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EFFECTS OF SOME PLANT EXTRACTS AND POWDER TO CONTROL ROOT KNOT NEMATODEES (*Meloidogyne javanica*) Chitwood on SWEET MELON IN YOLA, NIGERIA

Maijama'a N. A.
Department of Forestry Technology, Federal Polytechnic Mubi, Adamawa State
Corresponding Author: Email Address: Ngwamdaipaul@gmail.com

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ABSTRACT

Field and Laboratory experiment was conducted to determine the effect of some plant materials namely Nicotiana tabacum, Manihot esculentus, Curcucuma longa and Aloe barbadensis extracts, powder and NPK fertilizer rates to control root-knot nematode Melodogyne javanica on sweet melon. Laboratory experiment was conducted in Crop Protection Department, Modibbo Adama University Yola, while the field experiment was conducted in Loko Village of Song Local Government Area of Adamawa State in 2024 cropping season. In the Laboratory the effect of aqueous extracts of N. tabacum, M. esculentus, C. longa and A. barbadensis and a control (distilled water only) on juvenile mortality and egg hatchability of M. javanica was evaluated over a period of twenty four (24) hours for four days. The experiment was laid out in a Complete Randomized Design (CRD). Field experiment was laid out in split-split plot design with three replications. The three factors was three local cultivars of sweet melon assigned to the main plot, NPK Fertilizer rates as the sub plot while plant leaf powder as the sub-sub plot consisting of 135 plots. 50 g each of the plant leaf powder of Nicotiana tabacum, Manihot esculentus, Curcuma longa and Aloe barbadensis was incorporated into each plot with the control having zero application with three levels of fertilizer at three weeks intervals after sowing. Data was analyzed using Analysis of Variance (ANOVA) and means was separated using least significant difference (LSD) at 5 % level of probability. The parameters to be recorded were establishment count, number of leaves, vine length, number of flowers, number of fruits, fruit weight, fresh vine weight, dry vine weight, fresh root weight, dry root weight, root length, gall index, nematode population. It was discover that plant powder and extracts have the potentials to control root- knot nematodes both in laboratory and field, therefore more work should be carried out to ascertain the nematicidal efficacy of N. tabacum at 400 kg ha^{-1} rate before recommendation.

Keywords: Meloidogyne javanica, Juveniles, Petri Dishes, Plant Leaves, Extracts and Powder

INTRODUCTION

Melon (*Cucumis melon* L.) is a monoecious plant belonging to the family *Cucurbitaceae* (Mohmoud, 2019). Melon thought to have originated in Africa in the hot valleys of Southwest Asia, India, China, Turkey and Eastern Persia (Agricultural Guide, 2011. Center for North America Studies, 2021). Melons production is concentrated in Arid and semi-arid regions and is one of the most widely grown vegetable crops throughout the warmer regions of the world. It's mostly cultivated in the northern part of the warmer region of Nigeria according to Aguyoh (2010). Adeyeye, 2017). Sweet melon grows best on well drained upland, sandy loam soils with good irrigation facility, and require honey bees for effective pollination, with pH levels between 6.0 to 6.5 and beds should be 6-8 inches high to facilitate drainage, and the optimum temperature range for germination is between 21 ^{o}C Control 35 ^{o}C. Melons just as mangoes are actually summer season fruits, their season runs from April through August, when they are at their best (Kemble, 2014). The sweet melon market types common in Nigeria are honey dew melon, winter melon, musk melon, Persian melon, rock melon and water melon (Creight *et al.,* 2010. Telford, 2011). Ripe melons are prized for their sweetness and eaten raw as a cooling desert, and a popular finish to the meal (Burger, 2010). Health and fitness side dishes, the fruits is low in calories (100 g fruits have just 34 calories) and fats. Hosny

(2021) stated that the fruits is rich in numerous health promoting poly phenolic plant drive compounds. Vitamins and minerals that are absolute for optimum health. A slice of sweet melon contains large amounts of vitamin A, C and beta-carotene which may help protect against various forms of cancer due to their antioxidant properties reported by Harry (2015). *Meloidogyne* species*.* is recognized as one of the plant parasitic nematodes of importance in sweet melon production in Nigeria (Sukalpa *et al.* 2021). Similar statement was also reported by Gregory, *et al.* (2017) that plant, parasitic nematodes are costly burdens of crop production. Root-knot nematodes (*Meloidogyne* spp.) rank at the top list of the most economically and scientifically important phytoparasitic nematodes, due to their intricate relationship with the host plants, wide host range, and the level of damage ensued by infection. Typical symptoms of root-knot nematode injury include stunting, unthriftiness, premature wilting, malformed fruit ripens slowly or unevenly chlorosis (yellowing), gall formation, and non-uniform growth and reduced stand establishment (Maria *et al.,* 2020). Below ground plant parts form a tight mat of short roots and galls on roots of melon (Paris *et al.,* 2011). The damage caused by root knot nematode on sweet melon was recorded up to 50 % loss in melon according to Creight *et al.* (2010).
Research on nematicidal potential of botanicals and their application is on the increase where different plant parts are being tested to identify the sources of nematicidal substances (Abolusoro, 2014). This encouraged the undertaking of the present investigation on nematotoxic evaluation of plant materials which are available, cheap and environmentally friendly and as well as effective in controlling nematodes.

Root-knot nematodes (*Meloidogyne* spp.) rank at the top list of the most economically and scientifically important phytoparasitic nematodes, due to their intricate relationship with the host plants, wide host range, and the level of damage ensued by infection. Damage caused by root knot nematode on sweet melon infestation increases with the yield loss. (Noling, 2012).
Synthetic nematicides are not affordable by the local farmers, beside its environmental hazards. Research on the potential of botanicals and their application is on the increase. Different plant parts are being tested to identify the sources of nematicidal substances. This encouraged the undertaking of the present investigation on nematotoxic evaluation of the use of plant materials which are available, cheap and environmentally friendly and is effective in controlling nematodes. The main objective of this work, is to evaluate plant extracts and leaf powder of *Nicotiana tabacum, Manihot esculentum, Curcuma longa* and *Aloe barbadensis* in the control of root knot nematode *Meloidogyne. javanica* on sweet melon.

MATERIALS AND METHODS

Laboratory Experiment

The laboratory experiment was conducted in the Department of Crop Protection Laboratory of the Modibbo Adama University, Yola in July, 2024. The Laboratory experiment was conducted to determine the effect of aqueous extracts of the leaves of tobacco (*Nicotiana tabacum),* cassava (*Manihot esculentus),* turmeric *(Curcuma longa)* and aloe vera (*A. barbadensis)* on root-knot nematode *Meloidogyne javanica* with distilled water serving as the control. The experimental design for laboratory experiment was Complete Randomize Design (CRD) with twenty (20) treatments replicated three times.

Source of plant materials

The selected plants used for the experiments was obtained in Adamawa State University Campus in Mubi North Local Government Area of Adamawa State. Adamawa State University Mubi is located at Latitude 10^{o}. 28′ 1245′N and Longitude of 13.281245″E at elevation of 1906 feet above sea level according to (www.adsu. edu.ng.).

Preparation of the Plant Powder
The leaves for the experiments *N. tabacum, M. esculentus, C. longa* and A*. barbadensis* was plucked, washed and spread to air dry for two weeks under room temperature of 27^0C after which it was properly ground into powder using pestle and mortar before sieving to obtain fine powder and labeled in a polythene bag for the laboratory and field experiments.

Preparation of the plant extract
Water soluble extracts of the plant materials; *Nicotiana tabacum, Manihot esculentus, Curcuma longa* and A*loe barbadensis* leaves was prepared using method described by Adegbite and Adesiyan, (2005). Fifty gram (50 g) each of the plant powder was weighed separately and poured into a 500 ml conical flask with 200 ml distilled water added. The set up was allowed to stand for 48 hours before it was centrifuged at 500 rpm and filtered through what man No. 42 filter paper. The extracts was then concentrated using a rotary evaporator in a water bath set at 40 °C which constituted the undiluted (100%) Crude extract designated as C1. Serial dilution of the crude extract was carried out with 10 ml, 20 ml and 30 ml with distilled water to obtain C2, C3, and C4 respectively. Distilled water alone was served as control C5.

C1 = 100% crude extract
C2 = 100% crude + l0 ml distilled water
C3 = 100% crude + 20 ml distilled water
C4 = 100% crude + 30 ml distilled water
C5 = control (only distilled water)

Inoculum source and extraction of *Meloidogyne javanica* juveniles
The inoculum for these experiments was second stage juvenile (J_2) of *M. javanica* extracted from pure culture of infested tomato roots. The extraction of juveniles was done using the modified Baerman method (Whitehead and Hemming, 1965). This involve the use of shallow trays with sieve lined with tissue paper and macerated roots of tomato placed on it, water was then poured in from the side of the tray to a level just submerging the materials on the sieve. This set up was left to stand for 24 hours and the nematode juvenile was collected by decanting into a beaker. This process was carried out by slightly tilting the immiscible mixture and slowly pouring out the top layer. After pouring the top layer, the mixture was then tilted to complete the process. Aliquots of 10 ml in syringes was taken and counted under a stereoscopic microscope using a grid counting dish and average of 1000 juveniles was used for the juvenile mortality test in the laboratory and inoculation of plants for field experiments.

Extraction of egg masses for hatchability test
The eggs of *M. javanica* was extracted from pure culture of infected tomato plant roots using Hussey and Baker (1973) method. For the preparation of nematode egg suspension at a concentration of 100 eggs/ml. Nematode eggs was extracted from galled tomato roots and washed with pure water and cut into pieces with a pair of scissors and placed in a beaker containing 0.05 % NaOCl (Sodium hypochloride) and agitated for three minutes. The resultant sodium hypochloride root suspensions was passed through 200 mesh sieve place over 500 mesh sieve. Eggs was collected and rinsed with tap water and sieves to remove the sodium hypochloride. The root segments was further rinsed with tap water to remove additional eggs adhering to it. The eggs suspension was then wash into beaker. Three 10 ml aliquots was taken from the nematode suspension and then counted under stereoscopic microscope using a grid counting dish and the average of 1000 nematode eggs was obtained to used for egg hatchability test.

Effect of the aqueous extract on egg hatchability

The effect of the plant extracts *Nicotiana tabacum, Manihot esculent, Curcuma longa* and *Aloe barbadensis* on hatchability of eggs of *M. javanica*. Nematode eggs suspension at a concentration of 1000 eggs/ml was introduced into each of sixty (60) petri dishes followed by addition of 10 ml, 20 ml and 30 ml of the plant extracts including 100% crude extracts, unto the petri dishes where as distilled water alone was served as the control. The set up was left for four days after which the number of eggs hatched in each treatment was counted and recorded over a period of 24 hours. There was five treatments including control with four concentrations making up to twenty treatments replicated three times, the set up was arranged in a completely randomized design (CRD) in the laboratory.

Effect of the aqueous extract on juvenile mortality test

Using 10 ml syringe, aliquots of 10 ml each of the water soluble extracts of *Nicotiana tabacum, Manihot esculent, Curcuma longa* and *Aloe barbadensis* with serial dilution of crudes, 10 ml, 20 ml, 30 ml and distilled water was serve as control. Extracts was dispensed into 60 petri dishes each containing 1000 second stage juveniles of *M. javanica*. Dead nematodes was counted every 24 hours for four days. Identification of dead nematodes was done by touching them with a needle to see if they exhibit mobility. There were five treatments including control with four concentrations making up to twenty treatments replicated three times, the set up was arranged in a Completely Randomized Design (CRD) in the laboratory.

Field Experiment

The experiment will be carried out at irrigation site of Loko village in Song Local Government Area of Adamawa State between July and December, 2024 cropping season. The experiments will consist of fifteen (15) treatments including control laid out in a split–split plot design. Three local cultivars of sweet melon (Jimeta local cultivar, Loko local cultivar and Jos local cultivar) will be used as the main plot, Plant powder of *Nicotiana tabacum, Manihot esculentus, Curcuma longa and Aloe barbadensis* will be used as the subplot while NPK fertilizer will be assign as the sub- sub plot. The experimental plots will be measured 5 x 4 m (20 m^2) for subplots, making total of 45 plots per replication and a total of 135 plots for the whole three replications with spacing of 0.5 m between each plot and spacing of 1 m between each replicates. Soil samples were obtained randomly by digging with soil auger 0-30 cm depth from the experimental fields to collect samples for physical and chemical analysis to determine its various nutrients present in soil before planting. Seeds Lsmx-Jos were purchased in Jos market in Plateau State and the other two, Lsmx-Jemita and Lsmx-Loko was purchased in Jimeta vegetable market Adamawa State. Each fifty gram (50 g) of treatment plant materials powder was thoroughly mixed into the plots measuring 5m x 4m randomly as *Nicotiana tabacum*, *Manihot esculentus, Curcuma longa, Aloe barbadensis* with the untreated plot (control) respectively. This was done in a split-split plot design to allow proper decomposition of the plant powder into the soil two weeks prior to planting. Planting of sweet melon seeds LSMx-Jos, LSMx-Jimeta and LSMx-Loko was carried out in July 2024 and was repeated in 2025 in the field by planting 4 seeds per hole. The seeds was sown at the depth of 2 cm at row spacing of 1.3 x1.3 m apart. Later thin to two (2) plants per stand.

Inoculation of field plants with *Meloidogyne javanica* (second stage) juveniles.

The extracted second stage juveniles (J_2) of *Meloidogyne javanica* was used to inoculate all plants including control in the field with approximately 1000 juveniles of *M. javanica* contained in 10 ml suspension for both cropping seasons. The suspension was applied at the base of each sweet melon plants two weeks after emergence using 10 ml syringe, this inoculation was done by removing the top soil around the roots of the plant and emptying the contain of syringe and cover the soil back after inoculation.

Agronomic practices

Weeding was done at interval of four and eight weeks after sowing .Fertilizer N. P.K (15: 15: 15) was applied at the rate of (0 kg ha^{-1}, 200 kg ha^{-1} and 400 kg ha^{-1}) twice at three and six weeks after sowing. The crops were sprayed three times with lamda cyahalothrin (karate) insecticide and benomyl (benlate) fungicide at the rates of two litres and 1.5 kg ha-1 respectively at four, six and eight weeks after sowing to contain with the highly destructive melon fly (*Bactrocera cucurbitae Conquillent).* Crops was irrigated twice a week towards the maturity stage when rainfall begins to cease.

Data Collection

Data was collected on three sampled crops in each plot at the experimental field in both years: number of leaves per plant, vine length per plant, number of flowers per plant, number of fruits per plant, fruit weight per plant, cumulative fruit weight per plant, fresh vine weight per plant, dry vine weight per plant, fresh root weight per plant, dry root weight per plant, root length per plant, gall index per plant, and final nematode population in 30 g of soil after harvest. All data collected was subjected to the analysis of variance (ANOVA) and the means was separated with least significant difference (LSD) at 5 % level of probability.

RESULTS AND DISCUSSION

Physical and Chemical Characteristics of Loko experimental Site Soil

Loko experimental site soil textural classes showed to be sandy, clay loam with pH of (6.81) and shows to be slightly acidic to neutral. The soil at the experimental site were generally characterized by high available Nitrogen, Potassium, Phosphorus, Organic compound which is an indication of high nutrient content. The high performance in yield of sweet melon could be attributed to more nutrient content of the soil despite the activities of nematodes on the roots of sweet melon. Based on the results obtained on physical and chemical properties of Loko soil at the experimental site revealed to be fertile.

Effects of phytochemical analysis of the plant materials used for the experiments

The phytochemical contents of the whole leaf extracts revealed to contain. Saponins, Terponoids, Flavonoids, Alkanoids, Tannins, Phenols and Steriods at varying levels of concentrations. While Tannins, Steroids and Phenols shows to be present in any two of the leaf extracts at different levels and absent in either two of the leaf extracts recorded respectively. So far, Phenol recorded the highest phytochemical value of 20.01% in *N. tabacum* and 14.86% was recorded in *A. barbadensis,* followed by Alkanoids which also recorded higher value of 19.53 % in *A. barbadensis* and 12.04% in *N. tabacum.* Terponoids had the lowest amount of the phytochemical content of 1.03% and 1.14% recorded in *N. tabacum* and *M. esculentus*.

Sanaa *et al.* (2018) found out that leaf and root extracts of four selected medicinal plants (*Azadirachta indica, Moringa oleifera, Lantana camara,* and *Glycyrrhiza labra*) were effective against root-knot nematode, *Meloidogyne* spp. Stated that there was a gradual decrease in egg hatching with increasing extract concentration and the duration of exposure. As the most effective, the crude extract of *A. indica* was analyzed by using GC/MS for the effective ingredients and found that alkaloids, flavonoids sponin, amides, benzamide and ketones and others, showed effectiveness in preventing egg hatching of the root-knot nematodes, *Meliodogyne incognita.*

	Presence of Phytochemicals				Quantity of Phytochemicals			
	Nicotiana tabacum	*Manihot esculentus*	*Curcuma Longa*	*Aloe barbadensis*	*Nicotiana tabacum*	*Manihot esculentus*	*Curcuma Longa*	*Aloe barbadensis*
Saponins	+	+	+	+	3.79	8.14	6.80	6.31
Tanins	+	+	-	-	11.63	9.51	0.00	0.00
Terponoids	+	+	+	+	1.03	1.14	4.52	3.77
Flavonoids	+	+	+	+	13.06	17.11	10.27	13.82
Alkanoids	+	+	+	+	12.04	7.60	9.48	19.53
Steroids	-	+	-	+	0.00	2.21	0.00	5.88
Phenols	+	-	-	+	20.01	0.00	0.00	14.86

Table 3: Results of Presence and Quantity of Phytochemicals in the Plant Materials Used

Key:
+ =Present
- = Absent

Effects of Plant Extracts on Nematodes Egg Hatchability

The crude extract of *Nicotiana tabacum* on egg hatchability showed that the highest percentage of egg inhibition after 96 hours of exposure recorded 0.00 %. The diluted extracts also recorded higher percentage egg inhibition compared to other plant extracts and control. As the crude extracts concentration decreases toxicity result in the corresponding decreased in egg inhibition. Egg hatched was significantly highest in lower concentrations. This could be as a result of the nematicidal contents present in the plant extracts which acted as ovicidal by killing the egg masses of *M. javanica*, stopped it from molting into second stage juveniles. This study agrees with the report of Aminu Taiwo (2014) and Liman (2010) who earlier reported that extracts contained flavonoids, saponins, amides, alkaloids, limonete, glycocides singly or in combination inhibited egg hatch of nematode. The inhibitory effects observed in this study on egg hatching could be due to the possession of ovicidal and lavicidal properties present in the plant extracts. Liu *et al.* (2013) also earlier reported in their findings that the result of the in-vitro studies of plant extracts on egg hatch and juvenile mortality of the root knot nematode, *M. incognita* showed the nematostatic and nematotoxic effects of the tested plant extracts, by 24 hours and 48 hours more than 50% and 75% of the juveniles respectively had died in most of the treatments. This might be due to the present of Alkanoids, flavonoids, phenol present in the plant materials. Faruk (2014) also reported after evaluation of four plant methanol extracts on egg hatch inhibition stated that all plant extracts recorded inhibition in the nematode egg hatching as compared to the control and distilled water. Although the highest concentration at level 12% (v/v) of the extracts of *M. azedarach (*97%*)* and *S. nigra* (92.9%) caused the highest egg hatching inhibitions. *H. lupulus* showed the highest egg hatching inhibition at 2.5% (v/v) as 76.3% over control.

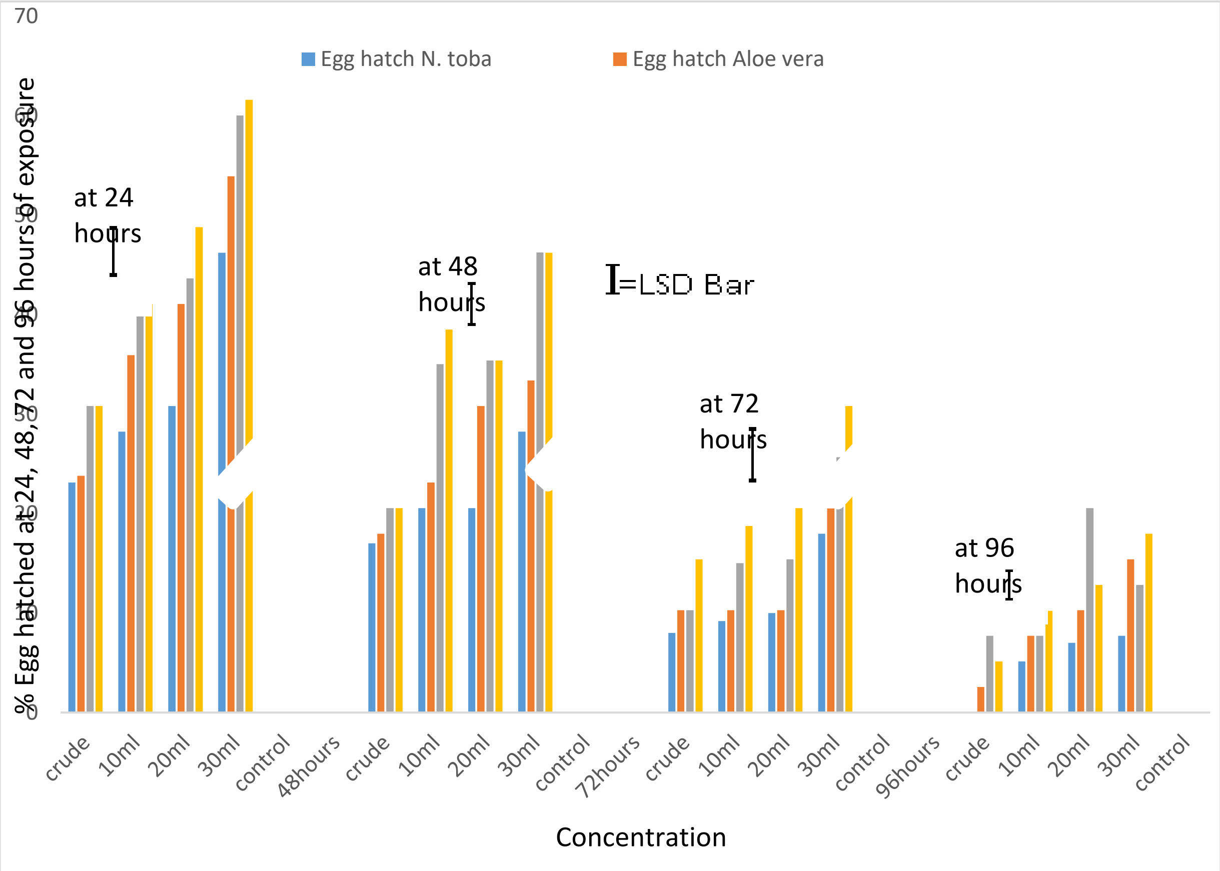

Figure 6: Effects of plant materials on *Meloidogyne javanica* egg hatchability test in the Laboratory
Key:
Nicotiana tabacum
Aloe barbadensis
Curcuma longa
Manihot esculentus

Effects of Plant Extracts on Juvenile Mortality
Many plants are known to have nematicidal compound which may be utilized as botanical extracts. Many researches have been carried out on the plant extracts for the management of root-knot nematodes. In this study the effects of crude extracts of *Nicotiana tabacum, Manihot esculentus, Curcuma longa* and *Aloe barbadensis* plants concentration and different time of exposure on juvenile mortality of *M. javanica* shows significant difference. The crude extract of *N. tabacum* recorded highest juvenile mortality with 64.4% after 96 hours of exposure, even the diluted extracts recorded higher juvenile mortality compared to control that recorded 0.00% juvenile mortality, followed by *A. barbadensis* which also recorded values of 64.2% after 96 hours of exposure as that of *N. tabacum* and the lowest 0.00% was recorded in the control. These nematicidal effects of the leaf extracts on mortality of juveniles of *M. javanica* could be due to the presence of phytochemical content of alkaloids, Phenol and flavonoid present in the plant materials which enable it to cause juvenile mortality of *M. javanica*. Mashela (2012) and Maina (2012a) also confirmed in their, report that *N.tabacum* leaf extracts inhibit egg hatching and causes juvenile mortality, and significantly reduced population of *M. javanica* on tomato, where 100 % concentration of the extracts gave 100 % egg hatch inhibition. He further reported that extracts of *N. tabacum* contained Alkaloids, which has nematicidal property. Several Authors have reported the potential of using plant materials in

controlling root-knot nematodes and other parasitic nematodes. (Micheal *et al* 2010, Umar 2012, Noling 2012, Umar and Ngwamdai 2014 and Hosny 2021). Jada (2015) validated this finding when he reported that *M. javanica* mortality in bark extract of *Deutarium* Specie was recorded in both water and enthanol extracts. Nematode juvenile mortality is strongly influenced by extracts concentrations with duration of exposure. Aanany, *et al.* (2017b) also confirmed in his finding after evaluation of five fresh leave extracts reported that aqueous extracts of tested plant leaves showed nematicidal effect against *M. javanica*. In this study, root-knot nematode mortality of juveniles increased with increase in exposure of time and showed efficacy in the control of root-knot nematode, *M. javanica*. Results revealed that egg hatchability inhibition decreased with decreased concentration with an increase in time of exposure.

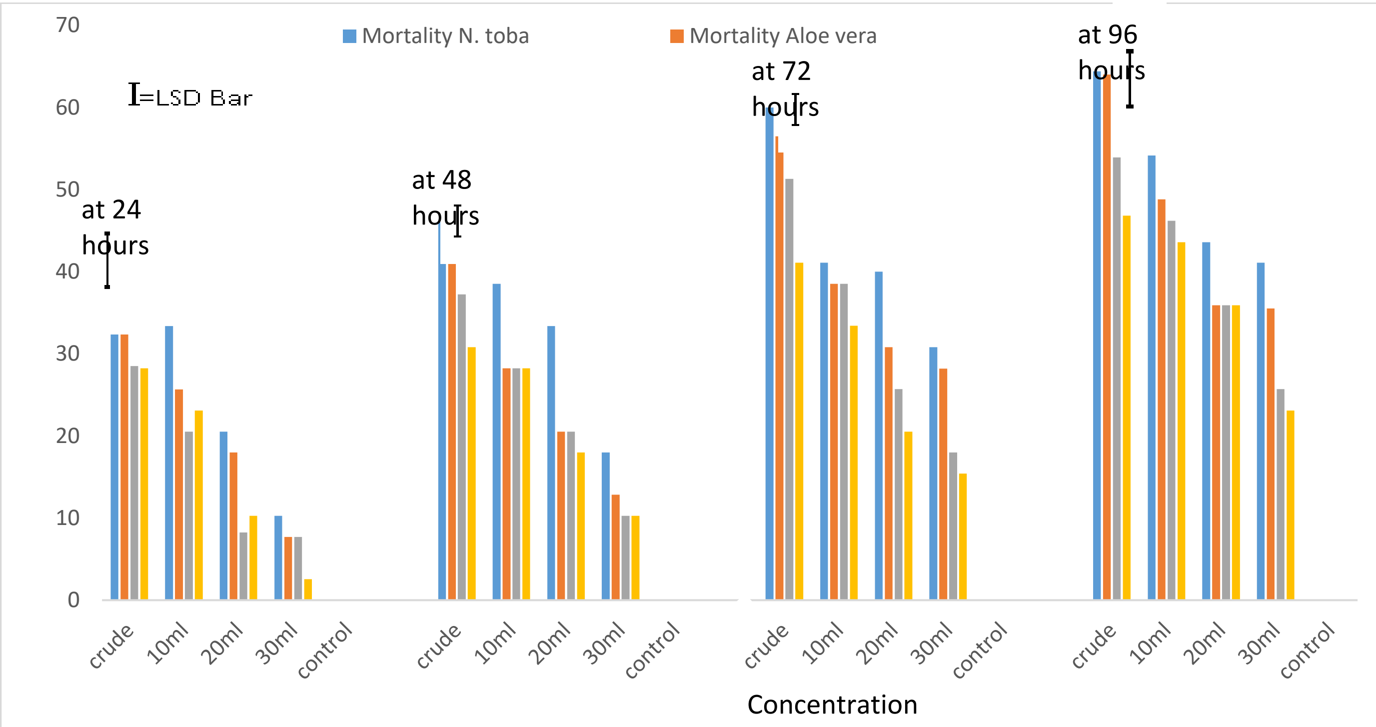

Figure 5: Effect of Plant Materials on Juvenile Mortality of *Meloidogyne Javanica* in the Laboratory

Key:

- *Nicotiana tabacum*
- *Aloe barbadensis*
- *Curcuma longa*
- *Manihot esculentus*

Effect of Cultivars, NPK fertilizer Rates and Plant Powder on Number of Leaves of Sweet Melon Plant.

The mean performance of sweet melon revealed that, Ex-Jimeta cultivar recorded the highest number of leaves 40 followed by Ex-Loko cultivar which also recorded reasonably higher leaves number of 38, Ex-Jos cultivar also recorded 38 number of leaves. Statistically there were no significant ($P < 0.05$) differences among the cultivars. Rustam *et al.* (2020) also carried out studies on over 350 species of local cultivars of sweet melon to analysis its useful properties of growth development, yield, fruit weight, fruit size and the medicinal properties, cultivars recorded significant ($P < 0.05$) differences on number of leaves and plant height. Dark green cultivar produced the highest number of leaves and the tallest plants, followed by the white green ripped cultivars, while the shortest plants with fewer number of leaves was produced by the light green cultivars.

Plants treated with *N. tabacum* gave the highest number of leaves also plants treated with *A. barbadensis* recorded 40 number of leaves compared to control treatment. This could be due to the nematicidal effects present in phenol, alkanoid and flavonoid found in plants powder, which probably reduce or lower the activities of nematodes to allow general increase in all growth parameters. This study agreed with Nura (2011) and Mashela (2017) who reported that incorporation of wild cucumbers amendments suppressed *M. incognita* and increased number of leaves of tomato purely to nematode suppression. The least number of leaves was recorded on plants in control plot. This might be due to nematode infestation which could possibly affects the vegetative growth of leaves. This finding was in line with Sajid *et al.* (2011) who earlier reported that severely infestation of nematodes on plants rendered plants stunted, canopy development impaired leaves become chlorotic depending on the soil conditions. They further stated in their findings that plant extract could be the best management option to reduce the population of root-knot nematode *M. incognita.* Plants that had second fertilizer application rate of 400 kg ha^{-1} per plot recorded the highest 40 number of leaves, followed by plants treated with 200 kg ha^{-1} also recorded 39 number of leaves and 38 number of leaves was obtained on plants that had 0kg ha^{-1} rate fertilizer application. This could be as a result of proper incorporation of the fertilizer into the soil making it readily absorbed by plants. The highest number of leaves recorded by 400 kg ha^{-1} may be attributed to adequate supply of nitrogen which is essential for vigorous vegetative growth. According to Kelly (2018) Nitrogen element in NPK fertilizer facilitate stronger vegetative growth and provide healthy stems and leaves while promoting fruit and seed productions, it stimulate growth in roots and is necessary for the uptake of other nutrients and also serves as a deterrent to nematodes by reducing their effects on plant roots and lower their populations. This result is in agreement with the findings of Muluki (2016) and Jayasinge (2016) who reported that the number of leaves was improved by fertilization of sweet melon with 100% super Veit (SV), followed by using 100% gave the lowest value. Lant Fort (LF) and using 50% Lant Fort (LF). This finding was in agreement with Nwukwu *et al.* (2020) who reported that placement of chemical fertilizer within the top 2 to 4 inches of soil provide zone of protection for seed germination transplant, establishment and protect initial growth of plant roots from seeds or transplants.

Effect of Cultivars, NPK Fertilizer Rates and Plant Powder on Vine Length of Sweet Melon Plant

The highest vine length was observed in Ex- Jimeta with values of 198.50 cm, Next to it was Ex-Loko which also recorded 190.20 cm vine length and the lowest vine length was observed in Ex-Jos cultivar with values of 174.90 which differ significantly from Ex-Jimeta and Ex-Loko respectively. Ex-Jimeta cultivar recorded the highest vine length compared to other local cultivars. These may be due to its phytochemical constituents which have been observed in the leave materials and is effective in the control of a root-knot nematode species. This result is in tandem with Harry *et al.* (2015) who observed the significant genotypic differences among the genotypes of bringal, with highest number of fruits plant in Arka Sirish compared to other genotypes, which release nutrients to enhance the performance of the plant and in turns enhanced the elongation of longer vines on all the three local cultivars. Rustam (2020) also reported that, 350 cultivars of sweet melon were accessed for their useful properties, were shown that, five cultivars matured early 65 – 75 days ripe. Thirty-two (32) cultivars was found to mature and ripe between 80 – 105 days together with the average summer melon varieties, while 86 cultivar ripe between 100 – 140 days and fall winter varieties.

In this study, plants treated with *N. tabacum* recorded the highest vine length of 200.3 followed by plants treated with *A. barbadensis* which also recorded vine length of 194.30 cm. These might be due to the efficacy of the nematicidal materials found to be present in the plant powder evenly incorporation into the soil to cause mortality of nematode species. These could probably lead to proper uptake and utilization of water nutrient to enhanced maximum growth and developments of the vegetative parts. The lowest vine length was recorded in control plot with 171.20 cm which could possibly be attributed to the above ground nematode infestations leading to poor water and nutrients uptake by the roots. This study is in line with Saifullah (2012) who reported that nematicidal properties are attributed to the synergy in active compounds present in trees biomass which provide excellence control over ectoparasitic and endoparasitic nematodes. Fengiuan (2020) also reported that the amount of organic amendment affects soil nematode activity and function at entry levels in soil food web, and that metabolic footprints of soil nematodes may be better indicator than their abundance in assessing their relationship with soil nutrients.

Plants dressed with second application of fertilizer rate 400 kg ha^{-1} gave the best results, recorded vine length of 193.60 cm followed closely by results of plants dressed with only once fertilizer application rate of 200 kg ha^{-1} which gave 190 cm compared to control plot 0 kg ha^{-1} that had 174.9 cm vine length. This could be as a results of additional nutrient being effectively and evenly incorporated and distributed through the soil and being effectively absorbed by the plant roots yielding in profound vegetative growth and development of the sweet melon cultivars, it also suppressed nematode activities on the roots. Similar result was earlier reported by Nafiu (2011) who earlier reported that increase in inorganic fertilizer addition tends to increase number of leaves per plant compared with the unfertilized control. Noling (2012) also reported in her findings that, the use of broad spectrum fumigant nematicides effectively reduces nematodes populations and increases vegetable crop yields. The shortest vine was recorded on control plants. This might be due to heavy nematode infestation on the roots by blocking the conducting vessels of the plant denying sufficient nutrients and water uptake of the plant. Stephen (2020) reported that application of compost at the amount of 2 t ha^{-I} and carbofuran at 3 kg ha^{-I}, brought about significant reduction of the root-knot nematode population in soil and roots, and a significant increase in the growth and yield of tomato.

Effect of Cultivars, NPK fertilizer Rates and Plant Powder on number of Fruits per Plant (g)

There were significant ($P < 0.05$) differences among the cultivars observed in both years. Ex-Jimeta cultivar recorded the highest number of fruits of 7.80 g followed by Ex-Loko that had 5.85 g number of fruits. The lowest number of fruits recorded was in Ex-Jos that obtained 3.95 g. This could be attributed to the nematicidal property of the amendments which inhibited nematodes growth and reproduction and the nitrogen fertilizer which enhances growth and development of plants. Oraegbunam *et al.* (2016) reported their findings after evaluation of three water melon varieties (Lagone (exotic), Koloss and Charleston gray (Local) serving as control) on sandy loam soil for agronomic performance including vegetative growth and fruit yield. Results revealed that Koloss took less time (10 days) to emerge compared to lagone (15 days) and Charleston gray (14 days). Lagone attained first and 50 % flowering earlier (36-39 days) than others. Charleston gray had longest vine length of (196.42 cm) nine weeks after planting, but show fewer fruits (3.33) than others. While Koloss showed largest fruit width of (15.66 cm). Fresh fruit yield indicated nominal differences but tended to be highest in Koloss (1.95 kg/plant), Lagone and Charleston gray had (1.85) and (174 kg/plant), respectively.

Atungwu *et al*. (2020) also reported their findings on three cultivars of *Telfairia occidentalis* assessed for their tolerance and susceptibility to root-knot nematodes (*Meloidogyne* spp.) infection on the field. Results showed that cultivars NHTo-020 and NHTo-030 were susceptible to root-knot nematode which implied that plants allowed nematode reproduction and also suffered yield loss while cultivar NHTo-010 was tolerant to nematode infestation meaning that nematode reproduction took place but the plant does not suffer yield loss. There was no significant ($P < 0.05$) difference in the mean vine length and number of leaf irrespective of the levels of inoculum, while effect on the vine girth was significantly variable.

The effect of level of NPK fertilizer application rates on number of fruits showed significant ($P < 0.05$) differences among the level of application rates on the number of fruits. Plants treated with 400 kg ha^{-1} recorded the highest number of fruits of 7.62 g which statistically differs from the number of fruits obtained with application rate of 200 kg ha^{-1} that recorded value of 6.49 g. The highest number of fruits recorded could be as a result of proper timing of fertilizer application for maximum output of the plants. Nwokwu *et al.* (2020) earlier in his findings reported after evaluation of effects of NPK fertilizer rate and method of application on growth and yield of Okro *(Abelmoschus escutentus*) revealed that method of NPK application rate have a profound effect on the overall performance of okra. Bernard (2018b) also stated that application of NPK fertilizer at different levels had significant effect on the growth characters except on number of leaves, but has effect on the yield and components of okro. and the lowest number of fruits of 3.48 g was obtained in the control (untreated plot). Bernard *et al.* (2018a) stated that due to improper use of inorganic fertilizers leading to low yield and poor quality fruits and low incomes among watermelon small holder farmers carried out study to determine the effects of organic (cattle manure) and inorganic fertilizer (calcium ammonium nitrate (CAN) and diammonium phosphate (DAP) on quality of watermelon. Cattle manure was applied at the rate of 0, 2.5, 5 and 7.5t ha^{-I} and inorganic fertilizer (three combinations of CAN and DAP were 0, 50 and 100kg/$P_2O_5ha^{-I}$. Results showed that fruits quality and benefits cost ratio responses of water melon to manure application were dependent on the level of supplementation with CAN and DAP. Generally, the quality of watermelon fruits and the level of supplementation of cattle manure with nitrogen and phosphorus.

The effect of plant materials powder on number of fruits of sweet melon showed that there were highly significant ($P < 0.05$) differences among the plant materials powder in both years. The highest number of fruits 8.52 g was recorded in plants treated with *N. tabacum* which significantly differ from the values observed with other treatments. The next higher value on number of fruits was observed with plants treated with *A. barbadensis* which had 7.12 g. The highest number of fruits recorded could be due to the nematicidal effects of the phytochemical content present in Alkaloids, flavonoid and phenol which after incorporation releases ammonia and other nutrient that are antagonistic to nematode species, inhibiting their hatch and depopulation of root knot nematodes in soil around the root zone making free penetration and invasion creating conducive soil environment for adequate uptake of water and other essential nutrient to the above ground plant parts. Olabiyi *et al.* (2011) reported that tomato (*Lycopersicon esculentum*) using CV Ibadan local raised on stream sterilized soil revealed that application of aqueous leaf extracts at 50% and 100% of *Hyptis suaveolens Nicotiana tabacum* and *Carica* papaya resulted in higher growth and yield of tomato as compared with the control using distilled water only, also plant height, number of leaves per plant, root weight, fruit weight of leaf extracts treated tomato was better. Sukalpa *et al.* (2021) also assessed the potential of vermicompost and biogas digestate (BD) as the two forms of organic amendments reported to have potentials to limit root knot nematode infestation. marigold (*Tagates*) and cabbage (*Brassics oleacea*) are two widely studied botanicals having shown their potential to control root knot nematodes reported that increasing mortality and incubation of hatching was higher and steadier in botanical extracts than those of organic amendments.

The lowest number of fruits obtained in 0 kg ha^{-1} (zero application) recorded value of 3.48 g which do not differ statistically. The lowest number of fruits obtained could be due to high invasion of the root of the host plant by nematodes to freely feed, grow, reproduce and multiple within the host plant compared to other treatments. This led to roots multiplication causing stunted growth and production of poor yield. Ayoola, *et al.,* (2010) reported that application of organic manure either singly or in combinations resulted in significant increase in total growth and marketable yield, fruit numbers, and fruit weight of water melon compare to control (zero application) also influences soil diverse and important biological activities and free living and parasitic nematodes are altered by rotational crops, cover crops, green manure and other sources of organic matter. With proper soil management programs improve soil chemical and biological parameters as to suppress plant-parasitic nematodes and soil –borne pathogens.

Effect of Cultivars, NPK fertilizer Rates and Plant Powder on Root Galling Index per Plant (g)

The effects on galling index on the local cultivars of sweet melon in both years indicated that Ex-Jimeta cultivar recorded few or no galls and followed by Ex-Loko cultivar. This could be attributed to the cultivar potentials to resist nematodes infestation also the nematicidal property of the amendments that suppressed and inhibit nematode damage to prevent them from penetrating the roots to produce galls. This finding is in line with Fengiuan (2020) who reported that galls otherwise called root knot is the major symptoms of *M. javanica* infestation injury on plant roots. The heaviest galling index was recorded on Ex-Jos cultivar. This could be due to severe nematodes infestation to predispose cultivar making it susceptible for attack by creating wounds, injury to the entire roots and swells up to a giant structure called root knots or galls. Mitkowski and Abawi (2011) reported that the degree of galling generally depends on the nematode population density, as the nematode population increases the number of galls per plants also increases. Plants in the control plot recorded the heaviest galling index compared with other treatments. This could be attributed to the free invasion of the plant roots by nematode species to produce galls, leading to poor performance of the entire plant by blocking the conducting vessels making it difficult for the roots to draw water and other essential nutrients needed by the plant for healthy growth and yield development. Mohammed *et al*. (2012) reported that symptoms of plant injury is related to nematode population density, crop susceptibility, and prevailing environmental conditions, under heavy nematode infestation crop seedlings or transplants may fail to develop, maintain a stunted condition or die causing poor stand development. Also under less severe infestation level, symptoms expression may be delayed until later in the crop season after a number of nematode reproduction cycle has been completed on the crop.

Plants treated with *N. tabacum* recorded few or no galls, and followed by plants treated with *A. barbadensis* compared to other treatments. This could be due to the fact that *N. tabacum* contain some nematicidal subtances in high amount, such as the Alkanoids, flavonoids and phenols which inhibited nematodes attacked and development. This findings is in line with Aanany *et al.* (2017a) who reported that incorporation of some plant materials proves to be antagonistic to nematode activities and attack living the roots free from infestation resulting to healthy roots by enhancing the utilization of soil nutrients and decreased nematode damage.

Plants dressed with second fertilizer application of 400 kg ha^{-1} recorded fewer galls or no galls followed by plants dressed with 200 kg ha^{-1}. This might be due to adequate supply of essential nutrients to the roots of plants to enhanced vigorous growth and development. Sujavanthi *et al.* (2021) reported their finding on the effect of chitin rich shrimp and crab exoskeleton powder against *M. incognita*. Results revealed that all the chitin amendments treated plants exhibited a significant reduction in the extend of galls ($P < 0.05$) which indicate that chitin amendment have ability to suppress the infestation of *M. incognita.* The root knot index was 2 in crab exoskeleton powder treated plant and highly significant in compares to untreated control (root-knot index 5). Gall index decreases as fertilizer rate also increased from 0 kg ha^{-1} to 400 kg ha^{-1} during both experimental seasons. Plants having zero (0 kg ha^{-1}) fertilizer rate recorded the heaviest gall index. This could be due to lack of nitrogen and essential minerals in the root zone of the control plants that attributed to nematodes to freely invade the roots causing root knots symptoms showing obvious swelling known as galls on roots, leading to poor growth development and yield of the entire plants.

CONCLUSION

In conclusion, the study revealed that plant materials leaf of *N. tabbacum,* and *A. barbadensis* extracts has the potential to inhibit egg hatch in 100% crude concentrations with 0.00% and 2.57% also has the ability to cause juveniles mortality of *Meloidogyne javanica* in 100% crude concentrations with 64.4% and 64.2% in the laboratory. Physical and chemical properties of Loko soil at the experimental site at the depth of 30 cm revealed to be sandy, clay and loam. Phytochemical of the whole leaf extracts revealed that the four leaf extracts contain Saponins, Terponoids, Flavonoids and Alkanoids at varying levels of concentrations. Phenol recorded the highest phytochemical value with 20.01 % in *N. tabacum,* followed by Alkanoid which recorded 19.53 % in *A. barbadensis* and the least phytochemical value (zero) 0 % was recorded in Glycoside. The plant leaf powders also has the ability to suppressed and kill *Meloidogyne javanica,* lowering its population in the field.

RECOMMENDATIONS

Based on findings from this research work outline the following recommendations:-

Application of 50 g per plot of *Nicotiana tabacum* and *Aloe barbadensis* powder were able to suppresss and kill nematode juveniles in soil under rainfed, also increasing the quantity will also increase juvenile mortality of root-knot nematodes. Application of 400 kg ha^{-1} fertilizer rates on field showed to be the best fertilizer application rate suitable for sweet melon growth, development and yield. While crude with concentrations of *Nicotiana tabacum* and *Aloe baradensis* at longer hours of exposure have showed to be effective on egg hatch inhibition and juvenile mortality.

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