

Use of botanicals and poultry manure as potential bio-nematicides against root-knot nematodes infecting cucumber

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Abstract

Crop losses due to root-knot nematodes are typically mitigated by the application of highly toxic chemical nematicides. Which can be expensive. Consequently, ongoing efforts are focused on the search for ecofriendly and sustainable strategies. The purpose of this study was to assess the efficacy of soil amendments in management of *Meloidogyne incognita* both a screen house and a field setting. Four varieties of cucumber, all infected were evaluated for the effectiveness of soil amendments against in nematodes. The experimental design included a factorial set-up in a completely randomised design and for the screen house and a randomized complete block design for the field. Phytochemical screenings of botanicals were carried out using Gas Chromatography Mass Spectrometry. Data were collected on various parameters, including fresh root weight, fresh shoot weight, fruit yield, soil and root nematode population, reproduction factor, number of egg mass, and gall index. Numerical data obtained were analyzed using descriptive statistics of Microsoft excel packaged and analysis of variance (ANOVA). In the screen house, all four susceptible cucumber varieties exhibited highly pathogenicity when exposed to 2000 juveniles of root-knot nematodes. Powdered poultry manure demonstrated comparable efficacy to carbofuran in reducing the number of root-knot nematodes in the root of cucumber and soil, as well as the number of egg mass, root galling and reproduction factor within the screen house. Cucumber treated with carbofuran (C1cb) and powdered poultry manure (C1pd) showed reduction of 0.01 and 0.001 respectively. Notably, cucumber treated with powdered poultry manure recorded gall index of 24.50 (C1pd), while untreated cucumbers had a gall index of 5.25 (C4c). Phytochemical screening revealed the presence of Xanthane, Imidazole and Boron etc. The extract of powdered poultry manure significantly ($P<0.05$) inhibited egg hatching, increased juvenile mortality, and enhanced yield cucumber compared to other treatments. Phytochemicals such as Xanthane, Imidazole and Boron in botanicals likely contributed to the observed effects in the results.

Keywords: Juveniles, Phytochemicals, Reproduction factor, Root galling

Introduction

Cucumber (*Cucumis sativus* L) is one of the most popular members of the Cucurbitaceae family, originally native to Southern Asia (Sharma, 2016). However, it now grows on most continents. Cucumber thrives in tropical, subtropical and warm temperate climates worldwide, holding significant economically importance as a vegetable (Huixia and Halping, 2021). According to Kubitzki (2011), cucumber is

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ranked among the top 10 vegetables in global production.

The worldwide production of cucumbers and gherkins reached 80.6 million tones, with China leading at nearly 77% of the total (FAOSTART, 2016). In Africa, particularly in Nigeria, cucumber is considered one of the most important exotic vegetables and is commonly consumed. Globally, cucumber are cultivated and appreciated for their nutritional value, serving as a rich source of vitamins, minerals, fiber, and roughage (Mukhtar *et al.*, 2013; Zhang *et al.*, 2014). Cucumbers are a valuable source of conventional antioxidant nutrients including vitamin C, beta carotene and manganese. Additionally, the seeds are a It is also source of edible oil used in cooking (GBIF, 2013).

This economically significant vegetable faces significant threats from diseases and pests, including Anthracnose, Damping-off, Fusarium wilt, Angular leaf spot, Cucumber mosaic and Aphids including root- knot nematodes (RKN). Among these, plant parasitic nematodes are major contributors to substantial quantitative and qualitative losses (Palomares-Rius *et al.*, 2017). Nearly 20 genera of plant parasitic nematodes have been identified in association with vegetables. Among them, root- knot nematodes are the most prevalent and destructive, particularly since these crops serve as natural hosts. Even low levels of nematode infestation can lead to significant yield losses, making them one of the most destructive pathogens for vegetables (Mukhtar *et al.*, 2013; Liu *et al.*, 2015). Bernhardt *et al.* (2013) have identified *Meloidogyne* spp. as a major pest of cucumber.

The implementation of management strategies in cucumber production is crucial to combat parasites and ensure high yield of disease-free and clean fruits. Synthetic chemical nematicides among various nematode management strategies adopted has been highly effective especially in large scale farming due to their rapid total knock down effect (Wacheira *et al.*, 2009). However, considering the current concerns about their adverse effects on the ecosystem and human health, there is a growing need to explore safe and non chemical alternatives for managing Plant parasitic nematodes.

Effective management of phytonematodes can be achieved through the use of organically based materials. Several authors have emphasized the importance of organic manure as a source of nutrient and a means of soil rejuvenation (Abolusoro *et al.*, 2019) as well as for the suppression of plant parasitic nematodes (Baba *et al.*, 2020). Animal manure and agro – industrial wastes such as tea (*Camellia sinensis*) residue have been employed for the management of RKN in grape vines (Rivera and Abally, 2008).

Currently, cucumbers production in Africa like other vegetables is thriving. Cucumbers are recognized as a rich source of vitamins, minerals, fiber, and roughage (Mukhtar *et al.*, 2013; Zhang *et al.*, 2014), providing valuable conventional antioxidant nutrients such as vitamin C and beta carotene. In Nigeria, cucumber production is rapidly gaining popularity due to its utility as a vegetable and a source of income for producers. However, the high demand for this versatile vegetable crop is not being met, as the demand continues to daily with growing a population over the years, while production has not seen a significant increase.

Addressing the challenges posed by plant parasitic nematodes, hunger, malnutrition, diseases, unemployment and food insecurity as well as increasing the revenue of producers through enhanced cucumber productivity is considered a priority. Therefore, investigating the effect of some bio-pesticides such as botanicals and poultry manure on four cucumber varieties becomes imperative. These bio-pesticides are readily available, cost effective, biodegradable and environmentally friendly, making them reliable alternatives to imported, expensive and environmentally persistent nematicides.

Materials and Methods

Soil Sterilization

Sandy- loam topsoil was collected from the farmland around Department of Agronomy Pavilion, University of Ilorin, Ilorin. Using the method described by Gautama and Goswani (2002), the soil was steam pasteurized in a drum at 90°C for 9 hours. The steam pasteurized soil was allowed to cool sufficiently for 72 hours. Subsequently, 8.5 kg of the pasteurized soil was later weighed into each of 112 perforated 10 litre plastic buckets with a diameter of 11 cm. The buckets were placed on an elevated platform to prevent reinfestation by other microorganisms and they were kept inside a screenhouse for planting.

Establishment of pure culture of *Meloidogyne incognita* on susceptible *Celosia argentea*

Three seeds of *Celosia argentea* were planted in each twenty 10 litre plastic buckets containing steam pasteurized soil. *M. incognita* infected roots of *Celosia argentea* were collected from a pure culture in the screen house of International Institute of Tropical Agriculture Ibadan (IITA) and used as inoculum. After one week, seedlings were thinned down to two seedlings per bucket. The infected roots were chopped into very small pieces of about 1cm and 20 g of chopped roots were incorporated into each bucket around the base of seedlings. The plants were maintained for 12 weeks to allow for the growth of the plant and the development of galls on infected roots. This experiment was repeated for the multiplication of the nematode culture as the needed. The culture thus maintained, was used for various experiments after reconfirmation of the root knot nematode species present.

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 a knife, and a sub sample of 5 g chopped roots was weighed using a digital measuring scale. The weighed roots were transferred to a clean tissue paper inside a sieve and placed in a plastic tray. Water was added to the extraction plates at the base to wet the roots, ensuring that the water is sufficient enough. The set up was labeled accordingly. After 48 hours, Water from the plastic tray was poured into a labeled cup using a wash bottle to rinse the plate. The Suspension was allowed to settle for 4 minutes, and supernatant from the labeled cup was gently decanted. The infranatant portion was used for nematode enumeration. Used tissue papers and roots were discarded, and the number of nematode population in 2 ml suspension was identified and counted using a compound microscope.

Preparation of Plant Extracts

The plants evaluated against *Meloidogyne incognita* on cucumber were *Bryopyllum pinnatum* (Life plant) and *Gliricidia sepium* (quick stick). Leaves of both plants were collected in the morning along the river side at Kulende, Ilorin, Kwara State, before sunrise, and their identity was confirmed at the Department of Plant Biology Herbarium University of Ilorin, Ilorin. Three 50 kilogram sacks each of *B. pinnatum* and *G. sepium* leaves were air dried for 5 weeks and 14 days at room temperature of 25°C-27°C, respectively. Aqueous extracts of the test plants were prepared by soaking 1kg of the ground test plants in 4 L of 90°C hot water for 24 hours, following the technique described by Oyedunmade and

Izuogu (2011). The suspension was sieved using muslin cloth in both cases and the aqueous extracts were collected in containers. This served as the stock solution. Five hundred grams (500 g) each of the leaf powdered were taken to the Department of Chemistry and Chemical Engineering, University of Ilorin, Ilorin for Phytochemical screening and Gas Chromatography, respectively.

Preparation of Poultry Manure (Compost Tea)

This involves the creation of a liquid concentrate enriched by poultry manure. Raw manure was collected from the layers chicken house at the Sobi area of Ilorin, Kwara State in a sack bag that was tied up. Twenty five kilograms of fresh layers chicken droppings were collected and allowed to air dry for 16 weeks on a clean surface to eliminate moisture and reduce the toxicity. The cured manure was transferred to a plastic bucket, leaving (9.6 cm) of the headroom at the top of the bucket for stirring without spilling. Fifty litres (50 L) of dechlorinated tap water were added. The water was dechlorinated by allowing it to sit in the sun and fresh air for 7 hours, breaking down any chlorine as chlorine can harm the beneficial bacteria in the compost tea. The Poultry manure tea was stirred three times each day over a 7 day period to infuse the nutrients into the water and provide oxygen following a modified method from Ingham (2005). After 7 days, the liquid was sieved using muslin cloth and the tea was poured into gallons for application.

Preparation of powdered poultry manure

Raw poultry manure (30 kg) was spread thinly on a clean surface for proper curing. It was left to air dry and decompose for sixteen weeks so as to reduce the ammonium and moisture content, using a modified method from Ellis *et al.* (2013). Before use, the dried manure was ground using a mortar and pestle, later sieved using a 2.0 mm sieve, properly bagged, and stored until needed.

Gas Chromatography Mass Spectrometry (GC-MS) of Plant Extracts Sample Analysis

Gas chromatography from Agilent USA hypherrated to a mass spectrophotometer (5975C) with a triple axis detector equipped with an auto injector (10 µl syringe), was utilized. Helium gas served as the carrier gas. Chromatographic separation occurred on a capillary column with the following specification: length of 30 m, internal diameter 0.2 µm, thickness of 250 µm, treated with phenyl methyl siloxane. Other GC-MS conditions included an ion source temperature (EI) of 250°C, interface temperature of 300°C, pressure of 16.2 psia, out time of 1.8mm, 1µl injector in Split mode with a split ratio of 1:50, and an injection temperature of 300°C. The column temperature initiated at 35°C for 5 minutes, changed to 150°C at a rate of 4°C/min and was raised to 250°C at a rate of 20°C/min, held for 5 minutes. The total elution time was 47.5minutes. To determine the real identity of compounds present in crude extracts. Further quantitative analysis using GC-MS was conducted. Plant powdered extracts (0.5 g each) were macerated in methanol (1.5 ml) using a soxhlet extractor. Samples were filtered and sterilized using 0.22 µm pore size filter unit, then analyzed with GC-MS (QP2010 ULTRA, Shimadzu). The oven temperature was set up from 50°C with an increase of 20°C/min to 100°C for 2 mins and 20°C/min to 250°C for 5 min. Helium gas was employed as the carrier gas at a constant flow rate of 8 ml/min. An aliquot of 2µl of the sample was injected into the column with the injector at 280°C and the split ratio of 10:1. Mass spectra solution software provided the supplier controlled the system and acquired the data. Compound

identification was carried out by comparing the mass spectra obtained with those of the standard mass spectra from the National Institute of Standards and Technology (NIST) standard database library software. The Machine model used was 7890A GC system, 5675C Inert MSD with triple –Axis Detector, packing material: capillary column, carrier gas: helium gas, flow rate: in the instrumentation parameter temperature programmed, column length: 30 m, dimension: 30 m × 250 µm × 0.25 µm, column: Agilent 19091-433HP-5Ms 5% phenyl methyl siloxane.

Effect of botanicals on Cucumber plants infected with *Meloidogyne incognita* in the screen house

An experimental trial was carried out in the Screen house of Crop Protection, University of Ilorin, Ilorin to assess the effect of aqueous leaf extract, poultry manure, and carbofuran on four cucumber varieties (Market more, Marketer, Poinsett and Murano) obtained from Premier Seeds, Sango area Ilorin, Kwara State. Perforated plastic buckets of 10 litres with a diameter of 11cm were filled with 8.5 kg of cool pasteurized soil were placed on an elevated platform to prevent reinfestation by other microorganisms. The experimental set up was arranged in a 4 × 7 factorial experiment fitted into a Completely Randomized Design (CRD) with four replications, totaling 112 buckets. Two seeds were planted in each bucket and allowed to germinate. A week after planning, three holes were marked at the base of each plant using a glass rod for inoculum incorporation. Ninety six buckets were inoculated with 2,000 freshly hatched juveniles of *Meloidogyne incognita*, and inoculated plants received treatments: aqueous leaf extracts of *Bryopyllum pinnatum* and *Gliricidia sepium*, powdered poultry manure, and Poultry manure tea. These treatments were applied at the third day of inoculation and repeated a month after the first application at rate of 50 ml, 50 ml, 50 g and 50 ml respectively.

Carbofuran obtained from chemical shop at Ipata, Ilorin, served as a standard check and was applied four weeks before planting at a rate of 0.5 g per bucket (Amulu and Adekunle, 2015). The chemical was thoroughly mixed with 8.5 kg of steam-pasteurized soil in 10litres sized buckets. Five hundred millilitres of water were sprinkled on the soil every three days for four weeks to allow the chemical to dissolve. Uninoculated plants (16 buckets) that were not inoculated served as the negative control, while inoculated plants (16 buckets) that did not receive treatments served as the positive control. Maintenance practices such as daily watering using watering can, hand picking of weeds and insect control were carried out using 5% cypermetherin insecticide. The second experiment was conducted without any modification.

Data collected included vine length, number of leaves and at harvest, fresh shoot weight, fresh root weight, number of fruits, and weight of fruits, soil nematode population and root gall index scored according to the method described by Makete (2000). The reproduction factor was calculated by dividing the final nematode population (Pf) by the initial nematode population (Pi); $Rf = Pf/Pi$. Each treatment was replicated four times and details of treatments were as follows:

- T-1: Bucket application with powdered poultry manure at 50 g
- T-2: Bucket application with poultry manure tea at 50 ml
- T-3: Bucket application with *Gliricidia sepium* at 50 ml
- T-4: Bucket application with *Bryopyllum pinnatum* at 50 ml
- T-5: Bucket application with Carbofuran at 0.5 g
- T-6: Bucket with positive control

T-7: Buckets with negative control

Field Experiment to assess the Effects of Test Plants Extracts and Poultry Manure

The field experiment was conducted during a cropping season to assess the effect of test plants extracts and poultry manures on cucumber varieties at the Teaching and Research Farm of University of Ilorin, Ilorin. The farm is located at longitude 4° 35' E and latitude 8° 29' N in the Southern Guinea Savannah of Nigeria at an elevation of 310 m above sea level. The annual rainfall ranged from 1000 to 1200 mm, and the soil type is sandy loam soil with a pH of 4.35. A piece of land measuring 100 m × 50 m was mapped out, plowed, harrowed and ridged. The initial soil nematode population was determined before planting by collecting soil samples in a zigzag pattern at a depth of 0-20 cm using an auger. The soil samples were properly labeled and taken to the laboratory at the Nematology and Striga Unit of International Institute For Tropical Agricultural Ibadan (IITA) for identification and population estimation. The field was divided into four blocks; each was divided into 20 plots representing the treatments and was replicated four times. The plot was sprayed with pre-emergence herbicides [Paraquat and Atrazine]. The layout was a 4 × 5 factorial experiment fitted into a Randomized Complete Block Design (RCBD) and was replicated four times. Spacing was 0.5 m alley between column and 1.5 m alley between rows. Two seeds were planted at a depth of 5 cm and Seedlings were later thinned to one plant per stand after one week of germination. Powdered poultry manure, compost tea poultry manure, aqueous leaf extracts of *Bryopyllum pinnatum* and *Gliricidia sepium* at the rate of 50 g, 50 ml, 50 ml and 50 ml respectively, per plant were incorporated into the soil a week after planting and repeated four weeks after the first treatment application at accurately measured amounts: all control plots did not receive any treatment. Farm maintenance practices, such as weeding using a hoe and spraying 5% cypermethrin insecticide to ward off insect pests, were carried out. Vegetative and reproductive data were collected on vine length, number of leaves, number of branches, and days to 50% flowering. At harvest, fresh shoot weight, fresh root weight, number of fruits, weight of fruits, number of healthy fruits, and final soil nematode population, and gall rating were recorded. Root systems were uprooted, washed and the galls on the roots were scored using the method described by Makete (2000) method as follows:

- 0 = No galls (clean root system)
- 1 = 1-10% of the root system galled
- 2 = 11-35% of the root system galled
- 3 = 36-65% of the root system galled
- 4 = 66-90% of the root system galled
- 5 = 91-100% of the root system galled

All numerical data obtained were analyzed using descriptive statistics of Microsoft Excel packaged and analysis of variance (ANOVA) was conducted. The mean differences were determined by Duncan's Multiple Range Test (DMRT) at 5% level of significance using SAS 9.3.

Results

The GC-MS Analysis of Methanolic Extract of *Gliricidia sepium*

The methanolic extract of *Gliricidia sepium* leaves revealed several peaks representing different compounds as shown in chromatogram obtained through Gas Chromatography-Mass spectrometry (GC-MS) analysis. The peaks in the chromatogram were integrated and were compared with the database of spectra of known components stored in the Gas Chromatography-Mass Spectrometry library. The identification of phytochemical compounds was based on the peak area, retention time and molecular formula (Fig.1). The results indicated the presence and retention time of the following compounds: Stannane (9.666), Xanthene (12.646), Silane (16.323), Bromomethyl (19.170), Copper iodide (22.433), Zirconium (27.721), Stannane (30.624), Methoxy (34.274), Trimethylazulene (36.193), Boron (38.340), Hexaselenaadamantane (40.061), Imidazole (41.118), and Benzene (42.944). Fig. 1 illustrate the chemical compounds present in *Gliricidia sepium* below.

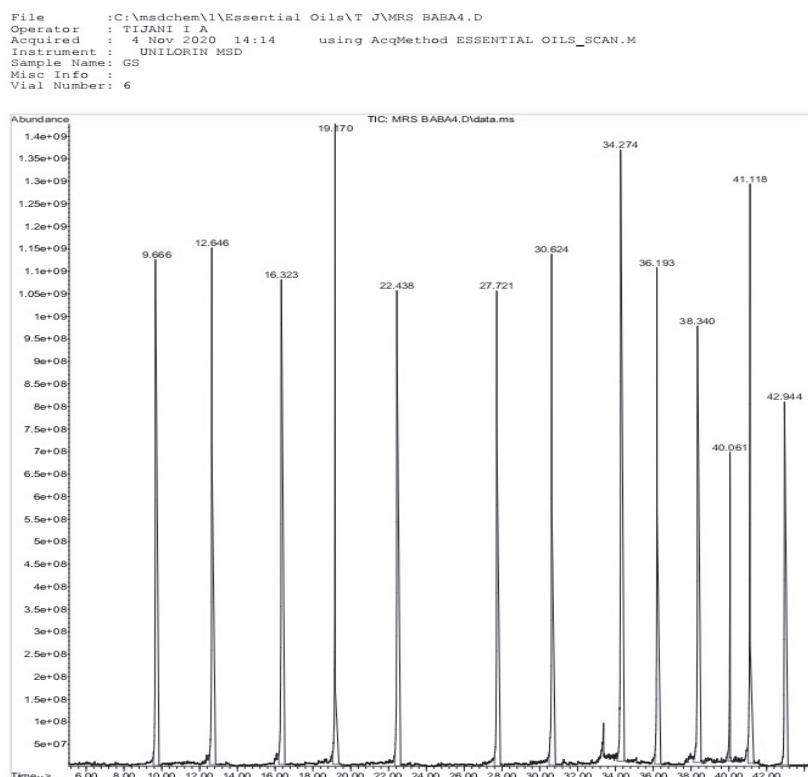


Fig. 1. Chemical compounds present in *Gliricidia sepium*

The GC-MS Analysis of Methanolic Extract of *Bryophyllum pinnatum*

In methanolic extract of *Bryophyllum pinnatum* leaves, thirty-two compounds were identified through GC-MS analysis, showcasing various phytochemical activities predominantly responsible for

the antimicrobial activities effects in the extract. The retention time, and peak area, of different bioactive compounds are presented in Fig.2. The major phyto-constituents present in the leaf extract were 4-Benzodiazepin-2-one (40.162), Tetrakis (41.892), Boron (36.997), Pregnan (35.178), Bromomethyl (31.418), oxime (28.294), zulene (25.091), Silane (24.108), Disulfide (23.279), phenyl ether (22.186), Androsta (22.086), Bromomethyl (21.777), Mytiloxanthinone (21.316), Zirconium (20.886), Piperazine (20.483), Pentabromodiphenyl (19.382), Boroxin (18.764), Tribromodibenzo (18.254), Cyclotrisiloxane (18.103), Crotonic acid (17.371), Methoxy (15.851), Isogalpinone (14.356), Ioanhydroxanthosine (13.418), Hexadecane (12.632), Methyloxime (12.017), Silane (11.337), Methoxy (11.337), Diacetoxyl (10.474), Copper iodide (9.986), methanone (9.649), Pentacarbonyl (8.953), Diphenyl ether (6.050), and Dibenzo (5.969) . Fig. 2 Presents Chemical Compounds in *Bryophyllum pinnatum* below.

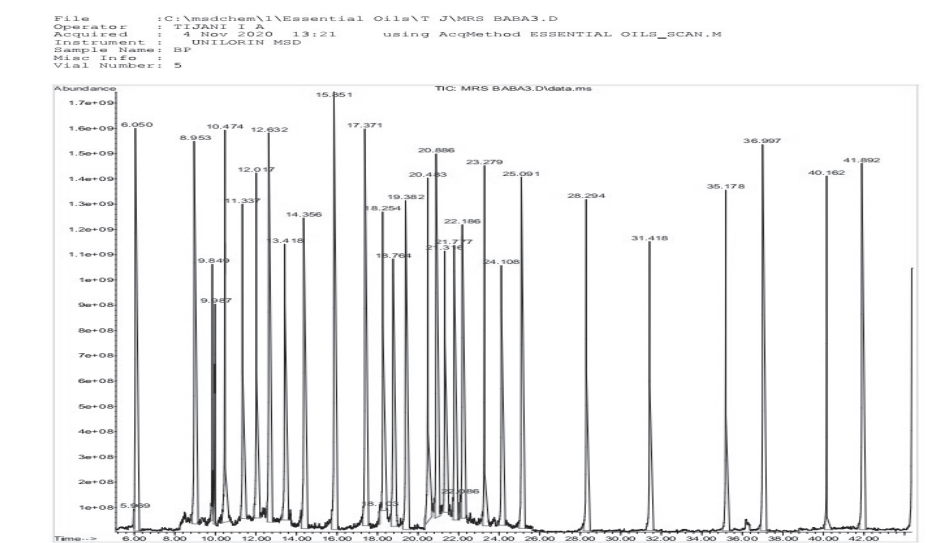


Fig. 2. Present chemical compounds in *Bryophyllum pinnatum*

Effect of Soil Amendments on Mean Vine Length (cm) of Cucumber Infected with *Meloidogyne incognita*

The impact effect of soil amendments on cucumber vine length at 2,4,6,8 and 10 weeks after sowing in the screen house experiment is presented in Table 1. Powdered poultry manure and carbofuran were observed to significantly increased ($p < 0.05$) vine length reaching 144.00 cm and 109.300 cm respectively for cucumber plant compared to other tested treatments tested at week 10. The lowest vine length was observed in the untreated control (Control-) measuring 60.30 cm. Significant differences ($p < 0.05$) were noted between poultry manure tea, powdered poultry manure, *Bryophyllum pinnatum*, *Gliricidia sepium* and carbofuran in terms of plant vine length. Poultry manure tea outperformed separately higher than *Bryophyllum pinnatum* and *Gliricidia sepium* individually. However, no significant difference ($p > 0.05$) was observed between *Bryophyllum pinnatum*, *Gliricidia sepium* and plants that were neither inoculated nor treated (Control+). The inoculated control recorded a lower length at week 10, while non-inoculated control exhibited a higher number of plants at 73.80 cm.

Table 1. Effect of organic amendments on mean vine length (cm) of cucumber plants infected with *Meloidogyne incognita*

V & T	Week 2	Week 4	Week 6	Week 8	Week 10
C1Pd	28.20±0.00 ^a	49.71±0.01 ^b	104.01±0.02 ^a	109.31±0.02 ^a	114.01±0.00 ^a
C1Pt	18.91±0.04 ^d	40.50±0.02 ^c	94.32±0.01 ^a	100.32±0.02 ^a	106.82±0.35 ^a
C1Gs	19.60±0.01 ^d	34.50±0.10 ^{cd}	56.50±0.45 ^d	79.51±0.01 ^c	91.33±0.00 ^a
C1Bp	22.92±0.00 ^c	38.32±0.35 ^c	63.84±0.00 ^c	68.33±0.24 ^{cd}	81.80±0.78 ^b
C1Cb	25.00±0.53 ^b	42.75±0.00 ^c	96.82±0.21 ^a	105.34±0.00 ^a	109.30±0.91 ^a
C1C-	24.42±0.01 ^{bc}	32.31±0.01 ^{dc}	47.33±0.05 ^e	57.30±0.00 ^d	67.50±0.00 ^c
C1C+	25.32±0.15 ^b	38.30±0.20 ^c	54.04±0.22 ^d	61.81±0.04 ^d	73.80±0.00 ^b
C2Pd	11.31±0.68 ^{fg}	66.30±0.01 ^a	77.3±0.45 ^b	96.82±0.14 ^a	104.84±0.00 ^a
C2Pt	13.00±0.01 ^f	52.31±0.10 ^b	71.81±0.00 ^{bc}	92.33±0.10 ^{ab}	102.30±0.00 ^a
C2Gs	12.80±0.03 ^f	26.50±0.56 ^d	67.33±0.11 ^c	85.54±0.01 ^b	94.01±0.05 ^a
C2Bp	11.30±0.56 ^{fg}	26.52±0.36 ^d	64.81±0.42 ^c	83.01±0.00 ^b	88.50±0.51 ^{ab}
C2Cb	11.83±0.00 ^{fg}	57.83±0.42 ^{ab}	70.52±0.85 ^{bc}	90.00±0.35 ^{ab}	99.83±0.24 ^a
C2C-	15.82±0.03 ^e	25.84±0.42 ^d	47.53±0.56 ^e	58.03±0.70 ^d	65.02±0.75 ^c
C2C+	25.30±0.03 ^b	42.81±0.00 ^c	57.04±0.11 ^d	73.32±0.04 ^c	81.31±0.11 ^{ab}
C3Pd	18.82±0.00 ^d	73.02±0.10 ^a	80.30±0.06 ^b	87.81±0.00 ^b	96.50±0.32 ^a
C3Pt	9.81±0.01 ^{gh}	13.30±0.00 ^f	73.02±0.65 ^{bc}	82.34±0.23 ^b	91.04±0.00 ^a
C3Gs	9.50±0.12 ^{gh}	20.01±0.11 ^{de}	69.31±0.13 ^c	79.03±0.01 ^{bc}	83.82±0.09 ^b
C3Bp	8.80±0.01 ^h	20.84±0.41 ^{de}	63.34±0.00 ^{cd}	71.31±0.00 ^c	78.30±0.06 ^b
C3Cb	10.01±0.45 ^g	58.80±0.00 ^{ab}	66.51±0.35 ^c	80.01±0.75 ^b	92.01±0.44 ^{ab}
C3C-	8.50±0.01 ^h	15.83±0.11 ^e	45.52±0.00 ^e	55.33±0.32 ^d	60.33±0.03 ^c
C3C+	8.82±0.03 ^h	16.34±0.22 ^e	54.33±0.11 ^d	62.84±0.08 ^{cd}	72.04±0.45 ^b
C4Pd	16.03±0.21 ^{de}	34.01±0.32 ^{cd}	96.04±0.20 ^a	107.50±0.75 ^a	114.31±0.42 ^a
C4Pt	9.04±0.21 ^{gh}	26.84±0.14 ^d	83.50±0.23 ^b	93.81±0.00 ^a	97.03±0.04 ^a
C4Gs	11.80±0.11 ^{fg}	24.50±0.23 ^d	70.32±0.45 ^{bc}	83.02±0.11 ^b	99.01±0.23 ^a
C4Bp	9.01±0.12 ^{gh}	22.81±0.25 ^d	79.04±0.23 ^b	94.33±0.26 ^a	94.02±0.11 ^a
C4Cb	10.53±0.00 ^g	32.02±0.10 ^{cd}	82.51±0.00 ^b	101.34±0.17 ^a	105.84±0.07 ^a
C4C-	9.54±0.42 ^{gh}	20.30±0.00 ^{de}	57.84±0.02 ^d	68.52±0.24 ^{cd}	64.80±0.00 ^c
C4C+	10.82±0.62 ^g	22.34±0.21 ^{de}	62.83±0.00 ^{cd}	67.34±0.55 ^{cd}	74.81±0.10 ^b

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan Multiple Range Test (DMRT): Mean Vine length; SEM = standard error of mean; C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum*; C+: Non Inoculated Pot Control; C- Inoculated Pot Control; Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; Cb: Carbofuran; V & T: Variety and Treatment

Effect of Soil Amendments on Number of Cucumber Leaves Infected with *M.incognita*

The impact of soil amendments on the number of leaves of cucumber plants infected with *M.incognita* at 2,4,6,8 and 10 weeks after planting in the Screen house is presented in Table 2. Significant differences in the number of leaves were observed from the Table 2. Inoculated (Control-) plants recorded the lowest number of leaves followed by non-inoculated plants (Control+) with number of leaves at week 10 being 13.80 and 16.30 respectively. There was no significant difference ($p > 0.05$) between the number of leaves treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum*. As shown in Table 4., there was no difference between plants treated with poultry manure and plants treated with carbofuran. However, across the weeks and treatments, plants treated with powdered poultry manure recorded the significantly highest number of leaves ($p < 0.05$). The cucumber marketer variety treated with powdered poultry had the highest number of leaves, followed by cucumber Poinsett variety.

Table 2. Effect of soil amendments on the number of leaves of cucumber infected with *Meloidogyne incognita*

V & T	Week 2	Week 4	Week 6	Week 8	Week 10
C1Pd	7.50±0.04 ^a	10.01±0.23 ^{bc}	12.81±0.32 ^b	26.01±0.00 ^a	33.81±0.20 ^a
C1Pt	6.01±0.02 ^b	8.83±0.10 ^{cd}	11.00±0.10 ^{bc}	17.03±0.00 ^b	24.52±0.43 ^b
C1Gs	6.02±0.00 ^b	9.32±0.23 ^c	11.02±0.10 ^{bc}	18.52±0.00 ^b	20.83±0.04 ^b
C1Bp	6.53±0.00 ^{ab}	8.51±0.12 ^{cd}	11.03±0.10 ^{bc}	16.54±0.00 ^b	23.54±0.07 ^b
C1Cb	7.04±0.00 ^a	9.50±0.25 ^c	11.54±0.10 ^{bc}	20.50±0.00 ^{ab}	29.50±0.95 ^a
C1C-	4.51±0.00 ^c	7.01±0.01 ^d	9.51±0.10 ^{cd}	12.01±0.00 ^{cd}	16.32±0.82 ^c
C1C+	6.00±0.00 ^b	7.01±0.01 ^d	9.03±0.10 ^{cd}	13.03±0.00 ^c	13.83±0.20 ^d
C2Pd	5.02±0.00 ^c	14.82±0.01 ^a	17.04±0.10 ^a	21.04±0.00 ^{ab}	23.01±0.10 ^b
C2Pt	5.01±0.00 ^c	8.00±0.03 ^{cd}	10.50±0.10 ^c	16.30±0.00 ^b	22.30±0.10 ^b
C2Gs	4.83±0.00 ^c	7.31±0.00 ^d	9.52±0.10 ^{cd}	13.02±0.31 ^c	17.01±0.10 ^c
C2Bp	6.04±0.00 ^b	10.03±0.00 ^{bc}	13.01±0.05 ^b	17.54±0.12 ^b	22.52±0.10 ^b
C2Cb	6.02±0.10 ^b	13.00±0.00 ^a	17.50±0.05 ^a	21.53±0.03 ^{ab}	23.53±0.10 ^b
C2C-	5.01±0.12 ^c	6.81±0.00 ^d	9.51±0.05 ^{cd}	12.30±0.03 ^{cd}	15.30±0.10 ^c
C2C+	5.02±0.21 ^c	7.83±0.00 ^d	11.50±0.05 ^{bc}	13.51±0.09 ^c	18.01±0.10 ^{bc}
C3Pd	5.53±0.07 ^{bc}	11.32±0.00 ^b	14.52±0.05 ^a	18.83±0.01 ^b	28.83±0.10 ^a
C3Pt	4.54±0.03 ^d	6.51±0.00 ^d	8.54±0.05 ^d	15.82±0.01 ^{bc}	19.01±0.01 ^{bc}
C3Gs	5.01±0.30 ^c	7.80±0.00 ^d	10.03±0.05 ^c	15.04±0.03 ^b	19.02±0.11 ^{bc}
C3Bp	5.00±0.34 ^c	7.31±0.03 ^d	9.51±0.05 ^{cd}	12.51±0.03 ^{cd}	17.03±0.15 ^c
C3Cb	5.53±0.20 ^{bc}	11.03±0.04 ^b	14.01±0.05 ^a	17.50±0.05 ^b	25.04±0.50 ^b
C3C-	5.04±0.35 ^{bc}	8.02±0.16 ^{cd}	10.54±0.40 ^c	11.31±0.04 ^d	13.00±0.62 ^d
C3C+	5.53±0.54 ^{bc}	8.31±0.13 ^{cd}	10.53±0.05 ^c	13.52±0.00 ^c	16.01±0.55 ^c
C4Pd	5.04±0.09 ^c	10.32±0.23 ^{bc}	12.01±0.12 ^b	14.50±0.00 ^c	21.31±0.02 ^b
C4Pt	5.52±0.10 ^{bc}	8.34±0.21 ^{cd}	9.83±0.12 ^{cd}	12.01±0.00 ^{cd}	19.82±0.04 ^{bc}
C4Gs	5.50±0.10 ^{bc}	9.32±0.32 ^c	11.34±0.45 ^{bc}	14.02±0.00 ^c	17.03±0.09 ^c
C4Bp	5.04±0.10 ^c	9.30±0.13 ^c	11.02±0.32 ^{bc}	13.84±0.00 ^c	20.34±0.02 ^b
C4Cb	5.03±0.10 ^c	10.31±0.24 ^{bc}	12.31±0.10 ^b	14.50±0.00 ^c	19.80±0.00 ^{bc}
C4C-	5.02±0.10 ^c	7.03±0.52 ^d	10.04±0.11 ^c	11.52±0.00 ^d	15.50±0.01 ^c
C4C+	5.01±0.12 ^c	9.01±0.15 ^c	11.83±0.00 ^{bc}	13.51±0.00 ^c	16.01±0.00 ^c

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan Multiple Range Test (DMRT): Mean Number of leaves; SEM = standard error of mean; C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; C-: Inoculated Pot Control; C+: Non-Inoculated Pot Control Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; Bp: *Bryophyllum pinnatum*; Cb: Carbofuran; V & T: Variety and Treatment

Effect of soil amendments on fresh root weight of cucumber infected with *Meloidogyne incognita* for Screen house experiment

The impact of treatments on the fresh root weight of cucumber plants is presented in Table 3. The fresh root weight per plant was significantly increased ($p < 0.05$) in the untreated pots (Control-) compared to treated plants. Significant differences ($p < 0.05$) were observed between plants treated with carbofuran, powdered poultry manure, poultry manure tea, *Gliricidia sepium*, and *Bryophyllum pinnatum*, in comparison to control plants. No significant difference ($p > 0.05$) was observed among powdered poultry manure, poultry manure tea, *Gliricidia sepium*, carbofuran, and *Bryophyllum pinnatum* treated plants for fresh root weight (Table 3). However, a significant difference was observed between the negative control and positive control; inoculated plants recorded the highest fresh root weight of cucumber plants at 0.65 kg, while non - inoculated cucumber plants had the lowest root weight of cucumber at 0.13 kg.

Effect of soil amendments on fresh shoot weight of cucumber infected with *Meloidogyne incognita*

The highest fresh shoot weight was recorded in plants treated with powdered poultry manure treated plants (0.73 g), followed by the application of carbofuran (0.53 g) in Table 3. The lowest fresh shoot weight was obtained from the inoculated plants (Control-) with a fresh shoot weight as 0.33 g. Significant differences ($p < 0.05$) were observed between the fresh shoot weight of cucumber plant treated with powdered poultry and the rest of the treatments. Cucumber plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum* were not significantly different from each other, but a significant difference ($p < 0.05$) was recorded between negative control and positive control.

Effect of soil amendments on number of fruits on cucumber infected with *Meloidogyne incognita*

The effect of treatments on the number of fruits of cucumber grown in the screen house experiment is shown in Table 3. The application of powdered poultry manure and carbofuran significantly increased ($p < 0.05$) the number of fruits more than other treatments applied.

There was a significant difference between treated plants and the two controls. However, the uninoculated control had a significantly higher in number of fruits per plant than the inoculated control. There was no significant difference in the plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum*.

Effect of soil amendments on weight of fruits of cucumber infected with *Meloidogyne incognita*

The effect of treatments on weight of fruits per plant (kg) of cucumber plant grown under screen house experimentation is presented in Table 3. The results showed there were significant differences between the treated plants and non-treated. Inoculated plants fruits recorded the lowest weight, followed by uninoculated plant weight of fruits. Plants treated with powdered poultry manure and carbofuran recorded the highest weight of fruits per plants. Meanwhile, plants that received treatment of poultry manure tea recorded a higher weight of fruits than those treated with *Gliricidia sepium* and *Bryophyllum pinnatum*. However, the highest weight of fruits per plants was recorded in plants treated with powdered poultry manure and carbofuran with weight of fruits as 0.65 and 0.63 respectively.

Effect of treatments on soil and root nematode population of cucumber infected with *Meloidogyne incognita*

Table 4 illustrates the effects of organic amendments on the soil nematode population, eggs and gall index of cucumber in the screen house. The treatments significantly ($p < 0.05$) reduced the number of root-knot nematode population in the soil compared to their control counterparts. Plants treated with powdered poultry manure and carbofuran treated plants performed significantly higher than the other treatments. No significant differences ($p > 0.05$) were observed between cucumber plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum* treated cucumber plants. No observation of root-knot nematodes was made in the uninoculated plants (Control+).

The reproductive factor of root-knot nematodes ranged from 0.02 to 1.17. In Table 4, reproductive factors were observed to be highly reduced in the plants treated with the tested amendments.

There were significant difference ($p < 0.05$) observed in reproductive factor of soil treated with the tested amendments, where poultry manure powder and carbofuran performed significantly higher than

Table 3. Effect of soil amendments on the fresh root weight, fresh shoot weight, number of fruits, weigh of fruits of cucumber infected with *Meloidogyne incognita*

V & T	FRW (kg)	FSW (Kg)	No. of fruits	Weight of fruits (kg)
C1Pd	0.25±0.00 ^d	0.73±0.22 ^a	19.74±0.11 ^a	0.65±0.12 ^b
C1Pt	0.28±0.00 ^{cd}	0.65±0.34 ^b	16.50±0.12 ^b	0.28±0.11 ^{cd}
C1Gs	0.28±0.00 ^{cd}	0.63±0.13 ^b	15.00±0.24 ^b	0.30±0.13 ^c
C1Bp	0.25±0.00 ^d	0.53±0.12 ^c	10.00±0.25 ^c	0.33±0.24 ^c
C1Cb	0.30±0.00 ^c	0.73±0.13 ^a	18.75±0.35 ^a	0.63±0.24 ^b
C1C-	0.40±0.00 ^{ab}	0.33±0.12 ^c	4.75±0.35 ^f	0.15±0.35 ^c
C1C+	0.20±0.00 ^{de}	0.43±0.12 ^d	5.75±0.14 ^{ef}	0.23±0.22 ^{cd}
C2Pd	0.23±0.11 ^{de}	0.68±0.23 ^{ab}	11.25±0.25 ^c	0.85±0.12 ^a
C2Pt	0.25±0.21 ^d	0.55±0.23 ^c	9.25±0.23 ^{cd}	0.40±0.23 ^{bc}
C2Gs	0.28±0.22 ^{cd}	0.50±0.34 ^c	8.75±0.23 ^d	0.53±0.12 ^{bc}
C2Bp	0.23±0.23 ^{de}	0.63±0.23 ^b	10.00±0.23 ^c	0.60±0.12 ^b
C2Cb	0.40±0.91 ^{ab}	0.28±0.32 ^{ef}	4.75±0.36 ^f	0.18±0.13 ^d
C2C-	0.15±0.23 ^f	0.30±0.35 ^e	7.25±0.45 ^{de}	0.20±0.57 ^{cd}
C2C+	0.23±0.13 ^{de}	0.58±0.21 ^c	10.00±0.35 ^c	0.73±0.45 ^{ab}
C3Pd	0.23±0.23 ^{de}	0.55±0.25 ^c	9.75±0.36 ^{cd}	0.60±0.11 ^b
C3Pt	0.25±0.23 ^d	0.48±0.32 ^d	8.75±0.35 ^d	0.50±0.55 ^{bc}
C3Gs	0.33±0.98 ^c	0.43±0.23 ^d	7.50±0.23 ^{de}	0.38±0.34 ^c
C3Bp	0.28±0.25 ^{cd}	0.55±0.14 ^c	19.76±0.24 ^a	0.60±0.33 ^b
C3Cb	0.43±0.12 ^a	0.20±0.23 ^f	3.50±0.11 ^f	0.20±0.23 ^{cd}
C3C-	0.18±0.19 ^e	0.25±0.27 ^f	4.50±0.13 ^f	0.20±0.33 ^{cd}
C3C+	0.13±0.11 ^f	0.40±0.12 ^d	9.50±0.11 ^{cd}	0.53±0.11 ^{bc}
C4Pd	0.15±87 ^{ef}	0.35±0.12 ^c	7.50±0.23 ^{de}	0.33±0.23 ^c
C4Pt	0.25±12 ^d	0.33±0.45 ^e	6.25±0.25 ^c	0.38±0.24 ^c
C4Gs	0.23±35 ^{de}	0.33±0.12 ^e	5.75±0.23 ^{ef}	0.35±0.25 ^c
C4Bp	0.18±0.24 ^e	0.43±0.45 ^d	8.50±0.56 ^d	0.55±0.25 ^{bc}
C4Cb	0.38±0.23 ^b	0.15±0.34 ^g	3.00±0.27 ^f	0.13±0.26 ^d
C4C-	0.13±0.23 ^f	0.20±0.21 ^f	1.00±0.22 ⁱ	0.23±0.31 ^{cd}
C4C+	0.17±0.23 ^e	0.24±0.21 ^f	2.30±0.13 ^j	0.28±0.24 ^f

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan Multiple Range Test (DMRT): SEM = standard error of mean; C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum*; C+: Non- Inoculated Control; C-: Inoculated Control; Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; Cb: Carbofuran; V & T: Variety and Treatment

other treatment materials. Inoculated (Control-) soil recorded the highest reproductive factor. No record of the reproductive factor was observed in uninoculated soil (Control+).

Table 4 presents the effects of soil amendments on number of juveniles in the root at harvest. Significant difference ($p < 0.05$) were observed in the number of juveniles found in the roots of infected cucumbers that received treatments compared to the controls. Roots treated with powdered poultry manure and carbofuran recorded a lower number of juveniles than other tested treatments. No significant difference ($p < 0.05$) was found between cucumber plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum*.

In Table 4, the number of eggs extracted from the roots of infected cucumber is shown. The highest number of eggs was observed in the roots of untreated pots (control-). Treated plants recorded a lower number of eggs. With powdered poultry manure and carbofuran showing fewer eggs than other treatments.

The gall index of root- knot nematodes as presented in Table 4, shows that there were significant

Table 4. Effect of soil amendments on soil and root nematode population of cucumber infected with *Meloidogyne incognita*

V & T	ISNP	SNP at harvest	RF= Pf/pi	E	J	GR
C1Pd	2000.00±0.00 ^a	154.30±0.11 ^c	0.03±0.00 ^a	3.33±001 ^a	10.62±0.02 ^a	0.01±001 ^a
C1Pt	2000.02±0.00 ^a	406.31±0.11 ^d	0.08±0.00 ^b	118.61±001 ^c	164.01±001 ^c	0.67±001 ^c
C1Gs	2000.03±0.00 ^a	552.02±0.13 ^e	0.11±0.00 ^b	151.32±001 ^{cd}	253.60±001 ^d	1.33±001 ^d
C1Bp	2000.06±0.00 ^a	1659.31±0.14 ^b	0.33±0.00 ^c	244.61±001 ^{ef}	697.31±001 ^h	2.31±001 ^e
C1Cb	2000.00±0.00 ^a	130.33±0.14 ^c	0.03±0.00 ^a	6.60±001 ^a	6.60±001 ^a	0.01±001 ^a
C1C-	2000.02±0.00 ^a	5594.01±0.21 ⁱ	1.12±0.00 ^{de}	583.31±001 ^g	797.61±001 ⁱ	4.20±001 ^g
C1C+	0.00	0.00	0.00	0.00	0.00	0.00
C2Pd	2000.06±0.00 ^a	115.30±0.18 ^b	0.02±0.00 ^a	19.62±001 ^b	15.00±001 ^{ab}	0.03±001 ^a
C2Pt	2000.00±0.00 ^a	241.61±0.70 ^e	0.05±0.00 ^a	124.03±001 ^c	166.61±001 ^c	0.01±001 ^a
C2Gs	2000.02±0.00 ^a	341.63±0.15 ^f	0.07±0.00 ^a	214.63±001 ^c	169.31±001 ^c	1.00±001 ^d
C2Bp	2000.03±0.00 ^a	587.62±0.17 ^e	0.12±0.00 ^b	282.01±001 ^f	596.60±001 ^g	1.00±001 ^d
C2Cb	2000.06±0.00 ^a	108.61±0.00 ^b	0.02±0.00 ^a	10.01±001 ^{ab}	18.32±001 ^b	0.01±001 ^a
C2C-	2000.04±0.00 ^a	5134.60±0.00 ⁱ	1.03±0.00 ^d	761.32±001 ^h	757.62±001 ⁱ	4.40±001 ^g
C2C+	0.00	0.00	0.00	0.00	0.00	0.00
C3Pd	2000.00±0.00 ^a	80.31±0.00 ^a	0.02±0.00 ^a	16.60±001 ^b	10.00±001 ^a	0.01±001 ^a
C3Pt	2000.02±0.00 ^a	170.63±0.00 ^c	0.03±0.00 ^a	116.62±001 ^c	100.00±001 ^c	0.31±001 ^b
C3Gs	2000.03±0.00 ^a	176.01±0.00 ^c	0.04±0.00 ^a	166.62±001 ^{cd}	150.01±001 ^c	0.33±001 ^b
C3Bp	2000.06±0.00 ^a	1150.00±0.00 ^f	0.23±0.00 ^{bc}	116.61±001 ^c	333.33±001 ^e	1.32±001 ^d
C3Cb	2000.00±0.00 ^a	75.01±0.00 ^a	0.02±0.00 ^a	296.63±001 ^f	13.32±001 ^a	0.01±001 ^a
C3C-	2000.02±0.00 ^a	3927.32±0.00 ⁱ	0.79±0.00 ^d	554.01±001 ^g	633.31±001 ^g	3.00±001 ^f
C3C+	0.00	0.00	0.00	0.00	0.00	0.00
C4Pd	2000.06±0.00 ^a	119.63±0.00 ^b	0.02±0.00 ^a	10.00±001 ^{ab}	30.02±001 ^b	0.01±001 ^a
C4Pt	2000.00±0.00 ^a	295.67±0.00 ^d	0.06±0.00 ^a	100.02±001 ^c	266.61±001 ^d	0.31±001 ^b
C4Gs	2000.02±0.00 ^a	368.67±0.00 ^d	0.07±0.00 ^a	175.01±001 ^d	286.63±001 ^e	0.67±001 ^c
C4Bp	2000.03±0.00 ^a	1414.61±0.00 ^g	0.28±0.00 ^{bc}	125.03±001 ^c	400.00±001 ^f	2.03±001 ^e
C4Cb	2000.06±0.00 ^a	118.32±0.00 ^b	0.02±0.00 ^a	12.51±001 ^b	30.01±001 ^b	0.02±001 ^a
C4C-	2000.06±0.00 ^a	5855.03±0.11 ^j	1.17±0.11 ^e	875.02±0.11 ⁱ	910.00±0.11 ^j	4.30±001 ^g
C4C+	0.00	0.00	0.00	0.00	0.00	0.00

Values in the same column followed by the same letters superscript (s) have no significant differences at $p<0.05$ according to Duncan Multiple Range Test (DMRT): Mean Soil and root of nematode population; SEM = standard error of mean; C1: Market; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum*; C+: Non- Inoculated Control; C-: Inoculated Control Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; Cb: Carbofuran; V & T: Variety and Treatment; ISNP: Initial Soil Nematode Population; SNPH: Soil Nematode Population at Harvest; RF Reproductive factor (Pf/Pi) E: Eggs; J: Juvenile and GR: Gall ratings

differences ($p<0.05$) between treated and untreated plants. Gallings was significantly higher ($p<0.05$) in the inoculated and untreated control than in all the other treatments. Gallings was significantly reduced ($p<0.05$) in the roots of cucumber treated with powdered poultry manure and carbofuran. Additionally, for the gall index, plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum* were significantly smaller ($p<0.05$) than plants with no treatment application (Table 4)

Effect of soil amendments on mean vine length of cucumber grown in the field

The results presented in Table 5, reveal an increase in vine that vine length across all the treated plants. When considered individually, the application of powdered poultry manure at 50 g/plants was observed to be the most effective in increasing vine length followed by the application of poultry manure tea at 50 ml/plant stand. Both of these treatments were different from the others. An increase in vine length was also observed with *Gliricidia sepium* at 50 ml and *Bryophyllum pinnatum* at 50 ml/plant stand (Table 5). However, there was a significant ($p<0.05$) reduction in vine length observed with untreated cucumber plants.

Table 5. Effect of soil amendments on mean vine length of cucumber grown in the field

V & T	Week 2	Week 4	Week 6	Week 8	Week 10
C1Pd	27.50±0.11 ^b	57.00±0.21 ^{bc}	110.00±0.16 ^a	118.25±0.00 ^a	124.50±0.09 ^a
C1Pt	26.25±0.11 ^b	46.25±0.12 ^{ef}	99.75±0.32 ^b	109.00±0.45 ^b	112.70±0.43 ^b
C1Gs	20.75±0.11 ^c	43.00±0.12 ^{fg}	88.00±0.33 ^{cd}	97.25±0.23 ^{cd}	105.25±0.19 ^{bcd}
C1Bp	23.00±0.45 ^c	38.25±0.11 ^{gh}	80.50±0.12 ^{de}	84.75±0.65 ^{efg}	92.25±0.12 ^{ef}
C1C	20.75±0.73 ^c	36.50±0.11 ^{hi}	53.00±0.55 ^h	65.75±0.28 ⁱ	72.25±0.24 ^{hi}
C2Pd	26.50±0.91 ^b	68.25±0.11 ^a	85.50±0.26 ^{cd}	104.25±0.63 ^{bc}	109.50±0.78 ^{bc}
C2Pt	15.50±0.30 ^{de}	57.50±0.11 ^b	73.00±0.11 ^{ef}	103.75±0.12 ^{bc}	103.75±0.63 ^{cd}
C2Gs	11.75±0.76 ^{ghi}	50.00±0.12 ^{de}	66.75±0.11 ^f	90.00±0.30 ^{def}	90.00±0.00 ^{ef}
C2Bp	12.50±0.63 ^{efghi}	52.25±0.12 ^{cd}	67.00±0.11 ^f	81.75±0.13 ^{fgh}	81.75±0.00 ^g
C2C	12.25±0.21 ^{fghi}	42.50±0.26 ^{fg}	52.50±0.11 ^h	55.25±0.55 ^{jk}	55.25±0.00 ^{kl}
C3Pd	36.00±0.18 ^a	67.50±0.19 ^a	72.00±0.12 ^f	81.00±0.11 ^{fgh}	97.25±0.00 ^{de}
C3Pt	16.50±0.32 ^d	53.75±0.38 ^{bcd}	65.50±0.34 ^{fg}	75.25±0.11 ^h	81.25±0.47 ^g
C3Gs	10.25±0.31 ⁱ	45.50±0.93 ^{ef}	57.75±0.76 ^{gh}	64.00±0.11 ^{ij}	71.75±0.73 ⁱ
C3Bp	14.00±0.29 ^{efgh}	42.75±0.27 ^{fg}	55.50±0.12 ^h	63.25±0.74 ^{ij}	65.50±0.11 ^{ij}
C3C	14.50±0.54 ^{defg}	38.50±0.49 ^{gh}	43.75±0.92 ⁱ	47.75±0.12 ^k	49.50±0.00 ^l
C4Pd	35.00±0.00 ^a	36.75±0.18 ^{hi}	90.25±0.15 ^c	107.25±0.45 ^b	112.00±0.36 ^b
C4Pt	15.25±0.00 ^{def}	33.00±0.29 ^{ij}	81.75±0.12 ^d	92.00±0.48 ^{de}	94.25±0.11 ^{ef}
C4Gs	11.00±0.00 ^{hi}	31.50±0.34 ^j	69.50±0.22 ^f	87.25±0.54 ^{efg}	87.25±0.00 ^{fg}
C4Bp	12.75±0.00 ^{efghi}	29.00±0.32 ^j	68.25±0.42 ^f	80.00±0.12 ^{gh}	80.00±0.57 ^{gh}
C4C	14.25±0.00 ^{defg}	31.25±0.20 ^j	38.75±0.12 ⁱ	49.25±0.60 ^k	58.00±0.00 ^{jk}

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan Multiple Range Test (DMRT): C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum* C: Control Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; V & T: Variety and Treatment

Effect of soil amendments on mean number of leaves of cucumber grown in the field

The results from Table 6 indicate that effects of different amendments were significantly different ($p < 0.05$) on the number of leaves of cucumber. Amongst all the treatments, powdered poultry manure at 50 g/plant was found to be the most effective, resulting in 36.00 leaves per plant, while the untreated control recorded the lowest number of leaves. There was no significant difference ($p > 0.05$) between plants treated with poultry manure tea, *Gliricidia sepium* and *Bryophyllum pinnatum*. Generally, treated plants had a higher number of leaves than their control counterpart.

Effect of soil amendments on fresh root weight, fresh shoot weight, number of fruits and weight of fruits of cucumber grown in the field

Table 7 presents the fresh roots weight of cucumbers plants. Powdered poultry manure and poultry manure tea resulted in significantly lowest fresh root weight. The highest root weight was recorded in untreated cucumber plants. There was no significant difference in root weight between cucumbers treated with *Gliricidia sepium* and *Bryophyllum pinnatum*.

Effect of soil amendments on fresh shoot weight of cucumber grown in the field

Regarding the fresh shoot weight (Table 7) of cucumber plants, significant differences were observed between treated and untreated cucumber plants. Powdered poultry manure and poultry manure tea resulted in significantly higher fresh shoot weights. Plants treated with *Gliricidia sepium* and *Bryophyllum pinnatum* did not show a significant difference ($p > 0.05$) in terms of fresh shoot weight. However,

Table 6. Effect of soil amendments on number of leaves of cucumber grown in the field

V & T	Week 2	Week 4	Week 6	Week 8	Week 10
C1Pd	8.00±0.54 ^a	10.50±0.72 ^{bc}	13.50±0.12 ^{bc}	27.50±0.18 ^a	36.00±0.52 ^a
C1Pt	6.50±0.43 ^{bc}	9.25±0.74 ^{cdef}	11.50±0.53 ^{def}	22.50±0.48 ^b	28.00±0.56 ^{bc}
C1Gs	6.50±0.21 ^{bc}	9.75±0.46 ^{cde}	11.00±0.82 ^{efgh}	21.00±0.32 ^{bc}	25.75±0.17 ^{cde}
C1Bp	7.00±0.45 ^{ab}	8.75±0.13 ^{efg}	11.25±0.64 ^{efg}	17.50±0.01 ^d	23.25±0.73 ^{efg}
C1C	6.50±0.17 ^{bc}	7.00±0.20 ⁱ	9.50±0.03 ^{hi}	12.25±0.10 ^{ghi}	13.50±0.63 ^{kl}
C2Pd	6.00±0.34 ^{bcd}	14.75±0.03 ^a	19.50±0.05 ^a	21.50±0.11 ^b	27.00±0.34 ^{bcd}
C2Pt	6.50±0.56 ^{bc}	9.25±0.48 ^{cdef}	12.00±0.42 ^{cde}	16.50±0.47 ^{de}	24.00±0.28 ^{ef}
C2Gs	5.00±0.64 ^d	9.00±0.09 ^{defg}	11.00±0.30 ^{efgh}	13.50±0.22 ^{fghi}	24.50±0.65 ^{def}
C2Bp	6.50±0.18 ^{bc}	10.25±0.34 ^{cd}	12.00±0.73 ^{cde}	14.50±0.46 ^{efg}	17.00±0.73 ^{ij}
C2C	6.50±0.71 ^{bc}	8.50±0.03 ^{efgh}	10.50±0.53 ^{efghi}	12.25±0.92 ^{ghi}	13.00±0.40 ^{kl}
C3Pd	6.00±0.65 ^{bcd}	11.75±0.00 ^b	14.50±0.45 ^b	22.00±0.27 ^b	29.25±0.20 ^b
C3Pt	5.00±0.45 ^d	7.00±0.00 ⁱ	9.00±0.67 ⁱ	16.00±0.50 ^{def}	22.00±0.21 ^{fg}
C3Gs	5.00±0.56 ^d	7.75±0.00 ^{ghi}	10.00±0.24 ^{fghi}	14.50±0.55 ^{efg}	19.00±0.55 ^{hi}
C3Bp	5.00±0.65 ^d	7.25±0.00 ^{hi}	9.75±0.82 ^{ghi}	11.00±0.69 ⁱ	12.75±0.52 ^{kl}
C3C	6.50±0.36 ^{bc}	8.00±0.00 ^{ghi}	10.50±0.63 ^{efghi}	11.25±0.41 ^{hi}	12.00±0.83 ^l
C4Pd	6.50±0.35 ^{bc}	10.50±0.00 ^{bc}	13.00±0.92 ^{bcd}	18.50±0.73 ^{cd}	23.50±0.17 ^{efg}
C4Pt	6.00±0.18 ^{bcd}	9.50±0.10 ^{cde}	11.00±0.56 ^{efgh}	16.00±0.19 ^{def}	21.00±0.10 ^{gh}
C4Gs	6.00±0.83 ^{bcd}	9.25±0.10 ^{cdef}	11.75±0.49 ^{de}	14.00±0.60 ^{efgh}	18.00±0.01 ⁱ
C4Bp	5.50±0.53 ^{cd}	9.25±0.10 ^{cdef}	11.25±0.31 ^{efg}	13.00±0.43 ^{ghi}	14.75±0.34 ^{jk}
C4C	6.50±0.40 ^{bc}	8.50±0.00 ^{efgh}	9.50±0.01 ^{hi}	11.50±0.64 ^{hi}	12.50±0.82 ^{kl}

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan Multiple Range Test (DMRT): C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum* C: Control Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; V & T: Variety and Treatment

untreated control plants recorded the lowest weight of fresh shoot weight.

Effect of soil amendments on fruit numbers of cucumber grown in the field

Table 7 reveals the number of fruits produced by cucumber plants. A significantly higher number of fruits were recorded in cucumber plants treated with powdered poultry manure, followed by those treated with poultry manure tea. There was no significant difference ($p > 0.05$) between the number of fruits in cucumber plants treated with *Gliricidia sepium* and *Bryophyllum pinnatum*. However, all the treated cucumber plants recorded a higher number of fruits than the untreated cucumber.

Effect of soil amendments on fruit weight of cucumber plants grown in field

Weight of cucumber fruits shows in Table 7, reveals that all treated cucumber recorded significant increase in weight of fruits than the untreated. Powdered poultry manure cucumber gave the highest weight of cucumber fruits, lowest weight was recorded in the untreated cucumber fruits. There was no significant difference ($p > 0.05$) between fruits weight of cucumber treated with *Gliricidia sepium* and *Bryophyllum pinnatum*.

Effect of soil amendments on number of healthy fruits of cucumber grown in the field

The number of healthy fruits observed from the field experiment is presented in Table 7. The highest numbers of healthy fruits was recorded in cucumbers treated with powdered poultry manure followed by those treated with poultry manure tea. The least number of healthy fruits was recorded in untreated

Table 7. Effect of soil amendments on fresh root weight, fresh shoot weight, number of fruits and fruit weight of cucumber in the field

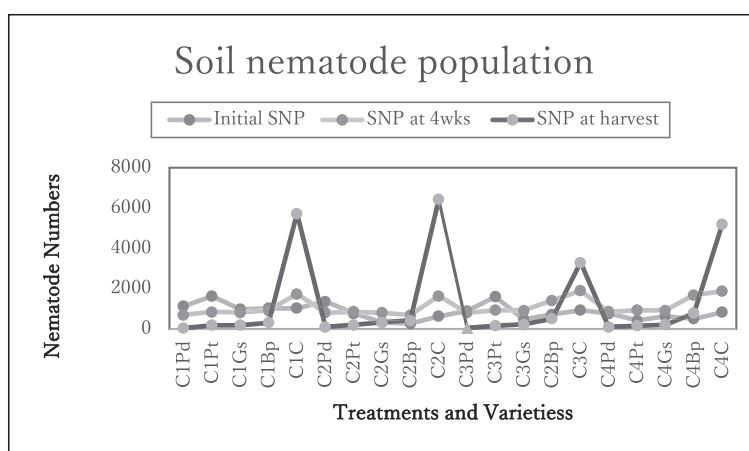
V & T	Fresh root weight (g)	Fresh shoot weigh (g)	Number of fruit	Weight of fruit (g)
C1Pd	0.45±0.01 ^{efg}	1.25±0.10 ^{ab}	24.50±0.30 ^a	1.75±0.02 ^a
C1Pt	0.57±0.00 ^{cd}	1.25±0.35 ^{ab}	22.00±0.02 ^b	1.55±0.20 ^b
C1Gs	0.67±0.03 ^{bc}	1.25±0.90 ^{cde}	18.50±0.20 ^{cd}	0.75±0.10 ^d
C1Bp	0.70±0.56 ^b	0.90±0.63 ^{def}	15.00±0.90 ^{ef}	0.57±0.01 ^f
C1C	0.92±0.05 ^a	0.50±0.65 ^h	10.75±0.03 ^{hi}	0.32±0.00 ^{ijk}
C2Pd	0.40±0.23 ^{fg}	1.27±0.38 ^a	17.00±0.51 ^d	0.90±0.04 ^c
C2Pt	0.42±0.32 ^{efg}	1.15±0.71 ^{abc}	16.75±0.61 ^{de}	0.62±0.52 ^{ef}
C2Gs	0.52±0.65 ^{de}	1.75±0.72 ^{bcd}	12.50±0.38 ^{gh}	0.57±0.53 ^f
C2Bp	0.70±0.25 ^b	1.00±0.00 ^{cde}	11.00±0.20 ^{hi}	0.57±0.51 ^f
C2C	0.87±0.03 ^a	0.65±0.00 ^{gh}	7.50±0.00 ⁱ	0.30±0.20 ^{jk}
C3Pd	0.37±0.15 ^g	1.75±0.00 ^{abc}	19.00±0.00 ^c	0.90±0.00 ^c
C3Pt	0.45±0.90 ^{efg}	1.00±0.82 ^{cde}	14.00±0.00 ^{fg}	0.60±0.01 ^{ef}
C3Gs	0.52±0.42 ^{de}	1.00±0.57 ^{cde}	12.50±0.00 ^{gh}	0.52±0.53 ^{fg}
C3Bp	0.52±0.02 ^{de}	1.00±0.00 ^{cde}	10.25±0.00 ^{ij}	0.42±0.16 ^{ghi}
C3C	0.82±0.18 ^a	0.52±0.00 ^h	9.75±0.00 ^{ijk}	0.25±0.18 ^k
C4Pd	0.42±0.61 ^{efg}	0.92±0.00 ^{def}	11.00±0.00 ^{hi}	0.70±0.45 ^{de}
C4Pt	0.50±0.07 ^{def}	0.87±0.25 ^{ef}	10.00±0.4 ^{ij}	0.45±0.26 ^{gh}
C4Gs	0.60±0.10 ^{bcd}	0.85±0.56 ^{ef}	8.75±0.05 ^{kl}	0.37±0.18 ^{hij}
C4Bp	0.67±0.01 ^{bc}	0.75±0.26 ^{fg}	8.00±0.02 ^{kl}	0.42±0.01 ^{ghi}
C4C	0.87±0.02 ^a	0.65±0.82 ^{gh}	5.25±0.00 ^m	0.25±0.75 ^k

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$

cucumbers. Meanwhile, there was no significant difference between the number of healthy fruits in cucumber treated with *Gliricidia sepium* and *Bryophyllum pinnatum*.

Effect of soil amendment on mean soil nematode population of cucumber in field experiment

The soil nematode population is illustrated in Fig. 3, revealing significant differences between the

**Fig. 3.** Effect of treatments on soil nematode population

SNP: Soil Nematode Population; C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum*; Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*

initial soil nematode population, the soil nematode population one month after planting and soil nematode population at harvest. A significant reduction in the soil nematode population was recorded in the soil treated one month after planting, with the lowest number of soil nematodes recorded at harvest. Reduced numbers of soil nematode were observed four weeks after planting in cucumber plants treated with powdered poultry manure and poultry manure tea.

However, the highest number of soil nematode was recorded in untreated plants (control). The soil nematode population at harvest was shown in the Fig. 3; at harvest, the highest population of soil nematodes was observed in an untreated cucumber plants. Generally, there was a significant reduction in the soil nematode population in treated cucumber plants. Fig. 3 presents the soil nematode population below.

Effect of soil amendments on root-knot nematode egg population, juvenile population and root ratings on cucumber in field experiment

Effect of soil amendment on mean number of nematode eggs: The root-knot nematode population of eggs extracted from 10 g of cucumber roots is shown in Table 8 revealing the number of nematode eggs, the lowest number of root-knot nematode eggs was observed in soil treated with powdered poultry manure, followed by soil treated with poultry manure tea. Soil treated with *Gliricidia sepium* and *Bryophyllum pinnatum* showed a significant reduction in the number of root-knot nematode eggs when compared to untreated soil. The control soil of cucumber plants recorded the highest number of root-knot nematode eggs.

Effect of soil amendments on root-knot nematode juvenile population

The effect of soil amendments on the mean number of root-knot nematode juveniles is also shown in Table 8. The nematode juveniles population was significantly reduced ($p > 0.05$) in treated soil compared to untreated soil. The highest numbers of nematode juveniles were recorded under the root of control cucumber plants. A significant reduction in the number of nematode juveniles was observed in plants treated with powdered poultry manure and poultry manure tea.

Effect of soil amendments on root-knot nematode gall index: The highest gall index was observed in the untreated soil cucumber plants (Table 8). The least gall index was recorded in cucumbers treated with powdered poultry manure, followed by poultry manure tea. However, there were significant differences between gall ratings of all the treated plants. There was no significant difference between soil amended with *Gliricidia sepium* and *Bryophyllum pinnatum* with respect to the root galling rates of cucumber.

Discussion

At both the screen house and field, treated plants generally exhibited significantly higher performance than their untreated counterparts. Poultry manures and carbofuran significantly increased plant growth, yield and decreased the number of root-knot nematodes compared to other treatments. This aligns with the findings of Daramola *et al.* (2013) who reported the efficacy of poultry manure in mitigating the impact of plant-parasitic nematode population on pineapple, resulting in increased yield.

Table 8. Effect of soil amendments on root-knot nematode egg population, juvenile population and root gall ratings on cucumber in field experiment

V & T	Root-knot nematode egg population	Root-knot nematode population juveniles	Gall rating
C1Pd	10.67±0.02 ^a	60.00±0.03 ^{ab}	0.00±0.00 ^a
C1Pt	160.00±0.50 ^{ab}	140.00±0.30 ^{cd}	0.01±0.01 ^a
C1Gs	240.00±0.00 ^c	240.00±0.50 ^d	0.70±0.10 ^c
C1Bp	280.00±0.40 ^{cd}	326.67±0.10 ^e	1.20±0.49 ^{ab}
C1C	1333.33±0.52 ^f	1443.33±0.55 ^e	5.60±0.23 ^g
C2Pd	80.00±0.90 ^{ab}	80.00±0.00 ^b	0.02±0.03 ^a
C2Pt	200.00±0.65 ^b	146.67±0.02 ^{cd}	0.10±0.89 ^{ab}
C2Gs	306.67±0.12 ^d	235.33±0.70 ^d	0.70±0.62 ^c
C2Bp	313.33±0.40 ^d	276.67±0.54 ^d	1.00±0.10 ^d
C2C	1888.67±1.65 ^h	1315.33±1.50 ^f	6.00±0.03 ^h
C3Pd	9.20±0.10 ^a	20.98±0.20 ^a	0.01±0.03 ^a
C3Pt	120.00±0.35 ^{ab}	101.33±0.20 ^c	0.02±0.00 ^a
C3Gs	246.60±0.00 ^{bc}	208.67±0.34 ^d	0.30±0.28 ^b
C3Bp	266.67±0.22 ^c	195.33±0.70 ^{cd}	0.70±0.05 ^c
C3C	1120.00±1.50 ^e	1166.67±1.35 ^e	2.70±0.01 ^e
C4Pd	100.00±0.05 ^{ab}	106.67±0.90 ^{cd}	0.04±0.10 ^a
C4Pt	160.00±0.32 ^b	149.33±0.45 ^{cd}	0.20±0.00 ^{ab}
C4Gs	160.00±0.40 ^b	133.33±0.01 ^{cd}	0.30±0.20 ^b
C4Bp	280.00±0.03 ^{bc}	280.00±0.50 ^d	1.00±0.10 ^d
C4C	1780.67±0.75 ^g	1253.33±0.00 ^{ef}	3.73±0.01 ^f

Values in the same column followed by the same letter superscript (s) have no significant differences at $p < 0.05$ according to Duncan's Multiple Range Test (DMRT); C1: Marketer; C2: Market More; C3: Poinsett; C4: Murano; Bp: *Bryophyllum pinnatum* C: Control Pd: Powdered Poultry Manure; Pt: Poultry Manure Tea; Gs: *Gliricidia sepium*; V & T: Variety and Treatment

Similarly, Kankam *et al.* (2014) utilized poultry manure to promote growth, yield and reduced both galling and nematode population on carrots infected with root-knot nematodes.

The higher efficacy of poultry manure may be attributed to its higher concentration of nutrients, such as nitrogen, which stimulates the growth and development of the plants, while simultaneously a significant reducing soil nematodes populations and gall formation. In this work, Jimini *et al.* (2013) reported a significant increase in watermelon yield using poultry droppings as a soil amendment. According to Olatunji *et al.* (2006), the application of organic manure has been found to have a higher comparative economic advantage over the use of inorganic fertilizer. Adeniyi and Ojeniyi (2005) also noted that animal manure contains most of the essential nutrients required by plants including 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 cucumber growth and the suppression of nematode population have been attributed to its nitrogen contents and notably to the release of ammoniacal nitrogen from the soil amendments. When comparing the effect of poultry manure tea and powdered poultry manure, it was observed that powdered poultry manure suppressed both soil and root nematode populations and the increased the growth and yield of the plant. The stronger effects of powdered poultry manure over poultry manure tea may be due to nutrients loss during handling practices. The observation is consistent with the finding of Mohammed *et al.* (2010), who reported that poultry manure loses nitrogen during handling practices. Additionally, powdered poultry manure has a loose and concentrated weight

improving soil structure, water infiltration and soil moisture holding capacity. Furthermore, the effect of poultry manure in this study may be attributed to the presence of bacteria and fungi. According to Giannakoa and Proophetia (2004), they reported that the addition of manure or other organic amendments stimulates the activity of the indigenous soil microbial community.

From the experiments, it was deduced that aqueous leaf extracts of *Gliricidia sepium* and *Bryophyllum pinnatum* suppressed root-knot nematodes, supported the growth and yield of cucumber plants. The effects of the organic amendments on growth, yield parameter, and their impact on the reduction of root-knot nematode populations can be attributed to the high toxicity of phytochemical in the extract which was able to suppress the activities of the nematodes.

Regarding varietal response, variety three (Poinsett) was found to have higher performance than other varieties. The synergistic effect of variety three and powdered poultry manure resulted in the robust cucumber vegetative growth and yield in this experiment, as well as suppression of nematode population. The higher yield recorded by cucumber Poinsett could be traced to the genetic makeup of the cucumber variety and its interaction with the environment, possibly leading to higher absorption, resulting in sturdy and healthier plants with a high yield.

The phytochemical screening and Chromatography-Mass Spectrometry (GC-MS) analysis of leaf extracts in this Study revealed the presence of bio- active compounds such as Xanthene, Imidazole, Boron, Disulfide, Metyl ester, Carbene, Benzene, Silane, Oxylic acid and Phenyl ether e.t.c. Notably, Xanthene, Imidazole and Phenyl ether. Xanthene possesses antimicrobial properties, Boron can be used in the preparation of fertilizer, while Benzene and Methyl ester can also be utilized as adjuvant in the preparation of insecticides, herbicides, detergents and fungicides (Agnieszka *et al.*, 2017). The plant extracts also contain metabolites like Hexacadonic acid and phenols that might be responsible for inhibiting nematodes from feeding, migrating, developing of feeding cells, reproducing and causing damage to the plants. Kazuki *et al.* (2019) reported that flavonoids, a large class of secondary metabolites in plant extracts, play important roles in plant-parasitic nematode management by functioning as nematocides, nematostatic compound (which do not kill but inhibit their movement), repellents or inhibitors of egg hatching.

This study supports the work of chin *et al.* (2018) and Adekunle and Akinlua (2007) on the utilization of *Gliricidia sepium* for the control of plant-parasitic nematode on okra plant. Similarly, Adekunle and Fawole (2003) reported that the application of water extracts of neem leaves and siam weed leaves and roots at 20,000 mg/Kg and reduced the population of *M. incognita* on tomato plants. Regarding varietal response, variety three (Poinsett) demonstrated higher performance than other varieties. The synergistic effect of variety three and powdered poultry manure resulted in the robust cucumber vegetative growth and yield in this experiment as well as the suppression of nematode population. The higher number and weight of fruits recorded by cucumber Poinsett could be attributed to the genetic makeup of the cucumber variety and its interaction with the environment, possibly leading higher nutrient absorption, resulting in sturdy and healthier plants with a high yield.

Conclusions and Recommendations

The results of these experiments demonstrated that the treated plants performed significantly higher ($p < 0.05$) than untreated control.

The treatment combination of powdered poultry manure with Poinsett and Marketer varieties of cucumbers exhibited significantly superior performance compared to other treatments combinations in terms of growth, yield and suppression of nematode population.

The secondary metabolites such as Imidazole, Phenols, Hexacadonic acid and others revealed in this study are likely responsible for the anti nematocidal activity of the leaf extracts.

The findings of the present experimental work propose a new alternative for the management of *M. incognita* infecting cucumbers. The infestation caused by *M. incognita* could be reduced through the application of leaf extracts of *Gliricidia sepium*, *Bryophyllum pinnatum*, poultry manure tea and powdered poultry manure at rate of 50 ml, 50 ml, 50 ml and 50 g respectively. These method are ecofriendly and affordable. They have an advantage over expensive and hazardous chemical nematocides which have toxic effect on man, flora and fauna and on the environment as a whole.

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