Original Article **Asian J Agri Biol, 2015, 3(4): 132-138.**

RESPONSE OF SWEET BELL PEPPER TO MORINGA LEAF EXTRACT AND ORGANO-BIO DEGRADABLE FERTILIZER

Oluwagbenga Dunsin and Theo Okiemute Odeghe
Department of Crop & Soil Sciences, Landmark University, Omu-Aran, Kwara-State. Nigeria

ABSTRACT

An experiment was carried out at the Teaching and Research Farm of Landmark University Omu-Aran, Nigeria in the Savannah ecosystem of Nigeria from November to March for evaluating the response of sweet bell pepper to Moringa Leaf Extract (MLE) and Organo Bio Degradable fertilizer (OBD^+). The treatments included four levels of Organo-Bio Degradable fertilizer (0g, 20g, 40g and 60g) Moringa Leaf Extract at ratio 1:32 (v/v) was sprayed directly at the plant at 1 and 2 weeks after transplanting respectively and replicated thrice in a Completely Randomized Design (CRD).The results showed that plant height, number of leaves, fruit weight and yield of sweet bell pepper were significantly ($P \leq 0.05$) influenced by the application of Moringa Leaf Extract and Organo-Bio Degradable fertilizer (OBD^+).

Keywords: Sweet bell pepper; Moringa Leaf Extract; Organo-biofertilizer (OBD^+)

INTRODUCTION

Sweet bell 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 high amounts of antioxidant, capsaicin and capsantin as main active substances in it (Aminifard et al., 2012).

In Nigeria, sweet bell pepper is mainly grown around the Savanna agro-ecological zones together with annual crop like maize or singly during the rainy season and dry season. It is an important vegetable for human consumption in Nigeria in fresh form or processed into paste, pure and juice or ground with other vegetables in the preparation of stew and soup. Although the crop is widely cultivated in Nigeria, yet the estimated yields of about 9 t/ ha^{-1} obtained on farmers' fields are often very low, compared to estimated yields of 15 t/ ha^{-1} obtained in Western Europe (Aliyu, 1994). The low yields obtained in Nigeria have been attributed to a number of production constraints that include problems of diseases, pests and poor weed management and soil fertility.

Plant extracts of some trees and crop residues have been reported to influence crop growth and yield (Farooq et. al., 2008; Ahmed and Nimer, 2002). Leaf extracts of *M. oleifera* have been reported to accelerate growth of young plants, strengthen plants, improve resistance to pests and diseases, increase leaf area duration, increase number of roots, produce more and larger fruits and generally increase yield by 20 to 35% (Fuglie, 2000).

The nutrient requirement of sweet bell pepper is very high leading to excessive removal of nutrients from soil by the plant and as such correct nutrient management practiced is found to have increased the growth and yield of crop which is important from the point of view of small farmers (Ganjare et al., 2013). For optimal yield and growth, plants require a well-balanced nutrient diet which can be fulfilled using manures as supplementary fertilizers. Organic manures contribute to the fertility of the soil through addition of macro and micronutrients and organic matter to improve physical and chemical properties of soils. Hence, organic manures can serve as alternative to mineral fertilizers for improving soil structure and microbial biomass (Dauda et al., 2008).

Capsicum is the most important vegetable crop in Nigeria and indeed the rest of the world. It is considered for its rich source of vitamins and minerals with various culinary uses either in its fresh form as salad or as puree in stew and soups. Increase in its yield is very vital. One of the strategies in achieving yield increase is the use of plant growth regulators (PGR) and bio-fertilizer. In Nigeria not much work has been done on the use of PGR and bio-fertilizer, more especially the use of natural product such as moringa extract to improve crop yield. Moringa

**Corresponding author:* e-mail: dunsin.oluwagbenga@lmu.edu.ng

is a common plant in households in this sub region, if its extract can increase crops yields farmers will embrace the technology and utilize the available resource with little or no cost. Furthermore, even though chemical fertilizers were reported to improve crops yields they are scarce and when available they are beyond the reach of a poor resource farmer (s). Therefore, there is the need to explore substitute and/or synergist to minimize its use and meet up with fertilizer demands.

MATERIALS AND METHODS

The experiments were carried out as pot experiment under a controlled environment of Landmark University Teaching and Research Farm Omu-aran, Kwara Screen house from November 2014 to March 2015. The study area is located on latitude 8.1333N and longitude 5.1000S, with altitude of 506m above sea level of the Guinea Savannah zone of Nigeria. The pots were filled with 10kg sandy loamy soil. Four week old seedlings were hand transplanted into each pot and later thinned to one plant per pot, two weeks after transplant. Soil sample were taken from each pots before and after the experiment.

Moringa leaves were collected from a mature moringa tree and juice was extracted. An amount of 20 g of young moringa leaves was mixed with 675 ml of 80 % ethanol as suggested by Makkar and Becker (1996). The solution was then filtered by wringing the solution using a mutton cloth. The solution was re-filtered using No. 2 Whatman filter paper. Using a method developed by Fuglie (2000), the extract was diluted with distilled water at a 1:32 ratio (v/v) and then sprayed directly on plants. The extract was used within five hours from cutting and extracting (if not ready to be used, the extract or the solution prepared was stored in the refrigerator at 0^0C and only taken out when needed for use). An amount of 25 ml of the solution was applied per plant.

The treatments was made up of four levels of Organo-biofertilizer (OBD+) $0g^{-pot}$, $20g^{-pot}$, $30g^{-pot}$, $40g^{-pot}$ and Moringa Leaf Extract (MLE); One week and Two weeks after transplanting arranged in Complete Randomized Design (CRD) with three replications, Organo-biofertilizer (OBD^+) was applied a week before transplanting. Data collected were plant height, number of leaves taken at 2, 6, 8, 10 & 12 Week after Transplant (WAT), fruit numbers and weight at the time of harvesting. Data collected were analyzed using analysis of variance (ANOVA), with the help of SAS statistical package (SAS, 1999) was used for data analysis. The differences between means were determined using the Duncan's Multiple Range Test (DMRT) at 5% probability level.

RESULTS

Initial Soil Characteristics

Results of the soil sample taken from the depth of 0-15cm are presented in the table – I. The soil pH was strongly acidic. The Nitrogen content of the soil was very low, organic matter, organic carbon and available phosphorous was also low. The soil was high in sand contents with low silt and clay contents; so, textural class of the soil was sandy clay loam.

Effects of moringa leaf extract and organo-bio degradable fertilizer (OBD^+) on soil chemical properties

Table – II shows the effects of Moringa leaf extract (MLE) and Organo-bio degradable fertilizer (OBD^+) on soil chemical properties. It was noted that the soil pH was increased by the application of Moringa Leaf Extract and Organo-bio degradable fertilizer in all the treated pots as compared to the control, likewise the soil organic matter, nitrogen, phosphorus, and potassium by MLE and OBD^+ respectively.

Effects of moringa leaf extract and organo-bio degradable fertilizer (OBD^+) on number of leaves of bell pepper (*Capsicum annuum* L.)

Table - III shows the effects of Moringa leaf extract (MLE) and Organo-bio degradable fertilizer on number of leaves of bell pepper at 2, 4, 6, 8, 10, and 12 weeks after transplanting respectively. The application of MLE and OBD^+ had significant difference on the number of leaves compared with the control ($P>0.05$). The highest value of number of leaves was observed in T_2M_0 (40g fertilizer and no moringa) except at week 10 and 12 where T_3M_1 was found to have the highest value. Though T_3M_1 had the highest value, it was not significantly different from the MLE and OBD^+ fertilizer treatments at 2 weeks except when compared with T_1M_1, T_1M_2, T_0M_2, T_0M_0, and T_0M_1. At 4 and 6WAT, T_2M_0 was significantly

from all the other treatments while T_1M_0, T_1M_1, T_1M_2, T_2M_1, T_2M_2, T_3M_0, T_3M_1, and T_3M_2 were not significantly different at 2, 4, and 6WAT. At 10 and 12 weeks that T_3M_1 had the highest value it was significantly different from the other treatments except when compared with T_2M_0, T_2M_2, and T_3M_2 treatments respectively. Throughout the pair of observation the T_0M_0 (control) plants recorded the lowest values for number of leaves.

Effects of moringa leaf extract and organo-bio degradable fertilizer (OBD$^+$) on plant height of bell pepper (*Capsicum annuum* L.)

Table – IV shows the effects of Moringa leaf extract (MLE) and organo-bio degradable fertilizer on plant height of bell pepper at 2, 4, 6, 8, 10, and 12 weeks after transplanting (WAT) respectively. The application of MLE and OBD$^+$ had significant effect on the plant height compared with the control (P>0.05). At 2 WAT, the highest value of plant height data was recorded in treatment with 40g fertilizer only. At 10th and 12th week, treatment T_3M_1 (60g of OBD$^+$ and moringa application at 1 week after transplant) had the highest value and was significantly different from the control. Throughout the pair of observation the control (T_0M_0) recorded the lowest values for plant height.

Effects of moringa leaf extract (MLE) and organo-bio degradable fertilizer (OBD$^+$) on yield of bell pepper

Table – V shows the effect of effects of Moringa leaf extract (MLE) and Organo-bio degradable fertilizer (OBD$^+$) on the fruit number of bell pepper. The application of Moringa leaf extract (MLE) and Organo-bio degradable fertilizer (OBD$^+$) had a significant difference on the fruit number of bell pepper. T3M1 had the highest value of fruit number than other rates of MLE and OBD$^+$ applied and the control (P>0.05). There was no significant difference between the different rates of MLE and OBD$^+$ compared to the control.

The application of Moringa leaf extract (MLE) and Organo-bio degradable fertilizer (OBD$^+$) had a significant difference on the fruit weight of bell pepper. T3M1 had the highest value of fruit weight than other rates of MLE and OBD$^+$ applied and the control (P>0.05). The lowest fruit weight was recorded in the T0M0 (control), there was significant difference between the different rates of treatments compared to the control (Table – IV, V).

Table – I: Physicochemical properties of the experimental soil.

Parameter	Soil sample
Sand (%)	63.24
Silt (%)	14.00
Clay (%)	22.76
Textural class Sandy Clay loam	
pH (2:1 H_2O)	5.25
Organic matter	0.879
Organic Carbon (g/kg)	0.51
Total nitrogen	0.102
Available P (mg/kg)	3.00

Table – II: Effects of Moringa Leaf Extract and Organo-Bio Degradable Fertilizer (OBD^+) on soil properties

TRTS	pH (H_2O)	O. M (%)	Total N (%)	Av. P (mg/kg)	Exc. K (cmol/kg)
T0M0	5.65	5.09	0.25	6.16	2.05
T0M1	5.62	5.02	0.25	9.16	2.31
T0M2	5.56	5.38	0.23	5.81	2.56
T1M0	5.78	5.09	0.24	5.46	2.05
T1M1	5.47	5.81	0.16	7.40	2.31
T1M2	5.68	5.21	0.31	4.05	2.05
T2M0	5.79	5.33	1.45	3.35	2.31
T2M1	5.90	5.02	1.40	11.10	2.31
T2M2	5.65	5.57	0.15	7.93	2.05
T3M0	5.59	5.09	3.08	10.74	1.79
T3M1	5.94	4.84	1.02	6.17	2.05
T3M2	5.74	5.26	0.41	10.04	2.31

Table – III: Effects of Moringa Leaf Extract and Organo-Bio Degradable Fertilizer (OBD^+) on number of leaves (NL) of bell pepper (C*apsicum annuum* l.)

TRTS	NL2	NL4	NL6	NL8	NL10	NL12
T0M0	3.667^{d}	5.333^{d}	8.667^{e}	10.000^{e}	18.667^{d}	23.333^{d}
T0M1	7.333^{c}	11.000^{bc}	15.000^{cde}	24.000^{cd}	39.000^{c}	49.000^{bc}
T0M2	7.667^{c}	9.33^{cd}	11.333^{de}	17.333^{de}	33.333^{c}	38.000^{cd}
T1M0	9.333^{abc}	11.667^{bc}	18.333^{bcd}	25.000^{cd}	42.333^{bc}	49.667^{bc}
T1M1	8.000^{bc}	11.333^{bc}	16.000^{bcde}	24.667^{cd}	40.667^{bc}	52.667^{bc}
T1M2	8.000^{bc}	12.333^{bc}	18.000^{bcde}	24.667^{cd}	37.333^{c}	43.000^{c}
T2M0	11.667^{a}	23.333^{a}	34.000^{a}	35.667^{a}	54.000^{ab}	66.000^{ab}
T2M1	9.667^{abc}	12.333^{bc}	17.000^{bcde}	24.667^{cd}	45.000^{bc}	50.333^{bc}
T2M2	10.333^{abc}	15.000^{b}	25.000^{b}	26.667^{bc}	47.000^{abc}	61.000^{ab}
T3M0	10.333^{abc}	16.000^{b}	23.000^{bc}	32.667^{abc}	44.000^{abc}	51.333^{bc}
T3M1	11.333^{ab}	15.333^{b}	23.333^{bc}	34.667^{ab}	59.333^{a}	69.333^{a}
T3M2	10.333^{abc}	13.667^{bc}	17.000^{bcde}	29.667^{abc}	54.333^{ab}	55.000^{abc}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level.

Table – IV: Effects of Moringa Leaf Extract and Organo-Bio Degradable Fertilizer (OBD$^+$) on plant height of bell pepper (*Capsicum annuum* L.)

TRTS	PH2	PH4	PH6	PH8	PH10	PH12
T0M0	9.500^{a}	11.033^{a}	12.500^{d}	13.500^{d}	17.800^{d}	26.333^{b}
T0M1	10.167^{a}	16.033^{a}	16.167^{bcd}	18.200^{bcd}	21.667^{cd}	29.000^{ab}
T0M2	10.000^{a}	13.600^{a}	15.167^{cd}	17.500^{cd}	24.667^{bcd}	34.000^{ab}
T1M0	12.667^{a}	16.200^{a}	22.667^{abc}	24.500^{abc}	28.167^{abcd}	32.667^{ab}
T1M1	10.167^{a}	14.967^{a}	20.167^{abcd}	24.567^{abc}	31.667^{abc}	39.333^{ab}
T1M2	10.167^{a}	14.267^{a}	17.500^{abcd}	22.100^{abcd}	28.733^{abcd}	32.167^{ab}
T2M0	12.833^{a}	15.433^{a}	21.667^{abcd}	22.167^{abcd}	26.500^{abcd}	30.333^{ab}
T2M1	10.667^{a}	13.933^{a}	20.833^{abcd}	24.500^{abc}	32.167^{abc}	36.667^{ab}
T2M2	12.000^{a}	16.167^{a}	26.400^{a}	28.333^{ab}	33.867^{ab}	35.333^{ab}
T3M0	12.500^{a}	18.100^{a}	26.333^{a}	30.500^{a}	34.000^{ab}	39.000^{ab}
T3M1	12.333^{a}	17.467^{a}	24.733^{abc}	28.200^{ab}	36.333^{a}	42.233^{a}
T3M2	12.500^{a}	17.433^{a}	25.333^{ab}	27.167^{abc}	35.133^{ab}	36.333^{ab}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level.

Table – IV: Effects of Moringa Leaf Extract and Organo-Bio Degradable Fertilizer (OBD$^+$) on yield of bell pepper (*Capsicum annuum* L.)

Treatments	Mean fruit number	Mean fruit weight
T0M0	1.00	12.33
T0M1	2.00	19.00
T0M2	1.33	21.33
T1M0	2.33	23.67
T1M1	2.67	26.00
T1M2	1.67	19.33
T2M0	2.00	29.00
T2M1	1.67	28.00
T2M2	2.33	45.00
T3M0	2.00	27.00
T3M1	3.67	54.33
T3M2	3.33	31.00

DISCUSSION

The mean number of leaves was significantly influenced by the application of MLE and OBD^+; this might be attributed to the release of nutrients from the OBD^+ and the growth hormone stimulant in the moringa leaf. The highest number of leaves was recorded from the 40g OBD^+ fertilizer for the 2, 4, 6, and 8WAT but at the 10 and 12WAT, the highest number of leaves was recorded from the T_3M_1 (60g OBD^+ and spraying of MLE one week after transplant). A report by FAO (2010) suggest that the use of organic fertilizer derived from Moringa seed processed with the right procedure can increase the density and richness of indigenous invertebrates, specialized endangered soil species, beneficial arthropods, earthworms, symbionts and microbes. The highest fruit number and weight was recorded in T_3M_1, and there was significant difference between the yield of the MLE and OBD^+ treatments compared with the control. Recent studies conducted on the effect of its extracts on the growth performance of *Telferia occidentalis* (Anyaegbu et al., 2013), showed that its extracts increased significantly the yield and yield components of *T. occidentalis.* Jason (2013) also reported that Moringa leaf extract contains a plant growth hormone, called Zeatin which has been reported to increase yields by 25 to 30% for nearly any crop. Jason (2013) recommended that the foliar spray should be used in addition to a balanced nutritional fertilizer program containing NPK and minerals.

The crops treated with a combination of OBD^+ and MLE had high plant height compared to the control at 6, 8, 10, and 12WAT. The highest value for 10 and 12 weeks were recorded in T_3M_1, while for 2WAT the highest was from T_2M_0. From the recorded data it was noticed that the MLE and OBD^+ did not have significant difference on the control at 2 and 4 weeks this can be attributed to the slow release of the nutrients in the fertilizer for the plant use. This is in line with the report of several authors that organic fertilizers are characterized with slow release of nutrients, which leads to reduction in soil nutrient loss (Abou el-magd M. M *et al.,* 2005). The OBD^+ rate of 60g performed better in improving the height of plant and that of leave number when compared to the 40g and 20g rate respectively.

CONCLUSION

The results of this experiment showed that the combination of Moringa Leaf Extract and Organo-bio degradable fertilizer influenced significantly the plant height, leaf number, fruit weight, fruit number compared with the control. Therefore, for cultivation of sweet bell pepper (*Capsicum annum* L.) in the study area, the combination of 60g of OBD^+ and application of Moringa Leaf Extract at 1 week after transplanting is recommended

REFERENCES

Abou El-Magd MM, Hoda AM and Fawzy ZF, 2005. Relationship, growth and yield of broccoli with increasing N, P or K ratio in a mixture of NPK fertilizers. Annals Agriculture Science Moshtohor, 43 (2):791-805 (As cited by Abou El – Magd et al., 2006).

Ahmed DM and Nimer AM, 2002. Effects of *Acacia senegal* (L., Wild) on sandy soils. A case study of El Damokya Forest, Northern Kordofan State. Univ. Khartoum J. Agric. Sci., 10: 106-118.

Aliyu, 1994. Growth and yield of pepper (*Capsicum annum* as influenced by N and P levels and plant density Ph. D Agronomy thesis: Unpublished (Department of Agronomy ABU Zaria).

Aminifard MH, 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.

Anyaegbu PO, Iwuanyanwu UP and Omaliko CPE, 2013. Comparative evaluation of effects of *Moringa oleifera* extracts and different Fertilizers on the Performance of Telfaria occidentalis. Int. J. Appl. Res. Technol. 2(11):127-134.

Dauda SN, Ajayi FA and Ndor E, 2008. Growth and yield of water melon (*Citrullus lanatus*) as affected by poultry manure application. J. Agric. Soc. Sci. 4: 121-124.

FAO , 2010. Soil biota and biodiversity "The Root of sustainable development" ftp:/ftp.fao/010/i0112e07.pdf, February, 2010.

Farooq M, Jabran K, Rehman H and Hussain M, 2008. Allelopathic effects of rice on

seedling development in wheat, oat, barley and berseem. Allelopath. J.22: 385-390.

Fuglie LJ, 2000. The Miracle Tree: *Moringa oleifera*: Natural Nutrition for the Tropics. The Miracle Tree: The Multiple Attributes of Moringa, pp 172.

Ganjare H, Futane NW, Dagwar S and Kurhade K, 2013. Growth and yield characters of capsicum in response to planting distance and sources of nutrients. Schol. J. Agric. Sci. 3(9): 386-390.

Jason P, 2013. Pepe's Fruit Trees, www.pepesplants.com.

Makkar HPS and Becker K, 1996. Nutritional value and ant nutritional components of whole and ethanol extracted *Moringa oleifera* leaves. Anim. Feed Sci. Technol. 63: 211-228.