EFFECT OF DIFFERENT LEVELS OF NPK FERTILIZER ON THE GROWTH AND YIELD OF OKRA (*Abelmoschus Esculentus L.)*

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Abstract
The experiment was carried out at Federal College of Forestry, Jos to examine the effect of different levels of NPK fertilizer on the growth and yield of Okra (*Abelmoschus esculentus L*). The treatments comprises of 10grams of NPK 15:15:15, 13grams of NPK 15:15:15 and Control. These treatments were laid out in randomized complete block design in three replications. Clemson spineless okra was planted at a spacing of 50cm x 30cm, weeding and earthen up of the beds were carried out at 2WAP and 5WAP. Growth parameters were collected on plant emergence count, plant height, leaf area, number of leaf and collar girth. The result showed that there was no significant difference in the effect of different levels of NPK fertilizer on plant height, number of leaf, leaf area, leaf length and collar girth. But however, 13grams had the highest number of plant emergence count followed by 10grams while in terms of fresh pod yield, 10grams did better followed by the control treatment. It can therefore be concluded that 13grams of NPK fertilizer has the best potentials of increasing okra growth in the study area.

Keywords: Okra, NPK Fertilizer, Abelmoschus esculentus, Growth, Yield.

Introduction

Okra (Abelmoschus esculentus L.) is an annual crop belonging to the family Malvaceae. It is an important vegetable especially in West Africa, India, Brazil and the United States (Kemble et al., 1995; ECHO, 2003; Alimi, 2004). Abelmoschus esculentus L. is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is traditionally grown in countries such as Cote d'Ivoire, Ghana, Nigeria, Egypt, Sudan, Togo, Benin, Burkina Faso, Cameroon, Tanzania, Zambia and Zimbabwe. The most important production countries are Ghana, Burkina Faso and Nigeria (Raemaekers, 2001).

Okra is widely grown primarily for its soft immature fruits or pods. The pods contain a glutinous, sticky substance that is used to thicken soups and stews. They are boiled or fried and eaten as vegetable. They can also be cut into pieces, dried and/or powdered and stored for use in soups during the dry season when fresh Okra fruits are scarce. The young leaves are also boiled and used in soups (Norman, 1992). The leaves are further used for medicinal purposes. Martin and Ruberte (1978) in their studies on "Vegetables of the humid tropics" confirmed the usefulness of okra leaves as a curative medicine against ulcers and haemorrhages. Again, okra leaves promote digestion since it has considerable amount of roughages. The seeds can be used as a source of edible oil as well as in the soap industry (Oyolu, 1983).

Fertiliser is a material that is added to the soil to supply one or more elements required for plant growth and development (Masarirambi et al., 2012). The major three elements are nitrogen, potassium and phosphorus, the secondary elements are calcium, sulphur,

magnesium and other elements are boron, manganese, iron, zinc, copper and molybdenum (De, 1988). Fertilisers enhance the natural fertility of the soil or replace the chemical elements taken from the soil by harvesting, grazing, leaching or erosion.

This vegetable has formed part of food for most people especially in the rural areas and low income earning group in tropical and sub-tropical countries including Nigeria. The plant's requirements for the different nutrient elements supplied in fertilisers needed for growth and development may differ. Nitrogen, phosphorus and potassium (NPK) fertilisers have different concentrations of the elements needed by the plants for their growth and development. With the concentrations of the NPK fertilisers different, the yield and growth rate of the plant may also be different, thus the need to investigate the effects of different level of NPK fertilisers on growth and yield of okra. The broad objective of this research is to assess the effect of NPK fertilizer on plant emergence, plant Height, number of leaf, leaf area, collar girth and leaf length. While the specific are to assess the effect of different levels of NPK fertilizer on okra on the growth parameters, yield parameters and the most appropriate quantity or level of fertilizer for the optimum growth and yield of okra and also to assess the soil nutrients content before planting.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted in Federal College of Forestry Jos, Plateau State. It is a region of the middle belt of Nigeria located in the North West of Plateau State and falls between Latitude 7^0 and 11^0 North, Longitude 7^0 and 25^0 East with an altitude of about 1,200mm above sea level. The topography of the area lays South of guinea Savannah of Nigeria with mean annual rainfall of 1460mm and temperature between 10^0c and 32^0c (Pam,2009).

Soil analysis

Soil samples were taken from the experimental site using the zigzag method (Brady and Weil, 2007) from four different points. The samples were taken to Agricultural Services Training Center (ASTC) Vom, Jos South local government of Plateau state. The results of the soil analysis taken before the application of NPK fertilisers on the onset of the experiment are presented in Table 1. Most of the nutrients were below the optimum level (Edje and Ossom, 2009). Hence there was a need for the application of soil amendments in form of NPK fertilisers.

Table 1: Physicochemical Properties of the Soil

Soil Depth (cm)	P^H	N (%)	OM (%)	P(ppm)	Exchangeable Bases (Mmol/100g)				Clay (%)	Silt (%)	Sand (%)	Textural Class
					K	Na	Mg	Ca				
0 – 15	6.30	0.060	2.07	2.8	20	0.1	0.45	1.5	6.16	8.0	85.84	Loamy sand
16 – 30	6.33	0.040	1.38	7	21	0.15	0.5	1.8	8.16	8.0	83.84	Loamy sand

The physicochemical properties of the soil at the experimental site from Table 1 indicate that Sand constituted the major particle size fraction in the soil followed by silt and clay. The soil therefore has sandy loam texture. The pH of the soil revealed that the soil was lightly alkaline (6.30 and 6.33) in the first and second depths respectively.

Experimental Design and Layout

The treatments were laid down in a Randomized Complete Block Design (RCBD) in three replications (Table 2). Okra seeds were planted at a depth of 2cm on raised beds. The crop was planted at a spacing of 50cmx30cm.Weeding was carried out at two weeks after planting and at 4 weeks, subsequent weeding was carried out depending on the intensity of weed. Fertilizer was applied using ring method at 5weeks after planting. The bed size was 2.5 x 1.5m, with discard area of 0.5m and this gave a total of 9 beds in the experiment. The total area of the experimental site was 9m x 6m giving a plant density of 144 plants for the whole experimental site.

Table 2: Field lay-out of the treatments laid in a randomized complete block design (RCBD)

Block	Treatments (Randomised)		
1	T_o	T_1	T_2
2	T_1	T_2	T_o
3	T_2	T_o	T_1

Keys: To (control), T_1 (Treatment 1), T_2 (Treatment 2)

Seeds of okra (Abelmoschus esculentus L.) of the variety Clemson spineless were collected from Agricultural Services Training Centre (ASTC) Kassa, Vom, Jos South of Plateau State and sown in the experimental field. The field was ploughed, cross ploughed and levelled properly and divided into 9 plots, each measuring 2.5 × 1.5 m with 0.5m discard area between plots. Different doses of NPK fertilizers were applied per plot are as follows Control treatment is treatment zero (T_O), NPK 15:15:15 at 10grams is treatment one (T_1) and NPK 15:15:15 at 13grams is treatment two (T_2). Treatment one (T_1) having 160grams per bed for

three bed (having a total of 480grams for treatment one) and treatment two (T_2) having 208grams per bed for three bed (having a total of 624grams).

Data were collected on plant emergence as at two weeks after planting, number of leaves, stem diameter, Plant height and fruit yield. Results were analyzed using the Analysis of Variance (ANOVA) by means of Statistical Analysis System (SAS) (SAS, 1999). The Least Significant Difference (LSD) at 5% was used to separate the means of treatments which were compared using factorial.

Results and Discussion

Plant height: The result from table 3 shows that there was no significant (P>0.05) differences in plant height across all the week intervals. This implies that the level of fertilizer application has no significant effect on plant height. However the treatment of 13grams (T_2) has the highest plant height (55.15cm) followed by control treatment (To) at 54.47cm.

Table 3: Mean values of Plant height

Treatment	4WAP	6WAP	8WAP
T1	15.02[a]	29.39[a]	52.61[a]
T2	18.62[a]	32.95[a]	55.15[a]
T0	18.46[a]	32.96[a]	54.47[a]
SE±	3.06	3.71	4.09
LSD	0.663	0.746	0.903
Remark	Ns	Ns	Ns

Means in the same column having the same superscript are not significantly different (p>0.05), Ns – Not significant

Leaf Area: From table 4 the result indicates that the treatments have no significant variation in all the week intervals on Leaf Area. This then implies that the level of fertilizer application has no significant effect on Leaf Area. Having both 10grams (T_1) and 13grams (T_2) on the value of 20.43 and having the same superscript thereby having the largest leaf Area.

Table 4: Mean values of Leaf Area

Treatment	4WAP	6WAP	8WAP
T1	7.04[a]	14.91[a]	20.43[a]
T2	8.29[a]	15.26[a]	20.43[a]
T0	8.18[a]	14.39[a]	19.88[a]
SE±	1.56	1.15	0.94
LSD	0.825	0.866	0.894
Remark	Ns	Ns	Ns

Means in the same column having the same superscript are not significantly different (p>0.05). Ns – Not significant

Number of Leaves: The treatments from table 5 show no significant variation in all the week intervals on Numbers of Leaves. This indicates that the level of fertilizer application has no significant effect on Numbers of Leaves. However 13grams (T_2) had the highest mean

number of leaves (23.13), followed by the control treatment (To) with 20.13 then 10grams (T_1) at 18.13.

Table 5: Mean values of Numbers of Leaves

Treatment	4WAP	6WAP	8WAP
T1	6.60[a]	13.73[a]	18.13[a]
T2	6.73[a]	15.40[a]	23.13[a]
T0	7.53[a]	13.20[a]	20.13[a]
SE±	1.45	2.11	3.13
LSD	0.887	0.755	0.558
Remark	Ns	Ns	Ns

Means in the same column having the same superscript are not significantly different ($p>0.05$)
Ns – Not significant

Leaf Length: Table 6 indicates that the treatments have no significant variation in all the week intervals on Leaf Length. This shows that the level of fertilizer application has no significant effect on Leaf Length. But T_1 (27.53) have the highest leaf length followed by T_2 (15.42) and T0 (14.56).

Table 6: Mean values of Leaf Length

Treatment	4WAP	6WAP	8WAP
T1	5.50[a]	11.47[a]	27.53[a]
T2	6.77[a]	12.21[a]	15.42[a]
T0	6.78[a]	11.15[a]	14.56[a]
SE±	1.20	1.00	6.43
LSD	0.702	0.754	0.346
Remark	Ns	Ns	Ns

Means in the same column having the same superscript are not significantly different ($p>0.05$)
Ns – Not significant

Collar Girth: From table 7, the treatments show no significant difference in all the week intervals on Collar Girth. This indicates that the level of fertilizer application has no significant effect on Collar Girth. However T_1 is having the largest collar girth followed by T_2.

Table 7: Mean values of Collar Girth

Treatment	4WAP	6WAP	8WAP
T1	1.34[a]	2.73[a]	4.23[a]
T2	1.74[a]	2.73[a]	4.20[a]
T0	1.57[a]	2.58[a]	4.07[a]
SE±	0.13	0.26	0.32
LSD	0.161	0.895	0.937
Remark	Ns	Ns	Ns

Means in the same column having the same superscript are not significantly different ($p>0.05$)
Ns – Not significant

Fresh Pod Yield: There were significant ($P<0.05$) differences in the number of fresh pods produced by each plant among the two treatments at harvesting. The plants treated with 13g of NPK had the highest mean number of pods (32), closely followed by 10g with 21, and control being the least(15) as shown in Figure 1. The applied NPK fertilisers did not significantly affect subsequent okra pod number. The effect of NPK fertilizers for the increase of yield of okra in the present investigation was found consistent with the findings of Ahmed and Tullock-Reid (1986) and Philip et al. (2010).

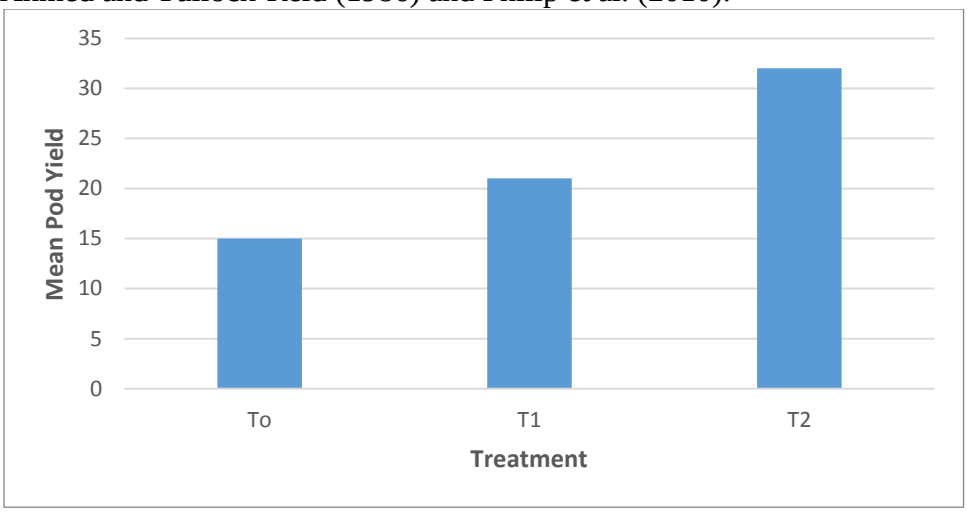

Figure 1: Mean number of Fresh Pod

Growth Parameters: The height of plant is an important growth characteristic directly linked with productive potentials of plant in terms of fodder, grains and fruit yield. An optimum plant height is claimed to be positively correlated with productivity of plant (Saeed et al., 2001). The result showed significant ($p>0.05$) response to different levels of NPK fertilizer (Table8). Okra plant respond well when received 13grams of NPK fertilizer than when received 10grams(lower level) due to higher nitrogen content which induced higher Plant Height, Leaf Area, Number of leaf, Leaf Length and Collar Girth. This is in agreement with the findings of Omotoso et al. (2007) who reported that increasing level of NPK fertilizer was observed to increase growth and yield of okra in a finding on effect of NPK fertilizer rate and method of application on growth and yield of okra at Ado-Ekiti South-western, Nigeria. There was no significant different in plant emergence count however, 13grams of NPK fertilizer had the highest number of plant emergence count followed by 10grams while in terms of fresh pod yield, 10grams did better followed by the control treatment. These findings are in accordance with the previous findings of Obi et al (2005) who reported that there was no significant difference in both fresh and dry weight of okra with increasing rate of NPK fertilizer treatment.

Table 7: Mean effects of treatments on growth parameters

Treatment	PH	LA	NL	LL	CG	PEC	FPY
T1	32.34[a]	14.13[a]	12.82[a]	44.51[a]	8.30[a]	11.00[a]	524.78[a]
T2	35.57[a]	14.66[a]	15.09[a]	34.40[a]	8.67[a]	13.00[a]	375.76[a]
T0	35.30[a]	14.15[a]	13.62[a]	32.49[a]	8.22[a]	9.00[a]	652.27[a]
SE±	3.19	0.96	2.05	7.78	0.51	2.56	185.20
LSD	0.740	0.906	0.741	0.538	0.813	0.574	0.599
Remark	Ns	Ns	Ns	Ns	Ns	Ns	Ns

CONCLUSION AND RECOMMENDATIONS

The study showed that the application of NPK fertilizer increased the growth and yield components of Okra better. The treatment of 13g kg NPK was more superior in the areas assessed. Most of the crops in T_1 and T_2 were affected by verticillium disease which could possibly be the cause of the low yield of plant as most pods die premature. Fertilizer application at 13grams is most suitable for the growth of okra in the study area, resistant variety of Okra should be planted and treatment should commence once symptoms of verticillium disease is noticed immediately.

Reference

Ahmed, N. and Tullock-Reid L.T. (1986) The combined effect of NPK fertilizers for the increase of yield of Okra. Agronomy Journal. 60: 353-356.

Alimi T., (2004). Use of Cultural Practices and Economic Impact of Insecticide Use, Awareness and Practices of Insecticide Safety Precaution on Okra Production. Journal of Vegetable Crop Production 10(1): 23-36.

Brady, N. and Weil, R. (2007). Nature and Properties of Soils. 13th Edition. Prentice Hall, New York, New York USA.

De, R. (1988). Efficient fertiliser use in summer rainfed areas: Fertiliser use. In FAO, Fertiliser and Plant Nutrition Bulletin (11):7-15. FAO, Rome, Italy.

ECHO (2003). Plant Information Sheet. ECHO, North Fort Myers, Florida, USA.

Edje, O.T. and Ossom, E.M. (2009). Crop Science Handbook. Blue Moon Publishers, Manzini, Swaziland.

Kemble, J.M., Sikora E.J., Zehnder, G.W., and Patterson M.G., (1995). Guide to Commercial Okra Production. http://www.aces.edu/pubs/docs/A/ANR-0959/

Martin E.W. and R.M. Ruberte. 1978. Vegetables of the Hot Humid Tropics Part II. Okra Science and Education. USDA. Pp 22.

Masarirambi, M.T, Hlawe, M.M., Oseni, O.T. and Sibiya, T.E. (2010). Effects of organic fertilizers on growth, yield, quality and sensory evaluation of red lettuce(Luctuca sativa L.) 'Veneza Roxa'. Agriculture and Biology Journal of North America. 1 (6):1319-1324.

Norman J.C. 1992. Tropical vegetable crops. Arthur H. Stock well Ltd. London, UK. p. 68.

Obi, C. O., Nnabude, P. C., Onucha, E., (2005) Effect of Kitchen Wastes Compost and tillage on soil chemical properties and yield of okra. (A. E). Nigerian Journal of Soil Science 15: 69-76. Retrieved 2016-10-17.

Omotoso, S. O., and Shittu, O.S (2007) Effect of NPK Fertilizer Rates and method of Application on growth and yield of okra (Abelmuschus esculentus L. Moench) At Ado-Ekiti South-western Nigeria International Journal of Agricultural Research, 2: 614 – 619.

Oyolu C. (1983) Okra Seeds, Potential Source of High Quality Vegetable Oil. Proceedings, 5th Annual Conference, Horticulture Society. Nigeria, Nsukka.

Pam C. (2009) Constraints of potato production (salanium tuberosum L) A Case study of Bokkos Local Government Area of Plateau State. Unpublished HND II Project, Federal College of Forestry, Jos, Plateau State.

Philip C.B, Sajo A.A and Futuless K.N (2010) Effect of spacing and NPK fertilizer on the yield and yield components of okra (Abelmoschus esculentus (L. Moench.) in Mubi, Adamawa State, Nigeria. Journal of Agronomy, Vol. 9 Pp 131-134.

Raemaekers R.H. (2001) Crop Production in Tropical Africa. Directorate General for International Co-operation. Ministry of Foreign Affairs, External Trade and International Co-operation. Brussels, Belgium. p. 455.

Saeed I. M.K Abbasi and M.Kaz (2001)mi response of Maize (Zea mays L.) Response of Maize to NPK Fertilization under agro-climatic conditions of Rawalakot Azad Jammu and Kashmir Pakistan, Journal Biological Sciences pp. 4: 949-952.