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Effect of Desert Date (*Balanite. aegyptiaca*l.) Leaf Powder on Root Knot Nematodes (*Meloidogyne. Incognita* Kofoid and White 1919*)* Infestation on Tomato plant (*Solanum lycopersicum mill.)* in Yola, Adamawa State

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Abstract
Screen house experiment (potted experiment) was conducted at the landscape garden of Modibbo Adama University Yola to evaluate the efficacy of plant powder for the control of root- knot nematode in tomato plant. The experimental design used was the Completely Randomized Design (CRD) with four treatments replicated three times. *B. aegyptiaca* powders were incorporated at different levels into the bucket each containing 4kg of sterilized soil. The plant powder was incorporated at the rate of 15 g, 10 g, and 5 g (T_1, T_2, and T_3) respectively and T_4 with no level of powder 0g. *B. aegyptiaca* powder at 15g gave the best effect on *M. incognita* in the potted experiments as higher plant height, number of leaves; fresh shoot weight, galling index and least final nematode of both soil and roots were recorded. Therefore, from these findings, *B. aegyptiaca* at 15 g exhibited nematicidal effect on *M. incognita* in tomato plant followed by 10 g, 5 g, respectively. The nematicidal characteristics exhibited by this plant material (desert date) might be due to some phytochemical constituents present in the plant material. The control plant has least plant height, number of leaves, fresh shoot weight, plant fruit and higher fresh root weight as well as galling index and highest final root and soil nematode population.

Keywords: *Meloidogyne incognita* , *Balanite. aegyptiaca*, Dessert date, leaf powder ,Tomato, nematodes

Introduction

Tomato (*Solanum lycopersicum mill.)* is a flowering plant which belongs to the family solanaceae, it's been regarded as one of the most popular and widely cultivated vegetable fruit plant according to Food and Agricultural Organization (FAO, (2006). Tomato originated in the South America and Central American Andes, with Egypt as the major producers, in the world, producing six million tons annually and Nigeria is reported to be the second largest producers, producing up to 10.8% of fresh tomatoes fruit (Ebimieowei, 2013).

Tomato is adapted to wide range of climatic conditions, ranging from temperate to hot and humid tropical. The optimum temperature for most tomatoes plant lies between 21- 24^{0}C, even though it can survive under wide range of temperature, however temperature below 10^{0}Cand above 30^{0}Cdamage plant tissues. Tomato can be grown on many soil types that has proper water holding capacity and aeration but prefers deep, well drained sandy loam soil with P^H

range of 5.5 – 6.0 and it also require moderate amount of rain fall for growth and development (Vander-vosson *et al.,* 2004).

It is reported to have good source of vitamin and minerals such as vitamin A, Band C, lycopere, beta carotene, potassium, calcium, magnesium ion, and zinc which serves as anti-oxidant against oxygen radicals that causes cancer, aging and arteriosclerosis (FAOSTAT, 2011). The crop is known to provide higher income to peasant farmers in Adamawa state and Nigeria at large (Bawa *et al.,* 2014).

Despite the benefit of tomato, its production is limited. The limitation can be attributed to several factors, such factors includes: susceptibility of the crop to various pest and diseases. Among the various pest and disease limiting the production of tomatoes are plant parasitic nematodes, resulting in 90-100% yield loss (Bawa *et al.,* 2014). The infected tomato plants show above and below ground symptoms such as yellowing of leaves and galling in the root system.

Application of chemical nematicides have been found as an effective means for control of nematode but due to its residual and toxic effect, couple with their non-availability besides the requirement of skilled labor for application, however discourage its use, especially by small farmers who produced more than 70% of vegetables in Nigeria (Yusuf*et al.,* 2006). Therefore, there is need to develop alternative nematode control strategies (Bawa *et al.,* 2014). One of the alternative controls is the use of plant parts in the control of plant parasitic nematodes. This plant can be either extracts or powder form (Oka and Yermiayahu, 2006). In view of the research work, this study will seek to evaluate plant powder to control root- knot nematode in tomato plant.

Materials and Methods

Experimental Site

The experiment was carried out at landscape Garden of Modibbo Adama, University Yola which lies between Latitude 8^0 N and longitude 11.5^0 S at an altitude of 185.9m, above the sea level (Bashir, 2000).

Treatment and Experimental Design

Desert date (*B. aegyptiaca)* leaf were collected within and around Modibbo Adama, University Yola. The fresh leaves collected was shade dry for seven days after which it was grind into powder to obtain the respective treatments (T_1, T_2, T_3, and T_4). The treatment was replicated three times and was laid in Completely Randomized Design (CRD).

Inoculum Source and Extraction of Nematode Juvenile

Second stages of juvenile (J_2) of *M. incognita* was extracted from an infested plant using the modified Baermann method (Whitehead and Hemming, 1965).

Screen House preparation

Tomato seed was purchased from Agro-chemical shop in Jimeta ultra-modern market Yola, Adamawa state. Sandy loam soil at the depth of 5 – 10 cm was collected from the landscape Garden of Modibbo Adama University, Yola. The soil was sterilized in a large metal drum for 4hours and was allowed to cool for 72hours (Gautam and Goswani, 2007). From the soil, 4 kg was weighed and filled into each of the experimental pot.From the grind powder 5g, 10g, and15g, was weighed and mixed thoroughly with sterilized soil before transplanting of tomato on each experimental pot. It was allowed to decompose for 2weeks. The tomato seedling was raised on a plastic tray containing sterilized soil for 3 weeks before transplanting into the experimental pot.

Agronomic practice

Tomato seedling was transplanted after 21 days of emergence into pots containing 4 kg of sterilized soil mixed with the plant materials. Two seedlings were transplanted into each pot after a week. The tomato plants were irrigated at the interval of three days.Weeding was done manually with hand at two weeks' interval after transplanting.

Inoculation with M. incognita

The second stage juvenile of *M. incognita*was used for inoculation of each tomato stands contained in the pot with approximately 100 J_2 of *M. incognita* contained in the 100 ml of syringe after two weeks of transplanting. The suspension was applied using 10 ml syringe to the root zone of the test plant.

Data collection

Data were collected on some growth, yield and nematode parameters; plant height was measured after two-week interval starting from two weeks after inoculation (WAI) with a measuring tape. The measurement was done from the base of the plant to the tip of the innermost leaves. The number of leaves of each potted plant for all treatment was determined by counting after two-week interval, for six weeks, starting from two weeks after inoculation of seedlings. The fresh shoots from each pot was up-rooted separately; the root was separated from shoot and was weighed (g) with an electric weigh balance. The fresh root from each pot was determined by removing soil adhering to the root in order to avoid additional weight. The fresh root was weighed with an electric weighing balance.

At harvest, tomato plants were uprooted and the number of galls rated using a scale as described by Anwar *et al.* (2007).

0 = no galls

1 = 1 – 2 galls
2 = 3 – 10 galls
3 = 11 – 30 galls
4 = 31 – 100 galls
5 = more than 100 galls.

The final nematode population was determined from both the root and soil. Root from each pot was uprooted, weighed (g) and was rinsed with distilled water in order to have a clear view of the galls on the roots. Also 250g of soil from each pot was used to determined final nematode population. Nematode was extracted using method described by Whitehead and Hemming (1965).

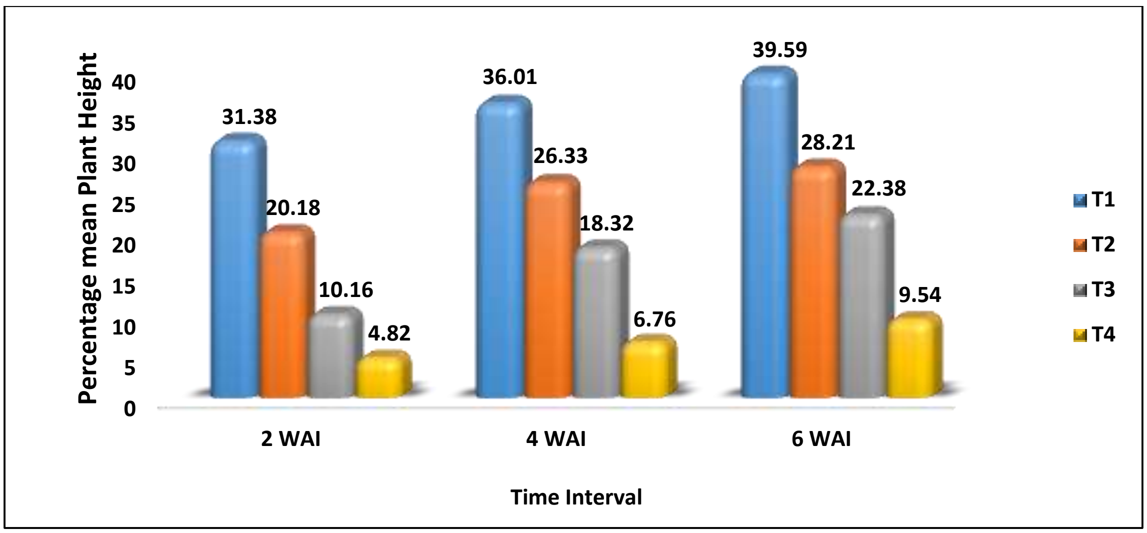
Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) and the mean was separated using least significant difference (LSD) at $P \leq 0.05$.

Result and Discussion

Effect of B. aegyptiaca leaf powder on mean plant height (cm) at 2, 4, and 6 weeks after inoculation

Result of the screen house experiment presented in Figure 1, shows a progressive growth on the tomato plant that are treated with *B. aegyptiaca* powder, compared to the untreated (control). Treatment with the highest level of *B. aegyptiaca* powder (T_1; 5g *Balanites aegyptiaca* powder) had the highest mean plant height; 31.38, 36.01 and 39.59 at 2, 4, and 6 weeks after inoculation respectively. While the untreated i.e. the control (T_4 0g No powder) had the lowest mean; 5.87, 10.77 and 15.54 at 2, 4, and 6 weeks after inoculation respectively.

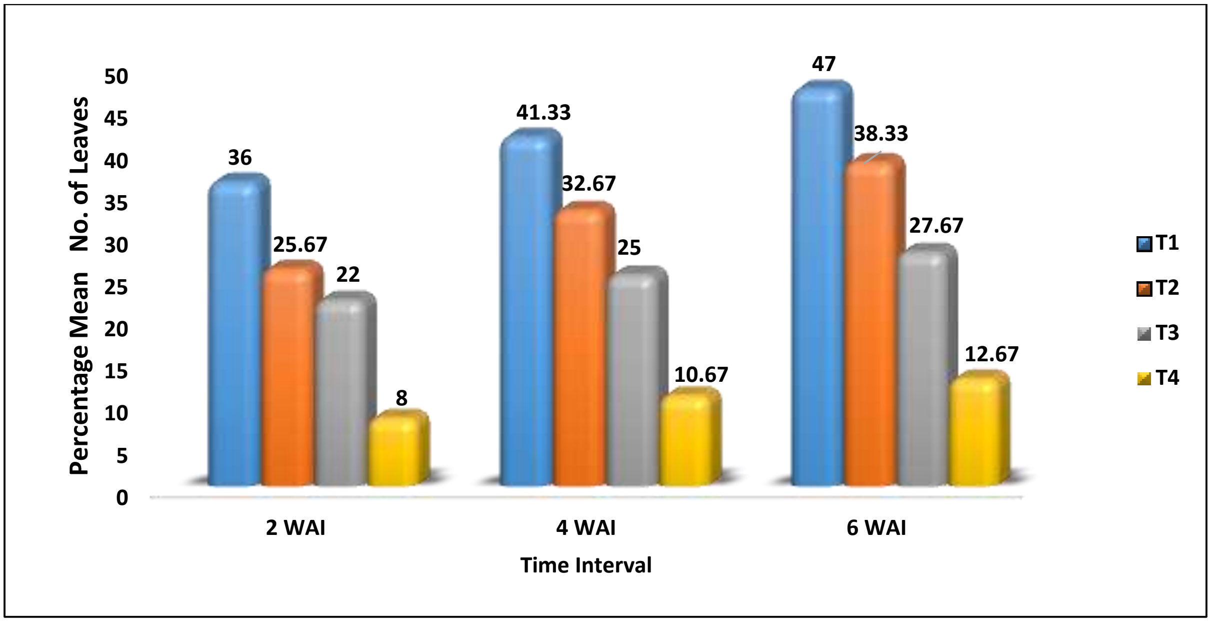


Key: WAI=Weeks After Inoculation; WAI=Weeks After Inoculation**; T1** =15g of *B.* aegyptiaca Leaf Powder**;**
T2 =10g *B.* aegyptiaca Leaf Powder**; T3** =5g *B.* aegyptiacaLeaf Powder**; T4** =0g *B.* aegyptiaca Leaf Powder

Figure1: Effect of *B. aegyptiaca* Powder on Plant Height (cm)

Effect of B. aegyptiaca leaf powder on number of leaves at 2, 4 and 6 weeks after inoculation

Tomato treated with 15g of the *B. aegyptiaca* powder produced the highest mean number of leaves. This may be due to its phytochemical constituents such as Saponins, Terpenoids, Steroids, Flavonoid among other. Which have been reported to be effective for the control of several nematodes species. Also, the release of nutrients which enhanced the performance of the plant and in turn, enhanced the production of several leaves of tomato plants. This goes along with the finding of Chitwood (2002) and Oka (2010), that toxic substance to plant parasitic nematodes are found in many plants and plant decomposition. The least mean number of leaves was recorded in the control plant which appeared stunted, being one of the above ground symptoms of *M. incognita* infestation. The low performance of the control plants might be due to the absence of the *B. aegyptiaca* powder which resulted in the increase of the nematodes population (Aktar and Malik 2000; Ahmed *et al.,* 2004). (Figure 2).



Key: WAI=Weeks After Inoculation**; T1** =15g of *B.* aegyptiaca Leaf Powder**; T2** =10g *B.* aegyptiacaLeaf Powder**; T3** =5g *B.* aegyptiacaLeaf Powder**; T4** =0g *B.* aegyptiacaLeaf Powder

Figure 2: Effect of Different level of *B. aegyptiaca* Leaf Powder on Number of Leaves

Effect of B. aegyptiaca leaf powder on fresh shoot weight (g)

Result of the screen house experiment presented in Table 1, indicates that there was a significant difference between the treated and the untreated (control) tomato plant ($P \leq 0.05$). pots/plants with the highest level of *B. aegyptiaca* powder (T_1; 5g *Balanites aegyptiaca* powder) had the highest mean shoot weight; 26.42 at 6 weeks after inoculation. While the untreated i.e. the control (T_4 0g No powder) had the lowest mean shoot weight; 6.97, at 6 weeks after inoculation. This could be attributed to the nematicidal activities of the amended powder decayed due to beneficial microbial activity at the root zone as a result of the phytochemicals that were presents in the material. This help in increasing the plants performance which allows the plants to grow vigorously. This is in lined with the studies reported by Umar, (2007), that plant powder incorporation or amendment in soil reduce root knot nematode and enhance growth and development of plants.

Effect of B. aegyptiaca leaf powder on fresh root weight (g)

The highest root weight was recorded in the control (0g) untreated pot/plant. The treated tomato plant recorded the lowest or least root weight. The highest root weight recorded in the control could be as a result of numerous galls that were on the root due to (*M. incognita*) infestation that leads to the increase in the root weight (Table1). This is in lined with the findings of Kumar *et al.*, (2010), which reveals that galls otherwise called root-knot cause increase in root weight of many *Malvacious* and *Solanacious* crops. Lowest root weight might be due to nematiciadal ability and property of the powder in suppressing nematodes infestation. (Javed *et al*, 2008).

Effect of B. aegyptiaca powder on Number of Fruits

T_1 (15g *Balanites aegyptiaca* powder) recorded the highest number of fruits (23.67), followed by T_2 (10 g *Balanites aegyptiaca* powder) which recorded14.33, and T_3 (5g *B. aegyptiaca* powder) recorded 10.00 while the control, T_4 (0g; No powder) recorded the lowest yield (3.33) Table 1.

Table 1: Effect of *B. aegyptiaca* powder on Fresh Shoot weight, Fresh Root Weight (g) and Number of Fruits on tomato Plant at 6 weeks after Inoculation

Treatment	**FSW**	**FRW**	**YPP**
15g of B. aegyptiaca	26.42	7.71	20.67
10g of B. aegyptiaca	18.39	12.45	16.33
5g of B. aegyptiaca	12.09	21.51	13.00
0g of B. aegyptiaca	6.97	36.45	4.33
SE	2.21	3.57	1.87
LSD	1.34	5.20	1.83

KEY:FSW = Fresh Shoot Weight, **FRW** = Fresh Root Weight, **FPP** =Fruit Per Plant

Effect of B. aegyptiaca leaf powder on root galling index

The result indicated that the control had the highest root galling index compared to the treated tomato, this could be due to absence of plant powder that will inhibits nematodes in the root which resulted to the highest galling index. Lower root galls index was recorded in the treated plants. 15g treated tomato plant were recorded with (0.33) number of galls (Table2). This could be due to the phytochemical properties of the powder as well as increase in quantity level that serves as an antagonist to nematode and prevent them from penetrating the roots and produced galls. This goes along with the studies of Hassan *et al. (*2001*),* in their studies of plant powder and extracts ginger against root knot nematode and the result showed a better growth of the plant with lower roots index on Brinjal. Yasmin *el at,* (2003) found that extract and powder of neem seed was more effective against juvenile mortality of *M. javanica* compared to bark and leaf powders.

Effect of B. aegyptiaca leaf powder on final nematode population in the root

The T_4 (0g) untreated tomato plants had the highest nematode population. The presence of relatively high population of *M. incognita* in the control plant might be attributed or ascribed to non-application of the *B. aegyptiaca* powder at different levels which may help in suppressing or inhibiting nematode penetration into the plant roots. The result indicated that, all treated plants showed significant different than the untreated tomato plants as maximum reduction of *M. incognita* was recorded in treated tomato compared to the control (untreated) tomato plant (Table2).

Effect of B. aegyptiaca leaf powder on final nematode population in the soil

The control T_4 (0g) tomato plants had the highest nematode population. The presence of relatively high population of *M. incognita* in the control plant might be attributed or ascribed to non-application of the *B. aegyptiaca* powder at different levels which may help in suppressing or inhibiting nematode penetration into the soil. The treated plants, recorded with least final nematode population due to the presence of phytochemicals in the leaf powder o *B. aegyptiaca* that help in suppressing the nematode(Table2).

Table 2. Effect of different level of *B. aegyptiaca* powder on the Galling Index and Final Nematode Population *M. incognita* on Tomato Plants Roots and in Soil (6 weeks after Inoculation) 6 WAI

Treatment	**GAR**	**NPR**	**NPS**
15g of *B. aegyptiaca*	0.33	5.67	13.67
10g of *B. aegyptiaca*	1.00	11.00	23.33
5g of *B. aegyptiaca*	1.67	16.67	36.33
0g of *B. aegyptiaca*	3.33	73.67	50.33
SE	0.38	6.19	4.26
LSD	0.05	2.90	3.20

KEY: GAR = Galls Rating**, NPR** = Nematode population in the Root**, NPS** = Nematode population in the Soil

Conclusion and Recommendation

Based on the findings from this study, it can be concluded that desert date (*B. aegyptiaca)* leaf powder contained or possess phytochemicals properties that are nematicidal, as it suppresses or control the activities of *M. incognita* in the screen house. Thus, this finding is important in the identification and development of alternative strategies in controlling the root-knot nematodes. However, further studies in terms of phytochemical analysis o the plant material should be carried out to determine exactly the chemical properties or constituents inherent in *B. aegyptiaca* to ascertain its efficacy.

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