American-Eurasian J. Agric. & Environ. Sci., 2 (5): 523-527, 2007
ISSN 1818-6769

Control of Certain Nematode Pests with Different Organic Manure on Cowpea

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Abstract: A field experiment was carried out to study the effect of different organic manure on the certain nematode pests on cowpea cv. Ife brown. Both decomposed and un-decomposed manure applied as organic amendment caused significant reduction in the soil population of *Meloidogyne* spp., *Helicotylenchus* sp. and *Xiphinema* sp. on cowpea. The organic manure resulted in a significant reduction of root galls on the root of cowpea. The result of the field experiment showed that organic manure significantly improved growth and yield of cowpea. Moreover, organic manure enhanced soil nutrient status that invariably increased the growth rate of cowpea. All these gave resultant high cowpea yield.

Key words: Cowpea · organic manure · plant parasitic nematodes

INTRODUCTION

Cowpea (*Vigna unguicutata* L. Walp) belongs to the family Fabaceae. It is an annual leguminous crop, otherwise referred to as southern pea, crowder pea, lubia, niebe, black eye or pea. It is widely grown in tropical and subtropical countries. It is chiefly used as a grain crop, for animal fodder, or as a vegetable. Cowpea seed is a nutritious component in the human diet and livestock feed [1-3].

Cowpea had been reported to be susceptible to nematode pests. Different *Meloidogyne* species are major nematode pests of cowpea [4]. Moreover, dwarfing, patchy growth of the plant, death of young seedlings, poor pod formation and germination had been observed as nematode infection on cowpea [5].

Compost is a mixture of degraded plant material and the associated by-products of the degrading organisms. It is produced through a process otherwise referred to as "Composting". Substrate size, temperature (heat), the placement and dimensions of the compost are different factors, which may influence the process and rate of composting [6].

Applications of plant materials that are toxic to nematodes have been regarded favourably in nematode pest control in environmental consciousness world [7, 8]. Organic manure, such as composted leaf mould [9], Neem cake [10, 11] had been reported to control nematode pests effectively. The difficulties associated with nematicidal chemicals, especially its high cost, persistency in soil after harvest, contamination of ground water and residues in crop [12] have spur researchers to look for alternative control measures.

In this paper, attempts were made to use both decomposed and un-decomposed organic manure to control nematode pests of cowpea cv. Ife Brown.

MATERIALS AND METHODS

Preparation of the compost (decomposed organic material): A pit, 1.5 m long X 1.0 m wide X 1.0 m deep was prepared for each of the compost materials (maize stover, cassava peel and wild sunflower leaf) at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. 500 kg each of the compost material was placed into the pit and 10 kg of poultry manure was spread across the top of the compost material as a biological activator, then the pit was covered with plastic sheet. A month later, the pit was uncovered and the premature compost was mix thoroughly together using garden fork. After another month, the pit was uncovered and mix thoroughly again. A month later, the mature compost was removed from the pit, spread and dry. After drying, the compost was applied as treatments on the field.

Field experiment: A field experiment was carried out during 2006 cropping season at the Teaching and

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Research Farm of the Ladoke Akintola University of Technology, Ogbomoso, Nigeria using decomposed and un-decomposed plant materials of wild sunflower leaf, maize stover and cassava peel and one control treatment. They were laid out in a Randomized Complete Block Design with four replicates.

At planting, soil samples were taken and assessed for nematode population counts by the modified Baermann technique [13]. Cowpeas cv. Ife Brown (from IITA, Ibadan) seeds were planted in two rows 50 cm apart on 1 m ridges and 25 cm within rows. 3-4 seeds were sown but later thinned down to 1-healthy-seedling per stand at 1-week after sown. Four 5m ridges were used per plot. One week after planting, each cowpea plant grown in naturally nematode pests infested soil was inoculated with 1500 freshly hatched second stage juveniles of root knot nematodes, *Meloidogyne* species by pipetting the nematodes into 1-cm holes around the base of the plant and filling the holes with moist soil. The experimental field was inoculated with root knot nematode in order to augment the nematode population in the soil. The root knot nematodes were obtained [14] from infested *Celosia argentea* (cv. TLV 8) roots maintained in a screen house. Ten [10] grams each of the organic manure (decomposed and un-decomposed forms) were banded along the two rows of 2-week-old cowpea seedlings. Hand-weeding was used to control weed infestation during the field work while insect pests were controlled by spraying karate 2.5 EC at weekly intervals from the fifth to tenth week at the rate of 1 litre ha^{-1}.

Records of number of leaf per plant, plant heights, number of seeds per pod, number of pod per plant and grain yield per plot were taken. Post-harvest soil samples were taken for nematode population assessment. Root gall indices were scored on a scale of 0-5 following a standard method [15]. Where 0 = no gall, 1 = 1-2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100 galls and 5 = more than 100 galls. The compost materials were subjected to chemical analysis and each compost material was assessed for the presence of nitrogen, phosphorus, potassium, iron, zinc and copper. All the data were subjected to analysis of variance and Duncan's multiple range tests was used to partition the differences between the means.

RESULTS

Nematode pests encountered in the soil at planting and harvest were *Meloidogyne* spp., *Xiphinema,* sp. and *Helicotylenchus* sp. Nematode pest populations at the onset of the experiment (initial nematode population) did not vary significantly ($p < 0.05$) among the treatments (Table 1). At harvest (final nematode population), the populations of all the three nematodes varied significantly ($p<0.05$) between treatments with the control treatment having the greatest populations in the trial (Table 1).

Table 1: Soil nematode population in 200-ml soil sample at planting (initial population) and harvest (final population),percentage reduction of nematodes and root gall index

	Meloidgogyne spp.			*Helicotylenchus* sp.			*Xiphinema* sp.			
Treatment	Initial population	Final population	% reduction	Initial population	Final population	% reduction	Initial population	Final population	% reduction	Gall index
Decomposed wild sunflower leaf	546	341b	62.45	113	38a	33.63	69	41a	59.42	1.2a
Decomposed maize stover	569	308a	54.13	108	47a	43.52	72	38a	52.78	1.0a
Decomposed cassava peel	581	311a	53.53	119	31a	26.05	75	35a	46.67	1.0a
Undecomposed wild sunflower leaf	552	361b	65.40	115	48a	41.74	64	31a	48.44	1.3a
Undecomposed maize stover	568	307a	54.05	109	29a	26.61	67	33a	49.25	1.0a
Undecomposed cassava peel.	580	402b	69.31	107	35a	32.71	62	40a	64.52	1.5a
Control	577	2641c	457.71	114	188b	164.91	70	227b	324.29	4.7a
	NS		NS	NS						

NS = Not Significant

Means followed by the different letter(s) along the same column are not statistically different at 5% probability level

Table 2: Effect of compost on the growth of cowpea cv. Ife Brown infected with nematode pests

Treatments	Average No. of leaves per plant	Average plant height (cm)	Average root length
Decomposed wild sunflower leaf	26.8ab	18.4b	31.5a
Decomposed maize stover	29.1a	20.3ab	25.4b
Decomposed cassava peel	28.4a	18.1b	28.5ab
Un-decomposed wild sunflower leaf	25.7b	18.6b	28.8ab
Un-decomposed maize stover	30.2a	21.6a	28.5ab
Un-decomposed cassava peel	29.9a	18.7b	33.7a
Control	12.7c	11.5c	14.7c

Means followed by the different letter(s) along the same column are not statistically different at 5% probability level.

Table 3: Effect of compost on the yield of cowpea cv. Ife Brown infected with nematode pests

Treatments	Average No. of seeds per pod	Average No. of pod per plant	Average grain yield per plot (kg)
Decomposed wild sunflower leaf	15.5a	16.8a	3.0a
Decomposed maize stover	13.9a	14.4b	3.2a
Decomposed cassava peel	15.7a	14.3b	2.95a
Un-decomposed wild sunflower leaf	13.1a	14.01b	2.9a
Un-decomposed maize stover	13.6a	15.5ab	3.00a
Un-decomposed cassava peel	14.7a	15.5ab	2.88a
Control	6.3b	9.2c	1.52b

Means followed by the different letter(s) along the same column are not statistically different at 5% probability level.

Table 4: Chemical properties of the compost materials

Chemical constituent	Wild sunflower leaf	Cassava peel	Maize stover
N (g/kg^{dw})	1.20	0.60	7.30
P (g/kg^{dw})	0.48	0.43	11.40
K (g/kg^{dw})	0.40	0.25	11.70
Fe ($mg\ kg^{-1}$)	1.00	0.12	3.20
Zn ($mg\ kg^{-1}$)	1.40	1.20	140.00
Cu ($mg\ kg^{-1}$)	0.29	0.98	22.50

Number of leaf per plant and plant height were significantly ($p<0.05$) higher in plots treated with both decomposed and un-decomposed wild sunflower leaf, maize stover and cassava peel than in the control plots. Moreover, root length was significantly ($p<0.05$) longer in plot treated with organic manure than in the control plots (Table 2).

Number of seed per pod, number of pod per plant and grain yield per plot varied significantly ($p<0.05$) among the treatments (Table 3). The cowpea plants treated with both decomposed and un-decomposed wild sunflower leaf, maize stover and cassava peel gave significantly.

The chemical analysis of the compost revealed the presence of Nitrogen, Phosphorus, Potassium, Iron, Zinc and Copper (Table 4). It was observed that the chemical composition of the compost made from wild sunflower leaf, cassava peel and maize stover varied tremendously. Maize stover had the highest quantity of Nitrogen, Phosphorus, Potassium, Iron, Zinc and Copper while cassava peel has the least.

DISCUSSION

In our earlier study, plant parasitic nematodes, especially species of *Meloidogyne, Pratylenchus, Scutellonema, Xiphinema* and few others had reached endemic situation at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso [17]. The high population of the plant parasitic nematodes observed during the course of this study therefore corroborates our previous findings at the experimental site.

Number of leaf per plant, plant height, number of seeds per pod, number of pod per plant and grain yield per plot were significantly higher in the compost treated plots than in the control. Addition of compost to soil decreased nematode pests and resulted in increased crop growth and yield. This might be due to the fact that addition of compost to the soil increases soil nutrient status, changes the physical and tropic structures of soil which might affect the plant growth and yield performances. This is in agreement with the observations of several other researchers [18-21] on various economic food crops. When organic manure breaks down, the nutrients and toxicants are released into the soil. While the released nutrients enhanced crop growth and yield, the toxicants help to checkmate the soil inhabiting plant parasitic nematodes which equally gives resultant increased in crop growth and yield.

Addition of compost to soil infested with nematode pests resulted in significantly reduced soil nematode populations and root gall index. This might be attributed to the fact that compost is capable of producing antagonistic fungi that could destroy nematode pest, resulting into low soil population count and reduce galls on plant root. Similar results using other organic manure have been reported by other workers on different economically important agricultural crops [22, 23].

The readily availability of the organic materials used in this study and their effects on nematode population, root galls, cowpea growth and yield suggest the need for additional studies in the field to assess the economics of their uses. Also, laboratory study should be carried out to determine the toxic substances in the organic manure. Mechanism of action of organic manure with respect to nematode control needs to be understudied in our next research output.

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