

Efficacy of Leaf Extract of Drumstick Tree (*Moringa Oleifera* Lam.) On The Growth of Local Tomato (*Lycopersicon esculentum*)

Bashir, K.A.¹, Bawa, J.A.² And Mohammed, I.³

¹(Department of Biological Sciences, Federal University Dutsin-Ma, Nigeria)

²(Department of Biological Sciences, Federal University Dutsin-Ma, Nigeria)

³(Department of Biological Sciences, Federal University Dutsin-Ma, Nigeria)

Abstract: A field study was conducted on the growth of tomato plants with leaf extracts of *Moringa oleifera*. Different concentrations of the crude extract measured for treatments: A 20%, B 40%, C 60%, D 80%, and E with 100%. In the treatments used, 100ml of distilled water was sprayed at the stem base of the plant labeled F which served as control. Four (4) parameters were determined at each week of the experiment i.e. plant height (PH), number of leaves (NL), number of branches (NB) and number of flowers (NF) at five (5) different times. A corresponding increase appeared in the study area. Treatments D (80g/20ml), C (60g/40ml) B (40g/60ml) and an average plant height, A (20g/80ml). Control was found to have the least of all the growth parameters with an average plant height, leaves number, number of branches and number of flowers of 18.8, 51.0, 9.1 and 1.6. This indicates that, the *Moringa* leaf extract used significantly increased the growth and yield of tomato plants in all the trials with erect stemming, fresh leaves, regular branching and healthy fruits and regular flowering.

Key words: *Moringa*, Leaf extract, concentrations and tomato

I. Introduction

Drumstick tree (*Moringa oleifera*) is a horse radish tree belonging to the family of Moringaceae, associated with multipurpose attributes, wide adoptability, and ease of establishment. Its leaves, pods, and flowers are packed with nutrients important to both human and animals [1]. *M. oleifera* is a native to north India but is now found throughout the tropics.

M. oleifera is not a nitrogen fixing tree, but its fruits, flowers and leaves all contain 5% to 10% protein on average. All of these parts are eaten widely as vegetables; provide excellent food, for both humans and eaten like green beans. These roots taste similar to horse radish and is popular food (leaves) in the East Africa. *M. oleifera* flowers also produce a good honey. It has density of 0.5 to 0.7 and yield approximately 4,600kcal/kg [2].

The seeds of *Moringa* are usually used as anticoagulant [3]. Harvested dry seed are shelled crushed in to powdered form and made in to paste with the water before mixing with more water. The mixed water is then allowed to settle and sieved its turbidity is extensively reduced including hardness reduction [4].

The leaves of *Moringa* are full of nutrients and vitamins *Moringa oleifera* leaves were reported to have 25.1% crude protein, 0.50% methionine and a metabolisable energy value of 2271kcal/kg [5]. A survey of over 120 species of tropical and subtropical edible plants for nutrient content, antioxidant activity, and a crop trait indicated that *Moringa oleifera* is one of the promising crops which could contribute to increased intake of micronutrient and antioxidant. *Moringa oleifera* leaves can be excellent sources of calcium, potassium and protein [6].

It was also reported that the leaves of *Moringa oleifera* plants an excellent source of vitamins, mineral and protein perhaps more than any other tropical vegetable. *Moringa* leaves extract had so been reported to exhibit antimicrobial activities including inhibition for the growth of *staphylococcus aureus* that are commonly isolated from food and animals intestines, It also has a medicinal uses among the natives [7].

M. oleifera is increasingly becoming popular among communities in Nigeria for use as a vegetable, and for medicinal purposes. In the wake of high cost or skyrocketing global prices and skill labor in application, the land, water pollution and hazardous nature associated with use of inorganic fertilizer and the contribution of inorganic fertilizer to climate change and effect on soil ecosystem, there is a need to search for alternative sources of plant nutrients. *M. oleifera* is one such alternative being investigated to ascertain its effect on growth and yield of vegetable crops like tomato so that such plants can be promoted as a possible supplement or substitute to inorganic or chemical fertilizer and be promoted as a multipurpose plant that may develop better, safer and cheaper way of increasing the yield of stable vegetable crops indeed tomato for healthy nourishment.

This research was carried out to evaluate the effect of *Moringa oleifera* leaf extract on the growth and yield of local tomato plants.

II. Materials And Method

The study was conducted at the Biological Science Garden, in Usmanu Danfodiyo University Sokoto Nigeria, from the period of May 2010 – February, 2011. Moringa leaves were collected from the garden, tomato seeds were collected from Kasuwa Daji, in Sokoto Area, and equipment were collected from Mycology laboratory.

2.1 Treatments

A total of eighteen (18) polythene bags measuring 12.5cm in diameter and 20cm high were filled with the garden soil and seeds were planted in 3 replicates. Two types of treatments were carried out; which include treatment with *M. oleifera* leaves extract and treatment with distilled water, which serve as control. Hence, study on germination and growth of tomato was carried out on the same garden area.

2.2 Filling Of Poly Bags

The 18 polythene bags were filled with mixture of soil and manure in a ratio of (2:1). The bags were then watered for the soil to saturate, and all the bags were perforated at their bases, so as to avoid water logging.

2.3 Raising Of Tomato Seedlings

A total of 18 poly bags were used in planting the tomato seedlings after collecting the seeds. Seed bed was prepared and was watered for two (2) days. The tomato seeds were then sprayed on the seed bed and covered completely with a neem tree branches to serve as shade for 5-6 days. After fourteen (14) days, they were transplanted in to the polythene bags i.e one seedling per polythene bag. They were arranged randomly in six (6) blocks of 18 plants with different concentrations labeled A, B, C, D, E and F; where A carries 20%, B 40%, C 60%, D 80%, and F 100% of the crude extract of *Moringa oleifera* leaves and later, the extract was spread at five (5) different times. The first spread was after the first reading; the 2nd was at the 4th week, third was at 5th week, fourth was at 6th week and fifth was at 7th week. Those labeled F served as control; they were only sprayed with distilled water at the same time.

2.3.1 Method Of Extraction

The extract was made by pounding young *Moringa* leaves (not more than 40 days) together with a bit of water (about 200ml per 1kg of fresh leaves). A muslin cloth was used in sieving the decoction. A fine filtrate was obtained, the residue was discarded which served as the crude or stock solution. From the stock, stem out the 5 concentrations. A spraying gun was used to spray the seedlings in each of the polythene bags. About 33.3mls of the different percentage of the concentration was directly spread on each seedling.

However, the different concentrations referred to as treatments were prepared, viz: 1kg of fresh *Moringa* leaves was pounded and 200mls of water was added. After extracting the crude, extract measured for treatment A with 20%, B with 40%, C with 60%, D with 80%, and E 100%. One hundred (100ml) of distilled water collected from mycology laboratory was also sprayed at the stem base of the plant labeled F at the same time which serves as control.

2.3.2 Measurement And Analysis Of Data

The plants were watered regularly with tap water. The following four (4) parameters were determined at each week of the experiment i.e. plant height (cm)-PH, number of leaves-NL, number of branches-NB and number of flowers-NF. All data on observations were recorded using descriptive statistics and one way analysis of variance, ANOVA.

III. Results

The application of different rates of *Moringa oleifera* leaf extract and water mixture to the tomato plants at the duration of five (5) weeks with parameters were determined and readings were taken for six (6) weeks from 0 to five weeks, which depends on the volume of extracts used in the growth of local tomato plants as seen in **Table 1**.

Table 1: Different concentrations of Moringa leaf extract

Concentrations of extracts	Volume of undiluted Moringa leaves extract (%)	Volume of water used to dilute the extract (mls)
A (20/80)	20	80
B (40/60)	40	60
C (60/40)	60	40
D (80/20)	80	20
E (100)	100	-
F	Control	100ml of distilled water only.

During the first week, the average plant height was 15.1cm with 20%, concentration of the leaf extract. This increased to 20.6 at the 2nd week. The plant height was 21.4, 26.5, and 28.8cm during the 3rd, 4th and 5th weeks respectively. The average plant height was 15.3 at the 1st week with 40%, concentration of the leaf extract. This increased to 21.6, 22.4, 27.4, 30.1cm during the 2nd, 3rd, 4th and 5th weeks respectively as indicated in **Table 2**. The average plant height was 16.3 at the 1st week with 60%, this increased to 23.3, 23.6, 29.8 and 33.4cm during the 2nd, 3rd, 4th and 5th weeks respectively **Table 2**. The average plant height was 17.0cm at the 1st week with 80%, concentration of the leaf extract; this increased to 23.8, 25.7, 31.7 and 36.0cm during the 2nd, 3rd, 4th and 5th weeks respectively. The average plant height was 18.0 at the 1st week with 100%, concentration of the leaf extract. This increased to 25.5, 27.6, 34.6 and 40.8cm during the 2nd, 3rd, 4th and 5th weeks respectively **Table 2**.

Table 2: Effect of different concentrations of Moringa oleifera leaf extract on the plant height of tomato plant seedlings (cm)

Concentrations (%)	1 PH	2 PH	3 PH	4 PH	5 PH
20	15.1	20.6	21.4	26.5	28.8
40	15.3	21.6	22.4	27.4	30.1
60	16.3	23.3	23.6	29.8	33.4
80	17.0	23.8	25.7	31.7	36.0
100	18.0	25.5	27.6	34.6	40.8
AV	16.3	23.0	24.2	30.0	33.3

PH = Plant height

The result in **Table 3** shows that in the first week, the average leaf number was 31.3 with 20%, concentration of the leaf extract. This increased to 38.7 at the 2nd week. The leaves number was 48.7, 71.7 and 122.0 during the 3rd, 4th and 5th weeks respectively. The average leaves number was 34.3 at the 1st week with 40%, concentration of the leaf extract **Table 3**. This increased to 42.4, 50.0, 97.7 and 171.3 during the 2nd, 3rd, 4th and 5th weeks respectively. The average leaves number was 36.3 at the first week with 60%, concentration of the leaf extract. This increased to 52.0, 66.3, 110.3 and 175.3 during the 2nd, 3rd, 4th and 5th weeks respectively **Table 3**. The average leaves number was 42.3 at the first week with 80%, concentration of the leaf extract. This increased to 66.7, 82.0, 136.7 and 206.7 during the 2nd, 3rd, 4th and 5th weeks respectively. The average leaves number was 42.3 at the 1st week with 100%, concentration of the leaf extract. This increased to 81.7, 91.0, 160 and 236.0 during the 2nd, 3rd, 4th and 5th weeks respectively **Table 3**.

Table 3: Effect of different concentrations of Moringa oleifera leaf extract on the leaves number of tomato plant seedlings

Concentrations (%)	1 LN	2 LN	3 LN	4 LN	5 LN
20	31.3	38.7	48.7	71.7	122.0
40	34.3	42.3	50.0	97.7	171.3
60	36.3	52.0	66.3	110.3	175.3
80	38.7	66.7	82.0	136.7	206.7
100	42.3	81.7	91.0	160.0	236.0
AV	36.6	56.3	67.6	115.3	182.3

LN = Leaf Number

The result in **Table 4** indicates that during the 1st week, the average number of branches was 4.7 with 20%, concentration of the leaf extract. This increased to 7.0 at the 2nd week. The number of branches was 10, 14.3 and 18 during the 3rd, 4th and 5th weeks respectively. The average number of branches was 5.3 at the 1st week with 40%, concentration of the leaf extract. This increased to 8.3, 9, 15 and 18.7 during the 2nd, 3rd, 4th and 5th weeks respectively. The average number of branches was 6.7 at the first week with 60%, concentration of the leaf extract. This increased to 9.7, 12.7, 16 and 19.7 during the 2nd, 3rd, 4th and 5th weeks respectively **Table 4**. The average number of branches was 7 at the 1st week with 80%, concentration of the leaf extract. This increased to 10.7, 14, 18.7 and 21.7 during the 2nd, 3rd, 4th and 5th weeks respectively. The average number of branches was 9.7 at the 1st week with 100%, concentration of the leaf extract. This increased to 13.3, 17, 20.7 and 23.7 during the 2nd, 3rd and 5th weeks respectively **Table 4**.

Table 4: Effect of different concentrations of Moringa oleifera leaf extract on the number of branches of tomato plant seedlings

Concentration (%)	1 NB	2 NB	3 NB	4 NB	5 NB
20	4.7	7.0	10.0	14.3	18.0
40	5.3	8.3	9.0	15.0	18.7
60	6.7	9.7	12.7	16.0	19.7
80	7.0	10.7	14.0	18.7	21.7
100	9.7	13.3	17.0	20.7	23.7
AV	6.7	9.8	12.5	16.9	20.4

NB = Number of Branches

In the 1st, 2nd and 3rd weeks, flowers were not observed with 20%, but during the 4th and 5th weeks flowers were been observed with the average number of 2.7 and 8 respectively. During the first week of 40%, no flowers observed, but in the 2nd, 3rd, 4th and 5th weeks, flowers were observed with an average number of 1.2, 8 and 3.7 respectively **Table 5**. During the first week of 60%, no flowers observed, but during the 2nd, 3rd, 4th and 5th weeks flowers were observed with an average number of 2.7, 5.3, 10.7 and 17.7 respectively. During the 1st week of the 80%, no flowers observed, but during the 2nd, 3rd, 4th and 5th weeks flowers were observed with an average number of 4.3, 8.3, 14.3 and 20.7 respectively. During the 1st week of 100%, no flowers observed, but during the 2nd, 3rd, 4th and 5th weeks flowers were observed with average of 5.3, 8.7, 15 and 23 as seen in **Table 5**.

Table 5: Effect of 80g/20ml Leaf concentration of Moringa oleifera plant on the growth of Tomato plants

Concentration (%)	1 NF	2 NF	3 NF	4 NF	5 NF
20	0	0	0	2.7	8
40	0	1	2	8	13.7
60	0	2.7	5.3	10.7	17.7
80	0	4.3	8.3	14.3	20.7
100	0	5.3	8.7	15.0	23.0
AV	0	2.7	4.9	9.6	16.2

PH = Plant height, LN = Leaves Number, NB = Number of branches and NF = Number of flowers.

Results in **Table 6** served as control, in which the plant height at the 1st week was 13.0cm; leaves number 29.7, number of branches 5 and no flowers were observed. In the 2nd week further readings increased, as noticed with plant height of 16.1cm, leaves number of 39.7, number of branches 6.3 and no flowers were observed respectively. There is also an increase in the 3rd week with plant height of 20.1cm, leaves number of 44, number of branches 8.7 and 0 respectively. Further increase at the 4th week was noticed with plant height of 24.7cm, leaves number of 65.7, number of branches 13 and number of flowers was 2.3 respectively. Another increase was noticed in the 5th week with plant height of 27.4cm, leaves number 103.3, number of branches 16 and number of flowers 7 **Table 6**.

Table 6: Effect of control on the growth of tomato plants

Concentration	1			2			3			4			5		
	PH	LN	NB	PH	LN	NB	PH	LN	NB	PH	LN	NB	PH	LN	NB
F ₁	13.0	28		15.5	40		20.0	46		25.1	52	12	27.2	97	16
	5	0		7	0		9	0		3			8		
F ₂	13.1	29		17.2	41		20.1	44		25.7	74	14	27.6	108	18
	5	0		6	0		9	0		2			6		
F ₃	13.0	32		15.7	30		20.1	42		23.2	71	13	27.3	105	14
	5	0		6	0		8	0		2			7		
AV	13.0	29.7		16.1	39.7		20.1	44	8.7	24.7	65.7	13	27.4	103.3	16
	5	0		6.3	0		0			2.3			7		

PH = Plant Height, LN = Leaves Number, NB = Number of Branches and NF = Number of flowers.

Table 7: The mean (average) of all the treatments with different concentrations on the growth of tomato plants

	A	B	C	D	E	F	SE
1. Plant height (cm)	19.9	21.6	23.2	24.4	26.8	18.8	3.26
2. Number of leaves	55.4	71.0	77.6	91.0	96.1	51.0	18.30
3. Number of branches	9.6	10.6	11.4	12.6	14.7	9.1	2.10
4. Number of flowers	1.8	4.3	6.1	7.9	9.0	1.6	3.10

IV. Discussion

The increase in plant parameters namely; the plant height, leaves number, number of branches, and number of flowers as a result of extracts used in this research significantly increased the growth of tomato plants used in this research. This luxuriant growth of the tomato plants might be due to the volume of concentration (up to 100%) of *Moringa oleifera* extracts used. The magnitude of increase which appeared might depend mainly on the concentrations used, and increase in concentration yielded a simultaneous increase up to the limit in the above growth parameters. Plant extracts of some trees and crop residues have been reported to influence crop growth and yield vegetable crops [8; 9; 10; 11; 12]. Leaf extracts of *M. oleifera* have been reported to accelerate growth of young plants, strengthen plants, increase leaf area duration, increase number of roots, produce more and larger fruits and generally increase yield by 20 to 35% [13]. It has been established in this research that average plant height was initially 16.3cm, which increased to 23.0, 24.2, 30.0 and 33.3cm. Leaf number also increased to 56.3, 67.6, 115.3 and 182.3. It could be deduced that the chemical components incorporated in the extracts used might be responsible to inhabit the development of these tomato plants in comparison with the control treatments. Both the plant height and leaf number increase with the constant application of the *Moringa* leaf extracts at 80% concentrations with regular plant height (40.8cm) and leaf number (236.0). This could also be explained that *M. oleifera* leaf extracts enhanced the germination of tomato plants by 20-80%. [14] reported that aqueous extract of *M. oleifera* at the ratio of 1:10 (w/v) prepared in a 30 g of plant leaf material with 300 ml of distilled water was found to influence the duration of height and hypocotyls growth in tomato and sorghum. The leaf extracts of *M. oleifera* also gave higher (100%), vigorous and good quality of tomato seedlings in height, leaf number and flowering. [15] demonstrated that incorporation of dried sunflower leaf material into the soil; treatment with aqueous extract, root exudates and leaf leachates inhibited germination and growth of grain sorghum (*Sorghum bicolor*) and tomato (*Lycopersicon esculentum*).

It was reported from this research that, the average number of branches was 6.7 up to 20.4. It was also revealed that during the 1st week, no flowers were observed, and the average number of flowers was 9.8 but continue to increase to 12.5, 16.9 and 20.4. This could be explained by the fact most of the tomato plants grown in the trials are highly sensitive to the extracts used followed by the influence of the weather and condition of the soils which may seem to be more in retaining moisture contents and leaf extracts. The improvement in growth parameters of tomato plants in response to shikimic acid application is mediated through the increased longevity of leaves and branches by retaining chlorophylls and increasing mineral contents which perhaps contributed to increased plant growth [16]. In addition, the results obtained here are in accordance with the results of [17] who stated that seed priming with shikimic acid and *Moringa* root extract increased growth and yield of cowpea plants grown under greenhouse conditions through photosynthetic activity.

In this work, it was reported that treatment E had the highest (26.8, 96.1, 14.7 and 9.0) numbers of growth parameters of the tomato plants. It was therefore, found to be the most appropriate concentration for increasing the healthy vegetative growth and parameters of the tomato plants. This was probably due to the high concentration of the growth promoting substances contained in this treatment. The effect of *Moringa* leaves extract in stimulating plant growth was reported by [18].

It was also observed that treatment D (80g/20ml) with an average plant height leaves number, number of branches, and number of flowers of 24.4, 91.0, 12.6 and 7.9. This indicates that reduction in the concentration of *Moringa oleifera* leaves extract might have affected the growth of tomato plants. It was also observed that treatment C (60g/40ml) followed with an average plant height, leaves number, number of branches and number of flowers of 23.3, 77.6, 11.4 and 6.1 respectively. But, treatment B (which is 40g/60ml) followed with an average plant height, leaves number, number of branches and number of flowers of 21.6, 72.0, 10.6 and 4.3 respectively. It was also observed in treatment A (20g/80ml) followed with an average plant height, leaves number, number of branches and number of flowers of 19.9, 55.4, 9.6 and 1.8 respectively having the least growth promoting substances among treatments with *Moringa* leaves extract. Control was found to have the least of all the growth parameters with an average plant height, leaves number, number of branches and number of flowers of 18.8, 51.0, 9.1 and 1.6. Meanwhile, those that were not statistically different from the controls

might be due to inhibition of the growth of tomato plants which is generally related to changes in the plants water status and ability to retain the leaf extracts.

This supports the report of [19] who noticed that, application of Moringa root and leaf extract by 2-4 weeks after planting significantly ($p < 0.05$) increased fresh fruit weight and number of stem, flowers and branches of the tomato plants. Plant residues often contain a variety of toxins that are known inhibitors of seed germination or seedling growth [20; 21]. Recycling crop residue and leachates from plants to the soil have been reported to inhibit seed germination and vegetative propagules, and early seedlings growth in tomatoes [22; 23]. With this vision, [24] applied Moringa oleifera leaf extracts in the ratio of 1:10 (w/v) on seeds of maize, rice, sorghum and wheat in a growth room at 25°C for 14 days and found that it not only increased the length of radical but also increased hypocotyl length of maize and wheat. It was reported that this hormone application as a seed treatment not only improved the vegetative growth but also enhanced the grain yield even applied in very small amounts as a seed treatment.

V. Conclusion

Moringa oleifera leaves extract contained growth promoting substances. When applied on the foliage of tomato plants, it showed an appreciable level of growth. Application of the extracts at 100g/0ml was found to be the best concentration for stimulating growth of tomato plants. However, even the least concentration of 20g/80ml showed promising results in the growth parameters studied. In the field experiments, it may be concluded the higher the frequency of Moringa application, the greater the increase in plant height, erect stemming, good branching, fruits yield and regular flowering of the crop. Furthermore, the control had the least growth of all the parameters, investigated, as it has no extract that contained growth promoting substances.

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