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Soil Application of Cow Dung with Foliar Application of Boost Extra, Effect on Growth and Yield of Okra in an Ultisol, Nigeria

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Abstract

Experiments were carried out at the student's experimental field, Kabba College of Agriculture, Horticulture section to examine the effect of soil application of cow dung combined with foliar application of boost extra on growth and yield of okra in an ultisol, Nigeria. The land was ploughed each year and harrowed with the aid of tractor mounted implements. The experiment was laid out in a randomized complete block design (RCBD). The treatments consisted of A = 3t/ha cow dung, B = 1.0 L/ha foliar + 2.5t/ha cow dung, C =1.5L/ha foliar + 2t/ha cow dung, D = 2 L/ha foliar + 1.5 t/ha cow dung, E = 2.5L/ha foliar + 1.0t/ha cow dung, F = 3t/ha foliar. Each year experiment was conducted using a single field having dimension of 35 by 14m which was laid out into three blocks with 1m guard row between blocks. Each block consists of six plots (5 by 4m) and 1m guard row between plots. Cow dung manure was applied a week before planting. Okra variety Lady's finger was used. Three seeds per hole were planted on April 4th in both years on the flat with a spacing of 60cm x 25cm between and within the rows and later thinned to one plant per stand. Data taken included plant height at 50 % flowering, number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant; and pod weight and yield (t/ha). The data were subjected to Analysis of Variance (ANOVA) while the Least Significant Difference

(LSD) was used to separate treatment means. The result shows that plot treated with 2.0L/ha foliar + 1.5 t/ha cow dung had the best performance in yield and yield components in this study. It is therefore recommended that okra farmers should integrated foliar fertilizer (boost extra) at the rate of 2L per hectare with cow dung at rate of 1.5t per hectare be used for okra production in the study area.

Keywords: Abelmochus esculentus, Lady finger, Malvaceae, Significant, Yield

1. Introduction

Okra (Abelmochus esculentus (L.) Moench is a member of the family Malvaceae (George 1999). It is usually grown in Nigeria primarily for its mucilaginous content. Pods and seeds are rich in phenolic compounds (Arapitsas, 2008). Fresh pods are low in calories, no fat, high in fiber, and have several valuable nutrients (NAP, 2006). Fresh okra pods are the most important vegetable source of viscous fiber, an important dietary component to lower cholesterol (Kendall and Jenkins, 2004). Seven-days-old fresh okra pods have the highest concentration of nutrients (Agbo et al., 2008). Potential of mucilage for medicinal applications includes uses as an extender of serum albumin (BeMiller et al., 1993), as tablet binder (Ofoefule et al., 2001) and as suspending agent in formulations (Kumar et al., 2009). Okra mucilage is used as a protective food additive against irritating and inflammatory gastric diseases (Lengsfelf et al., 2004).

Use of organic manures as a means of maintaining and increasing soil fertility has been advocated (Alasiri and Ogunkeye, 1999: Smil, 2000). Organic manures, when efficiently and effectively used, ensure sustainable crop productivities by immobilizing nutrients that are susceptible to leaching. Nutrients contained in manures are released more slowly and are stored for a longer time in the soil, ensuring longer residual effects. Improved root development and higher crop yields

(Sharma and Mittra, 1991: Abou El Magd et al., 2005). Manures are usually applied at higher rates, relative to inorganic fertilizers. When applied at high rate, they give residual effects on the growth and yield of succeeding crop (Makinde and Ayoola, 2008). Improvements of environmental conditions as well as the need to reduce cost of fertilizing crops are reasons for advocating use of organic materials (Bayu et al., 2006). Organic manures improve soil fertility by activating soil microbial biomass (Ayuso et al., 1996). Applications of manures sustain cropping system through better nutrient recycling (El-Shakweer et al., 1998). Manure provides a source of macro and micro nutrient in available forms, thereby improving physical and biological properties of the soil (Abou El-Magd et al., 2006). Long time use of cow dung increased aggregate stability, pore space, bulk density and available water range (Vanlauwe et al., 2001). Cow dung applied with inorganic nitrogen (N), increased soil pH and ameliorated acidity (Olayinka and Ailenubhi, 2001). Continous application of cow dung increased soil organic matter (Maestro et al., 2007), contents of available phosphorus and inorganic nitrogen (Zhao et al., 2009), soil cation exchange capacity (Yadev and Prasad, 1992).

Crop plants require 17 nutrients to complete their life cycle. Macronutrients are required in higher amounts compared to micronutrients. However, from the plant essentiality point of view, all the nutrients are equally important for plant growth. First three macronutrients (C, H and O) are supplied to plants by air and water. Hence, their supply to plants is not a problem. Hence, the remaining 14 nutrients should be present in the plant growth medium in adequate amount and proportion for plant growth (Fageria, 2007). Research on foliar fertilization was possibly started in the late 1940s and early 1950s (Fritz, 1978; Haq and Mallarino, 2000; Girma *et al.*, 2007). Unlike many technologies, its pace followed an unpredictable sequence of events. In the early 1980s, studies on foliar application of fertilizers investigated for selected crops, including cereals (Girma *et al.*, 2007). The practice of applying liquid fertilizer to plant leaves (foliar fertilization), is recently done in Nigeria, and it is gradually gaining popularity among peasant farmers in many cultivated crops. This method of fertilizer application has been reported to increase the growth, yield and quality of crops such as okra (Selvi and Rani, 2000), soybean (Barge, 2001) and tomato (Alexander et al., 2004) among others. Boost extra, is a foliar fertilizers that is commonly used by farmers in Nigeria. It is manufactured by Candel Company and contains both the macro and micro nutrients in various combinations (20% N, P and K, 0.075% Zn, Cu and Mg, 1.5% Fe, 0.35% Mn, 0.035% Bo and 0.012% Mo with pH range of 4.0-4.5).

The objective of this research is to examine the effect of soil application of cow dung combined with foliar application of boost extra on growth and yield of okra in an ultisol, Nigeria

2. Materials and Methods

Experiments were carried out at the student's experimental field, Kabba College of Agriculture, Horticulture section. It is located in the southern guinea savannah agro ecological zone of Nigeria of 07^0 $53^/$N, 06^0 08E. Kabba has average rainfall of 1250mm per year, temperature ranges from 18^0c - 32^0c. It also has the mean relative humidity (R.H) of about 59% and four hundred and twenty seven meters (427m) above sea level, according to Kabba College of Agriculture Metrological Station, field survey, (2011).

3. Field Work

The land was ploughed each year and harrowed with the aid of tractor mounted implements. The experiment was laid out in a randomized complete block design (RCBD). The treatments consisted of A = 3t/ha cow dung, B = 1 l/ha foliar + 2.5t/ha cow dung, C =1.5l/ha foliar + 2t/ha cow dung, D = 2 l/ha foliar + 1.5 t/ha cow dung, E = 2.5 l/ha foliar + 1t/ha cow dung, F = 3t/ha foliar. Each year experiment was conducted using a single field having dimension of 35 by 14m which was laid out into three blocks with 1m guard row between blocks. Each block consists of six plots (5 by 4m) and 1m guard row between plots. Cow dung manure was applied a week before planting. Okra variety Lady's finger was used. The seeds were treated with Peperomie pellucida leaf powder at 30g per 100 seeds as recommended by Ibe *et al.* (1998) as quoted by Iyagba *et al.* (2012) to control disease causing organisms. Three seeds per hole were planted on April 4^{th} in both years on the flat with a spacing of 60cm x 25cm between and within the rows and later thinned to one plant/stand. The required quantity of foliar spray of boost extra in formulated concentrations (20% N, P and K, 0.075% Zn, Cu and Mg, 1.5% Fe, 0.35% Mn, 0.035% Bo and 0.012% Mo with pH range of 4.0-4.5) was applied to crop at 2, 4, 6 and 8 week after planting. The control treatment was sprayed with sole water. Weeding was done manually at 3 and 8 weeks after sowing. Ten plants were randomly selected at the centre of each plot for data collection.

4. Soil Sampling and Analysis

Before the commencement of the experiment in 2014, surface soil samples (O – 15cm depth) were taken randomly from the experimental sites. The samples were bulked, air dried and sieved using a 2mm sieve and analyzed for particle size, soil organic matter total N, P, K, Ca, Mg and pH. The samples were taken, bulked and sub sampled as described by Carter (1993). Particle size analysis was done using hydrometer method (Bouyoucos, 1962) while organic matter was determined by the procedure of Walkley and Black using the di -chromate wet oxidation method (Nelson and Sommers, 1982). Total N was determined by micro – Kjeldahl digestion method (Bremner, 1965) and available P was by Bray – 1 extraction followed by molybdenum blue colorimetry (Bray and Kurtz, 1945). Exchangeable K, Ca and Mg were extracted by EDTA titration method (Jackson, 1962). Soil pH was determined in 1:2 soils – water ratio using digital electronic pH meter. Cow dung was obtained form Obaba Farms, Ponyan. Samples from these cow dung materials were taken for laboratory analysis in other to determine nutrient composition. The samples were air dried, crushed, passed through a 2mm sieve before analysis. The samples were analysed for organic C, N, P, K, Ca and Mg contents

Data taken included plant height at 50 % flowering, number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant, pod weight and yield (t/ha). The data were subjected to Analysis of Variance (ANOVA) while the Least Significant Difference (LSD) was used to separate treatment means following the procedure of Steel and Torrie (1980)

5. Results and Discussion

5.1 Soil Analysis and Organic Material Used

The soil was 64.7% sand, 20.3% clay and 15.0% silt, slightly acidic (pH 5.8) and with a total N content of 0.24%. Available phosphorus was 0.92 mg kg^{-1} and exchangeable potassium was 0.24 mg kg^{-1}, contents of Ca and Mg were 2.01 and 2.63 cmol/kg respectively (Table 1). The chemical composition of cow dung revealed that it had a pH of 6.4 , total nitrogen content of 3.6%,, 1.87% available P, 38.4% organic carbon, 3.14% available K and C/N ratio of 10.6% (Table 2). Fertilizer and manure are one of the most important inputs contributing to crop production because it increases productivity and improve yield quality and quantity. The general low ambient soil nutrient content made the soil suitable for study of response to fertilizer.

5.2 Effect of Cow Dung and Foliar Fertilizer on Growth Component of Okra

Nutrients supplied in the form of cow dung and foliar fertilizer alone or in combination, affect okra plant height, stem girth, number of leaves produced and leaf area (Table 3). Plants treated with 1.5 l/ha foliar fertilizer plus 2t/ha cow dung had the tallest plants. Plots with 1l/ha foliar + 2.5 t/ha cow dung and 2l/ha foliar + 1.5 t/ha cow dung produced plants with comparable heights. Sole application of both foliar fertilizer and cow dung had shorter plants that were similar in height.

Stem girth was affected by treatment (Table 3). Plants with combined application of cow dung and foliar fertilizer had taller plants compared to plants with sole application of either foliar fertilizer or cow dung. Plants with 1.5 l /ha foliar fertilizer + 2t/ha cow dung, 2l/ha foliar + 1.5 t/ha cow dung had similar girth. The least stem girth was observed in plants treated with 3t/ha cow dung alone.

Okra plant leaf area was highest in plant treated with 2l/ha foliar fertilizer + 1.5 t/ha cow dung (Table 3). However, this was not significantly different from plots with 1 l/ha foliar + 2.5 t/ha cow dung, 1.5 l/ha foliar + 2 t/ha cow dung and plants with 2.5l/ha foliar + 1 t/ha cow dung. Plants with foliar alone and cow dung residue alone were smaller and similar.

These results are in agreement with that of Alston (1979) who reported better vegetative growth of crop with foliar application of N. Similar, Soyln *et al.*, 2005; Kenbear and Sade (2002) and Arif *et al.*, (2006) reported significant increase in plant height, stem girth and leaf area of crop with foliar application of different nutrients individually or in combination. The result of this findings support the earlier results. The combination of cow dung materials with foliar produced plants those were similar. This indicated that the high dose of organic manures can be reduced by half and mix with reduced rate of inorganic fertilizer (foliar). The nutrient use efficiency of crops is better with a mix of manure and inorganic fertilizer (Murwira and Keirehmann, 1993). Nutrients seemed more available to Okra plants with the mixes then either cow dung or foliar fertilizer alone.

5.3 Effect of Cow Dung and Foliar Fertilizer on Yield and Yield Components of Okra

Number of Okra fruit per plant, length of okra fruit and average weight of okra fruit were lowest in plants treated with 3t of cow dung per ha. The highest fruit number was from application of 2.5 l/ha foliar + 1 t/ha cow dung, this was not statically better than plants with application of 2 l/ha foliar + 1.5 t/ha cow dung. Okra fruit yield was lowest for the plants treated with cow dung alone (0.24 t/ha). Yield form plants treated with combined use of cow dung and foliar fertilizer were similar and significantly higher than either plants with cow dung alone or foliar application alone. Among the treatments, plants treated with 2 .0t of foliar + 1.5t or cow dung recorded the greatest yield. However, the yield was not statistically better than plot treated with 2.5l of foliar fertilizer + 1t or cow dung per ha = (Table 5).

Foliar fertilization gave significant higher fruits yields. Application of a mix or organic manure (Cow dung) and inorganic fertilizer can be used to sustain okra in the tropics. A similar trend of response had been earlier observed with other crops such as maize (Makinde and Ayoola., 2008); Sorghum (Bayu *et al.*, 2000); and wheat (Parvez *et al.*, 2009).

6. Conclusion

Field experiment was carried out at Kabba on responses of okra yield to organic manure and inorganic foliar fertilizer the experiment consist of six treatments which are 0 L/ha foliar + 3t/ha cow dung, 1.0L/ha foliar + 2.5 t/ha cow dung, 1.5 L/ha foliar + 2t/ha cow dung, 2 L/ha foliar + 1.5 t/ha cow dung, 2.5 L/ha foliar + 1t/ha cow dung and 3L/ha foliar + 0t/ha cow dug. The result shows that plot treated with 2.0L/ha foliar + 1.5 t/ha cow dung had the best performance in yield and yield components in this study. It is therefore recommended that okra farmers should integrated foliar fertilizer (boost extra) at the rate of 2L per hectare with cow dung at rate of 1.5t per hectare be used for okra production in the study area.

Table 1. Properties of soil before the experiment in 2014.

Particle Size	Percentage (%)
Sand	64.7
Clay	20.3
Sit	15.0
Soil Texture	Sandy Clay Loam
pH (H_20)	5.8
Total N	0.24
Available p (mg/kg	0.36
Exchangeable Cation (Cmol/kg	
K	0.24
Ca	2.01
Mg	2.63

Table 2. Chemical properties of cow dung used

Chemical properties	**(%)**
Orgianic carbon	38.4
Total N	3.60
C/N	10.6
Phosphorus	1.87
Potassium	3.14
Calcium	1.22
Magnesium	0.31
Soil pH	6.4

Table 3. Effects of cow dung and foliar fertilizer on growth component of okra (mean of two years).

Treatment	Average plant height (cm)	Number of leaves	Stem diameter (cm)	Leaf area (m^2)
A	18.68^{c}	16.02^{a}	2.34^{a}	90^{b}
B	26.31^{ab}	18.31^{a}	2.63^{ab}	105^{a}
C	31.86^{a}	18.42^{a}	2.86^{a}	108^{a}
D	29.41^{ab}	16.94^{a}	2.82^{a}	112^{a}
E	22.43^{bc}	17.45^{a}	2.61^{ab}	94.6^{ab}
F	18.64^{c}	18.21^{a}	2.53^{b}	77^{c}

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. A = 3t/ha cow dung, B = 1 l/ha foliar + 2.5t/ha cow dung, C =1.5l/ha foliar + 2t/ha cow dung, D = 2 l/ha foliar + 1.5 t/ha cow dung, E = 2.5 l/ha foliar + 1t/ha cow dung, F = 3t/ha foliar.

Table 4. Effect of application of cow dung and foliar fertilizer on yield and yield component of okra (mean of two years).

Treatment	Number of fruit/plant	Length of fruits (cm)	Fruit diameter (cm)	Average weight of fruit (g)
A	6.2^{c}	5.8^{a}	3.2^{b}	0.71^{b}
B	7.4^{b}	6.1^{bc}	3.3^{ab}	0.76^{b}
C	7.6^{b}	6.3^{b}	3.10^{b}	0.91^{a}
D	8.3^{a}	7.4^{a}	3.1^{b}	0.94^{a}
E	9.8^{a}	6.2^{b}	3.6^{a}	0.85^{c}
F	7.4^{b}	6.5^{b}	3.1^{b}	0.78^{b}

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. A = 3t/ha cow dung, B = 1 l/ha foliar + 2.5t/ha cow dung, C =1.5l/ha foliar + 2t/ha cow dung, D = 2 l/ha foliar + 1.5 t/ha cow dung, E = 2.5 l/ha foliar + 1t/ha cow dung, F = 3t/ha foliar.

Table 5. Effect of application of cow dung and foliar fertilizer on yield and yield component of okra continued (mean of two years).

	Fruit weight/plant (g)	**Yield t/ha**
A	4.41[c]	0.24[c]
B	5.40[b]	0.30[bc]
C	6.92[ab]	0.38[ab]
D	7.80a	0.43[a]
E	7.48[a]	0.42[a]
F	5.77[b]	0.32[b]

In a column, figures bearing same letter(s) do not differ significantly at 5% level of probability by DMRT. A = 3t/ha cow dung, B = 1 l/ha foliar + 2.5t/ha cow dung, C =1.5l/ha foliar + 2t/ha cow dung, D = 2 l/ha foliar + 1.5 t/ha cow dung, E = 2.5 l/ha foliar + 1t/ha cow dung, F = 3t/ha foliar.

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