ISSN:
Print - 2277 - 0755
Online - 2315 - 7453

Journal of Agricultural Science and Environment

COMPOSTED MUNICIPAL WASTE AS A SUBSTITUTE TO FURADAN IN THE MANAGEMENT OF *Meloidogyne incognita* INFECTION ON COWPEA

ODEYEMI ISHOLA SEGUN

Department of Crop Protection, University of Agriculture, Abeokuta, P.M.B 2240, Abeokuta, Ogun state, Nigeria

***Corresponding Author:** e-mail: odeyemi_presi@yahoo.com

ABSTRACT

There is a worldwide search for alternatives to synthetic pesticides in management of Root-knot nematodes (*Meloidogyne incognita* Kofoid and White 1919, Chitwood, 1949). Screen-house studies were conducted to compare effects of composted municipal waste (CMW) and furadan on Root-knot nematode infection on cowpea (*Vigna unguiculata* L. Walp), var. Ife brown. Treatment significantly reduced the number of *M. incognita* in the soil with furadan being the most effective followed by CMW. Growth and yield of cowpea was improved in all treatments compared with untreated plants. Plants treated with CMW produced the best growth and highest yield. Use of CMW may be a viable soil amendment for management of Root-knot nematode.

Keywords: *Meloidogyne incognita*, cowpea, organic manure, Root-knot nematode

INTRODUCTION

Root knot nematodes (*Meloidogyne incognita* Kofoid and White 1919, Chitwood, 1949; RKN) attack a wide variety of crops (Adesiyan et al., 1990). Due to frequency of occurrence and high level of infestation RKN is an important pest of cowpea (*Vigna unguiculata* L. Walp) (Adesiyan et al., 1990). Cowpea grain yield loss of up to 69% caused by RKN has been reported (Babatola and Omotade, 1991) and under heavy infection early senescence and total crop failure may occur (Olowe, 1978).

Management of RKN on cowpea primarily relies on application of nematicides (Sosanya, 2006), but high costs, non-availability of the pesticide and hazards posed as environmental pollutants discourage most potential users in developing countries (Yudelman et al., 1998). The worldwide organic movement in crop production and protection has necessitated management of RKN infection in cowpea with alternative measures. Green manure, cow dung, poultry litter, dried crop residue and industrial waste from neem (*Azadirachta indica* A Juss.) and castor (*Ricinus communis* L.) oil cake have been used successfully in management of RKN (Abubakar and Majeed, 2000; Akhtar and Mahmood, 1996, 1997; Akhtar and Alam, 1991, 1993; Abubakar, 1999). How-

ever, practical use depends on readily-available supply of these materials on a large scale, cost of transportation and large amounts needed for adequate control (Bridge, 1972; Ogunfowora, 1976). Municipal wastes may be used as a source of organic fertilizer and the material is available on a large scale. This study was undertaken to evaluate suppressive ability of an alternative to synthetic pesticides for control of RKN infection on cowpea.

MATERIALS AND METHODS

The soil (88.8% sand, 4.6% clay and 6.6% silt), pH 6.1, was collected from farmers fields around the University of Agriculture, Abeokuta, Nigeria, and heat sterilized using electric soil sterilizer at 65^{o}C for 90 min. The soil was cooled and stored in jute sacks for six weeks.

Ten-L plastic buckets were filled with 5 kg of the sterilized soil. The composted municipal waste (CMW) produced released by the Oyo State Ministry of Agriculture to farmers is comprised by volume of domestic and agricultural waste. The CMW was mixed with the soil 2 weeks before planting to allow mineralization. Buckets were arranged in a completely randomized design and watered. Three seed of cowpea, var. Ife brown, were planted per bucket. Treatments included cowpea plants grown in: 1) untreated, sterile, soil (control); 2) soil inoculated with 5,000 eggs of RKN only; 3) soil inoculated with 5,000 eggs of RKN and treated with 1% w/w composted municipal waste (CMW), and 4) soil inoculated with 5,000 eggs of RKN and treated with furadan at 3 kg·ha^{-1} a.i. at 2 weeks after inoculation. The soil was inoculated with RKN eggs extracted from cultures maintained on *Celosia argentea* L. for 3 months using the trench method of Iheukwuemere et al. (1995). The experiment took place in a screen house of the Department of Crop Protection, College of Plant Science and Crop Production, University of Agriculture, Abeokuta, Nigeria. Plants were thinned to one per bucket one week after emergence. Treatments were replicated six times, and the experiment repeated.

At harvest, destructive sampling was carried out to determine RKN juvenile population by collecting 250 g soil samples per bucket using the Whitehead and Hemming (1965) modified tray method. Composite samples were placed in the upper sieve of a pair of sieves sandwiched with a double ply serviette paper and placed in a bowl containing 250 mL water for 18 hrs. The suspension was concentrated to 25 mL by removing excess water through the settling-siphon method (Caveness, 1975). The water-nematode residual was poured into 500 mL Nalgene bottles with spouts and left for 5 hrs. Rubber tubing (3mm inside dia) was filled with water and slipped over the spout to drain excess liquid. The suspension was placed in a Doncaster (1962) dish and counted using a stereomicroscope.

Extraction of RKN eggs from cowpea root samples was at harvest (Hussey and Barker, 1973). Root samples were washed under gentle running tap water. Roots were cut into pieces about 2 cm long and placed in a 500 mL conical flask with 200 mL of bleach and shaken vigorously for 3 min to dissolve the gelatinous casing surrounding eggs which were collected on a 500 mesh sieve. This was done by pouring the content in the conical flask onto a stack of sieves. The upper sieve (200 mesh) was used for collecting plant debris; the 500 mesh was used to collect eggs, which were counted as before.

Data on plant height, numbers of leaves and

leaf area were collected biweekly beginning 2 weeks after inoculation. At harvest, data were collected on grain yield, pod weight, nematode population in the soil and root, and numbers of galls. The nematode reproduction factor was determined. Data collected from the two experiments were subjected to analysis of variance (ANOVA). Means were separated using least significant differences (LSD) in SAS (ver. 8.0, SAS, Inc., Cary, N.C.).

RESULTS AND DISCUSSION

Data from the experiments were similar allowing pooling. Reduction in number of leaves and fresh shoot weight occurred on cowpea plants infected only with RKN compared with the control and other treatments (Table 1). Application of CMW improved plant height, number of leaves, shoot fresh and root weights compared with other treatments (Table 1). Plants infected with RKN did not differ in plant height and root fresh weight compared with the control. Plants infected with RKN had lower number of pods and grain yield compared with the control (Table 2). Plants treated with CMW had the highest number of pods, number of seeds and grain yield. Number of galls, juveniles, eggs and nematode population were lower on furadan and CMW treated plants compared with plants infected with RKN only. Treatment did not affect number of nodules per plant (Table 3).

Table 1: Effect of Furadan, composted municipal waste (CMW) and *M. incognita* on leaf number, fresh shoot weight, and fresh root weight of Cowpea

Treatment	Plant height	Leaf number	Shoot fresh weight	Root fresh weight
M. incognita + 1% w/w CMW	144.33	43.08	36.33	3.13
M. incognita + 3 kg·ha-1 a.i. furadan	127.38	35.33	30.33	2.18
M. incognita only	107.00	21.33	26.58	1.91
Control (Sterile soil)	109.33	26.64	21.00	1.33
LSD(P<0.05)	7.58	4.07	4.95	0.65

Table 2: Effect of furadan, composted municipal waste (CMW) and *M. incognita* on numbers of pods, number of seed and grain yield of Cowpea

Treatment	**Number of pod**	**Number of seed**	**Grain yield**
M. incognita + 1% w/w CMW	15.66	32.16	18.76
M. incognita + 3 kg·ha-1 a.i. furadan	10.33	18.83	14.83
M. incognita only	5.66	16.50	6.45
Control (Sterile soil)	9.80	20.67	13.45
LSD	1.51	6.52	2.44

Table 3: Effect of furadan and composted municipal waste (CMW) and *M. incognita* on numbers of galls, nodulation, juvenile, eggs and nematode populations on Cowpea

Treatment	Galls/ plant	Nodulation/ plant	Juveniles/ plant	Eggs/ plant	Nematode population/ Plant
M. incognita + 1% w/w CMW	15.00	51.88	1878.7	1101.2	5632.5
M. incognita + 3 kg·ha-1 a.i. furadan	12.00	44.22	1444.3	804.7	4920.8
M. incognita only	36.88	49.88	5074.8	6904.0	7105.5
Control (Sterile soil)	-a	49.11	-	-	-
LSD	7.42	7.78	579.49	321.68	945.86

[a] "-" indicates that nematode was not present

CONCLUSION

Addition of manure to soil improved root growth. Utilization of soil nutrients likely occurred due to reduced nematode damage (Alam et al., 1994). When organic material degrades, nutrients and toxicants are released into the soil. The nutrients likely enhance crop growth and yield; toxicants may check soil inhibiting plant parasitic nematodes (Rodriguez-Kabana, 1986). The effect of CMW on nematode population, root galls, cowpea growth and yield suggest the need for additional studies in the field to assess the economic feasibility of use of this material.

REFERENCES

Abubakar, U. 1999. Studies on the nematode of cowpea *Vigna unguiculata* of the savanna region of northern Nigeria and control of *M .incognita* using selected plane extract and animal manure. PhD Diss., Department of Crop Protection, Usmanu Danfodeyo University, Sokoto, Nigeria.

Abubakar, U. and Q. Majeed. 2000. Use of animal manure for the control of root-knot nematode of cowpea. J. Agric. Environ. 1(1): 29-33.

Adesiyan, S.O., F.E. Caveness, M.O. Adeniyi, and B. Fawole. 1990. Nematode pests of tropical crops. Heinemann Educational Books, Ibadan, Nigeria.

Akhtar, M and M.M. Alam. 1991. Integrated control of plant parasitic nematode on potato with organic amendments and Mixed cropping with mustard. Nematol. Mediterr. 19: 169-171.

Akhtar,M. and M.M. Alam. 1993. Utilization of waste materials in nematode control: a review Biores. Technol. 45: 1-7.

Akhtar, M. and I. Mahmood. 1996. Effect of plant based product 'Nimin' and some plant oils on nematodes. Nematol. Mediterr. 24: 3-5.

Akhtar, M. and I. Mahmood. 1997. Control of root-knot nematode *M. incognita* in tomato plant by seed coating with sunhemp and neem oil. J. Pesticide Sci. 22: 37-38.

Alam, M.M., Siddiqui, S.A. and M.A.

Khau.1994. Mechanism of control of the plant parasitic nematodes as a result of organic amendment to soil III. Role of phenot in host roots, Ind. J. Nematol. 7(1): 23-31.

Babatola, J.O. and M.A. Omotade. 1991. Chemical control of the nematode pests of cowpea, *Vigna unguiculate* (L) Walp. Crop Prot. 10: 131-134.

Bridge, J. 1972. Plant parasite nematode of irrigated crops in the northern states of Nigeria. Samaru Misc. Paper 42, Inst. Agric. Res., Zaria, Nigeria.

Caveness, F.E. 1975. A simple siphon method for separating nematodes from excess water. Nematropica 5: 30-32.

Doncaster, C.C. 1962. A counting dish for nematodes. Nematologia 7: 334-336.

Hussey, R.S. and K.R. Barker. 1973. A comparative of method of collecting inocula for *Meloidogyne* spp, including a new technique. Plant Dis. 57: 1025-1028.

Iheukwumere. C.C., G.I. Ateri., B. Fawole and K. Dashiell. 1995. Evaluation of some commonly grown soybean cultivars for resi stance to root-knot nematodes and soybean mosaic virus in Nigeria. Fitopath. Bras. 20:190-193.

Ogunfowora, A.O. 1982. Root-knot nematodes on cowpea and some selected vegetable crops. Proc. 3rd research planning conference of root-knot nematodes, *Meloidogyne* spp. 16-20 Nov. 1981, Ibadan, Nigeria.

Olowe, T.O. 1978. International *Meloidogyne* project progress report, 1976. Proc. second International *Meloidogyne* Project research planning conference on Root-knot Nematode, *Meloidogyne* spp. 20-24 February 1978. Abidjan, Ivory Coast.

Rodriguez-Kabana, R. 1986 Organic and inorganic nitrogen amendments to soil as nematode suppressants. J. Nematol. 18: 129-135.

Sosanya, O.S. 2006. Comparative efficacy of carbofuran and monocrotophos for maagement of nematode pests of three cowpea*Vigna unguiculata* (L) Walp] cultivars. PhDThesis. Department of Crop Protection, University of Agriculture, Abeokuta.

Whitehead, A.G. and J.R. Hemming. 1965. A comparative of some quantitative methods of extracting small vermiform nematodes from soil. Annals App. Biol. 55: 25-38.

Yudelman, M.A. Ratta and D. Nygaard. 1998. Pest management and food production: Looking to the future. Food Policy Research Institute, Food, Agriculture and the Environment. Discussion paper 25, International Food Policy Research Institute, Washington Washington, DC.

(Manuscript received: 10th May, 2016; accepted: 18th April, 2017