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Entomofauna associated with a silvopastoral system of *Tithonia diversifolia* cv. ICA Cuba oc-10, intended for bull fattening

Entomofauna asociada a un sistema silvopastoril de *Tithonia diversifolia* vc. ICA Cuba oc-10, destinado a la ceba de toros

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To evaluate the entomofauna associated with a silvopastoral system (SSP) of tithonia and improved and natural grasses, intended for bull fattening, an experiment was conducted for four years. A sample of 20 raids was taken during three climatic moments (January, May and September), with the use of the entomological net for each plant component. Results showed the superiority of Insecta class. An amount of 14 orders, 37 families and 76 morphospecies were collected. Out of them, 38 phytophages, 13 visitors, 22 bioregulators, 2 hematophages and 1 omnivore. The most common phytophages were the leafhoppers: *Empoasca* sp., *Hortensia similis*, *Draeculacephala cubana* and a complex of chrysomelids of *Epitrix*, *Diabrotica*, *Colaspis*, *Diachus*, *Typophorus*, *Cryptocephalus*, *Oedionychus* and *Anysostena* genera, which provoke their damage with greater emphasis on base grass and on the control area. However, they only reached the category of frequent. The rest were included in the category of infrequent (<10). September was the most representative month of the associated entomofauna. It is concluded that the study of the entomofauna in the evaluated areas confirms the function of the tree component in the agroecosystem. Regarding the SSP with tithonia and base grass, it is demonstrated that the system manages to maintain phytophagous, visitor and bioregulatory species in biological balance, without causing economic damage to the associated plant components. Therefore, it is recommended to maintain phytosanitary surveillance in these areas, by promoting increasingly diverse systems, in order to contribute to the comprehensive management of the agroecosystem.

Keywords: *bioregulators, grazing, Mexican sunflower, pest insects*

Para evaluar la entomofauna asociada a un sistema silvopastoril (SSP) de tithonia y gramíneas mejoradas y naturales destinado a la ceba de toros, se condujo un experimento durante cuatro años. En tres momentos climáticos (enero, mayo y septiembre) se tomó, una muestra de 20 redadas, con la utilización de la red entomológica, por cada componente vegetal. Los resultados evidenciaron la superioridad de la clase Insecta. Se colectaron, 14 órdenes, 37 familias y 76 morfo-especies. De ellas 38 fitófagos, 13 visitadores, 22 biorreguladores, 2 hematófagos y 1 omnívoro. Los fitófagos de mayor ocurrencia fueron los saltahojas: *Empoasca* sp., *Hortensia similis*, *Draeculacephala cubana* y un complejo de crisomélidos de los géneros *Epitrix*, *Diabrotica*, *Colaspis*, *Deloyala, Diachus*, *Typophorus*, *Cryptocephalus*, *Oedionychus* y *Anysostena*, que ejercen sus daños con mayor énfasis en el pasto base y en el área testigo. Sin embargo, sólo alcanzaron la categoría de frecuente. El resto estuvieron en el entorno de poco frecuente (<10). Septiembre fue el mes más representativo de la entomofauna asociada. Se concluye que el estudio de la entomofauna en las áreas evaluadas ratifica la función del componente arbóreo en el agroecosistema. En lo que respecta al SSP con tithonia y pasto base, se constata que el sistema logra mantener en equilibrio biológico especies fitófagas, visitadoras y biorreguladoras, sin provocar daños económicos en los componentes vegetales asociados. Por tanto, se recomienda mantener la vigilancia fitosanitaria en dichas áreas, al promover sistemas cada vez más diversos, en aras de contribuir al manejo integral del agroecosistema.

Palabras clave: *biorreguladores, botón de oro, insectos-plaga, pastoreo*

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Introduction

Tithonia diversifolia (Hemsl.) A. Gray., commonly known as *Mexican sunflower*, is a shrub species of the *Asteraceae* family with forage potential, which use in animal feeding is becoming increasingly important. Its agronomic performance (Londoño *et al.* 2019), nutritional quality and value (Vargas *et al.* 2022), rapid growth and low demand for inputs and management for its cultivation (Ríos 2002), together with its adaptability to multiple climates and soils, make it a strategic plant for the assembly of silvopastoral systems (SSP) (Murgueitio *et al.* 2015 and Murgueitio 2023).

Comprehensive research, conducted at the Institute of Animal Science of Cuba, led by Ruiz *et al.* (2016), confirm the benefits and attributes of this shrub for its use in animal production. As a result of these studies, *T. diversifolia* materials collected in Cuba are available, and can be used in grazing systems (Alonso *et al.* 2015 and Ruiz *et al*. 2023a). In this research, technological elements were defined for the use of this species in silvopastoral systems. Recently, it has been shown that its sowing by gamic seed can be sustained, with positive economic effects (Báez *et al*. 2022 and Padilla *et al.* 2023).

Despite there being few reports of damage or herbivory in this species, to achieve a deeper knowledge about phytosanitary, the objective of this study was to evaluate the entomofauna, associated with a silvopastoral system of *T. diversifolia* cv. ICA CUBA Oc-10, intended for bull fattening.

Materials and Methods

Location: The research was carried out for four years at the Institute of Animal Science (ICA), located at 22º 53' North, 82º 02' West, and 92 m a.s.l., in San José de las Lajas municipality, Mayabeque province, Republic of Cuba. The evaluation covered from 2019 to 2023.

Experimental area: A total of 10 ha was used, which were composed of a mixture of improved grasses (*Cynodon nlemfuensis*) and natural grasses (*Paspalum notatum*, *Sporobolus indicus*, *Dichantium* sp.). The study area was divided into two systems, 5 ha each. One of them was composed of grasses (control area) and the other, of a silvopastoral system (SSP) of grasses-tithonia associated in 100 % of the area, which was intended for the fattening of male Siboney cattle from Cuba.

Tithonia SSP establishment methodology: The sowing of *T. diversifolia* was carried out on a brown carbonated soil (Hernández *et al.* 2019), according to the concepts and methodologies developed by Ruiz and Febles (1999) and Ruiz *et al.* (2006). Previous soil preparation was carried out in strips in grassland areas. The tithonia strips were oriented from East to West and sowing was performed by cuttings, pastures and botanical seed. For this, the registered variety ICACUBA Oc-10 was used, proposed by Ruiz *et al.* (2010) for its implementation in grazing.

Experimental procedure: For studies of the associated entomofauna, the baseline was initially drawn in both areas before sowing tithonia. Two samples of 20 raids were taken in an area representative of the area to be sown, and two equal samples in the control area, composed by grasses. Subsequently, with the promotion of the SSP, stratified sampling was implemented in five blocks. In the center of each block, the representative sampling area was defined, according to the methodology proposed by CIBA-GEIGY (1981). Sampling was carried out at three climatic times of the year (January, May and September). In each block, a sample of 20 raids was taken with the use of the entomological network for each plant component (tithonia and base grass) for a total of 10 samples (five in tithonia and five in the base grass). In the control area, established only with grasses, five samples were taken. All were individualized in plastic bags, with their respective identifications, and were transferred to the Pest Management Laboratory of the Pasture Department of the ICA for their processing and taxonomic identification. A stereoscopic microscope, entomological collections and related dichotomous keys were used for this purpose. Phytophagous insects, visiting organisms and the associated beneficial fauna (bioregulators) were identified in each study area, considering the assignment of functional groups, according to Metcalf and Flint (1965), Triplehorn and Johnson (2005), Mancina and Cruz (2017) and World Spider Catalog (2020). The level of damage caused by insect-pests in each plant component was also evaluated, in accordance with what was described by Calderón (1982).

Climatic conditions of the study area: Average annual temperature was 24.86 °C. The accumulated rainfall in 2019 was 1,254.7 mm, with 71 days of rain. In 2020, there was an accumulated of 1,599.4 mm in 118 days. In January, May and September, it was 6.9 mm with 4 d of rain, 351.8 mm with 13 d and 240.7 mm with 15 d, respectively. The accumulated rainfall in 2021 was 1,497.9 mm with 88 days of rain. January had 34 mm in just 1 day, May only 40.1 mm with 7 days and September 218.7 mm with 15 days. In 2022, the accumulated rainfall was 1,903.7 mm within 100 days. In January, May and September, 24.9 mm, 253.8 mm and 258.1 mm were registered in 4 d, 14 d and 18 d, respectively. In 2023, it was 1,171.6 mm in 95 days of rain: January with 4.6 mm in 2 days, May with 182.5 mm in 13 days and September with 159.8 mm in 12 days of rain. This last year appeared to have more rain. However, the accumulated rainfall was much lower than the historical mean (40 years), with 258.4 mm less. On the contrary, in 2022, it rained 473.7 mm more than the historical mean.

Data processing and analysis: An Excel database was created with all the collected information. The ecological indicators were determined: number of individuals (N), species richness (S), uniformity (E), Margalef index (DMg), Simpson index (Dsp), Shannon index (H'), Shannon variance, Berger-Parker index (d) and alpha (log distribution) for the baseline, according to the Diversity program, according to Henderson and Seaby (1998). Then, the associated arthropodfauna was grouped in each experimental area according to the plant component and the richness and abundance of species, according to the sampling moment in the year. In the first year, proportion comparison analysis (chi-square) was carried out for each plant component evaluated, according to the ComparPro version 1 statistical package (Font *et al.* 2007). For the abundance of species, the procedure was performed according to the sampling moment and the test of Duncan (1955) for P<0.05 was applied to differentiate means in the necessary cases.

In the second year of sampling, relative frequency (Fr) and relative abundance (Ar) of the associated arthropodfauna were determined, with emphasis on the insect fauna. In addition, the percentage of intensity (% intensity) and of distribution (% distribution) were determined when moderate insect lesions were found. Next, the corresponding formulas and scales are issued according to INISAV (2006):

$$Fr = \frac{Fi}{Ft} \;x\; 100$$

where:
Fr: relative frequency
Fi: times in which each insect appeared per month
Ft: number of times it was evaluated

Scale
Very frequent ≥ 30
Frequent ≥ 10 ≤ 29
Little frequent < 10

$$Ar = \frac{n}{N} \;x\; 100$$

where:
Ar: relative abundance
n: number of individuals of one species per month
N: total number of all the collected individuals from the different species found

$$\%\;\; Intensity = \frac{\sum(n.v)\;\; x\;\; 100}{\mathrm{i\,x\,N}}$$

where:
n: # of studied leaves
N: total # of studied leaves
i: highest value of the scale
v: value of the scale (1 to 4)

$$\%\;\; Distribution = \frac{a}{b} \;x\; 100$$

where:
a: number of affected leaves
b: number of sampled leaves

Results and Discussion

Table 1 shows the ecological indicators recorded in the baseline carried out before the promotion of the SSP. Homogeneity is demonstrated in both areas, as there is no evidence of dominant species (0.3217 and 0.2692). As can be seen, there was similarity in the range of abundance (136 and 153), as well as in uniformity (0.7197 and 0.8411) for the area to be sown and the control area, respectively. This is demonstrated by the Diversity program (Henderson and Seaby 1998), when graphing the range of abundance of the collected species (figure 1).

The taxonomic identification of the arthropodfauna associated with the SSP with tithonia and base grass, as well as in the control area, only with grasses (*C. nlemfuensis* + natural grasses) showed that Insecta class has superiority with respect to the rest (Malacostroca, Gastropoda and Arachnida). This result is evident, knowing that insects can indeed be found in almost all environments on the planet and are considered as the most diverse group of animals on Earth, with approximately one million described species. More than all other groups of animals combined, it is estimated that there could be up to 10 million species of insects not yet described (Barrera and López 2016). During the experimental period, 14 orders, 37 families and 76 morphospecies were collected (table 2). In total, 38 morphospecies with phytophagous habits, 13 visitors, 22 bioregulatory morphospecies, 2 hematophagous and 1 omnivorous were associated.

With the exception of visiting organisms, mainly associated with the flowering season, attracted by the tithonia flowers, such as bees (*Apis mellifera*), butterflies and dragonflies, the rest frequent the plant component of the areas (SSP with tithonia, SSP base grass and control grass), in greater or lesser proportion, at some time of the year.

Among the most recurring phytophages, a complex group of leafhoppers (*Empoasca* sp., *Hortensia similis*, *Draeculacephala cubana*) and another of chrysomelids of *Epitrix*, *Diabrotica*, *Colaspis*, *Diachus*, *Typophorus*, *Cryptocephalus*, *Oedionychus* and *Anysostena* genera were found, which, although were observed in tithonia, exert their damage with greater emphasis on base grass and grasses (control area). It was confirmed that only the bean-leaf webworm moth (*Omiodes indicata*) prefers tithonia, where it develops its entire biological cycle. However, *T. diversifolia* is still a plant that pests consume little, with a low damage percentage, inferior to 20 %.

Table 1. Ecological indicators of the experimental area (sowing and control areas). Baseline

Diversity index	Sowing area	Control
Number of individuals (N)	136	153
Species richness (S)	14	23
Uniformity (E)	0.7197	0.8411
Margalef index (DMg)	2.7398	4.3566
Simpson index (Dsp)	6.9439	9.4159
Shannon index (H’)	2.2566	2.6374
Shannon variance	0.0075	0.0068
Berger-Parker index (d)	0.3217	0.2692
Alpha (log distribution)	4.1761	7.4441

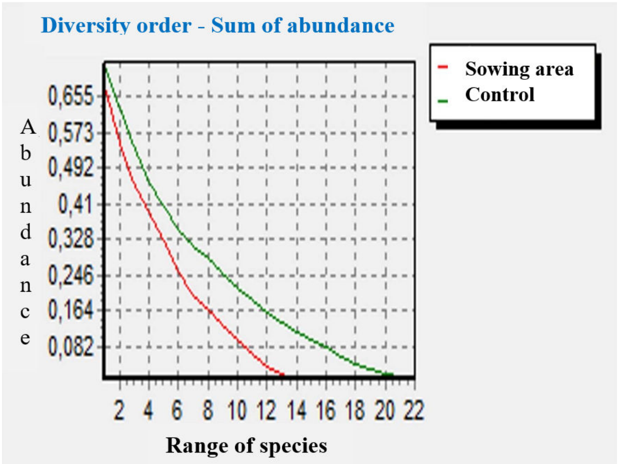

Figure 1. Range of abundance of the collected species in both studied areas

This result coincides with what was reported in studies by Ruiz *et al.* (2017) under Cuban conditions. This performance could be associated with the presence of secondary metabolites in the plant (Scull *et al.* 2022).

González-Sierra *et al.* (2019), when carrying out the qualitative and quantitative determination of said metabolites in ethanolic extracts of roots, stems and leaves of *T. diversifolia* under the conditions of Cuba, reported a wide variety of bioactive substances like phenols, flavonoids, coumarins, quinones and terpenoids, with higher contents in roots and with great antioxidant activity.

In a similar study by Sabaris *et al.* (2023) multiple bioactive substances were found present in leaves, stems and flowers, which are used by the plant as a defense mechanism after the action of herbivores. Hence, they are capable of manifesting repellent, phagodeterrent or insecticidal action against certain pest-insects (Bagnarello *et al*. 2009, Castaño-Quintana *et al.* 2013, Rodríguez *et al.* 2015, Jiménez *et al.* 2016, Devi *et al*. 2022, Kerebba *et al.* 2022 and Miranda *et al.* 2022). Its molluscicide action has even been recently verified from foliar extracts of the plant (Ballada and Baonan 2023).

Other studies report that the plant has allelopathic action (Tongma *et al.* 2001, Rodríguez-Cala and González-Oliva 2017), nematocidal (Ferreira *et al.* 2012 and Neto *et al.* 2018), as well as anthelmintic action (Duarte *et al.* 2020) and antiparasitic (Lezcano-Más *et al.* 2016). This ability of the plant to maintain a low incidence of pest-causing organisms and, consequently, low damage levels, constitutes a novel result, obtained and verified in the present study, which enhances the interest in its use, which makes it even more attractive to encourage its use in animal feeding.

The control area, with only grasses, always obtained the highest abundances at the time of sampling with respect to the rest of the evaluated plant components (table 3). Studies by Alonso-Amaro *et al*. (2021) in leucaena-guinea silvopastoral systems also obtained higher values of insect diversity, numerous and similar in the sampled areas, although not representative for the herbaceous stratum.

May was also the month with the lowest proportion of insects, collecting the lowest abundances with significant differences with the rest. This could be due to the fact that it was the month when the dry period intensified (40.1 mm) and, logically, the plant species were also suffering from the lack of water in the soil. Therefore, the plants are less turgid and less desirable by the phytophagous organisms that feed on them. This performance has been evident in multiple studies, where climatic factors determine the appearance of organisms associated with plants (Baltazar 2016 and Doria-Bolaños *et al*. 2021), and even more so if it is known, according to research by Herrera *et al*. (2018), the evident effect of climate change in the study area. Insects, due to their very short life cycles (days, weeks), compared to other animals or plants, can have effects on their development, movement, reproduction and performance in front of these extreme climatic episodes, such as heat waves or temperature variations (Nolasco *et al.* 2021). In this way, younger leaves are consumed more by herbivores, since they represent a more nutritious resource and, presumably, are not so defended by chemical substances, especially by compounds that reduce their digestibility and, therefore,

Table 2. Arthropodfauna associated to the studied area during all the experimental period

CLASS	ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME	FUNCTIONAL GROUP
Insecta	Hemiptera	Cicadellidae	*Empoasca* sp. δ ϕ £	Leafhopper	F
			Hortensia similis (Walk.) δ ϕ £	Leafhopper	F
			Draeculacephala cubana (M y B.) ϕ £	Leafhopper	F
			Chlorotettix minimus Baker δ ϕ £	Leafhopper	F
			Thamnotettix sp. δ ϕ £	Leafhopper	F
		-	2 unidentified morphospecies £	Leafhoppers	F
		Flatidae	*Ormenaria rufifascia* (Walker) £	Palm flatid planthopper	F
		Cixiidae	*Bothriocera* sp. δ ϕ £	Cixiid	F
			Oliarus sp. δ ϕ £	Cixiid	F
		Membracidae	*Stictocephala rotundata* Stål. ϕ £	treehopper	F
		Rhyparochromidae	*Paromius longulus* (Dallas) ϕ £	Long grey seed bug	F
		Pentatomidae	*Mormidea pictiventris* (Stål) ϕ £	Stink bug	F
			Nezara viridula L. ϕ £	Green stink bug	F
		-	1 unidentified morphospecie ϕ £	Stink bug	F
	Diptera	Dolichopodidae	*Condylostylus* sp. δ ϕ £	Fly	B
		Chamaemyiidae	*Leucopis* sp. δ ϕ £	Fly	V
		Otitidae	*Euxesta stigmatias* (Loew.) δ ϕ £	Cornsilk fly	V
		Syrphidae	*Toxomerus* sp. δ ϕ £	Syrphid fly	B
		Culicidae	*Culex pipiens* L. £	mosquito	H
		-	5 unidentified morphospecies δ ϕ £	dipteran	V
	Lepidoptera	Crambidae	*Omiodes* (*Hedylepta*) *indicata* (Fab.) δ	Bean-leaf webworm moth	F
		-	4 unidentified morphospecies δ	Butterflies	V
		Noctuidae	3 unidentified morphospecies δ	Moths	F
			1 unidentified morphospecie ϕ £	Lepidopteran larvae	F
	Coleoptera	Chrysomelidae	*Diabrotica* sp. δ ϕ £	Cucurbit beetle	F
			Colaspis brunnea (Fab.) ϕ £	Leaf beetle	F
			Deloyala guttata (Oliver) δ ϕ £	Mottled tortoise beetle	F
			Oedionychus pictus (Fab.) ϕ £	beetle	F
			Diachus auratus (Fab.) δ ϕ £	Bronze leaf beetle	F
			Epitrix sp. δ ϕ £	Flea beetle	F
			Typophorus nigritus F. δ ϕ	Sweetpotato leaf beetle	F
			Cryptocephalus viridipennis Suffrian δ ϕ	Leaf beetle	F
			Anisostena cyanoptera Suffrian δ ϕ	Leaf beetle	F
		Curculionidae	*Centrinaspis* sp. ϕ	Leaf beetle	F
		Coccinellidae	*Brachiacantha bistripustulata* Fab. δ ϕ	Ladybug	B
			Chilocorus cacti Lδ ϕ	Ladybug	B
			Cycloneda sanguinea limbifer Casey δ ϕ	Ladybug	B
		Lycidae	*Thonalmus suavis* Duval ϕ	Net-winged beetle	F
		-	1 unidentified morphospecie ϕ	Little black beetle	F
	Hymenoptera	Apididae	*Apis mellifera* L. δ	Bees	V
		Ichneumonidae	*Ophion* sp. δ ϕ £	Ichneumonid wasp	B
			Coccygomimus rufoniger (Cresson) δ	Wasp	B
		Chalcididae	*Brachymeria robusta* Alayo y Hernández δ	Chalcid wasp	B
			Conura (*Spilochalcis*) *femorata* Fab. δ	Chalcid wasp	B
			2 unidentified morphospecies δ	Chalcid wasp	B
		Formicidae	*Wasmannia auropunctata* (L.) δ ϕ £	Little fire ants	B
			Paratrechina longicornis Latreille δ ϕ £	Crazy ant	V
		Vespidae	2 unidentified morphospecies δ	Wasps	B
	Orthoptera	Tettigonidae	*Conocephalus cuspidatus* (Scud.) ϕ £	Long-horned grasshopper	F
			Conocephalus sp. ϕ £	Conehead	F
		-	1 unidentified morphospecie ϕ £	Grasshopper	F
	Neuroptera	Chrysopidae	*Chrysopa* sp. δ	Green lacewing	B
	Dermaptera	Forficulidae	*Doru taeniatum* (Dohr.) δ	Earwig	B
	Thysanoptera	Thripidae	1 unidentified morphospecie ϕ £	Trip	F
	Blattodea	Blattidae	*Periplaneta americana* L. ϕ £	Cockroach	O
Malacostraca	Isopoda	Armadillidae	*Armadillidium vulgare* (Latreille) ϕ £	Common pill woodlouse	F
Gastropoda	-	-	1 unidentified morphospecie δ ϕ £	Snail	F
Arachnida	Araneae	-	6 unidentified morphospecies δ ϕ £	Spiders	B
	Ixodida	Ixodidae	*Rhipicephalus* (*Boophilus*) *microplus* Canestrini δ ϕ £	Ticks	H

V- visitors F- phytophagous B- bioregulators H-hematophagous O- omnivores **δ** SSP-tithonia **ϕ** SSP-pasto **£** control (grasses)

Table 3. Performance of the arthopodfauna in each plant component, regarding richness and abundance of species, according to the sampling moment of the year

Plant component	Sampling moment	Orders	Species richness	Abundance	Percentage
SSP tithonia	January	6	15	221	52.49[a]
	May	7	15	86	20.42[c]
	September	7	16	114	27.07[b]
	SE and Signif.		±2.29 P<0.001		
	Total			**421**	**100**
SSP base grass	January	9	24	237	29.81[b]
	May	8	38	196	24.65[c]
	September	8	28	362	45.53[a]
	SE and Signif.		±1.67 P<0.001		
	Total			**795**	**100**
Control (grass)	January	8	24	274	20.01[b]
	May	9	29	215	15.70[c]
	September	8	34	880♦	64.28[a]
	SE and Signif.		±1.27 P<0.001		
	Total			**1,369**	**100**

a,b,c- Common letters in each plant component are not significantly different (p<0.05) (Duncan 1955)
♦- 530 species of Hortensia similis leafhopper in 880 total individuals

herbivores prefer them to old leaves with greater resistance due to the accumulation of structural compounds (Rusman *et al.* 2020). However, recent research carried out in Yucatán, Mexico, by Ruiz-Santiago *et al.* (2023) evaluated the influence of plant and leaf age on foliar characteristics and its relationship with defoliation caused by herbivorous insects in three forage species (*Tithonia diversifolia*, *Morus alba* and *Moringa oleifera*). Results showed that there is more defoliation in old and intermediate leaves compared to young leaves in *T. diversifolia*. In relation to age, defoliation was significant in plants with 60 d. Studies by Ambrósio *et al.* (2008) attribute the relationship between herbivory and the antifeedant activity manifested by *Tithonia diversifolia* to the presence of trichomes on its leaves with a high load of secondary metabolites, which prevents its action by exerting antimicrobial defense.

A strong attack of leafhoppers occurred in this control area in September, in which the climatic conditions were favorable for its appearance with dominance of *Hortensia similis*. Out of the 880 total collected insects, 530 corresponded to this specimen alone, associated with the prairie grasses present in said area (star grass and natural grasses). However, these high population levels of phytophagous insects, with a biting-sucking habit, were not frequent over time, and it is possible that the presence of the beneficial fauna associated with SSPs has also prevented populations from increasing and economic damages.

Studies by Ramírez-Barajas *et al.* (2019) highlighted the role of trees and shrubs in creating these refuge sites, microclimates and suitable habitats so that a greater number of organisms, such as insects, can coexist. However, many other groups of living beings can also coexist in functional biodiversity: birds, reptiles, mammals, amphibians and mollusks, which, together with the presence of cattle, which constitute the main animal component in the SSP, actively participate in the agroforestry dynamics. That is why these systems are granted greater connectivity with natural ecosystems with respect to conventional ones with single-crop pastures, which in turn suggests ideas for the integration between livestock production and biodiversity conservation (Harvey *et al.* 2004). Something similar occurs with agroecosystems composed of polycultures (García-González *et al.* 2022), which host greater diversity of insects with higher proportions of beneficial fauna. Studies by Ruiz *et al.* (2023b) highlighted the importance of the tree component in the benefits provided by the silvopastoral system.

The insects collected in the experimental area during the evaluated period, which reached the category of frequent, according to the used scale (≥ 10 ≤ 29), were from the orders Hemiptera (*Empoasca* sp., *Hortensia similis* and *Draeculacephala cubana*), Diptera (two unidentified morphospecies), Orthoptera (*Caulopsis cuspidatus*) and the order Hymenoptera (*Paratrechina longicornis* and *Wasmannia auropunctata*). The order Araneae (two unidentified morphospecies) also stood out from the class Arachnida. The rest of the collected specimens were in the low frequent range (< 10). None reached the category of very frequent. Even in this period, the leaf pecker (*Omiodes indicata*) could be seen, which, although it has been recorded with a preference for protein crops (Valenciaga *et al.* 2018), population levels in this study were minimal. Therefore, the lesions found did not exceed slight damage, so their intensity and distribution were not determined, as there was no economic damage to the crop.

In the silvopastoral system, *Tithonia diversifolia* remains as plant tolerant to the attack of harmful organisms. In this period, practically no presence or incidence of the chrysomelid complex was observed. Only *Colaspis brunnea* and *Deloyola guttata* were little frequent, both collected in the base pasture. In January, the cattle tick *Rhipicephalus* (*Boophilus*) *microplus* appeared, although with low frequency, and mainly associated with grass, in the base pasture of the SSP as in the control area. *R. microplus* is known to be a single-host tick, which spends all of its life stages on the same animal, sucking blood. The female of this organism in its adult phase falls to the ground where it lays eggs. Therefore, the eggs are said to hatch in the environment and the newly hatched larvae crawl across grass or other plants to find a host (CFSPH 2007, Alonso-Díaz and Fernández-Salas 2022). This justifies finding tick larvae or first instars in the collected samples. Added to this is that there are currently deficiencies in the implementation of the Gavac vaccine in Cuba, which, together with a comprehensive control program that accompanied it, keeps this organism regulated at non-harmful levels. Results on the demonstrated tolerance coincided with studies by Medina *et al*. (2009), who determined a low appearance value of tithonia pests and diseases under nursery conditions. These authors stated that the plant resistance is excellent, which they attribute to the insecticidal or anti-food action exerted by the secondary metabolites that make up said plant.

Conclusions

The study of the entomofauna in the evaluated areas confirms the importance of the tree component in the agroecosystem, in this case the SSP with tithonia and base grass, by confirming that the system manages to maintain a biological balance of phytophagous, visitor and bioregulatory species over time, without causing economic damage to the associated plant components. Therefore, it is recommended to maintain phytosanitary surveillance in these areas by promoting increasingly diverse and resilient systems. in order to contribute to the comprehensive management of the agroecosystem.

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