Emirates Journal of Food and Agriculture. 2020. 32(4): 303-308
doi: 10.9755/ejfa.2020.v32.i4.2096
http://www.ejfa.me/

RESEARCH ARTICLE

Resistance sources to root-knot nematode *Meloidogyne enterolobii* in *Solanum* species

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ABSTRACT

The objective of this work was to prospect sources of resistance to root-knot nematode *Meloidogyne enterolobii* in *Solanum* species with potential to be used as rootstocks for cultivated Solanaceae. Nine accessions of *Solanum sessiliflorum*, 27 accessions of *S. lycocarpum*, 21 accessions of *S. acanthodes*, 22 accessions of *S. scinericum* and 26 accessions of *S. scuticum* for resistance to *M. enterolobii*. Rutgers and Nemadoro tomatoes were used as susceptible and resistant controls, respectively. The experiment was conducted in a greenhouse at Embrapa Vegetables, Brasília-DF, Brazil, in a completely randomized design with six replications. The experimental unit was a represented by a single plant grown in a plastic pot containing 3 L of substrate. 4000 eggs and eventual juveniles of second stage *M. enterolobii* were inoculated per pot. At 119 days after inoculation, gall index (Gi), egg mass index (EMI), number of eggs per root gram (NE) and reproduction factor (Fr) were evaluated. Data were subjected to analysis of variance and grouping of treatments by Scott-Knott. It was verified that *S. acanthodes* and *S. Lycocarpum* are species with high resistance to *M. enterolobii*, with accessions being classified identified as immune. *S. scuticum* also has great potential, as several resistant accessions were identified, although some accessions were quite susceptible; whereas for *S. subinerme* only 4 resistant accessions were identified, although all others presented a reproduction factor much lower than tomato cv. Nemadoro as control; and all evaluated *S. sessiliflorum* accessions were susceptible.

Keywords: Grafting; Host-parasite relationship; *Solanum* species

INTRODUCTION

Root-knot nematodes belonging to the Meloidogyne genus are considered the most important in the world due to the significant economic losses caused in crops, with a wide range of hosts (Ntalli et al., 2016; Bernard et al., 2017). The species *Meloidogyne enterolobii* (Yang and Eiseinback, 1983) is known to damage hybrids that present resistance genes to other Meloidogyne species (Carneiro et al., 2006; Tigano et al., 2010) for instance Mi-1 and N (Kiewnick et al., 2009; Melo et al., 2011).

In Brazil, *M. enterolobii* (syn. *Meloidogyne mayaguensis*) was originally reported in 2001 in guava (*Psidium guajava* L.) orchards situated in the states of Pernambuco and Bahia (Carneiro et al., 2001). Since then, this nematode spread quickly in the national territory, causing significant damages in several other species, threatening the horticulture productive chain (Melo et al., 2011). Even though the identification of resistance sources to this nematode within the same genus allows the utilization of cell biology and cisgenesis in order to isolate or transfer beneficial alleles of interest into the recipient plant (Michereff-Filho et al., 2012), grafting is a simpler technology with the potential of reducing damage.

According to Mendonça et al. (2018) although vegetable grafting is an efficient technique to overcome the appearance of new pathogen species or races, its adoption in the country is evolving gradually due to the high cost of hybrid rootstocks and scions seeds. Alternatively, grafting using native species that are compatible with other cultivated Solanum, with the possibility of seed production by growers, can reduce costs and improve its sustainability.

The graft compatibility of tomato with native Solanaceae species was confirmed by several authors, for instance, Farias et al. (2013), Simões et al. (2014) and Mendonça et al. (2018) with *S. stramonifolium* and Lopes & Mendonça (2014) with *Solanum paniculatum* L. Similarly, Zeist et al. (2017) and

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Received: 01 February 2020; **Accepted:** 12 April 2020

Guimarães et al. (2019) established the compatibility with *Solanum sessiliflorum*. Although Simões et al. (2014) and Mendonça et al. (2009) verified lesser compatibility with *Solanum lycocarpum* and Pereira et al. (2018b) with *S. acanthodes*.

Looking for rootstocks resistant to *M. enterolobii*, Pinheiro et al. (2014) evaluated the reaction of *S. stramonifolium* to this nematode, and found that of 17 accessions, 7 were resistant. Likewise, Pereira et al. (2018) evaluated 22 accessions of S. *stramonifolium* to *M. enterolobii*, and found that 11 were resistant.

Thus, the objective of this work was to prospect sources of resistance to the root-knot nematode *Meloidogyne enterolobii* in Solanum species to be used as potential rootstocks for cultivated Solanaceae.

MATERIAL AND METHODS

An experiment was conducted in a single span greenhouse from January to June, 2017 at Embrapa Vegetables – 996 MASL, 15º 56' S, and 48º 08' W – Brasília-DF, Brazil. Nine (9) *Solanum sessiliflorum* accessions; twenty-seven (27) *Solanum lycocarpum* accessions, 21 *Solanum acanthodes* accessions; 22 *Solanum subinerme* accessions and 26 *Solanum scuticum* accessions were evaluated for resistance to *Meloidogyne enterolobii*. The tomato cultivars 'Rutgers' and 'Nemadoro' were used as susceptible and resistant controls, respectively. The trial was held in a completely randomized design with six replications, with one plant representing the experimental plot. Seedlings were produced in plastic trays with 128 plugs (40 cm^3 per plug) using coconut coir and peat moss mix based substrate (Plantmax®, Eucatex, São Paulo, Brazil). Thirty days after sowing (DAS) plants were transplanted in plastic pots containing 1.5 dm^3 of a mix: sterilized subsurface soil (a clayey Oxisol, typically encountered in the Cerrado Biome region in Brazil), washed sand, cow manure and carbonized rice husk in the proportion of 1:1:1:1. It was fertilized and corrected with 300 g of 4-30-16 formulation and 300 g of calcined dolomitic lime per 300 kg of this mixture. After transplantation, plants were inoculated with 5.000 eggs and eventual second-stage juveniles (J2) of *M. enterolobii* by means of a 5 ml suspension applied around the plant shoot region.

One hundred and nineteen days after inoculation (119 DAI), the gall index (Gi), egg mass index (EMI), number of eggs per gram of roots (NE) and reproduction factor (Rf) were evaluated according Dickson and Struble (1965). IMO was obtained according to Taylor and Sasser (1978) using a scoring scale from 0 to 5, wherein: 0 = roots without egg masses; 1 = presence of 1 to 2 galls or egg masses; 2 = presence of 3 to 10 galls or egg masses; 3 = presence of 11 to 30 galls or egg masses; 4 = presence of 31 to 100 galls or egg masses and 5 = presence of more than 100 galls or egg masses. Gi was quantified according to Taylor and Sasser (1978) likewise, using the aforementioned scoring scale. Rf was obtained by dividing the initial and final nematode population (Rf=Pf/Pi), considering the initial population (Pi) the one inoculated and the final population (Pf) as the one extracted from the root system using Boneti and Ferraz (1981) recommendations. Plants were considered immune (I) when presented an Rf value = 0, resistant with an Rf value <1 and susceptible (S) with Rf value >1 (Oostenbrink, 1966).

Data were subjected to an analysis of variance (ANOVA) and the means were clustered using the Scott-Knott test at a significance level of 0.05. All computations were performed using Genes software (Cruz, 2013).

RESULTS AND DISCUSSION

Significant differences were observed for all the evaluated characters in each species (P<0,005). The coefficient of variation values for NE ranged between 20.00% and 53.35%, being higher than the other evaluated characters. The relation between the genotypic coefficient of variation and the environmental coefficient of variation (CVg/CV) was superior to the unity value for all the characters. This indicates the preponderance of genetic variability when compared to the environmental variability, as well a satisfactory degree of accuracy regarding the obtained results.

Giving the EMI, Gi, and Rf values, conjointly, it can be observed that the resistant Solanum species to *M.* enterolobii in a decreasing order were: *S. acanthodes*, *S. lycocarpum*, *S. subinerme*, *S. scuticum* and *S. sessiliflorum*. The control treatments, tomato cultivars 'Nemadoro' considered resistant and 'Rutgers' considered susceptible to root-knot nematodes, were both susceptible to *M. enterolobii* (Tables 1-5). An important aspect to take into consideration is that the tomato hybrids available in the national market with resistance to *M. incognita* race 1 and *M. javanica* are all susceptible to *M. enterolobii*. This species presents a wide polyphagia and aggressive behavior for most of the cultivated vegetables compared to the aforementioned nematode species that prevail in the country. Other aspect to bear, regarding crop rotation and the necessity of resistant sources, is the ability of *M. enterolobii* to multiply its population in the soybean cultivar 'Forest', 'CDH' sweetpotato cultivar and 'Rossol' tomato cultivar, considered resistant to other *Meloidogyne* species, a case registered in Africa in the late 80's (Fargette, 1987).

Regarding *S. sessiliflorum*, all the accessions were susceptible to *M. enterolobii* with an average population 28 times higher than the inoculated, even when compared to the controls – 'Nemadoro' and 'Rutgers' tomato cultivars, according to

Table 1: Evaluation of *Solanum sessiliflorum* accessions to *Meloidogyne enterolobii*. Embrapa Vegetables, 2019

Accessions	*Meloidogyne enterolobii*			
	EMI	Gi	Ne	Rf/Reaction
CNPH 067	4.02^{b}	4.33^{b}	1968.82^{b}	3.07$^{b/S}$
CNPH 197	4.57^{a}	4.61^{a}	3047.08^{b}	4.17$^{b/S}$
CNPH 201	4.96^{a}	4.96^{a}	1303.30^{b}	7.42$^{b/S}$
CNPH 441	4.97^{a}	5.00^{a}	1106.08^{b}	11.00$^{b/S}$
CNPH 443	4.88^{a}	4.94^{a}	1769.84^{b}	11.89$^{b/S}$
CNPH 196	5.02^{a}	3.72c	2795.17^{b}	12.01$^{b/S}$
CNPH 203	4.96^{a}	4.96^{a}	2293.80^{b}	16.42$^{b/S}$
CNPH 442	5.01^{a}	4.99^{a}	3357.12^{b}	26.23$^{b/S}$
CNPH 440	4.93^{a}	5.02^{a}	7611.87^{a}	111.80$^{a/S}$
Rutgers	4.00^{b}	4.00^{c}	2882.50^{b}	13.33$^{b/S}$
Nem^{a}doro	5.00^{a}	4.00^{c}	2220.00^{b}	13.32$^{b/S}$
Me^{a}ns	4.77	4.63	3310.70	28.08
CV	5.71	5.58	20.00	25.31
CVg/CV	1.33	1.83	1.67	2.41

Gall index (Gi) and egg mass index (EMI) - Taylor and Sasser (1978); (NE) - number of eggs per gram of roots; Rf: reproduction factor = initial/final nematode population (Rf=Pf/Pi) (5000 eggs and J2); Resistance reactions according to Oostenbrink (1966): immune (I) when presented a Rf value = 0, resistant with a Rf value <1 and susceptible (S) with Rf value >1; Means followed by the same lowercase letters in the columns and capital letters in the lines do not differ by Scott-Knott clustering test at 5% probability; CV: coefficient of variation; CVg/CV: relation between the genotypic and environmental coefficient of variation

the Rf values (Table 1). Guimarães et al. (2019) affirm that *S. sessiliflorum* provided vigor to tomato cultivar 'Santa Clara'. However, even though it presents such an advantage, due to its susceptibility to *M. enterolobii*, its adoption as a rootstock should be restricted to areas without the presence of this pathogen, taking advantage of its resistance to bacterial wilt *Ralstonia solanacearum* (Fernandes and Bentes, 2018).

Some of the accessions of *S. lycocarpum* were considered resistant, providing a smaller nematode population than the inoculated, with the exception of CNPH 310, which presented EMI and Gi equivalent to the controls. Accessions CNPH 303, CNPH 304 and CNPH 320 presented value of Rf above its unit being considered susceptible. Accessions CNPH 321, CNPH 299, CNPH 307, CNPH 314 and CNPH 329 were immune, that is, although a small amount of eggs (EMI and NE) and galls on the roots (Gi) were observed, no nematodes were found surviving in the samples (Table 2). Mendonça et al. (2005) and Farias et al. (2013), in the conditions of the Cerrado and Amazon Biomes, respectively, recommend *S. lycocarpum* due to its good compatibility with tomato, resistance to *R. solanacearum* and adaptability to organic production systems. Thus, in complementary usage to these indications, since they are considered immune to *M. enterolobii,* the accessions mentioned above are considered suitable rootstock alternatives.

Table 2: Evaluation of *Solanum lycocarpum* accessions to *Meloidogyne enterolobii*. Embrapa Vegetables, 2019

Accessions	*Meloidogyne enterolobii*			
	EMI	Gi	Ne	Rf/Reaction
CNPH 321	1.13^{d}	0.96^{c}	44.46^{c}	0.00$^{b/I}$
CNPH 299	1.17^{d}	1.00^{c}	57.33^{c}	0.00$^{b/I}$
CNPH 307	1.50^{d}	1.00^{c}	162.00^{c}	0.00$^{b/I}$
CNPH 314	1.00^{d}	1.00^{c}	103.67^{c}	0.00$^{b/I}$
CNPH 329	1.83^{d}	1.67^{b}	69.50^{c}	0.00$^{b/I}$
CNPH 306	1.58^{d}	1.38^{c}	157.22^{c}	0.16$^{b/R}$
CNPH 316	1.00^{d}	1.00^{c}	236.33^{c}	0.17$^{b/R}$
CNPH 317	1.17^{d}	1.00^{c}	283.17^{c}	0.17$^{b/R}$
CNPH 331	2.83^{c}	2.33^{b}	90.50^{c}	0.17$^{b/R}$
CNPH 326	1.83^{d}	1.50^{c}	396.00^{c}	0.17$^{b/R}$
CNPH 302	2.42^{c}	2.20^{b}	69.48^{c}	0.24$^{b/R}$
CNPH 308	1.17^{d}	1.00^{c}	79.68^{c}	0.24$^{b/R}$
CNPH 305	1.33^{d}	1.17^{c}	109.67^{c}	0.33$^{b/R}$
CNPH 311	1.67^{d}	1.50^{c}	122.33^{c}	0.33$^{b/R}$
CNPH 312	2.00^{c}	2.00^{b}	238.50^{c}	0.33$^{b/R}$
CNPH 330	1.83^{d}	1.50^{c}	151.33^{c}	0.33$^{b/R}$
CNPH 315	1.17^{d}	1.17^{c}	251.17^{c}	0.33$^{b/R}$
CNPH 300	1.42^{d}	1.00^{c}	165.08^{c}	0.44$^{b/R}$
CNPH 328	2.17^{c}	2.00^{b}	146.00^{c}	0.50$^{b/R}$
CNPH 365	1.50^{d}	1.00^{c}	156.33^{c}	0.50$^{b/R}$
CNPH 322	2.58^{c}	1.98^{b}	286.02^{c}	0.59$^{b/R}$
CNPH 309	1.33^{d}	1.33^{c}	263.67^{c}	0.67$^{b/R}$
CNPH 319	2.33^{c}	2.00^{b}	331.33^{c}	0.83$^{b/R}$
CNPH 304	1.67^{d}	1.50^{c}	493.83^{c}	1.17$^{b/S}$
CNPH 303	3.50^{b}	2.00^{b}	567.33^{c}	1.67$^{b/S}$
CNPH 320	3.01^{c}	2.61^{b}	903.23^{c}	1.69$^{b/S}$
CNPH 310	4.97^{a}	4.96^{a}	940.53^{c}	7.74$^{b/S}$
Rutgers	4.93^{a}	4.96^{a}	4679.86^{a}	25.35$^{a/S}$
Nem^{a}doro	5.00^{a}	5.00^{a}	3146.17^{b}	25.50$^{a/S}$
Me^{a}ns	2.10	1.85	506.96	2.39
CV	13.32	10.63	49.84	41.83
CVg/CV	1.53	2.09	1.53	1.88

Gall index (Gi) and egg mass index (EMI) - Taylor and Sasser (1978); (NE) - number of eggs per gram of roots; Rf: reproduction factor = initial/final nematode population (Rf=Pf/Pi) (5000 eggs and J2); Resistance reactions according to Oostenbrink (1966): immune (I) when presented a Rf value = 0, resistant with a Rf value <1 and susceptible (S) with Rf value >1; Means followed by the same lowercase letters in the columns and capital letters in the lines do not differ by Scott-Knott clustering test at 5% probability; CV: coefficient of variation; CVg/CV: relation between the genotypic and environmental coefficient of variation

As for *S. acanthodes* accessions, only two were susceptible - CNPH 171 and CNPH 337. Thirteen accessions were resistant, and accessions CNPH 145, CNPH 147, CNPH 157, CNPH 166 and CNPH 167 were immune (Table 3). However, although the immunity of this accessions, they should be evaluated regarding their influence in the tomato yields, as Pereira et al. (2018b) state that *S. acanthodes* had a lower response in terms of fruit production than accessions of *S. scuticum*, *S. stramonifolium*, *S. subinerme* and not grafted tomato cv. BRS Kiara.

Most of the accessions of *S. subinerme* were considered susceptible. However, their average means value of Rf was 2.55, much lower than the controls. Accessions CNPH 126, CNPH 134, CNPH 141 and CNPH 207, were resistant (Table 4).

Table 3: Evaluation of *Solanum acanthodes* accessions to *Meloidogyne enterolobii.* Embrapa Vegetables, 2019

Accessions	*Meloidogyne enterolobii*			
	EMI	Gi	Ne	Rf/Reaction
CNPH 145	1.17^{d}	1.17^{d}	76.00^{c}	$0.00^{b/I}$
CNPH 147	1.50^{d}	1.33^{d}	83.62^{c}	$0.00^{b/I}$
CNPH 154	1.33^{d}	1.17^{d}	93.33^{c}	$0.00^{b/I}$
CNPH 157	1.33^{d}	1.33^{d}	352.00^{c}	$0.00^{b/I}$
CNPH 166	1.83^{c}	1.83^{c}	53.33^{c}	$0.00^{b/I}$
CNPH 167	1.00^{d}	1.00^{d}	96.83^{c}	$0.00^{b/I}$
CNPH 155	1.39^{d}	1.19^{d}	71.49^{c}	$0.03^{b/R}$
CNPH 168	1.00^{d}	1.00^{d}	78.33^{c}	$0.17^{b/R}$
CNPH 151	2.50^{b}	2.33^{b}	177.33^{c}	$0.17^{b/R}$
CNPH 156	1.00^{d}	1.00^{d}	126.00^{c}	$0.17^{b/R}$
CNPH 152	2.33^{b}	2.17^{c}	111.83^{c}	$0.33^{b/R}$
CNPH 158	1.83^{c}	1.83^{c}	261.33^{c}	$0.33^{b/R}$
CNPH 164	1.00^{d}	1.00^{d}	108.67^{c}	$0.33^{b/R}$
CNPH 146	2.50^{b}	2.50^{b}	139.50^{c}	$0.50^{b/R}$
CNPH 153	2.67^{b}	2.67^{b}	70.50^{c}	$0.50^{b/R}$
CNPH 162	1.83^{c}	1.50^{d}	158.17^{c}	$0.50^{b/R}$
CNPH 149	2.00^{c}	1.17^{d}	121.50^{c}	$0.67^{b/R}$
CNPH 150	2.17^{c}	2.17^{c}	203.67^{c}	$0.83^{b/R}$
CNPH 165	2.00^{c}	1.33^{d}	400.67^{c}	$0.83^{b/R}$
CNPH 171	1.33^{d}	1.17^{d}	152.17^{c}	$1.00^{b/S}$
CNPH 337	1.00^{d}	1.00^{d}	424.33^{c}	$1.50^{b/S}$
Rutgers	5.00^{a}	5.00^{a}	8814.00^{a}	$5.00^{b/S}$
Nemadoro	5.00^{a}	5.00^{a}	3034.83^{b}	$15.50^{a/S}$
Means	1.94	1.82	661.28	1.23
CV (%)	11.00	10.00	53.35	31.38
CVg/CV	1.84	2.16	2.10	1.76

Gall index (Gi) and egg mass index (EMI) - Taylor and Sasser (1978); (NE) - number of eggs per gram of roots; Rf: reproduction factor = initial/final nematode population (Rf=Pf/Pi) (5000 eggs and J2); Resistance reactions according to Oostenbrink (1966): immune (I) when presented a Rf value = 0, resistant with a Rf value <1 and susceptible (S) with Rf value >1; Means followed by the same lowercase letters in the columns and capital letters in the lines do not differ by Scott-Knott clustering test at 5% probability; CV: coefficient of variation; CVg/CV: relation between the genotypic and environmental coefficient of variation

Table 4: Evaluation of *Solanum subinerme* accessions to *Meloidogyne enterolobii*.Embrapa Vegetables, 2019

Accessions	*Meloidogyne enterolobii*			
	EMI	Gi	Ne	Rf/Reaction
CNPH 126	2.50^{b}	1.83d	167.50^{c}	$0.50^{c/R}$
CNPH 134	3.02^{b}	1.80d	114.24^{c}	$0.55^{c/R}$
CNPH 141	4.00^{a}	2.50^{c}	120.50^{c}	$0.50^{c/R}$
CNPH 207	2.67^{b}	2.50^{c}	133.33^{c}	$0.67^{c/R}$
CNPH 125	4.50^{a}	3.67^{b}	321.00^{c}	$1.00^{c/S}$
CNPH 127	1.83^{b}	1.67d	237.17^{c}	$1.00^{c/S}$
CNPH 129	4.00^{a}	2.67^{c}	247.33^{c}	$1.00^{c/S}$
CNPH 128	4.50^{a}	3.17^{c}	284.17^{c}	$1.33^{c/S}$
CNPH 140	4.67^{a}	2.67^{c}	358.50^{c}	$1.50^{c/S}$
CNPH 138	4.88^{a}	4.16^{a}	599.67^{c}	$1.52^{c/S}$
CNPH 123	5.00^{a}	4.33^{a}	357.67^{c}	$1.52^{c/S}$
CNPH 137	4.17^{a}	3.00^{c}	1021.50^{c}	$1.83^{c/S}$
CNPH 133	4.67^{a}	3.00^{c}	764.67^{c}	$2.00^{c/S}$
CNPH 132	5.00^{a}	3.50^{b}	567.83^{c}	$2.33^{c/S}$
CNPH 131	5.00^{a}	3.83^{b}	740.44^{c}	$2.35^{c/S}$
CNPH 136	4.33^{a}	3.17^{c}	588.50^{c}	$2.83^{c/S}$
CNPH 139	5.02^{a}	3.00^{c}	600.44^{c}	$2.95^{c/S}$
CNPH 202	4.17^{a}	3.33^{b}	792.00^{c}	$3.00^{c/S}$
CNPH 31	4.33^{a}	3.50^{b}	2607.00^{b}	$4.00^{c/S}$
CNPH 130	4.33^{a}	3.33^{b}	917.33^{c}	$4.67^{c/S}$
CNPH 144	3.67^{a}	3.67^{b}	899.17^{c}	$4.67^{c/S}$
CNPH 143	4.00^{a}	3.00^{c}	1262.50^{c}	$6.33^{c/S}$
Rutgers	5.00^{a}	5.00^{a}	4643.00^{a}	$14.50^{b/S}$
Nemadoro	5.00^{a}	5.00^{a}	3718.50^{a}	$23.00^{a/S}$
Means	4.18	3.22	919.33	3.56
CV	13.57	12.72	52.72	36.04
CVg/CV	0.71	0.90	1.01	1.34

Gall index (Gi) and egg mass index (EMI) - Taylor and Sasser (1978); (NE) - number of eggs per gram of roots; Rf: reproduction factor = initial/final nematode population (Rf=Pf/Pi) (5000 eggs and J2); Resistance reactions according to Oostenbrink (1966): immune (I) when presented a Rf value = 0, resistant with a Rf value <1 and susceptible (S) with Rf value >1; Means followed by the same lowercase letters in the columns and capital letters in the lines do not differ by Scott-Knott clustering test at 5% probability; CV: coefficient of variation; CVg/CV: relation between the genotypic and environmental coefficient of variation.

S. scuticum was the Solanum species with the greatest variation regarding the Rf values, with 14 resistant accessions and 12 susceptible accessions. Among the susceptible, 4 were extremely susceptible, grouped together with EMI values above 3.50, NE values above 3,000 eggs per gram of roots; and Rf greater than 17 (Table 5). Of the accessions of *S. scuticum* considered resistant in the present study (Table 5), Lopes and Mendonça (2016) found that the vast majority are also resistant to *R. solanacearum*; the only access that was resistant in the present study and which was susceptible to *R. solanacearum* was CNPH 84, while the CNPH 64 access was not characterized in that study. These results further emphasize the importance of this species for potential use as rootstocks.

González et al. (2010) evaluated the reaction of wild Solanaceae to *M. incognita* race 2 and *M. arenaria*, and found that *Datura stramonium* L. was immune, and *S. mammosum* L. was highly resistant to both nematode species; while *S. torvum* and *S. erianthum* were immune to *M. incognita* race 2 and highly resistant to *M. arenaria*. Navarette et al. (2018) classified accessions of *S. hirtum* and *S. arboreum*, as resistant to *M. incognita*, whereas the accessions of *S. auriculatum*, *S. hispidum*, *S. quitoense*, *S. betaceum* were susceptible. Cardoso et al. (2019) evaluated the reaction of wild Solanaceae species to *M. javanica* and found that the species *S. capsicoides*, *S. palinacanthum* were resistant; while *S. viarum* was susceptible.

Looking for rootstocks resistant to *M. enterolobii*, Pinheiro et al. (2014) evaluated the reaction of *S. stramonifolium* to this nematode, and found that of 17 accessions, 7 were resistant. Likewise, Pereira et al. (2018) evaluated 22 accessions of S. *stramonifolium* to *M. enterolobii*, and found that 11 were resistant.

Thus, *Solanum acanthodes* and *S. lycocarpum* are species with a high degree of resistance to *M. enterolobii*, with

Table 5: Evaluation of *Solanum scuticum* accessions to *Meloidogyne enterolobii*. Embrapa Vegetables, 2019

Accessions	*Meloidogyne enterolobii*			
	EMI	Gi	Ne	Rf/Re^{a}ction
CNPH 53	0.17^{d}	0.17^{e}	4.88^{e}	0.04$^{f/R}$
CNPH 78	1.00^{c}	1.00^{d}	4.78^{e}	0.07$^{f/R}$
CNPH 61	1.17^{c}	1.17^{d}	12.65^{e}	0.09$^{f/R}$
CNPH 51	0.67^{d}	0.67^{e}	23.07^{e}	0.11$^{f/R}$
CNPH 62	0.50^{d}	0.50^{e}	11.02^{e}	0.11$^{f/R}$
CNPH 68	1.00^{c}	1.00^{d}	16.93^{e}	0.13$^{f/R}$
CNPH 60	0.50^{d}	0.67^{e}	15.31^{e}	0.13$^{f/R}$
CNPH 48	0.33^{d}	0.50^{e}	50.18^{e}	0.18$^{f/R}$
CNPH 73	0.67^{d}	0.67^{e}	39.50^{e}	0.20$^{f/R}$
CNPH 52	0.67^{d}	0.67^{e}	37.95^{e}	0.21$^{f/R}$
CNPH 64	0.33^{d}	0.33^{e}	38.69^{e}	0.22$^{f/R}$
CNPH 63	0.83^{d}	0.83^{e}	37.32^{e}	0.24$^{f/R}$
CNPH 79	0.83^{d}	1.00^{d}	48.82^{a}	0.27$^{f/R}$
CNPH 84	1.50^{c}	1.67^{c}	219.30^{d}	0.99$^{f/R}$
CNPH 85	2.00^{b}	2.17^{b}	267.39^{d}	1.49$^{f/S}$
CNPH 74	1.50^{c}	1.67^{c}	430.93^{d}	2.23e$^{/S}$
CNPH 87	2.00^{b}	2.17^{b}	308.53^{d}	2.34e$^{/S}$
CNPH 81	1.50^{c}	1.67^{c}	346.70^{d}	3.15e$^{/S}$
CNPH 90	2.17^{b}	2.17^{b}	895.28^{c}	5.05d$^{/S}$
CNPH 82	1.83^{b}	2.50^{b}	575.42^{c}	5.88d$^{/S}$
CNPH 83	2.50^{b}	2.17^{b}	2202.47^{b}	6.83d$^{/S}$
CNPH 69	2.67^{b}	3.50^{a}	2040.46^{b}	12.65c$^{/S}$
CNPH 88	3.50^{a}	4.17^{a}	3801.30^{a}	17.48b$^{/S}$
CNPH 89	3.50^{a}	3.83^{a}	3588.46^{a}	17.54b$^{/S}$
CNPH 86	3.83^{a}	4.00^{a}	4356.35^{a}	22.68$^{a/S}$
CNPH 70	3.67^{a}	3.83^{a}	3554.02^{a}	23.97$^{a/S}$
Nemadoro	2.17^{b}	3.83^{a}	199.50^{d}	1.04$^{f/S}$
Rutgers	3.58^{a}	4.83^{a}	1640.12^{b}	7.04d$^{/S}$
Means	1.63	1.86	889.65	4.60
CV	15.92	14.55	41.14	22.31
CVg/CV	1.88	1.89	2.36	3.26

Gall index (Gi) and egg mass index (EMI) - Taylor and Sasser (1978); (NE) - number of eggs per gram of roots; Rf: reproduction factor = initial/final nematode population (Rf=Pf/Pi) (5000 eggs and J2); Resistance reactions according to Oostenbrink (1966): immune (I) when presented a Rf value = 0, resistant with a Rf value <1 and susceptible (S) with Rf value >1; Means followed by the same lowercase letters in the columns and capital letters in the lines do not differ by Scott-Knott clustering test at 5% probability; CV: coefficient of variation; CVg/CV: relation between the genotypic and environmental coefficient of variation

accessions considered to be immune. *S. scuticum* also has a high potential, as several resistant accessions have been identified as resistant, although some accessions have been highly susceptible; whereas for *S. subinerme*, only 4 resistant accessions were identified, although all the others had Rf values much lower than the controls; and all accessions of *S. sessiliflorum* evaluated were susceptible.

CONCLUSIONS

S. acanthodes and *S. Lycocarpum* are species with high resistance to *M. enterolobii*, with accessions being classified identified as immune. *S. scuticum* also has great potential, as several resistant accessions were identified, although some accessions were quite susceptible; whereas for *S. subinerme* only 4 resistant accessions were identified, although all others presented a reproduction factor much lower than tomato cv. Nemadoro as control; and all evaluated *S. sessiliflorum* accessions were susceptible.

Authors' contributions

All authors participated in the planning of this work and also contributed to the written. Jadir Borges Pinheiro, Danielle Biscaia and Jhenef Gomes de Jesus performed the evaluations in the laboratory and greenhouses. The authors Giovani Olegario da Silva and Raphael Augusto de Castro e Melo helped in all stages of the work development, they just did not participate in the greenhouse and laboratory evaluations.

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