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Efficacy of Poultry Manure on *Meloidogyne incognita* Infection of Beetroot crop

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Abstract

Poultry manure, whether applied as powdered or aqueous extract, constitute an effective, available and friendly environmentally sustainable approach to mitigate soil nutrient deficiencies and nematode infestation in beetroot cultivation. This experiment investigated the susceptibility of beetroot to *Meloidogyne incognita* and to determine the effectiveness of tea and powdered poultry manure on infected beetroot development, yield as well as nematode population under screen house investigation. The experiment was fitted into completely randomized design (CRD), with 3 forms of organic extracts (poultry manure tea, powdered poultry manure, combination of tea and powdered poultry manure, negative and positive controls and 1 beetroot seed, and each were replicated 10 times, resulting in a total of 50 buckets. Data were gathered on plant height, fresh root and shoot weight, number of leaves per plant, fruit numbers, fruit weight (g), soil nematode population, egg numbers in the root and, root gall ratings. All data recorded were analyzed using Analysis of Variance (ANOVA), using the GENSTAT statistical programme, with the means separated using Least Significant Difference (LSD) test at a 5% significance level ($p \leq 0.05$). Plants that were treated with poultry manure performed significantly better than the untreated plants (control). However, plant treated with powdered poultry manure performed better in terms of plant heights (38.00, 35.47 and 34.75), number of leaves (10.25, 9.50 and 8.50), fruits numbers (54.01, 39.61 and 35.05), fruits weight (95.30, 80.40 and 70.00). Meanwhile, plants treated with powdered poultry manure and poultry manure tea recorded the reduced number of adult *M. incognita*, number of eggs in the root, root galling significantly. Plants treated with the combination of both form of poultry manure recorded least (2.00) numbers adult nematode in the soil, number of eggs (1.50) in the root and root galling (0.50). In this experiment generally, plants treated with poultry manure, performed significantly ($P < 0.05$) better than their controls (negative and positive). Farmers are encouraged to use any form of cured poultry manure in the replacement of synthetic nematicides which are expensive and harmful to flora and fauna.

Keywords: Nematodes, nematicides, poultry manure, susceptibility, beetroot

Introduction

Beetroots (*Beta vulgaris* L.) are widely grown vegetable, belonging to the family of *Amaranthaceae* and subfamily *Betoideae*. They are rich source of nutrients that are medicinal. These vegetable bulbs are rich in carotenoids and some important vitamins which prevent chronic diseases, aid in weight management, reduce blood sugar and pressure also are essential for bone health, all of these making beetroot economic important in growing market in the health and wellness sectors (Ceclu *et al.*, 2020).

However, Root-knot nematodes (*Meloidogyne incognita*) pose a significant threat to the production of this crop causing significant damage to the roots of plant and resulting to yield reduction, this statement was reported by Bornowski *et al.* (2024). Their feeding behavior leads to disruption of the plant cells thereby preventing the uptake of water and nutrient leading to poor growth and yields reduction (Diaz – Manzano *et al.*, 2023).

Conventional solutions such as chemical controls are effective but expensive and raise environmental concerns. According to Tiwari (2024). Crop rotation and resistant varieties are also right strategies of preventing infection of plants, however they have their limitations Use of organic management approaches, brings about an opportunity to address this issue effectively. The integration of organic amendments such as poultry manure represents an innovative, cost effective and eco-friendly strategy for managing nematodes as it is widely available and has added benefit of improving soil health and fertility. Poultry manures, being rich in nutrients are the closest in nutrient profile to N.P.K fertilizers among the faeces of livestock species (Atteh, 2015).

Researchers like Lilo *et al.* (2025) worked with poultry manure in the suppression of soil nematodes. The prospects of reducing plant parasitic nematodes, hunger, malnutrition, diseases, unemployment and food insecurity as

well as increase revenue of the producers through increase in beetroot productivity is considered a priority. However, their effectiveness in managing nematodes and boosting crop productivity requires further exploration, particularly in beetroot cultivation. Therefore, investigating the effect of some bio-pesticides such as poultry manure on beetroot production becomes imperative. These bio-pesticides are readily available, cheap, biodegradable and ecofriendly and could serve as reliable alternatives to imported, expensive and environmentally persistent synthetic nematicides.

Materials and methods

Experimental site

The trials were conducted at the screen house of the Department of Crop Protection, Faculty of Agriculture, University of Ilorin, Ilorin. The screen house is situated at longitude 4° 35' E and latitude 8° 29' N in the University of Ilorin, Southern Guinea Savannah of Nigeria at 310m above sea level having temperature of 26°C.

Soil pasteurisation

Well drain sandy loam topsoil was collected from farmland surrounding the Department of Agronomy greenhouse, University of Ilorin. The soil collected was steam pasteurised in a drum at 90°C for 9 hours following a method modified from Gautama and Goswani (2002). The steam-pasteurised soil was allowed to cool for 72 hours. The pasteurised soil was then weighed, and 8.5 kg was placed into each of 50 perforated 10-litre plastic buckets with an 11 cm diameter. The buckets were placed on a raised platform to prevent re-infestation by other microbes and stored within a screen-house for planting.

Juvenile Extraction from Root Samples

Using the methods described by Coyne *et al.*, (2007), galled roots of *Celosia argentea* from the established pure culture of *M. incognita* were rinsed under a tap to remove adhering soil particles. The roots were chopped with knife and a sub sample of 100 g chopped root was weighed

using a milligram digital measuring scale. The weighed roots were transferred to a clean tissue paper inside a sieve and placed inside a plastic tray. Water was added to the extraction plates at the base so as to wet the roots, ensuring that the water is sufficient. Water from plastic tray was poured into cup after 48 hours, using a wash bottle to rinse the plate. Suspension was allowed to settle for 4 minutes and suspension from cup was gently decanted. Number of nematode juveniles in 5000 ml suspension was counted using counter dish under a compound microscope. Each 20 ml of suspension contained 50 nematode juveniles.

Collection and preparation of poultry manure (Tea)

Fresh poultry droppings of 2 days were collected from layers' chicken house at Yoruba road area, Ilorin, Kwara State Nigeria in a sack. Twenty kilograms of fresh layers' chicken droppings were collected and allowed to air dry at 22°C for 15 weeks on a clean surface to get rid of moisture and reduce the toxicity. The cured manure was later turned into a plastic drum 27 liters, leaving (9.6 cm) at the top of the drum so to allowed proper stirring without the tea spilling. Eighteen liters (18 L) of dechlorinated borehole water was added to it. The water was dechlorinated by allowing water in the sun and fresh air for 24 hours, following modified method of Ingham (2005), this allowed any chlorine in the water to be neutralized. This prevent chlorine from killing the beneficial bacteria in the compost tea. The tea was stirred continuously three times each day over the course of 8 weeks. Stirring of Poultry manure tea four times each day was to infuse the nutrients into the water and provide oxygen following modified method of Ingham (2005). After 8 weeks, the liquid was sieved using muslin cloth. The tea was stored in gallons awaiting application.

Preparation of powdered poultry manure

Fresh poultry manure (25 kg) was spread thinly on a clean surface for proper curing. It was left to air dry and decompose for twelve (12) weeks so as to reduce the Ammonia and moisture content using

modified method of Ellis *et al.* (2013) before use, the dried manure was ground using mortar and pestle, later sieved using 2.0 mm sieve and was properly bagged and left till when the need arose.

Investigating the effect of powdered and tea poultry manure on beetroot plants in a screen house

Perforated 10-L plastic buckets with an 11-cm diameter were filled with 8.5 kg of pasteurised soil and placed on an elevated platform to prevent reinfestation by other microbes. This experiment was fitted into Completely Randomized Design (5×1),

with 2 forms organic extracts (Tea poultry manure, Powdered poultry manure), 2 controls (Positive and Negative control) and 1 beetroot seed, and each were replicated 10 times, resulting in a total of 50 buckets. Three seeds were sowed in each bucket. At 1 week after sowing, the seedlings were thinned into one vigor plant stand. Three holes were made at the base of each plant with a glass rod for inoculum inclusion, and 40 buckets were inoculated with 100 newly hatched *M. incognita* juveniles. Three days after inoculation, infected plants were treated with powdered poultry manure and tea poultry manures at the doses of 25g and 20ml respectively in ten infected plants buckets each. Another ten infected plants buckets were treated with combination of the two soil amendments (powdered poultry manure and tea poultry manures) at 10g and 10ml. The soil amendments were applied in a ring method. This application was repeated a month later. The remaining 20 plants were negative control (inoculated plants) and positive control (non-inoculated plants). Following method described by Oka *et al.* (2020), twenty millimeters (20ml) of water was used twice daily to keep the soil moist as the plants required less water at the beginning to prevent root rot. Afterwards, 75ml of water was used daily for better development. The open soil around the plant was mulched with dried leaves that has been sterilized with spirit to retain moisture, avoid re-infestation and reduce hot

temperature. Each treatment was replicated ten times and details of treatments were below:

Treatment: Five

T-1: Buckets application with powdered poultry manure at the rate of 25 g

T-2: Buckets application with poultry manure tea at the rate of 20 ml

T-3: Buckets application with combination of powdered and tea poultry manure the rate of 10 g and 10 ml

T-4: Uninoculated buckets as positive control

T-5: Inoculated buckets as negative control

Data collection

Collection of data started from 2 weeks to 12 weeks of plant growth. Data collected were on plant height, number of leaves, fresh shoot and root, fruits number, fruits weight (g), soil nematode population at 6 week and harvest, number of eggs in the root and root galls were rated using the method of Bridge and Page (1980), as described below:

0 – no root knots; 1 – few small knots, difficult to find; 2 – small knots only, but clearly visible, main roots clean; 3 – Some larger knots visible, main root clean; 4 – large, knots predominant but main root clean; 5 – 50% of roots affected knotting on some main roots; 6 – knotting on main roots; 7 – majority of main roots knotted; 8 – all main roots, including tap roots, knotted, few clean roots visible; 9 – all roots severely knotted; 10 – all roots severely knotted, no root system, plant usually dead.

Data analysis

Data collected were analyzed using Analysis of Variance (ANOVA) using the GENSTAT statistical programme, with means separated by the Least Significant Difference (LSD) test at a 5% significance level ($p \leq 0.05$).

Results

Table 1 showed the effect of organic amendments on beetroot plant height. From the table, there was no significant differences among treatments from 1 to 3 weeks after planting, but from 4 weeks after planting, significant differences were manifested among treatments. At 9 weeks after planting which was the last week before harvesting, beetroot plant treated with dried poultry manure recorded the highest height (38.00 cm); followed by plant treated with poultry tea with a value of 34.75cm height. Beetroot plant treated with both poultry tea and dried poultry manure exhibited a height of 35.47cm followed by untreated and uninoculated beetroot plant (27.50cm). untreated inoculated beetroot plant observed the lowest plant height recording 23.00cm.

Effect of treatments on number of leaves

Table 2 displayed the effect of organic amendments on beetroot number of leaves from Wk 1 to 9, there was no significant differences among treatments from week one to three. Significant differences were displayed from week four to week nine. At harvest, untreated inoculated control (BC-) recorded the least number of leaves with a value of 6.00, followed by the leaves number of untreated uninoculated (BC+) beetroot plant having value as 7.00. Among the treatments, Beetroot plant treated with poultry tea (Bpt) recorded least number of leaves (8.50), followed by beetroot plant treated with dried poultry (BPd) as 9.50. Beetroot plants that were treated with the combination of both poultry tea and dried poultry manure (BC) recorded the highest number of leaves as 10.25.

Effect of Treatments on Shoot and Root Weight

Table 3 showed the effect of treatments on both shoot and root weight. From the table, there were significant differences among the treatments of beetroot infected with *Meloidogyne incognta*. Lowest shoot and highest root weight was recorded by negative control beetroot having 13.50g and 29.27g. Beetroot treated with dried poultry manure gave highest shoot and lowest root weight among the treated beetroot with 43.80g

and 9.12g respectively. Plants treated with poultry tea observed 36.20g as shoot weight and 15.67g as root weight. Beetroot treated with combine treatments recorded 34.30g and 11.32g as shoot and root weight respectively. However, positive control had 16.80g and 12.70g.

Effect of treatments on number of fruits and weight of yield

Table 4 showed the effect of treatments on number and weight of fruits. From the table, there were significant differences among the treatments. Beetroot plants treated with dried poultry manure (Bdp) recorded the highest number and weight of fruits having 54.04g and 95.30g ; this was followed by plants treated with poultry tea (Bpt) with 39.61g and 80.40g as number and weight of fruits. Beetroot plant treated with the combination of dried poultry manure and poultry tea (Bc) exhibited 35.05g and 70.00g number and weight of beetroot fruits. Untreated inoculated control beetroot plant (Bc-) observed the lowest number and weight of fruits having 15.12g and 23.80 g. However, the untreated and uninoculted control (Bc+) recorded 19.32 and 28.90g as number and weight of fruits.

Effect of organic amendments on adult nematode population, number of eggs and root gall ratings

The results in table 5 showed significant differences in the effect of treatments on the soil nematode population, root nematode population, and the number of eggs at harvest. Soil of beetroot plants treated with dried poultry manure recorded the least soil nematode population, root nematode population and number of eggs at harvest as 7.50, 1.75 and 1.00 respectively. These results was followed by beetroot treated with combination of dried and tea poultry treatment having 2.00, 1.50 and 0.50 as soil nematode, root nematode and number of nematode eggs. Among the treated beetroots, those one treated with poultry tea manure observed the highest soil and root nematode population also highest number of nematode eggs having 10.50, 2.25 and 5.00 .

Control negative had highest soil nematode population, root nematode population and number of eggs as 34.50, 13.50 and 36.80 respectively among all the treatments.

Effect of organic amendments on gall rating of beetroot plant infected with *Meloidogyne incognita*.

Table 6 displayed the result of the effect of treatments on gall rating. From the table, there were significant differences among the treatments. Negative control beetroot plant recorded the highest root galls (8.00) followed by the plants treated with Poultry tea (3.75) then plant treated with dried poultry manure having gall ratings as (1.25), then that treated with the combination of both dried poultry manure and poultry tea (0.75) which recorded lowest root galls among the treated plants.

Figures of infected and uninfected beetroot plant

Figure 1 and 2 displayed infected beetroot plant and healthy beetroot plant. Figure 1 roots of the plants revealed heavy galls attached to the roots given it unattractive morphological appearance, this make it an evident that beetroot are susceptible to *M. incognita*.

Meanwhile figure 2 revealed clean root of beetroot plant, looking cosmetically clean in both morphological and roots.

Discussion

From the study, inoculated beetroot plants were susceptible to root knot nematode and showed an evident of infection by root galling. Generally treated plants performed significantly better than their untreated counterparts. Poultry manures significantly increased plant growth, yield and decreased population of root-knot nematode than controls. This was consistent with the findings of researchers like Akhtar and Malik (2020) and Adepoju and Nwokah (2023)that reported the efficacy of poultry manure in reducing the menace of plant-parasitic nematode population on pineapple which translated to high development

of plant and yield and organic amendments significantly increase biomass accumulation in nematode-infested crops by alleviating root stress and enhancing root proliferation respectively. Karimipour Fard and Doryanizadeh (2022) reported use of poultry manure to promote growth, yield and reduced both galling and nematode population on carrot infected with *M. incognita* nematode. The higher effectiveness of poultry manure could be due to higher concentration of nutrients such as nitrogen in poultry manure that induced growth and development of the plants as well as reduced soil nematodes population and gall formation. According to Oka *et al.* (2020) in their work reported significant increase in the yield of cucumber using poultry manures as soil amendment. Oladeji *et al* (2025b) reported the application of organic manure had been reported to have higher advantage over the use of inorganic fertilizer. According to Adepoju and Nwokah (2025), that animal manure contains most of the essential nutrients that are used by plants which include Nitrogen(N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), sulfur (S), Manganese (Mn) Copper (Cu), Zinc (Zn), Chlorine (Cl), Boron (B), Iron (Fe) and Molybdenum (Mo).

The effects of poultry manure on beetroot growth and suppression of root knot number have been attributed to nitrogen contents and most importantly to the release of ammoniacal nitrogen from the soil amendments.

The reduction in egg count and gall index was also most evident in the treatment, indicating that poultry manure (both in dried and aqueous form) interfere with the nematode's life cycle, especially egg hatching and juvenile development by preventing them from feeding. When comparing the effect of poultry manure tea, powdered poultry manure and the use of both as combine treatments. It was observed that powdered poultry manure suppressed soil and root nematode number as well as increased plant development and fruits of the plant. The higher effects of powdered poultry

manure over poultry manure tea may be due to loss of nutrients during handling practices. This statement might be consistent with the result of Mohammed *et al.* (2012) that poultry manure loses nitrogen during handling practices. In addition, powdered poultry manure is loose with concentrated weight which improves water infiltration, soil structure, and soil moisture holding capacity. In contrast, although the combination treatment improved growth, reduce soil and root nematode number significantly at $P < 0.05$, however, its yield performance was slightly lower, this might be due to microbial competition or temporary immobilization of nutrients from high organic loading or excess release of ammoniacal nitrogen (Ekine and Ezenwaka, 2024). This underlines the importance of proper C-N balance and the timing of amendment application to optimize nutrient dynamics and minimize nutrient lock-up.

In addition, the effect of poultry manure used in this research could be due to the presence of bacteria and fungi in the organic amendment. Oladeji *et al* (2025a) reported that the addition of manure or other organic amendments stimulate the activity of the indigenous soil microbial community. Improved soil microbial activity due to poultry manure may promote the proliferation of nematode-antagonistic organisms such as *Trichoderma spp.* and *Bacillus spp.*, which either parasites on nematodes eggs or inhibit juvenile development and supporting the effect on the number of nematode eggs (Poudel *et al.*, 2023).

The plant responded well to the pathogen; however, positive control beetroot plants performed significantly better than inoculated plants and almost competing with treated plants in terms of growth and yield, this could be attributed to some inherent genetic characteristics.

Conclusion

The present study provides definitive evidence that poultry manures, whether applied as dried or tea as soil amendment, constitute effective and

environmentally sustainable approach to addressing the interconnected challenges of nutrient deficiency and nematode infestation in beetroot production systems. The treatments consistently enhanced morphological development, yield while effectively suppressing nematode populations. Among the evaluated treatments, dried poultry manure exhibited superior performance characteristics, with poultry tea manures demonstrating comparable efficacy.

This study on poultry manure ameliorates *Meloidogyne incognita* infection and enhances beetroot yield, which provides valuable insights into managing root-knot nematodes and improving beetroot yield. The finding that dried poultry manure performed better than poultry tea

manure highlights the potential of organic amendments in sustainable nematode management. The research has significant implications for farmers and agricultural practitioners seeking eco-friendly alternatives to chemical nematicides. Future studies could explore the optimal application rates and mechanisms of action of poultry manure in different soil types and climates.

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Conflicts of Interest: I declare that there was no conflict of interest

Table 1: Effect of organic amendment on beetroot height (cm) infected with *Meloidogyne incognita*

Treatments	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9
BDp	2.23	9.90	14.88	21.5 ^{ab}	24.35 ^b	26.62 ^b	31.00 ^b	36.00 ^a	38.00 ^a
BPt	2.25	9.80	16.00	24.45 ^a	28.25 ^a	31.08 ^a	35.25 ^a	34.08 ^{ab}	34.75 ^b
BC	2.00	7.87	14.62	20.73 ^b	23.10 ^b	25.80 ^b	28.25 ^c	35.08 ^a	35.47 ^{ab}
BC+	1.75	7.50	13.60	18.73 ^c	20.90 ^c	22.7 ^c	25.25 ^d	26.75 ^b	27.50 ^c
BC-	2.15	9.70	14.00	17.13 ^c	18.73 ^{cd}	19.83 ^{cd}	22.00 ^e	23.00 ^c	23.00 ^c
LSD	0.66	3.19	4.95	6.23	5.55	5.87	6.45	6.66	6.43
Significance	NS	NS	NS	S	S	S	S	S	S

Key : Wk = Weeks After Planting; BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant; LSD = Least Significant Difference; NS= Not Significant and S = Significant

Table 2: Effect of organic amendments on beetroot number of leaves infected *Meloidogyne incognita*

Treatments	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9
BDp	2.00	4.00	7.00	7.75 ^a	7.75 ^a	8.00 ^a	7.75 ^b	9.50 ^a	9.50 ^a
BPt	2.00	4.00	7.00	8.00 ^a	8.50 ^a	8.75 ^a	9.00 ^a	8.50 ^{ab}	8.50 ^{ab}
BC	2.00	4.00	7.00	7.75 ^a	7.50 ^a	7.75 ^a	8.50 ^a	10.25 ^a	10.25 ^a
BC+	2.00	4.00	7.00	7.00 ^a	7.00 ^a	7.25 ^a	7.75 ^b	7.50 ^b	7.00 ^b
BC-	2.00	4.00	6.25	5.50 ^b	6.00 ^b	5.25 ^b	5.75 ^c	6.00 ^c	6.00 ^c
LSD	0.00	0.00	1.03	1.81	1.65	2.48	2.16	1.82	1.79
Significance	NS	NS	NS	S	S	S	S	S	S

Key : Wk = Weeks After Planting; BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant; LSD = Least Significant Difference; NS= Not Significant and S = Significant

Table 3: Effect of treatments on shoot and root weight (g) at harvest

Treatments	Fsw (g)	Frw(g)
BDp	43.80 ^a	9.12 ^d
BPt	36.20 ^b	15.67 ^b
BC	34.30 ^{bc}	11.32 ^{cd}
BC+	16.80 ^c	12.70 ^c
BC-	13.50 ^d	29.27 ^a
LSD	15.71	3.79
Significance	S	S

Key: FSW= Fresh shoot weight; FRW= Fresh root weight; BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant; LSD = Least Significant Difference; NS= Not Significant and S = Significant

Table 4: Effect of treatments on number and weight of fruits (g)

Treatments	Nf	Wf (kg)
BDp	54.04 ^a	95.30 ^a
BPt	39.61 ^b	80.40 ^b
BC	35.05 ^c	70.00 ^c
BC+	19.32 ^d	28.90 ^d
BC-	15.12 ^e	23.80 ^e
LSD	7.87	33.18
Significance	S	S

Key : Nf = Number of fruits; Wf = Weight of fruits ;BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant; LSD = Least Significant Difference; NS= Not Significant and S = Significant

Table 5: Effect of organic amendments on soil and root nematode population also number of eggs of infected beetroot

Treatments	Sn _p @ harvest	Rn _p @ harvest	No. Of eggs
BDp	7.50 ^c	1.75 ^c	1.00 ^c
BPt	10.50 ^b	2.25 ^b	5.00 ^b
BC	2.00 ^d	1.50 ^c	0.50 ^d
BC+	0.00	0.00	0.00
BC-	34.50 ^a	13.50 ^a	36.80 ^a
LSD	4.59	2.75	7.54
Significance	S	S	S

Key : Sn_p@ harvest = Soil nematodes at harvest ; Rn_p@harvest = Root nematode at harvest ; No. Of eggs = Number of nematode eggs at harvest ; BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant; LSD = Least Significant Difference; NS= Not Significant and S = Significant

Table 6: Effect of organic amendments on gall rating of beetroot infected with *M. incognita*

Treatments	Gall ratings
BDp	1.25 ^c
BPt	3.75 ^b
BC	0.75 ^d
BC+	0.00
BC-	8.00 ^a
LSD	0.09
Significance	S

Key :BDp: Beetroot plant treated with dried poultry manure; BPt = Beetroot plant treated with poultry tea; BC = Beetroot plant treated with both poultry tea and dried poultry manure;BC+ = Untreated and uninoculated control beetroot plant; BC = Untreated and inoculated control beetroot plant and S = Significant



Fig. 1- Infected beetroot plant



Fig. 2 - Uninfected beetroot plant

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