Exploring the Potential of Drumstick (*Moringa oleifera*) Leaf Extract as Vegetative Growth Enhancer of Guinea Corn (*Sorghum bicolor L.*)

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Abstract: ***Drumstick (Moringa oleifera) belongs to the flowering family Moringaceae. This study was aimed to assess the potential benefit of M. oleifera leaf extract as a vegetative growth enhancer, the effect of different application level of M. oleifera leaf extract on the growth of sorghum. The extract was prepared by blending young Moringa leaves together with water (500 m1 of distilled water per 100 kg of fresh leaves). A muslin cloth was used in sieving the decoction. A fine filtrate was obtained and the residue was discarded. From the stock, five concentrations were prepared. About 25 ml of the different percentage of the concentration was directly spread on each seedling. For plant height, 100 % concentration showed best growth with 43.00, 74.50, 88.75 and 105.7 cm at 1st, 2nd, 3rd, and 4th weeks respectively. The control had the least growth with 40.25, 60.25, 75.50 and 90.75 cm at1st, 2nd, 3rd and 4th weeks respectively. For number of leaves, the result at 100 % was 5.00, 6.00, 7.00 and 8.00 cm at 1st, 2nd, 3rd and 4th weeks respectively. The control had the least growth with 5.00, 5.00, 5.00 and 5.00 cm at 1st, 2nd, 3rd and 4th weeks respectively. Fresh and dry weight matter of the root was 1.50 and 0.20 g respectively for 100 %, with 0.55 and 0.05 g respectively for the control. Fresh and dry weight matter of the shoot was 12.73 and 1.33 g respectively for 100 %, with 6.21 and 0.76 g respectively for the control. Moringa leaf extract had potential value in increasing growth of Sorghum plant.***

Keywords: Growth, Leaf extract, *Moringaoleifera, Sorghum bicolor*

1. Introduction

Sorghum is an ancient crop and the origin as well as the early domestication of *Sorghum* took place in northeastern Africa north of the Equator and east of 10˚E latitude, approximately 5,000 years ago. However, carbonized seeds of *sorghum* with consistent radiocarbon dates of 8,000 years BP have been excavated at an early Holocene archaeological site at Nabta Playa near the Egyptian- Sudanese border (Dahlberg and Wasylikowa, 1996; Wendorf *et al*., 1992). These sorghums are 3,000 years older and 10-15˚ latitude further north than had been previously reported and suggests an early interest in sorghum by hunter and gathers and early agriculturalists. These early domestication events followed major trading and migratory paths of early Africans and Asians. As these early domesticated sorghum spread throughout Africa and Asia, plants were selected and dispersed throughout a broad range of environments and utilization giving rise to a widely adapted genetic base that has been further exploited throughout the agricultural process to create the current crop known as cultivated *sorghum*. Several authors have discussed the systematics, origin, and evolution of sorghum (De wet and Huckabay, 1967: De Wet and Harlan, 1971).

Drumstick (*Moringaoleifera*) belongs to the flowering family Moringaceae. The name was derived from the Tamil word ‘’Moringai’’ or the Malayalam word ‘’Muringa’’ English names include: mother's Best friendand drumstick tree (Bashir *et al.*, 2016; Manzoor, *et al*., 2007; and Nasir *et al.*, 1972). *"Moringa"* tree is grown mainly in semi-arid, tropical, and subtropical areas. It is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan (Bashir *et al.*, 2005). It grows best in dry sandy soil; it tolerates poor soil including coastal areas. It is a fast growing, drought resistant tree. Today it is widely cultivated in Africa, Central and South America, Sri Lanka, India, Mexico, Malaysia, Indonesia and the Philippines. *Moringa* is a short, slender, deciduous, perennial tree about 10 m tall with drooping branches, brittle stems and branches, corky bark, feathery pale green 30–60 cm long compound leaves, with many small leaflets which are 1.3–2 cm long, 0.6–0.3 cm wide, fragrant white or creamy-white flowers having 2.5 cm in diameter and borne in sprays, pendulous brown triangular pods, splitting lengthwise into 3 parts when dry, containing about 20 dark brown seeds embedded in the pith, pod tapering at both ends, the root of *Moringa* is thick (Foidle *et al*., 2001). It produces fruit between April to June in Pakistan. It is considered one of the world’s most useful tree, as almost every part of the *Moringa* tree can be used for food or has some other beneficial property. In the tropics, it is used as forage for livestock, and in many countries *Moringa* micronutrient liquid, a natural anthelmintic (kills parasites) and adjuvant (to aid or enhance another drug) is used as a metabolic conditioner to aid against endemic diseases in developing countries (Foidle *et al*., 2001).

M. oleifera leaves as rich protein source, which can be used by doctors, nutritionists and community health conscious persons to solve worldwide malnutrition or under nutrition problems. According to researchers *Moringa* has the potential to combat vitamin A and other micronutrient deficiencies (Noaman *et al.*, 2010). *Moringa* leaves contain a total of 40139 µg/100 g carotenoides on fresh weight of which 47.8 % or 19210 µg/100 g was β-carotene. Ascorbic acid at 6.6 mg/g on dry weight basis, 0.26 mg/g Fe, 22.4 mg/g calcium, 6.3 mg/g P, 11.2 mg/g oxallic acid and 0.9 g/100 g fiber. *Moringa* has been in use since centuries for nutritional as well medicinal purposes. Another important point is that *Moringa* leaves contain all of the essential amino acids, which are the building blocks of proteins. It is very rare for a vegetable to contain all of these amino acids. *Moringa* contains these amino acids in a good proportion. Given its nutritional value, it can be utilized in fortifying

sauces, juices, spices, milk, bread, and most importantly, instant noodles. Many commercial products like Zija soft drink, tea, and neutroceuticals are available all over the world.

Moringa leaves have attained a prominent position among the scientific community because its leaves contain a substance known as zeatin. This substance can be used as a source of substances of cytokinin. *Moringa* are rich in natural cytokinin along with other minerals, phytohormones and inorganic salts that are in a naturally balanced concentration which increase the yield of the crops when applied exogenously. A score of related compounds are found in a variety of plants called brassinosteriods. Brassica water extracts contain a substance known as brassinolide which is natural plant steroid. The brassinosteriods are included in a unique class of natural plant growth regulators having the potential to enhance yield of number of agronomic cropsTerakado, *et al.* (2005).

Half of the African countries were designated by Food and Agricultural Organization (F.A.O) as having short supply of these grains/seed (Taylor and Shewry, 2010). This has caused notable food shortages, In Sub-Saharan Africa. Some of the constraints to sustained production of these crops are lack of hormonal application and high cost of fertilizer. This leads to poor plant growth which results in declination in agricultural food production. The aim of this study was to to assess the potential benefit of *M. oleifera* leaf extract as a vegetative growth enhancer on *Sorghum* plant and to determine the effect of different application level of *M. oleifera* extract on crop vegetative growth and development.

2. Materials and Methods

Experimental Site
This research work was carried out in the Botanical Garden of Biological Sciences Department, Federal University Dutsin-ma, Katsina State. Dutsin-ma Local Government Area is located on Latitude 12^{o} 27'18"N and longitude 7^{o} 29'29"E and has its headquarters in Dutsin-ma town. It has an estimated area of 527 km^{2} (203 sq km) and a population of 169,671 as at 2006 census. The population and activities in the local government area have increased in the last 3 years which may be due to the establishment of the new Federal University .The Local Government is bounded by Kurfi and Charanchi Local Governments to the North, Kankia Local Government to the East, Safana and Dan-Musa Local Governments to the West, and Matazu Local Government to the Southeast. The people are predominantly farmers, cattle rearers and traders.

Sample Collection
The current study was conducted at the Biological Sciences Garden, Federal University Dutsin-Ma, Katsina State, Nigeria from May–August, 2017. *Moringa* leaves were collected from Barhim estate in Katsina state, *Sorghum* seeds were collected from Institute of Agricultural Research (IAR) Samuru, Zaria, Kaduna state.

Treatments
A total of 24 polythene bags measuring 12.5 cm in diameter and 20 cm high were filled with the garden soil and seeds were planted in 4 replicates. Two types of treatments were used for this study; which include treatment with *M. oleifera* leaves extract and treatment with distilled water, which serve as the control. Hence, study on germination and growth of *sorghum* was carried out in the Botanical Garden (Green House) at Federal University Dutsin-ma.

Filling of Polythene Bags
A total of 24 polythene bags were filled with mixture of clay soil and organic manure. 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.

Method of Extraction and Application
The extract was prepared by Blending young *Moringa* leaves together with a bit of water (about 500 m1 of distilled water per 100 kg of fresh leaves). A muslin cloth was used in sieving the decoction. A fine filtrate was obtained and the residue was discarded, the filtrate served as the crude or stock solution. From the stock, five different concentrations were prepared. A syringe was used to spray the seedlings in each of the polythene bags. About 25 ml's of the different percentage of the concentration was directly spread on each seedling. However, the different concentrations served as sub-treatments which include: treatment A with 100 %, B with 80 %, C with 60 %, D with 40 %, and E with 20 %.One hundred (l00 ml) of distilled water collected from Biological Sciences laboratory was also sprayed at the stem base of the *sorghum* plants labeled F at the same time which serves as control.

Growth Parameters

Plant Height and Number of Leaves
To determine the plant height, a thread was run from the base of the plant to the tip of the stem, the thread was transferred on a measuring tape and the readings were recorded. The number of leaves per plant were counted manually and recorded.

Fresh Weight Matter (Shoot/Root)
The weight of the fresh plant was examined before it was subjected into an oven, this was measured in (grams), and readings were taken immediately after carefully removing the plants from the soil. Loose soil was washed off.

Dry Weight Matter (Shoot/Root)
The weight of the dry plant was examined after the plant has been subjected at 60º C in an oven. Readings were taken after 24 hours interval until a constant dry weight was obtained repeatedly, and measured (in grams).

3. Results

Effect of *Moringaoleifera* Leaf Extract on the Growth and Parameters

Plant Height
The Application of different rates of *M. oleifera* leaf extracts and water mixture at the duration of four weeks after inoculation. Readings of plant height were taken for four weeks after inoculation, which depends on the volume of extracts used in the growth of *S.bicolor* plants.

During the first week after inoculation (WAI), the average plant height was 52.75cm for 20 %, concentration of the leaf extract. This increased to 57.50 at 2nd week. The plant height was 70.75 and 84.50 cm at 3rd and 4th weeks respectively. The average plant height for 40 % was 50.25 cm at the 1st week, this increased to 44.25, 76.00 and 93.2 cm at 2nd, 3rd and 4th weeks respectively. The average plant height for 60 % was 49.25 cm concentration of the leaf extract, this increased to 70.25, 84.00, and 101.5 cm at 2nd, 3rd, and 4th weeks respectively. The average plant height for 80 % was 40.75 cm at the 1st week, this increased to 72.00, 85.75 and 105.5 cm at 2nd, 3rd and 4th weeks respectively. The average plant height for 100 % was 43.00 cm at the 1st week, this increased to 74.50, 88.75 and 105.7 cm at 2nd, 3rd, and 4th weeks respectively. For control, the average plant height was 40.25 cm at the 1st week, this increased to 60.25, 75.50 and 90.75 cm at 2nd, 3rd and 4th weeks respectively as shown in Table 1.

Table 1: Means of plant height for five different concentrations at four week after application

Concentrations	1 WAI (cm)	2 WAI (cm)	3WAI (cm)	4WAI (cm)	Mean/SE
20 %	52.75	57.50	70.75	84.50	66.37 ± 7.14
40 %	501.25	44.25	76.00	93.25	65.94 ± 11.42
60 %	49.25	70.25	84.00	101.5	76.25 ± 11.04
80 %	40.75	72.00	85.75	105.5	76.00 ± 13.61
100 %	43.00	74.50	88.75	105.7	78.00 ± 13.30
Control	40.25	60.25	75.50	90.75	66.68 ± 10.79

WAI = week after application

Number of Leaves

During the first week after inoculation (WAI), the average leaf number was 5.00 cm for 20 %, concentration of the leaf extract. This increased to 5.00, 5.00 and 5.00 cm at 2nd, 3rd and 4th weeks respectively. The average number of leaves for 40 % was 5.00 cm, concentration of the leaf extract; this increased to 6.00, 6.00and 7.00 cm at 2nd, 3rd and 4th weeks respectively. The average number of leaves for 60 % was 5.00cm at first week, this increased to 6.00, 7.00 and 7.00 cm at 2nd, 3rd and 4th weeks respectively. The average number of leaves for 80 % was 5.00 cm at the first week, this increased to 6.00, 7.00 and 8.00 cm at 2nd, 3rd and 4th weeks respectively. The average number of leaves for 100 % was 5.00 cm at the 1st week, this increased to 6.00, 7.00 and 8.00 cm at 2nd, 3rd and 4th weeks respectively. For the control, the average number of leaves was 5.00 during the first week, 5.00, 5.00 and 5.00 cm at 2nd, 3rd and 4th weeks respectively as shown inTable 2.

Table 2: Means of leaf number for five different concentrations at four week after application

Concentrations	1 WAI (cm)	2 WAI (cm)	3WAI (cm)	4WAI (cm)
20 %	5.00	5.00	7.00	7.00
40 %	5.00	6.00	6.00	7.00
60 %	5.00	6.00	7.00	7.00
80 %	5.00	6.00	7.00	8.00
100 %	5.00	6.00	7.00	8.00
Control	5.00	5.00	5.00	5.00

WAI = week after application

Fresh and Dry Weight Matter (Root)

The result in Table 3 shows fresh and dry weight matter (Root), the average Fresh and dry weight matter of root was 0.69 and 0.07 g for 20 % concentration, for 40 % concentration, the fresh and dry weight matter of the root was 0.80 and 0.12 g respectively. While 60 % concentration, the fresh and dry weight matter of the root was 1.13 and 0.20 g respectively, for 80 % concentration, the fresh and dry weight matter of the root was 0.92 and 0.12 g respectively, the fresh and dry weight matter of the root was 1.50 and 0.20 g respectively for 100 % concentration. For the control the fresh and dry weight matter of the root was 0.55 and 0.05 g respectively.

Table 3: Means of Fresh and Dry Weight Matter (Root) measured at the end of the experiment

Concentrations	Fresh root matter (g)	Dry root matter (g)	Mean/SE
20 %	0.69	0.07	0.38 ± 0.31
40 %	0.80	0.12	0.46 ± 0.34
60 %	1.13	0.20	0.66 ± 0.47
80 %	0.92	0.12	0.52 ± 0.40
100 %	1.50	0.20	0.85 ± 0.15
Control	0.55	0.05	0.30 ± 0.25

Fresh and Dry Weight Matter (Shoot)

The result in Table 4 shows fresh and dry weight matter (shoot), the average fresh and dry weight matter of the shoot was 6.07 and 0.64 g for 20 % concentration, for 40% concentration, the fresh and dry weight matter of the shoot was 8.13 and 0.85 g respectively. While 60 % concentration of fresh and dry weight matter for the shoot was 9.89 and 1.12 g respectively, for 80 % concentration, the fresh and dry weight matter of the shoot was 8.36 and 1.19 g respectively, the fresh and dry weight matter of the shoot was 12.73 and 1.33 g respectively for 100 % concentration. For the control the fresh and dry weight matter of the shoot was 6.21 and 0.76 g respectively.

Table 4: Means of fresh and dry weight matter (shoot) measured at the end of the experiment

Concentrations	Fresh shoot matter (g)	Dry shoot matter (g)	Mean/SE
20 %	6.07	0.64	3.35 ± 2.72
40 %	8.13	0.85	4.49 ± 3.64
60 %	9.89	1.12	5.50 ± 4.39
80 %	8.36	1.19	4.77 ± 3.59
100 %	12.73	1.33	7.03 ± 5.70
Control	6.21	0.76	3.48 ± 2.73

4. Discussion

Based on the findings of this study, *Moringa oleifera* leaf extract was found to significantly increase the growth of *S. bicolor* plant.This work is in line with the work of Fuglie (2000a) who reported that application of *Moringa* extract increased maize growth. Exogenous application of *Moringa* extract causes responses which can vary depending on the plant species. Responses also depend on the cultural

practices and the environmental conditions under which the crop is growing. Fuglie (2000b) showed that to get the optimum results from the foliar spray of *Moringa* leaf extract to crops, it should be used in addition to (and not in lieu of) fertilizers, watering and sound agricultural practices. The soil nutrient status is complementary to the effectiveness of *Moringa* extract sprays. The findings of Culver *et al*. (2013) and that of Bashir *et al*. (2014) showed similar result with the findings of this study, and they reported that application of *Moringa* extract increases the growth of maize, common bean and tomato plants.

Another finding by Culver *et al*. (2012) showed that application of *Moringa* extract significantly increased yield, root dry weight and plant height of tomato plants. El Award (2003) pointed out that in *Moringa* there is zeatin hormone in very high concentrations of between 5 mcg and 200 mcg/g of material. Fuglie (2000) confirmed that this cytokinin (CK) related hormone increases crop yields when sprayed as an extract from fresh *Moringa* leaves.

5. Conclusion

From the results obtained, it can be concluded that *Moringa* leaf extract has potential value in increasing growth of *Sorghum* plant. Thus, *Moringa oleifera* leaves extract contained growth promoting substances when applied on the root of *Sorghum* plants; it showed an appreciable level of growth. Application of the extracts at 100 % was found to be the best concentration for stimulating growth of *Sorghum* plant. However, even the least concentration of 20 % showed promising results in the growth parameters studied. Furthermore, the control had the least growth of most of the parameters investigated, as it has no extract that contained growth promoting substances.

References

[1] Bashir, K.A., Bawa, J. A. and Mohammed, I. (2014). Efficacy of leaf extract of drumstick tree (*Moringa oleifera* Lam.) on the growth of local tomato (*Lycopersicon esculentum*). *Journal of Pharmacy and Biological Sciences*. 9(4): 74-79.
[2] Bashir, K. A., Waziri, A. F. and Musa, D. D. (2016).*Moringaoleifera*, A potential miracle tree; A review. *Journal of Pharmacy and Biological Sciences.*11(6): 25-30.
[3] Culver, M. Fauna, T. and Chiteka, A.Z.(2012). Effect of *Moringa* extract on growth and yield of tomato, *Greener Journal of Agricultural Sciences*. 2 (5): 207-211.
[4] Dahlberg, J.A. and Wasylikowa, K. (1996). Image and statistical analyses of early *sorghum*
[5] remains (8000 B. P.) from the Nabta Playa archaeological site in the Western
[6] Desert, southern Egypt Vegetation History and Archaeobotany 5: 293-299.
[7] De Wet, J.M. and Huckabay JP, 1967.The origin of *Sorghum bicolor*. II. Distribution and
[8] domestication. Evolution 21: 787-802
[9] De Wet, J.M. and Harlan, J.R, (1971).The origin and domestication of *Sorghum bicolor*.
[10] Economic Botany. 25: 128-135.
[11] El Award, A. (2003). *Moringa* Tree: Nature's Pharmacy.
[12] http://www.islamonline.net/english/Science/2003/02article06.shtml (download 20/10/2007).
[13] Fuglie, L.J. (2000a) The Miracle Tree: *Moringa oleifera*: Natural Nutrition for the Tropics (Lowell J. Fuglie, CTA, Wageningen, Netherlands 2000, Pp172).
[14] Fuglie, L.J. (2000b). New Uses of *Moringa* Studied in Nicaragua: ECHO's Technical Network Site-networking global hunger solutions. ECHO, Nicaragua. holder Markets in Sub-Saharan Africa.
[15] Foidl, N.H, Makkar, H.P. and Becker, S.K. (2001).The potential of *Moringa oleifera* for agricultural and industrial uses, in: The Miracle Tree: (The Multiple Attributes of *Moringa* (Ed) Lincon Publishers XP, pp 45-76).
[16] Manzoor, M., F.Anwar, T., Iqbal and Bhnager, M.I. (2007).Physico-chemical characterization of *Moringa*concanensis seeds and seed oil.*J Am. Oil Chem. Soc.*, 84: 413-419.
[17] Nasir, E., and Ali, S.I., (1972). Flora of West Pakistan: an annotated catalogue ofvascular plants of west Pakistan and Kashmir. Karachi, Pakistan: Fakhri Printing Press.1028p.
[18] Noaman, W. Siddiqui, M.T and Ahmed, S.M., (2010). *Moringa oleifera* leaf extract: An innovative priming tool for rangeland grass. Basra University of Agriculture, Faisalabad. Pakistan.

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