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RESEARCH ARTICLE

THRIPS SPECIES (THYSANOPTERA: THRIPIDAE) ASSOCIATED WITH WATERMELON CROPS IN CENTRAL BRAZIL

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ABSTRACT

Infestations of virus vector insects have caused a significant increase in the production cost of watermelon (*Citrullus lanatus*). However, the lack of knowledge about these species, especially of thrips associated with the crop, difficult the establishment of management strategies. Thus, this study aimed to identify the trips species associated with watermelon crop in the state of Tocantins, in Central Brazil. Thrips specimens were collected in four municipalities during the harvests of 2013 and 2014, mounted in permanent microscope slides and identified following taxonomic key. Out of the 1.569 thrips species three species were identified: 76.9% corresponds to *Frankliniella schultzei* (76.9%), *F. tritici* (22.7%) and *F. insularis* (0.4%). *F. schultzei* is the most abundant speciesin watermelon crops in the state, with preference to the apical branches and flowers, while *F. insularis*, was identified only in the Formoso do Araguaia municipality. The identification of these thrips species provides the basis to control these insects.

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INTRODUCTION

With planted area of 9,123 hectares and production of 185,893 tons (IBGE, 2014), the watermelon culture (*Citrullus lanatus*) has significant share in the fruit production agribusiness in the state of Tocantins, where it is grown predominantly by major producers in the region of floodplains and small producers in other regions (IBGE, 2014). In all growing areas, regardless of the adopted production system, the attack of insect pests, especially those vectors of plant viruses, has been intense throughout the crop cycle, causing considerable increase in the costs and limiting fruit production. It is noteworthy that the occurrence of virus is a major problem in the watermelon cultivation in natural conditions (Leão *et al*., 2014). Among the pests of watermelon, thrips (Thysanoptera: Thripidae) has demanded great management efforts by producers. They are small insects, ranging from 1.0 mm to 2.0 mm long, with fingers wings and asymmetrical sucking mouthparts (Hoddle *et al*., 2012) that have a dispersive behavior on demand of the host plant species which is facilitated by the action of wind (Kirk, 1997). Phytophagous thrips are found in all plant parts, especially on leaves and flowers, with preference for young parts. Due to feeding on the plant tissue, it causes direct damages by cell destruction or indirect consequences by virus vectoring (Kirk, 1997; Souza *et al*., 2010). In Brazil, *Groundnut ringspot virus*, vectored by a thrips species, occurs in watermelon crops (Leão *et al*., 2014). In Brazil 556 species are known (Monteiro & Lima, 2011; Lima, 2016), however, there are few records of this diversity of insects associated with watermelon culture in the country and also in Tocantins State. As the identification of the infesting pest species provides the basis to the use of integrated control practices, this study aimed to identify the thrips species associated with watermelon crop in the state of Tocantins.

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MATERIALS AND METHODS

Surveys: Thrips specimens were collected in the months of June, August and October 2013 and 2014, in commercial watermelon crops in the municipalities of Gurupi (latitude 11 43 '45' 'S and longitude 49 04' 07 " W), Formoso do Araguaia (latitude 11º 47 '48 "S and longitude 49º 31' 44" W), Lagoa da

Confusão (latitude 10º 47 '37 "S and longitude 49º 37' 25" W) and Porto Nacional (latitude: 10º 42 '29 " S and longitude 48º 25 '02 "W) (Figure 1), according to the methodology described by WAQUIL *et al*. (1986).

gently massaged to expel the contents of the body. In sequence, legs, antennae and wings were distended. Following, the thrips were transferred to a Petri dish containing distilled water to which 50% Ethanol was gradually added.

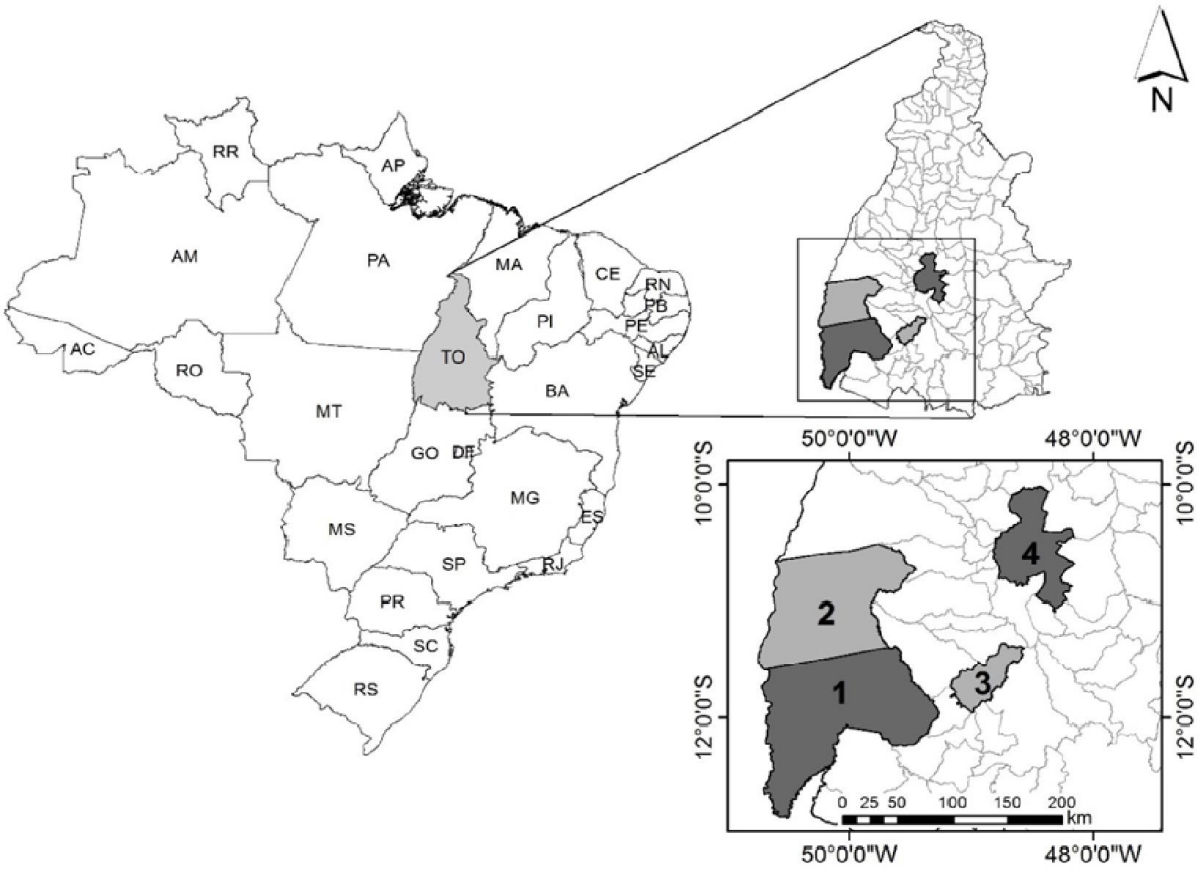


Figure 1. Collection areas of the thrips species in commercial plantations and location of the municipalities in Tocantins State: (1) Formoso do Araguaia; (2) Lagoa da Confusão; (3) Gurupi e (4) Porto Nacional. Gurupi - TO, 2015

Table 1. Number of thrips adults collected in commercial plantations of watermelon in the municipalities of Tocantins State

Thrips species	Specimens / Municipalities			
	Gurupi	Formoso do Araguaia	Lagoa da Confusão	Porto Nacional
F. schultzei	245	289	439	233
F. tritici	27	135	49	146
F. insularis	-	6	-	-
Total	272	430	488	379

Branches and buds samples were taken from watermelon plants with insect and were processed in the Integrated Pest Management Laboratory at the Federal University of Tocantins (UFT) - Campus of Gurupi. The adult thrips were placed in a freezer at -5 ° C for 5 minutes and then quantified by municipalities and stored in Eppendorf tubes containing 60% alcohol. The identification was performed at the Arthropod Bioecology and Systematics Laboratory of the Federal University of Piauí (UFPI) - Campus Amílcar Ferreira Sobral, in Floriano - PI.

Specimens preparation

Microscope slides were prepared according to MONTEIRO (1994). Initially, thirty insects were placed in a Petri dish (80x15mm) containing 60% ethanol and stored for 24 hours. Individuals were transferred to watch glasses containing sodium hydroxide (NaOH) 5% for over 4 hours. During this period, the insect abdomen was punctured between the posterior coxae with a fine needle, and then the specimen was

The insects were then transferred to another Petri dish with 60% ethanol and stored for 24 hours. Subsequently, the specimens were dehydrated Petri dishes containing different solutions for different time intervals: 70% ethanol for 60 minutes; 80% ethanol for 20 minutes; 90% ethanol for 10 minutes; 96% ethanol for 5 minutes; 96% ethanol for 5 minutes; and clove oil for 30 to 60 minutes prior to mounting.

Slide preparation

The slides were prepared under stereomicroscope through the following steps: (i) a cover slip was placed on the stereomicroscope; (ii) a Canada balsam drop was placed on the center of the cover slip, where then one thrips was put in ventral position; (iii) antennae, wings and legs of the specimens were stretched with the fine needle; (iv) a slide was lowered over the specimen on the cover slip; and (v) when the slide touched the cover slip, the preparation was turned up. After these steps, the material was placed in an oven at an average temperature of 40 ^{o}C to dry for about one week before

the identification of the specimens. The slides received two labels – one with the collection data (right) and another with the identification (left).

Identifications

The identification was performed by means of the keys available in MOUND & KIBBY (1998), LIMA (2011) and MONTEIRO *et al*. (2001). We also proposed one key to the thrips species collected in our survey to facilitate the identification of these insects in the watermelon crops of the region.

distributed on all continents and found mainly in tropical climates, with probable center of origin in South America (hoddle *et al*., 2012). This species is polyphagous, with records in Brazil in several crop plants and weeds (Lima *et al*, 2013; Lima *et al*., 2000). In watermelon, it has economic importance for causing direct damages, while feeding on the plant tissue, and indirect damages caused by virus transmission (Leão *et al*., 2014). According to the report of Nagata *et al*. (2002), *F. schultzei*, has a high affinity in the transmission of viruses *Groundnut ringspot virus* (GRSV), with 93% in transmissibility of scallion plants.

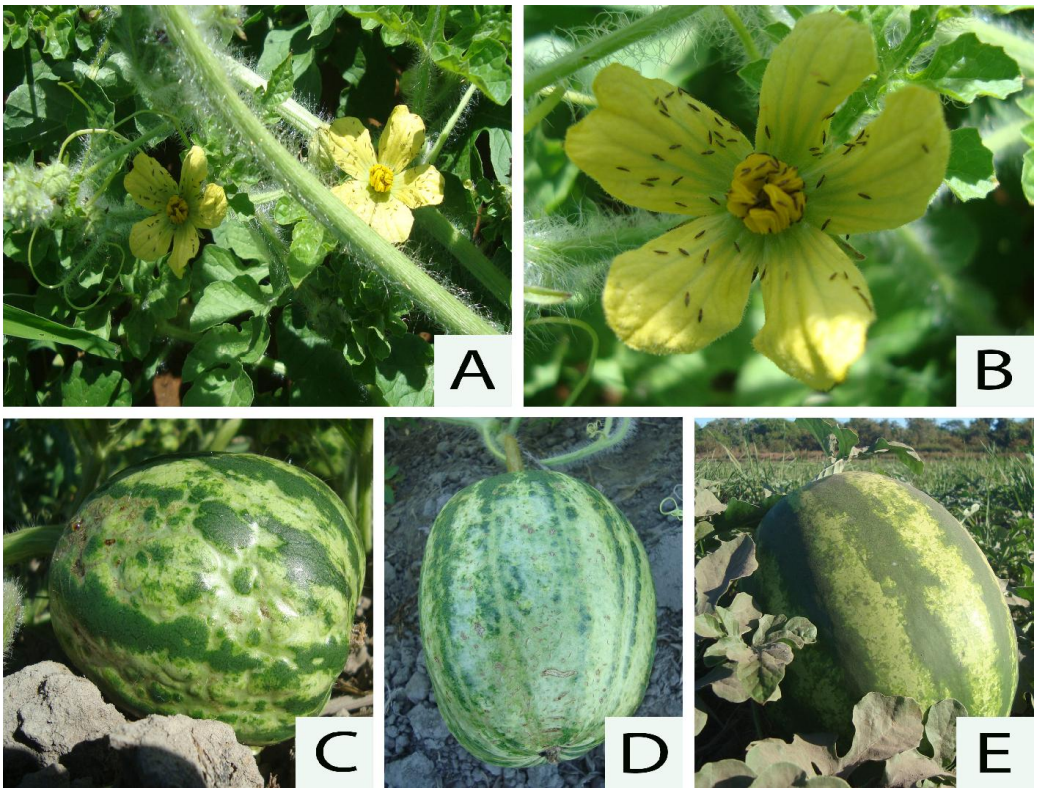


Figure 2 - Thrips infestation in watermelon flowers in commercial plantation in the municipality of Porto Nacional/TO. (A and B) Watermelon flowers and branches with thrips, (C and D) fruit indirect damages caused by thrips at virus transmission and (E) watermelon fruit. Author photos

Table 2. Number of thrips collected at the flowers and apical branches of watermelon plants in the municipalities producers of Tocantins State

Municipalities producers of watermelon							
Lagoa da Confusão		Formoso do Araguaia		Porto Nacional		Gurupi	
Flowers	Apical Branches*	Flowers	Apical Branches	Flowers	Apical Branches	Flowers	Apical Branches
51±3,02	18±1,67	43±0.98	14±4.87	39±7.87	21±2.25	31±4.56	11±3.30
29±2,06	15±1,06	49±0.87	23±5.32	32±3.98	16±3.45	37±3.21	10±3.21
67±6,78	21±2.01	31±2.23	26±4.22	64±4.02	19±1.09	33±2.09	5±1.21
76±1,17	26±1,90	71±3.45	19±2.23	71±8.21	27±4.21	49±4.78	18±4.32
87±2,02	19±1,55	63±4.21	13±1.78	81±7.21	13±1.98	41±3.98	13±2.12
45±2.09	12±1,79	45±2.67	15±3.87	56±4.21	19±2.34	35±2.78	12±1.09
72±8,76	17±1,30	59±4.29	15±4.98	63±3.33	15±1.89	57±5.21	09±1.09
56±5,09	18±1,02	47±5.32	17±5.32	53±3.78	12±0.98	43±3.09	16±3.06
41±4,05	21±2,07	75±1.34	13±6,31	25±3.67	23±4.56	15±2.71	11±2.06
51±5,13	23±1,06	41±2.11	16±4,01	44±3.78	11±2.98	23±4,65	6±2.87
575**	190	524	171	528	176	364	111

*Apical branches.**Total of insects collected per tem samples in watermelon plants in the municipalities producers in Tocantins state. Average ± SD.

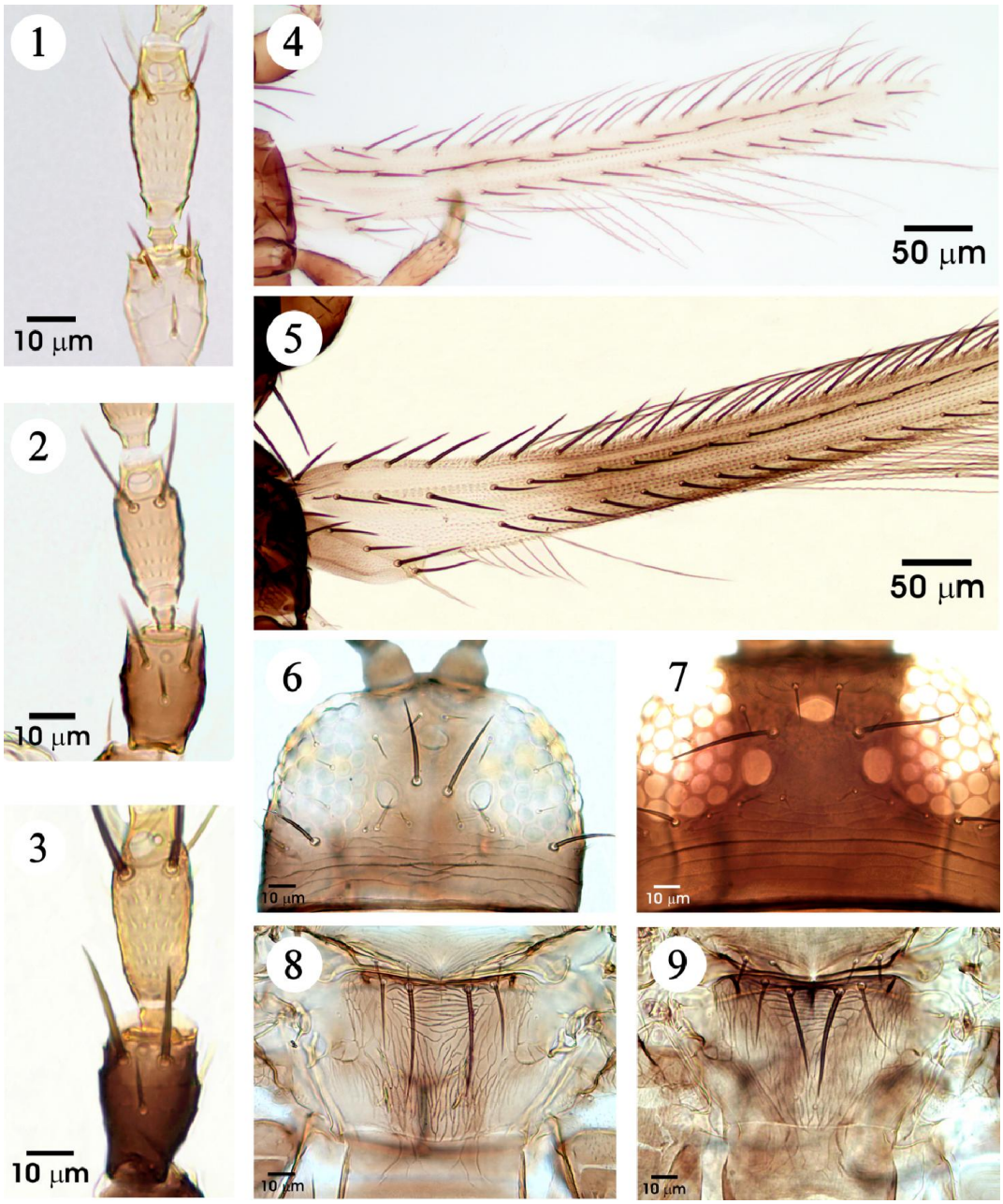
RESULTS AND DISCUSSION

Three thrips species were identified in the watermelon fields in the state of Tocantins: *Frankliniella schultzei* (Trybom, 1910), *Frankliniella tritici* (Fitch, 1855) and *Frankliniella insularis* (Franklin, 1908). Among these species, *F. schultzei* was the most abundant (Table 1). *F. schultzei* is an insect widely

Thus, this insect vector may be associated with the epidemic GRSV in watermelon crop fields. High populations occurred in the flowers, apical branches and fruit symptoms of the plants, in all samples (Figure 2A and 2B; Table 2) and indirect damages caused by virus transmission (Figure 2C and 2D). This high infestation of this species in flowers was also reported by COSTA *et al*. (2015), in a work in the state of Rio

Grande do Norte. The presence of insects in flowers may be related to the availability of food (pollen grain) or other exudates offered by the flowers to thrips in order to ensure resources for biological maintenance. It can also be related to the growing season, from May to September, characterized by low or no rainfall, characteristic of the region (Marcuzzo & Goularte, 2013).

cycle of thrips, ranging between 10 to 30 days. *F. tritici* was the second most abundant species, occurring in all municipalities. In Brazil there are records of *F. tritici* in peanut plants (*Arachis hypogaea*), soybean (*Glycine max*), pigeon pea (*Cajanus cajan*) and Lima beans (*Phaseolus lunatus*) (Lima *et al*., 2013), therefore this is the first report *F. tritici* in watermelon plants in Brazil.



Figures 3. 1-9 Morphological structures for the identification of the thrips species collected in watermelon crops in Tocantins state. Antennal segments II-III, 1. *Frankliniella tritici*, 2. *F. schultzei*, 3. *F. insularis*; Fore wing, 4. *F. schultzei*, 5. *F. insularis*; Head, 6. *F. schultzei*, 7. *F. insularis*; Metanotum, 8. *F. schultzei*, 9. *F. insulari*

On the other hand, thrips infestation may be associated with the yellow color of the flowers, as it isan attractive color to these insects (Figure 2A and 2B, Table 2). As reported by PAVAN *et al*. (1993), the intense yellow color of wild tomato flowers was found to be important for *F. schultzei* preferably for this kind of plant. As also observed by LIMA *et al*. (2000) in weed yellow coloring of flowers, there was a predominance of *F. schultzei*. Another factor related to the incidence of high populations can be intense temperatures recorded in the state, with variations from 16.6 to 38 ^{o}C (INMET, 2014). According to LEWIS (1997), the temperature directly influences the life

According to HODDLE *et al*. (2012), this species causes damages during feeding, particularly in roses. Regarding the presence of this species in Brazil, there are no reports on possible direct damages and/or indirect cultivated plants. The other identified species was *F. insularis*, commonly found in southern Central America, with presence in Mexico, Hawaii and Argentina (Hoddle *et al*., 2012). These authors also reported that *F. insularis* species is considered a secondary pest in pigeon pea crops and Mexican potatoes (*Pachyrhizus*) in Central America. In Brazil there are records of *F. insularis* presence in cowpea (*Vigna unguiculata*), pigeon pea and Lima

bean in the states of Maranhão and Piauí (Lima *et al*., 2013). However, the species is only known to cause damages on roses in Brazil (Lima *et al*., 2016). In watermelon crops, it is the first report of the occurrence of *F. insularis*. However, it was identified only in Formoso do Araguaia (Table 1).

As the following key is proposed for the identification of the thrips species that occur in watermelon crops on the state of Tocantins, Brazil:

1.Females yellow. Pedicel of theantennal segment III expanded (Figure 3.1)…….*Frankliniella tritici* Females brown. Pedicel of the antennal segment III simple (Figs.3.2 and 3.3)……..…2

2.Forewing uniformly yellowish brown (Fig. 3.4). Ocellar setae III between hind ocelli (Fig. 3.6). Metanotum without campaniform sensilla (Fig.3.8)……*F. schultzei*

3. Fore wing bicolored (basal fourth pale in contrast with brown three distal thirds) (Fig. 3.5). Ocellar setae III above hind ocelli (Fig. 3.7). Metanotum with campaniform sensilla (Fig. 3.9)…….*F. insularis*

Conclusions

Frankliniella schultzei is the most abundant thrips species in watermelon crops in the state of Tocantins, Brazil. *F. tritici* and *F. insularis* are first reported on the crop in the Country. The identification of these thrips species will facilitate the adoption of IPM in this culture.

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