Effects Of Organic Manure Types On Root-Gall Nematode Disease And African Yam Bean Yield

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ABSTRACT: Evaluation of the effects of different organic manures on root-gall nematode disease on African yam bean was conducted in a sandy loam soil naturally infested with a root-gall nematode, *Meloidogyne incognita*. The experiment was conducted in a randomized complete block design with four replications. African yam bean plant were treated with sawdust, municipal garbage, swine, compost, poultry and farmyard manures at 2.5 ton/ha. Results showed that severe root galls occurred on plants treated with sawdust and rare galls on those treated with poultry and farmyard manures. Growth and yield characteristics of the plant were also affected by root-gall damage at the various organic manure treatments. [The Journal of American Science. 2008;4(1):76-79]. (ISSN: 1545-1003).

Keywords: African yam bean, organic manures, root-galls, growth and yield, Owerri, Imo State, Nigeria

INTRODUCTION

Plant parasitic nematode problems have most commonly been managed by chemical soil treatments and crop rotation (Murphy *et al*, 1974). Although both practices improve yields of many crops, there are undesirable features associated with each. Crop rotation designed to reduce a specific nematode species often does so at the expense of increasing other species to damaging levels (Brodie *et al*, 1970; Daulton, 1963; Minton and Donnelly, 1971). Chemical soil treatment, which generally improves crop yields, rarely reduces nematode population densities for more than 2 – 3 months, resulting in post harvest population densities greater than preplant densities (Brodie and Good, 1973).

Considerable interest has however developed in the possibility of using organic manures to reduce nematode populations and increase crop yields (Johnson, 1962; Mankau and Minteer, 1962; Lear, 1959). This innovation satisfies the undesirable features of chemical soil treatments and crop rotation (Ismaila *et al*, 1973). Little is however known about the relative efficacy of different organic manures in the control of root nematodes. This study evaluated different organic manures for effective control of root-gall nematode disease on African yam bean (*Sphenostylis stenocarpa*).

METHODS

The study was conducted in the cropping seasons (April – September) of 2005 and 2006 at the Teaching and Research Farm of Federal University of Technology, Owerri, located between latitudes 5^0 20'N and 5^0 27'N and longitude 7^0 00'E. The soil was sandy loam (91.44% sand, 3.44% silt and 5.22% clay) and naturally infested with a root-gall nematode, *Meloidogyne incognita*. The nematode population densities was estimated by modified sieving and Bearman's Funnel Technique (Viglierchio and Schmitt, 1983).

Before planting, the land was cleared, ploughed, harrowed and made into 28 seedbeds (1.2 x 8 m) at 7 seedbeds/block. The seedbeds were treated by incorporating no manure, sawdust, municipal garbage, farmyard, compost, swine and poultry manures at 0.024 tons/seedbed (i.e. 2.5 tons/ha) in a randomized complete block design with four replications. Percentage organic carbon, ammonium, potassium, phosphorus and carbon/nitrogen ratios in the organic manures were respectively analysed using Walkley-Black method (Black, 1965), Colorimetric determination method (Anderson and Ingram, 1993); Flame Photometry and Vanado-Molybdate methods (AOAC, 1970);and Fumigation and Extraction method (Wander and Traina, 1996). All seedbeds were repulverized 7 days later and immediately seeded with African yam bean (Benue brown cv) at 0.8 x 0.8 m, a population density of

Table 1: Approximate percentage of organic carbon, ammonium (nitrogen form), potassium, phosphorus, carbon/nitrogen ratio of organic manures (dry weight basis)

Constituent	Sawdust (%)	Poultry (%)	Farmyard (%)	Municipal garbage (%)	Compost (%)	Swine (%)
Organic carbon (c)	60.0	20.0	50.0	40.0	40.0	45.0
Ammonium (N)	0.1	6.5	4.0	0.5	1.3	1.5
C:N ratio (C/N)	600:1	4:1	12:1	80:1	30:1	30:1
Potassium (K)	5.0	1.0	2.0	4.0	3.0	2.0
Phosphorus (P)	2.0	1.0	1.5	2.0	3.5	1.0

15,625 plants/ha. The plants were staked with two plants/stake and hoe weeding done 40 and 75 days after planting. At 14 day intervals from 30 to 100 days after plantings, leaf area index (area of leaf materials divided by the ground area over which it is displayed), leaf area growth rate (cm^2/day), number of shoots, seed bearing pods and leaves/stand and plant heights were recorded. Pods and 1000 seeds dry weights were also recorded at harvest (150 days after planting). Root-gall incidence (percentage of infected plants) and severity were measured. Root-gall severity was scored using the following scale: 1 = no root-galls, 2 = 1 – 25%, 3 = 26 – 50%, 4 = 51 – 75% and 5 = 75 – 100% roots galled. Twenty cores (2.5 x 15 cm) of soil were also collected from the centre rows of each seedbed and processed for nematode population density according to the methods of Viglierchio and Schmitt (1983). All data were subjected to analysis of variance (Steel and Torrie, 1981) and means separated by Fisher's least significant difference (Fisher, 1948) at P = 0.05.

RESULTS AND DISCUSSION

Results of the study showed that incidence and severity of root-gall nematode disease on African yam bean varied with different organic manure treatments. Highest disease incidence and severity occurred on sawdust treated African yam bean plants. These were followed by those on plants treated with municipal garbage. Moderate root-galls occurred where swine or compost manure was applied. Plants treated with poultry manure were rarely galled. The same was true for farmyard manure but with higher disease incidence. Nutrient constituent analysis (Table 1) showed that the different organic manures varied significantly in amounts of potassium, phosphorus, ammonium (in form of nitrogen), organic carbon and carbon/nitrogen ratios. Amounts of these nutrients influenced root-gall nematode damage on the African yam bean. This was as evidenced by severe root-galls associated with sawdust which had high (5%) potassium and very low (0.1%) ammonium contents. Also, poultry manure with high (6.5%) ammonium and low (1%) potassium contents gave rare root-gall damage. These observations agree with that of Otiefa (1959) which stated that root-gall nematode damage on cabbage increased with amounts of potassium available to the host plant because potassium increased the rate of reproduction of the nematode. Huber (1980) also reported that root-gall nematode damage on Lima bean decreased with increased ammonium supplied to the plant.

Growth and yield characteristics of the African yam bean were affected by root-gall nematode damage at the various organic manure treatments (Table 2 and 3). Leaf area index, leaf area growth rate, plant height, number of shoots, leaves and seed bearing pods and weights of dry pods and seeds were significantly reduced at high disease severities resulting from sawdust, municipal garbage and no manure applications. Plants treated with poultry and farmyard manures gave significantly higher yields than those of other organic manures. This was because rare root-galls occurred at poultry and farmyard manure applications. Plants with fewer root-galls would translocate more nutrients to vegetative organs than heavily galled roots (Otiefa and Elgindi, 1962). The C:N ratios of poultry and farmyard manures were also very narrow (Table 1). Miller and Donahue (1990) reported that organic residues with C:N ratios of 20:1 or narrower have sufficient nitrogen to supply to the decomposing microorganisms and also to release for plant use.

Conclusion: Application of sawdust as a soil amendment aggravated root-gall nematode damage on African yam bean in a sandy loam soil. This was as opposed to significant reductions in root-gall nematode damage caused by municipal garbage, swine, compost, poultry and farmyard manure applications. Poultry and farmyard manures most effectively controlled the disease and improved African yam bean growth and yield.

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Table 2: Growth and yield characteristics of African yam bean as affected by root-gall nematode (*M. incognita)* disease at various organic manure applications in 2005

Organic manure (2.5tons/ha)	Mean										
	Disease		Leaf area		Number of		Plant height (cm)	Number of seed bearing pods/stand	Dry weights of		Nematode counts/ 200cc of soil at harvest
	Incidence (%)	Severity (1 – 5 scale)	Index	Growth rate (cm^2/day)	Shoots/ Stand	Leaves/ Stand			Pods (gm)	1000 seeds (gm)	
No manure	65.20	5.00	2.40	166.00	8.50	143.18	218.12	7.00	31.20	122.30	28.90
Sawdust	64.90	5.00	3.20	180.04	9.00	152.40	220.24	6.68	33.10	120.00	32.44
Swine	47.80	3.40	4.96	256.06	11.70	198.02	251.15	15.06	80.40	168.15	10.43
Poultry	14.90	2.20	7.36	340.03	13.36	239.13	286.07	22.40	138.60	201.10	3.95
Farmyard	28.60	2.40	6.80	324.05	14.56	242.22	280.04	25.80	144.00	220.40	2.75
Municipal garbage	46.40	4.30	3.52	270.01	11.58	201.19	231.23	11.24	45.18	134.23	18.27
Compost	44.80	3.20	6.23	313.08	13.06	228.04	248.14	18.15	92.70	178.63	8.97
$LSD_{0.05}$	3.40	0.90	1.29	18.54	2.10	11.16	22.40	2.98	8.68	22.42	1.50

Table 3: Growth and yield characteristics of African yam bean as affected by root-gall nematode (*M. incognita)* disease at various organic manure applications in 2006

Organic manure (2.5tons/ha)	Mean										
	Disease		Leaf area		Number of		Plant height (cm)	Number of seed bearing pods/stand	Dry weights of		Nematode counts/ 200cc of soil at harvest
	Incidence (%)	Severity (1 – 5 scale)	Index	Growth rate (cm^2/day)	Shoots/ Stand	Leaves/ Stand			Pods (gm)	1000 seeds (gm)	
No manure	62.78	5.00	2.62	154.48	7.70	139.04	198.44	9.00	36.36	136.76	31.07
Sawdust	67.03	5.00	2.90	168.17	7.23	144.30	194.05	8.64	32.14	128.26	36.56
Swine	44.54	3.01	4.14	244.38	12.18	167.15	232.43	13.42	68.82	155.24	12.04
Poultry	20.15	2.12	7.76	322.12	12.04	231.18	256.48	23.01	55.22	218.00	2.84
Farmyard	22.63	2.43	7.22	312.44	13.24	236.14	261.22	24.61	161.78	226.18	3.01
Municipal garbage	45.19	4.16	4.14	258.62	10.28	198.42	220.13	10.04	54.06	121.67	21.54
Compost	44.16	3.12	6.06	301.12	12.44	222.06	240.33	15.10	84.21	164.18	10.18
$LSD_{0.05}$	4.86	0.52	1.12	20.01	20.01	8.15	12.02	3.18	12.23	18.86	2.07