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Analysis of different rates of N.P.K. (15:15:15) fertilizer on yield of eggplant (*Solanum melongena*) in Cross River University of Technology Teaching and Research Farm, Obubra Campus, Cross River State, Nigeria

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ABSTRACT

Field experiments were conducted to determine the effect of different rates of N.P.K. (15:15:15) fertilizer on yield of eggplant in Cross River State University of Technology Teaching and Research Farm, Obubra Campus for two cropping seasons that is 2016 and 2017. Four levels of N.P.K. (15:15:15) fertilizer applications were studied. The experiment comprises of four treatments via, control, N.P.K. at 109, 129 and 149 kg/ha. Experiments were laid in randomized complete block design with four replications. The treatments were soiled–applied and the parameter assessed was fruits (yield) at 10 weeks after transplanting (WAT) and 13 (WAT). The result shows that N.P.K. (15:15:15) fertilizer applied had significant effect on eggplant fruit yield at 10 WAT and 13 WAT. The result also shows that 129 kg/ha of N.P.K. (15:15:15) fertilizer applied gave fruit yield of 130.25 kg of eggplant fruit at 10WAT in 2014 cropping season while 100.25 kg of eggplant fruit at 10 WAT in 2015 season (Comparatively treatment T_3 (N.P.K. at 129 kg/ha at 10WAT in 2014 season compared to treatment T_3 (N.P.K. at 129 kg/ha at 10 WAT in 2015 season showed that eggplant fruit yield decreased from 130.25 to 100.25 kg, the yield has decline by 30 kg). When 149 kg/ha of N.P.K. (15:15:15) fertilizer was applied gave the highest fruit yield of 140.25 kg in Table 3 while in Table 4 was 114 kg, the yield has decreased by 26.25 kg. The result of this findings showed that eggplant requires N.P.K. (15:15:15) fertilizer at the rate of 148 kg/ha for maximum yield. This implies that fertilizer quantities can be varied to obtain optimal output. The result showed that yield of eggplant performance was better in plots that were applied fertilizer than in control plot. Based on the result of research findings, fertilizer application is economical in the production of eggplant fruit when the plant have produced enough roots. Younger eggplant should be treated with lower dosage of N.P.K. (15:15:15) fertilizer application and this could be increased as the plant get matured. The study also recommended that farmers who intend to produce eggplant at optimum level should applied N.P.K. (15:15:15) fertilizer about 10cm away from the base of each plant at the rate of 148 to 149 kg/ha at 13 weeks after transplanting. Extension agents should train eggplant farmers to adopt application of 129 kg/ha of N.P.K. (15:15:15) fertilizer applied gave fruit optimum yield of 130.25 kg of eggplant fruit at 10 WAT.

Keywords: Eggplant, bio-technology, fertilizer application, optimum yield, adoption.

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INTRODUCTION

Eggplant (*Solanum melongena*) belongs to the family of solananceace (Anon, 1991). The crop is cultivated for its fruits, which are used as stew for other food or consumed raw for its vitamins (Yondcower, 1986). Kroll (1972), Karl

(1977) and Oniah et al. (2010) maintained that eggplant fruit is an excellent source of carbohydrate, proteins, fats, fibre, water, minerals, salts and other vital mineral sources. Fruits of eggplant are eaten with groundnut, rice or yam. In the absence of kola-nut, eggplant fruits are served as substitute in wedding occasions, burials and ceremonial functions in most communities in Nigeria today (Oniah et al., 2010).

In Nigeria, predominant use of the traditional bush fallow system with shortened periods has led to decline in soil fertility. There is a need for shift away from this unsustainable practice and their resultant negative effects on crop yield and environment. In recent years the decline in eggplant fruits production is caused by decline in soil fertility, gap in information dissemination to eggplant farmers, weak linkage system in extension, non-adoption of new innovations, inefficient use of available resources in eggplant production (Kroll, 1972; Karl, 1977; Meera, 2004; Attoe et al., 2010; Oniah et al., 2010). According to Enya and Agba (2006), one of the questions confronting farmers in Nigeria is determining the economic optimum level of fertilizer to apply, the farmer must compare the added revenue, which would be received from the application of fertilizer with the additional cost of applying the fertilizer. Adinya et al. (2006) reported that fertilizer gave economic benefits to farmers and it helps them to cover all their overhead costs/expenditure in their farms. According to Ogunfowora (1986), Anne and Lal (1997) and Enya and Agba (2006), as production increases, external forces begin to guide the use of resources (land, labour, capital, fertilizer and management); reliance on technical efficiency alone becomes less important means of increasing farm output and income, thus economic efficiency in addition to technical efficiency becomes the most important means of increasing farm output and income (Ogunfowora, 1986).

Fertilizer application is economical in the production of eggplant fruit when the plant have produced enough roots (MacDonald and John, 1984; Buttour, 1987). N.P.K. (15:15:15) fertilizer application and increased dosage is only advantages when eggplants are matured and there are enough roots to absorb the available nutrient supplied to the plants (Buttour, 1987). Eggplant requires adequate supply of nutrients for good performance (Buttour, 1987). He maintained that N.P.K. (15:15:15) fertilizer be applied about 10 cm away from the base of each plant at the rate of 125 kg/ha four to thirteen weeks after transplanting; while Mac Donald and Law (1984) stated that eggplant requires N.P.K. (15:15:15) fertilizer at the rate of 148 kg/ha for maximum yield. Okongo (1981) reported that application of N.P.K. (15:15:15) fertilizer in single dose shows a significant yield response to nitrogen and phosphorus but there was no response from potassium application. According to Tindall (1968) phosphorus is a macro element required by eggplant in large quantity and it is need by eggplant for growth and seed formation. The effect of phosphorus on root development is well established (Hossain and Hamid, 2007). Application of phosphorus and nitrogen fertilizer enhances root development, which improves the supply of other nutrients and water to the growing parts of the plants, resulting in an increased photosynthetic area and thereby more dry matter accumulation (Ali et al., 2010). Non-addition of phosphorus to eggplant lead to decrease in yield and quantity of crop. Phosphorus fertilization is very essential for exploiting maximum yield potentials of different crop plants. Adequate amount of phosphorus in soils favours rapid plant growth, early fruiting or maturity and improves the quality of produce. Phosphorus fertilizer favours nitrogen fixation by increasing the efficiency of nodulation. Nitrogen is required for plant growth and reproduction. Potassium (K) is required for plant metabolism, carbohydrate formation and translocation of starch to all part of the plants. It is also necessary for the neutralization of organic acid in plants. Attoe et al. (2010) reported that biomass production in this crop responded to potassium (K) fertilizer application, however these were differential responds in each of the soil type, while 50 kg/ha was sufficient in the soils formed from Basalt, Sandstone 100 kg/ha gave the best biomass productivity of 176 g. The soils of basalt are adequate in potassium (K) and therefore require little or no potassium (K) application for optimum yield.

MATERIALS AND METHODS

The research was conducted in 2016 and 2017 cropping seasons at the Teaching and Research Farm of the Cross River State University of Technology, Obubra Campus, Cross River State, Nigeria. The experimental soil (0 to 18 cm depth) was analyzed for initial soil physicochemical properties. The soil texture was sandy soil having sand 52%, silt 30.80%, clay 17.20%, pH 7.5, organic matter 0.82%, $CaCO_3$ 5.8%, EC 1.45 dsm^{-1}, available K 124 $mgkg^{-1}$, AB-DTPA extractable Zn 0.92 $mgkg^{-1}$, AB-DTPA extractable Fe 2.94 $mgkg^{-1}$, AB-DTPA extractable Mn 1.14 mg kg^{-1}. Four levels of N.P.K. (15:15:15) fertilizer applications were studied. Experiments were laid in randomized complete block design (RCBD) with four replications. The four treatments were T_1 (control) N.P.K. at 0 kg/ha, T_2 (N.P.K. at 109 kg/ha), T_3 (N.P.K. at 129 kg/ha and T_4 (N.P.K. at 149 kg/ha). The treatment was soiled–applied and the parameter assessed was fruits at 10 and 13 weeks after transplanting (WAT), respectively. The soil was prepared manually using cutlass or machetes, rakes, shovels, West African hoe and measuring tape. All other agronomic practices (hoeing, thinning, insect and weed control) were kept same for all treatments. The name of the insecticide used was Thionex 50 EC at the dosage of 3mls per 1litre of water making a total of 60 ml per 20 L of water at the initial and young age of the crop. During flowering and fruiting the dosage was reduced to 50 ml per 20 L of water. This practice was carried out as often as infestation was observed in the farm.

Analysis of data

The yield data were recorded and year wise data was subjected to statistical analysis separately by using Analysis of Variance Technique. The difference among treatments means was compared by using least significant difference test at 5% probability level (Steel et al., 1997; Ali et al., 2010).

RESULTS AND DISCUSSION

The result of the effect of N.P.K. (15:15:15) fertilizer applications on number of eggplant fruiting is presented in Tables 1 to 4.

Analysis of Table 1 showed that applying 129 kg/ha of N.P.K. (15:15:15) fertilizer gave fruit yield of 130.25 kg of eggplant fruit at 10WAT in 2014 cropping season. Application of N.P.K. (15:15:15) fertilizer in eggplant plot had significant effect on fruit yield. This result showed that at the early stage of eggplant growth lower dosage of fertilizer is more appropriate since the roots are not yet developed enough to absorb the release nutrients. Analysis of data in Table 1 also revealed that at the early stage of growth of eggplant fruit at 10WAT in 2014 and 2015 cropping seasons requires plant lower level (129 kg/ha) of N.P.K. (15:15:15) fertilizer. This implies that at early stage of growth of eggplant, lower level (129 kg/ha) of N.P.K. (15:15:15) fertilizer is required which should be increased to 149 kg/ha as the plant advanced to maturity stage at 13WAT, as more plant roots were formed and require more nutrient for optimum yield. The result of this findings agrees with early findings of Tindall (1968) who reported that N.P.K. (15:15:15) fertilizer application in eggplant plot is important only when the roots must have been well established and the plant have attained a certain stage of maturity. The result of these findings also agrees with early findings of Ali et al. (2010) maintained that application of phosphorus and nitrogen fertilizer enhances root development, which improves the supply of other nutrients and water to the growing parts of the plants, resulting in an increased photosynthetic area and thereby more dry matter accumulation.

Table 2 revealed that 129 kg/ha of N.P.K. (15:15:15) fertilizer applied gave fruit yield of 100.25 kg of eggplant fruit at 10WAT in 2015 season.

Comparatively treatment T_3 (N.P.K.) at 129 kg/ha at 10WAT in 2014 season compared to treatment T_3 (N.P.K.) at 129 kg/ha at 10WAT in 2015 season showed that eggplant fruit yield decreased from 130.25 to 100.25 kg, the yield has decline by 30 kg.

Table 3 revealed that 149 kg/ha of N.P.K. (15:15:15) fertilizer was applied at maturity stage of growth gave the highest fruit yield of 140.25 kg of eggplant fruit at 13WAT. This result agrees with the early findings of Tindall (1968) who reported that N.P.K.(15:15:15) fertilizer application during the maturity stage of eggplant is important only when the roots must have been well established.

Comparative analysis of Tables 3 and 4 revealed that the highest number of fruits of 140.25 kg was recorded by plant when 149 kg/ha of N.P.K.(15:15:15) fertilizer was applied in 2014 while Table 4 showed that 149 kg/ha of N.P.K.(15:15:15) fertilizer applied gave eggplant fruit of 114 kg produced in 2015 cropping season. Summarily, applying 149 kg/ha of N.P.K.(15:15:15) fertilizer gave fruit yield of 140.25 kg in Table 3, while in Table 4 was 114 kg, the yield has decreased by 26.25kg. The result of this findings is in line with the earlier findings MacDonald and John (1984) which stated that eggplant requires N.P.K.(15:15:15) fertilizer at the rate of 148 kg/ha for maximum yield.

Table 1. Number of eggplant fruit at 10 Week After Transplanting (WAT) in 2014 season.

Treatment	Replications				Treatment total	Mean (kg)
	R_1	R_2	R_3	R_4		
T_1 (0 kg/ha)	44	105	60	53	262	65.50
T_2 (109 kg/ha)	22	71	62	125	280	70.00
T_3(129 kg/ha)	53	90	103	275	521	130.25
T_4 (149 kg/ha)	23	133	122	159	437	109.20
Total	142	399	347	612		

Source: Computed from field survey data, 2016.

Table 2. Number of eggplant fruit at 10 Week After Transplanting (WAT) in 2017 season.

Treatment	Replications				Treatment total	Mean (kg)
	R_1	R_2	R_3	R_4		
T_1 (0 kg/ha)	40	103	54	37	234	58.50
T_2 (109 kg/ha)	24	69	56	130	279	69.75
T_3 (129 kg/ha)	51	85	107	158	401	100.25
T_4 (149 kg/ha)	20	102	98	145	365	91.25
Total	135	359	315	470	1,279	319.75

Source: Computed from field survey data, 2017.

Table 3. Number of eggplant fruit at 13WAT in 2016 season.

Treatment	Replications				Treatment total	Mean (kg)
	R_1	R_2	R_3	R_4		
T_1 (0 kg/ha)	62	70	51	66	249	62.25
T_2 (109 kg/ha)	98	130	60	80	368	92.00
T_3 (129 kg/ha)	80	125	138	190	533	133.25
T_4 (149 kg/ha)	160	116	135	150	561	140.25
Total	400	441	384	486	1,711	427.75

Source: Computed from field survey data, 2016.

Table 4. Number of eggplant fruit at 13WAT in 2017 season.

Treatment	Replications				Treatment total	Mean (kg)
	R_1	R_2	R_3	R_4		
T_1 (0 kg/ha)	56	63	42	48	209	52.25
T_2 (109 kg/ha)	91	112	45	68	316	79.00
T_3 (129 kg/ha)	72	118	120	140	450	112.50
T_4 (149 kg/ha)	110	98	118	130	456	114.00
Total	329	391	325	386	1,431	357.75

Source: Computed from field survey data, 2017.

CONCLUSION

Application of N.P.K.(15:15:15) fertilizer in the soil of Cross River University of Technology Teaching and Research Farm, Obubra was carried out for two cropping seasons, that is, 2016 and 2017. Four levels of N.P.K. (15:15:15) fertilizer applications were studied. The experiment comprises of four treatments via, control, N.P.K. at 109, 129 and 149 kg/ha. Experiments were laid in randomized complete block design with four replications. The treatments were soiled–applied and the parameter assessed was fruits (yield) at 10 and 13 WAT. The result of the findings shows that N.P.K. (15:15:15) fertilizer applied had significant effect on eggplant fruit yield at 10 and 13 WAT. The result of the findings also shows that 129 kg/ha of N.P.K.(15:15:15) fertilizer applied gave fruit yield of 130.25 kg of eggplant fruit at 10WAT in 2014 cropping season while 100.25 kg of eggplant fruit at 10WAT in 2015 season (Comparatively treatment T_3 (N.P.K.) at 129 kg/ha at 10WAT in 2014 season compared to treatment T_3 (N.P.K.) at 129 kg/ha at 10WAT in 2015 season showed that eggplant fruit yield decreased from 130.25 to 100.25 kg, the yield has decline by 30 kg. Applying 149 kg/ha of N.P.K.(15:15:15) fertilizer gave the highest fruit yield of 140.25 kg in Table 3, while in Table 4 was 114 kg, the yield has decreased by 26.25 kg. The result of this findings is in line with the earlier findings MacDonald and John (1984) which stated that eggplant requires N.P.K.(15:15:15) fertilizer at the rate of 148 kg/ha for maximum yield. This implies that fertilizer quantities can be varied to obtain optimal output. The result showed that yield of eggplant performance was better in plots that were applied fertilizer than in control plot. Based on the result of research findings, fertilizer application is economical in the production of eggplant fruit when the plant has produced enough roots. Younger garden egg plant should be treated with lower dosage of N.P.K. (15:15:15) fertilizer application and this could be increased as the plant get matured.

RECOMMENDATIONS

Fertilizer application is economical in the production of eggplant fruit when the plant has produced enough roots. Younger eggplant should be treated with lower dosage of N.P.K. (15:15:15) fertilizer application and this could be increased as the plant matures. The study also recommended that farmers who intend to produce eggplant at optimum level should apply N.P.K. (15:15:15) fertilizer about 10 cm away from the base of each plant at the rate of 148 to 149 kg/ha at 13 weeks after transplanting. Extension agents should train eggplant farmers to adopt application of 129 kg/ha of N.P.K. (15:15:15) fertilizer which gave fruit optimum yield of 130.25 kg of eggplant fruit at 10WAT.

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