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EFFECTS OF NPK FERTILIZER AND SPACING ON THE GROWTH PARAMETERS OF OKRO (*Abelmoschus esculentus L.*)

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ABSTRACT
Field trials were conducted during rainy seasons in 2018 and 2019 at Federal, University Dutse Teaching and Research Farm in the Northern Sudan Savanna ecological zone of Nigeria. To evaluate effect of NPK fertilizer and spacing on the growth and yield of okro. The experiment consists of three levels of NPK fertilizer (30, 60 and 120 kg/ha) and three spacing (10, 15 and 20 cm). The treatments combination was laid out in randomized complete block design replicated three times. The results revealed that significant effect of NPK fertilizer on plant height, number of branches, more number of primary branches plant fruit length and number of pod per plant. The various spacing resulted in significant taller plant, more number of leaves, longer length of fruit and higher number of seed per pod. In conclusion, application of 120 kg/ha and spacing at 20 cm gave the best result.

Keywords: Okro, plant height, number of branches, number of pod per plant

INTRODUCTION

Okra (Abelmoschus esculentus (L.) Moench) is a popular vegetable in tropical and sub-tropical countries of the world; it is grown for its "pod" (Ogeniyi and Folorunso, 2003). It is an annual crop and most important grown mainly as fruits and leafy vegetables (Tiamiyu et al., 2012) and as a fresh fruit, is a good source of vitamins, minerals and plant protein (Maunda et al., 2009).

Okra requires an annual rainfall range of 900 – 1,000 mm and mean annual temperature ranging from 250C to 350C and It thrives well in different soil condition, the soil of the area is sandy loam (Tiamiyu et al., 2012). In Nigeria among the factors that effect crop production is poor soil fertility due to degradation and deficiency of major mutants (Aniekwe, 2017). Babatola (2006) recorded an increased yield in okra due to NPK fertilizer application. Recommended rates of NPK fertilization vary greatly depending on the variety and environment. Study by Aniekwe (2017) revealed that higher dose of NPK 15:15:15 resulted in significant increase in growth and yield of Okra. Fertilizer application to crops is a necessary condition for good yield of crops in Nigeria due to inherent low fertility status of the soils, particularly in the savannah regions and application of fertilizer have aid in increase in crop yield. (Philip et al., 2010). Proper spacing and population of the plant per unit area is an important factor that determine the yield crops by enhancing proper utilization of soil nutrient, water air and weed suppression (Danmaigoro et al., 2015).The study have revealed the influenced of spacing on the yield of okra especially the inter row spacing Plant spacing has a pronounced effect on the growth of crops, when plant population is too high, it encourages interplant competition for resources which affects crops net yield (Danmaigoro et al., 2015 and Agba, 2004). The objectives of this study therefore are to determine the effect of NPK fertilizer and spacing on growth and yield of okra and to determine the effect of Spacing and on growth and yield of okra.

MATERIALS AND METHODS

Experimental Site

The experiments were carried out during the 2018 and 2019 rainy season in Faculty of Agriculture Research Farm, Federal University Dutse (11°70' N, 9°34' E, and 460 m above sea level). The location is within the Sudan savannah zone of Nigeria. The climate of the location is characterized by two seasons: The wet season (May – September) and the dry season (October – April) with annual rainfall of 800 – 1000 mm (JARDA, 2012). The mean annual temperature is about 19.7°C-26.4°C (Climate-Charts.com, 2016). The experiments consisted of three rates of NPK fertilizer (0, 60 and 120 kg/ ha) and three plant spacing (10, 15 and 20 cm) intra-inter row spacing replicated three times. The treatments were laid out in a Randomized Complete Block Design (RCBD).

Planting and spacing: The okra seeds were obtained from the local farmers in Dutse. It was a local variety and a dwarf type which grow up to a height of 70 cm and matures in 45-50 days. The pods are medium long, green and five ridged, also rough and hairy.

Unit plot size will be 2 x 2 m (4 m^2) with 1 and 0.5m pathway between each replication and the plots, respectively. The three rates of fertilizer was applied as per treatment in two split doses at two and four weeks after sowing. Weeding will be done as when necessary with a simple hole. The land was harrowed and ridged at 75 cm apart before planting. This was then followed by ridging at 40 cm and 30 cm within the ridges apart and the field marked into plots and blocks (replications). The plots were separated by 0.5 m unplanted boarder while replications were separated by 1.0 m unplanted.

Cultural Practices: seeds were treated with seed dressing chemical Apron star (20% w/w thimethoxan, 20% w/w metalaxyl-m and 2% w/w difenoconazole) at the rate of 10 g per 5 kg of seed against fungicides and insecticides. Three healthy seeds were dibbled 2 cm deep. The soil was compacted over the seeds in order to provide good contact between the seed and soil particles and to facilitate seed germination. Supplementary irrigations were given at an interval of 6-10 days except during the period of intermittent rains. Thinning was done at 25 days after sowing, leaving single plant per hill. Weeding was done twice i.e. at 30 and 55 days after sowing. Malathion 50 EC (0.05%) was sprayed at 15 days of sowing to prevent insect attack. Picking of fruits was done manually when they were green tender and at marketable size. The picked fruits were weighed and subjected to other observations immediately, after each

picking. Five plants was randomly selected from each plot and tagged and observations were recorded from the same plants at 3, 6 and 9 Week after sowing (WAS). Plant height was carried out by measuring the heights of the tagged plants with a meter rule from the top soil level to the tip of the terminal buds and the average recorded for each of the treatment. Number of leaves per plant was taken by counting all fully expanded leaves on each of the tagged plants and the average value was recorded for each of the treatment. Number of primary branches per plant was determined by counting all the developed primary lateral branches on each tagged plants and the mean value was recorded for each of the treatment.

Fresh shoot weight: Fresh plant from the discard of each plot for the field trial were uprooted and shoots was separated from the roots and measured using Salter scale and the mean recorded for each of the treatment. Dry shoot weight: Dry shoot weight was done by putting the fresh shoot an envelope labelled and oven dried at temperature of 70^0C until it reaches a constant weight, there after weighed and the mean recorded for each of the treatment. Days to 50% flowering was recorded from daily visible observation covering the period of flower emergence up to 50% of the plants population in both the field.

Data Analysis: Data collected were subjected to analysis of variance (ANOVA) using Statistically Application software (SAS) and the means were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS

Effect of NPK fertilizer and spacing on the number of leaves of okra was significant (Table 1). In 2018, at all the sampling period, application of NPK fertilizer at 90kg/ha resulted in high number of leaves while the control (0kg/ha) produced the lowest leaves per plant. In 2019, similar trend was observed. Furthermore, effect of spacing on the number of leaves per plant was significant. Spacing at 20 cm intra row produced more leaves per plant than the other spacing (10 and 15cm) in both years. Interaction between NPK fertilizer and spacing was significant in both seasons (Table 1). In 2018, application of highest NPK and spacing of 20cm gave the best number of leaves while in 2019, however application of highest NPK rate and 15 and 20cm spacing gave best number of leaves of plant of Okra. Effect of NPK fertilizer and spacing on plant height of okra was significant (Table 2). In 2018, Application of highest rate of NPK fertilizer produced tallest plant at all the sampling period while control gave the shortest plant similar trend was observed in 2019.However, effects of spacing on the plant height of okra revealed that planting at 20 cm intra and inter row produced taller plant across the sampling period while 10cm gave the shortest plant in both seasons. Interaction between NPK fertilizer and spacing was significant both seasons (Table 2).

DISCUSSION

Effect of NPK fertilizer on the growth parameters of the okra revealed that application highest doze of the fertilizer resulted in significant increase in the growth parameter measured. Nitrogen is an essential macro nutrients and determinant in growth and development of crop plants. Majanbu et al (1986) reported that NPK are the most needed macro-nutrients that okra required for proper growth and yield. Babatola (2006) also observed increases in okra yield as a result of NPK fertilizer application. Application of 22.5 kg ha-1 N, 22.5 kg ha^{-1} P and 22.5 kg ha^{-1} P is recommended for effective okra production Philip et al. (2010). Aniekwe (2017) in a related finding also reported that increasing the rate of NPK fertilizer led to an increase in the growth parameters of okra. The result of the study indicates that N. P. K fertilizer application significantly increased growth parameters plant height, leaf area, number of leaves, of okra. Application of 120 kg NPK ha -1 and 20cm spacing was found to be better for okra production. Similar finding was reported by Omotoso and Shittu (2007), who reported application of N. P. K fertilizer application 150 kg NPK ha^{-1}. In a similar study, Babatola and Olaniyi, (1999) reported a better performance of okra when NPK fertilize. This showed that application of these nutrients are important for enhance yield of okra. Plant spacing has a pronounced effect on the growth of crops, when plant population is too high, it encourages interplant competition for resources which affects crops net yield (Danmaigoro et al., 2015). While in inadequate plant populations or wide spacing could limit crop yield due to inefficient use of solar energy. The result of this study revealed that spacing at 20cm gave the best growth parameter as the proper spacing enhance good growth and proper utilization of the crop growth factors.

Table 1: NPK fertilizer rate (kg/ha) and spacing (cm) on number of leaves of Okra (*Abelmoschus esculentus*) in 2018 and 2019 seasons

		Number of leaves per plant					
		2018			2019		
Treatment	**Rate**	**3weeks**	**6weeks**	**9weeks**	**3weeks**	**6weeks**	**9weeks**
NPK (F) (kg/ha)							
	30	3.2c	5.2c	6.9c	4.0c	5.5c	7.9c
	60	4.1b	6.6b	7.8b	4.7b	6.8b	8.5b
	90	5.2a	7.4a	8.7a	5.8a	7.8a	9.38a
	SE±	0.03	0.00	0.00	0.57	0.56	0.55
Spacing (S)	**(cm)**						
	10	3.8c	5.7c	7.0c	4.6b	6.0b	7.9c
	15	4.3b	6.7b	7.8b	5.0a	6.9a	8.4b
	20	4.5a	6.8a	8.7a	5.0a	7.2a	9.3a
	SE±	0.03	0.00	0.00	0.57	0.56	0.55
Interaction							
FXS		NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of each sets of treatments group are not significantly different at $P \leq 0.05$ using DMRT.
NS: No significant.

Table 2: NPK fertilizer rate (kg/ha) and spacing (cm) on plant height of Okra (*Abelmoschus esculentus*) in 2018 and 2019 seasons.

		Plant height					
		2018			2019		
Treatment	**Rate**	**3weeks**	**6weeks**	**9weeks**	**3weeks**	**6weeks**	**9weeks**
NPK (F)	**(kg/ha)**						
	30	3.6c	6.1c	19.6c	3.6c	6.8c	21.0c
	60	6.7b	9.8b	21.8b	6.7b	10.4b	22.0b
	90	9.0a	11.9a	23.4a	9.0a	12.8a	24.9a
	SE±	0.30	0.00	0.00	0.57	0.56	0.55
Spacing (S)	**(cm)**						
	10	4.5c	8.3c	20.5c	5.3b	9.3c	21.5c
	15	5.9b	9.2b	21.8b	6.6a	9.8b	22.7b
	20	6.4a	10.3a	22.6a	7.3a	11.0a	23.6a
	SE±	0.03	0.00	0.00	0.57	0.56	0.55
Interaction							
FXS		NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of each sets of treatments group are not significantly different at $P \leq 0.05$ using DMRT.
NS: No significant.

CONCLUSION

In conclusion, application of 90 kg/ha NPK and planting at 20 cm initial row spacing gave the best yield of okra in the study area.

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