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Reaction of common bean genotypes to *Meloidogyne incognita* Race 1

Reação do plantas de feijoeiro a Meloidogyne incognita *Raça 1*

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SUMMARY

The objective was to determine the reaction of 33 *Phaseolus vulgaris* L. genotypes to parasitism by *Meloidogyne incognita* race 1. The genotypes used in this study six included commercially exploited ("IAPAR-81", "EL-22", "Carioca", "Serrano", "BATT-477" and "Uirapuru") varieties, one susceptible ("Rico-23") and two resistant ("Aporé" and "Pérola") varieties; the others were provided by farmers of the South of Espírito Santo State. The experiment was carried out in a greenhouse in a completely randomized design with 7 replicates. The plants were inoculated with 4,000 eggs + second-stage juveniles (J2) of nematodes. After 50 days, the final population of nematodes (FP), reproduction factor (RF) and percentage reproduction rate (%RR) were evaluated. The resistance selection was based on the %RR, i.e., 0-25% = highly susceptible (HS); 26-50% = susceptible (SU); 51-75% = little resistant (LR); 76-95% = moderately resistant (MR); 96-99% = resistant (RE); 100% = highly resistant (HR) or immune (IM). Only the genotype "Preto Meia Lua" was highly resistant. The genotypes "Terrinha-2" and "Mulatinho" were classified as resistant, "EL-22", "BATT-477", "Vermelho", "Bate Estrada" and "Paina" as (susceptible) and genotypes "Rico 23" and "Morgado" as highly susceptible.

Key words: Resistance, bean, root-knot nematode.

RESUMO

Objetivou-se com esse trabalho estudar a reação de 33 genótipos de Phaseolus vulgaris *L. ao parasitismo de* Meloidogyne incognita *raça 1 em casa de vegetação. Desses genótipos seis são cultivados comercialmente ("IAPAR-81", "EL-22", "Carioca", "Serrano", "BATT-477" e "Uirapuru"), um é suscetível ("Rico-23"), dois são resistentes ("Aporé" e "Pérola") e os demais foram resgatados em propriedades localizadas no Sul do Espírito Santo. O experimento foi conduzido em casa de vegetação em delineamento inteiramente casualisado com 7 repetições. As plantas foram inoculadas com 4.000 ovos + juvenis de segundo estádio (J2) do nematóide. Após 50 dias da inoculação, foram avaliados a população final de nematóides (PF), fator de reprodução (FR) e o percentual de redução do fator de reprodução (% RFR). Os genótipos foram classificados como altamente susceptível (AS), susceptível (SU), pouco resistente (PR), moderadamente resistente (MR), resistente (RE), altamente resistente (AR) ou imune (IM). Apenas o genótipo "Preto Meia Lua" comportou-se como AR. Os genótipos "Terrinha-2" e "Mulatinho" foram classificados como RE, os genótipos "EL-22", "BATT-477", "Vermelho", "Bate Estrada" e "Paina" como SU e os genótipos "Rico-23" e "Morgado" como AS.*

Palavras chave: *Resistência, feijoeiro comum, nematóide das galhas.*

Introduction

The bean (*Phaseolus vulgaris* L.) is cultivated in Brazil in 5.5 million hectares, but, besides this considerably area, the yields are low compared to other countries (Hungria *et al.*, 2000). Probably, one cause of this reduced production is the action of phytopatogens, as root-knot-nematodes, *Meloidogyne* spp. (Vieira, 1988).

Although phytonematodes frequently are not observed by farmers because of its reduced size or to be associated to root system, the consequence of its parasitism can be drastic to bean plants, implying, in some cases, to the plant death (Vieira, 1988; Costa *et al.*, 2001).

According to some authors when bean plants are cultivated in soil highly infested by *M. javanica* (Treub) Chitwood or *M. incognita* (Kofoid & White)

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Chitwood, the yield reduction varies from 50% to 90% (Zaumeyer & Thomas, 1957, Freire & Ferraz, 1977 and Agudelo, 1980).

Some management methods are used to reduce nematode populations, nevertheless, not always they are applicable in all field conditions. Some of them, as nematicides, are very diffused in agriculture, however, there are dangerous to environment and health human, and are expensive, this way the use of these products are undesirable (Campos, 1999).

Only resistant varieties are the most economic and practice option to control phytonematodes, many researchers have tried to find resistance genes in bean against root-knot nematodes, however without success (Freire, 1976; Mendes *et al.*, 1978; Menten *et al.*, 1980; Ribeiro & Ferraz, 1983; Carneiro and Ferraz, 1992; Pedrosa *et al.*, 2000; Simão *et al.*, 2005).

In the search for plants that exhibit this so desirable level of resistance and tolerance to adverse environmental conditions, the man, since its inception, has selected seed plants more rustic and productive (Nass *et al.*, 2001).

Many farmers in the Southern Espirito Santo State have cultivated different bean genotypes for subsistence for a long time; however researchers have never made any scientific assessment of their resistance against root-knot nematodes. This information is crucial because, according to Alves & Campos (2001), environmental conditions such as high temperatures and sandy soils, common in the south of the Espírito Santo, favor the nematodes reproduction.

Material and Methods

The experiment was carried out in greenhouse from February to April 2006 in a completely randomized design with 7 replicates aiming to evaluate the resistance level of bean genotypes rescued in the Southern Espírito Santo against *Meloidogyne incognita* race 1.

Initially local cultivars of bean plants cultivated for years by farmers were collected in the southern of Espirito Santo State from august to October 2005 in the municipal districts of Alegre, Iconha, Montanha, Marechal Floriano, Mimoso do Sul, Muniz Freire and Vargem Alta.

Twenty-four genotypes were tested, corresponding to "Terrinha-1", "Macuquinho", "Amendoim Vermelho", "Enxofre", "Terrinha-2", "Manteigão-1", "Manteigão-2", "Painã", "Amarelinho", "Imperial", "Vermelho", "Fortuna", "Rio Doce", "Caeté-Pé-Curto", "Vagem Riscada", "Rosinha", "Bate Estrada", "Baetão", "Morgado", "Mulatinho", "Mamona", "Macuquinho Verdadeiro", "Preto Meia Lua" and "Sangue de Boi", 6 comercial cultivars ("IAPAR-81", "EL-22", "Carioca", "Serrano", "BATT-477" and "Uirapuru"). One susceptible ("Rico 23") and two resistant ("Aporé and Pérola") cultivars were included as a control for reference.

Populations of *Meloidogyne incognita* race 1 were obtained from roots of tomato plants cv. Santa Clara cultivated in bags containing a mixture of soil and sand 1:1 (V:V), previously sterilized in autoclave (121 ºC/2 h in three consecutive days), and maintained in greenhouse (Zauza *et al.*, 2007).

Sixty days after inoculation of tomato plants, the roots were separated from aerial parts, washed, cut into 5 cm pieces and ground in a blender using tap water, obtaining the inoculum. From this suspension three aliquots of 1 mL were taken and the number of eggs + second-stage juveniles (J2) was determinated in a Peters chamber with a binocular microscope.

The bean seeds were germinated in blotters sterilized and placed in a germination chamber with constant temperature of 25 ºC until the root emergence. Subsequently, the pre-germinated seeds were transferred to plastic bags containing 2 L of substrate. Each bag received two seeds.

The plant inoculation with nematodes occurred 19 days after planting and, in the previous day, one plant per bag was eliminated. Each plant received an aqueous suspension containing 4000 eggs + J2 of *M. incognita* race 1, pipetted into the hole on substrate with about 3 to 4 cm deep.

50 days after plant inoculation the final population of nematodes per root system (PF) was determined using the method proposed by Hussey & Barker (1973), modified by Bonetti & Ferraz (1981). This estimate gave support to determine the reproduction factor (RF) calculated by the ratio between the final population and the initial population of nematodes (RF = Pf/Pi), and subsequently the reduction of the reproduction rate (%RR) (Moura & Regis, 1987). The reaction of the hosts is presented in Table 1.

Table 1. Criterion to evaluate percentage of the reproduction rate (%RR) (adopted from Moura & Regis, 1987).

%RR	Host reaction
0-25	Highly susceptible (HS)
26-50	Susceptible (SU)
51-75	Little resistant (LR)
76-95	Moderately resistant (MR)
96-99	Resistant (RE)
100	Highly resistant (HR) or immune (IM)

Results and Discussion

In general manner, the genotypes showed low, moderate or no resistance to *M. incognita* race 1. Over the years many investigators have sought sources of resistance in bean to root-knot nematodes, and often do not succeed (Freire, 1976, Mendes *et al.*, 1978; Menten *et al.,* 1980; Ribeiro & Ferraz, 1983; Carneiro & Ferraz, 1992), which corroborates the results found here. Despite these results, it is noteworthy that in the present work three cultivars present a good potential to be assessed in future works.

The genotypes used as standard nematode-resistance ("Aporé" and "Pérola") were MR (Table 2). As the limit for change of classification from R to MR is close, it can be stated that the information about the level of resistance for these genotypes obtained in this study are consistent. Simão *et al.* (2005) evaluated the behavior of the common bean cv. Pérola and Iapar 81 against the *M. javanica* and related that both cultivars were efficient hosts. However, the authors did not evaluate these genotypes against *M. incognita*.

The genotype used as standard nematode-susceptible (Rich-23), behaved as HS (Table 2).

Among commercial genotypes studied two behaved as SU ("EL-22" and "BATT-477) and the others ("IAPAR-81", "Carioca", "Serrano" and "Uirapuru") as MR (Table 2). Simão *et al.* (2005) evaluated the genotypes Pérola and "IAPAR-81" for resistance to *M. javanica* and concluded that the first had higher rates of reproduction compared with the second.

With respect to genotypes rescued it was observed great mix of performance against the nematode. Among the 24 genotypes one behaved as HS, three as SU, eleven as LR, six as MR, two as RE. Only The "Preto Meia Lua "genotype was classified as HR (Table 2).

Table 2. Final population (FP), reproduction factor (RF), percentage of the reproduction rate (%RR) and reaction of 33 genotypes of common bean after 50 days inoculated with ***Meloidogyne incognita*** race 1.

Genotypes	RF	% RR	Reaction 1/
Preto Meia Lua	0,00	100,00	HR
Terrinha-2	0,50	96,77	R
Mulatinho	0,57	96,32	R
Amendoim Vermelho	0,68	95,60	MR
Uirapuru	1,00	93,55	MR
Pérola	1,20	92,26	MR
Aporé	1,83	88,17	MR
Sangue de Boi	2,04	86,83	MR
Enxofre	2,25	85,48	MR
Carioca	2,50	83,87	MR
Vargem Riscada	2,50	83,87	MR
Rio Doce	2,52	83,74	MR
Mamona	2,77	82,14	MR
IAPAR-81	3,22	79,21	MR
Serrano	3,38	78,23	MR
Macuquinho Verdadeiro	3,86	75,12	LR
Caeté-pé-curto	3,88	74,96	LR
Baetão	3,96	74,46	LR
Manteigão-2	4,44	71,37	LR
Terrinha-1	4,74	69,39	LR
Manteigão-1	5,73	63,05	LR
Imperial	6,18	60,14	LR
Amarelinho	6,58	57,52	LR
Rosinha	7,00	54,84	LR
Macuquinho	7,46	51,88	LR
Fortuna	7,49	51,66	LR
EL-22	8,92	42,48	SU
BATT-477	8,94	42,30	SU
Vermelho	10,05	35,14	SU
Bate Estrada	10,79	30,38	SU
Painã	11,46	26,04	SU
Rico-23	13,50	12,90	HS
Morgado	15,50	0,00	HS

1/ HR = highly resistant, RE = Resistant, MR = moderately resistant; LR = little resistant; SU = susceptible, and HS = highly susceptible.

A larger number of genotypes showed high susceptibility compared to resistant or highly resistant. This difficulty to find genotypes R or HR has also been reported by other authors (Mendes *et al.*, 1978; Carneiro & Ferraz, 1992). According to Fuzzato *et al.* (1994) the sources of resistance aren't the same for different nematode species, being difficulty to obtain multiple resistance, so it is necessary that these genotypes are also tested for other nematode species, such as *M. javanica*, common in areas where beans are grown (Vieira, 1988).

Since the most of the genotypes used in this study consisted of rustic plants, selected by farmers

for decades (Nass *et al.*, 2001), it is possible that sources of resistance to other diseases are present in these materials. So it is important that these genotypes are tested for resistance to other diseases, including those of aerial part, in order to find sources of resistance to pathogens that restrict beans cultivation in the Espírito Santo State and in other regions of Brazil, and indicate these genotypes for breeding programs, so that these potential resistance genes can be incorporated into commercial cultivars.

Conclusions

The results obtained from this and other previously published studies indicate that there are few resistance genes in bean to *M. incognita* race 1.

Three cultivars present a good potential to be assessed in future works.

In order to confirm the results, this experiment should be carried out again in field conditions.

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