Growth and Yield Response of Pepper (*Capsicum annum* L*)* to Varying Rates and Spraying Regime of Moringa Leaf Extract

***Onyegbule,U.N, ** Anyaoha, C.O, * Uwanaka, C.E and * Ibekwe, H.N**

** National Horticultural Research Institute,Mbato out-station Okigwe,Imo state*
*** National Horticultural Research Institute, Idi-Ishin Ibadan,Oyo state*
Corresponding author's Email; onyegbuleugochukwu@gmail.com

Abstract
The study evaluated the influence of Moringa leaf extract (MLE) and spraying regime on the growth and yield of sweet pepper during the 2018 early cropping season. Three rates of MLE (0, 50% and 100% concentration) and three spraying regimes (no spray, weekly spray, bi-weekly spray) were utilized. The experimental design was a 3 x 3 factorial in randomized complete block design replicated three times. Data were collected at 4,6,8 and 10 weeks after transplanting(WAT) on plant height (cm), number of leaves, canopy spread (cm), stem girth (cm), fruit number/plot, fruit weight (t/ha), fruit length (cm) as well as fruit diameter(cm). Results indicated that the Moringa leaf extract significantly ($p<0.05$) increased the growth and yield parameters measured relative to the control. . MLE application gave highest plant height of 79.3 cm at 10 WAT, while weekly spray recorded highest plant height of 78.1 cm also at 10 WAT. Weekly spray at 10 WAT showed higher stem girth of 1.6 cm although, this value was not significantly ($p>0.05$) different from the value (1.5 cm) obtained from the bi-weekly application. The interaction of MLE and spraying regime on plant height was not significant ($p>0.05$).The MLE increased the number of fruits, fruit weight, fruit length and fruit diameter relative to the control. Highest values on number of fruits (72), fruit weight (1.96 t/ha), fruit length (3.4 cm) and fruit diameter (2.48 cm) was obtained at 100 % concentration rate of application which was significantly ($p<0.05$) different from the control. Also, weekly spray gave better yield increases in number of fruits (78), fruit weight (1.48 t/ha) and fruit length (3.7 cm) although these values were not statistically different from that obtained from bi-weekly spray. The interaction effects of MLE and spraying regime on fruit weight, fruit length and fruit diameter was not significant.

Key words*; Growth and yield response, Moringa leaf extract, Pepper, Spraying regime,*

INTRODUCTION

Pepper (*Capsicum annum* L.) which belongs to Solananceae is an important vegetable which can be consumed fresh as well as processed is a good source of vitamins and minerals. Moreover, it is one of the valuable medicinal plants in pharmaceutical industry because of its high amounts of antioxidant, capsaicin and capsantin which are the main active substances in it (Aminifard *et al*., 2012).It is also rich in vitamins A and C and contains appreciable quantities of proteins and minerals (Temu and Temu, 2005). Pepper is the second most important vegetable in the world after tomato and used mainly as spices in various cuisines (Olaniyi and Ojetayo, 2010). Nigeria is the largest producer of pepper in Africa and is cultivated mainly in the savanna and derived savanna zones of the South West and also in the North. (Olaniyi and Ojetayo, 2010; Abdulmalik *et al*., 2012). *Moringa oleifera* is the most widely cultivated genus in the family*Moringaceae.* It is a tropical crop grown for its nutritional and medicinal purposes (Foidl*et al*., 2001). The leaves arerich in zeatin, a naturally-occurring cytokinin and other growth enhancing compounds like ascorbates, vitamin E, phenolics and minerals (Foidl *et al*., 2001; Nagar*et al*.,2006).Also *Moringa oleifera* were found among the most promising species according to their high antioxidant activity, high contents of micronutrients and phytochemicals, processing properties, ease of growing and palatability. According to Bharahi,(2003), Moringa plant is known to have high amount of essential nutrient, beta

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

carotene. Apart from medicinal uses, the plant leaves are a good source of amino acid and could be used as immune booster. All part of moringa tree are useful and have long been used by humans (Fahey, 2015). The leave also provide excellent materials for the production of biogas (Kivevele, *et. al*; 2011).

Foliar spray of crops with moringa leaf extract (MLE) accelerates plant growth, promotes resistance to stress and increases yield of crops (Fuglie, 1999; Foidl *et al*., 2001; Fahey, 2005; Marcu, 2005). Moringa is a common plant in households in this sub region, its extract can increase crops yields farmers can embrace the technology and utilize the available resource with little or no cost. The frequent and occasional excessive use of chemical inputs have been indicted for adverse effects on the environmental quality because they have potentials to upset the ecological balance of soils and make plants even more susceptible to pests and diseases (Panayotov *et al*., 2010; Fawzy *et al*. 2012). There is now a growing demand for sound and ecologically compatible and environment friendly techniques in agriculture, capable of providing enough food for the increasing human population; retaining soil quality and improving the quality and quantity of agricultural produce (Russo *et al*. 2012). In view of these, the use of natural growth enhancers has been advocated. Therefore, this work is aimed to investigate the effects of varying concentrations of moringa leaf extract (MLE) on the growth and yield of pepper (*Capsicum annuum*).

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research farm of National Horticultural Research Institute (NIHORT) Mbato out- station Okigwe to assess the response of pepper to varying rates and spraying regimes of Moringa leaf extract (MLE). The experimental site had been used to crop water melon after which it was left fallow for one year. The physico-chemical analysis of the experimental site before the commencement of the trial showed that the soil was acidic with textural characteristics of sandy loam. The soil was low in total Nitrogen, Organic carbon, ECEC and base saturation (Table 1). The experiment was a 3 x 3 factorial arranged in a randomized complete block design (RCBD) replicated three times. The treatments consisted of three levels of MLE (0, 50 % concentration, 100 % concentration) and three spraying regimes (no spray, weekly spray, bi-weekly spray). The pepper variety used for the trial was sourced from NIHORT Ibadan. Nursery preparation was done in April, 2018 and transplanted in June, 2018 on raised beds measuring 2 x 2 m at spacing of 50 x 50 cm. NPK 20:10:10 compound fertilizer was applied as basal dose. Pepper stands were sprayed with Cypermethrin(R) (insecticide) weekly at the rate of 30 ml per 10 liters of water to control insect pest attack. Weeding was carried out at four weeks interval. Data were collected at 4, 6, 8 and 10 WAT on plant height, number of leaves, canopy spread and number of branches. Also yield parameters were collected on fruit number per plot, fruit weight per plot,fruit length as well as fruit diameter. Plant height was measured with a meter rule from the surface of the soil to tip of the tallest leaf. Number of leaves, number of branches and fruit number were calculated by counting. Fruit yield was determined by weighing. Fruit diameter was measured using venire caliper. Six (6) candidate plants were used to obtain information from the plots.

Data analysis

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

All data collected were analyzed using analysis of variance (ANOVA). Treatment means were separated using Fisher's least significant difference (LSD) at 5 % probability level test.

RESULTS AND DISCUSSION

Effect of Moringa leaf extract and spraying regime on growth and yield of pepper

Growth parameters

The study showed that there was no significant ($p>0.05$) effect of the Moringa leaf extract and spraying regime on plant height. However, at 50% concentration MLE application gave highest plant height of 79.3 cm at 10 WAT, while weekly spray recorded highest plant height of 78.1 cm also at 10 WAT (Table 2). Similar trend of results were obtained with stem girth, but with 100% concentration rate of application showing highest stem girth of 1.9 cm at 10 WAT. Weekly spray at 10 WAT showed higher stem girth of 1.6 cm although this value is not significantly ($p>0.05$) different from the value (1.5 cm) obtained from the bi-weekly application. The interaction MLE and spraying regime on plant height was not significant ($p>0.05$) (Table 2).

The effect of MLE and spraying regime on canopy spread is shown on Table 3. The treatment applications increased the canopy spread relative to the control. At the 100% concentration rate of application, MLE significantly ($p<0.05$) increased the canopy spread compared with the control but not significantly different ($p>0.05$) with 50% concentration. Weekly spray showed highest increase in canopy spread. The interaction effects of MLE and spraying regime was not significant. The MLE increased the number of leaves relative to the control. The results showed that there was no significant interaction between the MLE and the spraying regime on number of leaves. The spraying regime also showed increases in the number of leaves compared with the control.

Yield parameters

The MLE increased the number of fruits, fruit weight, fruit length and fruit diameter relative to the control (Table 4). Highest number of fruits(72), fruit weight (1.96 t/ha), fruit length (3.4 cm) and fruit diameter (2.48 cm) was obtained at 100 % concentration rate of application which was significantly ($p<0.05$) different from the control. Also, weekly spray gave better yield increases in number of fruits (78), fruit weight (1.48 t/ha) and fruit length (3.7 cm) although these values were not statistically different from that of bi- weekly spray. The interaction effects of MLE and spraying regime on fruit weight, fruit length and fruit diameter was not significant.

The increases in both growth and yield parameters of sweet pepper using MLE confirms that moringa leaf is a foliar plant nutrient (Fuglie, 1999), and hence, has the ability to improve the growth and yield parameters measured. Foidl*etal*., (2001) reported that moringa leaves are credited with high protein content and a lot of minerals and vitamins. According to Maker and Becker (1997), moringa leaves have complete set of all the essential amino acids which serves as an excellent source of plant nurients . The yield increases recorded with moringa leaf extract also confirms the report of Akanbi *etal*., (2017) who disclosed that the juice extracted from the leaves of moringa can be used to make foliar nutrient capable of increasing crop yield. Foliar spray of crops with moringa leaf extract accelerates plant growth, promotes resistance to stress and increases yield of

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

crops (Fuglie, 1999, Foidl *etal*, 2001, Fahey, 2005, Marcu, 2005).

CONCLUSION

The study revealed that the growth and yield of sweet pepper can be enhanced using Moringa leaf extract at 100% concentration rate of application when sprayed at weekly interval to ensure better yield. The use of MLE should be introduced to resource poor farmers who may not be able to afford inorganic fertilizers that are scare with associated high cost. There is need to emphasize on the use of organic materials such as Moringa leaf extract that can sustain crop yield and improve the condition soils.

REFERENCES

Abdulmalik,M.M.,Olanrewaju,J.D.,Usman,I. S.andIbrahim,A.(2012).(*Capsicuman numL.*) cultivars. Production. Agriculture and Technology, (PAT). 8(1): 191-198.

Aminifard, M.H, Aroiee H, Ameri A and Fatem H,(2012). Effect of plant density and nitrogen fertilizer on growth, yield and fruit quality of sweet pepper (*Capsicum annum* L.). *African J. Agric. Res*. 7(6): 859-866.

Akanbi, W. B. A. Safa, R. F, and Ojo, M. A. (2017). Effect of growth media composition on early growth and development of Moringa(Moringa oleifera L) seedlings. Proceedings of the 30th Annual Conference of HORTSON Kabba 2017'. pp.164 – 171

Bharali, R., Tabassum, J and Azad, M..R.H, (2003).Chemomodulatory effect of *Moringa oleifera*, Lam, on hepatic carcinogen metabolism of enzymes, antioxidant parameters and skin papillomagenesis in mice. Asian Pacific journal of cancer prevention, pp 1-15.

Fahay, J. W. (2005). *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. *Tree for Life Journal.* www. TFL Journal. org.

Fawzy, Z. F., Abou El-magd M. M., Yunsheng Li, Zhu Ouyang and Hoda A. M. (2012). Influence of foliar application by EM Effective microorganisms, amino acids and yeast on growth, yield and quality of two cultivars of onion plants under newly reclaimed soil. Journal of Agricultural Science. 4(11): 26-39.

Foidl N., Makkar H. P. S. and Becker K. (2001). The potential of *Moringaoleifera* for agricultural and industrial uses. In: Fugile, L. J. (Ed). The Miracle Tree: The Multiple Attribute of Moringa. pp. 45-76.

Fuglie L. J.(1999). The Miracle Tree: *Moringaoleifera*: natural nutrition forthe tropics. Church World Service, Dakar, pp. 68; revised in 2001 and published as The Miracle Tree: The Multiple Attributes of Moringa . 172p.

Kivevele, T. T. Mbarawa, M. M, Bereezky, A and Zoldy, M. (2011). Evaluation of the oxidation stability of biodiesel produced from *Moringa oleifera* oil. *Energy Fuels,* 25(11): 5416-5421.

Marcu M. G. (2005). Miracle Tree. KOS Health Publications, Canada. pp. 108-115.

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

Nagar, P. K., Iyer R. I. and Sircar P. K. 2006. Cytokinins in developing fruits of *Moringapterigosperma* Gaertn. *Physiol Plant*. 55: 45-50.

Olaniyi J. O. and Ojetayo A. E.(2010). The Effect of Organomineral and Inorganic Fertilizer on the Growth, Fruit yield and Quality of Pepper (*Capsicum frutescence*). *Journal of Animal and Plant Sciences*, 8(3): 1070-1076.

Panayotov Nikolay, Mladen Najdenov, Yordanka Kartalsak and Krasimira Sapundjieva (2010). Influence of some beneficial microorganisms on the development of pepper seedling. BALWOIS - Ohrid, Republic of Macedonia-25, 1-6.

Russo A., Carrozza G. P., Vettori L., Felici C., Cinelli F. and Toffanin A. (2012). Plant Beneficial Microbes and Their Application in Plant Biotechnology. in Agbo E.C (Ed) Innovation in Biotechnology. ISBN: 978-956- 51-0096-6, In Tech. pp. 57-72.

Temu A. E. and Temu A. A. (2005). High Value Agricultural Products for Small Holder Market in Sub-Saharan Africa: Trends, Opportunities and Research Priorities. International journal of plant science 4(8) 146 -165

Table 1:Physico - chemical characteristics of the experimental site

Properties	**0- 15 cm**	**15 – 30 cm**
Sand (%)	81.80	80.80
Silt (%)	6.00	6.80
Clay (%)	12.20	12.40
pH	5.26	5.13
Organic matter (%)	2.71	2.60
Total Nitrogen (%)	0.05	0.05
Available P(mg/kg)	11.01	10.96
Ca (cmol/kg)	0.10	0.12
Na (cmol/kg)	0.06	0.05
K (cmol/kg)	0.10	0.12
Mg (cmol/kg)	1.40	1.20
Exchangeable Acidity(cmol/kg)	2.68	2.40
Base saturation (%)	56.30	54.83

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

Table 2: Effect of Moringa leaf extract and spraying regime on plant height (cm) and stem girth (cm) at 4,6,8 and 10 weeks after transplanting

	Plant height				Stem girth			
Moringa Leaf Extract(MLE)	**4WAT**	**6WAT**	**8WAT**	**10WAT**	**4WAT**	**6WAT**	**8WAT**	**10WAT**
0	56.7	66.0	66.5	70.7	1.21	1.30	1.30	1.39
50 % conc.	60.8	62.6	66.83	79.3	1.42	1.66	1.70	1.70
100% conc.	64.3	65.5	76.5	79.0	1.58	1.58	1.82	1.90
LSD(0.05)	NS	NS	NS	NS	NS	NS	0,88	0.82
Spraying regime								
No spray	51.0	59.2	66.4	70.0	0.83	1.02	1.02	1.13
Weekly spray	58.2	68.5	78.1	73.6	1.32	1.38	1.38	1.60
bi – weekly spray	73.6	75.6	73.4	81.0	1.46	1.58	1.58	1.50
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS
MLE X Spraying regime	70.5	70.1	78.8	68.9	1.30	1.28	1.62	1.54
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS

NS; Not Significant

Table 3:Effect of Moringa leaf extract and spraying regime on Canopy spread (cm) and number of leaves at 4,6,8 and 10 weeks after transplanting

	Canopy Spread				Number of Leaves			
Moringa Leaf Extract(MLE)	**4WAT**	**6WAT**	**8WAT**	**10WAT**	**4WAT**	**6WAT**	**8WAT**	**10WAT**
0	45.0	47.6	55.1	59.6	76	79	79	86
50 % conc.	61.7	60.9	68.0	71.9	101	110	110	126
100% conc.	66.6	70.4	72.3	74.3	74	84	90	92
LSD(0.05)	7.8	8.3	10.5	7.6	NS	14.8	15.3	9.4
Spraying regime								
No spray	58.8	50.9	62.4	66.2	77	83	87	99
Weekly spray	61.2	65.5	65.5	69.5	93	96	108	115
bi – weekly spray	62.0	63.8	64.1	67.4	84	95	105	127
LSD(0.05)	NS	NS	NS	NS	3.1	3.7	5.2	6.1
MLE X Spraying regime	60.1	62.0	60.8	84.1	77	68	86	115
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS

NS; Not Significant

ISSN 978-978-54729-6-7
THEME: "Horticulture for Improved Food Security, Sustainable Environment and National Economic Growth
18th – 22nd November, 2018

Table4:Effect of Moringa leaf extract and spraying regime on number of fruit/plot, fruit weight, fruit length and fruit diameter

Moringa Leaf Extract (MLE)	Number of fruit/plot	Fruit weight (t/ha)	Fruit length (cm)	Fruit diameter (cm)
0	50	0.46	2.4	1.26
50 % conc.	68	1.42	3.4	2.15
100% conc.	72	1.96	3.4	2.48
LSD(0.05)	12.2	0.03	NS	NS
Spraying regime				
No spray	59	0.68	2.36	1.37
Weekly spray	78	1.50	3.54	2.24
bi – weekly spray	70	1.48	3.7	1.98
LSD(0.05)	2.5	0.16	NS	NS
MLE X Spraying regime	79	1.36	3.3	2.44
LSD(0.05)	5.3	NS	NS	NS

ISSN 978-978-54729-6-7