

## Reaction of Canary melon (*Cucumis melo* var *Inodorus* Jacq.) to Inoculation with Root-knot Nematode (*Meloidogyne javanica*) Eggs in Jalingo, Nigeria

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### Abstract

An experiment was conducted in 2023 and 2024 to determine the reaction of canary melon to inoculation with *M. javanica* eggs in Jalingo, Nigeria. Eggs of *M. javanica* were inoculated into one-week-old canary melon plant roots at the rate of 500, 1000, 1500, 2000 and 0 (control) eggs per plant. The experiment was terminated at the end of week six. Data was collected on growth and nematode parameters and analysed. The result showed that among the inoculated treatments, T1 (500 egg treatment) with lowest number of *M. javanica* eggs showed better growth and nematode parameters than treatments with higher level of egg inoculation. T1 recorded lowest fresh root weight (2.23 g and 2.24 g/plant), lowest soil nematode population (3166.66 and 3162.66), lowest galling index (2.00 and 2.00) and higher fresh shoot weight (10.90 g and 11.40 g/plant) in both 2023 and 2024 respectively. From the result, canary melon will perform better in soil with 500 eggs inoculum than at higher levels and the *M. javanica* will be easier to manage. Field trial of this experiment is recommended.

Keywords: *M.javanica*, Eggs, Canary melon, Inoculation, Treatment

### 1.0 Introduction

Canary melon, a cultivar of *Cucumis melo*, is an important crop grown for its sweet, white flesh. Like other varieties of melon, it is susceptible to nematode infestations, particularly *Meloidogyne javanica* (Sasser and Freckman, 1987). Nematodes damage melon crops by attacking the root system, leading to reduced vigor, lower fruit yield, and poor quality (Kirkpatrick et al., 2015). *M. javanica* is a root-knot nematode known to affect a wide range of crops, including melons, leading to root damage, stunted growth, and reduced yields (Jones et al., 2013). Nematodes cause damage by penetrating plant roots and forming galls, which disrupt water and nutrient uptake (Hussey and Barker, 1973). *M. javanica* is known for its ability to alter host plant physiology, leading to the formation of root galls and reduced nutrient uptake and these ultimately result in stunted growth, wilting, and yield loss (Sikora and Fernandez, 2005).

Different cultivars of cucurbits, including canary melons, have displayed varied responses to nematode inoculation with some cultivars showing higher susceptibility and pronounced root galling, while others showing more resilience (De Boer *et al.*, (2014). Abood *et al.* (2019) observed a marked decrease in growth parameters, in sweet melon varieties heavily infested by *M. javanica* with galls formed on roots directly correlated with the severity of the nematode infection, leading to reduction in photosynthetic capacity and nutrient uptake. Nematode damage to roots disrupted water uptake, exacerbating drought sensitivity (Moens *et al.*, 2009).

Effective management of *M. javanica* in melon crops requires an integrated approach. Resistant melon cultivars, when available, are one of the most effective ways to manage nematode populations (Davis *et al.*, 2009). El-Wakeil *et al.* (2019) evaluated different sweet melon cultivars and found that certain lines displayed significantly lower nematode reproduction rates and less root galling, suggesting a potential for breeding programs aimed at nematode resistance. However, the development of resistant varieties for specific melon types, including canary melons, is an ongoing challenge. In addition to resistance breeding, cultural practices such as crop rotation, use of nematicides, and soil solarization are commonly employed to reduce nematode populations and limit the damage caused to melon crops (Abd-Elgawad *et al.*, 2018). Also, the introduction of certain microbial antagonists has demonstrated promise in suppressing nematode populations and alleviating the adverse effects on crop growth (Khan *et al.*, 2020).

The cultivation of canary melon has decreased along the River Lamurde in Jalingo, Taraba State, Nigeria in the last two years. There is need to intensify research on suitable conditions for growth of these melons in this geographical region. As *M. Javanica* infestation is linked to reduction in canary melon yield- there should be more studies on exploring what populations of *M.javanica* would significantly affect canary melon production. This work aims to find out the effect *M. Javanica* eggs on the growth of canary melons in a pot experiment at Jalingo, Taraba State, Nigeria.

## **2.0 Materials and Methods**

### **2.1 Experimental Site**

The experiment was conducted in June 2023 and 2024 at the Faculty of Agriculture, Taraba State University, Jalingo, Nigeria.

### **2.2 Nematode Egg Inoculum: Source and Extraction Method**

The eggs of *Meloidogyne javanica* used in this experiment were the inoculum and were extracted from a pure culture of infested okra plants raised in plastic pots. Galled okra roots were washed and cut into smaller sizes and then agitated in 0.05% NaOCl for 2-3 minutes (Hussey and Barker, 1973) followed by rinsing in tap water through 25-um pores (Dong *et al.*, 2007). These eggs were then used to prepare nematode egg suspension at a 100 eggs/ml concentration.

### **2.3 Soil Sterilization and Experimental Setup**

From the Teaching and Research Farm of Taraba State University, Jalingo, sandy-loam soil was collected, bulked and sterilized in an electric oven at 60°C for 30 minutes to eliminate any existing microbes. After that, 8.0 kg of sterilized soil was put into each of 18 perforated 20 cm diameter plastic pots. The setup included five treatments replicated three times and arranged in a Complete Randomized Design (CRD). The treatments were as follow: T<sub>1</sub> - 500

eggs, T<sub>2</sub> - 1000 eggs, T<sub>3</sub> - 1500 eggs, T<sub>4</sub> - 2000 eggs and T<sub>5</sub> - 0 eggs (control). This setup was repeated in 2024 to ensure reliability and accuracy of the results.

#### 2.4 Planting of Seeds and Soil Inoculation with Nematode

The seed of canary melon used in this research was Uranus F1 high-yielding variety from East-West Seed Co. purchased from Jalingo market. These seeds were planted at two seeds per hole in soil in the 15 pots in June 2023 and again in 2024. One week after emergence, the seedlings were thinned down to one seedling per pot. Also, a hole was made beside each seedling into which was dispensed the *M. javanica* egg suspension prepared above according to the treatment specification were applied. The hole was then covered up with soil. All other agronomic practices were carried out as required. The experiment was terminated at week 6 after emergence.

At termination, nematodes were extracted from each treatment using the modified Baermann method (Whitehead and Hemming, 1965). Galling index was determined using the rating scale of Sasser and Freckman (1984) as follows: 1 – no galls, 2 = less than 20 gall, 3 = 21 – 40 galls, 4 = 41 – 60 galls, 5 = more than 75 galls. Data collected were subjected to analysis of variance using GraphPad Prism Version 5.1, and the Standard Error of the Mean (SEM) was used for mean separation.

### 3.0 Results

Result of the vine length showed that the control (uninoculated) melon plants recorded significantly ( $p=0.05$ ) longer vines (38.5 cm in 2023 and 35.80 cm in 2024) than inoculated treatments (Table 3.1). Between the inoculated treatments in 2023, T1 produced longer vines than others (T2, T3 and T4); the shortest of all was produced in the T4 treated plants. This pattern of differences was repeated in 2024.

For number of leaves, the result showed that control recorded significantly more leaves (15.67 and 16.33 for both years) than all other treatments. Among the inoculated treatments, as the number of eggs used for inoculation increased there was a corresponding decrease in the number of leaves per plant. T1 (500 eggs inoculation) recorded 12.66 and 12.00 leaves for both 2023 and 2024 while the lowest was T4 (2000 eggs) with 8.00 and 8.33 leaves for both years (Table 3.1). In 2023 and 2024, result for number of branches showed control (T1) produced significantly ( $p=0.05$ ) more branches (3.33 in 2023 and 3.00 in 2024) than all the other treatments. T1 had more branches than others (2.33 in 2023 and 2.66 in 2024) followed by T3 and least was T4 with 1.33 branches in both years (Table 3.1).

Result for the fresh shoot weight showed control (T5) recorded significantly ( $p=0.05$ ) higher shoot weight (14.00 g in 2023 and 14.30 g in 2024) than all other treatment followed by T1 (10.9 g in 2023 and 11.40 g in 2024), and least was T4 (7.60 g in 2023 and 6.70 g in 2024) (Table 3.1). Higher levels of eggs led to higher number of individual nematodes whose attack on melon plants caused more damage leading to reduced shoot growth (Table 3.1). For fresh root weight, roots of T4 treatment melon plants were significantly heavier than all other treatments with 4.46 g in 2023 and 4.56 g in 2024. This was followed by T3 (4.13 g in 2023 and 4.16 g in 2024) and least was control with 2.00 g (2023) and 2.10 g (2024) (Table 3.2).

**Table 3.1: Effect of rootknot nematode (*M. javanica*) egg inoculation on some growth parameters of canary melon at 6 weeks after emergence in 2023/2024**

Parameters	VL (cm)		NL		NB		FSW(g)		RL (cm)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
T1 (500 eggs)	21.53	22.20	12.66	12.00	2.33	2.66	10.90	11.40	11.90	11.06
T2 (1000 eggs)	13.13	14.90	11.00	10.66	2.33	2.33	9.60	10.10	10.30	10.50
T3 (1500 eggs)	9.87	9.63	11.00	10.33	2.00	1.66	8.40	8.60	7.90	7.90
T4 (2000 eggs)	5.93	6.27	8.00	8.33	1.33	1.33	7.60	6.70	7.06	7.20
T5 (control)	38.50	35.80	15.67	16.33	3.33	3.00	14.00	14.30	14.06	13.16
<b>Mean</b>	17.79	17.76	11.66	11.53	2.26	2.20	10.10	10.22	10.24	9.96
<b>SEM (±)</b>	5.78	5.25	1.25	1.33	0.32	0.31	1.12	1.28	1.28	1.08

VL-Vine length, NL-Number of leaves, NB-Numbers of Branches, FSW-Fresh Shoot Weight, RL-Root Length, SEM-Standard Error of Mean

**Table 3.2: Soil Nematode (*M.javanica*) parameters and canary melon growth parameter at 6 weeks after emergence of canary melon in year 2023 and 2024**

Parameters	FRW (g)		SNP		GI		RF	
	2023	2024	2023	2024	2023	2024	2023	2024
T1 (500 eggs)	2.23	2.20	3166.66	3162.66	2.00	2.00	3.17	3.16
T2 (1000 eggs)	2.93	2.43	3443.66	3631.33	2.66	3.00	1.72	1.81
T3 (1500 eggs)	4.13	4.16	4485.33	4396.66	3.66	3.66	1.49	1.43
T4 (2000 eggs)	4.46	4.56	4967.00	4852.66	4.33	4.66	1.24	1.15
T5 (control)	2.00	2.10	0.00	0.00	0.00	0.00	0.00	0.00
<b>Mean</b>	3.15	3.09	3212.53	3208.66	2.53	2.66	1.53	1.51
<b>SEM (±)</b>	0.50	0.52	868.18	854.14	0.74	0.79	0.50	0.51

FRW-Fresh Root Weight, SNP-Soil Nematode Population, GI-Galling Index, RF-Reproduction Factor, SEM-Standard Error of Mean

Result for soil nematode population showed treatment T4 that received the highest number of eggs at inoculation recorded the highest number of soil nematode population of 4967.00 in 2023 and 4852.66 in 2024) than all other treatments. This was not significantly ( $p>0.05$ ) higher than T3 which was next (4485.33 in 2023 and 4396.66 in 2024) but significantly ( $p=0.05$ ) higher than both treatments T2 and T1. The control (T5) received no inoculation and so recorded no nematodes in the soil (Table 3.2).

The galling index result indicated that canary melon plants which received treatment T4 (2000 eggs) recorded higher galling index (4.33 in 2023 and 4.66 in 2024) than other treatments. This was followed by T3 (1500 eggs) with 3.66 in both 2023 and 2024. Treatments T2 (2.66 in 2023 and 3.00 in 2024) and T1 (2.00 in both years) recorded significantly ( $p=0.05$ ) lower galling index than T4 showing that t4 had more galls than these other treatments in both 2023 and 2024 (Table 3.2).

*M. javanica* seemed to reproduce more on canary melon plants with the least number of egg inoculation in both 2023 and 2024. The result for reproduction factor (RF) showed T1 (500 eggs) recorded significantly ( $p=0.05$ ) higher RF of 3.17 and 3.16 compared with other treatments which had more eggs inoculated. The control was not inoculated and therefore, there were no eggs (Table 3.2).

#### 4.0 Discussion

The study showed that for melon vine length, the higher the number of eggs of *M. javanica*, the shorter the vine length. This shows how damaging the nematode is to canary melon. Other studies show that inoculating susceptible melon varieties with eggs of nematodes leads to a significant reduction in growth and yield (Huang *et al.*, 2016). The result of vine length agrees with prior established research that indicates higher levels of inoculum have the tendency of overwhelming the defense mechanisms of a host plant thereby causing more severe damage (Khair *et al.*, 2020).

Akhtar and Malik (2000) reported that a reduced number of leaves and yellowing foliage is exhibited by plants suffering from nematode infestations which occur from the nematodes' detrimental impact on root health, thereby decreasing the plant's ability to absorb water and nutrients, ultimately reducing leaf production and overall plant growth. This present work has demonstrated this. .

From the result, the higher the number of *M. javanica* egg inoculum used, the lower the number of branches produced by the canary melon plants. This may have resulted from the greater damage done to the plants by a higher population of nematodes attacking them. Haseeb *et al.* (2015), reported that infestation of plants by nematodes can limit the plant's branching capacity by damaging root systems and disrupting nutrient and water uptake and thereby adversely affect branch development. Jones (2017) reported that nematode infestations can adversely affect shoot weight by damaging plant tissues and disrupting nutrient uptake. This reinforces the need for effective management strategies to mitigate these impacts. The results show that the higher the inoculum level, the higher the root weight which are signs of poor root health. Galls frequently affect plant health negatively by blocking water and nutrient flow, resulting in stunted growth (McSorley and Frederick, 2000). This could have accounted for why the inoculated treatments with their higher root weights recorded lower fresh shoot weight and shorter vine length. This agrees with Abood *et al.* (2019) who reported that galls formed on the roots of sweet melon plants by *M. javanica* were directly correlated with the severity of the nematode infection, leading to reduced photosynthetic capacity and nutrient uptake. There was higher reproduction of *M. javanica* in melon plants treated with lower amount of the inoculum. This may have resulted from the fact that the nematodes that hatched out of eggs in the lower-level treatment (T1-500 eggs) had more plant tissue in which to invade and reproduce whereas the higher eggs in T2 (1000), T3 (1500) and T4(2000) meant stiffer competition by individual worms for available plant tissue. Different plant varieties exhibit varying levels of resistance to nematodes, affecting their ability to support nematode populations and influencing overall plant health (Jones *et al.* (2018).

#### 5.0 Conclusion and Recommendation

This study has demonstrated that, canary melon will perform better in soils with 500 eggs inoculum than at soils with higher nematode egg populations between 1000-2000 eggs; at 500 eggs inoculum *M. javanica* damage level was lower on number of leaves/branches and shoot and root weight. These parameters ultimately determine canary melon yield. Therefore, it is important for farmers to find out the inoculum level in soils known to be infested with the nematode to avoid areas of high infestation or carryout measures that reduce the amount of inoculum in the soil. A field trial of this experiment is also recommended.

## References

- Abd-Elgawad, M. M., Elsheikh, E. A., & Handoo, Z. A. (2018). Response of melon varieties to *Meloidogyne javanica* infestation in Egypt. *Nematology*, 20(4):485-493.
- Abood, T. A., Aslam, S., & Ibrahim, M. H. (2019). Response of sweet melon (*Cucumis melo*) to *Meloidogyne javanica* infestation. *Journal of Nematology*, 51(2):1-10.
- Akhtar, M.F. and Malik, A. (2000). Roles of organic amendments and soil organisms in the biological control of plant-parasitic nematodes: A Review. *Bioresource Technology*, 74(1):35-47.
- Barker, K. R., and Koenning, S. R. (1998). Developing sustainable systems for nematode management. *Annual Review of Phytopathology*. 36, 165-205.
- Davis, R. F., Roberts, P. A., & Smith, R. D. (2009). Nematode resistance in melon and watermelon cultivars. *HortScience*, 44(3), 683-688.
- De Boer, J., Van der Veen, A., & O'Donnell, A. (2014). "Host plant response to root-knot nematodes in cucurbits." *Plant Pathology*, 63(4):712-721.
- Dong, W., Holbrook, C.C., Timper, P., Breneman, B.T. and Mullinix, B.G. (2007). Comparison of Methods for Assessing Resistance to *Meloidogyne arenaria* in Peanut. *Journal of Nematology*, 39(2): 169 – 175.
- El-Wakeil, N. E., El-Sayed, S. A., & Abo-Elyousr, K. A. (2019). Evaluation of sweet melon cultivars for resistance to *Meloidogyne javanica*. *Crop Protection*, 123:1-5.
- Haseeb, A., Khan, M. A., and Ali, S. (2015). Impact of Nematodes on Plant Growth and Development. *Journal of Plant Pathology*, 97(1), 123-130.
- Huang, H., Zhang, W., & Zhang, Y. (2016). Effects of *Meloidogyne javanica* infection on melon growth. *Nematology*, 18(9):1105-1115.
- Jones, J. T., Haegeman, A., Danchin, E. G. J., Gaur, H.S., Helder, J., Jones, M.G.K., Kikuchi, T., Lopez, R.H.M., Palomares-Ruis, J.E., Wesemael, W.M.E. and Perry, R. (2013). Top 10 plant nematodes in molecular plant pathology. *Molecular Plant Pathology*, 14(9), 679-689.
- Jones, R. (2017). The Impact of Nematodes on Shoot Development and Growth. *Plant Health Journal*, 15(2), 45-52
- Khan, S. A., Anwar, S., and Khan, M. R. (2020). Integrated Management of *Meloidogyne javanica* in Cucumber and Melon: A Review. *Annals of Plant Protection Sciences*, 28(1):1-7.
- Khair, S., Khan, A., & Abbasi, S. (2020). Influence of nematode inoculum density on the resistance of melon varieties to *Meloidogyne javanica*. *Acta Horticulturae*, 1226:79-86.
- Kirkpatrick, T. L., Harris, T. M., & Gill, M. L. (2015). Managing nematode pests in melon crops. *Nematropica*, 45(2), 255-267.

- Koenning, S. R., Overstreet, C., Noling, J. W., Donald, P. A., Becker, J. O., & Fortnum, B. A. (1999). Survey of crop losses in response to phytoparasitic nematodes in the United States for 1994. *Journal of Nematology*, 31, 587-618.
- McSorley, R., & Frederick, J. (2000). Nematode Galls: Impact on Plant Growth and Management Strategies. *Journal of Nematology*, 32(1), 1-7.
- Moens, M., Perry, R. N., and Starr, J. L. (2009). Meloidogyne species – A diverse group of novel and important plant parasites. In: Perry, R. N., Moens, M., & Starr, J. L. (Eds.), Root-knot nematodes. CABI International, Cambridge, MA (USA), pp. 1-17.
- Sasser, J. N., and Freckmann, D. W. (1984). A scale for rating root galling in soybeans. *Journal of Nematology*, 16(1), 198-202.
- Sasser, J. N., and Freckman, D. W. (1987). A world perspective on nematology: The role of the society. *Agricultural Research*, 17(2):54-57.
- Sikora, R. A., & Fernández, E. (2005). Nematodes parasites of vegetables. In: Liuc, M., Sikora, R. A., and Bridge, J. (Eds.), Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. CAB International, Wallingford (GBR), pp. 319-392.
- 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 – 38.