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Root-Gall Nematode Disease of Pineapple as Affected by Seed Material, Amount and Type of Organic Soil Amendment

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Abstract: Effects of seed material, amount and type of organic soil amendment on root-gall nematode disease of pineapple were assessed. The study was conducted in a 3×3×3 factorial experiment in randomized complete block design replicated 4 times. Planted pineapple crowns, slips and suckers were treated with 0.00, 1.50 and 3.00 tons ha^{-1} of poultry manure, sawdust and pigdung. Results showed that plants propagated from pineapple crowns were most susceptible to the disease at 0.00 tons ha^{-1} of organic soil amendment. The disease however decreased in all the seed materials as rates of the organic soil amendments increased. At 3.00 tons ha^{-1} of poultry manure application, no root-gall damage occurred in any of the pineapple plants. Highest fresh fruit weight obtained on crown propagated plants occurred at this 3.00 tons ha^{-1} of poultry manure application.

Key words: Pineapple, crown, slip, sucker, root-gall, poultry manure, pig dung, sawdust, Owerri, Imo State, Nigeria

INTRODUCTION

Cultivated pineapple (*Ananas comosus* (L) Merr.) is a self-sterile monocotyledonous perennial herb vegetatively propagated from crowns, slips, suckers or stumps (Evans *et al*., 1988). It grows on almost any type of soil and is grown worldwide for fresh fruit and processing (Ian and John, 1984). Pineapple for processing is generally grown as a plantation crop while that for fresh fruit is frequently grown by small scale farmers and sold at local fruit and vegetable markets typical of developing countries.

The major production areas are Hawaii, Mexico, Philipines, Thailand, Kenya, Honduras, Costa Rica, Zimbabwe, South Africa, Ivory Coast, Taiwan, Malaysia and Australia. Planted hectarages in these areas have however declined in recent years due to nematode problems (Rohrbach and Apt, 1986). More than one hundred species of plant-parasitic nematodes have been reported in association with pineapple root systems (Mitchel *et al*., 1990). The most important of these are the root-gall nematode *Meloidogyne javanica*, *M. incognita*; the reniform nematode, *Rotylenchulus reniformis* and the root-lesion nematode, *Pratylenchus brachyurus* (Sipes, 1996). The root-gall nematode, *M. javanica* is the most severe and basic nematode disease problem in all pineapple producing areas (Boradly *et al*., 1993). A single juvenile of *M. javanica* in a root or soil sample is interpreted as a potential problem as the plant crop yield can be reduced by 60-74% by the nematode (Keetch, 1982).

Emphasis of nematode control in pineapple has been on protection of the young, growing root system by reduction of nematode inoculum in the soil prior to planting through clean fallow (Sarah, 1987); crop rotation (Anon, 1987); chemical nematicides (Apt and Caswell, 1988) and organic soil amendment (Egunjobi and Larinde, 1975). Although host plant resistance is not available in pineapple or closely related species (Rohrbach and Apt, 1986), susceptibility to the nematode may vary among the planting materials. This study therefore concerned the effect of seed/planting material, amount and type of organic soil amendment on root-gall nematode disease in pineapple.

MATERIALS AND METHODS

The study was carried out at the Teaching and Research Farm of Federal University of Technology, Owerri, 5° 27'N, 7° 00'E and 1025 m asl. The soil was ultisol (FAO/UNESCO, 1994) with sandy loam topsoil (91.44% sand, 3.4% silt and 5.22% clay).

Soil preparation included bush clearing, ploughing (45-60 cm depth) and harrowing. After tillage, the soil was fumigated with Furadan 10 G (a carbofuran) at 25 kg ha^{-1} and black plastic strips laid over the soil. The plastic mulch served to retain the fumigant, control weeds and raise soil temperature. Sixty days later, the soil was repulverized and the experiment laid out in a 3×3×3 factorial in randomized complete block design with 3 replications.

Pineapple seed materials included crowns, slips and suckers and organic soil amendment applied at 0.00, 1.50 and 3.00 tons ha^{-1} included sawdust, pigdung and poultry manure. The seed materials were obtained from a 20 months old pineapple (cv. "Smooth cayenne") farm at National Institute of Horticulture, Ibadan, Nigeria. After curing for 10 days, the pineapple seed materials were planted in double rows 60 cm apart with 80 cm between the double rows and 30 cm between plants in the row, a population density of 47,600 plants ha^{-1} (Ian and John, 1984). Water was applied as and when necessary by overhead sprinkler to help establish the planting materials.

The plants were inoculated 30 days after planting with pineapple roots on which *Meloidogyne javanica* had been maintained. Severely infected pineapple roots (10 kg) with more than 30 galls $plant^{-1}$ were macerated and applied to each plot (4×2 m) following the procedure of Agu (2004). A urea/iron/zinc solution (Collins, 2000) at 10 L ha^{-1} was applied bi-weekly beginning 3 months after planting until fruiting was initiated.

At harvest (20 months after planting), root-gall damage on each randomly sampled plant was assessed on the scoring system of Ogbuji (1981) in which 0 = no infection (no galls); 1 = rare infection (1-3 galls); 2 = light infection (4-10 galls); 3 = moderate infection (11-30 galls) and 4 = severe infection (> 30 galls). Fresh fruit weights and number of roots $plant^{-1}$ were also recorded. These data were analyzed by the method of Steel and Torie (1981) using Fishers' Least Significant Difference (Fisher, 1948) for treatment means at p = 0.05.

RESULTS AND DISCUSSION

Results of this study showed that pineapple (cv. "Smooth cayenne") plants propagated from crowns, slips and suckers were all susceptible to *M. javanica* infection. Galling responses of these seed materials to the nematode however varied (Table 1). Plants propagated from crowns were severely galled and those from slips and suckers were moderately and lightly galled respectively. These differences in root-gall severity were due to differences in amounts of roots produced by the different seed materials. The crowns produced significantly (p = 0.05) higher number of roots than the slips and suckers (Table 1). This was because crowns are in juvenile development growth phase and tend to grow more vigorously than the slips and suckers in adult growth phase (Hartmann and Kester, 1986). Wallace (1963) reported that increased number of roots per unit area increased respiration and reduced oxygen and increased carbon dioxide content of the soil environment and soil solution, so producing gradients of oxygen and carbon dioxide close to the roots which increases nematode activity on the roots. Bird (1959) also stated that orientation of root-gall nematode larvae in concentration gradient of some stimuli emitted by plant roots increased with increased plant roots.

Table 1: Pineapple seed material root production and root-gall response to *M. javanica* infection

Seed material	Mean number of roots	Mean root-gall indices (0-4)
Crown	49.00	4.00
Slip	34.20	3.20
Sucker	27.10	2.15
$LSD_{0.05}$	6.30	1.26

Table 2: Effect of manure rates on root-gall damage on pineapple plants propagated from different seed materials

Planting material	Manure type	Manure rate (tons ha^{-1}) 0.00	1.50	3.00	$LSD_{0.05}$
Crown	Poultry manure	4.00	2.30	0.00	1.28
	Pig dung	4.00	3.20	2.20	1.02
	Sawdust	4.00	4.00	3.00	0.76
Slip	Poultry manure	3.30	1.40	0.00	0.98
	Pig dung	3.30	2.80	2.00	1.12
	Sawdust	3.20	3.30	2.40	Ns
Sucker	Poultry manure	2.40	1.60	0.40	1.04
	Pig dung	2.20	1.88	0.86	0.44
	Sawdust	2.10	2.40	1.80	Ns

Amount and type of organic manure applied as soil amendment affected the extent of root-gall damage by the nematode (Table 2). Crown propagated plants treated with poultry manure, pig dung and sawdust at 1.50 tons ha^{-1} had light, moderate and severe root-galls, respectively. No root-gall damage occurred at 3.00 tons ha^{-1} poultry manure application. This was not so with pigdung and sawdust. Instead, light and moderate root-gall damage occurred respectively. Slips and suckers propagated plants also had decreases in root-gall damage as the application rates of the various organic manures increased. Poultry manure was most effective, followed by pigdung and then sawdust. This observation agrees with that of Agu (2008) which reported that root-gall nematode damage on African Yam Bean (*Sphenostylis stenocarps*) was best controlled with poultry manure application. Poultry manure generates ammonia (Ogbede and Nwokeji, 2005) which has lethal effect on nematodes (Eno *et al*., 1955).

First crop fresh fruit weight measured at harvest (20 months after planting) varied amongst the seed materials, amounts and types of organic manure applied (Table 3). Plants propagated from crowns gave higher fresh fruit weights than those from slips and suckers. Highest fresh fruit weight which also differed significantly from others was obtained from plants propagated from crowns and treated with 3.00 tons ha^{-1} poultry manure. This was so because such plants were free from moisture and nutrient stress associated with root-gall damage in pineapple (Edward *et al*., 1990). Crown propagated

Table 3: Pineapple fresh fruit yield as affected by infected seed material, amount and type of organic soil amendment

Planting material	Manure type	Manure rate (tons ha^{-1})	Mean root-gall indices (0-4)	Fresh fruit yield (tons ha^{-1})
Crown	Pig dung	0.00	4.00	104
		1.50	3.20	114
		3.00	2.20	183
	Poultry manure	0.00	4.00	115
		1.50	2.30	111
		3.00	0.00	200
	Sawdust	0.00	4.00	85
		1.50	4.00	114
		3.00	3.00	159
Slip	Pig dung	0.00	3.30	56
		1.50	2.80	70
		3.00	2.00	81
	Poultry manure	0.00	3.30	61
		1.50	1.40	51
		3.00	0.00	81
	Sawdust	0.00	3.20	55
		1.50	3.30	59
		3.00	2.40	70
Sucker	Pig dung	0.00	2.20	74
		1.50	1.88	80
		3.00	0.86	98
	Poultry manure	0.00	2.40	76
		1.50	1.60	58
		3.00	0.40	74
	Sawdust	0.00	2.10	62
		1.50	2.40	56
		3.00	1.80	74
	$LSD_{0.05}$		0.96	51

pineapple plants have also been reported to be better fresh fruit yielders than those of slips and suckers (Ian and John, 1984).

CONCLUSION

Root-gall damage caused by *Meloidogyne javanica* in pineapple was influenced by pineapple seed material, type and quantity of organic soil amendment applied. Plants propagated from pineapple crowns were most susceptible to the nematode. These were followed by those of slips and suckers. Poultry manure was most efficacious of the three organic manures tested and effectively controlled the disease at 3.00 tons ha^{-1}. Highest fresh fruit weight was also obtained from plants treated with 3.00 tons ha^{-1} of poultry manure.

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