pests. Thus, the objective was to evaluate the occurrence of pests in weeds in three crop management strategies. The experiment was conducted in the 2016/17 harvest. Each management had an area of 0.5 ha, used to assess pests: (1) cotton / soybean / *Urochloa decumbens*; (2) millet / soybean / millet and (3) millet / soybean / *Crotalaria*. Pest surveys were carried out monthly on weeds during the management of soybean crops and on coverages in succession. Shannow-Weaner diversity, abundance, dominance, frequency and constancy indices and population fluctuation were determined. Fourteen species of pests were identified in association with weeds in the three rotation systems. The order Hemiptera had the largest number of individuals collected, followed by the order Lepidoptera. The millet / soybean / *Crotalaria* rotation provided the highest number of pests and the cotton / soybean / *U. decumbens* rotation had the lowest number of pests. The pests *Bemisia tabaci*, *Aphys gossypii* and *Daubulus maidis* presented the largest number of individuals in the evaluations in the three managements.

Keywords: Entomofauna; *Glycine max*; Alternative hosts, Culture rotation.

Resumen

Las malas hierbas pueden ser anfitriones importantes para posibles plagas de cultivos. Por lo tanto, el objetivo fue evaluar la ocurrencia de plagas en malezas en tres estrategias de manejo de cultivos. El experimento se realizó en la cosecha 2016/17. Cada manejo tenía un área de 0.5 ha, utilizada para evaluar las plagas: (1) algodón / soja / *Urochloa decumbens*; (2) mijo / soja / mijo y (3) mijo / soja / *Crotalaria*. Las encuestas de plagas se llevaron a cabo mensualmente en malezas durante el manejo de los cultivos de soja y en las coberturas en sucesión. Se determinaron los índices de diversidad, abundancia, dominancia, frecuencia y constancia de Shannow-Weaner y la fluctuación de la población. Se identificaron catorce especies de plagas en asociación con malezas en los tres sistemas de rotación. El orden Hemiptera tuvo la mayor cantidad de individuos recolectados, seguido por el orden Lepidoptera. La rotación de mijo / soja / *Crotalaria* proporcionó el mayor número de plagas y la rotación de algodón / soja / *U. Decumbens* tuvo el menor número de plagas. Las plagas *Bemisia tabaci, Aphys gossypii* y *Daubulus maidis* presentaron el mayor número de individuos en las evaluaciones en las tres manejos.

Palabras clave: Entomofauna; *Glycine max*; Hospedadores alternativos, Rotación de cultivos.

1. Introduction

Soybean (*Glycine max* (L.) Merril) has become the most important legume cultivated in the world (Bornhofen et al., 2015) and its management is among the activities that showed high production growth rates (Hirakuri & Lazzarotto, 2014).

In Brazil, soybean is the main grain produced and should reach a production of 120.3 million tons in the 2019/20 harvest, in a cultivated area of 36.8 million hectares, with an average productivity of 3.3 thousand kg ha^{-1} (CONAB, 2020). In contrast, competition with planted weeds aggressively intervenes in the crop, due to reduced resources such as water, light and nutrients, resulting in a fall in grain productivity (Braz et al., 2010; Silva et al., 2009).

These weeds occupy space and aggressively consume primordial elements for establishing crops, such as water, space, light, nutrients and minerals, etc. (Dias et al., 2010). They also provide intermediary hosting conditions for insect pests (Arthropoda, Insecta), providing shelter and food, enabling rapid infestation and population growth of these pests in commercial farming (Foerster et al., 2015; Nepomuceno et al., 2007).

The rapid development of invasive plants, especially those selective to the use of herbicides with the same active principle and without product rotation, causes the seed bank to germinate in the fallow in the post-harvest season during the off-season due to the inefficient control of weeds during the harvest (Dalazen et al., 2016).

Some authors argue that non-weed control affects the population dynamics of arthropod pests, which persist throughout the year in economic crop environments in the absence of major crops (Sá et al., 2009). This is due to the availability of weeds as a green bridge for the next crops when an economically viable crop sowing stabilizes, and as a consequence the severe attack of pests (Dalazen et al., 2017).

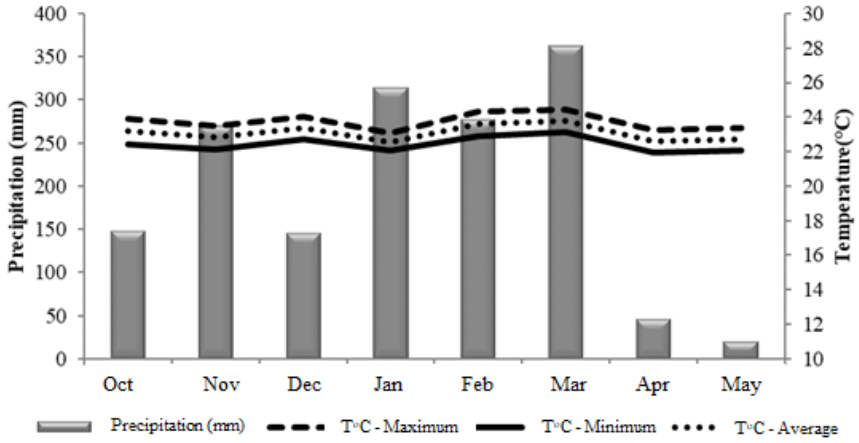
Crop rotation and soil cover in the off-season provides diversification in the environment, reducing the selection and occurrence of weed species (Silva et al., 2018) that interferes in the maintenance or proliferation of crop pest insects (Dalazen et al ., 2016; 2017; Fontanetti, Salgado & Galvão, 2018). Crop rotation can define the evolutionary behavior of fauna and flora ecophysiology, which takes into account plant ecology and integration with the living environment (Erasmo, Pinheiro & Costa, 2004),

In general, the effects of weed control and pest control are studied separately. Nevertheless, the interaction and behavior in these two situations must be taken into account and studied together, considering the population dynamics, migration and use of hosts, as research by Dalazan et al. (2016; 2017) indicates. Therefore, this research aimed to evaluate the occurrence of pests in weeds with different crop managements.

2. Methodology

A research is done with the purpose of bringing new knowledge to society as stated by Pereira et al. (2018). This research was carried out in the agricultural area of Fazenda Campo Bom, located in the municipality of Chapadão do Sul-MS, with an approximate location at 18º48'459" S, 52º36'003" W, and altitude of 810 meters. In the survey for the 2016/2017 harvest, the climate was tropical humid (Aw) according to the Köppen classification, with well-defined seasons, a dry period concentrated from May to September (autumn/winter) and rainfall from October to April (spring/summer). It presents annual temperature that varies between 13°C and 28°C, average precipitation of 1,850 mm and average annual relative humidity of 64.8% (Cunha, Magalhães & Castro, 2013). Rainfall data and monthly air temperature were recorded during the experiment (Figure 1).

Figure 1 - Rainfall (mm) and average monthly temperature (ºC) during the survey period.



Source: prepared by the authors.

Three crop management strategies, each with an area of 0.5 ha, were used to assess pests: (1) cotton / soybean / *Urochloa decumbens*; (2) millet / soybean / millet; and (3) millet / soybean / *Crotalaria*. After the soybean harvest, the area was desiccated, and the cover crops were then planted in the management groups (1) *U. decumbens*, (2) millet, and (3) *Crotalaria*. Glyphosate potassium and Clethodim herbicides were used during soybean cultivation. Pest and disease control was also carried out during soybean cultivation. For cover crops, no application was made to control weeds, pests and diseases.

The pests surveys were carried out during soybean crop management, and in cover crops during soybean succession. During the soybean crop cultivation, pests surveys occurred in October, 15 days after emergence (DAE) while the crop was in stage V2.

The pest surveys were monthly. In soybean crops they occurred in October, November, December and January, while for cover crops they occurred in February, March, April and May. To measure and identify the pests, all individuals present on the weeds present in a m^2 were evaluated. In each management, 8 m^2 were evaluated at random, for sampling time.

The pest insects were collected from the weeds through direct collection and examined on the spot, in the adult, nymph or larval stages. For those who could not be identified at the site, they were collected, when possible, or the entire plant was bagged (Byerly et al., 1978) to be conducted to the laboratory. The identification of individuals was based on specialized entomological literature. A faunal analysis was subsequently performed using the ANAFAU® program (Moraes & Haddad, 2003) in order to determine the Shannow-Weaner diversity

indexes, abundance, dominance, frequency and constancy. The total number of insects was used for the population fluctuation.

3. Results and Discussion

Fourteen species of pests were identified in association with weeds in the three rotation systems, namely: *Bemisia tabaci, Aphys gossypii, Daubulus maidis, Frankliniella schultzei, Euschistos heros, Chrysodeixis includens, Spodoptera frugiperda, Anticarsia gemmatalis, Dichelops melacanthus, Diabrotica speciosa, Tetranychus urticae, Helicoverpa armigera, Phoebis sennae,* and *Aphis rumicis* which appeared according to their population fluctuation variations for the three sample areas (Figures 2, 3, 4). The Hemiptera order had the greatest number of collected individuals, followed by the Lepidoptera order with four individuals. Chiaradia et al. (2011) found that the Hemiptera order stood out, being the supplier of most of the evaluated pests with a total of 2,790 individuals, and a total of 1370 individuals of this order were also found in this survey.

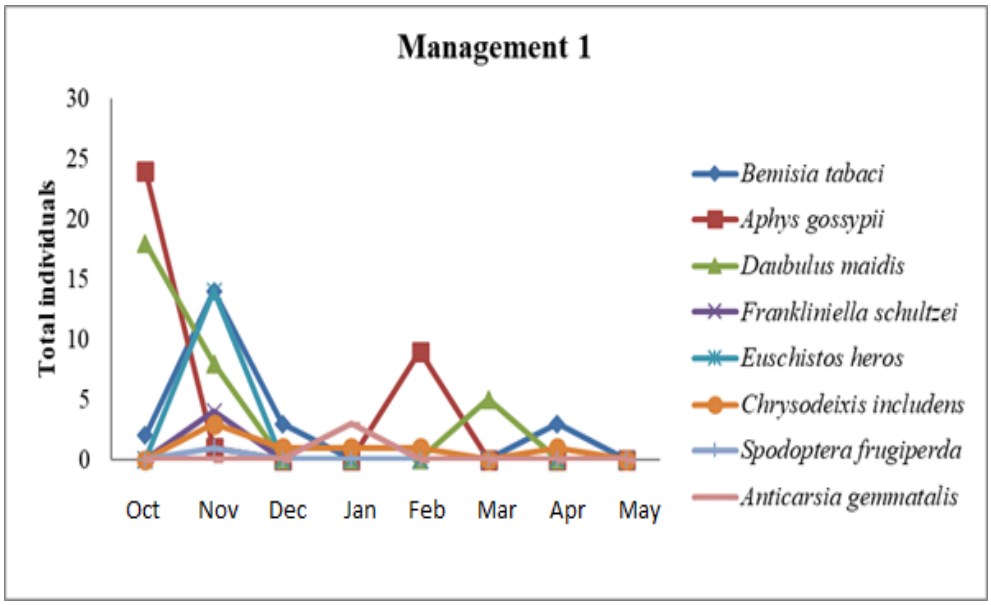
The common pests in all evaluations in the three treatments were: *B. tabaci, A. gossypii, D. maidis, F. schultzei, C. includens, S. frugiperda* and *A. gemmatalis. E. heros* was only found in the first and second management. It can be observed in Figure 3 that the pests that differed in only this area were *D. melacanthus, D. speciosa, and T. urticae.* In the evaluation of soybean/*Crotalaria*, only *H. armigera, P. sennae* and *A. rumicis* differed from the others.

In a study by Dalazen et al. (2017) in 2010 in the cities of São Vicente do Sul and Boa Vista do Incra (both in the state of Rio Grande do Sul), they carried out a faunal and pest analysis in soybean where they verified some pests found in this work such as: *Dichelops* spp., *E. heros, A. gemmatalis, S. frugiperda, C. includens* and *Helicoverpa* spp., and also observed the same result found in the population fluctuation analysis which indicated the occurrence of pests on weeds more frequently, especially in the initial cultivation period (October and November).

In the first management (soybean/*U. decumbens*) (Figure 2), the *A. gossypii* and *D. maidis* pests had a larger population in October, and when pest management started in December, this population fell sharply, then remaining low until February when *A. gossypii* had a slight increase. *Bemisia tabaci* and *Euschistos heros* had a fluctuation increase in November, however with an increasing fall in the remaining months and then remaining

stable, while *F. schultzei*, *C. includens*, *A. gemmatalis*, and *S. frugiperda* kept low populations in all evaluations with little fluctuation, but without interference.

Figure 2 - Population fluctuation of insect pests in soybean/ *U. decumbens* in Chapadão do Sul/MS, from October/2016 to May/2017.

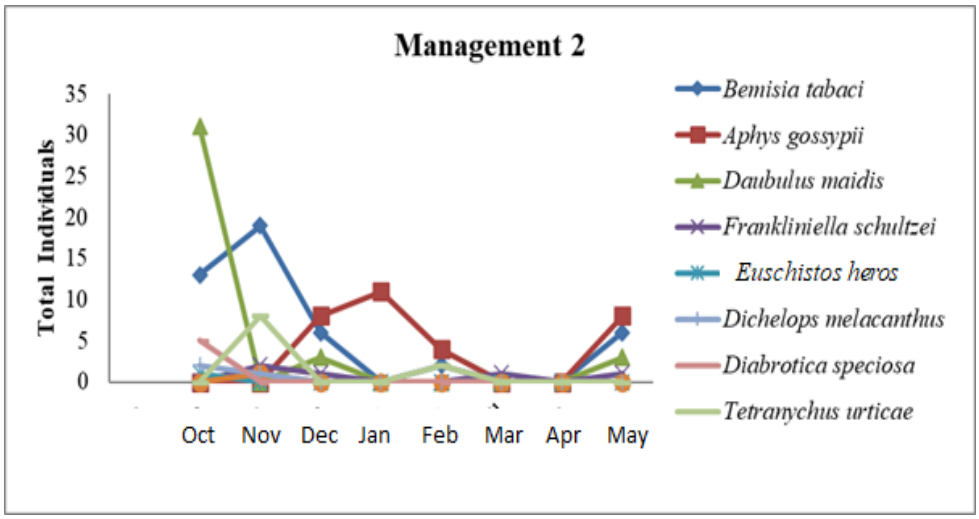


Source: prepared by the authors.

In management 2 (Figure 3), the *D. maidis* spittlebug again established with high initial infestation as in the first area evaluated. The whitefly (*Bemisia tabaci*) had the second highest infestation; a fact that can also be verified in management 3 (Figure 4), with an increase in November and December.

For management 2, the aphid (*A. gossypii*) was representative in January to March. The main pests had low population levels in April and May, but there was an increase in the population of the main pests at the end of May which can be explained by the lack of chemical management in the coverages at this time of year in order to reduce costs.

Figure 3 - Population fluctuation of insect pests in soybean/millet crop in Chapadão do Sul/MS, from October/2016 to May/2017.

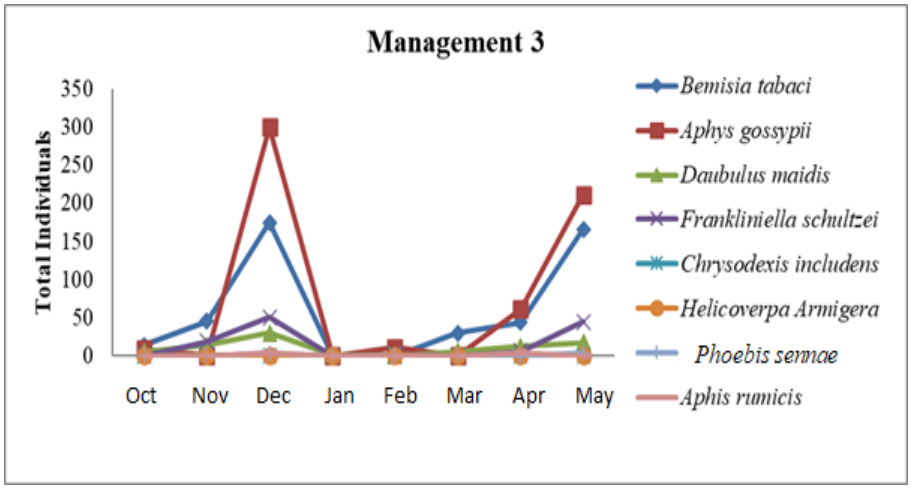


Source: prepared by the authors.

The soybean/*Crotalaria* management (Figure 4) showed the highest incidence of insects in relation to the other evaluated areas; a fact explained by the number of host weeds present in relation to the other managements, where *Bemisia tabaci* and *Aphys gossypii* (Tables 1,2 and 3) had the highest totals of individuals; this rise occurred in November to January, with a fall in February and March, but again had a population growth in April and May.

Frankliniella schultzei and *Daubulus maidis* pests obtained similar fluctuation as the others surveyed, but with a smaller number of individuals. According to the evaluations, the other pests were kept at low levels and had little population fluctuation. *D. melacanthus* and *D. speciosa* species occurred at the beginning of the soybean vegetative phase and in winter crops, as shown by Brondani et al. (2008), being contrary to what is observed in Figure 3, where they have low population fluctuation.

Figure 4 - Population fluctuation of insect pests in soybean/*Crotalaria* in Chapadão do Sul/MS, from October/2016 to May/2017.



Source: prepared by the authors

The *A. gossypii* species is a pest that has more than 90 families of host plants, including weeds such as ragweed (*Commelina benghalensis* L.). Michelotto, Silva and Busoli (2004) verified that the life of this insect increases in the presence of this weed, which was proven in this work, where the aphid was a pest that stood out for all the evaluated areas, having relevant population indices in all managements, and mainly in management 1 in which their individuals reached almost 25; and in the management 3 with 300 individuals in the first months evaluated.

The specie A. gossypii showed dominance in the evaluated cultivated areas, with the highest common frequency being very frequent (VF) and very abundant (VA) in all evaluations (Tables 1,2 and 3). In managements 2 and 3, the whitefly (*B. tabaci*) was common in evaluations of the two areas, being dominant, very frequent, very abundant and constant; the same was maintained for *D. maidis* in managements 1 and 2 (Table 1 and 2). The species that were dominant in the evaluations were: *B. tabaci, A. gossypii, D. maidis, F. schultzei, E. heros, C. includens, T. urticae, P. sennae,* and *A. rumicis.* For the area evaluated with soybean / *Crotalaria*, all the individuals were very abundant, as this was the management with the highest pest index. Eight individuals were identified in the soybean production area with *U. decumbens*, with the Hemiptera order standing out with 6 species. The species that presented the highest frequency were *A. gossypii* and *D. maidis* with a total of 34 and 31 individuals, respectively, and those that were frequent in order were: *F. schultzei, S. frugiperda* and *A. gemmatalis*, with varying frequency between 4 and 1 individuals (Table 1).

Table 1 - Frequency, dominance, abundance and constancy values in a community of weeds present in soybean/ *U. decumbens* production areas in Chapadão do Sul/MS, from October/2016 to May/2017.

Species	Management 1					
	Soybean/ *U. decumbens*					
	Total	D[1]	A[2]	F[3]	C[4]	Host weeds
Bemisia tabaci	22	D	c	F	W	*Commelina benghalensis; Richardia brasiliensis.*
Aphys gossypii	34	D	va	VF	Y	*Commelina benghalensis; Richardia brasiliensis; Amaranthus deflexus.*
Daubulus maidis	31	D	va	VF	Y	*Eleusine indica; Commelina benghalensis; Digitaria sanguinalis.*
Frankliniella schultzei	4	ND	d	LF	Z	*Commelina benghalensis; Richardia brasiliensis.*
Chrysodeixis includens	7	D	c	F	W	*Commelina benghalensis; Conyza canadenses; Amaranthus deflexus.*
Euschistos heros	14	D	c	F	Z	*Commelina benghalensis.*
Spodoptera frugiperda	1	ND	r	LF	Z	*Richardia brasiliensis.*
Anticarsia gemmatalis	3	ND	d	LF	Z	*Amaranthus deflexus.*

Predominant species: [1](D) Dominance: not dominant (ND); dominant (D); [2](A) Abundance: dispersed (d); common (c); very abundant (va); [3](F) Frequency: little frequent (LF); frequent (F); very frequent (VF); [4](C) Constancy: constant (W); accessible (Y); accidental (Z); Weed (WD). Source: prepared by the authors.

In management 2, *E. heros* and *C. includens* species which were frequent in management 1 became uncommon, and infrequently included *D. melacanthus* with 3 individuals. The *A. gossypii* and *D. maidis* species remained very frequent with the inclusion of the whitefly with a total of 46 individuals. The infrequent insects (*E. heros*, *C. includens* and *D. melacanthus*) were distinguished and decreased in size ranging from 1 to 3 individuals (Table 2).

Table 2 - Frequency, dominance, abundance and constancy values in a weed community present in soybean/millet production areas in Chapadão do Sul/MS, from October/2016 to May/2017.

Species	Management 2					
	Soybean/millet					
	Total	D[1]	A[2]	F[3]	C[4]	Host weeds
Bemisia tabaci	46	D	va	VF	W	*Commelina benghalensis; Ipomoea triloba.*
Daubulus maidis	37	D	va	VF	Y	*Eleusine indica; Digitaria insularis; Senna obtusifolia.*
Frankliniella schultzei	5	ND	c	F	Y	*Senna obtusifolia; Commelina benghalensis; Ipomoea triloba.*
Aphys gossypii	31	D	va	VF	Y	*Ipomoea triloba.*
Euschistos heros	1	ND	d	LF	Z	*Commelina benghalensis.*
Dichelops melacanthus	3	ND	d	LF	Z	*Digitaria insularis.*
Diabrotica speciosa	5	ND	c	F	Z	*Commelina benghalensis.*
Tetranychus urticae	10	D	c	F	Z	*Ipomoea triloba.*

Predominant species: [1](D) Dominance: not dominant (ND); dominant (D); [2](A) Abundance: dispersed (d); common (c); very abundant (va); [3](F) Frequency: little frequent (LF); frequent (F); very frequent (VF); [4](C) Constancy: constant (W); accessible (Y); accidental (Z); Weed (WD). Source: prepared by the authors.

The last management with soybean and *Crotalaria* found the largest number of individual pests in relation to the other management, with *Crotalaria* being a multiplier and pest storage for the soybean crop. *B. tabaci* and *A. gossypii* were very frequent with 475 and 595, respectively, which is much higher than the other evaluated treatments. The other species presented as frequent and superior, as well as for the other winter crops (Table 3).

Table 3 - Frequency, dominance, abundance and constancy values in a weed community in soybean/*Crotalaria* production areas, in Chapadão do Sul/MS, from October/2016 to May/2017.

Species	Management 3					
	Soybean/*Crotalaria*					
	Total	D[1]	A[2]	F[3]	C[4]	Host weeds
Bemisia tabaci	475	D	va	VF	W	*Ipomoea triloba; Commelina benghalensis; Ageratum conyzoides; Senna obtusifolia; Portulaca oleracea; Richardia brasiliensis; Chamaesyce hirta.*
Aphys gossypii	595	D	va	VF	W	*Ipomoea triloba; Commelina benghalensis; Ageratum conyzoides; Senna obtusifolia; Amaranthus deflexus; Chamaesyce hirta; Conyza canadenses; Bidens pilosa.*
Daubulus maidis	89	D	va	F	W	*Eleusine indica; Digitaria insularis; Commelina benghalensis; Digitaria sanguinalis; Portulaca oleracea; Ageratum conyzoides.*
Frankliniella schultzei	122	D	va	F	W	*Ipomoea triloba; Senna obtusifolia; Ageratum conyzoides.*
Chrysodeixis includens	4	ND	va	F	Y	*Commelina benghalensis; Ipomoea triloba.*
Helicoverpa armigera	2	ND	va	F	Y	*Commelina benghalensis; Senna obtusifolia.*
Aphis rumicis	10	D	va	F	Y	*Senna obtusifolia; Emilia fosbergii.*
Phoebis sennae	8	D	va	F	Y	*Senna obtusifolia.*

Predominant species: [1](D) Dominance: not dominant (ND); dominant (D); [2](A) Abundance: dispersed (d); common (c); very abundant (va); [3](F) Frequency: little frequent (LF); frequent (F); very frequent (VF); [4](C) Constancy: constant (W); accessible (Y); accidental (Z); Weed (WD). Source: prepared by the authors

4. Final Considerations

The millet / soybean / *Crotalaria* rotation provided the highest number of pests, and the cotton / soybean / *U. decumbens* rotation had the lowest number of pests.

The *Bemisia tabaci*, *Aphys gossypii* and *Daubulus maidis* pests presented the highest numbers of individuals in the evaluations of the three managements which were cotton / soybean / *Urochloa decumbens*; millet / soybean / millet and millet / soybean / crotalaria.

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