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Reaction of weeds, found in vegetable production areas, to root-knot nematodes *Meloidogyne incognita* and *M. enterolobii*

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ABSTRACT

Root-knot nematodes cause great damage to vegetable crops in Brazil, besides having a large range of host plants, such as weeds. Weeds can maintain the inoculum or even favor the multiplication of these nematodes. In this study we evaluated the reaction of selected weed species, present in a vegetable production area, to root-knot nematodes *Meloidogyne incognita* and *M. enterolobii*. The trials were conducted in a greenhouse at Embrapa Hortaliças, Brasília-DF, in a completely randomized design with six replicates. Fifteen weed species were evaluated for *M. incognita* race 1, and 16 weed species were evaluated for *M. enterolobii*. Two tomato cultivars were evaluated as resistance and susceptibility standards. Gall index (IG), egg mass index (IMO), number of eggs per gram of roots (eggs/g roots) and reproduction factor (FR) were evaluated. *M. enterolobii* survives and multiplies more easily in weeds collected in vegetable production areas than *M. incognita* race 1 and, the great majority of weed species evaluated in this study are hosts of both nematode species. Only the species *Urena lobata*, *Sonchus oleraceus*, *Euphorbia heterophylla*, *Melampodium perfoliatum* and *Tagetes* sp. were immune to *M. incognita* race 1. All evaluated species are either hosts or favor the multiplication of *M. enterolobii*. The species which are the most susceptible to *M. incognita* race 1, and therefore require greater control of crops infected by this nematode are *Ipomoea nil*, *I. triloba* and *Eleusine indica*, and for *M. enterolobii* are *I. nil*, *Solanum americanum*, *Hyptis suaveolens*, *Portulaca oleracea*, *I. triloba* and *Euphorbia heterophylla*.

Keywords: Weed host, reproduction factor, dissemination.

RESUMO

Reação de plantas daninhas, presentes em áreas cultivadas com hortaliças, aos nematoides-das-galhas *Meloidogyne incognita* e *M. enterolobii*

Os nematoides-das-galhas causam muitos prejuízos às lavouras de hortaliças no Brasil, além de possuírem grande gama de plantas hospedeiras, incluindo as plantas daninhas. Estas podem manter o inóculo ou mesmo favorecer a multiplicação desses nematoides. Diante do exposto, objetivou-se com esse trabalho avaliar a reação de espécies selecionadas de plantas daninhas, presentes em áreas cultivadas com hortaliças, aos nematoides de galhas *Meloidogyne incognita* e *M. enterolobii*. Os experimentos foram realizados em casa de vegetação na Embrapa Hortaliças, em Brasília-DF, em delineamento inteiramente casualizado, com seis repetições. Quinze espécies de plantas daninhas foram avaliadas para reação a *M. incognita* raça 1, e 16 espécies de plantas daninhas foram avaliadas para a reação a *M. enterolobii*. Duas cultivares de tomateiro foram utilizadas como padrão de resistência e suscetibilidade. As plantas daninhas foram avaliadas quanto ao índice de galhas (IG), índice de massas de ovos (IMO), número de ovos por grama de raízes (ovos/g raízes) e fator de reprodução (FR). *M. enterolobii* sobrevive e se multiplica com maior facilidade nas plantas daninhas coletadas em áreas cultivadas com hortaliças do que *M. incognita* raça 1 e, a maioria das espécies de plantas daninhas avaliadas são hospedeiras das duas espécies de nematoides. Apenas *Urena lobata* (malva-roxa), *Sonchus oleraceus* (serralha), *Euphorbia heterophylla* (amendoim-bravo), *Melampodium perfoliatum* (estrelinha) e *Tagetes* sp. (cravo-de-defunto) foram imunes a *M. incognita* raça 1. Todas as espécies avaliadas foram hospedeiras, ou propiciaram a multiplicação de *M. enterolobii*. As espécies mais suscetíveis ao *M. incognita* raça 1 e que, portanto, necessitam de maior controle nas lavouras infestadas por esse nematoide são *Ipomoea nil* (corda-de-viola), *I. triloba* (corda-de-viola) e *Eleusine indica* (capim-pé-de-galinha). Para *M. enterolobii* as espécies mais suscetíveis são *I. nil* (corda-de-viola), *Solanum americanum* (maria-pretinha), *Hyptis suaveolens* (hortelã), *Portulaca oleracea* (beldroega), *I. triloba* (corda de viola) e *Euphorbia heterophylla* (amendoim-bravo).

Palavras chave: Hospedabilidade de plantas daninhas, fator de reprodução, disseminação.

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The diversity of hosts and their interaction with other pathogens make the nematodes one of the main phytopathogens responsible for limiting agricultural productivity worldwide (Moens *et al.*, 2009). These pathogens are widely distributed in the most diverse agricultural areas all over the world, in several annual and perennial crops, causing damages of approximately US\$ 157 billions annually (Bellé *et al.*, 2017).

For vegetables, intensive cultivation has promoted the development of various diseases, such as occurrence of nematodes, with significant losses of heavily nematode-infested crops. Despite this pathogen's low natural mobility, constant soil tickler and machinery use, typical vegetable crop production operations, favor this spread. The root-knot nematode (*Meloidogyne* spp.) is quite destructive on most vegetables. In Brazil, *M. javanica* and *M. arenaria* are the most important pathogens on these crops (Pinheiro *et al.*, 2018).

In Brazil, *M. enterolobii* sin. *M. mayaguensis* was reported parasitizing guava plants in the state of Bahia, causing several damages (Carneiro *et al.*, 2001). This nematode has been identified in several plant species, including vegetables, in other regions of Brazil since then (Damaceno *et al.*, 2016), even in cultivars resistant to other root-knot nematode species (Melo *et al.*, 2011).

Weeds which grow next to crops can multiply the nematode inoculum and ensure the maintenance of high population densities of these pathogenic organisms in the soil, in the harvest or in the off season, making it difficult to control nematodes in production areas (Mônaco *et al.*, 2009). Thus, characterizing weeds which are nematode hosts for suitable controlling in production areas is extremely important.

Studies on weed hosts to various species of root-knot nematodes can be found in literature, showing contrasting results, though. Moreover, no reports on evaluation of several weed species to *M. enterolobii* can be found. Given the above, the aim of this study was

to evaluate the reaction of weeds, in vegetable production areas, to *M. incognita* and *M. enterolobii*.

MATERIAL AND METHODS

The trials were carried out in a greenhouse and the evaluations were done in the laboratory, at Embrapa Hortaliças, Brasília-DF, from October 23, 2014 to January 15, 2015.

The experimental design was completely randomized, with six replicates. Fifteen weed species were evaluated in relation to reaction to *M. incognita* race 1, and 16 species were evaluated in relation to reaction to *M. enterolobii*. Weed seeds were obtained from Agrocosmos Company, located in Engenheiro Coelho-SP, and selected based on botanical survey on an area cultivated during several years with vegetables in Brasília.

The evaluated weeds in relation to two nematode species were *Ipomoea nil* (corda de viola), *Solanum americanum* (maria preta), *Hyptis suaveolens* (spearmint), *Portulaca oleracea* (purslane), *I. triloba* (corda de viola), *Amaranthus hybridus* (caruru roxo), *Euphorbia heterophylla* (amendoim bravo), *Eleusine indica* (capim pé de galinha), *Bidens pilosa* (picão preto), *A. viridis* (caruru de mancha), and *Tagetes* sp. (marigold). Additionally, *Urena lobata* (malva roxa), *Sida rhombifolia* (guanxuma), *Sonchus oleraceus* (common sow thistle), *Melampodium perfoliatum* (estrelinha) for *M. incognita* race 1, and *Sida cordifolia* (guanxuma), *Ageratum conyzoides* (mentrasto), *Acanthospermum australe* (carrapichinho), *Digitaria horizontalis* (capim colchão) and *Alternanthera tenella* (apaga fogo) for *M. enterolobii* were also evaluated. Tomato 'Rutgers' was used as susceptibility standard, and tomato 'Nemadoro' as resistance standard to root-knot nematodes.

For both trials, female root-knot nematodes (*M. incognita*), collected from tomato roots in the experimental area of Embrapa Hortaliças, and females of *M. enterolobii* obtained from guava crop in Petrolina-PE, were previously identified using isoenzyme standard

(Carneiro & Almeida, 2001). Then, these pathogens were submitted to perineal cut and patterns described by Eisenback & Hirschmann-Triantaphyllou (1991) for species identification. Nematodes were, then, multiplied on tomato plant 'Rutgers', kept in a greenhouse. *M. incognita* was identified using host test, according to Taylor & Sasser (1978). After identification, nematodes were inoculated on tomatoes 'Rutgers', in order to produce and maintain the inoculum. About 45 days after inoculation, second stage eggs and juveniles (J2) were extracted from the plants to be used in the trials.

In both trials, weed species seeds were sown in 1.5-L plastic pots containing substrate composed of soil, washed sand, cattle manure and rice husk, in 1:1:1:1 ratio. After 26 days, thinning was carried out, leaving one plant per pot (experimental plot). Then, the seeds were inoculated with suspension of 5,000 eggs and eventual second stage juveniles (J2) of the nematodes in 5 mL water distributed around the base of the plants.

At 56 days after inoculation, egg mass index (IMO) was evaluated. Root systems were washed in running water and stained during 15 minutes in an aqueous solution of phloxine B, 0.5 g/L water (Taylor & Sasser, 1978). Then, the number of eggs on the roots was counted, using a stereoscope microscope.

IMO and gall index (IG) were obtained according to Taylor & Sasser (1978), using a note scale from 0 to 5. For IMO we considered: 0) roots without egg mass; 1) 1 to 2 egg masses; 2) from 3 to 10 egg masses; 3) from 11 to 30 egg masses; 4) from 31 to 100 egg masses and, 5) over 100 egg masses. Whereas for IG: 0) without galls; 1) 1 to 2 galls; 2) 3 to 10 galls; 3) 11 to 30 galls; 4) 31 to 100 galls and 5) over 100 galls.

To evaluate number of eggs per gram of roots (eggs/g roots), the roots were dried at room temperature during five hours, then weighed and processed according to Hussey & Barker (1973) modified by Boneti & Ferraz (1981).

Reproduction factor (FR) was obtained by the relationship between final and initial population densities

(FR= Pf/Pi) (Oostenbrink, 1966). As initial population (Pi), inoculums of 5,000 eggs and eventual juveniles (J2) were considered.

After verifying ANOVA assumptions, data were submitted to analysis of variance and Scott-Knott clustering test at 5% probability, using GENES statistical software (Cruz, 2016).

RESULTS AND DISCUSSION

According to analysis of variance, significant differences ($p= 0.05$) were observed for all variables in relation to the reaction of weeds to nematodes. The genotypic and phenotypic coefficients of variation ratio, being superior to unit, show the predominance of genetic variation compared to environmental variation (Cruz *et al.*, 2012). This fact shows reliability of estimates obtained for most evaluated traits. The authors

observed exception for number of eggs per gram of roots (eggs/g roots) for *M. enterolobii*, showing that despite the detection of significant differences in weed reaction to this species, the results were unreliable.

Gall index (IG) and egg mass index (IMO) were similar for the evaluated weeds in relation to reaction to *M. incognita* race 1, showing greater presence of galls and eggs in the susceptible control (tomato 'Rutgers'), followed by *I. triloba* and *I. nil*. Lower values for these indexes were obtained for *Tagetes* sp. and *S. oleraceus*, followed by the cluster formed by *S. rhombifolia*, *S. americanum*, *M. perfoliatum*, resistant control (tomato 'Nemadoro'), *B. pilosa* and *E. heterophylla*, and the cluster formed by *U. lobata*, *H. suaveolens*, *P. oleracea*, *E. indica*, *A. hybridus* and *A. viridis* (Table 1).

In relation to reproduction factor (FR) of *M. incognita* race 1, in evaluated weeds and controls, the greatest value

was obtained for the susceptible control 'Rutgers', showing the initial nematode population multiplied throughout vegetative cycle of the crop by a factor of 34.6 times. The second species in which greater nematode multiplication was noticed was *I. triloba*. Although not being statistically different from the most resistant species, *E. indica* and *I. nil* presented susceptibility reaction according to Oostenbrink (1966). Yet, according to this methodology used to evaluate the reaction of plants to *Meloidogyne* spp., *S. rhombifolia*, *S. americanum*, *H. suaveolens*, *P. oleracea*, *A. hybridus*, *B. pilosa* and *A. viridis*, they were considered resistant, it means, were hosts; but did not show final nematode population superior to the initial population, though. *Urena lobata*, *S. oleraceus*, *E. heterophylla*, *M. perfoliatum*, *Tagetes* sp., and the resistant control, tomato cultivar Nemadoro, were immune, since they did not provide *M. incognita* multiplication

Table 1. Reaction of weed plants to *Meloidogyne incognita* race 1. Brasília, Embrapa Hortaliças, 2018.

Family	Species	IG ¹	IMO ¹	Eggs/g ²	FR ^{3,4}
Amaranthaceae	<i>Amaranthus hybridus</i>	1.50 d	1.67 d	1441.76 c	0.84 c (R)
	<i>Amaranthus viridis</i>	1.83 d	1.33 d	1954.70 c	0.50 c (R)
Asteraceae	<i>Bidens pilosa</i>	0.83 f	0.83 e	9.33 d	0.02 c (R)
	<i>Melampodium perfoliatum</i>	0.67 f	0.67 f	0.00 d	0.00 c (I)
	<i>Sonchus oleraceus</i>	0.17 g	0.17 g	0.00 d	0.00 c (I)
	<i>Tagetes</i> sp.	0.17 g	0.17 g	0.78 d	0.00 c (I)
Convolvulaceae	<i>Ipomoea nil</i>	3.00 c	3.17 c	3071.52 c	1.36 c (S)
	<i>Ipomoea triloba</i>	3.83 b	3.83 b	7249.71 b	12.63 b (S)
Euphorbiaceae	<i>Euphorbia heterophylla</i>	0.83 f	0.83 e	33.33 d	0.00 c (I)
Lamiaceae	<i>Hyptis suaveolens</i>	1.17 e	1.00 e	170.43 d	0.12 c (R)
Malvaceae	<i>Sida rhombifolia</i>	0.67 f	0.67 f	46.94 d	0.09 c (R)
	<i>Urena lobata</i>	1.00 e	1.00 e	0.00 d	0.00 c (I)
Poaceae	<i>Eleusine indica</i>	1.00 e	1.00 e	1187.56 c	2.63 c (S)
Portulacaceae	<i>Portulaca oleracea</i>	1.00 e	1.17 e	463.31 d	0.15 c (R)
Solanaceae	<i>Solanum americanum</i>	0.67 f	0.67 f	42.89 d	0.01 c (R)
	Tomato Rutgers (susceptible)	5.00 a	5.00 a	10480.45 a	34.62 a (S)
	Tomato Nemadoro (resistant)	0.67 f	0.67 f	0.00 d	0.00 c (I)
General average		1.30	1.30	1378.36	2.79
CVg/CV		2.58	2.69	1.58	2.69

¹Gall index (IG) and egg mass index (IMO) according to Taylor & Sasser (1978); 0= roots without egg mass and/or galls; 1= roots with 1 to 2 egg masses and/or galls; 2= roots with 3 to 10 egg masses and/or galls; 3= roots with 11 to 30 egg masses and/or galls; 4= roots with 31 to 100 egg masses and/or galls; 5= roots with over 100 egg masses and/or galls; ²Eggs/g= number of eggs per gram of roots; ³FR= reproduction factor (FR), final population/initial population; ⁴Resistance reaction according to Oostenbrink (1966): I= immune (FR= 0); R= resistant (FR<1) and S = susceptible (FR>1). Averages followed by same letters do not differ from each other, Scott-Knott test ($p<0.05$). CVg/CV= genotypic and phenotypic coefficients of variation ratio.

(Table 1).

In general, we verified a relation between these species and their botanical family to *M. incognita*, except the Malvaceae, considering that the two evaluated species showed different responses: *U. lobata* was immune and *S. rhombifolia*, resistant. On the other hand, the two species of amaranths (*Amaranthus hybridus* and *A. viridis*) showed similar behavior: they both were resistant; three of the four species of Asteraceae were immune to the nematode (*Melampodium perfoliatum*, *Sonchus oleraceus* and *Tagetes* sp.); and the two species of Convolvulaceae (*Ipomoea nil* and *I. triloba*), were susceptible.

For reaction to *M. enterolobii* (Table 2), the greatest IGs were obtained for the two controls, tomatoes Rutgers (susceptible) and Nemadoro (resistant), and also *S. americanum*. The second cluster with the greatest IG was formed

by *I. nil*, *I. triloba* and *E. heterophylla*. The lowest IGs were obtained in *A. conyzoides*, *A. australe*, *D. horizontalis*, *E. indica*, *A. viridis* and *Tagetes* sp. In relation to IMO, the species which showed greater values were *I. nil* and *S. americanum*, followed by the cluster formed by *H. suaveolens*, *I. triloba* and tomato 'Nemadoro', used as resistance standard. The species which showed the lowest IMO were *A. conyzoides*, *A. australe*, *D. horizontalis*, *E. indica* and *Tagetes* sp., followed by the cluster formed by *S. cordifolia*, *A. hybridus*, *A. tenella* and *A. viridis*.

The greatest number of *M. enterolobii* eggs per gram of roots was found in the susceptible control (tomato 'Rutgers') and in *I. triloba*, followed by the cluster formed by *I. nil*, *S. americanum* and *E. heterophylla*. The other species were clustered with lower number of eggs per gram of roots (Table 2). According to the clustering for FR, the highest value was

obtained for tomato cultivar 'Rutgers', followed by *I. nil*, *S. americanum*, *I. triloba*, *E. heterophylla*, and tomato 'Nemadoro' (resistance standard); all of them were considered susceptible, according to Oostenbrink (1966). Using the same methodology, *H. suaveolens* and *P. oleracea* were also considered susceptible, although being clustered among species with lower FR. The other weed species were classified as resistant; any of them was considered immune to this nematode.

Considering the 11 common weed species in both trials, besides the two controls, we verified that *M. enterolobii* was more aggressive, managing to maintain or multiply on more weed species than *M. incognita* race 1. Considering these weed species, eight were considered resistant or immune to *M. incognita* race 1, and only five were considered resistant or immune to *M. enterolobii*. Only *E. indica* showed to

Table 2. Reaction of weed plants to *Meloidogyne enterolobii*. Brasília, Embrapa Hortaliças, 2018.

Family	Species	IG ¹	IMO ¹	Eggs/g ²	FR ^{3,4}
Amaranthaceae	<i>Alternanthera tenella</i>	1.00 e	1.00 e	43.00 c	0.02 c (R)
	<i>Amaranthus hybridus</i>	1.00 e	1.00 e	3246.33 c	0.91 c (R)
Amaranthaceae	<i>Amaranthus viridis</i>	0.50 f	0.50 e	105.17 c	0.11 c (R)
Asteraceae	<i>Acanthospermum australe</i>	0.00 f	0.00 f	42.67 c	0.02 c (R)
	<i>Ageratum conyzoides</i>	0.00 f	0.00 f	103.67 c	0.14 c (R)
	<i>Bidens pilosa</i>	3.00 c	3.17 c	3477.50 c	0.91 c (R)
	<i>Tagetes</i> sp.	0.00 f	0.00 f	7.67 c	0.04 c (R)
Convolvulaceae	<i>Ipomoea nil</i>	4.00 b	4.50 a	7966.83 b	12.31 b (S)
	<i>Ipomoea triloba</i>	4.17 b	4.00 b	16745.17 a	9.58 b (S)
Euphorbiaceae	<i>Euphorbia heterophylla</i>	3.83 b	3.50 c	8857.83 b	12.45 b (S)
Lamiaceae	<i>Hyptis suaveolens</i>	3.33 c	4.00 b	2238.00 c	3.27 c (S)
Malvaceae	<i>Sida cordifolia</i>	0.83 e	0.83 e	297.33 c	0.03 c (R)
Poaceae	<i>Digitaria horizontalis</i>	0.00 f	0.00 f	10.50 c	0.02 c (R)
	<i>Eleusine indica</i>	0.00 f	0.00 f	1.17 c	0.02 c (R)
Portulacaceae	<i>Portulaca oleracea</i>	2.00 d	2.33 d	1992.67 c	1.27 c (S)
Solanaceae	<i>Solanum americanum</i>	5.00 a	5.00 a	10271.67 b	15.33 b (S)
	Tomato Rutgers (susceptible)	5.00 a	3.33 c	17752.00 a	27.15 a (S)
	Tomato Nemadoro (resistant)	4.67 a	4.00 b	4036.17 c	9.74 b (S)
General average		2.35	2.17	4559.90	5.53
CVg/CV		3.73	2.98	0.70	1.48

¹Gall index (IG) and egg mass index (IMO) according to Taylor & Sasser (1978); 0= roots without egg mass and/or galls; 1= roots with 1 to 2 egg masses and/or galls; 2= roots with 3 to 10 egg masses and/or galls; 3= roots with 11 to 30 egg masses and/or galls; 4= roots with 31 to 100 egg masses and/or galls; 5= roots with over 100 egg masses and/or galls; ²Eggs/g= number of eggs per gram of roots; ³FR= reproduction factor (FR), final population/initial population; ⁴Resistance reaction according to Oostenbrink (1966): I= immune (FR= 0); R= resistant (FR<1) and S = susceptible (FR>1). Averages followed by same letters do not differ from each other, Scott-Knott test (p<0.05). CVg/CV= genotypic and phenotypic coefficients of variation ratio.

be more resistant to *M. incognita* race 1 than to *M. enterolobii*. This higher virulence of *M. enterolobii* can also be confirmed by the average FR value, which was 5.53 for this nematode species and 2.79 for *M. incognita* race 1.

The reaction of the weed species to *M. enterolobii* was directly related to botanical family. All tested Asteraceae species (*Acanthospermum australe*, *Ageratum conyzoides*, *Bidens pilosa* and *Tagetes* sp.) showed the same behavior: all they were resistant; the three amaranth species (*Alternanthera tenella*, *Amaranthus hybridus* and *A. viridis*) were also resistant; the two Convolvulaceae species were susceptible; and the two Poaceae species (*Digitaria horizontalis* and *Eleusine indica*) were resistant. These results show similar response of the weed species, belonging to the same family, to this nematode. This result is positive for further studies and nematode management strategies in the field. Weed differentiation at family or genus level is already sufficient to add information on nematode management, regardless of whether weed control is chemical, using herbicides; hand-picking or mechanical, using a hoe, a harrow, a grid or growers.

Tomato 'Nemadoro', which presented immunity reaction to *M. incognita* race 1, in relation to reproduction factor, with *E. heterophylla* and *Tagetes* sp, did not show the same immunity reaction to *M. enterolobii*. This result was expected for tomato, since this gene comprises resistance to *M. incognita*, *M. javanica* and *M. arenaria*, but does not show resistance to *M. hapla* and *M. enterolobii*. *Meloidogyne enterolobii* is known as a nematode which causes damages even to crops which carry genes showing resistance to other species of *Meloidogyne* spp. (Tigano *et al.*, 2010).

Some studies about reaction of weeds to *M. incognita* can be found in literature. Mônico *et al.* (2009) have studied the reaction of 57 species to *M. incognita* race 1. Considering these species, *E. heterophylla*, *A. hybridus*, *A. viridis*, *I. nil*, *S. rhombifolia*, *S. americanum* and *S. oleraceus* were also evaluated in this study. *Ipomea nil*, *S.*

oleraceus and *S. americanum* showed the same reaction in both studies. *Euphorbia heterophylla* was classified as resistant in the first study, *A. hybridus* and *A. viridis*, as susceptible; and *S. rhombifolia*, as immune; however, in this study, the first was considered immune and the others resistant.

Cordeiro *et al.* (2014) evaluated the reaction of 10 weed plants to *M. incognita*, without identifying the race, and among those which were common to this study, *E. heterophylla*, *S. americanum*, *B. pilosa*, all were considered resistant, which is in accordance with this study, considering the last two ones; whereas, *E. heterophylla* showed to be immune.

Thus, Bellé *et al.* (2017), studying the reaction of 34 weed plants to *M. incognita*, without identifying the race, verified that any species was immune to the nematode, 10 species were resistant and the others, susceptible. *I. nil*, *E. indica*, *E. heterophylla*, *A. hybridus*, *A. viridis*, *B. pilosa*, *S. rhombifolia* and *S. americanum* behaved the same way in this study. The first was considered susceptible, which is in accordance with this study; however, the others showed a different reaction. *E. indica* and *E. heterophylla*, which were classified as susceptible and resistant, respectively, in Bellé *et al.* (2017), were classified as resistant and immune, respectively, in this study; whereas all the other ones were considered susceptible in the cited study, and resistant in this study.

Similarly, Silva *et al.* (2013), evaluating the reaction of 23 weed species to *M. incognita* and *M. javanica*, without identifying races, concluded the same reaction pattern to two nematode species, considering 11 weed plants susceptible and 12 resistant. *A. hybridus*, *H. suaveolens*, *S. americanum*, *B. pilosa* and *E. heterophylla* were also evaluated in this study, and the reaction of *B. pilosa* was the same verified in this study; however, the others behaved differently: the three first ones were considered susceptible and in this study they were considered resistant. *E. heterophylla* was considered susceptible, in these evaluations it was considered immune. The same authors also evaluated *S. cordifolia*, another guaxuma species, which showed resistance standard,

in accordance with this study for *S. rhombifolia*.

Contrasting reaction patterns of some weeds found in literature for *M. incognita* can be explained using different conditions of evaluations of the experiments, such as, inoculation time after sowing, inoculum density, origin of isolate, identification or not of the races, time of evaluation after inoculation, among other factors.

In relation to reaction of weed plants to *M. enterolobii*, Almeida *et al.* (2011) collected weed plants in areas infested by this nematode in guava plants (*Psidium guajava*), are common in this study *B. pilosa* and *S. americanum*. The results showed that both plants presented eggs and juveniles in their roots, as in this study. In a similar study, also collecting weed plants in an area under guava cultivation, infested by *M. enterolobii*, Carneiro *et al.* (2006) studying 10 species of weed plants and cultivated, among these weeds *B. pilosa* and *Tagetes minuta*, verified the presence of females of these nematodes in *B. pilosa* and absence of *T. minuta*, similar situation observed in this study. Souza *et al.* (2006), also using 14 weed plant species, among them *A. hybridus* and *S. americanum*, observed the presence of females of this nematode in the roots, confirming that this species of nematodes is polyphagous and that knowing the plants which host or multiply this nematode is important for the control.

In general, most weed species evaluated in this study were hosts for both nematodes. Only *U. lobata*, *S. oleraceus*, *E. heterophylla*, *M. perfoliatum* and *Tagetes* sp. were immune, it means, they neither hosted nor allowed the multiplication of *M. incognita* race 1. However, all evaluated species were host or provided multiplication of *M. enterolobii*. The species which were the most susceptible to *M. incognita* race 1, and that, therefore, need to be controlled more carefully in crops infected by this nematode were *I. nil*, *I. triloba* and *E. indica*. Regarding *M. enterolobii* were *I. nil*, *S. americanum*, *H. suaveolens*, *P. oleracea*, *I. triloba* and *E. heterophylla*. In addition, *M. enterolobii* species are more easily maintained and multiply in

common weeds in vegetable crops than *M. incognita* race 1.

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