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Original Article

Effect of root ash of different tropical plants on growth and yield of mungbean (*Vigna Radiata* l.) Infested with root-knot nematode (*Meloidogyne* Spp)

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ABSTRACT

An experiment was conducted to determine the effect of the root ash of some tropical plants on the growth and yield of mungbean infested with root-knot nematodes. The pot experiment was carried out in an open field at the Department of Plant Health Management, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria. The experiment was laid out in a Completely Randomized Design (CRD) with eight (8) treatments each replicated five times. The treatments include the Root Ash of *Baphia nitida, Pentaclethra macrophylla, Dialium guineense, Delonix regia, Carica papaya* and synthetic nematode (Carbofuran). Inoculated/Untreated plants and Uninoculated/Untreated plants were used as control. Three months later, the experiment was terminated and the data collected on individual plants were plant height, number of pods, weight of pods, number of seeds, number of leaves per plant, fresh and dry shoots weight, fresh root weight, number of nodules, number of nematode galls, nematode population in the root and soil. Results obtained showed that the treatments had significant effect on all the parameters except on number of leaves, nodules, pods, seeds, fresh weight of roots and number of galls. Generally, the root ashes performed well could substitute Carbofuran in the farm.

Keywords: Mung bean, *Meloidogyne* spp., root chaff.

INTRODUCTION

Mungbean (*Vigna radiata* L.) is a legume which is mostly cultivated and consumed in the Asian countries and is fast gaining popularity in African countries. It is now widely cultivated in Africa, Australia and the United States of America (Kim *et al*., 2007). The crop is said to have originated from India (Akpapunam, 1996). About 90% of the world population of

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Mungbean (*Vigna radita* L.) is produced in Indo Burma region. Mungbeans are tropical (or sub-tropical) crops and requires warm temperature (optimally around 30-35^{0}C) and loamy soil is best for its cultivation (Opoku *et al*., 2003). It has attributes that suggest it could thrive in the south eastern Nigeria (Agugo, 2003). Mungbean is consumed as a seed sprout or in processed forms that include cold jellies, noodles, cakes and brew and could also be eaten roasted, fried or boiled. Mungbean as one of the pulses is a rich source of protein for animals and human consumption; it supplies a significant amount of minerals and vitamins. Typically, the average nutritional composition of mungbean is 22.9% protein, 61.8% carbohydrate, 1.2% fat, 4.4% and 3.5% ash (Duke *et al*., 2003). It has also been reported to have several medicinal uses (Akaerue and Onwuka, 2010). Several factors hamper the production and yield of mungbean.

The problems caused by Plant-parasitic nematodes especially *Meloidogyne* species is of great importance (Fademi and Bayero, 1993). The level of damage is influenced by the nematode species, crop cultivar, level of soil infestation and environment (Ononuju, 1999). Under severe infestation the pathogen can cause complete crop failure. Root-knot nematode feeding stimulates the development of abnormally large cells, resulting in gall formation along the root (Traunfeld, 1998). The galls prevent adequate water and nutrient uptake resulting to poor growth and yield. It is therefore important to manage and control this pathogen in order to obtain a better yield and growth of mungbean. The use of chemicals is still an effective measure to control plant diseases, however due to toxicity and high cost of chemicals; farmers are left with the challenge of developing an alternative and secure means of controlling the pathogen.

The objective of this investigation is to determine the effects of root ash of *Baphia nitida, Pentaclethra macrophylla, Dialium guineense, Delonix regia* and *Carica papaya* on growth and yield of Mungbean infested with Root-knot nematode.

MATERIALS AND METHODS

Experimental site

The pot experiment was carried out in an open field at the Department of Plant Health Management, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

Experimental Design

The experiment was arranged in a completely randomized design in open field platform using plastic pots with eight treatments replicated four times including the control.

Source of Planting Material

The variety of Mungbean (VC1163) used in this investigation was obtained from Dr B.M.C Agugo Department of Agronomy, College of Crop and Soil Sciences, Michael Okpara University of Agriculture, Umudike.

Preparation of nematode eggs for inoculation

Heavily galled roots of *Basella alba* (Cylon spinach) was where root-knot nematode eggs were extracted from using Hussey and Baker (1973) method. Thereafter a calculated suspension containing about 2,000 nematode eggs were used for the inoculation.

Planting of seeds

Three healthy seeds were planted in plastic pots containing 5kg mixture of sterilized sandy loam soil. The soil was sterilized using a metal tray for 1 hour at 103^0 C with fire wood as the source of heat. The plants were kept weed free by regular hand weeding and watered accordingly. Two weeks after planting, the plants were thinned to one seedling per pot.

Inoculation of nematode eggs

Three weeks after germination, the nematode eggs were used to inoculate the plant by pouring the suspension on the soil around the base of the plant.

Treatment application

Seven days after inoculation, 20g each of the plant root ashes were applied evenly on the soil surface around the plant roots and covered with topsoil. Also 3.00g ai of a synthetic nematicide (Carbofuran) was applied. The control consisted of pots without treatment application. The treatment combinations were as follows.

T1= Nematode +*Baphia nitida* root as.
T2= Nematode +*Pentaclethra macrophylla* root ash.
T3 = Nematode + *Dialium guineense* root ash.
T4= Nematode +*Delonix regia* root ash.
T5= Nematode +*Carica papaya* root ash.
T6=Nematode + Nematicide
T7= No nematode
T8=Nematode alone

Data Collection and statistical analysis

Three months later, the work was terminated and the following data were collected on individual plants: plant height, number of pods, weight of pods, number of seeds, number of leaves per plant, fresh and dry shoots weight, fresh root weight, number of nodules, number of nematode galls, nematode population in the root and soil.

Data collected were subjected to Analysis of Variance using procedure ANOVA in SAS (PROC ANOVA). Mean separation was done using Least Significant Difference (LSD) at 5% level of probability.

RESULTS

The effect of the treatments on plant height, number of leaves, fresh shoot weight and dry shoot weight of the plants is shown in Table1. The highest plant heights (11.00cm) observed in plants treated with *Baphia nitida and Dialium guineense* respectively were not significantly different from other treatments, except plants with nematode alone which had least plant height (3.50cm). On the number of leaves, significant differences were not observed among treatments, although the highest number of leaves (5.75) and the least (3.25) resulted from plants treated with *Pentaclethra macrophylla* and nematode alone respectively. On fresh weight of shoot plants uninoculated with nematode and *Baphia nitida* gave the highest weights of (14.03g) and (13.40g) respectively but did not differ significantly from other treatment except *Delonix regia* and nematode alone which had least plant weight(3.88g) and (3.43g) respectively. Similar observations were made on dry weight of shoot.

Table 2 shows the effect of the treatments on number of nodules and fresh weight of root of the plants. Significant differences were not recorded between the treatments on number of nodules and fresh weight of root, although *Baphia nitida* treated plants had the highest number of nodule (34.00) while uninoculated plants recorded the highest weight of fresh root (8.40g).

The effect of treatments on number of seeds, pods and weight of pods is presented in Table 3. The uninoculated plant produced the highest pod weight (38.90g) followed by nematicide treated plant (32.55g). There were no significant differences between these and other treatments except plants inoculated with nematode alone. On the number of pods and seeds, results did not differ significantly from each other.

Table 1: Effect of treatments on plant height, number of leaves, fresh and dry shoot weights of the plant

Treatments	Plant Height(cm)	Numbers of Leaves	Fresh shoot weight(g)	Dry weight of shoot (g)
T_1 (*Baphia nitida*)	11 .00	5.00	13.40	8.35
T_2(*Pentaclethra macrophylla*)	10.50	5.75	8.35	5.15
T_3(*Dialium guineense*)	11.00	5.00	5.70	3.40
T_4(*Delonix regia*)	7.50	3.50	3.88	2.85
T_5(*Carica papaya*)	8.50	4.75	6.85	4.40
T_6(Nematicide)	9.25	3.75	8.95	5.23
T_7(No nematode)	10.25	4.25	14.03	8.25
T_8(Nematode alone)	3.50	3.25	3.43	1.93
LSD(0.05)	3.41	NS	8.55	3.42

Where NS means no significance or non significance.

Table 2: Effect of treatments on number of nodules and fresh root weight of the plant

Treatments	Number of nodules	Fresh weight of Root(g)
T_1 (*Baphia nitida*)	34.00	8.00
T_2 (*Pentaclethra macrophylla*)	17.50	7.95
T_3(*Dialium guineense*)	16.00	5.10
T_4(*Delonix regia*)	10.75	7.22
T_5(*Carica papaya*)	10.50	6.40
T_6(Nematicide)	19.75	6.82
T_7(No nematode)	10.50	8.40
T_8(Nematode alone)	10.25	7.68
LSD(0.05)	NS	NS

Where NS means no significance or non significance.

Table 3: Effect of treatments on number of seeds, pods and weight of pods of the plant.

Treatments	Weight of pods (g)	Number of Pods	Number of seeds
T_1 (*Baphia nitida*)	14.45	2.25	19.25
T_2(*Pentaclethra macrophylla*)	30.08	2.75	29.25
T_3(*Dialium guineense*)	23.60	6.50	35.50
T_4(*Delonix regia*)	26.50	2.50	19.00
T_5(*Carica papaya*)	29.75	1.25	14.50
T_6(Nematicide)	32.55	4.75	38.25
T_7(No nematode)	38.90	3.50	35.00
T_8(Nematode alone)	7.10	2.25	10.50
LSD(0.05)	21.67	NS	NS

Where NS means no significance or non significance

Table 4: Effect of treatments on nematode gall, nematode in root soil of the plant.

Treatments	Number of galls	Eggs in Root	Nematode in Soil
T_1 (*Baphia nitida*)	0.00	1950.00	175.00
T_2 (*Pentaclethra macrophylla*)	1.50	1,675.00	425.00
T_3(*Dialium guineense*)	0.00	600.00	700.00
T_4(*Delonix regia*)	1.25	150.00	275.00
T_5(*Carica papaya*)	1.50	50.00	125.00
T_6(Nematicide)	0.75	225.00	175.00

T_7(No nematode)	00.00	0.00	0.00
T_8(Nematode alone)	3.75	3,400.00	1425.00
LSD(0.05)	NS	2344.57	716.19

Where NS means no significance or non significance

Table 4 reveals the effect of treatments on number of galls, eggs in root and nematode in soil. Plants that were inoculated alone produced the highest number of galls (3.75) and was not significantly different from other treatments. Nematode eggs was highest (3.400.00) in the roots of plants inoculated with nematode alone followed by plants treated with *Baphia nitida* (1950) and *Pentaclethra macrophylla* (1675.00) and was not significantly different from each other but differed significantly from other treatments. Similarly, population of nematode juveniles in the soil was observed to be highest (1425.00) in plants with nematode alone and differed significantly from other treatments.

DISCUSSION

The results recorded significant responses in respect to all the growth parameters measured when compared to the performance of plants treated with nematode alone. Growth reductions in plants such as Mungbean due to nematode vary depending on the population density of the nematode and environmental conditions to which the host is subjected to (Ononuju and Fawole, 2000a). The increase in fresh weight of roots in plants inoculated with nematode but no treatment application could be as a result of galls present on the root (Ononuju and Fawole, 2000b). Stunted plant heights recorded for control were probably as a result of the stunting action of nematodes as observed by (Adegbite and Adesiyan, 2001).

The reduction in leaf number could be attributed to ascission of aged leaves. This could also be due to chlorosis and necrosis which may have also affected biomers production and subsequently the fresh weight of root (Agbebite and Adesiyan, 2001). Decrease in weight of pods from the observation following number of pods, and seeds may be because of the higher inoculum level of nematode. However, nematode inoculated in mungbean with *M. incognita* decreased the number of pods and weights per plant as well as yield (Okorie *et al.,* 2011). Similarly the yield loss of 18 to 65% and 23 to 49% due to *M. incognita* and *M. javanica* respectively on mungbean has been reported from uttar Pradesh (Sharma *et al.*, 2000). The number of galls which were not significantly different is attributed to Root-knot nematode causing giant cells to form in the root and this disrupts the root vascular system reducing the uptake of water and nutrient and their transport from the roots to the shoots (Abad, 2003). Ononuju and Fawole (2000[a]) indicated that growth reduction due to nematodes varies depending on population density of nematodes and level of susceptibility of the crop cultivar. The treatments were highly effective in their ability in reducing the nematode eggs in the roots and juveniles in soil when compared to untreated plants (nematode alone). The various root ashes might be directly toxic to the eggs or juviniles and thus reduced nematode population. Similar results have been obtained by other research workers (Babatola, 1990; Akhtar and Alam 1993). According to Gommers (1981), active compounds with nematicidal activity which have been found to limit the activities of plant parasitic nematodes in plants includes alkaloids, diterpenes, fatty acids, glucosinolates, isothiocyanates, phenols, polyacetylenes, sesquiterpenes and thienyls. According to Gommers (1981), these compounds were extracted from different plant parts such as roots which could be responsible for the positive effects of root ash on the plants on the population of nematode in the soil and root.

CONCLUSION AND RECOMMENDATION

From the findings of this study, the application of root ash of *Baphia nitida, Pentaclethra macrophylla, Dialium guineense and Carica papaya* when compared with the nematicide application appeared to be more effective. Therefore, definite recommendation cannot be made at this point: there is need to repeat this study on mungbean in a better environment. Also, some environmental factors could have contributed to the results obtained. The nature of the active ingredient contained in the root ash should be investigated since its effectiveness could depend on the nature of the active ingredient. There is also need for further study on rates of application on pot and field trial.

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