Research Article

Reaction of common bean genotypes to *Heterodera glycines*[1]

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ABSTRACT

The soybean cyst nematode (*Heterodera glycines*) may result in a significant economic impact on bean cultivation. This study aimed to evaluate the reaction of 55 common bean genotypes from the Embrapa Arroz e Feijão core collection to the race 3/HG type 0 of *H. glycines*. Among the genotypes evaluated, 34 were considered resistant to the cyst nematode, and, in addition to showing a lower population of females in the roots, also reduced the fecundity of *H. glycines*.

KEYWORDS: *Phaseolus vulgaris*, cyst nematode, genetic resistance.

RESUMO

Reação de genótipos de
feijoeiro comum a *Heterodera glycines*

O nematoide de cisto da soja (*Heterodera glycines*) pode resultar em impacto econômico significativo no cultivo de feijão. Objetivou-se avaliar a reação de 55 genótipos de feijão comum da coleção nuclear da Embrapa Arroz e Feijão à raça 3/Tipo HG 0 de *H. glycines*. Dentre os genótipos avaliados, 34 foram considerados resistentes ao nematoide de cisto, os quais, além de apresentarem menor população de fêmeas nas raízes, também reduziram a fecundidade de *H. glycines*.

PALAVRAS-CHAVE: *Phaseolus vulgaris*, nematoide de cisto, resistência genética.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) has agricultural, nutritional, social and economic importance, being cultivated in several countries (Uebersax et al. 2022). Brazil is the second largest producer in the world (FAO 2022), with 3 million tons in just over 2.7 million ha (Conab 2023). The highest yield comes from the third harvest, partly due to the use of high technologies, inputs and irrigation in the central plateau of Brazil, in the Cerrado (Brazilian Savanna) region (Silva & Wander 2018).

Several species of nematodes are reported to cause diseases in common bean, including *Meloidogyne javanica* (Treub 1885) (Chitwood 1949), *M. incognita* (Kofoid & White 1919) Chitwood (1949) and *Pratylenchus brachyurus* (Godfrey 1929) (Freire & Ferraz 1977, Abawi & Widmer 2000, Bonfim Junior et al. 2021). However, host ability studies of common bean to *Heterodera glycines* (Ichinohe 1952) have showed that most cultivars are susceptible to the nematode (Noel et al. 1982, Jain et al. 2019, Dias et al. 2023). Although this nematode is mainly known for causing yellow dwarfism in soybean, some bean lines have behaved as more susceptible than soybean (Melton et al. 1986).

The cyst nematode has been considered an emerging pest in common bean crops in many regions, such as the midwestern USA (Shi et al. 2021). Symptoms such as plant yellowing and stunting were observed in common bean (Yan et al. 2017); however, the recognition of this nematode as the cause of crop losses usually occurs late in the season, since the symptoms are visible only at the end stage of the crop. At this time, it is impossible to eradicate the nematode due to its survival mechanisms, since the cysts produced by *H. glycines* remain viable in the soil for many years (Sato et al. 2019, Shaibu et al. 2020).

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The proper management of this nematode is performed by integration techniques that aim to reduce the pathogen population. Both crop rotation with non-host species and resistant cultivars are the most suitable measures to reduce *H. glycines* populations in the growing area (Ferraz et al. 1999, Yan & Baidoo 2018). The use of resistant cultivars allows the cultivation of the crop of interest, does not incur in additional costs or environmental harm, and enables the production in large areas (EPPO 2008). Nevertheless, in 2011, Singh & Schwartz considered that the breeding of common bean plants for resistance to cyst nematode was practically non-existent, what indicates a lack of studies for this species.

So far, there are few studies evaluating the reaction of bean genotypes to *H. glycines*. Abawi & Jacobsen (1984) showed that the evaluated bean and soybean cultivars did not differ in terms of cyst nematode development. On the other hand, Smith & Young (2003) concluded that *P. vulgaris* genotypes differed in their host suitability to different isolates of *H. glycines*. Similarly, Poromarto & Nelson (2009) described a variation in susceptibility for 24 bean cultivars evaluated in Iran. Most of the cultivars evaluated by Heydari et al. (2010) were considered susceptible or moderately susceptible to the HG type 0 populations. In the USA, of 317 lines from the USDA collection, only a small percentage was considered resistant (Jain et al. 2019). Later, a new study showed that, from the USDA core collection, out of 315 accessions, only 15 were resistant. In Brazil, a histological study revealed that both resistant and susceptible cultivars developed syncytium (Becker et al. 1999). Becker & Ferraz (2004) demonstrated that the nematode inoculum concentration may interfere with the development of bean and soybean plants. According to Dias et al. (2023), among 81 bean genotypes evaluated, only 7 were considered resistant to *H. glycines*.

The planting of susceptible host species such as common bean can increase the nematode population in the area and lead to a decline in crop yield. For that reason, the plantings in areas previously cultivated with crops such as soybean represent a greater risk of yield loss by allowing a nematode population increase (Noel et al. 1982). Furthermore, a large part of bean cultivation, especially in the third crop (also known as winter crop, which is grown between the months of April and October in Brazil), occurs in central Brazil (Silva & Wander 2018), where the presence of high populations (Dias et al. 2004, Dias et al. 2009) and diversity (Moreira et al. 2020) of *H. glycines* is frequent.

Thus, this study aimed to assess the reaction of 55 common bean genotypes belonging to the Embrapa Arroz e Feijão core collection to *Heterodera glycines*, race 3/HG type 0.

MATERIAL AND METHODS

The experiments were carried out under greenhouse conditions (16º35’52.1”S and 49º16’53.5”W), from January to April 2020. A completely randomized design was used, with six replications, in which the experimental unit consisted of a plastic cup (500 mL) containing one plant. Fifty-five common bean genotypes (of Mesoamerican origin) from the Embrapa Arroz e Feijão core collection were tested (Table 1). As a susceptibility standard to verify the inoculum viability, the Brasmax Desafio RR soybean cultivar was used. The 55 genotypes were divided into 3 experiments, with 25 genotypes tested in the first one (sowing on Jan. 13, 2020), 13 in the second (sowing on Jan. 20, 2020) and 17 in the third (sowing on Mar. 09, 2020).

Initially, 2 seeds were sown per cup containing a substrate composed of soil and sand (1:1, v/v), previously autoclaved. The plants were fertilized with 3 g of Osmocote (15 % of N, 9 % of P and 12 % of K) at the time of sowing. At 8 days after planting, thinning was performed, leaving 1 seedling cup^{-1}.

The *H. glycines* inoculum was obtained by multiplying a population extracted from soil field samples collected in Rio Verde (Goiás state, Brazil), previously characterized as race 3 or HG type 0. The cysts were collected from the soil throughout the suspension in 2 L of water and subsequently sieved using a 20-mesh sieve (0.84 mm) coupled to a 100-mesh sieve (0.149 mm). The cysts retained in the 100-mesh sieve were collected and transferred to a 100-mesh sieve (0.149 mm) coupled to a 500-mesh sieve (0.025 mm), for the eggs extraction. The cysts were macerated using a test tube and applying little water jets, releasing the eggs and juveniles from the inside of the cysts. The eggs and second stage juveniles (J2) were collected from a 500-mesh sieve (0.025 mm) and counted under a light microscope with the aid of a Peters slide. The inoculum was calibrated for 1,000 eggs + J2 per milliliter.

Table 1. Description of common bean (*Phaseolus vulgaris*) accessions belonging to the Embrapa Arroz e Feijão core collection used for the study of host ability to *Heterodera glycines*.

Nº	Accession	Common name	Nº	Accession	Common name
1	BGF0012533	Mulatinho/Favinha	29	BGF0005887	Goytacazes
2	BGF0013561	Vagem Brilhante	30	BGF0013875	Rajado
3	BGF0011861	Rosa	31	BGF0005494	Macanudo
4	BGF0016040	Cavalo Claro	32	BGF0011772	Roxo
5	BGF0011762	Roxinho and Chumbinho	33	BGF0011360	656 PV. N.E. PV. 0068
6	BGF0015931	Mulatinho Misturado	34	BGF0012685	Cafezinho
7	BGF0015682	Preto de Goiás	35	BGF0011367	Velazco Largo
8	BGF0007844	Akitã	36	BGF0016246	Mourinho
9	BGF0004514	Capixaba Precoce	37	BGF0011347	Marrocho
10	BGF0015887	Carioca sem Cipó	38	BGF0006141	Ouro Branco
11	BGF0015609	Carioca com Mistura	39	BGF0015655	Leite
12	BGF0005605	BR 2 Grande Rio	40	BGF0014855	Amendoim Vermelho
13	BGF0016090	Vermelho 1 Epamig	41	BGF0016096	Manteigão Fosco 3 Epamig
14	BGF0000878	Creme or Feijão Argentino	42	BGF0005482	AN 3508
15	BGF0007381	Gyza 0006	43	BGF0016165	Cajurí
16	BGF0013343	Paranazinho	44	BGF0011932	Mulatinho AC
17	BGF0013010	Catarina or Vagem Roxa	45	BGF0008202	BRS Horizonte
18	BGF0000840	Mont d'Or	46	BGF0011854	Preto
19	BGF0013955	Carioca	47	BGF0011743	Guapo Brilhante
20	BGF0013294	Chumbinho Brilhante	48	BGF0012734	Rajadinho
21	BGF0013355	Carioca	49	BGF0012148	Roxinho
22	BGF0011987	Paraná	50	BGF0008944	Emp 0413
23	BGF0011036	Kodate Zairai	51	BGF0016005	Taquara
24	BGF0011862	Preto	52	BGF0016084	Rapezinho Brilhante
25	BGF0012054	Café	53	BGF0006715	Jatu Rong
26	BGF0005484	Barriga Verde	54	BGF0006872	AN 911120
27	BGF0016146	Gargaú	55	BGF0015908	Rosinha
28	BGF0006497	G 13774			

The inoculation was performed at 8 days after sowing, using 4 mL of calibrated suspension per plant, totalling 4,000 eggs + J2 per plant, divided into two holes (3 cm deep) opened on each side of the plant stem, using an automatic pipette. Irrigation was performed daily. The cups were kept immersed in sand over metal benches to reduce the variation in temperature within the cups.

Evaluations were performed at 38 days after inoculation. The plants were taken to the laboratory and submitted to the evaluation of vegetative variables such as fresh root and shoot mass, and nematological variables such as number of females per root, number of females per 10 g of roots and number of eggs per female.

The root system was carefully removed from the cups and placed in a 20-mesh sieve (0.84 mm) coupled to a 100-mesh sieve (0.149 mm) and washed with strong jets of water for the female release. The roots and shoots of each plant were weighed on a digital scale and later discarded. The females collected on the 100-mesh sieve were transferred to 100-mL beakers with water (Zamboni et al. 2019). The contents of each beaker were poured into filter paper coupled with a small, screened gutter (Andrade et al. 1995). Then the filter paper was transferred to an acrylic plate (10 x 30 cm) for female counting under a stereoscopic microscope (15x magnification), thus determining the number of females and, later, the number of females/10 g of roots.

Ten females from each sample were randomly removed and placed in a beaker (50 mL) with water, then transferred to a 100-mesh sieve (0.149 mm) coupled to a 500-mesh sieve (0.025 mm) and macerated with a glass test tube according to the aforementioned methodology, allowing the release of eggs and J2. The suspension was quantified with the aid of a Peters slide under an optical microscope (50x magnification), thus obtaining the number of eggs + J2 per female. The genotypes resistance to the nematode was determined by the reproduction factor (RF), which was calculated by the ratio between the final (Fp) and the initial population (Ip) of the nematode of each plot (RF = Fp/Ip). According to Oostenbrink (1966), genotypes that present FR < 1.0 are considered resistant.

The obtained data were submitted to non-parametric statistical analysis, using the Kruskal-Wallis test, followed by the post-hoc test (Bonferroni test), and medians were compared at 5 % of probability by the RStudio version 4.1. 3 statistical software (R Core Team 2016). Statistical tests were performed among bean genotypes, and the Brasmax Desafio RR soybean cultivar was used to verify the inoculum viability.

RESULTS AND DISCUSSION

In the first experiment (Table 2), there was no statistical difference among the treatments for the variables evaluated. All bean accessions tested in this experiment were resistant to *Heterodera glycines*. The values referring to the reproduction factor (FR) were not subjected to statistical analysis and ranged from 0.07 to 0.66 among the bean accessions (Figure 1). Although no plant prevented the nematode from multiplying (FR = 0), the FR was low for the entire group tested.

For all the accessions tested (Table 2), the nematological variables showed lower values than those observed in soybean (susceptible standard), although it was not included in the statistical analysis. The lower number of eggs/female in the bean accessions, when compared to soybean, shows that the *H. glycines* fecundity is also affected when they feed on these bean genotypes. This suggests that the nematode has a greater fecundity when it parasitizes soybean. Despite the common bean being an alternative host, it does not offer the same conditions for its development.

All genotypes tested in the second experiment (Table 3) behaved as resistant to the nematode, with

Table 2. Reaction of 25 common bean accessions from the Embrapa Arroz e Feijão core collection to *Heterodera glycines*, at 38 days after inoculation, in the experiment 1.

Accession	Shoot fresh mass	Root fresh mass	Total females	Females/10 g root	Eggs/female
BGF0013955	18.93^{ns}	5.86^{ns}	13.83^{ns}	33.42^{ns}	67.30^{ns}
BGF0013561	15.04	8.32	24.67	44.54	80.73
BGF0015609	14.80	4.92	17.33	38.05	28.38
BGF0011861	14.36	5.11	23.33	44.86	88.35
BGF0000840	13.30	2.67	17.83	151.88	69.42
BGF0005605	13.23	6.76	21.83	28.55	73.97
BGF0013343	13.03	6.88	21.00	29.66	33.63
BGF0015931	12.56	3.70	16.33	83.78	76.83
BGF0015887	12.41	3.31	7.83	27.42	48.82
BGF0007381	12.35	3.40	35.50	119.40	70.92
BGF0013294	11.69	4.13	13.17	53.77	73.89
BGF0011987	10.93	5.20	8.33	19.52	48.36
BGF0011762	10.81	7.90	11.33	15.92	42.39
BGF0013355	10.61	3.71	12.67	49.09	80.84
BGF0016090	9.96	4.00	10.83	26.63	79.31
BGF0012054	9.64	3.58	6.17	16.08	56.06
BGF0004514	9.43	3.57	11.50	36.91	89.30
BGF0015682	9.39	6.35	38.00	67.02	68.42
BGF0016040	9.14	3.25	16.17	45.80	56.32
BGF0013010	8.65	3.57	21.50	59.43	59.30
BGF0011862	8.19	5.42	12.50	50.21	71.70
BGF0012533	8.08	3.28	4.83	25.93	36.25
BGF0007844	7.70	2.66	13.67	50.86	55.45
BGF0011036	5.86	2.26	10.50	42.94	58.32
BGF0000878	5.34	3.44	20.17	45.36	91.20
Soybean	11.31	2.75	79.17	461.65	256.72

^{ns} Not significant by the Kruskal-Wallis test.

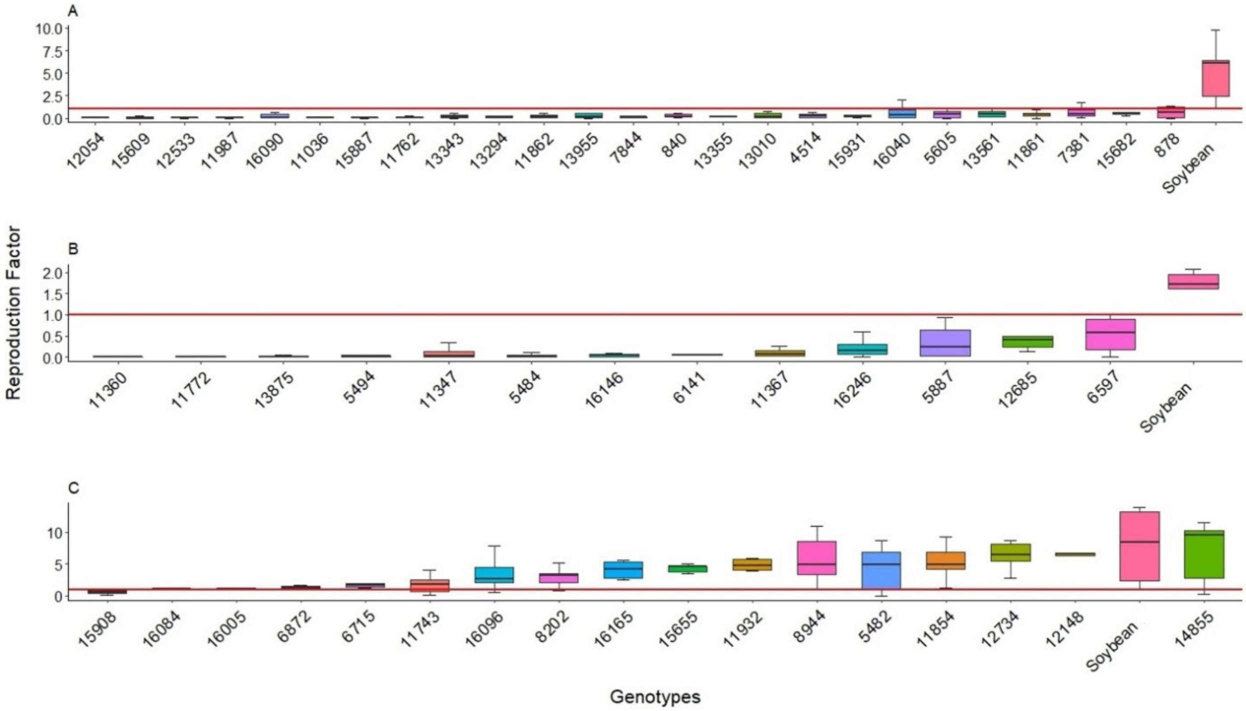

Figure 1. Reproduction factor of *Heterodera glycines* on common bean accessions from the Embrapa Arroz e Feijão core collection. A) experiment 1; B: experiment 2; C: experiment 3. All codes are reduced to the last 5 numbers, excluding "BGF00", for a higher image quality.

FR values ranging from 0.00 to 0.53 (Figure 1). The BGF0005484 genotype showed the lowest root fresh mass, when compared to BGF0006141, which had the highest values for this variable. In addition to the lower root fresh mass, BGF0005484, BGF0011347 and BGF0012685 showed a significantly lower shoot fresh mass, if compared to the BGF000641 genotype.

Regarding the nematological variables (Table 3), BGF0012685 presented the highest values for number of females and number of females/10 g of roots (25 and 340, respectively),

Table 3. Reaction of 13 common bean accessions from the Embrapa Arroz e Feijão core collection to *Heterodera glycines*, at 38 days after inoculation, in the experiment 2.

Accession	Shoot fresh mass	Root fresh mass	Total females	Females/10 g root	Eggs/female
BGF0006497	3.53 abc	7.07 ab	28.50 ab	183.48 abc	61.12 ab
BGF0011367	3.40 ab	5.88 ab	2.33 bcde	8.62 cd	157.42 a
BGF0006141	3.38 a	10.63 a	2.67 bcde	8.63 cd	114.00 a
BGF0005494	2.81 abc	3.93 abc	2.67 cde	16.60 bcd	39.21 ab
BGF0016146	2.14 abc	2.90 abc	4.50 cde	21.00 bcd	80.56 ab
BGF0016246	1.95 abc	4.36 abc	13.33 abcd	65.25 abcd	50.00 ab
BGF0011772	1.56 abc	2.08 bc	1.67 de	12.28 d	21.17 ab
BGF0005887	1.55 abc	2.13 bc	16.17 abc	168.23 ab	64.21 ab
BGF0013875	1.54 abc	3.09 abc	1.33 de	13.67 d	61.50 ab
BGF0011360	1.25 abc	2.55 abc	0.33 e	5.92 d	5.83 b
BGF0005484	1.17 c	1.51 c	1.33 de	13.54 bcd	70.42 ab
BGF0011347	1.14 c	3.79 abc	6.83 abcde	62.16 abcd	30.43 ab
BGF0012685	0.91 c	2.01 bc	25.00 a	340.89 a	56.00 ab
Soybean	5.24	17.86	48.67	119.09	137.95

Original data. Means followed by the same letter do not differ from each other by the post-hoc Bonferroni test.

concerning most of the genotypes studied. While the lowest values for these two variables were observed for the BGF0011360 genotype, 0.33 females and 5.92 females/10 g of roots were related to the BGF0012685, BGF0005887 and BGF0006497 genotypes. Interestingly, this genotype also presented the lowest number of eggs/female, when compared to the BGF0011367 and BGF0006141 genotypes, even when showing an RF = 0, being considered an immune genotype to *H. glycines*, concerning the Oostenbrink's classification.

In the experiment 3 (Table 4), 17 genotypes were tested and only BGF0015908 behaved as resistant. However, it did not differ from the other plants, in relation to root and shoot fresh mass. The nematode density (females/10 g of roots) in this genotype differed only from BGF0014855. The RF varied among the bean genotypes from 0.6 to 7.02 (Figure 1). The variable eggs/female showed a statistical difference among the genotypes, but the difference was not detected in the post-hoc test.

Although the results for soybean were not included in the statistical analyses, in the experiments 1 and 3 the total number of eggs/female was higher for soybean than in common bean genotypes, what did not occur in the experiment 2, in which only the value of the BGF0011367 genotype exceeded the control. The total number of females was lower for the common bean than in soybean, for all three experiments. This shows that the common bean, even being an alternative host for the soybean cyst nematode, offers conditions for its development, but it is not a better host than soybean. Regarding the variation observed in the nematode female populations, it is important to highlight that these are different bean genotypes. In addition, such variation is inherent in studies with nematodes (Acharya et al. 2021, Pinheiro et al. 2021).

The Oostenbrink's (1966) criterion for classifying genotypes, in terms of resistance to nematodes, is the simplest way, because it has only three classes, being susceptible for plants with RF ≥ 1.0, resistant with RF < 1.0 and showing immunity with RF = 0. In the present study, only one inoculum density was used; however, in general, there is an increase in the nematode penetration and reproduction in the plant roots as the inoculum increases up to a certain limit. So, it is desirable to carry out further studies increasing the inoculum concentrations in order to confirm their resistance under higher inoculum pressure (Abawi & Jacobsen 1984, Becker & Ferraz 2004, Araújo et al. 2019).

Differently from what was proved by Abawi & Jacobsen (1984), in the present study the nematode reproduction in susceptible bean genotypes was

Table 4. Reaction of 17 common bean accessions from the Embrapa Arroz e Feijão core collection to *Heterodera glycines*, at 38 days after inoculation, in the experiment 3.

Accession	Shoot fresh mass	Root fresh mass	Total females	Females/10 g root	Eggs/female
BGF0016084	11.21 c	14.76 bc	34.83 bc	102.98 ab	116.95^{ns}
BGF0016005	10.48 bc	14.68 abc	37.67 bc	80.89 ab	114.65
BGF0006715	9.44 bc	17.09 abc	57.33 abc	136.47 ab	123.77
BGF0011743	9.28 abc	12.60 abc	48.33 abc	62.88 ab	144.15
BGF0008944	8.88 abc	14.29 abc	103.17 abc	238.77 ab	202.13
BGF0012148	8.67 abc	14.06 abc	130.50 ab	139.88 ab	157.32
BGF0015908	8.14 abc	18.29 abc	24.83 c	38.16 b	95.10
BGF0006872	7.22 bc	17.25 c	42.33 abc	90.61 ab	130.52
BGF0012734	6.98 a	12.99 abc	139.17 a	126.99 ab	210.10
BGF0005482	6.93 abc	9.27 abc	85.17 abc	89.54 ab	152.98
BGF0016165	6.69 ab	10.24 abc	119.83 ab	123.25 ab	168.77
BGF0008202	6.45 abc	11.13 ab	87.67 abc	123.18 ab	141.87
BGF0016096	5.06 abc	8.33 abc	66.33 abc	251.89 ab	195.70
BGF0015655	4.91 ab	6.31 abc	94.83 abc	104.37 ab	164.80
BGF0011854	4.69 ab	11.60 abc	110.83 ab	130.18 ab	184.42
BGF0011932	4.64 ab	10.44 a	107.50 ab	124.37 ab	210.32
BGF0014855	3.72 bc	7.93 abc	106.83 abc	193.19 a	241.00
Soybean	7.34	11.09	148.33	238.68	283.57

Original data. Means followed by the same letter do not differ from each other by the post-hoc Bonferroni test. ^{ns} Not significant by the Kruskal-Wallis test.

always lower than that of susceptible soybean. These authors observed that the reproduction did not differ between susceptible cultivars of both crops.

Stricter criteria for classifying genotypes are important at an early stage of the breeding program, so that the best genotypes are selected and resistance genes identified. Becker et al. (1999) observed that the nematode developed syncytium in two bean cultivars ("Ouro" and "L-2300", susceptible and resistant, respectively); however, the development of syncytium in the resistant cultivar was not complete.

As observed in the experiment 3, in which most accessions behaved as susceptible, Smith & Young (2003) demonstrated that common bean lines could be hosts as good as soybean. This is what happened with the G122 bean genotype, which proved to be a host as good as the Lee 74 soybean cultivar, recommended as a susceptibility standard in the HG type test and race test. The study also reported a large variation in the genotypes' hostability in relation to the race of the nematode population.

Contrary to what was observed in the present study, Poromarto & Nelson (2009) reported that all 24 bean cultivars evaluated allowed the normal development of *H. glycines* females (HG type 0) under greenhouse conditions, representing a potential threat to dry bean in northern North Dakota and northern Minnesota. In this same sense, Heydari et al. (2010), studying the 11 most used bean cultivars in Iran, showed that most cultivars were susceptible or moderately susceptible to populations of HG Type 0 of *H. glycines*.

According to Mizobutsi et al. (2012), the *H. glycines* inoculum, race 3, produced in bean is less viable in the soil than that produced in soybean, since the development of the nematode is directly related to the formation of a viable feeding site that guarantees the development and support of female in its reproductive stage for a new cycle to be generated. This does not occur in the resistant and susceptible bean cultivars studied by the authors, indicating that there is a nutritional restriction in alternative hosts of the nematode, such as the common bean. This fact impacts the development of the nematode as well as the nutrition of the adult female, which affects the viability of eggs produced and causes population reduction in the next cycle.

The results of Mizobutsi et al. (2012) showed that the J2 penetration was low in L2300 (resistant) and Ouro (susceptible) bean cultivars, when compared to susceptible soybean (cv. FT-Cristalina). This phase is dependent on energy reserves that come from the accumulation of lipids during embryonic development, which, in turn, depends on the female's good nutrition. The same occurred in relation to female survival, which was lower in L2300, cv. Gold, and soybean. Thus, the use of resistant bean cultivars or those that have a low reproduction factor can be good alternatives in the management of the nematode. Furthermore, it shows the need to identify the resistance mechanisms that may be present in resistant genotypes.

It is important to point out that in the present study the genotypes were tested only for the race 3 (HG Type 0) of the nematode; but under field conditions, there are other races that may prevail among those existing in the area, and genotypes resistant to a certain race may be susceptible to others. Jain et al. (2019), through phenotyping tests, reported 86 bean accessions from the USDA common bean core collection as resistant to HG type 0. Shi et al. (2021), who also worked with these accessions, identified that of these only 59 accessions were resistant to the HG type 0 (race 6). As this HG type may correspond to race 3 or 6, it is possible that the 86 accessions were tested for race 3. Later, evaluating 81 common bean genotypes in Brazil, Dias et al. (2023) observed that only seven of them were considered resistant to the race 1 of the soybean cyst nematode.

In any case, those genotypes that proved to be susceptible, regardless of the HG type, should be discarded for future studies and focus on the resistant ones. Even those genotypes that behave as resistant must be subject of further studies to confirm the resistance and to investigate the mechanisms and genes involved. It is also important to continue phenotyping tests in order to evaluate the whole Embrapa Arroz e Feijão core collection with a view to identify sources of resistance to this nematode and other species.

CONCLUSIONS

Among the 55 bean accessions evaluated, 34 were resistant to *Heterodera glycines*. The accessions that proved to be resistant, in addition to presenting a lower population of females in the roots, also reduced the fecundity of the nematode, an important aspect in its hostability.

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