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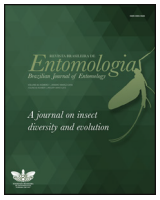

Do thrips (Insecta: Thysanoptera) cause economic damage to *Hancornia speciosa* Gomes fruits?

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ABSTRACT

The mangaba *Hancornia speciosa* Gomes (Apocynaceae) is more commercially viable than other native Cerrado fruit trees due to its nutritional properties and high production of fruit used in food products. Although thrips have been reported injuring mangaba, the identification of possible species of economic importance is not yet available. Thus, identifying species that may threaten mangaba plant health is a vital step in implementing management strategies. The aim of this present study was to survey thrips species during the reproductive stage of *H. speciosa*, determine the variety most susceptible to damage caused by these insects and to check whether the damage is economically important to this fruit tree. Thrips were collected from the *ex-situ* germplasm of the Agronomy School of the Federal University of Goiás, in Goiás state, Brazil. Twelve plants of three *H. speciosa* varieties (*gardneri*, *cuyabensis* and *pubescens*) were selected, from which 20 flowers and 20 fruits were assessed for the presence of thrips in September 2018 and 2019. A total of 1,306 thrips representing 13 species were collected from flowers. Of these, *Frankliniella gemina* was the most abundant. On the fruits, circular lesions were observed, initially as white spots that subsequently turned silver, possibly caused by *Heliothrips longisensibilis*. These injuries are superficial, rarely compromising large portions of the fruit, and do not cause economic damage. Therefore, thrips are not a primary threat to fruit production for fresh consumption or processing.

Introduction

The mangaba, *Hancornia speciosa* Gomes (Apocynaceae), is widely distributed in Brazil and stands out among other fruit trees in the Brazilian Cerrado for its high fruit production. Mangaba fruits are mainly obtained from extractivism, practiced by traditional peoples (Silva Júnior and Lédo, 2016). In Brazil, 1849 tons of mangaba were produced in 2022, with emphasis on the northeastern states of Paraíba, Sergipe and Bahia (IBGE, 2022). The fruits consumption usually occurs *in natura* or in juices, ice creams, jellies and others (Oliveira and Aloufa, 2021). Flowering occurs from June to November, and the fruits are harvested from October to December (Silva et al., 2001), although some production can be obtained off-season. Despite the food production potential of this fruit tree species, information on its management remains scarce (Pereira et al., 2010).

Reports of insects associated with mangaba suggest their occurrence primarily in nurseries (Pereira et al., 2010). The most abundant insects associated on mangaba plants are aphids and leafcutter ants (Vieira Neto et al., 2002), as well as scale insects (Silva et al., 2021), caterpillars, irapuá bees, stink bugs (Michereff Filho and Michereff, 2006) and gall midges (Maia et al., 2023). Mites are also reported, albeit less frequently (Silva et al., 2020).

In addition to these groups, a few thrips species native to the Neotropics are abundant in *H. speciosa*: *Coremothrips nubilicus* (Hood, 1954) and *Heliothrips longisensibilis* Xie, Mound and Zhang, 2019 are predominantly found on leaves (Silva et al., 2019), whereas *Frankliniella musaeperda* Hood, 1952 is usually found on flowers (Alves-Silva et al., 2013). *C. nubilicus* is endemic to Brazil and has no economic importance (Lima, 2023). *H. longisensibilis* is recorded from Argentina and Brazil and introduced to China, causing harm to a few crops (Lima et al., 2020, 2021). *F. musaeperda* is reported from Brazil, Haiti and Dominican Republic and can injury bananas (Hood, 1952; Lima, 2023).

Thrips are abundant in the dry season and cause direct damage to mangaba due to feeding and oviposition (Silva et al., 2019). Direct observations allowed to describe these injuries as white spots that subsequently turn silver. These lesions are frequently observed, but their relative importance to production remains unknown. In addition, the species that cause such damage has not yet been identified (Pereira et al., 2010).

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While studies have reported the presence of thrips on mangaba leaves and flowers, the relationship between these insects and the fruits is not yet understood. Thus, it is important to investigate whether mangaba varieties differ in terms of damage caused by thrips, and if thrips species associated with the leaves and flowers of these plants can also harm the fruits.

Given the potential of using *H. speciosa* in different industrial products or consuming its fresh fruit, studying the species associated with the reproductive parts of the plant and characterize the damage they cause is important. As such, this study aimed to survey the thrips population during the reproductive stage of *H. speciosa* and describe the damage that these insects cause to mangaba fruits.

Material and methods

Thrips were collected from the *ex-situ* germplasm of the Agronomy School (16º 35' 39'' S and 49° 17' 07'' W, altitude of 733 m) of the Federal University of Goiás, in Goiás state, Brazil. A randomized block design was used, with four repetitions and four *H. speciosa* varieties (*speciosa*, *cuyabensis*, *gardneri* and *pubescens*).

In order to assess thrips species associated with mangaba fruits and flowers, twelve plants of three varieties (*gardneri*, *cuyabensis* and *pubescens*) were selected. The variety *speciosa* was excluded from the study due to the small number of fruits and flowers during the assessment period. Collections were carried out during the reproductive stage of mangaba in September (full bloom) 2018 and 2019. For each plant, 20 flowers were collected and 20 fruits were assessed for lesions and thrips specimens. The specimens collected were mounted on permanent microscope slides, according to the methodology described by Monteiro (1994), and identified using the identification keys proposed by Mound and Marullo (1996) and Cavalleri and Mound (2012). Voucher specimens are deposited in the Natural History Collection of the Federal University of Piauí, Floriano, Brazil.

Lesions were visually assessed on fruits of the same age (peak fruiting for the different varieties) in October 2018 and 2019. The fruits were classified on a scale of 1 to 5, based on Goane et al. (2013), according to the level of damage, where 1 indicates no damage, 2 mild damage, 3 moderate, 4 severe, and 5 very severe (Fig. 1).

Statistical analysis

A generalized linear mixed model (GLMM) with Gaussian distribution was used to assess thrips-related damage on fruits. Average fruit damage was used as a response variable, variety as a predictor variable for fixed effects, and plot and collection year as random effects variables. The analyses were performed using the lme4 package of R 4.0.2 software (Bates et al., 2015). The residuals obtained were checked for compliance with the assumptions of analysis of variance (ANOVA) using the Lilliefors and Levene's tests, and then submitted to ANOVA via Tukey's test, with Bioestat® software.

Results and discussion

A total of 1,306 thrips specimens were found on *H. speciosa* flowers (Table 1), belonging to the families Thripidae and Phlaeothripidae (Table 1). The variety *gardneri* exhibited the largest thrips population (p=0.039) (43.93%), followed by *cuyabensis* and *pubescens* (Fig. 2).

Thirteen thrips species were identified on mangaba flowers, of which the most abundant were *Frankliniella gemina* Bagnall, 1919 and *F. gardeniae* Moulton, 1948 (Table 1). *Frankliniella* species (Fig. 3B) are commonly associated with flowers of several hosts (Cavalleri et al., 2018), and were the predominant group surveyed. This contrasts with the most abundant thrips species on leaves, *C. nubilicus* (Silva et al., 2019).

Most of the *Frankliniella* species identified in the present study were previously reported in the Cerrado biome in different hosts (Lima,

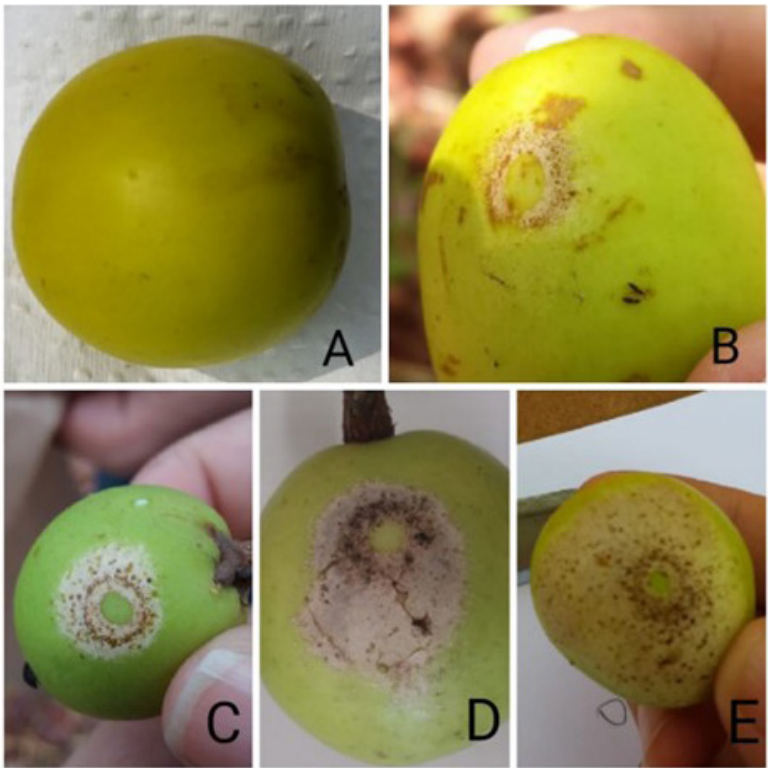

Figure 1 *Hancornia speciosa* fruits with damage caused by Thysanoptera. A- no damage, B- mild damage, C- moderate damage, D- severe damage and E- very severe damage.

Table 1
Thrips associated with the flowers of *Hancornia speciosa* varieties from the *ex-situ* germplasm collection of the School of Agronomy – Federal University of Goiás, Goiânia, in 2018 and 2019.

Family	Species	2018	2019	Total
Phlaeothripidae	*Haplothrips gowdeyi* (Franklin, 1908)	1	7	8
Thripidade	*Coremothrips nubilicus* (Hood, 1954)	2	0	2
	Frankliniella brevicaulis Hood, 1937	0	1	1
	Frankliniella gardeniae Moulton, 1848	249	161	410
	Frankliniella gemina Bagnall, 1919	377	144	521
	Frankliniella insularis (Franklin, 1908)	3	13	16
	Frankliniella musaeperda Hood, 1952	36	25	61
	Frankliniella serrata Moulton, 1933	0	1	1
	Frankliniella schultzei (Trybom, 1910)	0	1	1
	Frankliniella tritici (Fitch, 1855)	35	33	68
	Heterothrips striatus Moulton, 1932	0	1	1
	Frankliniella sp.	0	2	2
	Frankliniella sp. n.	5	4	9
	Frankliniella spp. immatures	142	63	205
Total	-	850	456	1306

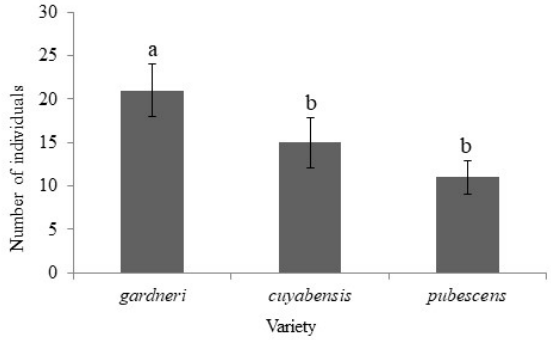

Figure 2 Abundance of thrips found on the flowers (mean + standard deviation) of *Hancornia speciosa* varieties from the *ex-situ* germplasm of the School of Agronomy – Federal University of Goiás. Means followed by the same letter do not differ according to Tukey's test (p≤0.05).

2023). In studies conducted by Alves-Silva et al. (2013), *F. musaeperda* was observed on mangaba flowers in Minas Gerais state. The same insect species was also reported on *Palicourea rigida* Kunth flowers (Rubiaceae) (Cardoso et al., 2016). The present study is the first record of *F. musaeperda* in Goiás state, a species previously identified in states in southeastern (Minas Gerais and São Paulo) and southern (Paraná) Brazil (Lima and Miyasato, 2017; Lima, 2023).

Frankliniella species are reported in flowers of various plants (Lima et al., 2016), in which they can cause injuries characterized by light patches. For instance, on soybeans *F. schultzei* was observed feeding on pollen and causing premature flowers fall, resulting in a productivity reduction (Neves et al., 2022). In the present study, however, no thrips-related damage was observed on the mangaba flowers (Fig. 3A). On the other hand, *Frankliniella* species may also feed on *H. speciosa* flower pollen, as other congeneric species do on other plants (e.g. Danieli-Silva and Varassin, 2012). Pollen grains may adhere to the insects during feeding, possibly resulting in the indirect pollination of mangaba plants. However, specific research is needed to confirm this hypothesis. To date, moths from the families Sphingidae (Pereira et al., 2010), Hesperiidae and Nymphalidae (Darrault and Schlindwein, 2006) are reported as the main mangaba pollinators.

The lesions on the fruits may have been caused solely by *H. longisensibilis* (Fig. 4), since adults and larvae of this species were the only ones found associated with injury on *cuyabensis* and *gardneri* varieties. Lima et al. (2020) reported that other species of the subfamily cause similar lesions, including *Heliothrips* spp., but no other species were observed feeding on the fruits. Though most *cuyabensis* fruits presented mild damage, some exhibited severe lesions. The variety *pubescens* had the lowest number of damaged fruits, possibly the presence of trichomes may indicate antiherbivore defense.

Silva et al. (2019) found a larger *H. longisensibilis* population on *gardneri* leaves, whose adaxial surface is glabrous, with pubescence along the central vein on the abaxial surface (Monachino, 1945). However, Scott-Brown and Simmonds (2006) reported that *Heliothrips* occurs in plants with smooth or coriaceous leaves. In mangaba, *H. longisensibilis* causes whitish lesions on the leaves, beginning at the margin and progressing toward the center, typically associated with dark-colored droppings (Silva et al., 2019). The lesions observed on the fruits are similar to those that occur on leaves, characterized by white spots that subsequently turn silver, with no damage in the center (Fig. 4B). Fecal droplets associated with the above-mentioned lesions are also visible.

Despite the morphological differences observed on leaves and flowers of the three mangaba varieties, their fruits exhibited similar damage (Fig. 5). As a result, the lesions on the fruits were expected to differ between varieties. While *cuyabensis* has glabrous leaves and corollas, *gardneri* differs from the other varieties by presence of trichomes on the dorsal surface or midrib of its leaves. On the other hand, in *pubescens*, trichomes are located on the abaxial surface of leaves, with pubescent corollas, lobes and outer floral tube (Monachino, 1945). The flowers are white, hermaphroditic, tubular and fragrant. The inflorescence has seven flowers (Almeida, 1998). The fruits are generally rounded and berry-like, measuring 2.5 to 6 cm, and display a variety of shapes and colors, ranging from yellow to greenish, with or without red pigment (Silva et al., 2001).

Different thrips-related damage is observed in other fruit species. In the peach *Prunus persica* L. (Rosaceae), *F. occidentalis* (Pergande, 1895) causes bronzing on the fruit surface and skin splitting (Tommasini and Ceredi, 2007), whereas damage to mangaba fruits is superficial. In mangaba, small populations of other *Frankliniella* species were observed only on the leaves, with no thrips-related damage to the fruits (Silva et al., 2019). Thrips-related damage in *Vitis vinifera* L. (Vitaceae) forms a whitish halo around small scars on the fruits (Moreira et al., 2014), similar to the lesions observed in *H. speciosa*. In lemon trees *Citrus limon* L. (Rutaceae), damage caused by the thrips species *Pezothrips kellyanus* (Bagnall, 1916) results in grayish or silver fruit or a ring at the peduncle base (Belaam-Kort and Boulahia-Kheder, 2017). Research conducted by Goane et al. (2013) in lemon orchards demonstrated that

Figure 3 *Hancornia speciosa* flowers from an *ex-situ* germplasm, Goiânia, Goiás. A- flower with no thrips, B- *Frankliniella* sp. on the corolla of a mangaba flower.

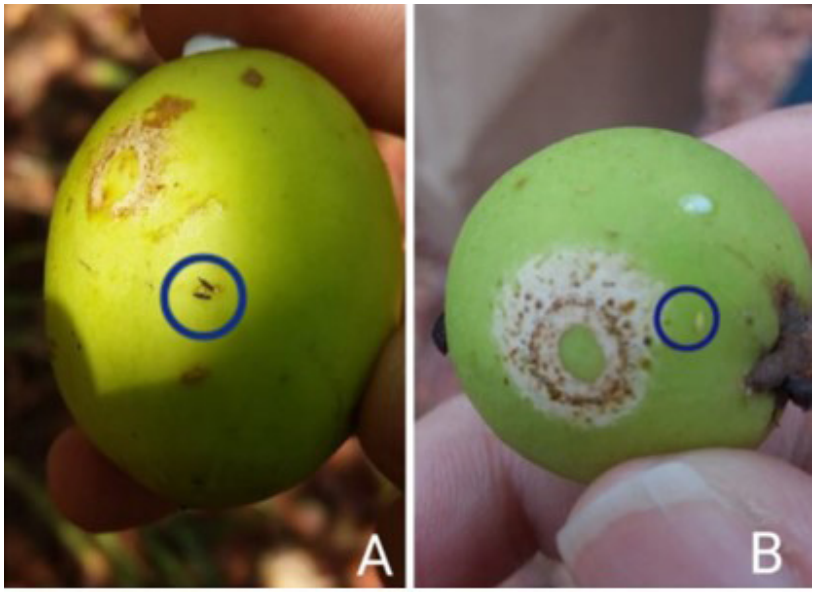

Figure 4 *Hancornia speciosa* Gomes fruits with damage caused by *Heliothrips longisensibilis*. A- Adults and B- Larvae.

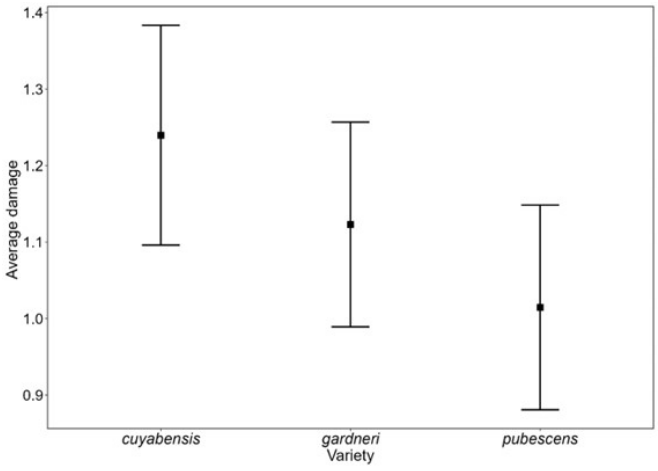

Figure 5 Average score (+ confidence interval) on a scale of 1 to 5 for thrips-related damage to the fruits of *Hancornia speciosa* varieties from the *ex-situ* germplasm of the School of Agronomy – Federal University of Goiás, Goiânia, Goiás.

the density of *Chaetanaphothrips orchidii* (Moulton, 1907) was related to fruit phenology, with greater densities in ripe fruits and damage concentrated on those at the bottom of the trees.

No predator thrips were identified on fruits or flowers of *H. speciosa*. Studies on Thysanoptera are important because these arthropods can cause direct and indirect damage to a variety of plants. In mangaba plants, thrips damage only the fruits. Although lesions were observed in all the varieties analyzed, the scores attributed were low, indicating that the damage was not extensive. This means that the damage would not result in economic losses that might compromise fruit quality and use of the pulp. Moreover, the fruits might not be rejected by consumers for fresh consumption, despite the aesthetic damage.

Conclusions

A complex of *Frankliniella* species predominates on flowers of *Hancornia speciosa*, especially *Frankliniella gemina*. Despite the injuries observed on the fruits, thrips do not economically harm the fruits of *H. speciosa*.

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Conflicts of interest

The authors declare no conflicts of interest.

Author contribution statement

JFS: data curation, formal analysis, investigation, methodology, project administration, writing – original draft; JMP: conceptualization, data curation, methodology, funding acquisition, project administration, resources, supervision, writing – review; editing; EFBL: conceptualization, data curation, investigation, methodology, funding acquisition, resources, supervision, writing – review; editing; CBSR: methodology, investigation; AJAP: methodology, investigation. All authors read and approved the manuscript.

References

Almeida, S.P., 1998. Cerrado: aproveitamento alimentar. 2. ed. Embrapa-CPAC, Planaltina.

Alves-Silva, E., Maruyama, P.K., Cavalleri, A., Del-Claro, K., 2013. Flower stage and host plant preference by floral herbivore thrips (Insecta: Thysanoptera: *Frankliniella*) in a Brazilian savanna. Stud. Neotrop. Fauna Environ. 48, 25-31.

Bates, D., Mächler, M., Bolker, B., Walker, S., 2015. Fitting linear mixed-effects models using lme4. J. Stat. Softw. 67 (1), 1-48.

Belaam-Kort, I., Boulahia-Kheder, S., 2017. Thrips in citrus orchards, emerging pests in Tunisia. Entomol. Faun. 70, 77-87.

Cardoso, J.C.F., Gonzaga, M.O., Cavalleri, A., Maruyama, P.K., Alves-Silva, E., 2016. The role of floral structure and biotic factors in determining the occurrence of florivorous thrips in a dystilous shrub. Arthropod-Plant Interact. 10, 477-484.

Cavalleri, A., Mound, L.A., 2012. Toward the identification of *Frankliniella* species in Brazil (Thysanoptera, Thripidae). Zootaxa 3270, 1-30.

Cavalleri, A., Mound, L.A., Lindner, M.F., Botton, M., Mendonça Junior, M.S., 2018. The Thrips of Brazil. Available in: http://www.thysanoptera.com.br/informacoes/detalhe/9/a-fauna-brasileira (accessed 09 November 2023).

Danieli-Silva, A., Varassin, I.G., 2012. Breeding system and thrips (Thysanoptera) pollination in the endangered tree *Ocotea porosa* (Lauraceae): implications for conservation. Plant Species Biol. 28, 31-40.

Darrault, R.O., Schlindwein, C., 2006. Polinização. In: Silva Junior, J.F., Lédo, A.S. A cultura da mangabeira. Embrapa Tabuleiros Costeiros, Aracaju, pp. 43-56.

Goane, L., Casmuz, A., Salas, H., Lizondo, M., Gastaminza, G., Vera, M.T., 2013. Spatial and temporal variation in *Chaetanaphothrips orchidii* Moulton (Thysanoptera: Thripidae) population and Its damage on lemon. Neotrop. Entomol. 42, 72-81.

Hood, J.D., 1952. A new *Frankliniella* injurious to banana (Thysanoptera, Thripidae). Proc. Biol. Soc. Wash. 65, 137-139.

Instituto Brasileiro de Geografia e Estatística - IBGE, 2022. Produção da extração vegetal e sivilcultura. Rio de Janeiro: IBGE. Available in: https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9105-producao-da-extracao-vegetal-e-da-silvicultura.html (accessed 14 March 2024).

Lima, E.F.B., Thomazini, M.J., Santos, R.S., Lopes, E.N., Saito, L., Zucchi, R.A., 2016. New findings of thrips (Thysanoptera: Thripidae) on plants in Brazil. Fla. Entomol. 19, 146-149.

Lima, E.F.B., Miyasato, E.A., 2017. The *Frankliniella* fauna of Brazil: additions and updated key to species (Thysanoptera: Thripidae). Zootaxa 4323, 391-402.

Lima, E.F.B., O'Donnell, C.A., Miyasato, E.A., 2020. The Panchaetothripinae (Thysanoptera, Thripidae) of Brazil, with one new *Caliothrips* species. Zootaxa 4820, 201-230.

Lima, E.F.B., O'Donnel, C.A., Souza, Y.L.C., Zamar, M.I., 2021. Identification of second larvae of Panchaetotrhripinae (Thysanoptera, Thripidae) in Brazil and Argentina. Zootaxa 5047, 453-464.

Lima, E.F.B., 2023. Thripidae in Catálogo Taxonômico da Fauna do Brasil. Rio de Janeiro: Jardim Botânico do Rio de Janeiro. Available in: http://fauna.jbrj.gov.br/fauna/faunadobrasil/1792 (accessed 09 November 2023).

Maia, V.C., Pereira, V.A.M., Funch, L.S., 2023. A new species of *Asphondylia* Loew, 1850 (Diptera, Cecidomyiidae) on *Hancornia speciosa* (Apocynaceae), a native plant to Brasil. Rev. Bras. Entomol. 67, e-20230024.

Michereff Filho, M., Michereff, M.F.F., 2006. Pragas. In: Silva Júnior, J.F.; Lédo, A.S. (Ed.), A cultura da mangaba. Embrapa Tabuleiros Costeiros, Aracaju, pp. 191-203.

Monachino, J., 1945. A revision of *Hancornia* (Apocynaceae). Lilloa 11, 19-48.

Monteiro, R.C., 1994. Espécies de tripes (Thysanoptera, Thripidae) associadas a algumas culturas no Brasil. Dissertação de Mestrado em Entomologia. Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo.

Moreira, A.N., Oliveira, J.V.D., Oliveira, J.E.D.M., Souza, G.M.M.D., Breda, M.O., 2014. Injuries caused by *Frankliniella* spp. (Thysanoptera: Thripidae) on seedless grapes. Cienc. Agrotec. 38, 328-334.

Mound, L.A., Marullo, R., 1996. The thrips of Central and South America: An introduction (Insecta: Thysanoptera). Mem. Entomol. Int. 6, 1-487.

Neves, D.V.C., Lopes, M.C., Sarmento, R.A., Pereira, P.S., Pires, W.S., Peluzio, J.M., Picanço, M.C., 2022. Economic injury levels for control decision-making of thrips in soybean crops (*Glycine max* (L.) Merrill). Res. Soc. Dev. 11, e52411932114.

Oliveira, K.S., Aloufa, M.A.I., 2021. Knowledge, use, and management of mangaba (*Hancornia speciosa* Gomes) by extrativista communities on the coast of Rio Grande do Norte, Northeast Brazil. Acta Bot. Bras. 35, 276-279.

Pereira, A.V., Pereira, E.B.C., Silva Júnior, J.F., Silva, D.B., 2010. Mangaba. In: Vieira, R.F., Agostini-Costa, T., Silva, D.B., Ferreira, F.R., Sano, S.M. Frutas nativas da região Centro-Oeste do Brasil. Embrapa Recursos Genéticos e Biotecnologia, Brasília, pp. 221-246.

Scott Brown, A.S., Simmonds, M.S.J., 2006. Leaf morphology of hosts and nonhosts of the thrips *Heliothirps haemorrhoidalis* (Bouché). Bot. J. Linn. Soc. 152, 109-130.

Silva, D.B., Silva, J.A., Junqueira, N.T.V., Andrade, L.R.M., 2001. Frutas do Cerrado. Embrapa Informação Tecnológica, Brasília.

Silva, J.F., Pereira, J.M., Rocha, C.B.S., Peres, A.J.A., Lima, E.F.B., 2019. Thrips species associated with varieties of the native Cerrado fruit tree *Hancornia speciosa.* Rev. Bras. Frutic. 41, e-053.

Silva, J.F., Pereira, J.M., Rocha, C.B.S., Peres, A.J.A., De Lima, E.L., Daud, R.D., 2020. Composition and abundance of mites (Arachnida: Acariformes: Parasitiformes) on *Hancornia speciosa* Gomes varieties. Int. J. Acarol. 46 (6), 394-400.

Silva, J.F., Pereira, J.M., Rocha, C.B.S., Peres, A.J.A., 2021. Primeiro registro de *Paraissetia nigra* e hemípteros associados às variedades de mangabeira *Hancornia speciosa.* Cienc. Florest. 31, 2023-2034.

Silva Júnior, J.F., Lédo, A.S., 2016. Sistema de produção de mangaba para a região Nordeste do Brasil. Embrapa Tabuleiros Costeiros, Aracaju.

Tommasini, M.G., Ceredi, G., 2007. Damages on nectarines by thrips in northern Italy: monitoring and control on late attacks. Bull. Insectol. 60, 71-75.

Vieira Neto, R.D., Cintra, F.L.D., Ledo, A.S., Silva Júnior, J.F., Costa, J.L.S., Silva, A.A.G., Cuenca, M.A.G., 2002. Sistema de produção de mangaba para os tabuleiros costeiros e baixadas litorâneas. Embrapa Tabuleiros Costeiros, Aracaju.