Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.12, 2018

Potentials of Moringa oleifera Leaf Extracts as Biostimulant on the Field Performance of Sweetcorn

Abosede F. Kehinde-Fadare Ayodeji E. Salami
Department of Crop, Horticulture and Landscape Design, Faculty of Agricultural Sciences,
P.M.B. 5363, Ekiti State University, Ado-Ekiti, Nigeria.

Abstract
The potentials of *Moringa oleifera* Leaf Extract (MLE) as a bio-stimulant have been established in some vegetable crops. A field experiment was conducted at the Teaching and Research Farm of Ekiti State University, Ado-Ekiti in 2015 cropping season to study the effects of MLE as bio-stimulant on the performance of two varieties of sweet corn. Treatment consisted of two forms of MLE (dry and fresh), three times of application which are 2 weeks after planting (WAP), 2 and 4 WAP, 2, 4 and 6 WAP and a control. The experiment was laid out in a randomized complete block design with three replicates. Application of MLE significantly increased plant height; stem girth, number of leaves, cob weight, cob length, kernel row and cob girth of sweet corn. The highest yield in terms of cob weight was observed to be 16.8% and 16.3% higher than the control for dry and fresh methods respectively. The highest cob weight which was 21.15% higher than the control was observed when application was done once. Furthermore, the yellow variety had higher cob weight than white variety with about 2.55%. It is concluded that application of MLE can be used to improve the productivity of sweet corn.
Keywords: Sweetcorn, Maize, leaf extract, *Moringa olifera*, biostimulant

1. Introduction

Corn (*Zea mays L.)* also known as maize is characterized by abundance of forms with highly differentiated features, botanical and utility. Among the numerous corn subspecies grown, sweet corn (*Zea mays spp. saccharrata)* has become more important especially as vegetable maize. Its taste and nutritional value has made it a valued crop in all countries and the scope of corn production is constantly increasing. Vegetable maize (*Zea mays spp. saccharrata)*, also known as sweet corn or green maize differs from other types of maize because it produces and retains large amount of sugar in the kernels. Fresh cobs of vegetable maize are usually consumed in raw, boiled or roasted form (Tindall, 1983).

As a vegetable, it arrives at the fruit produce market for direct consumption to the fruit and vegetable processing industry for frozen and canned foods, and for industrial processing (Brecht 1998, Jumagulow 1999, Kunicki 2003, Waligora *et al* 1998). In Nigeria, sweet corn production is gaining popularity due to increased demand especially from elites in towns and other urban centres. The short gestation period (about 60 days) is another reason for increased production since the crop is harvested green without the need to wait for it to dry as with the conventional maize. Thus, the rate of turnover is faster. Like other types of maize, sweet corn is a fairly heavy feeder, thus, proper soil fertility maintenance is critical for good growth and high yield (Xu, 2000).

The application of plant hormones can help ameliorate the constraint of low fertility. Plant hormones influence every phase of plant growth and development and can be used to increase yield. There are five groups of growth hormones; auxins, gibberellins, abscisic acid, ethylene and cytokinins (Prosecus, 2006). For the most part, each group contains both naturally occurring hormones and synthetic substances. Cytokinins regulate cell division and stimulate leaf expansion (Prosecus, 2006). Cytokinins enhance food production as they are involved in cell growth and differentiation, and their exogenous supply delays senescence of crop plants. Zeatin is one form of the most common forms of naturally occurring cytokinin in plants.

Fresh *Moringa oleifera* leaves have been shown to contain zeatin, a cytokinin related hormone (Fuglie, 2000). The zeatin concentration of moringa leaves sampled from various parts of the world varied between 5 µg and 200 µg/g of leaves (El Awady, 2003). Moringa leaf extract increased the yields of onions, bell pepper, soyabeans, sorghum, coffee, tea, chili, melon and maize (Fuglie, 2000). This demonstrates the potential benefit to the smallholder farmers in Africa where *Moringa oleifera* is locally available, relatively cheap and environmentally friendly (Noaman *et al*., 2010). The dependency on the use of inorganic fertilizer as a source of plant nutrients by farmers is further associated with land and soil degradation and environmental pollution (Phiri, 2010).Thus, there is need to search for alternative natural sources of plant nutrients and *Moringa oleifera* is one of such alternatives. Therefore, the objective of this study was to evaluate the effects of form and number of applications of *Moringa oleifera* leaf extracts on the growth and yield of sweet corn.

2. MATERIALS AND METHODS

2.1 Study Area

The trial was conducted at the Teaching and Research Farm of Ekiti State University, Ado-Ekiti in the year 2014.

The area lies between latitudes $7^0$37'N and $5^0$13'E.The area experiences a tropical climate with distinct wet and dry season and it is characterized by a bimodal rainfall pattern. Mean annual rainfall is about 1360.77mm and average number of rainy days is about 112 days per annum with mean annual temperature of 27^0C. The vegetation of the experimental site is with various types of bush re-growth, grasses, and creepers. Prior to this work, it has been under continuous cultivation of arable crops.

2.2 Experimental Layout and Treatment

The experiment was conducted between July and October 2015. The experiment consisted of three factors; (i) two varieties of sweet corn, (ii) two forms of moringa leaf extracts (fresh and dry) and (iii) number of applications which are; 2 weeks after planting (WAP), 2 and 4 WAP, 2,4 and 6 WAP. All these made up 12 treatments combinations with the control and was laid out in randomized complete block design (RCBD) replicated 3 times to make a total of 42 experimental plots.

2.3 Procedure

The experimental field was cleared, and residue gathered. The experimental land was divided into 3 blocks and each block was further divided into 14 plots each to make up 42 plots in all. The two maize varieties obtained from International Institute of Tropical Agriculture (IITA) Ibadan were planted on the 8th of July 2015 at a spacing of 75 cm by 50 cm and sown at three seeds per hole, which were later thinned to two seedlings at two weeks after planting.

The moringa leaf extract used was prepared in two forms, fresh and dry. For the fresh one, the procedures involved the use of a 100 g of fresh young moringa leaves of less than 4 weeks old which were plucked from previously established moringa plantation and blended using a domestic blender, 250 ml of distilled water were added to the leaves to enhance the blending process, the paste formed from the blending was further mixed with one litre of distilled water and the suspension formed was sieved using muslin cloth to get the filterate. After this, 500 mls of the filtrate were measured and further diluted with water at a ratio of 1:32

For the dry extract preparation, the following were involved: a 5 kg moringa leaves of less than 4 weeks old were plucked and air-dried under room condition for three weeks, the dry leaves were then blended and sieved to get the moringa powder. An amount of 100 g of the powder was mixed with a liter of water and then sieved out using a sieving cloth, about 500 mls of the filtrate was then diluted with water at ratio of 1:16.

The moringa leaf extracts were applied to the sweet corn crop at 2 weeks interval according to the treatment. Plants received the foliar application with the use of knapsack sprayer at 2 WAP, at 2 and 4 WAP and at 2, 4 and 6 WAP depending on the treatment. NPK fertilizer was applied at 2 WAP as basal application. Watering and good cultural practices that ensure good development of the crop was employed. Weed control was manually done as at when due after planting with the use of hoe.

2.4 Data collection

Pre-harvest parameters measured were;

(i) Plant height: the height of the sweet corn was measured from soil surface to the tip of the shoot using graduated tape at 2, 4, 6 and 8 WAP (ii) Stem girth: This was measured with use of venial caliper by putting it around the circumference of the stem at the height of 5 cm from the soil level at 2, 4, 6 and 8 WAP (iii) Number of leaves: This was done by counting the number of leaves present on the maize plants at 2, 4 6 and 8 WAP. At harvest, Cob length, Cob girth, Cob weight, Kernel row were determined

2.5 Data analysis

All data collected were subjected to analysis of variance (ANOVA) and the differences between treatment means were separated using least significant difference (LSD).

3.0 RESULTS AND DISCUSSION

3.1 Results

3.1.1 Effects of Moringa leaf extract on plant height of sweetcorn

Foliar application of moringa leaf extract significantly improved the plant height (Table 1). For the two varieties, there was significant difference as from 4 WAP with the white variety showing a higher plant height than the yellow variety. The result showed that there was no significant difference up to 4 WAP between the two forms of moringa leaf extract and the control. However, significant difference was observed from 6 WAP between method used and control,

Table 1. Effects of forms and number of application of moringa leaf extract on plant height (cm) of two varieties of sweet corn

	Weeks after Planting			
	2	4	6	8
		Variety(V)		
White	16.62	41.68	102.12	170.54
Yellow	14.71	33.43	82.19	153.33
LSD	ns	6.85**	13.40**	16.12**
		Forms of application(F)		
Control	13.26	32.97	62.35	116.82
Fresh	15.53	36.81	98.25	169.36
Dry	16.61	39.83	96.00	169.36
LSD	ns	Ns	18.86**	22.47**
		Number of times of application		
Control	13.26	32.97	62.35	116.82
Once	14.71	35.46	93.04	157.88
Twice	17.08	38.92	101.58	180.75
Thrice	16.42	40.58	96.75	169.75
LSD	ns	ns	19.81**	23.83**

the dry form was observed to enhance the height of plant by 53% compare with the control while fresh method was 57.6% higher than the control, although when the two forms are considered, no significant difference was observed. Similarly, there were no significant differences ($p>0.05$) for number of applications at 2 and 4 WAP, but as from 6 WAP, significant difference ($p<0.05$) was observed between the MLE treated plants and the control. Plants that received MLE at 2 and 4 WAP consistently supported the highest height at 6 and 8 WAP; though there were no significant differences ($p>0.05$) among the treated plants for number of application.

3.1.2. Effect of Moringa Leaf extract on stem girth of sweetcorn.

Stem girth did not differ significantly ($p>0.05$) among the two varieties only at 2 WAP (Table 2), there were significant differences ($p<0.05$) between the two varieties at 4, 6 and 8 WAP respectively (Table 2) while the white variety had higher stem girth throughout the period of observation. The forms of application were not significant difference from each other, except at 6 WAP with the fresh and dry forms higher than the control by 16.9 and 12.6% respectively. The number of times of application showed significant differences from the control only at 6 WAP with once, twice and thrice application being 10.6, 17.7 and 15.4% higher than the control respectively. While at 2, 4 and 6 WAP, there were no significant differences among the different times of MLE application.

3.1.3 Effect of Moringa leaf extract on number of leaf of sweetcorn.

As shown in Table 3, there was no significant difference among the two varieties at all the weeks after planting respectively. Forms of application only showed significant difference ($p<0.05$) which was 16.5% and 10.7% over the control for fresh and dry form respectively at 8 WAP. In terms of number of applications on number of leaves, it was observed that there was no significant difference($p>0.05$) among the three times of application except from the control which was observed at 8 WAP with once, twice and thrice application giving values of 12.3, 11.5 and 17.1% higher than the control. However, applying the moringa thrice tends to give a higher value which was observed from 6 WAP.

Table 2. Effects of forms and number of application of moringa leaf extract on stem girth (cm) of two varieties of sweet corn

	Weeks after Planting			
	2	4	6	8
		Variety(V)		
White	1.38	2.15	2.95	3.29
Yellow	1.34	1.93	2.77	3.06
LSD	ns	0.16**	0.20**	0.19**
		Forms of application(F)		
Control	1.36	1.97	2.54	3.08
Fresh	1.36	2.04	2.97	3.19
Dry	1.36	2.06	2.86	3.19
LSD	ns	ns	0.28 **	ns
		Number of times application(N)		
Control	1.36	1.97	2.54	3.08
Once	1.37	2.00	2.81	3.25
Twice	1.38	2.07	2.99	3.21
Thrice	1.34	2.09	2.93	3.13
LSD	ns	ns	0.30**	ns

3.2.1 Effect of Moringa leaf extract on yield traits.

The effect of MLE on the yield parameters of sweet corn is presented in Table 4. The form of application was observed to influence the yield parameters of sweet corn, as there was significant difference ($p<0.05$) between the forms and the control for the cob weight, kernel row, and cob girth except for the cob length in which no significant difference was observed. For cob weight, the fresh and dry forms were observed to be 16.3% and 16.8% greater than the control, for kernel row, the fresh and dry form were observed to be 12.6% and 15.5% greater than the control while cob girth for fresh and dry form was observed to be 13.5% and 10.34% higher than the control.

Table 3. Effects of forms and number of applications of moringa leaf extract on number of leaves of two varieties of sweet corn

	Weeks after Planting			
	2	4	6	8
		Variety(V)		
White	5.92	7.71	9.92	11.45
Yellow	5.48	7.43	10.00	11.76
LSD	ns	ns	ns	ns
		Form of application(F)		
Control	5.73	7.17	9.32	10.39
Fresh	5.78	7.67	10.36	12.11
Dry	5.61	7.61	9.78	11.50
LSD	ns	ns	ns	0.88**
		Number of times of application(N)		
Control	5.73	7.17	9.32	10.39
Once	5.42	7.50	9.79	11.67
Twice	5.75	8.00	10.08	11.58
Thrice	5.92	7.42	10.33	12.17
LSD	ns	ns	ns	0.93**

Table 4. Effects of forms and number of applications of moringa leaf extract on yield parameters of two varieties of sweet corn

	Cob weight (g)	No. Kernel Rows	Cob Girth (cm)	Cob Length(cm)
		Variety(V)		
White	118.74	12.84	3.84	18.41
Yellow	121.85	12.05	3.83	17.39
LSD	ns	ns	ns	0.75**
		Forms of application(F)		
Control	105.35	11.11	3.48	17.20
Fresh	122.49	12.51	3.95	18.00
Dry	123.08	12.83	3.84	18.04
LSD	10.16**	1.25**	0.20**	ns
		Number of times of application(N)		
Control	105.35	11.11	3.48	17.20
Once	127.63	12.38	3 .90	18.50
Twice	117.49	12.88	3.84	17.94
Thrice	123.25	12.75	3.95	17.63
LSD	10.78**	1.32**	0.21**	1.12**

Comparing the two varieties, it could be observed from Table 4 that a significant difference was observed in the cob length. The number of times of application was also observed to significantly influence the yield parameters when compared with the control for cob weight, kernel row, and cob length and cob girth. Among the three times of application however, no significant ($p>0.05$) difference was observed for cob weight, kernel row and cob girth except for cob length in which applying MLE once was observed to differ significantly from when the extract was applied twice and thrice, applying twice and thrice did not differ significantly from each other.

Figure 1 shows the effect of forms and number of times of application of MLE on the cob yield of two varieties of sweet corn. Once application gave the highest value yield. The yield for the two forms of moringa leaf extract was not significantly different, suggesting that both forms of MLE are essential in improving the yield of sweet corn.

3.2 Discussion

The height of a plant is an important growth character directly linked with the productive potential of plants in terms of fodder and grain yield (Saeed *et al*., 2001). An optimum height is claimed to be positively correlated with productivity of plant (Price 1985). In this study, MLE favorably influenced the plant height of the two varieties of sweet corn, with the greatest height observed at 8 weeks after planting for both varieties, although the white variety gave a higher value than the yellow variety. In terms of forms of application, there was also increase in plant height week after week of application, with significant difference from the control from 4 weeks but with no significant difference between the two numbers of application were also observed to affect the sweet corn height in response to MLE as the highest height was observed at twice application at 8 weeks after planting. Also, the girth of the plant is an important criterion, which determines its strength and ability to resist lodging. In this study, MLE application favorably influenced the girth of sweet corn plants (Foidl *et al*; 2001). The highest girth was observed at 8 weeks after planting for both varieties, in terms of forms of application, there was increase in stem girth week after week, with significant difference observed only after 6 weeks after planting from the control although, no significant difference between the forms of application. Regarding times of application, there was no significant difference in number of times of spraying of the extract except for that of control. This is contrary to findings of Mvumi (2013) where all the variables were significant with thrice application having the highest significance. Numbers of leaves were observed not to differ significantly from each other from the varieties in response to MLE.

Fresh MLE was observed to influence number of leaves better and thrice application was also observed to give higher number of leaves than others Mvumi (2013) although in term of significance, all the times of application were not observed to differ from one another except from the control. The response of sweet corn to MLE in term of growth and yield confirmed the findings of Fuglie (2000) who reported that application of moringa leaf extract increased maize growth. Considering the response by stem girth, it was observed to be stronger indicating the influence of potassium present in the moringa leaf extract (Foidl *et al*., 2001) and this potassium is known to increase stem strength and root development. The leaves numbers were also observed to increase, this is also evident that MLE influence the growth of sweet corn and this is due to the fact that the leaves of moringa are rich in zeatin, in addition to other growth enhancing compounds like ascorbates, phenolics, and minerals like calcium, potassium and iron that makes it an excellent growth enhancer (Makkar *et al*, 2007).

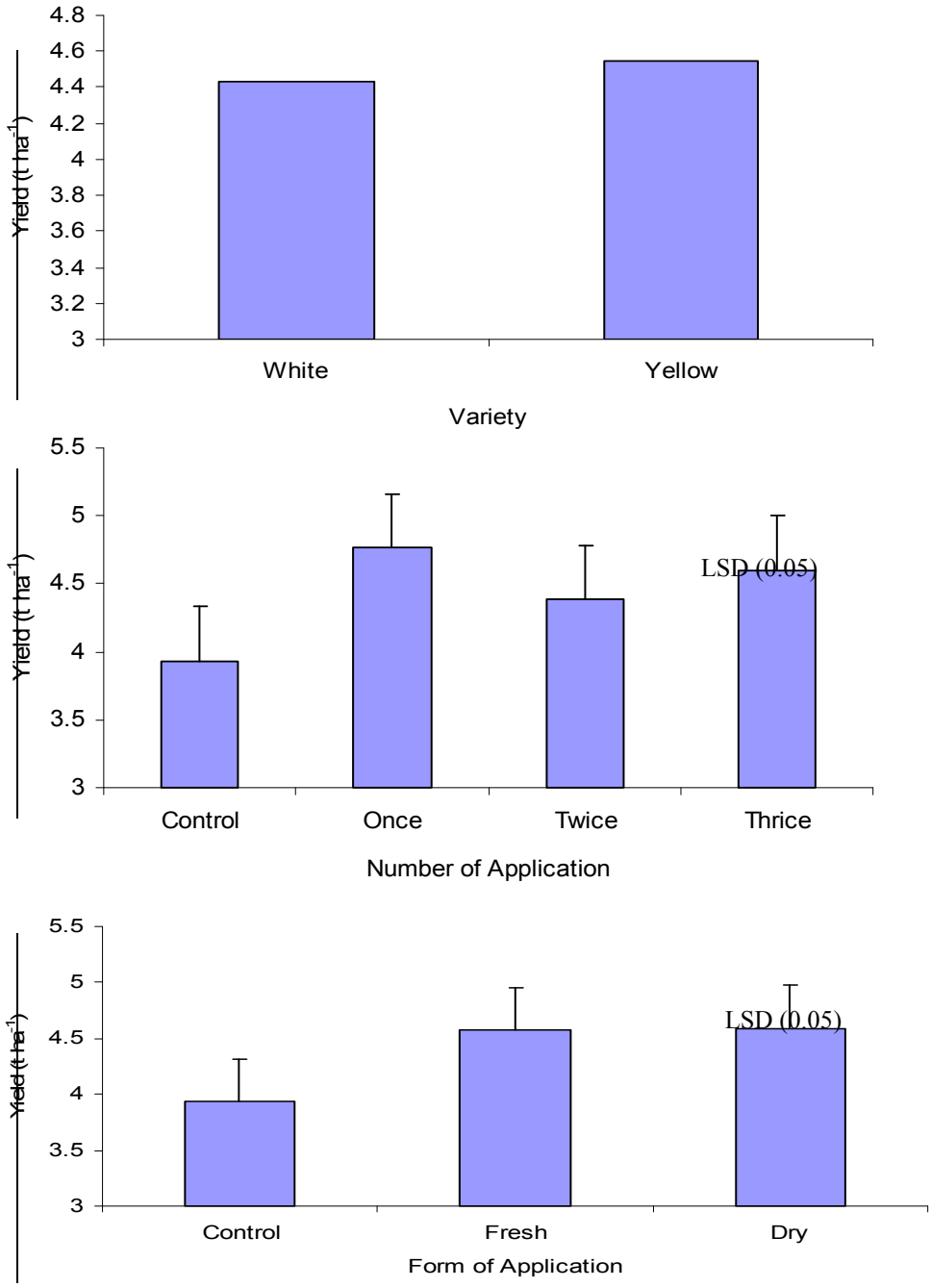

Figure 1. Effects of forms and number of applications of Moringa Leaf Extract on the cob yield (t ha^{-1}) of two varieties of sweet corn.

El Awady (2003) also pointed out that in moringa, there is zeatin hormone in very high concentrations between 5mcg and 200mcg.The growth enhancement observed also support the earlier results by Fuglie (2000) that the leaf of *Moringa oleifera* accelerated growth of young plants, strengthened plants , improved resistance to pest, diseases, increased leaf duration and increased number of leaves . The differences observed between the two varieties in terms of their response could be related to the statement that stated that, there are some known physiological effects caused by the application of hormones like cytokinins which depend on the type of cytokinins and crop species (Salisbury *et al*., 1992; Davies, 1995). Similarly exogenous application of MLE causes responses which can vary depending on the plant species.

The non-significant differences observed between the two forms suggest that both forms of extracts have the potentials of enhancing the growth of crops. Therefore, one can choose which of the form if extract can be preserved dry which will enhance its use during periods of moringa leaf scarcity. Also, the no n-significant difference observed in times of application is contrary to the findings of Mvumi (2013) where it was observed

that there were significant differences among the times of spraying and it was said that, the higher the frequency of spraying, the greater the increase in height, as the highest plant height was observed at the twice application.

Moringa leaf extract was also observed to have positive influence on the yield parameters of the sweet corn taken compared to the control, this supports Foidl *et al*. (2001) who reported that foliar spraying of some plant leaves with MLE produced some notable effects as overall increase in plant yield between 20 and 35% and higher sugar and minerals levels. The enhanced yield as seen from the yield parameters in response to MLE were due to high protein, sugar, and starch content of entire *moringa oleifera* which make it of great scientific and agricultural interest. (Foidl *et al*., 2001; Yameogo *et al*., 2011)

4.0 Conclusion

Application of MLE significantly increased plant height; stem girth, number of leaves, cob weight, cob length, kernel row and cob girth of sweet corn. The highest yield in terms of cob weight was observed to be 16.8% and 16.3% higher than the control for dry and fresh methods respectively. The highest cob weight which was 21.15% higher than the control was observed when application was done once. Furthermore, the yellow variety had higher cob weight than white variety with about 2.55%. It is concluded that application of MLE can be used to improve the productivity of sweet corn.

References

Brecht J.K (1998).Fresh cut sweet corn kernels. Citrus and Vegetable Magazine, 63(7), 36-37.

Davies P.J. (1995). Plant Hormones, Physiology, Biochemistry and Molecular Biology. Kluwer Academic publishers, Netherlands pp 758-759.

El Award A. (2003).Moringa Tree:Nature's pharmacy.

Foidl N, Makkar HPS, Becker K. (2001). The potential of Moringa oleifera for agricultural and industrial uses In: proceedings of the international workshop "what development potential for moringa products". Dares-Salaam,Tanzania pp 47-67

Fuglie L.J (2000) The miracle tree: *Moringa oleifera*. Natural nutrition for the tropics.The multiple attributes of moringa pp. 172.

Fuglie, L.J and Sreeja, K.V. (2001).Cultivation of moringa pp 123-128.In:The miracle tree, moringa oleifera: Natural nutrition for the tropics. (Ed.Fuglie, L.J). CWS, Darkar, Senegal.

Kunicki,E.(2003).Uprawa Kukurydzy Cukrowey.Wyd.plant press Krakow.

Makkar H.P.S., G.Francis, and K. Becker (2007). Bioativity of phytochemicals in some lesser known plants and their effects and potential applications in livestock and aquaculture production systems Animal 1:1371-1391.

Mvumi, C. (2013). Assessing the Effect of Adequate and Inadequate Inorganic Fertilizer Rates on the Yield Levels of Paprika in Mutasa Resettlement Area, Manicaland Province, Zimbabwe Greener Journal of Agricultural sciences 3(1) 55-62,

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, Falsalabad Pakistan.

Noaman W, Siddiqui M.T, Basra S.M.A (2011). *Moringa oleifera* leaf extract: An innovative priming tool for rangeland grass. Turk.J.Agric. For.TUBITAK 35:1-11

Phiri C. (2010). Influence of moringa leaf extracts on germination and early seedling development of major cereals. Agric Biol.J.N Amer.1 (5):774-777

Price M.L. (1985). The moringa tree ECHO.17391 Durrance Rd,North ft Myers FL 33917,USA

Prosecus P. 2006).Biosynthesis plant hormones and growth regulators: Chemistry and Biology. Biosynthesis Ag. co. Switzerland.

Saheed,M.Kaleem Abbasi and Mushtaque.Kazmi (2001). Response of Maize(*Zea mays*) t NP fertilization under Agro-climatic condition of rawalokot Azad Jammu and Kashmir.Pakistan journal of Biological science 4(8):946-952 2001.

Salisbury F.B and Ross C.W (1992). Plant physiology. Belmont, C.A: Wadworth, PP 357-548.

Tindall,H.D.(1983).Vegetables in the tropics. Macmillan press Ltd. London, 533p.University of Maine information sheet 2001 on commercial organic nitrogen recommendation.

Xu, H.I (2000) .Effects of microbial inoculants and organic fertilizers on growth, photosynthesis and yield of sweet corn. Journal of crop production.3 (1):183-214.

Yameogo C.W, Bengaly M.D, Savadogo A, Nikiema P.A, Traore S A.(2011).Determination of chemical composition and nutritional values of *Moringa oleifera* leaves Pak.J.Nutr.10(3):264-268.