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The Effect of Animal Manures on Susceptibility of Cowpea VAR. Moussa Local to Infection by Root-knot Nematode; *Meloidogyne javanica* Treub

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Abstract: The effect of three different types of animal manures namely; poultry, goat and cow dung on the susceptibility of cowpea (*Vigna unguiculata* (L.) Walp) Var moussa local to root-knot nematode infection caused by *Meloidogyne javanica* was tested in a replicated pot experiment. Manured plants were inoculated with 2000 eggs of *M. javanica* while uninoculated manured plants served as control for each manure type and unmanured but inoculated plants as general control. The result showed that unmanured and inoculated plants were susceptible to *M. javanica* to varying degrees. Plants applied with poultry manure were more resistant to root-knot nematode infection followed by those applied with cow dung and goat dropping in that order. The most susceptible plants were those inoculated but not applied with manure. Gall index and resistance rating showed that plants fertilized with poultry manure, cow dung and goat droppings were resistant, moderately resistant and susceptible, respectively.

Key words: Animal manures, moussa local, *Meliodogyne javanica*

INTRODUCTION

In many farming districts in northern Nigeria, the young succulent leaves of cowpea plants are eaten as vegetables, which form an important source of cheap vegetable containing about 25% protein (Ajibade and Morakinyo, 2000). The seeds form major source of storable and transportation protein in the tropics (Amirshahi and Tavakoli, 1970). Cowpea seeds have protein digestibility value of 86-90% and rank among the highest for major legumes (Boulter *et al*., 1973).

As important as this crop is, plant-parasitic nematodes constitute major constraints to its production (Mohammed *et al*., 2000). Root-knot nematode; *Meloidogyne javanica* is among the major pathogens affecting food supply globally because of its worldwide distribution and very extensive host range (Ogunfowora, 1976). Several species of root-knot nematodes, especially *Meloidogyne javanica* are parasitic on cowpea (Ogaraku and Akueshi, 2005), causing stunted growth, chlorosis, wilting and suppression of bacterial nodules, (Ogunfowora, 1976), seed protein content (Boulter *et al*., 1973) and grain yield (Oyenuga, 1968).

Many of the soil amendments used as nutrient sources of crop production have been found to control diseases of crop plants. The additions of such materials to the soil have therefore been recognized as an alternative means of nematode control. These materials include green manure, dried-crop residue (Akhtar and Alam, 1990, 1992). Although the use of nematicides have proved very effective in the control of nematodes, it is very expensive and most farmers can not afford it. There is therefore the need to find cheap but effective ways of controlling this disease. Babalola (1982) suggested that the use of organic amendments can be a good alternative to chemical control. The research was therefore conducted to test the efficacy of cow, poultry and goat manures in the control of *Meloidogyne javanica* on cowpea.

MATERIALS AND METHODS

The research was conducted in the Botanical Nursery of Nasarawa State University Keffi. Cowpea Variety, moussa local which was obtained from IITA, Ibadan has been found to be susceptible to root-knot nematodes (Ogaraku and Onovo, 2006) and so was chosen for this investigation. Three animals manure namely cow dung, goat dung and poultry dung were mixed with soil at a ratio of 1:3, respectively, the mixture then sterilized at 65°C for 90 min. The mixture was stored in jute sacs and allowed to rest for four weeks to restore stability before use. The mixtures were dispensed in 4 L plastic pots and each manure-soil mixture was in 4 replicates, while sterilized soil to which no manure was added served as control also in 4 replicates so that a total of 28, 4 L plastic pots were used for this research. The experiment arranged in a completely randomized design. Planting was done after five days watering. The eggs used as inoculum were extracted from galled *Celosia argentea* (on which a pure culture was previously maintained) using sodium hypochlorite (NaOCl) method (Hussey and Barker, 1985). Initially *Meloidogyne javanica* was identified by the transverse striations surrounding the vulva and anus of females; the perineal pattern as published by Eisenback *et al.* (1981). Estimation of nematode eggs was done by counting the number of eggs in 1 mL of a homogenized suspension of the inoculum using a stereoscopic microscope at ×40 magnification then projecting to the requisite quantity that would give the required number of eggs to be used for inoculation. One milliliter of the eggs suspension was estimated to contain 500 eggs; therefore 4 mL would contain 2000 eggs.

Two thousand eggs of *Meloidogyne javanica* were used to inoculate the cowpea plants at two-leaf stage. Inoculation was done by pipetting the juvenile suspension into 10 cm deep holes made around the base of the plants (Hussey and Boerma, 1981) and covered immediately with top soil (Goswami and Chenulu, 1974). Four plants in different pots from each manural type were inoculated while the remaining four served as control. Four plants grown in different pots without manuring were also inoculated to serve as general control. Watering was done every morning to enhance growth of plants as well as multiplication of nematodes (Okechalu and Wonang, 2004). The experiment lasted for 120 days. Number of pods per plant, number of seeds per pod, fresh root weight, pod length, stem height, number of leaflets, length of main root per plant, 100-seed weight, crop yield per plant obtained were recorded. Each plant was carefully uprooted and were examined for galls and number of galls counted. Gall indices were calculated using Taylor and Sasser (1978) 1-5 scale; 1 = 1-2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100 galls, 5 = >100 galls. The data obtained were subjected to statistical analysis using generalized linear Model procedure of the Statistical Analysis System, Version 8 (SAS Institute, cary, NC).

RESULTS

The root-knot nematode; *Meloidogyne javanica* parasitized and reduced growth and yield of cowpea variety moussa local (Table 1). Vegetative growth and yield of manured and inoculated cowpea plants were poor as compared to their uninoculated controls. Chlorosis of leaves of inoculated plants was observed to varying degrees. The mean number of pods per plant, number of seeds per pod, fresh root weight per plant, pod length per plant, stem height per plant, number of leaflets per plant, length of main root per plant of manured and inoculated cowpea were significantly reduced ($p<0.05$) as compared to their manured but uninoculated controls. The reduction of growth and yield was more in the unmanured but inoculated plants (Table 1).

The growth and yield of cowpea also differed with the manured type used on them. Yield was highest on plants fertilized with poultry manure followed by those with cow dung and goat droppings, respectively.

The mean dry weight of pods per plant, seeds per pod, root weight per plant, stem per plant, leaflets per

Table 1: Mean number of pods per plant, seeds per pod, fresh root weight, pod length, stem height, leaflets and length of main root per plant manured and inoculated with 2000 eggs of *M. incognita* and their uninoculated controls

Treatments	Mean No. of pods/ plant	Mean No. of seeds/ pod	Mean fresh root weight/ plant (g)	Mean pod length/ plant (cm)	Mean stem height/ plant (cm)	Mean No. of leaflets/ plant	Length of main root/ plant (cm)
Poultry dung with inoculum	46.0	13.00	35.3	14.00	131.0	120.00	35.00
Cow dung with inoculum	38.0	11.00	32.5	12.00	123.0	114.00	32.00
Goat dung with inoculum	33.0	9.00	30.2	11.00	119.0	109.00	29.00
Control without dung	30.0	8.00	28.4	10.00	108.0	103.00	27.00
Poultry dung without inoculum	55.0	15.00	39.5	16.00	139.0	124.00	39.00
Cow dung without inoculum	49.0	13.00	36.2	13.00	126.0	118.00	34.00
Goat dung without inoculum	42.0	11.00	34.1	12.00	121.0	112.00	31.00
LSD	23.5	1.92	4.17	1.18	26.4	5.60	4.78

Pairs of means that differ by more than their LSD are significantly different at 5% level of significance

Table 2: Mean dry weight of the plant in (g), manured and inoculated with 2000 eggs of *M. incognita* and their uninoculated controls

Treatments	Mean dry weight of pods/plant (g)	Mean dry weight of seeds/pod (g)	Mean dry root weight/plant (g)	Mean dry weight of stem/plant (g)	Mean dry weight of leaflets/plant (g)
Poultry dung with inoculum	4.40	1.10	8.10	10.01	4.07
Cow dung with inoculum	3.51	0.90	5.59	8.15	3.12
Goat dung with inoculum	2.09	0.70	3.38	7.20	2.91
Control without dung	2.02	0.60	3.12	5.13	2.82
Poultry dung without inoculum	4.42	1.21	9.31	10.09	4.03
Cow dung without inoculum	3.75	0.95	8.01	9.01	2.61
Goat dung without inoculum	2.66	0.77	5.38	6.73	2.54
LSD	0.79	0.015	1.74	3.51	0.50

Pairs of means that differ by more than their LSD are significantly different at 5% level of significance

Table 3: Gall indices of inoculated plants and their resistance rating

Treatments	Gall mean	Gall index	Resistance rating
Poultry dung	1.01	1.00	Resistance
Cow dung	3.70	1.70	Moderately resistant
Goat dung	12.45	2.20	Moderately susceptible
Control (Inoculated without dung)	31.20	3.00	Susceptible

plant significantly differed ($p<0.05$) from those of the manured but uninoculated controls (Table 2). Gall indices indicated variation in the degree of resistance to cowpea plants applied with the different manures to infection by root-knot nematodes. Plants applied with poultry, cow and goat manures were resistant, moderately resistant and susceptible, respectively. The plants that were not fertilized but inoculated were susceptible (Table 3). Chlorosis of leaves of inoculated plants was also observed. Inoculated plants applied with cow dung were more chlorotic while inoculated plants applied with poultry manure were the least chlorotic among manured plants. The unmanured but inoculated plants showed the highest degree of chlorosis.

DISCUSSION

The results obtained from the study showed that the infected plants were stunted with chlorotic leaves. The stunting or retarded growth of plants, chlorosis of leaves and early senescence are indicative of lack of physiological stability which might have been caused by *Meloidogyne* infection (Khan, 1987). It often results from reduced translocation, inadequate nutrient absorption and abnormal production of growth regular. The observation is in agreement with the findings of Wallace (1973) that the deficiency of many of the macro-elements of plants notably nitrogen, potassium and sulphur often leads to stunted growth and chlorosis. This is because the said nutrients are used in the synthesis of chlorophyll and other growth requirements. The manifestation of mineral deficiency symptoms by infected plants can be attributed to impaired translocation of minerals by root-knot nematode which feeds on and blocks vascular bundles of host plants (Adesiyan *et al*., 1990).

Galling and proliferation of lateral roots by infected plants can be attributed to abnormal secretion of growth hormones induced by *Meloidogyne javanica*. This may explain the relatively high root weight of inoculated plants as compared to their uninoculated controls. Resistance ratings showed that plants applied with poultry manure were resistant while those of cow and goat manures were moderately resistant and moderately susceptible, respectively. This is in line with findings of Okechalu and Wonang (2004) in their work on effect of three types of animal manures on tomato. Differences in resistance among cowpea plants applied with different animal manure suggest that the manures differ in quality or nutrient content required to support growth and vigour of infected plants. Poultry manures are richer in macro-elements such as nitrogen, potassium and phosphorus than cow and goat droppings. This might have accounted for their ability to improve the resistance of infected plants than cow and goat droppings (Alam *et al*., 1994). It may also be due to the fact that it has faster decomposition rate, making its nutrients available earlier than those of cow and goat droppings.

The unmanured but inoculated plants were the most affected. They had very poor growth and yield. This is expected since they suffered both nutrient deficiency and nematode attack (Adesiyan *et al*., 1990). Better growth and yield in manured but inoculated plants over unmanured but inoculated plants can also be explained as a product of toxic metabolites that are released in the process of decomposition of the manures which inhibits nematodes.

From the above findings, cultivation of cowpea plants susceptible to root-knot nematode; *Meloidogyne javanica*, poultry manure should be preferred to cow and goat droppings to reduce damage. In the absence of poultry manure, cow dung should be given preference to goat droppings.

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