

**EVALUATION OF DIFFERENT LEAF POWDER AND EXTRACTS IN CONTROLLING ROOT KNOT NEMATODE [*Meloidogyne javanica* (Chitwood) 1949] ON SWEET MELON IN YOLA, ADAMAWA STATE NIGERIA****Maijama'a, N. A.****Department of Forestry Technology, Federal Polytechnic, Mubi, Adamawa State**Corresponding Author: [ngwamdaipaul@gmail.com](mailto:ngwamdaipaul@gmail.com)**ABSTRACT**

Laboratory and field experiments were conducted in the year 2020 and 2021. Laboratory experiment was carried out at the Department of Crop Protection Modibbo Adama University, Yola, in September, 2020 to evaluate the effect of three plant extracts (*Datura stramonium*, *Tamarin Indica* and *Vitex doniana*) at different concentrations on juvenile mortality of *Meloidogyne javanica*. In the laboratory, aliquots of crude, 5, 10 and 15 ml each of the water-soluble plant extracts of *D. stramonium*, *T. indica*, *V. doniana* and distilled water as the control were dispensed using 10 ml syringe into 45 petri dishes containing 1000 second stage juveniles of *M. javanica* in 10 ml of water. Counts of dead nematodes were carried over 72 hours. The field experiments were carried out in two planting seasons (2020 and 2021). The field experiment consisted of four treatments (powder of *D. stramonium*, *T. indica*, *V. doniana* and control) replicated three times and arranged in split plot design. Data were collected on both above and below ground parts of the plant, galling index and final nematode population. The Laboratory results revealed that the crude extracts of *D. stramonium* at 72 hours gave 97 % juvenile mortality, followed by *T. indica* ( 85 %), *V. doniana* (19 %) and the least (0 %) in the control. The laboratory results also shows that the higher the concentration and time of exposure the higher the mortality and vice versa. The field results for both 2020 and 2021 revealed that *D. stramonium* treated plants recorded the longest vine length, highest number of leaves, number of fruits (23 and 24), and fruit weight (703 and 709 g), fresh vine weight (325 and 339.8 cm), root length (21 and 22.2 cm) and the lowest galling index (12.58 and 11.68) and nematode populations (155 and 158) respectively. For the cultivars, *Jimeta* local cultivar recorded better growth parameters and yield as well as fewer galling index and nematode population. It can be concluded that the plant materials had the potential for use as nematicides which could possibly replace the hazardous synthetic nematicide in the near future. It is recommended that further laboratory and field trials be carried out to ascertain the exact phytochemicals responsible for the efficacy of *D. stramonium* before recommending to farmers.

**Keywords: *Meloidogyne Javanica*, Juveniles, Petri Dishes, Plant Leaves Extract And Powder****INTRODUCTION**

Melon (*Cucumis melon* L.) is a monoecious plant belonging to the family *Cucurbitaceae*. Melon originated in Africa and southwest Asia. Melons production is concentrated in arid and semiarid regions, but they are grown in many states for local and interstate sales according to (Nkansah, *et al.*, 2012). Burger, (2010) reported that melon is one of the most widely grown vegetable crops throughout the warmer regions of Nigeria and the world at large. The sweet melon market types familiar in Nigeria are honey dew melon, muskmelon, rock melon, cantaloupe and water melon (Creight *et al.*, 2010). Ripe melons are eaten raw as a cooling desert, a popular finish to the meal, and as thirst quenching snack. It contains large amounts of vitamin C and beta-carotene which helps protect against various forms of cancer due to their antioxidant properties. It contain potassium which regulate heart functions and normalize blood pressure. Its fiber helps to maintain bowel regularity, colon and rectal cancer. Its seed contain cucurbititrin that lowers blood pressure

and improve kidney function. Melon contain up to 94 % water and is remaining 6 % nutrients (Salmazi, 2009 and Ibrahim, 2012).

One of the major factors limiting profitability of sweet melon production is the damage caused by plant parasitic nematodes especially *Meloidogyne* spp. symptoms of plant injury is related to nematode population density, crop susceptibility, and prevailing environmental conditions. Under heavy nematode infestation seedlings or transplants may fail to develop, maintain a stunted condition or die causing poor stand development, unthriftiness, premature wilting, and malformed fruit ripens slowly, yellowing and gall formation (Trifonovo, 2011 and Roy *et al.*, 2012). Below ground plant parts form a tight mat of short roots and galls, as infestation levels increases the damage and yield loss also increases. (Paris *et al.*, 2012 and Sana *et al.*, 2018). Nematodes are tiny, worm like multicellular animals adapted to living in water. The genus *Meloidogyne*, belong to the family *Meloidogynidae* in the order *Tylenchida*. *Meloidogyne* spp. are sedentary endo parasites, second stage juveniles of nematodes (larvae) hatches from eggs laid in either soil or plant tissues, on emergence the juveniles, thread like in appearance, actively seek the tips of roots for invasion and established in the root tissue. The nematode feed on plant cells and grow, the infected cells are stimulated to enlarge and become the feeding sites for the nematodes (Umar, 2012 and Aanany, 2017).

Root knot nematode (*Meloidogyne* spp.) are most economically damaging genera on horticultural and field crops and are obligate parasites of the roots of thousands of plant spp. The attacked crops suffer both quantitatively and qualitatively, the roots of injured plant and the galls block water and nutrient flow to the plant, resulting to stunting, impaired fruit production and causing foliage to yellow or wilt, rough or pimpled and susceptible to cracking, high level of damage can lead to total loss according to (Paris, 2012). A yield reduction of 25 % at inoculation level of 133 eggs of *M. incognita* per kg of Soil or 91 % reduction with 13,300 eggs of *M. incognita* per kg soil. Yield losses of more than 90 % in high population and crop damage relationship was also recorded earlier by Nkansah, *et al.* (2012 and Noling, 2012).

Research on nematicidal potential of botanicals and their application is on the increase. Different plant parts are being tested to identify the sources of nematicidal substances. Synthetic nematicides are costly and not affordable by the local farmers, beside its environmental hazards. Limitations on the use of chemical pesticides have brought increasing interest in studies on alternative methods of nematode control (Gregory, 2017). Botanical control of these plant parasitic nematodes could be highly achieved naturally through the use of plant extracts and powder. Allelopathy organism produces one or more biochemical that influence the growth, survival, and reproduction of other organisms as reported by (Jose, 2011). Alpha-terthienyl inhibits hatching of nematode eggs (Roy *et al.*, 2012). (Ayoola *et al.*, 2010) use rapeseed as a green manure crop to reduce the population of *Xiphinema americanum* sensu lato in temperate orchards. Umar (2012 b) reported that incorporation of pawpaw (*Carica papaya*) leaf powder at 22 t/ha gave the best control of *M. javanica* on cowpea. The leaves contained alkaloids and saponins, phytochemicals known to be harmful to soil microorganisms and nematodes. Nafiseh *et al.* (2010) reported that alcoholic extracts and oil of chinaberry and castor bean are effective on immobility of second stage juvenile and on hatching eggs of *M. incognita* in laboratory conditions, also reduced the number of galls and nematodes populations in soil on cucumber in green house experiment. Umar (2012a) reported that *Nicotiana tabacum* leaf extract inhibit egg hatching and causes juvenile mortality which significantly reduced population of *M. javanica* on tomato, and increased growth and yield of tomato, and 100 % concentration of the extract gave 100 % egg hatch inhibition. 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 objectives of this work therefore is to evaluate plant extracts and leaf powder of *D. stramonium*, *T. indica*, and *V. doniana*, in the control of root knot nematode (*M. javanica*) on sweet melon and the specific objectives are to determine the effect of different leaf

extracts on juvenile mortality of *M. javanica* in the laboratory also to determine the effect of different leaf powder on root knot nematode (*M. javanica*) in the field.

## **MATERIALS AND METHODS**

### **Laboratory Experiment**

#### ***Preparation of plant powder and extracts***

water soluble extracts of the plant materials were prepared using the method described by Agbenin (2005) as follows. The Leaves of *D. stramonium*, *T. indica*, *V. doniana* was air dried at room temperature of 27 °C for two weeks, after which the plant materials was finely ground into powder and stored separately in polythene bags in the laboratory. Thirty (30) g of each plant powder (*D. stramonium*, *T. indica* and *V. doniana*) was ground separately with pestle and mortar, and poured into a 500 ml conical flask and 300 ml distilled water was added. The set-up was allowed to stand for 24 hours and centrifuged at 5000 rpm and filtered through Whatman No. 42 filter paper. The filtrate obtained was designated as crude extract (T1). The crude extract was further diluted with 5, 10, and 15 ml distilled water to obtained T2, T3 and T4 respectively, while Control was only be distilled water and was as designated as T5.

#### ***Extraction of inoculum***

The inoculums for the experiment were the second stage juveniles extracted from infected tomato using the modified Baerman method (Whitehead and Hemming, 1965). This was involving the use of shallow trays with sieves lined with tissue paper and macerated roots of tomato placed on it, water was poured from the side of the trays to a level just submerging the materials on the sieves. The set up was left to stand for 24 hours and the nematode juveniles collected was decanted into a beaker. Aliquots of 10 ml in syringes was taken and counted under a stereoscopic microscope using a grid counting dish. 1000 juveniles was used for each inoculation of juvenile mortality test and field experiment.

#### ***Juvenile mortality test***

5 ml of crude and diluted extracts of *T. indica*, *D. stramonium* and *V. doniana* was separately dispensed into petri dishes using 5 ml syringe, except control which contained only distilled water. 1000 juveniles of *M. javanica* suspension was added to each petri dish with a 10 ml syringe. A total of forty five (45) petri dishes was used for the experiment. There were five (5) treatments replicated three times. Petri dishes were arranged in a Completely Randomized Design (CRD) in the laboratory. Dead nematodes were counted every 24 hours for three days. Identification of dead nematodes was done by touching them with a needle to see if they exhibit mobility.

### **Phytochemical Analysis of Plant Materials**

Phytochemical analysis of the plant powder was carried using the method described by Sofowora (1993) to determine tannin, saponin, flavonoid and alkaloid. The ethanol extract was prepared by soaking 30 g of each of the dry powdered plant materials in 1000 ml of ethanol at room temperature 27°C for 24 hours. The extracts was filtrated after 24 hours through a whatmann No. 42 filter paper. The extracts was concentrated using a rotary evaporator in a water bath set at 40°C. The test for the various constituents of Tannin, Saponnin, Flavaniod and Alkanoid was carried out.

### **Field experiments**

The experiments was carried out at irrigation farming site at loko village in Song Local Government Area of Adamawa State. Loko is located at latitude 09° 42' 00' N and longitude of 12°31' 45" E ([Distance .com, 2003](#)). The experimental plot measuring 23.5 m x 29.5 m was ploughed and harrowed. Plots were demarcated using split plot design. The two cultivars were the main plot

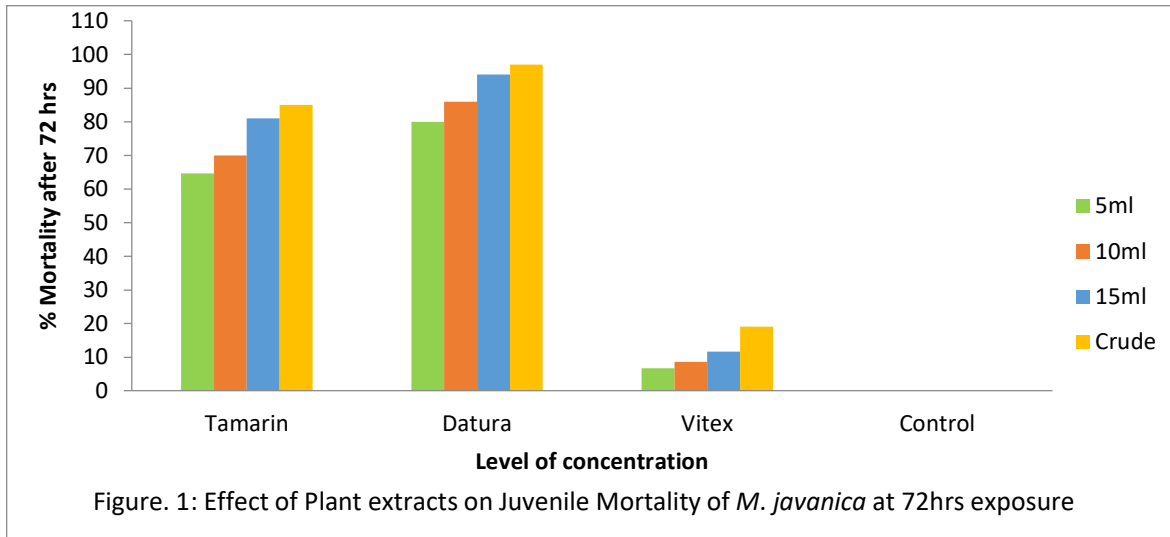
while different plant powder served as the subplots. Soil samples was obtained randomly by taken core samples from 1-15 cm with an auger from the experimental field before planting. The physiochemical tests were also carried out. Seeds of two cultivars Ex- Jos and Ex-Jimeta were planted in August 2020 (for the first experiment) and February – July 2021 (for the second experiment). Seeds were sown at a depth of 2 cm and row spacing of 1.5 by 1.2 m. Thirty gram (30 g) each of the different plant Powder of *D. stramonium*, *T. indica* and *V. doniana* obtained were separately incorporated into the base of each plant two weeks after emergence. Second stage juveniles (J2) of *M. javanica* was extracted from infested roots of sweet melon was used to inoculate all the plants including the control in the field with approximately 1000 juveniles of *M. javanica* contained in 10 ml suspension. All cultural practices were dully observed during the field trails. Following datas were collected on establishment count, number of leaves, vine length, days to 50% flowering, number of flowers, number of fruits, fruits weight, number of galls also final and initial nematode population were determined. All data collected were Analyzed Using Generalized Linear Model (GLM) procedure of Statistical Analysis System (SAS) 1996 appropriate for a Split -Plot Design and the means were separated using Duncan's Multiple Range Tests (DMRT) at 5 % probability level.

## **RESULTS AND DISCUSSION**

The results of the phytochemical analysis indicated highly presence of flavonoid, saponins, moderately presence of tanins, slightly presence of alkanoids in *D. stramonium*. *T. indica* extract revealed to contain highly presence of saponin, moderately presence of flavonoids, slightly presence of tanins and alkanoids, *V. doniana* recorded moderate presence of tanins and slightly presence of saponins, flavonoids, alkanoid. The results of the soil physical and chemical analysis revealed to be sandy loam soil.

### **Effect of the Plant Leaf Extracts on Juveniles Mortality Test**

The effect of plant extracts on juvenile mortality at 24 hours of exposure, results revealed that the highest juvenile mortality was recorded in the crude extract of *D. stramonium* (90.67 %) followed by *T. indica* (82 %) , *V. doniana* (14.67 %) and the least was recorded in control (0 %). And when the second stage juveniles were exposed for 48 hours to crude extracts of *D. stramonium* recorded (92.67 %) followed by *T. indica* (83.67 %), *V. doniana* (17 %) and (0 %) was recorded in control. At 72 hours of exposure of the second stage juveniles to crude extracts showed that the highest juvenile mortality was recorded in *D. stramonium*( 97 %), followed by *T. indica* (85 %), *V. doniana* (19 %) and the least( 0 %) was recorded in the control. In the 5 ml dillution of the crude extract the highest juvenile mortality was recorded in *D. stramonium* (94%), followed by *T. indica* (81 %), *V. doniana* (11.67 %) and the least in control (0 %). When 10 ml of diluted extracts was used, the highest juvenile mortality was recorded in *D. stramonium* (86 %), *T. Indica* (70 %) and *V. doniana* (8.67 %) the least was recorded in control. when 15 ml dilution of the crude extracts was used, a higher mortality rate of ( 80 %) was recorded in *D. stramonium*, followed by *T. indica* (64.67 %), *V. doniana* (6.67%) and the least of all was obtained in control( 0 %) respectively as presented in Figures 1. It was revealed that juvenile mortality increased with increased in concentration and time of exposure.



**FIELD EXPERIMENTS**

***Effect of Plant Powder on Number of Leaves***

The mean performance effects of plant powder on cultivars of sweet melon on number of leaves in 2020 and 2012 were highly significant (< 0.01%) difference among the treatments on the number of leaves in both years. The highest number of leaves was recorded in plants treated with *D. stramonium* which recorded (10) number of leaves in both year, followed by *T. indica* treated plant had (8 and 7) This could be due to the high concentration of the chemical constituent of saponnins and flavonoids present in the plant powder which are known to have effect on nematodes. Mashela (2012) reported that incorporation of wild cucumbers amendment suppressed *M. incognita* and increased the release of ammonia which enhance antagonistic effect to nematodes and promote vegetative growth in sweet melon. Least number of leaves was recorded in the control (5) each respectively. This could be due to nematode attacked which affected the vegetative growth of the leaves. 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*. Similar results was observed at 6, 8 and 10 WAS, throughout the experiment. From the mean effect of the cultivars there were highly significant (< 0.01%) difference among the cultivars throughout the experiments in 2020 and 2021. At 4 WAS Jimeta cultivar recorded the same highest number of leaves (8) in both years, which differs significantly from Jos cultivar which recorded (7 &6), similar result were observed at 6 and 8 WAS, while at 10 WAS there was no significant (> 0.05%) difference among the treatments on the cultivars on the number of leaves, as shown in (Table 1).

Table 1: Evaluation of different leaf Powder in the Control of Root-knot Nematode *M. javanica* on Sweet Melon on Number of Leaves 2020 and 2021

Plant materials	2020				2021			
	4 WAS	6 WAS	8 WAS	10WAS	4 WAS	6 WAS	8 WAS	10WAS
<i>T. indica</i>	7 <sup>ab</sup>	29 <sup>b</sup>	70 <sup>ab</sup>	127 <sup>b</sup>	7 <sup>ab</sup>	29 <sup>b</sup>	70 <sup>ab</sup>	127 <sup>b</sup>
<i>D.stramonium</i>	10 <sup>a</sup>	40 <sup>a</sup>	89 <sup>a</sup>	141 <sup>a</sup>	10 <sup>a</sup>	40 <sup>a</sup>	89 <sup>a</sup>	141 <sup>a</sup>
<i>V. doniana</i>	6 <sup>b</sup>	23 <sup>bc</sup>	70 <sup>ab</sup>	100 <sup>c</sup>	6 <sup>b</sup>	23 <sup>bc</sup>	70 <sup>ab</sup>	100 <sup>c</sup>
Control	5 <sup>c</sup>	17 <sup>c</sup>	35 <sup>d</sup>	65 <sup>d</sup>	5 <sup>c</sup>	17 <sup>c</sup>	35 <sup>d</sup>	65 <sup>d</sup>

<b>Mean</b>	7.00	31.98 <sup>c</sup>	35.22	110.89	7.00	31.98 <sup>c</sup>	35.22	110.89
<b>P of F</b>	0.0003	0.0012	0.0013	0.0015	0.0003	0.0012	0.0013	0.0015
<b>C.V</b>	12.35	11.19	9.3	10.58	12.35	11.19	9.3	10.58
<b>Cultivars</b>								
<b>Jos Cultivar</b>	6 <sup>b</sup>	34 <sup>ab</sup>	58 <sup>b</sup>	110 <sup>b</sup>	6 <sup>b</sup>	34 <sup>ab</sup>	58 <sup>b</sup>	110 <sup>b</sup>
<b>Jimeta Cultivar</b>	8 <sup>a</sup>	48 <sup>a</sup>	69 <sup>a</sup>	122 <sup>a</sup>	8 <sup>a</sup>	48 <sup>a</sup>	69 <sup>a</sup>	122 <sup>a</sup>
<b>Mean</b>	7.00	31.84	35.22	110.89	7.00	31.84	35.22	110.89
<b>P of F</b>	0.0031	0.057	0.044	0.0050	0.0031	0.057	0.044	0.0050
<b>C.V</b>	12.35	11.19	9.3	10.58	12.35	11.19	9.3	10.58
<b>A * B</b>	NS	**	**	**	NS	**	**	**

key :- ( WAS) = Weeks after sowing

Means in the same column with the same letter are not significantly different according to Duncans New Multiple range test at 5 %.

### **Effect of Plant Powder on Vine Length**

The mean performance of plant powder on the cultivars of sweet melon on vine length in 2020, is presented in Table 2. From the plant materials at 4 WAS there was no significant (> 0.05%) difference among the treatments on the vine length. At 6 WAS there were highly significant (< 0.01%) difference among the treatments on the vine length. *D. stramonium* treated plants had the longest vine length in both 2020 and 2021 (19.3 and 20.14 cm) similar trends were observed at 8 WAS and at 10 WAS.

Table 2: Evaluation of different leaf Powder in the Control of Root-knot Nematode *M. javanica* on Sweet Melon on Vine Length, 2020 and 2021

	2020				2021			
	4 WAS	6 WAS	8 WAS	10 WAS	4 WAS	6 WAS	8 WAS	10 WAS
<b>Plant materials</b>								
<i>T. indica</i>	5.67 <sup>a</sup>	16.7 <sup>a</sup>	39.67 <sup>ab</sup>	73.35 <sup>ab</sup>	5.36 <sup>ab</sup>	15.9 <sup>ab</sup>	37.76 <sup>ab</sup>	73.13 <sup>ab</sup>
<i>D. stramonium</i>	5.89 <sup>a</sup>	19.3 <sup>a</sup>	42.53 <sup>a</sup>	77.79 <sup>a</sup>	6.00 <sup>a</sup>	20.14 <sup>a</sup>	45.32 <sup>a</sup>	82.97 <sup>a</sup>
<i>V. doniana</i>	4.52 <sup>a</sup>	14.90 <sup>a</sup>	33.6 <sup>bc</sup>	59.60 <sup>bc</sup>	4.93	14.37 <sup>ab</sup>	32.11 <sup>ab</sup>	58.76 <sup>b</sup>
Control	4.66 <sup>a</sup>	9.9 <sup>b</sup>	27.17 <sup>c</sup>	49.05 <sup>c</sup>	0.232	8.7 <sup>c</sup>	29.78 <sup>c</sup>	41.30 <sup>c</sup>
Mean	5.03	15.15	15.59	64.92	23.4	14.44	35.36	65.90
P of F	0.251	0.0039	0.0025	0.0039		0.0041	0.0026	0.0037
C.V	24.2	25.68	16.86	18.54	25.18	17.16	17.87	
<b>Cultivars</b>								
Jos Cultivar	3.69 <sup>b</sup>	12.05 <sup>b</sup>	31.07 <sup>b</sup>	57.24 <sup>b</sup>	3.98 <sup>b</sup>	11.17 <sup>b</sup>	30.0 <sup>b</sup>	60.12 <sup>b</sup>
Jimeta Cultivar	6.38 <sup>a</sup>	18.26 <sup>a</sup>	40.12 <sup>a</sup>	72.61 <sup>a</sup>	5.37 <sup>a</sup>	16.36 <sup>a</sup>	37.18 <sup>a</sup>	79.17 <sup>a</sup>
Mean	5.03	15.15	15.59	64.92	4.93	14.44	35.36	65.90
P of F	0.0001	0.0012	0.0024	0.007	0.0011	0.0014	0.0020	0.006
C.V	24.2	25.68	16.86	18.54	23.4	25.18	17.16	17.87
<b>A * B</b>	NS	**	**	**	NS	**	**	**

key :- ( WAS) = Weeks after sowing

Means in the same column with the same letter are not significantly different according to Duncans New Multiple range test at 5 %.

This could be as a result of the nematicidal property of *D. stramonium* suppressing the activities of plant parasitic nematode around the root zone. Also it could be due to the availability of more nutrients to plants which promotes good root extension freely within the soil there by increasing the toxicity of the amendments to nematodes which affected their activities. Mashela (2012) who reported that incorporation of wild cucumbers amendments suppressed *M. incognita* and increased

number of leaves of tomato purely to nematode suppression. Control plot recorded the shortest vine length (9.9 cm) as compared to treated plots. The shortest roots recorded in control may be due to both physical and physiological damaged caused by nematodes penetrating and moving through the roots system, altering the metabolism of the root cells resulting in root cell modification called syncytia or galls. From the varieties there were highly significant ( $< 0.01\%$ ) difference among the cultivars. Thus at 4 WAS, Jimeta Cultivar recorded the longest vine length with (6.38 and 5.37 cm) both in 2020 and 2021 which differs significantly from Jos cultivar which had (3.69 and 3.98 cm) similar trends were observed at 6 WAS, 8 WAS and at 10 WAS.

### ***Effect of the Plant Powder on Fresh and Dry Vine Weight***

The mean effects of fresh vine weight in 2020 and 2021 are presented in Table 3 and 4. The results showed that plants treated with *D.stramonium* had the highest mean fresh vine weight (325 and 339.8 g) followed by *T. indica* (291.67 and 284.6 g), *V. doniana* (275 and 271.3 g). Abbasi (2010) in their findings also reported similar results that plant powder incorporation or amendment in soil reduced root-knot caused by nematodes and enhanced growth development of plants. And the least mean weight was recorded in the control (241.67 and 219.89 g), This could be as a result of availability of nutrients to the plants which resulted in more vegetative growth of the above parts of the sweet melon plants and less nematode attacked leading to the accumulation of more dry matter. The lowest mean dry shoot weight recorded in the control could be due to stunted growth induced by nematodes which resulted too little top growth that affected the dry matter accumulation. While for the cultivar means the result shows that Jimeta local cultivar recorded the highest (300 g) which is significantly higher than Jos local Cultivar (266.7 g). Paris (2012) also reported that, apparent variation is not only due to the genotypes but also due to the influence of environment. The result on the mean dry vine weight in 2020 and 2021, showed that *D. stramonium* and *T. indica* had the highest dry vine weights of (85.95& 90.73g) and (85.81 & 85.3 g) respectively, and the least dry vine weight was recorded in control (64.4 and 62.19 g).

### ***Effect of the Plant Powder on Fresh and Dry Root Weight***

The mean results on fresh root weight in 2020 and 2021 showed that *D. stramonium* recorded the lowest mean fresh root weight (18.9 and 16.56 g) followed by *Tamarin* (20.19 and 21.1 g) and control had the highest fresh root weight (36.17 and 36.02 g) respectively as presented in Table 3&4. This increased in weight could be due to changes that took place in the root zone produced by root-knot nematodes. For the cultivar mean, there was no significant ( $> 0.05\%$ ) difference between the two cultivars and significant ( $0 < 0.05\%$ ) differences were observed between the treatments and the control. The effect of the mean results on the dry root weight showed significant ( $< 0.05\%$ ) differences in the mean dry root weight, the results shows that control treatment had the highest mean dry root weight (5.99 and 6.02 g) compared with other treatments The root weight could lead to reduced efficiency of the root system, as galled root system does not utilized water and nutrient from large volume of soil compared to uninfected root system. *D. stramonium* treated plants had the lowest dry root weight (3.87 and 3.18 g) followed by *T. indica* and *V. doniana* respectively The treated plants recorded lower fresh and dry root weights with few or no galls probably due to the presence of nematocidal constituent's triterpenoid in saponnis, polyphenolic in tannin, quinolizidine in alkaloids and Flavonoids (Saifullah, 2012 and Kemble 2014). Among the Cultivar means the results revealed that Jos local Cultivar had the highest mean dry root weight (5.39 g) and Jimeta local Cultivar had (4.25 g) as indicated in Table 3 and 4.

### ***Effect of the Plant Powder on Root Length***

The mean performance of the effect of plant powder on root length in 2020 and 2021 are presented in Table 3&4 The result revealed that *D. stramonium* treated plants recorded the longest mean

root length (21.03 and 22.17 cm), followed by *Tamarin* (16.12 ). This could be as a result of the nematicidal property of *D. stramonium* suppressing the activities of plant parasitic nematode around the root zone, and the availability of more nutrients to plants which promotes good root extension freely within the soil there by increasing the toxicity of the amendments to nematodes which affected their activities. Ogwulumba *et al.* (2011) who reported that plant powder incorporation or amendment to the soil showed better performance and reduced root knot nematodes. And the shortest mean root length was in the control (12.33 and 11.03 cm) as indicated in Table 3 and 4. The shortest roots recorded in control may be due to both physical and physiological damaged caused by nematodes penetrating and moving through the roots system, altering the metabolism of the root cells resulting in root cell modification called syncytia or galls. Among the cultivars means for root length indicated no significant ( $> 0.05\%$ ) difference between the two cultivars as shown in Table 3 and 4.

#### ***Effect of the Plant Powder on Number of Fruits***

The mean performance of the effects of plant powder on number of fruits in 2020 and 2021 are presented in Tables 3 and 4. The results revealed that *D. stramonium* treated plants recorded the highest number of fruits (23 and 24) for both years respectively. This could possibly be as a result of nematicidal contents of the powder which may damage plant parasitic nematodes on contact or ingestion after incorporation and decomposition into soil which help in nematodes suppression and promote production of more fruits. 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 in a natural way and promote root and vegetative growth and increase yield of the plant. The least number of fruits was recorded in the control (14 and 12) respectively as indicated in Table 3 and 4. Could be due to damage to root system that decreased the ability of the plant to absorbed water and essential nutrients from the soil leading to low vigor of the plant and decreased fruit yield. This study is in agreement with Hassan *et al.* (2010) who reported that application of organic amendments in managing root-knot nematodes reduced nematodes population and improves growth and yield of crops. There was no significant ( $> 0.05\%$ ) difference between the two cultivars Jimeta local and Jos local with respect to number of fruits.

#### ***Effect of the Plant Powder on Fruits Weight***

The results on the mean fruit weight at harvest in both 2020 and 2021 are presented in Tables 3 and 4. In 2020, the results revealed that *D. stramonium* treated plants had the highest mean fruits weight at harvest (702.7 g), followed by *T.indica* (534 g). This finding is in line with Harry (2012) who reported that nematicidal properties are attributed to the synergy in active compounds present in tree biomass which provide excellence control over ectoparasitic and endoparasitic nematodes in a natural way to promote root and vegetative growth and increase yield of the plant. The least was recorded in control (425 g). Among the Cultivars, Jos local recorded the lowest mean (519 g) as compared with Jimeta local (553 g), Table 7. In the year 2021, control treatment had the lowest fruit weight (325 g) which significantly differs from *D. stramonium* (709 g). The untreated control recorded lower fruit weight because of the activity of nematodes that affected the absorption of nutrients by roots. This finding is also in line with Hassan *et al* (2010) also reported that application of organic amendments in managing root-knot nematodes enhanced reduction of nematodes population and improves growth and yield. The cultivar mean results indicated that Jos local recorded (507 g) which significantly differs from Jimeta local (550 g) as shown in Table 3 and 4.

### **Galling index**

The results for the mean number of galls in 2020 and 2021 are presented in Table 3 and 4. In 2020, the results revealed highly significant difference between the treatments. Control treatment significantly recorded the higher gall rating (32.75 and (31.21g). The results of both years field experiments recorded significantly higher galling index in control compared with other treatments. This could be due to lack of deterrent on the roots of the control plants that allowed nematodes to freely invade the roots, causing the plants to produce root-knot symptoms showing obvious swelling known as galls on roots of sweet melon resulting in poor performance of the entire plant. 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, followed by *V.doniana* (20.03 g), *T.indica* (16 g) compared to *D. stramonium* recorded the least galling index (12.58 and 11.68 g). This could be attributed to the phytochemical materials in the plants powders. This is similar to the findings of Ononuju and Nzeuwa (2011) who reported that hot water extracts (Hot Water Extracts) of *Lantana. cylindrica* and hot water extract of *Euphorbia hirta* significantly improved cowpea yield and reduced the number of galls on roots and nematode population in soil. For the Cultivars, the results indicated highest galling index mean in Jos Cultivar (21.87 and 17.98g) as compared to (18.82 and 19.58 g) galling index in Jimeta Cultivar as shown in Table 3 and 4.

### **Nematodes population**

In the year 2020 and 2021, control had significantly higher mean nematode population of (490 and 487) compared to other treatments. The results on nematode population revealed that the control plants had the highest nematode population in comparison to other treatments due to no treatment. This resulted in nematodes penetrating the roots, feeding freely, developed and multiply within the host plants in the control treatments. These lead to the heavy galling of roots of all the control plants, as well as stunted growth and poor production of fruits. 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. Followed by *V. doniana* (303) and the least nematode population was recorded in *D. stramonium* (155 and 158). All treated plants recorded lower nematode population especially *D. stramonium* treated plants. It could be attributed to the high presence of phytochemicals such as tannins, saponins and alkaloid in *D. stramonium* powder which inhibited the growth and development of *M. javanica* resulting in fewer or no galls on the roots. For the Cultivars, Jos local recorded the highest mean nematode population (329) compared to Jimeta local which had the least nematode population of (275) as shown in Table 3 and 4.

**Table 3: Evaluation of Different Leaf Powder on the Control of Root-Knot Nematodes *Meloidogyne javanica* on Sweet Melon on the Growth and Yield Parameters in 2020**

	NF	FW(g)	FVW(g)	DVW(g)	FRW(g)	DRW(g)	RL(cm)	GN	N. Pop
Plant materials									
<i>T. indica</i>	20 <sup>a</sup>	534b	291.67b	85.81a	20.19c	4.65a	16.12ab	1	260ab
<i>D.stramonium</i>	23 <sup>a</sup>	702.7a	325a	85.95a	18.9c	3.87b	21.03a	1	155b
<i>V. doniana</i>	18 <sup>ab</sup>	483.3c	275b	82.56a	28.76b	4.75a	15.89ab	1	303c
Control	14 <sup>c</sup>	425c	241.67c	64.39a	36.17a	5.99a	12.33c	2	490d
Mean	18.13	536.3	283.33	79.69	26.00	4.82	16.34	20.34	302.08
P of F	0.050	0.14	0.002	0.608	0.003	0.049	0.0038	0.0019	0.0021
CV	28.53	26.15	24.70	23.03	27.72	27.40	23.59	28.5	26.31
Cultivars									
Jos Cultivar	18 <sup>a</sup>	519a	266.67b	71.01a	25.87a	5.39a	16.34a	2	329a
Jimeta Cultivar	19 <sup>a</sup>	553a	300.00a	88.35a	26.69a	4.25a	16.34a	1	275b

Mean	18.13	536.3	283.33	79.69	26.00	4.82	16.34	20.34	302.08
P of F	0.786	0.686	0.051	0.049	0.9001	0.33	0.9997	0.5399	0.5000
CV	28.53	26.15	24.70	23.03	27.72	27.40	23.59	28.5	26.31
A*B	NS	NS	NS	NS	NS	NS	NS	NS	NS

Key:- NF= number of fruits, FW= fruit weight, FVW= fresh vine weight, FRW= fresh root weight, RL= root length, DVW= dry vine weight, DRW= dry root weight, GN= galling index and NP= nematode population. Means in the same column with the same letter are significantly not different according to Duncans New Multiple range test at 5 %.

**Table 4: Evaluation of Different Leaf powder on the Control of Root-knot Nematodes *Meloidogyne Javanica* on Sweet Melon on thG growth and Yield Parameters in 2021**

	NF	FW	FVW	FRW	RL	DVW	DRW	GN	N.P
.Plant Materials									
<i>T. indica</i>	20 <sup>b</sup>	524 <sup>b</sup>	284.6 <sup>b</sup>	21.1 <sup>b</sup>	17.02 <sup>b</sup>	85.3 <sup>ab</sup>	4.19 <sup>ab</sup>	1	256 <sup>c</sup>
<i>D.stramonium</i>	24 <sup>a</sup>	709 <sup>a</sup>	339.8 <sup>a</sup>	16.56 <sup>c</sup>	22.17 <sup>a</sup>	90.73 <sup>a</sup>	3.18 <sup>b</sup>	1	158 <sup>d</sup>
<i>V. doniana</i>	17 <sup>b</sup>	470 <sup>b</sup>	271.3 <sup>b</sup>	29.4 <sup>b</sup>	15.03 <sup>b</sup>	81.67 <sup>ab</sup>	4.79 <sup>ab</sup>	2	317 <sup>b</sup>
Control	12 <sup>c</sup>	325 <sup>c</sup>	219.89 <sup>c</sup>	36.02 <sup>a</sup>	11.03 <sup>c</sup>	62.19 <sup>c</sup>	6.02 <sup>a</sup>	2	487 <sup>a</sup>
Mean	18.06	465.3	280.05	25.27	16.5	78.86	4.77	19.6	304.8
P of F	0.048	0.138	0.003	0.002	0.0028	0.667	0.045	0.0021	0.0022
C.V	27.76	26.9	23.50	25.0	23.50	24.11	25.98	29.70	25.20
A * B	*	NS	**	**	**	*	*	**	**
Cultivars									
Jos Cultivar	17 <sup>a</sup>	507 <sup>b</sup>	256.67 <sup>b</sup>	23.87 <sup>a</sup>	16.000 <sup>a</sup>	70.09 <sup>b</sup>	5.48 <sup>a</sup>	1	298 <sup>a</sup>
Jimeta	19 <sup>a</sup>	550.3 <sup>a</sup>	308.07 <sup>a</sup>	24.67 <sup>a</sup>	17.89 <sup>a</sup>	82.29 <sup>a</sup>	5.00 <sup>a</sup>	1	131 <sup>b</sup>
Cultivar									
Mean	18.06	465.3	280.05	25.27	16.5	78.86	4.77	19.6	304.8
P of F	0.796	0.63	0.059	0.9402	0.9986	0.049	0.24	0.5187	0.4502
C.V	27.76	26.9	23.50	25.0	23.50	24.11	25.98	29.70	25.20
A*B	NS	NS	NS	NS	NS	NS	NS	NS	*

Key:- NF= number of fruits, FW= fruit weight, FVW= fresh vine weight, FRW= fresh root weight, RL= root length, DVW= dry vine weight, DRW= dry root weight, GN= galling index and NP= nematode population.

## SUMMARY, CONCLUSION AND RECOMMENDATION

**Summary:** Laboratory and field experiments were conducted to determine the effect of plant powder and extracts (*D. stramonium*, *T. indica* and *V. doniana*) in controlling juveniles of root-knot nematode on sweet melon in Yola, Adamawa State, Nigeria in 2020 and 2021. The design used for the field experiments were split plot design with four treatments replicated three times. Completely Randomized Design (CRD) was used in the laboratory with three treatments and five levels of concentration replicated three times.

Laboratory experiment was carried out at the Department of Crop Protection, Faculty of Agriculture, Modibbo Adama Universty, Yola and the field experiments were carried out at Loko Village in Song Local Government Area of Adamawa State. In the laboratory juvenile mortality test were conducted using 10 ml (1000 juveniles) suspension placed into aqueous solution to form crude extracts and distilled water as the control. Observation and count of dead nematodes were made after every 24 hours for three days. The crude extracts of *D. stramonium*, *T. indica* and *V.*

*doniana* gave the highest mortality rate of (97%, 85%, 19%) while control had the poorest of all 0% after 72 hours of exposure.

Two cultivars of local sweet melon (Jos local Cultivar and Jimeta local Cultivar) were planted using Complete Randomized Design (CRD) with four treatments including control replicated three times. Treated plants recorded lower galling index compared to untreated plants. *D. stramonium* treated plant recorded very few galls on the roots, lower nematode population, gave best fruit yield and fruits weight, longer root length, higher fresh and dry matter yield compared with other treatments and control. *T. indica*, is next to *D. stramonium* in all the parameters measured in terms of performance. Therefore these two plant powders exhibited nematicidal effects in them which indicated high phytochemical content present in the plant materials.

**Conclusion:** In conclusion, *D. stramonium*, both in laboratory and field trials shown to increase growth and yield of sweet melon. It gave the best results in all the parameters measured. Therefore, the plant materials powder and extracts have the potentials to control root-knot nematodes *M. javanica* which could possibly replace the hazardous nematicides which are environmentally unfriendly and hazardous to humans.

**Recommendation:** Based on this study the following recommendations were made:

1. *D. stramonium* and *T. indica* powder and extracts can be able to control root-knot nematodes *M. javanica* both in field and laboratory.
2. It is expected that the plant materials would have the potential for use as nematicides which could possibly replace the hazardous synthetic nematicides in the near future.

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## REFERENCES

- Aanany, A. M., Mahmoud, N. A., El-Mesalamy, A. F. and AbdelHafeez, A. R (2017a) Effects of plant powder of (*Solanum melongena* L.) to different rates of nitrogen under field conditions. *Journal of Central European Agriculture.*, 11(4):453-458.
- Abbasi, M. W., Ahmed, N., Zaki, M. J. and Shahid, S. S. (2010). Soil amendment with halophytes to induce physiological changes and reduce root knot nematode infection in eggplant and okra. *Phytopathology Mediterranean.* 49:352-260.
- Agbenin, N.O.; Emechebe, A. M.; Marley, P.S. and Akpa, A. D. (2005). Evaluation of nematicidal action on some botanicals on *Meloidogyne incognita* in vivo and vitro. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 106: 29-39.
- Ayoola P.B. and Adeyeye, A. (2010). Phytochemical and nutrient evaluation of *Carica papaya* (Pawpaw) leaves. *International Journal on Recent Research in Applied Sciences* 5(3), 325-328.
- Burger, Y. and Paris, H. S. (2010). Genetic diversity of *cucumis melon* in Janick J. ed. *Horticultural Reviews*. 36. New York, N.Y: Wiley, 165-198, 4P.

- Creight, J. D; Kokanova, E; Wehner, T. C; and Davis, A. R. (2010). Turkmenistan Melon (*Cucumis melon*) and water melons (*Citrullus Lanatus*) germs plasma expedition (2008). In: Thies J.
- Distance from .com (2003). www .distance from .com/ng/com. Retrieved on 14<sup>th</sup> November 2020.
- Faruk, A. (2014) Effect of some plant methanol extracts on egg hatching and juvenile mortality of root-knot nematode, *Meloidogyne incognita*. *American Journal of Experimental Agriculture* 4 (11): 1471-1479.
- Fenguan, P. (2020). Effect of organic amendment among soil nematodes community structure and metabolic foot prints in Soyabean phase of a maize rotation on mollisols. *Pedosphere*. 30: 554 - 554.
- Gregory, C. B., Marceline, E and Bonsi, C. (2017). The impact of plant-parasitic nematodes on Agriculture and Methods of Control. Doi/10.5772.68958
- Harry, S; Paris, Z. A. and Efraim L. (2012). Medieval emergency of sweet melons *Cucumis melo (Cucurbitaceae)*. *Annals of Botany* page 1-11.
- Hassan, M. A; Chinda, P. S. and Alegbeje, M. D. (2010). Management of root-knot nematode on tomato using organic wastes in Zaria, Nigeria. *Plant prot. Sci* 46: 34-39.
- Hussy, R. S. and Barker, K. R. (1973). A comparison of methods of collecting inocula of *Meloidogyne* spp. including new technique. *Plant Disease Reporter* 57: 1025-1028
- Ibrahim, E. A., (2012). Variability, heritability and genetic Advances in Egyptian sweet melon (*Cucumis melon* var Egyptians L.) under water stress conditions. *International Journal of Plant Breeding and Genetics* (4): 238-244.
- Jose Anthonio, L.P., Scott, E. and Ploeg, A. (2011). Control of root knot nematodes on tomato in stone wool substrate with biological nematicides. *The Journal of Nematology*. 43(2): 61-62
- Kemble, J. M. (2014). Guide to the commercial production of muskmelon (*cantaloupe*) and Related melons. Alabama cooperative Extension system.
- Mashela, P. W., H. A. and Madau, F. N. (2017). Comparison of the efficacy of ground wild cucumber fruits, Aldicarb and Fenamiphos on suppression of *Meloidogyne incognita* in tomatoes *Phytopathology*. 156:264-267.
- Mitkoski, N.A. and Abawi, G. S. (2011). Root knot nematode the plant health instructor. DOI: 10.1094/2003-0917, REVISED 2011.
- Nafeseh, K; Esmā, M. M; Abdolhosein, I. and Saeid, N. (2010). Management of root knot nematode *Meloidogyne incognita* on cucumber with the extract and oil of nematicidal plants. *International Journal of Agricultural Research*, 5(8): 582-586.
- Nkansah, G. O; Kanton, R. A. L; Arretefe, C. Z; Quaye, F. B and Mawuli, (2012). Agronomic Performance of Eight Sweet Melon Cultivars in three ecological zones of Ghana. *Journal of Agronomy*. 11(14): 94-100.

- Noling, J. W. (2012). Nematodes Management in *cucumbites* (cucumber, melon, and squash):- Continuing education seminar published by University of Missouri Extension.
- Ogwulumba, S. I; Ugwuoka, K. I. and Ogbiyi, R. O. (2011). Reaction of tomato Cv. Roma vf (*Soalnnum lycopersicum*) to *Meloidogyne javanica* Trent infestation in an ultisol treatment with Aqueous leaf extract of Bitter leaf (*Vernonia mygdalina* L.) and Mango (*Magnifera indica*). *Journal of Plant protection Research*, 51(1) : 14-17.
- Ononuju, C. C. and Nzenwa, P. O. (2011). Nematicidal effects of some plants extracts on egg hatchability and control of *Meloidogyne* spp. on cowpea (*Vigna unguiculata* L. Walp). *African Journal of Plant Science*. 5(3): 176 -182.
- Parris, H. S. (2012). Semitic-language records of snake melons (*Cucumis melon*, *Cucurbitaceae*) in the medieval period. *Genetic Resources and Crop Evolution* 59" 31-38.
- Roy, A; Bal, S. and Ferganym, S. (2012). Wild melon diversity in India (Punjab state). *Genetic Resources and crop Evolution* 59: 755-767. Sardenelli, S., and F. Elison ( 2005).
- Sajid, AK., Javed, N., Khan, M. A., Haq, I.U., and Safdar, A. (2011). Use of plant extracts as bare root treatment for the management of *Meloidogyne incognita*. *Pakistan Journal of Phytopathology*, 23(1):9-13.
- Saifullah, A; Naza, I; Palomares, J. E; Block, R. B; Khan,V.M. R; Ali, D. and Ali, S. C. (2012). Quantitative determination of nematicidal compound of plant origin. *Cell and molecular sciences*. 64 (4) 943-952.
- Sanaa, A. H., Baraa, A. A. H., Fatima, M., Hamad, M. M., Rady. (2018). The efficiency of some natural alternatives in root-knot nematode control *Plants and Agricultural Research*. 8:4
- Sofowora, A. (1993). Medicinal plants and traditional medicine in Africa. Spectrum Books Ltd (pub.), Ibadan.
- Szamosi, C; Solmaz, I; Sari, N. and Baraony, C. (2010). Morphological evaluation and comparison of Hungarian and Turkish melon (*Cucumis melo* L.) germ plasm *Scientia Horticulture* 124: 170-182.
- Telford, I. R. H; Sebastian, P; Bruhl, J. J; Renner, S. S. (2011). *Cucumis* (*Cucurbitaceae*) in Australia and Eastern Malesia, including newly recognized species and the sister species to C. Melo *Systematic Botany* 36: 376-389.
- Trifonovo, Z. and Atanasor, A. (2011). Control of potato cyst nematodes (*Globoderra rostochiensis*) with some plant extracts and neem products Bulgarian. *Journal of Agricultural Science* 17: (5) 623-627.
- Umar, I. (2012a). Comparative efficacy of four organic amendments for controlling root knot nematode in Cowpea (*Vigna unguiculata*)(L) Walp *Journal of Agriculture, Biotechnology and Ecology*, 5: 75-83.

Umar, I. (2012b). Effect of Pawpaw (*Carica papaya*) leaf powder on the control of *Meloidogyne javanica* on cowpea (*Vigna unguiculata* (L. Walp) *Journal of Arid Agriculture*, 21(52): 55-60.

Whitehead, A. D. and Hemming, J. R. (1965). A comparison of some quantitative methods of extracting small and vermiform nematodes from soil. *Annals of Applied Biology* 55; 25-