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EFFICACY OF OIL PALM BUNCH ASH IN CONTROLLING *MELOIDOGYNE INCOGNITA* ON SOYBEAN (*GLYCINE MAX*)

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A B S T R A C T

An investigation to evaluate the effect of Oil Palm Bunch Ash on *Meloidogyne incognita* infections on soybean (*Glycine max*) was carried out at the Research and Teaching Farm of the Federal College of Agriculture Ishiagu, Ebonyi State, Nigeria, in 2012 and 2013 cropping seasons. The treatment was Oil Palm Bunch Ash at different levels, (control, 5tons/ha, 8tons/ha and 11tons/ha) fitted into a Randomized Complete Block Design (RCBD) with three replications. Data collected were averaged on plant height (cm), the number of leaves, the number of galled roots, and the number of galls per root (gall index) and nematode population at harvest. The data were subjected to statistical analysis of variance. Significant treatment means were separated using least significant difference at 5% level of probability. Results showed that Oil Palm Bunch at 11tons/ha produced the greatest control for root-knot nematode by significantly ($P<0.05$) reducing the number of galled root and galls per root at harvest (gall index). Results also revealed that nematode population was high in the control plots. The growth and yield parameters were significantly ($P<0.05$) higher in the plots treated with 8tons/ha and 11tons/ha of Oil Palm Bunch Ash. It is therefore, recommended that oil palm bunch ash from 11tons/ha could be employed by farmers to suppress root-knot nematode in a soybean field and increase soybean yield.

Keywords: Different levels, yield, suppress, galled roots, nematode population, investigation.

INTRODUCTION

Soybeans are botanically called *Glycine max.* The crop belongs to the family *Leguminouseae* and sub family of *Papilinoideae*. *Glycine max* is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. The plant is classified as an oilseed rather than a pulse (FAO,2009).

Soybean grown for seed production is annual, leguminous, warm temperature, short day plant, normally bushy and erect. Usually, plant height varies from 40 to 100cm, plants are much branched with well-developed root and each plant produces a number of small pods containing one to four rounds usually yellow in colour according to the cultivar. The plants are categorized into determinate and in determinate types. The determinate types are short and terminate growth with the onset of flowering and growth tips and in a pod bearing raceme. The harvesting can be in one round because all pods usually ripen at the same time (Upfold and Olechowski, 2000).

Among the many pests that affect grain legumes, soybeans production particularly, are plant parasitic nematodes (Muthukarishnan *et al*, 2003). Root-knot nematode (*Meloidogyne incognita*) has been one of the major limiting factors to soybean production in Ishiagu. The root-knot nematode (*Meloidogyne incognita*) causes conspicuous root galls and serious reductions in growth and yield in soybean. Local farmers use inorganic nematicides like Furadan and some Pyretheroids in checkmating the effects of this nematode. Though, nematicides hold major promise in nematodes control (Adegbite, and Adesiyani, 2001), the high cost, their non-availability at the time of need and the hazards they pose as environmental pollutants discourage most potential users in Nigeria.

Nematodes have long been causing economic loss to soybean farmers. This is because of the nematode persistence in the soil even. Nematode infection has been overcome using synthetic nematicides which are

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costly and hazardous to our environment. Therefore, there is need to seek for alternative control measures, which are affordable and which will protect man and his environment during controlling the pathogen (nematode).

The objective of the research was to determine the effect of oil palm bunch ash on root-knot nematode infections on soybean.

MATERIALS AND METHODS

The research was carried out in the Research and Teaching Farm of the Federal College of Agriculture, Ishiagu Ebonyi State of Nigeria during 2012 and 2013 growing seasons.

Experimental Design: The treatment used was oil palm bunch ash at the levels of 5t/ha, 8t/ha and 11t/ha and control. The experimental design used was Randomized Complete Block Design (RCBD) with the treatments replicated three (3) times.

The site measured 8m x 10m giving a total land space of 80m^2 (0.008/ha). The land was demarcated into three (3) blocks or replicates giving twelve (12) plots. The plot size used was 2m x 2m. The inter bed spacing was 0.5m (50cm) and the space between each block was 1m.

Soil Analysis: The physical and chemical properties of the soil in the experimental area were analyzed in the laboratory by collecting a composite soil sample from different representative field locations using soil auger at a depth of 20 cm for initial soil characteristics. At harvest, another soil samples were collected from each of the plots to determine the changes that occurred due to treatment application.

Oil Palm Bunch Ash: The chemical compositions of the oil palm bunch ash were analyzed in the laboratory to determine the chemical compositions of the ash.

Planting/Sowing: The soybean seeds were sown directly into the field, at a spacing of 40cm by 30cm on the bed at the rate of two seeds per hole and later thinned down to one two weeks after planting.

Maintenance of experimental plots: Two weeding operations were carried out manually with hoe and hand pulling. The first and second weeding operations were carried out two weeks and four weeks after planting.

Extraction of root-knot nematode from the soil: 100g soil sample was collected from each experimental plot. The soil was collected in the middle of each plot at the depth of 15cm, rapped with two layers of facial tissue, placed inside a 2mm sieve and placed on top of a 500ml white plastic basket. Then, water was poured on the side of the sieve until it touched the bottom of the sieve (USDA, 2007).

The setups were left to stand for 3 days to allow the nematodes to crawl into the water, after which the water level was reduced to 100ml. Then, using a pipette, 5ml of each sample was pipetted into a nematode counting dish placed on a powerful stereo microscope for viewing. This was repeated three times for each sample. The average number of the live nematodes was obtained for each sample per the treatments before treatment application and at harvest.

Data collection

Data were collected on:

Nematode population density in 100g soil per treatment before treatment application and at harvest.

Plant height (cm) at 3 MAP.

Leaf number at 3 MAP.

A number of fresh pods at harvest.

The weight of fresh pods at harvest in (kg).

A number of galled root at harvest.

Number of galls per root (gall index) at harvest which was scaled thus;

0 = No galls,1 = 1 – 10 galls,2 = 11 – 20 galls,3 = 21 – 30 galls,4 = 31 – 40 galls, 5 = 41 – 50 galls and 6 = > 51 galls.

Data analysis: The data collected were subjected to Analysis of Variance (ANOVA) per the procedure for Randomized Complete Block Design (RCBD) as outlined by Obi, (2002). Significant treatment means were separated using Least Significant Difference (LSD) at 5% level of probability.

RESULTS

The result in Table 1 showed that the application of the oil palm bunch ash positively increased the physic-chemical properties of the soil among the treated plots, which significantly differed ($P<0.05$) from each of the treated plots showing higher value than the control plots. Table 2 shows the chemical constituents of the oil palm bunch ash used in the experiment.

Result obtained from Table 3 focused on the effect of treatment on the mean plant height (cm) and a number of leaves of soybean. The result showed that the control produced the lowest mean plant height of 39.34cm followed by 5t/ha with mean plant height of 39.63cm. 11t/ha produced the height mean plant of 49.38cm followed by 8t/ha with mean plant height of 44.47cm. There was no significant ($P>0.05$) difference among the treatment mean.

Table1. Effect of Oil palm Bunch Ash on the Soil physicochemical Properties.

Before treatment Application		After treatment application			
Physical		Control	5t/ha	8t/ha	11t/ha
% sand	41:80	55.80	57.80	49.80	49.80
%silt	33.40	26.06	26.00	30.00	30.00
% clay	24.80	18.20	16.20	20.20	20.20
Texture	Loam	Loam	Loam	Loam	Loam
Chemical		Control	5t/ha	8t/ha	11t/ha
PH (H_2O)	6.5	5.04	6.30	6.54	6.89
P (mg/kg)	3.50	8.80	12.30	15.50	20.50
% N	0.046	0.042	0.063	0.070	0.098
% OC	0.53	0.308	0.476	0.784	1.204
% OM	0.91	0.531	0.821	1.351	1.208
Ca ($cmolkg^{-1}$)	4.00	4.00	4.00	6.00	8.40
Mg($cmolkg^{-1}$)	1.60	2.80	3.20	3.20	3.60
K ($cmolkg^{-1}$)	0.133	0.077	0.143	0.149	0.195
Na ($cmolkg^{-1}$)	0.683	0.052	0.122	0.165	0.174
$H+/E_A$ AL^{3+}	1.60/0.72	1.68	0.92	1.28	0.48

Table 2. Chemical Properties Of The Oil Palm Bunch Ash.

Nitrogen (N)	0.42
Phosphorus (P)	0.325
Potassium (K) Cmol/kg)	1.025
Calcium (Ca) (Cmol/ha)	0.40
Magnesium (Mg) (Cmol/kg)	0.091
Sodium (Na)	0.58
Organic Carbon (OC)	28.49
pH	0.10

Table 3. Effect of Oil Palm Bunch Ash on plant height(cm) and a number of leaves at 3MAP.

Treatment	Plant height (cm)	Number of leaves
Control	39.34	29.53
5t/ha	39.63	29.61
8t/ha	44.47	33.78
11t/ha	49.39	35.42
LSD(0.05)	NS	NS

The results showed the control had the lowest mean number of leaves followed by 5t/ha. 11t/ha produced the highest mean of leaves by 8t/ha. There was no significant ($P>0.05$) difference among the treatment mean.

Results obtained from the Table 4 showed that the application of the oil palm bunch ash to the soil significantly ($P<0.05$) increased the number and weight (kg) of fresh pods at harvest. The mean number of fresh pods produced by the plant at the control plots was significantly ($P<0.05$) lower than those obtained from plots treated 11t/ha.

Table 4. Effect of Oil Palm Bunch Ash on Number and Weight (kg) of Fresh pods at Harvest.

Treatment	Number of fresh pods	Weight (kg) of fresh pods
Control	70.08	0.057
5t/ha	70.75	0.130
8t/ha	98.50	0.240
11t/ha	79.47	0.340
LSD (0.05)	4.86	0.110

The results obtained showed that the application of the oil palm bunch ash to the soil significantly ($P<0.05$) reduced the number of galled roots and gall index at harvest (table 5). The number of galled roots produced by the plant at the control plots was significantly ($P<0.05$) higher than those obtained from other treatment levels.

The results obtained showed that the application of the oil palm bunch ash to the soil significantly ($P<0.05$) reduced nematode population (Table 6). The nematode population produced by the soil at control plots was significantly ($P<0.05$) higher than those obtained from other treatment levels.

Table 5. Effect of Oil Palm Bunch Ash on Number of Galled Roots and Gall Index at Harvest.

Treatment	Number of galled roots	Gall index
Control	3.95	1.84
5t/ha	0.67	0.34
8t/ha	0.56	0.30
11t/ha	0.39	0.06
LSD (0.05	0.86	1.20

Table 6. Effect of Oil Palm Bunch Ash on Mean Nematode Population per 100g of Soil.

Treatment	Initial nematode population	Final nematode population
Control	5.67	9.89
5t/ha	6.56	5.45
8t/ha	6.44	2.78
11t/ha	7.00	1.89
LSD (0.05)	NS	0.96

NS = Not Significant.

DISCUSSION

The effect of oil palm bunch ash on soil physio-chemical properties shows that the treated plots from each of the treated plot showing higher value than the control plots.

The application of the treatment increased the soil nitrogen, and when nitrogen combines with the hydrogen ion in the soil it produces ammonia which helps to reduce the population of nematodes in the soil and suppress nematode activities. This agrees with the observation made by Liang *et al,* (2009) and Hu, and Qi, (2010) that nitrogen addition decreased total nematode abundance and diversity. The increase in nitrogen also leads to vigorous plant growth which was observed in the treated plots which is in line with the observation made by Brady and Weil, (2002) that nitrogen is responsible for vigorous growth and development of a dense, attractive lawn and in plants. The oil palm bunch ash increased the nitrogen content from 0.046% before treatment application 0.042% (control), to 0.063%(5t/ha), 0.070%(8t/ha), 0.098%(11t/ha).

The application of oil palm bunch ash also increased the phosphorus content of the soil. This increase in the phosphorus content helped the seed production as observed in the 11t/ha by giving the highest mean of pod weight (0.340) and the plant height (49.38). Silva and Uchida, (2000) observed that adequate supplies of phosphorus enhance early root formation and growth, greater flowering, seed production and grain quality of plants. The treatment application also increased the potassium content of the soil more than the control plots, with 11t/ha giving the highest potassium content in the soil, The presence of potassium in the soil helps the plant during photosynthesis, enhances the fruit quality and reduces plant susceptibility to disease and growth regulation; and this was observed well in treated soil than in the control. Datnoff, (2007) reported that potassium helps in the building of protein, photosynthesis, fruit quality and reduction of disease in plants.

The treated plots produced the highest number of fresh pods with the control having the lowest number. This was due to the reduction of the nematode activities in the treated plots thereby allowing the plants in the treated plots to absorb the available nutrients for pod development. Nematode interference with the physiological functions of plants leads to reduced development in most of the plant parts and organs. This work agreed with the work of Cavenesis *et al,* (2010) who stated that bitter leaf extract increases the yield of okra due to reduction of disease interference.

The number of galled roots produced by the plants in the control plots was significantly higher than those obtained from the treated plots. This was attributed to the chemical contents and their combination of oil palm bunch ash and their interactions with other soil properties contributed to the suppression of nematode attacks on the plants. This accounted for the low numbers of galled roots and gall index obtained from the treated plots. This work agreed with the work of Grandison, (2004) who stated that bitter leaves extracts have an action against root-knot nematode, it also agrees with the work of Schmuttere, (2000) who stated that neem leaf is widely used in controlling root-knot nematodes and another insect pest.

The nematode population per 100g of soil at the control plots was significantly higher than those obtained from other treated plots. The reduction in population levels of the nematode in the treated plots showed that oil palm bunch ash either repelled or exerted lethal effects on the nematode which varied with the levels of the oil palm bunch ash applied. The higher the level of oil palm bunch ash, the lower the population level of the nematode. This work agreed with the Schmuttere, (2000) who stated that most part of the neem plant especially the leaves prepared as dust, the seeds and kernel and the ash repels root-knot nematodes on tomato, okra and soybean plant.

In conclusion, application of oil palm bunch ash to soybean field helped in improving the physicochemical properties of the soil, enhanced plant growth and development, increased plants disease resistance and suppressed the activities of root-knot nematode in the soil. application of oil palm bunch ash at 11t/ha reduced nematode incidence on the test crop and enhanced its growth and yield parameters.

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