INFLUENCE OF RICE HUSK ASH ON *Meloidogyne javanica* TREUB INFESTATION ON TURMERIC (*Curcuma longa.* L)

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ABSTRACT
The influence of rice husk ash on *Meloidogyne javanica* infestation on turmeric (*Curcuma longa.* L) was investigated at the Research and Teaching Farm of Federal College of Agriculture Ishiagu Ebonyi State , Nigeria, in 2010 and 2011 cropping seasons. Rice husk ash (RHA) at four rates; 0 t/ha (control), 10 t/ha, 20 t/ha, and 30 t/ha were amended to soil one week before planting turmeric rhizomes. The experiment was a randomized complete block design with three replications. Following amendment, plant height (cm) and number of leaves at 3 and 5 months after planting, stem girth (cm), rhizome length (cm), number of galled roots, number of nematodes per 20 g soil and fresh rhizome weight (t/ha) at harvest were determined. The collected data were subjected to analysis of variance (ANOVA) using GENSTAT 3 Edition Release 7.2 and significant treatment means were separated using Least Significant Difference (LSD) at 5 % level of probability. There was no significant difference in treatment effects between the two years, therefore data was combined for analysis. Rice husk ash significantly ($P < 0.05$) increased the plant height, stem girth, rhizome length, and fresh rhizome weight compared to the non-treated control. There was no significant ($P > 0.05$) effect on the number of leaves. The number of galled roots was significantly ($P<0.05$) reduced with increase in the rates of the rice husk ash. The highest fresh rhizome weight of 3.07 t/ha was obtained from soil amended with 20 t/ha rice husk ash and it is therefore recommended.
Keywords: rice husk ash; *Meloidogyne javanica*; live nematodes; soil amendment

INTRODUCTION

Turmeric (*Curcuma longa* L.) like ginger belongs to the family *Zingiberaceae.* It is valued for its underground orange coloured rhizome which is used as a natural colouring agent for food, cosmetics, and dye (Hossain, and Ishimine, 2005). The rhizome of turmeric is known to have some medical properties and has been efficiently used in treatment of circulatory problem, liver disease, dermatological disorders and blood purification. India is the largest producer of turmeric and supplies 4% of the world's commercial demand with the product exported as dried rhizomes which are later prepared into different forms to meet diverse end uses.

Tumeric requires a well drained sandy or clay loam soil and temperatures ranging between 20-30 ^{o}C with annual rainfall of 1500 mm or more. In view of the prevailing favourable soil and climatic condition in Nigeria, this country can play a leading role in turmeric production. Albeit, this potential has not been fully harnessed as production techniques are poorly understood restricting production in homestead gardens. Turmeric has been found to be highly susceptible to root knot nematodes (Udo and Ugwuoke, 2010).

Root-knot nematode (*Meliodogyne* spp.) can cause severe galling on the tumeric root system as well as withering, wilting and severe growth reduction of the aerial part of the plant. It has been estimated that the average yield loss due to plant-parasitic nematodes is around 12% annually (Taylor, 2003). Chemicals have been used to control nematodes in the soil, but chemicals may destroy many other species of plants, insects, fishes and soil microorganisms.

Nematode control in turmeric farms using chemical is costly and most times not readily available. It sometimes has some adverse environmental effects. This justifies the need to find alternative effective nematode control measures that are affordable, readily available and environmentally friendly. The objective of the study was to determine the effect of rice husk-ash on *Meloidogyne javanica* infestation on turmeric.

MATERIALS AND METHODS

The experiment was carried out at the Research and Teaching Farm, Federal College of Agriculture Ishiagu, Ebonyi State, Nigeria in 2010 and 2011. Ishiagu is located in the derived savannah zone on latitude 05^{0}, 56' N, longitude 07^{0}, 31' E and altitude 150m above sea level. The soil at the experimental site was characterized as ultisol (Nwite *et al.,* 2011). The turmeric rhizomes were obtained from the National Root Crop Research Institute, Umudike, Abia State, Nigeria. The experimental field measured 11.5 m by 8.0 m (0.0092 ha). The

field was assayed for live nematodes each year. The nematodes assayed were identified in the laboratory through their perineal pattern. The field was marked into three blocks of 2 m X 11.5 m. The blocks were divided into four plots of 2 m X 1 m with 0.5 m between plots and 1 m between blocks. Rice husk-ash was applied at four rates, 0 t/ha (control), 10 t/ha, 20 t/ha and 30 t/ha. The rhizomes weighing 30 g were selected for planting. The distance between rhizomes was 50 cm x 75 cm. The various rates of the rice husk ash were randomly applied to the plots within blocks one week before planting. The experimental design was randomized complete block design with three replications.

Data were obtained on the plant height (cm) and number of leaves at 3 and 5 months after planting (MAP), stem girth (cm), rhizome length (cm), number of galled roots, number of live nematodes/ 20 g soil and fresh rhizome weight (t/ha) at harvest.

Statistical analysis

The averaged data were subjected to analysis of variance (ANOVA) using GENSTAT 3 Edition Release 7.2 and significant treatment means were separated using Least Significant Difference at 5% level of probability.

RESULTS

Root knot nematode (*Meloidogyne javanica*) was identified in experimental field. The results presented are the average of the two years data since there were no significant difference between the two years.

Table 1: Chemical constituents of rice husk ash used as soil amendment

Chemical constituents	Quantity (%)
Calcium (Ca)	1.506
Magnesium (Mg)	0.486
Potassium (K)	1.125
Sodium (Na)	0.575
Phosphorus (P)	0.207
Nitrogen (N)	0.140

The RHA used as soil amendment was subjected to laboratory analysis to determine the chemical constituents. The results obtained showed that the RHA contained higher quantity of calcium, followed by Potassium (Table 1). The other elements were of lower quantities.

Table 2: Effect of rice husk-ash on mean plant height (cm) per plant at 3 and 5 months after planting (MAP).

Rice husk ash (tha^{-1})	3 MAP	5 MAP
0 (control)	32.62	61.33
RHA 10	38.61	71.00
RHA 20	42.60	76.67
RHA 30	44.11	82.00
$LSD_{0.05}$	5.69	6.80

RHA 10 = rice husk ash at 10 tha^{-1}; RHA 20 = rice husk ash at 20 tha^{-1}; RHA 30= rice husk ask at 30 tha^{-1}

The application of RHA significantly ($P < 0.05$) increased plant height at 3 and 5 MAP (Table 2). All rates of the RHA resulted in significantly ($P < 0.05$) greater plant heights compared to the control. At 3 MAP and 5 MAP, the highest plant heights of 44.11 cm and 82.00 cm respectively were obtained from plants treated with 30 t/ha RHA. The lowest plant heights of 32.62 cm and 61.33 cm were obtained from the control plants at 3 MAP and 5 MAP, respectively.

Table 3: Effect of rice husk ash (RHA) on mean number of leaves per plant at 3 and 5 months after planting (MAP).

Rice husk- ash (tha^{-1})	3 MAP	5MAP
0 (control)	4	9
RHA10	5	9
RHA20	6	10
RHA 30	6	11
$LSD_{0.05}$	NS	NS

NS= not significant

The number of leaves was not significantly ($P > 0.05$) affected by the RHA at 3 and 5 MAP (Table 3). Though not statistically significant, there was increase in the number of leaves produced with increasing rates of RHA.

Table 4: Effect of Rice husk ash (RHA) on the stem girth (cm) and rhizome length (cm) per plant at harvest.

Rice husk ash (tha^{-1})	Stem girth (cm)	Rhizome length (cm)
0 (control)	5.33	1.62
RHA10	6.54	5.94
RHA 20	8.19	6.78
RHA 30	10.05	7.73
L.S.D $_{0.05}$	1.03	0.73

Stem girth and rhizome lengths were significantly ($P < 0.05$) increased at harvest (Table 4). The plants treated with RHA at 30 t/ha produced the highest stem girth and rhizome lengths of 10.05 cm and 7.73 cm, respectively which differed significantly ($P < 0.05$) from the stem girth (5.33 cm) and rhizome length (1.62 cm) produced by the plants not treated with RHA.

Table 5: **Effect of rice husk-ash (t/ha) on mean numbers of galled roots, live nematode/20 g soil and rhizome weight (t/ha) per plant at harvest**

Rice husk-ash (tha^{-1})	number of galled roots	nematode population/20g soil	weight (t/ha)
O (control)	15.44	4.93	1.62
RHA 10	10.06	3.13	2.40
RHA 20	9.41	1.67	3.07
RHA 30	7.67	0.80	2.99
LSD $_{0.05}$	2.03	1.19	0.56

The RHA reduced significantly ($P<0.05$) the number of galled roots. The number of live nematodes obtained from 20 g soil significantly ($P < 0.05$) decreased with increase in the rate of the RHA (Table 5). The highest number of live nematodes (4.93) was obtained at the control soil while the lowest number of live nematodes (0.80) was obtained from the soil treated with 30 t/ha of RHA. The weight of the fresh rhizomes was significantly ($P < 0.05$) affected by the application of RHA. The plants treated with RHA at the various rates produced rhizomes of higher weight than the control plants. The highest fresh rhizome weight of 3.07 t/ha was obtained from plants treated with 20 tha^{-1} of RHA. This weight did not differ significantly ($P > 0.05$) from the weight obtained from plants treated with 30 tha^{-1} which produced fresh rhizome weight of 2.99 t/ha. The lowest fresh rhizome weight of 1.62 t/ha was obtained from plants not treated with the RHA (control).

DISCUSSION

The increase in plant height, number of leaves, stem girth and rhizome length obtained from the plants treated with rice husk ash showed that the rice husk contained plant nutrients which were readily available for the plants to absorb. The soil nutrients were increased with the application of the various rates of the rice husk. Rice husk ash is amongst the organic manures found to increase soil nutrient status. Application of rice husk ash to tomato farm enhanced the growth and yield parameters of UC82B tomato variety (Ogwulumba *et al*., 2009). Oguike and Mbagwu (2001) stated that one of the important ways of improving soil nutrient status and enhancing continuous soil is through the use of organic manures.

The application of rice husk ash reduced the number of galled roots, number of live nematodes and increased the fresh rhizome weight. This was attributed to the deleterious effect the rice husk ash exerted on the nematodes thereby allowing the treated plants to absorb the nutrients contained in the rice husk ash. Rice husk ash contains more phosphorus and potassium than the experimental soil. These elements are essential for general plant health. The rice husk ash was attributed to have either increased the plant resistance and/or mitigated against the fecundity and virulence of the nematodes. This property could have resulted in the increase in the vegetative and yield parameters in the treated plants than in untreated plants. Organic manures of various sources have been used to control plant diseases. Dufour *et al*., (2003) reported that organic matter is the basis of sustainable nematode control and the maintenance of a healthy soil food. Abubakar *et al*., (2004) stated soil amendments of different kinds used as nutrient sources for crop production have been effective in the control of root diseases in plants. It was however observed that the application of RHA at 20 t/ha produced the highest fresh rhizome weight.

Conclusion

The results of the experiment showed that using RHA as soil amendment in the production of turmeric not only serves as nutrient source but also as nematicide. This is evident in the decreasing level of nematode population with increasing level of RHA. Rice husk ash at 20 t/ha could therefore be employed in the control of root knot nematode infections on turmeric.

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