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Influence of vermicompost in root- knot nematode management as a function of soil fortification

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ABSTRACT

Green house experiment was conducted to explore the influence of different concentrations of Vermicompost in root–knot nematode management against *Meloidogyne incognita* infecting Cluster bean *Cyamposis tetragonaloba*. Vermicompost fortification treatment resulted in reduced nematode infection and increased growth characteristics such as shoot – root length and shoot – root weight. With the increase of concentration of Vermicompost corresponding increase noticed in growth characteristics of treated plants. Vermicompost fortified plants showed increment in sugar, protein and lipid over untreated control. Increment of these metabolites reflects treated plants were metabolically cope up the infection and promoting excessive plant growth.In vitro studies of hatching trials revealed significant reduction in larval emergence. The percent reduction of larval emergence showed a significant positive correlation with increased concentration of Vermicompost. Vermicompost treatment significantly affects the soil population of nematode which again reflects a dosage dependent phenomenon. Present investigation confirms Vermicompost as an excellent growth promoters and potential prophylactic agent.

Introduction

Plant parasitic nematodes are one of the most important groups of agricultural pests. They are capable of damaging a number of crops and reduce the profit to the poor farmer. Among the various species, *Meloidogyne incognita* is distributed more (52 percent) and hence it is of major interest in the field of agricultural economy especially in developing countries.

Green revolution technology is an intensive use of land through the use of heavy doses of chemical fertilizers, pesticides, assured irrigation, hybrid seeds and improved agronomic practices etc., has resulted in significant increase in agricultural productivity. But the present level of production is not being sustained and there is a decline in productivity due to the reduction in soil fertility.

Most Indian soils are generally deficient in organic matter. Improvement of soil properties by the application of organic manures helps in improvement of soil structure, increased water holding capacity, increased chelating capacity. It is well established fact that the organic manures can play a significant role with improvement of physical, chemical and biological condition of soil, besides enriching the soil with nutrients.

In recent years many farmers became aware of this menace and switching over to organic farming. To achieve sufficiency in food production and in maximizing crop yield potential, many developing countries will need to accelerate the efforts to halt the declining in the soil productivity and to improve the productivity of degraded soils in the shortest possible time. The goal can be achieved through proper management and utilization of organic materials such as farm wastes and farmyard manure.

The recycling of various farm wastes have the advantages of converting bulky organic materials into useful plant nutrient sources for meeting nutrient requirements of crop besides maintaining soil productivity and improving the overall ecological balance (Selvi and Shanthi, 2003). Thus the old agricultural system/ Biological/ organic/ ecological/ regenerative/ natural/ biodynamic low input are the need of the day.

Control of root-knot nematode therefore is necessary and several means are adopted. Of which use of bio-chemicals, organic compost for the management of plant parasitic nematode have shown encouraging results and proved to be potential in suppressing the nematode population.

In spite of increased research contribution *M. incognita* during the last decade or two there is hardly any report exists regarding the influence of vermicompost against *M. incognita* infecting Cluster bean *Cyamposis tetragonaloba*. An attempt has therefore been made in this investigation to study the nematicidal effect vermicompost as a function of soil fortification on growth characteristics, such as length, weight, root;shoot branches, number of leaves and metabolism of host plant, *Cyamposis tetragonaloba* against *M.incognita* infection.

Materials and methods:

Green house experiments were conducted in 15cm earthen pots filled with sterilized sand soil mixture. Seeds of cluster bean were surface sterilized with 0.1% mercuric chloride and sown in pots and the pots were watered with regular interval. 1%, 2%, 3% and 4% of vermicompost extract were prepared by grinding desired quantity of vermicompost with tap water; 100 ml of vermicompost tonic was added to the experimental pots twice a week.

Seedlings of all the treatments were inoculated with 1000 J2 larvae of *M. incognita* ten days after germination. All the treatments were replicated thrice and maintained for 35 days under green house conditions. On the termination of experiment the plants were carefully uprooted and observations were recorded for growth characteristics, total sugars, protein and lipid content of the host plant and hatchability of nematode.

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Total sugar, protein and lipid were respectively employing the method of Seifter *et al*., (1950); Bragdon 1951 and Lowry *et al*; 1951.

Result:

Perusal of data presented in Table-1 revealed the impact of vermicompost, on mean length, fresh and dry weight of *Cyamposis tetragonaloba*, cluster bean plant infected with *M.incognita*.

When the plants were uprooted after 35 days period of infection, it was found there was considerable reduction in plant growth characters when compared to uninfected control plants. Such reduction in shoot length was 40.00 %; in root length 44.89%, shoot fresh weight 30.32% root fresh weight 25.74 %. Trench application of vermicompost, promoted the plant growth considerably. Out of these treatments plants treated with 4% vermicompost show best results than untreated control, the increment was 91.66% in shoot length and 75.92% in root length, 87.98% in shoot fresh weight, 67.83% in root fresh weight, 81.86% in shoot dry weight and 82.71 % in root dry weight.

Similarly the other growth parameters such as (table 2) number of leaves and number of root branches also showed better increment when plants were treated with vermicompost. Statistical analysis of Critical difference of 1 % revealed all the vermicompost treatments significantly influence both the shoot and root length. Similar trends have also been observed in the fresh and dry weight of the host plant.

Effect of Vermicompost on the hatchability of *M. incognita* is furnished in the Table 4. The data obtained suggest that all the treatments considerably reduce the hatchability of *M.incognita*. Statistical analysis of C.D at 1% reveals that all the treatments significantly reduce the hatchability over control and also significantly varied among the treatments.

A perusal of table 3 reveals the influence of different treatments of vermicompost on metabolism. All the four treatments showed significant impact on host metabolism. Statistical analysis of critical difference at 1% and 5% revealed that all the metabolic parameters should are significantly influenced by the nematode as well as different treatments.

Due to nematode infection the sugar content was found to be depleted in the host plant. Such depletion was 31.81% in untreated control. Treatments with vermicompost increase sugar content of the host plant. Total protein content was observed to increase in shoot as well as root tissues as the result of infection compared control plants. Treatment of organic amendment showed that the infectional stress is combated by the trench application of these amendments as evidenced by the increment of the protein.

Regarding lipid content the infected host plants showed increments over untreated control. Fortification of the organic compost, resulted in shifting of metabolism towards uninfected control.

Discussion:

The results of the present investigation clearly indicate that cluster bean is highly susceptible host to root-knot nematode as evidenced by potential damage in the infected untreated plants. The trench applications of vermicompost extract were effective in inhibiting the penetrations of nematode larvae in all treatments. Growth of all treated plants was improved due to trench application of these bio components.

It has been observed that the growth parameters were significantly influenced by the vermicompost treatment .This might be due to the presence of growth hormones micro nutrients such as carotenoids, flavones, phenolic compounds which are present in vermicompost of these bio-components. The results of present investigation reveal that vermicompost is not only exhibited more potentiality as nematicides but probably it acted as better growth promoter also.

Improved tolerance is attempted through increasing the resistance in the viable hosts. Even a highly viable host exhibits resistance functionally during pathogenesis through its metabolism which is reflected in growth parameter and metabolite turn over. A well nourished plant would thrive in spite of severe infection (Nattuthurai, 1987)

From the present work it was observed that the sugar content in the infected plant was decreased which is a well fact. The derouting of sugar carbon for the synthesis of phenol, amino acid, protein and also be due to possible consumption by the nematode for its sustenance and part mobilized for synthesis of non-carbohydrate metabolites(Roy, 1979)

The untreated plants are in crisis due to impact of nematode infection while manuring of bio components seem to over come the crisis. Changes in carbohydrate metabolism in plant tissue in response to application of bio components revealed that the treated plants were metabolically capable of combating infection and promoting the host plant growth.

Increased levels of soluble protein and amino acid indicate the extensive proteolytic activity (Tayal and Agarwal, 1982). The proteolytic activity of nematode proteases (Roy, 1981) releasing amino acids may lead to production of new proteins and many pathogens are known to exhibit proteolytic activity (Matsubra and Feder, 1970). Such phenomenon also noticed in the present studies in the plants. On treatment with vermicompost the protein metabolism is shifted towards the normal level shows the impact of treatments of bio components

Lipid play a vital role as energy source in the biological organization, since its calorific value is more that twice that of carbohydrate and protein. The lipid content increased in the infected plant tissue might be due to hypersensitive reaction to combat the infectional stress. The treated plants also shifted their metabolism towards normalcy as revealed in the present investigation.

Mishra and Prasad (1978) observed 78 percent mortality of second stage juveniles of *Meloidogyne* using neem cake water extract at N/10 concentration reported the maximum inhibition of hatching at N/10 dilution of leaf extract of neem; the water extracts of medicinal plants reduced egg hatching and emergence of *Heterodera cajani*.

In the present investigation inhibition of egg hatching was very significant in all the vermicompost treatments. These results are in general agreement with earlier reports with neem cake and neem principle, (Devakumar *et. al*.,1985). Even though the nemato toxins from plant origin are not being used on a commercial scale, Varaprasad and Swarup (1986) yet, to avoids, soil and environmental pollution due to pesticides, there is a strong need to develop nematicides of biological origin and antimetabolites, especially capable of stimulating or inhibitating egg hatch or interfering with establishment of nematode in host tissue (Sethi and Gaur,1986).

To summarize as a net effect improved tolerance of vigour is reflected especially under treated conditions such as introduction of growth hormones, phenols, ammonia, fatty acids amino acids which have a metabolic role in the plant with enhanced level of metabolite, In view of low cost, waste, cheap

and easily available, no inward residual effects on soil as well as plants parts amendments of large scale exploration in the regard is desirable towards organic farming.

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Table 1: Effect of different concentrations of Vermicompost on the growth characteristics of *Cyamposis tetragonaloba* infected with root-knot nematode *M. incognita*. Each value (Mean ± S.D) represents an average performance of 3 observations.

Concentration (%)	Length (cm)		Fresh weight (g)		Dry weight (g)	
	Shoot	Root	Shoot	Root	Shoot	Root
Control	15±1023	24.5±1.290	16.033±0.719	13.36±0.2874	2.28±0.1028	1.9±0.040
0	9±0.816 (-40.00)	13.5±1.35 (-44.89)	11.171±0.1563 (-30.32)	9.921±0.3925 (-25.74)	1.787±0.273 (-21.62)	1.587±0.241 (-16.47)
1	12.5±0.512 (+35.88)	16.3±0.91 (+20.74)	14.280±0.975 (+27.83)	11.250±0.873 (+13.39)	1.875±0.731 (+4.92)	1.791±0.231 (+12.85)
2	14±0.816 (+55.55)	20.5±0.577 (+51.85)	17.365±1.10 (+55.44)	13.357±0.5773 (+34.63)	2.431±0.630 (+36.03)	1.92±0.236 (+2098)
3	15.5±0.712 (+72.22)	22.0±0.831 (+62.96)	19.475±1.50 (74.33)	15.250±0.875 (+53.71)	2.975±0.750 (+66.48)	2.251±0.421 (+41.83)
4	17.25±0.805 (+91.66)	23.75±0.671 (+75.92)	21.000±1.25 (+87.98)	16.651±0.921 (+67.83)	3.250±0.652 (+81.86)	2.895±0.320 (+82.71)
C.D at 5 %	1.0655	1.493	0.644	1.506	0.0964	0.102
C.Dat1 %	1.487	2.065	0.891	1.473	0.133	0.138

Values in paranthesis indicate percent decrease (-) over control; percent increase (+) over untreated control

Table 2: Influence of different concentrations of Vermicompost on number of leaves, branches, root nodules and galls in the host plant *Cyamposis tetragonaloba* infected with *M. incognita*. Each value (Mean ± S.D) represents an average performance of observations

Concentration (%)	Number of leaves	No of branches	Number of root nodules	No of Galls
Control	15.5±0.5773	6.5±0.5	6.25±0.5	0
0	11.75±0.50 (-24.19)	4.5±0.5 (-30.76)	3.00±0.5 (-52.00)	14± 1
1	18.5±0.521 (+57.44)	8.75±0.5 (+94.44)	3.5±0.5 (+16.66)	11± 1
2	23.1±0.721 (+96.59)	10.25±0.45 (+127.77)	4.6±0.4 (+53.33)	8 ±1
3	25.4±0.821 (+116.17)	12.75±0.4 (+183.33)	5.7±0.6 (+90.00)	5± 1
4	28.2±0.577 (+140.00)	14 +95±0.5 (+232.22)	6.9±0.5 (+130.00)	3 ±1
C.D at 5 %	0.752	1.38	0.55	1.50
C.D at 1 %	1.040	1.918	1.020	2.00

Values in paranthesis indicate percent decrease (-) over control; percent increase (+) over untreated control

Table3: Effect of different concentrations of Vermicompost on sugar, Protein and Lipid content of *Cyamposis tetragonaloba* infected with root-knot nematode *M. incognita*. Each value (Mean ± S.D) represents an average performance of observations.

Concentration (%)	Sugar (mg/gm)	Protein (mg/gm)	Lipid (mg/gm)
Control	4.4±0.1825	1.31±0.0454	1.91±0.026
0	3.0± 0.1925 (-31.81)	1.45± 0.2390 (+10.68)	2.805±0.017 (+46.85)
1	3.6±0.2160 (+20.00)	1.28±0.1290 (-11.72)	2.105±0.809 (-24.95)
2	4.0±0.1825 (+33.33)	1.47±0.140 (+1.372)	2.000±0.1825 (-28.69)
3	4.4±0.1125 (+46.66)	1.59±0.1120 (+9.65)	1.930±0.050 (-31.19)
4	4.8±0.5830 (+60.00)	2.00±0.1401 (+37.93)	1.960±0.040 (-30.12)

Values in paranthesis indicate percent decrease (-) over control; percent increase (+) over untreated control

Table 4: Effect of different concentrations of Vermicompost on cumulative emergence, percent emergence over check and percent reduction in emergence of root-knot nematode *M. incognita*.

Concentration (%)	Mean	Percent emergence	Percent reduction
Control	308.25±7.675	-	-
0	286±5.12	92.78	7.22
1	246.75±10.75	80.05	19.95
2	203.75±11.08	66.10	33.90
3	168.25±7.675	54.59	45.41
C.D at 5 %	14.54	-	-
C.Dat1 %	20.38	-	-

Values in paranthesis indicate percent decrease (-) over control; percent increase (+) over untreated Control