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NOTE

Analysis of the composition of thrips (Insecta: Thysanoptera) in spontaneous vegetation and crops associated with peanut in Argentina

Análisis de la composición de trips (Insecta: Thysanoptera) en vegetación espontánea y cultivada asociadas a maní en Argentina

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ABSTRACT

Peanuts (*Arachis hypogaea* L.) are a crop from tropical and subtropical regions. Argentina is a significant producer and exporter, with the province of Córdoba concentrating *ca.* 84% of the peanut-cultivated area in the country. Thrips pose a threat to the crop by causing direct damage through feeding and indirect damage as vectors of orthotospoviruses. Despite the importance of these insects and the crop, little is known about the diversity of thrips in the vegetation surrounding peanut crops in Córdoba province. The aim of this study was to expand knowledge on thrips diversity in the plant environment around peanut crops in fields located in Río Primero, Río Segundo and General Roca counties (Córdoba, Argentina). Sampling was conducted during the 2021-2022 growing season. The adult thrips were collected from spontaneous plants and crops neighboring the peanut, and they were prepared and identified using specific keys. In 14 plant species, specimens of *Frankliniella schultzei* (Trybom), *Frankliniella gemina* Bagnall, *Caliothrips phaseoli* (Hood), *Frankliniella occidentalis* (Pergande), *Thrips tabaci* (Lindeman), *Frankliniella frumenti* Moulton, and *Arorathrips mexicanus* (Crawford) were recovered. Individuals from the genera *Heterothrips* and

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Hoplandrothrips were also collected. *Frankliniella schultzei* was the most frequent and abundant species. Spontaneous plants and soybean crops contained thrips species able to transmit orthotospovirus. This study reports for the first time the presence of *F. schultzei* in *Gomphrena pulchella*, as well as the first documentation of thrips diversity and their association with spontaneous vegetation in peanut fields in the province of Córdoba.

Keywords: *Arachis hypogaea*, biodiversity, Córdoba, corn, soybean.

RESUMEN

El maní (*Arachis hypogaea* L.) es un cultivo de regiones tropicales y subtropicales. Argentina es un productor y exportador significativo; la provincia de Córdoba concentra alrededor del 84% de la superficie sembrada. Los trips representan una amenaza para el cultivo causando daños directos por alimentación e indirectos como transmisores de orthotospovirus. A pesar de la importancia de estos insectos y del cultivo, poco se conoce sobre la diversidad de trips en la vegetación circundante al cultivo de maní en la provincia de Córdoba. El objetivo de este trabajo fue ampliar el conocimiento sobre la diversidad de trips del entorno vegetal del cultivo de maní en campos ubicados en los departamentos Río Primero, Río Segundo y General Roca. Los muestreos se realizaron durante la campaña agrícola 2021-2022. Los trips adultos fueron recolectados de plantas espontáneas y cultivos vecinos al maní, y fueron preparados e identificados mediante claves específicas. En 14 especies vegetales, se recolectaron especímenes de *Frankliniella schultzei* (Trybom), *Frankliniella gemina* Bagnall, *Caliothrips phaseoli* (Hood), *Frankliniella occidentalis* (Pergande), *Thrips tabaci* (Lindeman), *Frankliniella frumenti* Moulton, *Arorathrips mexicanus* (Crawford), e individuos de los géneros *Heterothrips* y *Hoplandrothrips*. *Frankliniella schultzei* fue la especie más frecuente y abundante. Las plantas espontáneas y el cultivo de soja contenían especies de trips capaces de transmitir orthotospovirus. Este estudio informa por primera vez la presencia de *F. schultzei* en *Gomphrena pulchella*, además de dar a conocer, por primera vez, la diversidad de trips y su asociación con la vegetación espontánea en campos de maní de la provincia de Córdoba.

Palabras clave: *Arachis hypogaea*, biodiversidad, Córdoba, maíz, soja.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an annual plant cultivated in tropical and subtropical regions around the world. In Latin America, Argentina is the largest producer and the world's leading exporter, dominating the international market for high-quality edible peanuts (Food and Agriculture Organization of the United Nations [FAO] 2024). Nationally, the province of Córdoba is the primary production region, responsible for 84% of the cultivated area over the past decade (Secretaría de Agricultura, Ganadería, Pesca y Alimentos [SAGPyA] 2024).

Among the factors that limit peanut production, thrips (Thysanoptera) are widely recognized as significant pests of the crop. In Argentina, the most abundant thrips species in peanut are *Frankliniella schultzei* (Trybom) and *Caliothrips phaseoli* (Hood) (Boito, Ornaghi, Giuggia, Giovanini, 2006; de Breuil, et al. 2021b), while *Frankliniella occidentalis* (Pergande), *Frankliniella gemina* Bagnall, and *Thrips tabaci* (Lindeman) are less abundant or sporadic (de Breuil et al., 2015; 2021b). The lesions caused by the feeding of these insects include discoloration, silvering, bronzing, and leaf distortion, and when the infestation is severe, they can delay peanut maturity, reduce crop yield, and even cause plant death (Srinivasan et al., 2018). Besides the direct damage caused by feeding, some species also cause indirect damage by acting as vectors for viruses belonging to the genus *Orthotospovirus* (Riley, Joseph, Srinivasan, Diffie, 2011).

When addressing a management technique against thrips pests, it is necessary to consider the plant species that make up the spontaneous vegetation associated with the crop. These, in addition to competing with the crop for water, light, and nutrients, can be potential hosts for a wide diversity of insects, including thrips (Capinera, 2005). In the province of Córdoba (Argentina), several species of spontaneous plants have been reported in peanut cropping systems, with *Amaranthus spp*. currently being the most common and difficult to manage (Daita, Gerardo, Mulko, 2017; Peterson, Collavo, Ovejero, Shivrain, Walsh, 2018). In this context, spontaneous plants could potentially act as sources for the migration of thrips to the crops or offer beneficial effects by regulating pest populations (MacLaren, Storkey, Menegat, Metcalfe, Dehnen-Schmutz, 2020). At present, only the presence of *F. schultzei and F. occidentalis* inhabiting flowers of *Hirschfeldia incana* (L.) Lagr. Fossat (Brassicaceae) and *Ipomoea purpurea* (L.) Roth., (Convolvulaceae) growing within peanut fields in the province of Córdoba has been recorded (de Breuil et al., 2015). This study was conducted to expand knowledge about the diversity and abundance of thrips present in the surrounding environment of peanut crops in the province of Córdoba, to provide information to be applied in pest management plans.

MATERIALS AND METHODS

Study sites

The study was carried out in the province of Córdoba during the 2021-2022 growing season in peanut fields located in Río Primero, Río Segundo and General Roca counties.

A total of six peanut fields, three in the northern and three in the southern regions of the peanut-producing area, were selected to study the species of thrips present in spontaneous vegetation and neighboring crops associated with peanuts (Fig. 1).

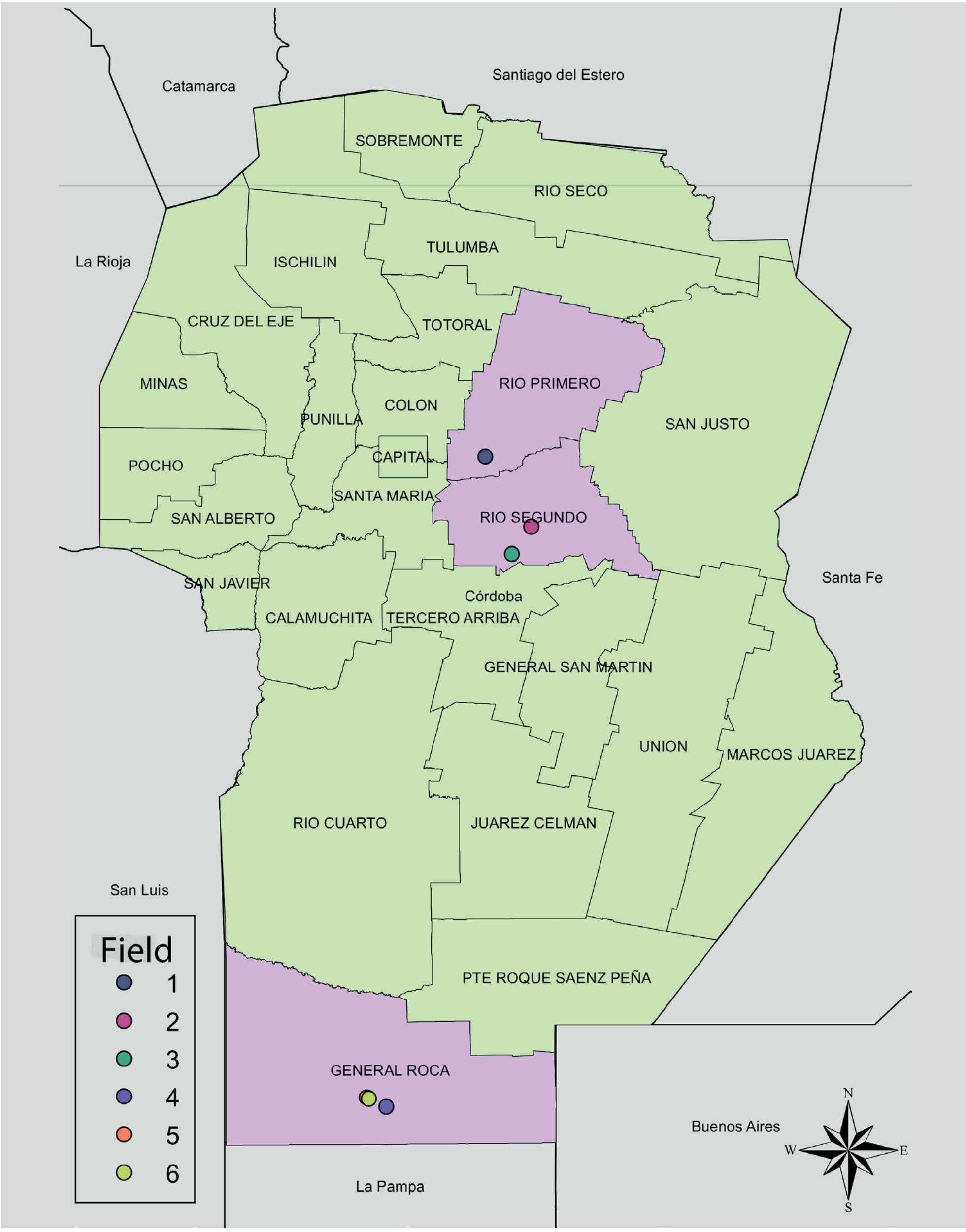

Figure 1. Geographic location of peanut fields sampled for Thysanoptera species in the province of Córdoba. ●1: -31.4177 -63.7530; ●2: -31.7825 -63.5122; ●3: -31.9261 -63.613742; ●4: -34.8131 -64.2692; ●5: -34.7674 – 64.3700; ●6: -34.7702 -64.3643.

Sampling and Identification of Thrips

Sampling was carried out between December 2021 and February 2022, covering the phenological stages of peanuts from V20 to R5 (Boote, 1982). Each peanut field was sampled four times, at intervals of 20 days approximately, depending on weather conditions. In each sampling date, the most abundant species forming the spontaneous vegetation within and/or on the edge of each peanut field were identified through visual observation. For each plant species, 5 plants were randomly selected, and each plant was shaken 10 times over a white container (28 cm long, 19 cm wide, 5 cm deep) moistened with 70% ethanol. Adult thrips were collected using a brush and transferred to tubes containing 70% ethanol. When the spontaneous vegetation bloomed, a sample consisting of 5 flowers per plant was extracted, which were then placed in tubes with 70% ethanol. Thrips were also collected from *Glycine max* (soybean) and *Zea mays* (corn) neighboring crops using the same shaking method described above.

The identification of adult thrips was carried out based on microscopic preparations following the techniques of Mound and Marullo (1996) and using the available keys (de Borbón and Zamar, 2018; Lima, O'Donnell, Miyasato, 2020; Mound and Marullo, 1996). Images of the thrips species were obtained using a NIKON Optiphot microscope with an integrated digital camera. The microscopic preparations are deposited at the Instituto de Patología Vegetal of the Centro de Investigaciones Agropecuarias of INTA (Córdoba province) and in the "Dra. Lilia Estela Neder" Entomological Collection of the Instituto de Biología de la Altura of the Universidad Nacional de Jujuy.

RESULTS AND DISCUSSION

During the sampling period, 901 adult Thysanoptera were collected. Of these, 660 were obtained from shaking 12 species of spontaneous plants distributed across nine families, in addition to soybean and corn, and 241 were collected from flowers of spontaneous plants in the peanut crop environment in the province of Córdoba (Tables 1 and 2). The diversity of thrips included seven species of Thripidae, one of Heterothripidae, and one of Phlaeothripidae (Table 1). Among those in Thripidae, *F. schultzei* (Fig. 2a) was the most abundant thrips species, constituting 52.50% of the total abundance, followed by *F. gemina* (Fig. 2e) with 15.76%, *C. phaseoli* (Fig. 2c) with 13.21%, and *F. occidentalis* (Fig. 2b) with only 7.44%. Together, these four species accounted for more than 90% of the adult thrips collected. On the other hand, a few individuals of *Heterothrips* sp., *T. tabaci* (Fig. 2d), *Hoplandrothrips* sp., *Frankliniella frumenti* (Fig. 2f), and *Arorathrips mexicanus* (Fig. 2g) were also collected, but they did not exceed 7% of total abundance.

During the growth of peanuts, adult thrips were found in the 14 species of plants studied, with varying levels of abundance (Table 2). *Frankliniella*

Table 1. Analysis of the composition of thrips (Insecta: Thysanoptera) in spontaneous and cultivated vegetation associated with peanuts in Córdoba (Argentina) with two sampling methods, between December 2021 and February 2022.

Tabla 1. Análisis de la composición de trips (Insecta: Thysanoptera) en vegetación espontánea y cultivada asociadas a maní en Córdoba (Argentina) con dos métodos de muestreos, entre diciembre de 2021 y febrero de 2022.

Suborder	Family	Species	Shaken plants	Flower samples	Total
Terebrantia	Thripidae	*Frankliniella schultzei* (Trybom)	400	73	473
		Frankliniella gemina Bagnall	71	71	142
		Caliothrips phaseoli (Hood)	102	17	119
		Frankliniella occidentalis (Pergande)	43	24	67
		Thrips tabaci Lindeman	9	10	19
		Arorathrips mexicanus (Crawford DL)	5	0	5
		Frankliniella frumenti Moulton	5	0	5
	Heterothripidae	*Heterothrips* sp.	22	40	62
Tubulifera	Phlaeothripidae	*Hoplandrothrips* sp.	3	6	9

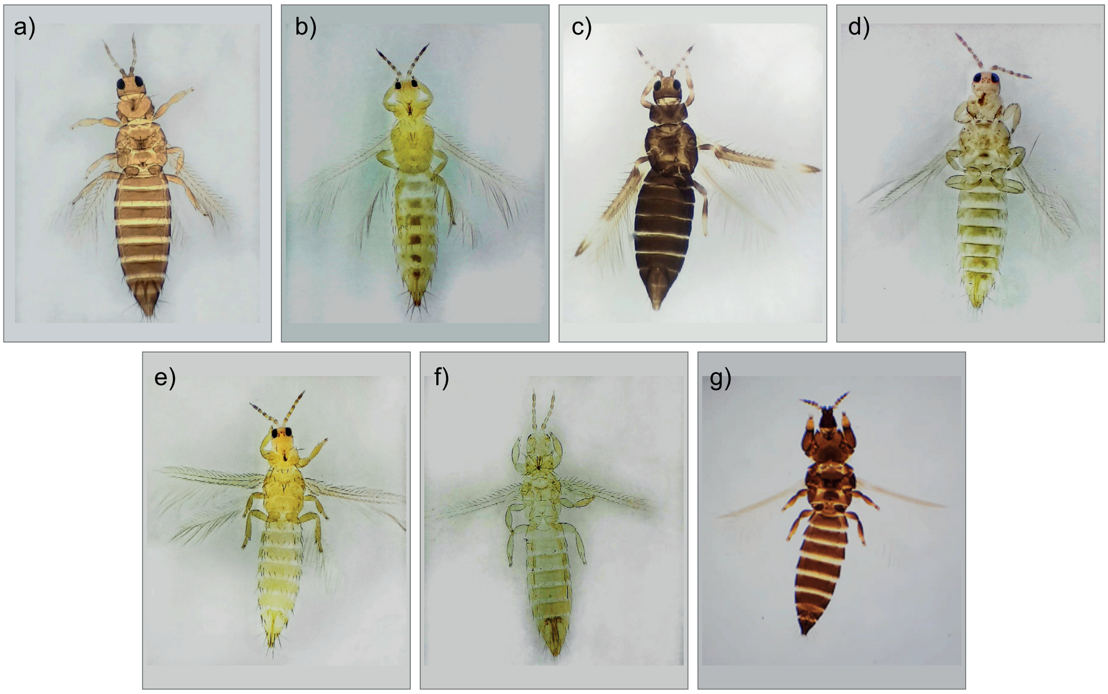

Figure 2. Thysanoptera species collected in the vegetation associated with peanut crops in Córdoba (Argentina): a) *Frankliniella schultzei*, b) *Frankliniella occidentalis*, c) *Caliothrips phaseoli*, d) *Thrips tabaci*, e) *Frankliniella gemina*, f) *Frankliniella frumenti*, g) *Arorathrips mexicanus*.

schultzei, *F. gemina*, and *F. occidentalis* were found in 12, 11, and 8 plant species, respectively, demonstrating their polyphagous habits (Zamar, 2011; de Borbón, 2013; Cavalleri et al., 2018). These species are also considered important pests in various crops, not only due to the damage caused by feeding but also because they are vectors of orthotospoviruses (de Borbón, Gracia, Piccolo, 2006; de Borbón, 2013). They could be responsible for the presence of *Orthotospovirus arachianuli* (groundnut ringspot virus - GRSV), an orthotospovirus that sporadically reaches high incidence levels

Table 2. Abundance of Thysanoptera species by plant species sampled in the surroundings of peanut crops in the province of Córdoba (Argentina) between December 2021 and February 2022.

Tabla 2. Abundancia de especies de Thysanoptera en las especies vegetales evaluadas en el entorno de cultivos de maní en la provincia de Córdoba (Argentina) entre diciembre de 2021 y febrero de 2022.

Spontaneous plants and crops	Thysanoptera										
Genus or Species (Family)	*F. schultzei*	*F. gemina*	*F. occidentalis*	*F. frumenti*	*T. tabaci*	*C. phaseoli*	*A. mexicanus*	*Heterothrips* sp.	*Hoplandrothrips* sp.	Total species	Total abundance
Amaranthus sp. (Amaranthaceae)	37	20	9	1	---	1	3	2	---	7	73
Bassia scoparia (Chenopodiaceae)	12	---	---	---	---	---	2	---	---	2	14
Borreria spinosa (Rubiaceae)	12	26	4	---	---	---	---	6	---	4	48
Commelina erecta (Commelinaceae)	24	1	---	---	2	---	---	---	---	3	27
Conyza bonariensis (Asteraceae)	5	22	---	---	1	---	---	7	---	4	35
Datura ferox (Solanaceae)	---	1	---	---	---	---	---	---	---	1	1
Glycine max (Fabaceae)	121	3	14	1	2	105	---	---	---	6	246
Gomphrena pulchella (Amaranthaceae)	120	19	21	---	---	4	---	18	9	6	191
Heterotheca latifolia (Asteraceae)	5	---	---	---	---	---	---	---	---	1	5
Oxalis corniculata (Oxalidaceae)	2	2	---	---	---	---	---	1	---	3	5
Rapistrum rugosum (Brassicaceae)	---	21	16	---	8	---	---	---	---	3	45
Senecio sp. (Asteraceae)	78	---	1	---	3	---	---	---	---	3	82
Sorghum halepense (Poaceae)	47	21	1	3	1	9	---	24	---	7	106
Zea mays (Poaceae)	10	6	1	---	2	---	---	4	---	5	23
Total number of plants per thrips species	**12**	**11**	**8**	**3**	**7**	**4**	**2**	**7**	**1**		
Total abundance of thrips	**473**	**142**	**67**	**5**	**19**	**119**	**5**	**62**	**9**		**901**

in peanut crops in the main production area of the country (de Breuil et al., 2021a). Soybeans have been reported as a host for both *F. schultzei* and GRSV (López Lambertini and Fiorona, 2008), which could influence the incidence of this thrips species and the viral disease in peanut crops.

Adult thrips of *F. gemina* and *F. occidentalis* were also collected from nine and six spontaneous plants, respectively, in addition to soybean and corn. It is important to note that in peanut crops in Córdoba, these thrips species were considered accidental (de Breuil et al., 2021b), suggesting that adults of these species likely prefer to inhabit spontaneous vegetation rather than peanuts. On the other hand, Riley (2018) indicated that the removal of spontaneous vegetation favors the dispersal of thrips towards crops. Based on this information, it could be feasible that spontaneous vegetation may act as a sink for thrips, then its monitoring could be used in assessing the risks associated with orthotospovirus vectors, as suggested by Carrizo and Amela García (2019). Among such plant species, *Gomphrena pulchella*, a summer perennial weed tolerant to glyphosate, should be specially considered as it is an attractive plant for *F. schultzei*, one of the most abundant thrips species present in the peanut crop environment, making worthy to perform studies to evaluate its usefulness for an integrated pest management program for peanuts.

Caliothrips phaseoli was mainly present in soybeans and three other spontaneous plants but with few individuals (Table 2). This species has been reported to cause severe damage to various Fabaceae plants, including peanuts, making both crops serve as feeding hosts (Boscardin et al., 2019; de Breuil et al., 2021b). However, it has been reported that *C. phaseoli* can become a facultative predator of mite eggs under laboratory conditions (Villagran-Mancilla et al., 2023). Since mite is a relevant pest in peanuts, such predator behavior deserves to be more studied. Other species such as *F. occidentalis, F. schultzei,* and *T. tabaci* also combine phytophagous and predatory habits, being capable of feeding on leaves, flowers, and as facultative predators (Morse and Hoddle, 2006).

Thrips tabaci was recorded on seven plant species, including soybean and corn. Its frequency in the studied vegetation was low, consistent with previous findings in peanut crops grown in Córdoba, Argentina (de Breuil et al., 2021b). This thrips species is globally distributed and infests a wide range of host plants. Additionally, it has been identified as a vector of tomato spotted wilt virus (TSWV), a significant orthotospovirus affecting peanut crops (Rotenberg, Jacobson, Schneweis, Whitfield, 2015; Srinivasan et al., 2018). However, de Borbón et al. (2006) failed to transmit TSWV using local populations of *T. tabaci*, indicating that further research is needed to clarify the role of this species in orthotospovirus transmission.

Frankliniella frumenti and *A. mexicanus* inhabit various grasses (Zamar, 2011), although in the present study, a few individuals were accidentally found in *Amaranthus sp*., *G. max* and *Bassia scoparia* (Table 2).

Heterothrips species feed and reproduce on flowers and presumably exhibit a high level of host specificity (Mound, 1996). In this study, specimens of one species were found on the foliage of seven of the plants studied, although they were more numerous on *G. pulchella* and *Sorghum halepense* (Tables 1 and 2).

Among the Phlaeothripidae, a species of Hoplandrothrips was identified. This genus includes thrips species that feed on fungal hyphae on fallen branches (Mound and Tree, 2013). The presence of this species could be associated with the leaf litter accumulated at the base of the plants that make up the spontaneous vegetation in the surrounding environment.

The mere presence of adult thrips on a plant does not necessarily indicate a biological significative interaction between the thrips and the plant. This is particularly relevant for thrips species that serve as vectors for orthotospoviruses, as transmission is only possible when the virus is acquired during the larval stages (Rotenberg et al., 2015).

In agricultural contexts where the incidence of orthotospoviruses is significant, such as in peanut cropping systems, research involving collections of both adults and larvae from vegetation neighbouring the crop is mandatory. The results achieved in this study represent a starting point for understanding the role of the plants identified as hosts for feeding, mating, or oviposition of thrips, as well as their ability to act as virus reservoirs.

CONCLUSIONS

This is the first study conducted on the Thysanoptera fauna in spontaneous vegetation associated with peanut crops in Córdoba, Argentina. The set of spontaneous plants and crops associated within the peanut cropping system in the studied region supports populations of adult thrips that are vectors of orthotospoviruses affecting peanut crops. The most abundant vector species was *F. schultzei*, followed by *F. gemina* and *F. occidentalis*. These thrips species were also found on soybean. Since peanut and soybean share the same planting area and growth cycle, both crops may contribute to the occurrence of orthotospoviruses in the region. Therefore, these crops should be considered as an interconnected system for pest management. Additionally, this study reports *F. schultzei* on *Gomphrena pulchella* for the first time.

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CONFLICT OF INTEREST

The authors declare no potential conflicts of interest.

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