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Resistance to *Meloidogyne mayaguensis* in *Psidium* spp. Accessions and their Grafting Compatibility with *P. guajava* cv. Paluma

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ABSTRACT

Meloidogyne mayaguensis has been reported in some states of Brazil causing severe damage on commercial guava (*Psidium guajava* L.). Accessions of *Psidium* spp. were selected from a collection maintained in Embrapa Clima Temperado (Pelotas, Rio Grande do Sul State). Plants of different accessions were grown from seed in plastic bags and, when they reached 15-20 cm in height, were inoculated with 10,000 eggs/plant of *M. mayaguensis*. Eight months after inoculation, the different accessions were evaluated for resistance to *M. mayaguensis*. Three accessions of *P. guajava* were highly susceptible (RF=59.2) to this nematode. *Psidium friedrichsthalianium* was considered to be moderately resistant (RF=1.9). Three accessions of *P. cattleyanum* were immune to *M. mayaguensis* (RF = 0). When used as rootstocks *P. cattleyanum* and *P. friedrichsthalianium* were compatible with *P. guajava* cv. Paluma. Considering these results, the use of resistant rootstocks provides a promising control method for *M. mayaguensis* in commercial guava crop.

Additional keywords: root-knot nematode, guava, rootstock, *Psidium cattleyanum, Psidium friedrichsthalianium.*

RESUMO

Resistência de acessos de *Psidium* spp. a *Meloidogyne mayaguensis* e compatibilidade de enxertia com *P. guajava* cv Paluma

Meloidogyne mayaguensis tem sido assinalado em alguns estados do Brasil causando danos severos em goiabeiras comerciais (*Psidium guajava* L.). Acessos de *Psidium* spp. foram selecionados a partir de uma coleção mantida na Embrapa Clima Temperado (Pelotas, RS). Plantas de diferentes acessos foram transplantadas em sacos plásticos e quando atingiram 15-20 cm de altura foram inoculadas com *M. mayaguensis* (10.000 ovos/planta). Oito meses após a inoculação, os diferentes acessos foram avaliados quanto à resistência a esse nematóide. Três acessos de *P. guajava* foram altamente suscetíveis (FR=59,2). *Psidium friedrichsthalianium* foi considerado moderadamente resistente (FR=1,9). Três acessos de *P. cattleyanum* foram imunes (FR=0) a *M. mayaguensis*. *P. friedrichsthalianium* e *P. cattleyanum* quando usados como porta-enxertos foram compatíveis com *P. guajava* cv. Paluma. Considerando esses resultados, o uso de porta-enxertos resistentes poderá vir a ser um método promissor para o controle de *M. mayaguensis* em plantios comerciais de goiaba.

Palavras–chave adicionais: nematóide de galhas, goiaba, porta-enxerto, *Psidium cattleyanum, Psidium friedrichsthalianium.*

INTRODUCTION

The common guava (*Psidium guajava* L.) is indigenous to tropical America. The root-knot nematode (*Meloidogyne* spp.) is a recognized limiting factor in commercial guava production in Central American countries (El Borai & Duncan, 2005). Considering the difficulty of identifying *Meloidogyne mayaguensis* Rammah & Hirschmann, 1988 only by the perineal pattern (Carneiro *et al*., 2001; Brito *et al*., 2004), it is possible that *M. mayaguensis* from guava has been misidentified in different regions of the world. It is therefore possible that the severe root-knot problem in the Americas and the isolated cases in Africa involve only this particularly virulent species.

The guava is one of the fruit trees that is best adapted to the region of the Mid São Francisco river valley in Brazil. It is the best choice for small-holders as it uses the abundant local labor, has a low production cost and presents a fast return on investments. The species *Meloidogyne mayaguensis* was detected for the first time in Brazil, in Petrolina (Pernambuco State) and Curaçá and Maniçoba (Bahia State) (Carneiro *et al.,* 2001). Severely infected trees decline rapidly, culminating in the death of the plants. Moderate infestations are associated with general chlorosis, nutrient deficiency symptoms and reduced flowering and fruiting. Roots of infected trees show multiple galls and secondary infections by other soil micro-organisms. This nematode is making cultivation of guava in the infested areas unfeasible, causing serious economic problems to growers and the economy of the region (Moreira *et al.,* 2003).

In the mid San Francisco region, the area cultivated with guava has decreased from 6,000 ha to 1,669 ha in seven years (2000-2006), a reduction of more than 70% of the guava production (Plantec/Codevasf, personal communication). Recently, severe symptoms of the attack of *M. mayaguensis* on guava have been reported from different regions and States of Brazil: Ceará and Rio Grande do Norte (Torres *et al.,* 2004, 2005), Rio de Janeiro (Lima *et al*., 2003), Espirito Santo (Lima *et al*., 2007)**,** São Paulo (Almeida *et al.*, 2006a), Paraná (Carneiro *et al*., 2006) and Piauí (Soares *et al*., 2006). This species was detected in the state of Rio de Janeiro in native areas of Atlantic forest (Lima *et al.*, 2005), suggesting that the nematode has not been introduced in Brazil from other countries, as suggested when it was reported for the first time in the country (Carneiro *et al.,* 2001). In all recent surveys in Brazil the species *M. mayaguensis* was identified using esterase profile (Est M2, Rm: 0.7, 0.9) (Carneiro *et al,* 2000). The perineal patterns of *M. mayaguensis* isolates from Brazil showed morphological variability and are often similar to *M. incognita.* In Brazil, *M. incognita* was identified on guava by Moura & Moura (1989), using female perineal patterns. However, this species has not been detected in recent field surveys in Pernambuco State, and was probably misidentified in the past. The purpose of this study was to evaluate indigenous *Psidium* species for resistance to *M. mayaguensis* and their compatibility as rootstock for *P. guajava* cv Paluma.

MATERIAL AND METHODS

Accessions of *Psidium guajava* (3), *P. friedrichsthalianium* (Berg.) Nied (1) and *P. clatteyanum* Sabine (3) were evaluated under greenhouse conditions (25-30 °C) for resistance to *M. mayaguensis* (population from Petrolina). The susceptible commercial variety Paluma was used as control. *M. mayaguensis* was identified using the methodology described by Carneiro & Almeida (2001) and maintained in a greenhouse on 'Santa Cruz' tomato.

Plants of different accessions were grown from seed in plastic bags (3000 cm^3 volume) containing a moist, steam-sterilized loamy sand soil (85 % sand, 10 % of silt and 5% of clay). When plants were 15-20 cm high, they were inoculated with 10,000 eggs/plant (Pi=initial inoculum level), extracted from infected tomatoes, using NaOCl 0.5 % according to Hussey & Barker's method (1973), using a blender instead of manual agitation. The pots were arranged in a randomized complete block design with 8 replicates. Eight months after inoculation, the accessions were evaluated by Hartmant & Sasser's (1985) rating index, according to the scale: 0 = no galls or egg masses, 1=1-2 galls or egg masses, 2=3-10, 3=11-30, 4 = 31-10, and 5=over 100 galls or egg masses. Plants that had an average gall and egg mass index of 2 or lower were considered resistant.

The seven accessions were also evaluated by extracting the eggs from the entire root system, as in the methodology described above, using 1% of NaOCl. The final population density (Pf) was quantified using a Peters slide under the microscope and the nematode reproduction factor (RF= Pf/Pi) was calculated. The reproduction factors were compared by Tukey's test with significant difference at 5% of probability. We considered treatments with Rf < 1.00 as resistant to *M. mayaguensis*. Twelve-month-old plants of *P. friedrichsthalianium* and *P. clatteyanum* were grafted with *P. guajava* cv. Paluma using whip grafting method (Manica *et al*., 2000).

RESULTS AND DISCUSSION

The reproduction factor (RF) of *M. mayaguensis* (Table 1) in three accessions of guava was high, confirming that *P. guajava* is highly susceptible to *Meloidogyne* spp. (Figura 1) (Cuadra &

TABLE 1 - Response of different accessions of *Psidium* spp. to *Meloidogyne mayaguensis*

Psidium **species and accession/origin**	**Rating index number**		**Root weight**	**Total number of eggs/g of root**	**Reproduction factor (RF)**
	gall	**egg mass**			
P. guajava cv Paluma Petrolina, PE, Brazil	5	5	26.9	11,111.2	27.1c* (S)**
P. guajava Colombian acession	5	5	62.5	13,793.4	94.1 d (S)
P. guajava Accession FRF 1433 Pelotas, RS, Brazil	5	5	27.0	23,119.13	56.3 e (S)
P. friedrichsthalianium Accession Costa Rica	3	2	19.25	965.75	1.9 b (MR)
P. clatteyanum Red Araçá Pelotas, RS, Brazil	0	0	14.9	0	0 a (R)
P. clatteyanum Acession Leodoro Pelotas,RS, Brazil	0	0	7.0	0	0 a (R)
P. clatteyanum Acession Ya-cy Pelotas, RS, Brazil	0	0	7.14	0	0 a (R)

*mean number with different lower–case differ from one another by Tukey's test at 5% **S = susceptible, MR = moderately resistant, R = resistant

Quincosa, 1982; Babatola & Oyedunmade, 1992; Maranhão *et al*., 2001). *Psidium friedrichsthalianium* was considered to be moderately resistant (RF=1.9) to *M. mayaguensis* (Table 1, Figure 1). These results confirm the observations made by Cassava *et al*. (1998) and Matheus *et al.* (1999). According to these authors, *P. friedrichsthalianium* was only slightly affected by *M. incognita* race 1. The problem in Cuba was also addressed by screening other *Psidium* species for possible resistant rootstocks and resulted in the commercial use of the rootstock *P. friedrichsthalianium*, which evidently shows a high degree of resistance to *Meloidogyne* spp. (Fernandez Dias Silveira, 1975). However, the reaction appears to vary with plant material or nematode species. Gonzales & Sourd (1982) and Villota *et al.* (1997) found *P. friedrichsthalianium* to show only moderate tolerance to *Meloidogyne* or susceptibility to *M. mayaguensis* (Almeida *et al.*, 2006b).

The reproduction factor (RF) of the nematode in three accessions of *Psidium cattleyanum* was zero and this species can be considered highly resistant or immune to *M. mayaguesis* (Table 1, Figura 1). However, *P. cattleyanum* was considered highly susceptible to *Meloidogyne* sp. Unfortunately, the species of *Meloidogyne* was not identified (Cuadra & Quincosa, 1982). Recently, Molinari *et al.* (2005) detected *M. mayaguensis* parasitizing guava in Venezuela and tomato in Cuba using isozyme analysis. Considering the difficulty of identifying *M. mayaguensis* only by the perineal pattern (Carneiro *et al*., 2001; Brito *et al*., 2004), it is possible that *M. mayaguensis* from guava was misidentified in Venezuela, Cuba and other countries.

The grafting assay showed that the species *P. friedrichsthalianium* and *P. cattleyanum* are compatible with *P. guajava* cv. Paluma (Figure 2). Approximately 50% of plants survived after grafting. The roots of *P. friedrichsthalianium* (19.2 g) and *P. cattleyanum* Red Selection 10 (14.9) presented high weight when compared with the roots of *P. cattleyanum* Leodoro (7.6 g) and Ya-cy (7.1 g) (Table 1). Above all, these first two rootstocks presented high root vigor and high capacity for root emission. This information agrees with the results obtained for *P. friedrichsthalianium* by Cassava *et al*. (1998).

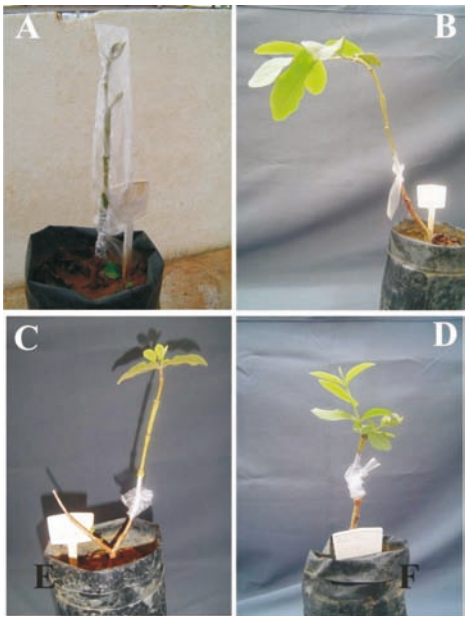

FIG. 2 - Plant of *Psidium guajava* cv Paluma grafted on: **A.** *Psidium cattleyanum* accession Leodoro; **B.** *P. cattleyanum* accession Red Selection 10; **C.** *P. cattleyanum* accession Ya-cy; **D.** *P. friedrichsthalianum* from Costa Rica.

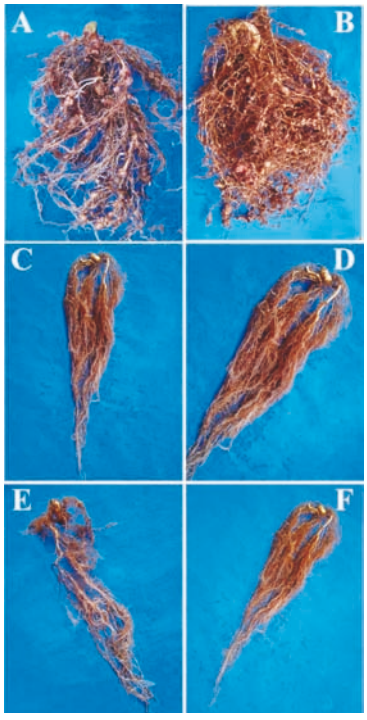

FIG. 1 - Symptoms of *Psidium* spp. roots infected by *Meloidogyne mayaguesis*. **A.** *P. guajava* cv.Paluma (Susceptible); **B.** *P. guajava* Colombian accesion (susceptible); **C**. *P. friedrichsthalianum* (moderately resistant); **D.** *P. cattleyanum* Red Accession 10 (resistant); **E.** *P. cattleyanum* accession Leodoro (resistant); **F.** *P. cattleyanum* accession Ya-cy (resistant).

Considering these results, the use of resistant rootstocks provides a promising control method for *M. mayaguensis* in commercial guava plantations. However, other experiments will be essential to study the development of grafted plants under field conditions, especially in the Mid San Francisco valley region.

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