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RESPONSE OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA* L. VERDE.) CULTIVARS TO ROOT–KNOT NEMATODE (*MELOIDOGYNE JAVANICA*)

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ABSTRACT
A screen house experiment was conducted at the Federal University of Technology, Yola (Latitude 9^0 30'N and Longitude 12^0 11'E at an altitude of 185.9 m above sea level) to study the response of eight cultivars of Bambara groundnut (Vigna subterranea L. Verde) to root - knot nematode (Meloidogyne javanica). The cultivars were Fara sola, Sola I, Sola II, Warki, Kiya, Gujiyan kurege, Roko and Bayan jiki. These were sown in 4 litre plastic pods each filled with 2.5 kg of sterilized soil mixed with cowdung at a ratio of 3:1. Tomato roots infected with root-knot nematode were obtained from a farmer's field. Meloidogyne females and their egg masses were removed using forceps and needles. Perennial pattern of each of these were prepared and observed under the microscope and M. javanica and its eggs were identified. The egg masses were cultured in plastic pods containing tomato seedlings. Eight weeks later, the tomato plants were uprooted and the egg masses of M. javanica isolated. Five egg masses were then inoculated into each of the Bambara groundnut cultivar one week after emergence. The experiment was arranged in a completely randomized design replicated three times. The plants were allowed to grow until harvest. At harvest, data were collected on plant height, root length, root gall index, number of M. javanica egg masses, juveniles in soil and yield weight per plant. Data obtained were subjected to analysis of variance. Results showed that all the eight cultivars studied were susceptible to root–knot nematode at varying degree with some signs of resistivity in some cultivars which enabled them performed better than others even with the infection. Sola II displayed the ability of resisting attack and recorded the tallest plant (17.19 cm) and highest seed yield (4.67 g plant^{-1}) compared with the others. It is therefore recommended that farmers should adopt Sola II in order to boost Bambara groundnut production in Adamawa State, Nigeria, where the soil is infested with M. javanica.

Key words: Bambara groundnut, Cultivars, Root–knot nematode, Meloidogyne javanica

INTRODUCTION

Bambara groundnut (*Vigna subterranea* L. Verde) is the most important pulse after cowpea and groundnut in Nigeria. It is mainly grown by subsistence farmers with myriad production advantages. It can tolerate adverse environmental conditions, low soil fertility, low rainfall and pest and diseases (Jakusko and Belel, 2009). According to Sajo and Kadams (1999), Bambara groundnut is a vegetable crop which contains 18.8% protein, 6.25% oil, and 61% carbohydrate in the dry seeds. The immature seed can be eaten after grilling or boiling. The mature seeds can be floured and used in making different traditional foods such as *kosai* and *moimoi*.

Plant parasitic nematodes (*Meloidogyne* species) have been reported to constitute serious impediment to intensified crop production of this important food crop in various parts of the world. They attack the underground roots of plants causing the development of knot or galls, which blocks the vascular bundles so that the plant appears stunted and wilted and yield are greatly reduced (Bishop *et al*., 1983). According to Egunjobi (1985) among the four most common species of *Meloidogyne*, *M. incognita* and *M. javanica* are the most widely distributed in the tropics, sub-tropics and warm temperate climate but *M. javanica* predominates the savanna zone. Bird (1974) reported that root–knot nematode has a very wide host range including crop plants and weeds and losses due to its attack in crops such as cowpea, cotton, okra, tobacco, banana, sorghum, maize, rice, soybean and sugarcane range from 20–100 per cent.

The research was therefore carried out to determine the response of Bambara groundnut cultivars to root–knot nematode with the view to identify which cultivar(s) will show resistance to the devastating pest.

MATERIALS AND METHODS

A screen house experiment was conducted at the Federal University of Technology, Yola (Latitude 9^0 30'N and Longitude 12^0 11'E at an altitude of 185.9 m above sea level) in 1999 to examine the response of eight cultivars of Bambara groundnut to root-knot nematode (*M. javanica*). The Bambara groundnut local cultivars used in the experiment with other pertinent information are shown on Table 1. Four litre plastic pots were perforated at the bottom and each filled with 2.5 kg sterilized soil mixed with cowdung at a ratio of 3:1. Two seeds were sown in each of the pots which were later thinned to 1 plant per pot at 1 week after sowing.

Tomato roots infested with root-knot nematode were obtained from a farmer's field. *Meloidogyne* females and their egg masses were removed using forceps and needles. Perennial pattern of each of these were prepared and observed under the microscope and *M. javanica* and its eggs were identified. The egg masses were cultured in plastic pods containing tomato seedlings. Eight weeks later, the tomato plants were uprooted and the egg masses of *M. javanica* isolated. Five egg masses were then inoculated into each of the Bambara groundnut cultivar one week after emergence. The experiment was arranged in a completely randomized design replicated three times. The plants were allowed to grow until harvest. At harvest, assessment was done on the following characters:

Plant height: the height of plant in each pot was measured from the base of the plant to the tip of the terminal bud.
Root length: this was measured from the base of the plant to the tip of the root.
Root gall index: this was quantified using ratings from 1-5 according to Nwanzor and Ihediwa (1992), where;
1 = 0 (no galling virtually complete root system)
2 = 1– 25 (light galling with less than 25 per cent of the root system galled)
3 = 25 – 50 (fairly moderate galling with less than 50 per cent of the root system galled)
4 = 50 – 75 (moderate galling with less than 75 per cent of the root system galled)
5 = >75 (moderate galling with few large galls)

Number of *M. javanica* egg masses per plant: The infested root was placed under the microscope and observed at x 40 magnification. The egg masses were then counted using a needle.

Juveniles in soil: these were extracted using floatation sieving method described by Barker (1985) with minor modifications. Two hundred and fifty grams of soil was taken from each plastic pot and mixed with water and stirred. It was allowed to settle for about 2 minutes and the mixture was sieved with a 38 µm mesh sieve. The 38 µm mesh sieve was then rinsed over a 150 µm mesh sieve in order to collect the nematodes. The nematodes from the 150 µm mesh sieve were rinsed in a beaker containing distilled water. The content was then swirled and allowed to settle for 5 seconds. The suspension was then poured into six sieves arranged on trays and lined with tissue paper and left for 24 hours. Juveniles passed through the tissue paper into the water inside the trays. The water was then collected in a Petri dish and juveniles counted under the microscope.

Seed yield weight: this was obtained by weighing seeds harvested from each plant.
Results obtained were subjected to analysis of variance using the SAS system for windows (SAS, V8, 1999). Means showing significant F–test were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 2 shows the effect of *M. javanica* on root gall index, egg masses and juveniles per kilogram of soil. There were significant ($P < 0.05$) effects of *M. javanica* on Bambara groundnut cultivars. Root gall index was higher on *Fara sola* and *Sola 11* (2.67 each), although they were at par with the rest of the treatments except *Sola I* which recorded the lowest (1.33). The result corroborates that of Olowe (1992), who reported four cultivars of cowpea, two cultivars of soybean and ten cultivars of Lima bean that were resistant to root-knot nematode. Egg masses were higher in *Bayan jiki* (8.3), followed by *Warki* (7.3), while the least was recorded on *Gujiyan kurege* (2.00). There were no significant differences ($P > 0.05$) between cultivars on number of juveniles per kg of soil. All cultivars were susceptible and support a reasonable number of juveniles, although *Bayan jiki* recorded the highest juveniles (145.33), while the lowest was recorded by *Sola II* (102.67). This shows that all cultivars were susceptible to root-knot nematode, although *Bayan jiki* was more susceptible than others which indicate that Bambara groundnut is an important host to this pest. This corresponds with the earlier work by Hillocks *et al.* (1995), who reported that Bambara groundnut was as good a host for *M. javanica* as was tomato. The higher susceptibility to root-knot nematode exhibited by *Bayan jiki* could have been due to its low resistivity against the devastating pest. Table 3 shows the effect of *M. javanica* on some growth and yield characters of Bambara groundnut. Significant effects of *M. javanica* on plant height and seed yield were observed with some variation on susceptibility between cultivars. *Sola II* recorded the tallest plant (17.19 cm), although it was at par with the other treatments except *Gujiyan kurege* which recorded the shortest plant (13.00 cm). The ability of some cultivars to grow taller than others might not be unconnected with the ability of some cultivars displaying some elements of resistance to the pest. This result supports the earlier work by Misari (1992), who reported that breeding for resistance to root–knot nematodes produced cultivars with important genetic variation which prevent massive and wide spread nematode build up in crops. There were no significant differences between cultivars on root length as affected by *M. javanica* infection. Seed yield was significantly ($P < 0.01$) affected by *M. javanica* infection and the most affected cultivar was *Roko,* which recorded the lowest seed yield of 1.18 g $plant^{-1}$ although it was at par with the other treatments, except *Sola II* and *Warki*, which were least affected. This indicates that the higher yields recorded by some cultivars may be due to the possession of resistance against the root-knot nematode by these cultivars.

The result contradicts the earlier findings of Ogbuji (1979), who reported that Bambara groundnut cultivars inoculated with local population of *M. incognita* and *M. javanica* showed stunted growth, reduced dry matter accumulation and more flower abortion compared with the control; and that of Olowe (1992), who reported that tested cowpea cultivars did not display any significant resistance to *M. incognita, M. javanica* and *M. arenaria* compared with the control.

Table 1: Local names of Bambara groundnut cultivars used and their descriptions

Local cultivar	Description
Sola 1	White creamy, round shape with black strips pigmentation around the eye, white eye, smooth shiny seed coat.
Sola 11	White creamy round shape, white eye, a mixture of grey and pink, round eye, smooth shiny seed coat.
Warki	A mixture of cream and brown colour, dark brown strips, round flat shapes, smooth shiny seed coat.
Kiya	Dull, white round shape with black strips pigmentation around the eye with smooth shiny seed coat.
Gujiyan kurege	Wild form, creamy with black strip pigmentation, small size with with white eye, smooth shiny seed coat.
Roko	Reddish brown, cream oval patches; more prominent around the eye, white brown eye, round shape, smooth shiny seed coat.
Bayan jiki	Dotted pink black and white dark brown, round white eye, smooth shiny seed coat.

Source: Dabai (1993)

Table 2: Effect of *M. javanica* on root gall index, mean egg masses and juveniles kg $^{-1}$ of soil.

Treatment	Root gall index	Mean egg masses	Juvenile kg^{-1} of soil
Fara sola	2.67[a]	3.00[c]	136.00
Sola 1	1.33[b]	3.67[bc]	117.33
Sola 11	2.67[a]	6.00[b]	102.67
Warki	2.33[ab]	7.30[ab]	130.67
Kiya	2.00[ab]	6.30[b]	122.67
Gujiyan kurege	1.67[ab]	2.00[c]	120.00
Roko	2.00[ab]	4.00[bc]	117.33
Bayan jiki	2.30[ab]	8.30[a]	145.33
	*	*	NS
SE±	0.03	0.18	

Means in the same column followed by the same letter are not significantly different at 5% level of probability.
*Significant at 5% level of probability, NS= Not significant at 5% level of probability.

Table 3: Effect *M. javanica* on some growth and yield characters of Bambara groundnut

Treatment	Plant height (cm)	Root length (cm)	Seed yield (g plant^{-1})
Fara sola	13.67[ab]	9.00	1.57[c]
Sola 1	14.37[ab]	8.67	2.37[bc]
Sola 11	17.19[a]	12.33	4.67[a]
Warki	14.84[ab]	9.67	3.76[ab]
Kiya	14.08[ab]	13.33	1.26[c]
Gujiyan kurege	13.00[b]	12.67	1.96[c]
Roko	15.55[ab]	10.00	1.18[c]
Bayan jiki	15.76[ab]	14.67	2.24[bc]
	*	NS	**
SE±	0.09		0.06

Means in the same column followed by the same letter are not significantly different at 5% level of probability.
*Significant at 5 % level of probability, ** Highly significant at 1% level of probability, NS= not significant at 5% level of probability.

CONCLUSION

All the eight cultivars studied were susceptible to root–knot nematode at varying degrees with some resistivity in some cultivars which enabled them perform better than others even with the infection. *Sola II* displayed the ability of resistivity more than the other cultivars and produced the tallest plant and highest seed yield. It is recommended that farmers should adopt this cultivar in order to boost Bambara groundnut production in Adamawa State, Nigeria, where the soil is highly infested with *M. javanica*.

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