

**ASSESSMENT AND MANAGEMENT OF ROOT-KNOT NEMATODE (*Meloidogyne Spp.*) ON THE GROWTH OF DIFFERENT ACCESSIONS OF MUNG BEAN (*Vigna radiata*)**

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**ABSTRACT**

Root-knot nematodes (*Meloidogyne spp.*) represent a major biotic constraint to mung bean production worldwide, severely impacting root function, nutrient uptake, and ultimately, crop yield. This study was conducted to assess the effect of *Meloidogyne spp.* inoculation on the growth of five mung bean accessions (TVR 44-TV 141) and to evaluate the efficacy of two locally sourced botanical extracts: lemon grass (*Cymbopogon citratus*) and bush mint (*Hyptis suaveolens*), applied individually and in combination. The experiment was laid out in a Completely Randomized Design (CRD) using five accessions: TVR 44, TVR 83, TVR 97, TVR 101, TVR 141 and five treatment levels: T1-Control, T2-Inoculated, T3-Powered form of lemon grass leaves, T4-Powered form of bush mint, T5-Combination of powders. Results showed that plants inoculated with nematodes with no botanical (T2) had the lowest growth and yield across all monitored parameters. Accession TVR 141 also showed better performance and tolerance to the nematode infestation, achieving the highest pods per plant of 4.8. These findings demonstrate that utilizing tolerant mung bean varieties alongside eco-friendly botanical formulations offers a highly effective and sustainable strategy for Integrated Nematode Management (INM) in mung bean cultivation, providing a viable alternative to synthetic chemical nematicides.

**Keywords:** Accession, Control Nematicide, Mung Bean, Plant Extracts.

**1. INTRODUCTION**

Mung bean (*Vigna radiata*) a legume plant of the pea family (Fabaceae). It is cultivated primarily for its edible seeds and young sprouts (Melissa, 2023). It is a dicotyledonous plant commonly referred to as green or golden gram, moong, ludou (Chinese), green soy, and chop bean (Agugo, 2003; Leung, 2007). The crop is also grown in relatively dry tropical and subtropical regions, including the Caribbean and parts of Africa. In Nigeria, it has been successfully cultivated in many places, especially in mid-Western and Southern regions (Agugo, 2003; Mensah & Tope, 2007).

Nutritionally, mung bean are high in dietary fiber, and protein, and are also a source of iron, magnesium, potassium, and a number of essential amino acids. (Melissa, 2023). The high protein content in mung beans makes them an essential dietary staple in many regions where protein deficiency is a concern, particularly in developing countries where meat consumption is limited. Additionally, mung beans contain antioxidants and bioactive compounds that contribute to their

functional qualities, including anti-inflammatory properties and potential roles in reducing the risk of chronic diseases such as diabetes and cardiovascular ailments. Apart from its role in human nutrition, mung bean has various applications, including use as green manure, forage for livestock, and medicinal purposes (Huijie et al., 2003; Ugeese & Avan, 2005). In human diets, it is commonly consumed as boiled seeds, incorporated into vegetables and meat dishes, or prepared as a dessert. It is also processed into flour for making bread and cakes. Additionally, mung bean sprouts are popularly used in egg rolls and other vegetable dishes (Mendoza et al., 2001). Sprouts are particularly nutritious as they contain higher levels of vitamin C, folate, and other essential nutrients compared to unsprouted beans. Agronomically, *Vigna* crops have the ability to fix atmospheric nitrogen in association with soil *Rhizobium* bacteria, improving soil fertility and reducing the nitrogen fertilizer requirement of the main crop in a pulse crop-related rotation system. (Luce et al., 2015). The nitrogen-fixing ability of mung bean not only benefits its own growth but also enriches the soil for subsequent crops, making it an excellent choice for crop rotation systems, especially in sustainable and organic farming.

However, despite its numerous advantages, mung bean production faces several challenges, with pests and diseases being the most significant threats. Pests and diseases account for nearly 50% of yield losses in mung bean cultivation. Among these, root-knot nematodes (*Meloidogyne* spp.), belonging to the phylum Nematoda, pose a major problem. These pathogens pose a great problem to the cultivation of pulse crops causing severe yield losses. Nematodes attack a wide range of crops, causing significant economic losses worldwide. These soil-borne pathogens cause the formation of root galls, resulting in the reductions of growth by troubling the nutrient and water uptake, increased wilting, mineral deficiency, and poor yield of diseased plants (Abad et al., 2003). These symptoms make affected plants more susceptible to secondary infections by other soil pathogens, compounding the negative impact on crop production. Researchers have recorded high-yield losses of mung bean due to *M. javanica* and *M. incognita* under field conditions (R. Howard & Chris Taylor, 2008). The impact of these nematodes is particularly severe in tropical and subtropical regions, where favorable environmental conditions allow them to thrive year-round, leading to recurring infestations. According to (Taniwiryono et al., 2007), synthetic nematicides have been mostly used by farmers over the years, leading to their excessive and unsafe usage. This led to the need for alternative control options that will be of economic importance, effective as the synthetic nematicides, nontoxic and readily available (Fernandez et al., 2001). Hence, identifying and developing resistant mung bean varieties is a critical aspect of sustainable nematode management for a long-term and environmentally friendly solution that can significantly reduce dependency on chemical control methods.

Thus, this study aims to assess the impact of root-knot nematodes on mung bean growth and yield, with the objective of identifying resistant accessions that can withstand nematode infestations while maintaining high productivity.

### **Objectives**

1. To determine the effects of root-knot Nematodes on the growth of five accessions of mung bean.
2. To determine the efficacy of two plant extracts in the management of root-knot nematode infecting mung bean.

## 2. MATERIALS AND METHODS

**2.1 Study Area:** Laboratory experiment was carried out at the Department of Crop Science and Horticulture while the greenhouse experiment was at the Teaching/Research Laboratory of the Botany Department in Nnamdi Azikiwe University, Campus, Anambra State.

**2.2 Collection of Materials:** Certified seeds of selected mung bean (*Vigna radiata*) accessions were collected from the Germplasm unit of International Institute of Tropical Agriculture, Ibadan. Infested roots containing root-knot nematodes (*Meloidogyne* spp.) were obtained from the Department of Crop Protection, University of Ilorin.

**2.3 Soil Sterilization:** Top soil (0-15 cm) was collected from Nnamdi Azikiwe University premises. The soil mixture was moistened and then put into a cut drum, covered and heated for 24 hours (Ononuju et al., 2014). After cooling, 3 kg of soil was weighed and filled into each pots.

**2.4 Experimental Design and Treatments:** The experiment was laid out in a completely Randomized Design (CRD) and replicated 3 times. Five accessions of mung bean (V1-TVR 44, V2-TVR 83, V3-TVR 97, V4-TVR 101, V5-TVR 141) was used while botanical applications include T1- Control (Non-inoculated), T2- Inoculated, T3- *Cymbopogon citratus* powder, T4- *Mesosphaerum suaveolens* powder, T5- Combination of *Cymbopogon citratus* and *Mesosphaerum suaveolens*.

**2.5 Nematode inoculum preparation and sowing of seeds:** To obtain the nematode inoculum, root-knot nematode (*Meloidogyne incognita*) eggs were extracted from infected tomato roots using the sodium hypochlorite method. The eggs were collected and incubated in water at 25°C to hatch, producing second-stage juveniles (J2s), which was used as the inoculum for the experiment. About 500 eggs and juveniles was pipetted into each of the pots except the control. Mungbean seeds were pre-soaked for six hours to enhance germination. Three seeds were sown per hole in the plastic buckets containing 2 kg of the sterilized soil. Two weeks after sowing, the seedlings were thinned to retain only one healthy seedling per pot. (Polthanee et al., 2015). Before planting, each pot was inoculated with 1000 J2s of *M. incognita* by pipetting the nematode suspension into four holes around the root zone of each plant.

## 2.6 Preparation and Application of Botanical Extracts

**Collection and Preparation of Plant Extracts:** Fresh lemongrass (*Cymbopogon citratus*) leaves and bush mint leaves (*Mesosphaerum suaveolens*) were harvested from Nnamdi Azikiwe University Premises Awka, Anambra State. Washed thoroughly and chopped into small pieces and were taken to the Department of botany for processing.

**Extraction of powdered leaf extracts of botanicals:** Fresh leaves of lemongrass and bush mint were separated, washed thoroughly with clean water and air-dried for 14 days until they became crisp. Five hundred grams of the dried leaves were then blended into fine powder using an electric blender and passed through a fine mesh sieve to ensure uniform particle size. The powdered botanicals were stored in labeled, airtight containers in a cool, dry place until use (Ezeonu et al., 2017; Yusuf et al., 2021).

**Application of botanical:** The treatments were applied one week after planting. Round holes were made around the base of each plant, and 100 g of the botanical powder was placed into the holes and covered with soil immediately after application (Izuogu et al., 2016; Okechalu et al., 2016)

**2.7 Cultural Practices:** Regular watering was done to maintain optimal soil moisture, and weeding was carried out as frequently as weeds emerged, by hand-picking with no chemical pesticides used to prevent disruption of nematode-plant interactions.

**2.8 Data Collection and statistical analysis**

*Data were collected on plant height, yield, nematode population in the soil and root, number of eggs, and root knot rating. The gall index was determined by rating the number of galls on a 0–4 scale. The General Statistical Package (GENSTAT) 2009 was used for analysis of variance (ANOVA). In cases where significant differences were found, LSD test was used to separate the means at a 5% probability level.*

**3. RESULTS**

Table 1 shows the effect of mung bean accessions on plant height. At weeks 1 and 2, TVR 101 recorded the highest heights (20.47 cm and 23.79 cm), followed closely by TVR 141 (19.47 cm and 22.87 cm). However, there was a significant difference in plant height. By week 8, TVR 141 attained the highest plant height (40.13 cm) which was significantly higher than other accessions, and followed by TVR 101 (34.87 cm). Meanwhile, TVR 97 had the lowest height (31.21 cm)

**Table 1: The Effect of five mung bean accessions on plant height**

Accession	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8
TVR 44	16.21	19.21	22.47	23.47	25.01	27.53	31.09	31.93
TVR 83	17.21	20.75	23.55	26.07	27.17	30.17	32.67	32.19
TVR 97	12.53	17.85	20.31	21.77	24.93	25.46	28.83	31.21
TVR 101	20.47	23.79	25.65	27.05	29.37	30.88	33.57	34.87
TVR 141	19.49	22.87	25.53	29.31	32.47	34.54	37.91	40.13
<b>LSD</b>	<b>2.530</b>	<b>3.173</b>	<b>3.574</b>	<b>4.104</b>	<b>4.437</b>	<b>4.905</b>	<b>4.969</b>	<b>5.012</b>

Table 2 showed the effect of botanicals on plant height. At week 1, the control had the highest plant height (18.65), followed closely by the combination of both botanicals (17.71) and lemon grass powder (17.47), while bush mint powder had the lowest height 15.85 cm, however, there was no significant difference among the treatments at this stage. By week 8, combination of both botanicals attained the highest height 39.91 which was significantly higher than other botanicals, followed by Control (35.15), while bush mint powder had the lowest height (30.15).

**Table 2: Effect of different treatments on mung bean plant height**

TRT	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8
T1	18.65	22.75	24.75	26.61	28.93	30.81	33.01	35.15
T2	16.27	19.47	21.05	23.03	25.75	27.79	31.31	32.71
T3	17.47	21.17	23.39	24.41	26.49	28.01	32.69	32.41
T4	15.85	18.17	20.79	22.81	23.45	25.58	29.15	30.15
T5	17.71	22.91	27.53	30.73	33.33	36.39	37.91	39.91
<b>LSD</b>	<b>3.156</b>	<b>3.303</b>	<b>3.393</b>	<b>3.999</b>	<b>4.329</b>	<b>4.647</b>	<b>5.011</b>	<b>4.994</b>

T1=control, T2=Inoculated, T3= powdered form of lemon grass leaves, T4=powdered form of bush mint leaves, T5=combination of both botanicals

Table 3 showed the effect of accessions on the number of pods per plant. Results showed there was no significant difference among the accessions. Notwithstanding, TVR 142 (4.2) had more pods than other accessions while TVR 83 (3.8) had the least

**Table 3: Effects of accessions on number of pods per plant**

Accessions	No of pods per plant
TVR 44	4.1
TVR 83	3.8
TVR 97	3.9
TVR 101	4.0
TVR 141	4.2
<b>LSD</b>	<b>0.524</b>

Table 4 showed the effect of botanical treatments on the number of pods per plant. From the results, the control had the highest number of pods which was significantly higher than inoculated pots (without botanicals), but not significantly higher than pods with botanical treatments.

Botanicals	No of pods per plant
T1	5.2
T2	3.2
T3	4.9
T4	4.8
T5	4.8
<b>LSD</b>	<b>0.61</b>

The effect of plant extracts on soil nematode population (SNP), root nematode population (RNP), number of eggs and gall rating is shown in Table 5. Result revealed a significant lower population of SNP, RNP, No of eggs and gall rating in Uninoculated (0.00) compared to other treatments. The nematode population was also significantly lower in lemon grass powder, bush mint powder, and Combination of both botanicals compared to inoculated plants which had significantly higher population. Similarly, lemon grass powder, bush mint powder and Combination of both botanicals also had a remarkably reduced nematode levels, with low gall ratings (1.45 and 1.25 respectively), showing an increase growth and moderate nematode control. In contrast, inoculated had the highest gall index (8.3), which was significantly higher than other treatments

**Table 5: Effect of plant extracts on Mung bean accessions infected with *Meloidogyne* spp.**

TREATMENTS	SNP	RNP	NO. OF EGGS	Gall rating
T1	0	0	0	0
T2	33.9	10.6	36.4	8.3
T3	9.5	5.25	2	1.45
T4	7.5	2.75	4	1.25
T5	5	1.5	2.5	0.75
LSD	4.596	2.752	7.54	1.646

#### 4. DISCUSSION

The result from this experiment revealed the growth and yield response of five mung bean accessions to root-knot nematodes (*Meloidogyne* spp.) infection and botanical management (*Cymbopogon citratus* and *Mesosphaerum suaveolens*). The five mung bean accessions (TVR 44 –TVR 141) exhibited variable responses to nematode infestation and botanical treatments. We also observed that treatments inoculated with *Meloidogyne* spp. alone consistently recorded the lowest performance in growth and yield parameters. This indicates that *Meloidogyne* spp. cause severe damage to plant roots, restricting water and nutrient absorption, thereby stunting overall growth and photosynthetic activity. Similar reports by Izuogu et al. (2016) and Kayani et al. (2017) also showed that *Meloidogyne* spp. infections result in poor plant establishment and reduced yield in legumes.

Conversely, applications of *Cymbopogon citratus* and *Mesosphaerum suaveolens* treatments enhanced plant growth compared to the nematode-only treatment. Among these, powder combination of *Cymbopogon citratus* and *Mesosphaerum suaveolens* seems to have the highest performance. This suggests a synergistic nematicidal effect, where bioactive compounds from both plants interact to suppress nematode populations and reduce root damage. *Cymbopogon citratus* contains citral, limonene, and geraniol, while and *Mesosphaerum suaveolens* possesses menthol and pulegone, all of which have been documented to inhibit nematode activity and promote healthier root systems (Sharma et al., 2018).

The variations in responses of accessions observed also indicate genetic variability in resistance or tolerance to nematode infestation. Accessions TVR 97 and TVR 101 maintained relatively higher growth performance even under stress, implying the presence of inherent tolerance mechanisms, possibly thicker root walls, production of secondary metabolites, or resistance-related gene expression. Such genotypes can serve as useful sources of resistance in mung bean improvement programs.

The findings from this experiment emphasize the potential of using botanicals as eco-friendly alternatives to chemical nematicides. This was also the observation of previous authors that superior performance of plants treated with the combination of lemon grass and bush mint indicates that natural plant products can provide effective, sustainable control of root-knot nematodes.(Poudel et al., 2023). The moderate tolerance displayed by certain mung bean varieties (e.g., TVR 97) suggests that resistance breeding can be combined with botanical applications to achieve Integrated Nematode Management (INM). Moreover, the decomposition

of the botanical materials may improve soil fertility and microbial activity, enhancing root health and nutrient uptake.

The integration of botanical treatments with tolerant varieties offers a practical strategy for smallholder farmers, especially in regions where access to synthetic nematicides is limited. It also supports sustainable agriculture by promoting soil health and biodiversity while maintaining productivity.

## 5. CONCLUSION

The study demonstrated that root-knot nematode infestation significantly reduces vegetative growth in mung bean. However, the application of botanical treatments, particularly the combination of and *Mesosphaerum suaveolens* effectively mitigated these effects and promoted better plant performance. Varietal differences indicated that some mung bean assertion possess partial tolerance to nematode infection, while the combined botanicals exhibited synergistic nematicidal properties that enhanced growth recovery. The integration of tolerant varieties with botanical treatments is therefore a promising and sustainable approach to nematode management in mung bean production systems.

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