FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 10 No. 4, December 2024: Pp.108-112

https://doi.org/10.33003/jaat.2024.1004.15.393

EFFECTS OF NPK 15:15:15 FERTILIER AND SPACING ON THE PHYSIOLOGICAL PARAMETERS OF OKRO (*Abelmoschus esculentus L.*) AT DUTSE, JIGAWA STATE

[1]Danmaigoro. O., [2]Umar M.M., [1]Halidu. J., [1]Muhammad . F., Suliaman, D. [1]Abdujalil, T. and [3]Salami, K. D.
[1]Department of Crop Science, Faculty of Agriculture, Federal University Dutse, Jigawa
[2]Department of Extension Federal Ministry of Agricultural Development and Rural Development Abuja
[3]Department of Forestry and Wildlife Management, Federal University Dutse, Jigawa state
Corresponding Author: foristsalam@yahoo.com ; odanmaigoro@gmail.com

ABSTRACT

A two-year field investigation was conducted at the Federal University Dutse Teaching and Research Farm, situated in the Northern Sudan Savanna ecological zone of Nigeria, during the 2018 and 2019 rainy seasons. This study aimed to assess the synergistic effects of NPK 15:15:15 fertilizer applications and plant spacing on the physiological parameters of okra. The experiment employed a Randomized Complete Block Design (RCBD) with three replications, comprising three levels of NPK fertilizer (30, 60, and 120 Kgha^{-1}) and three spacing (10, 15, and 20 cm). The results revealed significant ($p < 0.05$) effects of NPK fertilizer application on okra plant height, branching habit, primary branches, fruit length, and pod production per plant. Furthermore, varying spacing treatments significantly ($p < 0.05$) influenced plant height, leaf production, fruit length, and seed number per pod. The optimal combination of 120 kgha^{-1} NPK fertilizer and 20 cm spacing yielded the best results, highlighting the potential for improved okra production in the region. It is recommended that okra farmers apply 120kgha^{-1} NPK fertilizer and adopt 20cm spacing to optimize growth, yield, improves food security, creates jobs, and boosts farmer incomes, contributing to economic growth and productivity in the Northern Sudan Savanna zone.

Key words: Okro, NPK fertilizer, Spacing, Physiological parameters and *Abelmoschus esculentus*

INTRODUCTION

Okra (*Abelmoschellus esculentus* (L.) Moench), a nutrient-rich and versatile vegetable crop, has garnered significant attention globally, particularly in tropical and subtropical regions, due to its edible pods and leafy greens (Tiamiyu et al., 2012). As an annual crop, okra is extensively cultivated, providing an excellent source of essential vitamins, minerals, and plant-based proteins (Elkhalifa et al., 2021). Notably, okra's adaptability to diverse environmental conditions, including a wide range of soil types, makes it an attractive crop for farmers in various regions (Tiamiyu et al., 2012). However, in Nigeria, poor soil fertility, resulting from degradation and nutrient deficiencies, poses a significant challenge to okra production (Aniekwe, 2017). To address this challenge, research has emphasized the importance of NPK fertilizer application and optimal spacing in enhancing okra yields (Aniekwe, 2017; Danmaigoro et al., 2015). Specifically, studies have demonstrated that NPK fertilizer application can significantly improve okra growth and yield, with optimal rates varying depending on the specific variety and environmental conditions (Aniekwe, 2017). Moreover, proper spacing and population management have been identified as critical factors influencing okra yields, impacting soil nutrient utilization, water availability, air circulation, and weed suppression (Danmaigoro et al., 2015). Given the significance of these factors in optimizing okra production, this study aimed to investigate the effects of NPK fertilizer application and spacing on the growth and yield of okra, providing valuable insights for improving okra cultivation practices in Nigeria.

Experimental Site

The experiments were conducted during the 2018 and 2019 rainy seasons at the Faculty of Agriculture Research Farm, Federal University Dutse, situated in the Northern part of Nigeria (11°70″ N latitude, 9°34″ E longitude, and 460 meters above sea level). The research farm is nestled within the Sudan savannah zone, a region characterized by a distinct bimodal rainfall pattern, with two prominent seasons: a wet season spanning from May to September, and a dry season extending from October to April (Atampugre, 2018). The area receives an annual rainfall of 800-1000 mm, with a mean annual temperature fluctuating between 19.7°C and 26.4°C. Specifically, the research farm experiences an average annual rainfall of 743 mm and a temperature of 34.50°C. The topography of the area is generally flat, with a high land area of approximately 750 meters. The soil type in this region is predominantly sandy-loam, as reported in previous studies (Garba et al., 2021; Ilu et al., 2021; Salami et al., 2020; Jibo et al., 2018). This soil type is characterized by a mix of sand, silt, and clay, providing a suitable medium for plant growth. The research farm's location within the Sudan savannah zone, combined with its specific climatic and soil conditions, provides an ideal setting for conducting agricultural research, particularly on crops such as okra.

Data Collection and Experimental Design

The experiment employed a 3 × 3 factorial arrangement, incorporating three levels of NPK fertilizer application (0, 60, and 120 $kgha^{-1}$) and three plant spacing treatments (10, 15, and 20 cm intra-inter row spacing). The treatments were replicated three. The experiment was laid out in a Randomized Complete Block Design (RCBD).

Planting and Spacing

Okra seeds of a local, dwarf-type variety were sourced from local farmers in Dutse, Jigawa State, Nigeria. This variety, characterized by its compact growth habit, reaches a maximum height of 70 cm and matures within 45-50 days. The pods are medium-long, green, and exhibit a distinctive five-ridged morphology, with a rough and hairy texture. To facilitate accurate data collection and minimize environmental variability, each plot was carefully measured and marked to a size of 2 × 2 m (4 m^2), with 1 m alleys between replications and 0.5 m pathways between plots. Fertilizer application was strategically split into two doses, administered two and four weeks after sowing, to optimize nutrient uptake and promote healthy plant growth. Weeding was performed as necessary using a simple hoe, ensuring that the experimental area remained free from competing vegetation and allowing for accurate assessment of treatment effects.

Land Preparation and Cultural Practices

Prior to planting, the land was thoroughly prepared through harrowing and ridging, with ridges spaced 75 cm apart. To safeguard against fungal and insect pests, okra seeds were treated with the seed dressing chemical Apron Star (20% w/w thiamethoxam, 20% w/w metalaxyl-m, and 2% w/w difenoconazole) at a rate of 10 g per 5 kg of seed. Seeds were then dibbled 2 cm deep, and the soil was carefully compacted over the seeds to ensure optimal contact and facilitate uniform germination. To supplement natural rainfall, irrigation was provided at 6-10 days intervals, except during periods of intermittent rainfall. At 25 days after sowing, thinning was performed to maintain a single, healthy plant per hill. Weeding was conducted twice, at 30 and 55 days after sowing, to control competing vegetation and prevent nutrient depletion. Additionally, Malathion 50 EC (0.05%) was applied via foliar spray at 15 days after sowing to prevent insect infestations and protect the developing crop.

Data Collection

Prior to planting, the land was thoroughly prepared through harrowing and ridging, with ridges spaced 75 cm apart. To safeguard against fungal and insect pests, okra seeds were treated with the seed dressing chemical Apron Star (20% w/w thiamethoxam, 20% w/w metalaxyl-m, and 2% w/w difenoconazole) at a rate of 10 g per 5 kg of seed. Seeds were then dibbled 2 cm deep, and the soil was carefully compacted over the seeds to ensure optimal contact and facilitate uniform germination. At 25 days after sowing, thinning was performed to maintain a single, healthy plant per hill. Weeding was conducted twice, at 30 and 55 days after sowing, to control competing vegetation and prevent nutrient depletion. Additionally, Malathion 50 EC (0.05%) was applied via foliar spray at 15 days after sowing to prevent insect infestations and protect the developing crop.

Data Analysis

The data collected were subjected to statistical analysis using the Statistical Analysis System (SAS) software package 16. Analysis of variance (ANOVA) was performed to determine significant differences between treatment means. Means separation was conducted using Duncan's Multiple Range Test (DMRT) at a 5% probability level (Duncan, 1955), allowing for the identification of statistically significant differences between treatment combinations.

RESULTS

The application of NPK fertilizer and spacing exerted a profound impact on okra's morphological characteristics, specifically the number of leaves and plant height (Tables 1 and 2). A consistent trend emerged across both the 2018 and 2019 growing seasons, wherein the application of NPK fertilizer at 90 kg/ha significantly enhanced leaf production per plant compared to the control treatment (0 $kgha^{-1}$). Similarly, okra plants grown at a 20 cm intra-row spacing produced a higher number of leaves per plant relative to those grown at 10 cm and 15 cm spacing. Notably, the interaction between NPK fertilizer and spacing was statistically significant in both seasons, with the combination of the highest NPK rate and 20 cm spacing yielding optimal results in 2018. Conversely, in 2019, the highest NPK rate combined with 15 cm and 20 cm spacing produced superior results. Regarding plant height, the application of the highest NPK rate consistently produced the tallest plants across both seasons, while the control treatment resulted in significantly shorter plants. Furthermore, okra plants grown at a 20 cm intra and inter-row spacing exhibited increased height across all sampling periods, whereas those grown at 10 cm spacing remained relatively stunted. The significant interaction between NPK fertilizer and spacing in both seasons underscores the importance of optimizing the combination of NPK rate and spacing to enhance okra plant growth and development.

DISCUSSION

The application of NPK fertilizer had a profound impact on the growth parameters of okra, with the highest dose resulting in significant increases in plant height, leaf area, and number of leaves. This is corresponded with the essential role of nitrogen as a macro-nutrient in crop growth and development. Previous studies have also demonstrated the benefits of NPK fertilizer application on okra yield, with Babatola, (2013) and Aniekwe, (2017) reporting increased growth parameters with higher NPK rates.

The findings of this study align with those of Omotoso and Shittu (2007), who reported optimal okra production with NPK application at 150 kg/ha. Similarly, Babatola and Olaniyi, (1999) observed improved okra performance with NPK fertilization. These results collectively emphasize the importance of NPK fertilizer application in enhancing okra yield.

Plant spacing emerged as a critical determinant of okra growth, with optimal spacing facilitating the efficient utilization of growth factors such as light, water, and nutrients. Inadequate plant populations or wide spacing can compromise crop yield due to suboptimal solar energy utilization, whereas high plant populations can foster inter-plant competition, leading to a decline in net yield (Danmaigoro et al., 2015). The findings of this study unequivocally demonstrated that a spacing of 20 cm yielded superior growth parameters, underscoring the paramount importance of optimal spacing in okra production. By adopting this spacing regimen, farmers can optimize okra growth, maximize yields, and enhance the overall efficiency of their production systems. This is in line with the findings of Ajala and Adelana (2012), who reported that closer spacing significantly improved okra growth and yield in a study conducted in the southwestern region of Nigeria. Similarly, a study by Olanipekun et al. (2015) published in the Nigerian Journal of Agricultural Science also emphasized the importance of optimal spacing in okra production, highlighting its impact on plant growth, yield, and overall productivity.

CONCLUSION

The study demonstrated that NPK fertilizer application significantly enhances the growth parameters of okra, with the highest dose resulting in substantial increases in plant height, leaf area, and number of leaves. Optimal okra production was achieved with an application rate of 120 kg NPK ha-1 and a spacing of 20cm, which allowed for efficient utilization of growth factors and minimized interplant competition. These findings highlight the importance of balanced nutrient application and proper spacing for maximizing okra yield. Overall, the results suggest that NPK fertilizer is a crucial component in okra cultivation, and its optimal application can significantly contribute to improved crop productivity and sustainability.

Table 1: 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					
Treatment	**Rate**		**2018**			**2019**	
NPK (F)	**(Kgha-^{1})**	**3weeks**	**6 weeks**	**9 weeks**	**3 weeks**	**6 weeks**	**9 weeks**
	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

Number of leaves per plant							
Treatment	**Rate**	**2018**			**2019**		
NPK 15:15:15 (F)	**(Kgha-1)**	**3weeks**	**6 weeks**	**9 weeks**	**3 weeks**	**6 weeks**	**9 weeks**
	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 ≤ 0.05 using DMRT.
NS: No significant.

REFERENCES

Ajala, M. A., and Adelana, O. A. (2012). Effects of spacing on growth and yield of okra (Abel*moschus esculentus* L.) in southwestern Nigeria. Journal of Agricultural and Food Science, 10(1), 12-18.

Aniekwe N. L. (2017): Growth and yield of Okra in response to plant density and NPK 15:15:15 fertilizer in Abakaliki, South Eastern Nigeria, *Nigerian Journal Crop Science* 4: 71-78.

Atampugre, G. (2018). *Climate Variability and Farm-households in the Sudan Savannah Zone of Ghana* (Doctoral dissertation, The University of Adelaide).

Babatola, L. A and Olaniyi, J.O. (1999). Effect of N P K 15:15:15 level and plant spacing on performance and shelf-life of okra. *Annal of Agricultural Sciences*, (1): 24-29.

Babatola, L.A. (2013). Effect of NPK 15: 15: 15 on the performance and shelf life of Okra (*Abelmoschus esculentus*). *Journal of Agriculture Biotechnology and Ecology*, 6 (1): 95-101.

Danmaigoro. O., Ishaya. D. B and Yakubu, H. (2015): Performance of upland rice (*Oryza sativa L.*) As influenced by weed control treatment poultry manure and stand density. *Biological and Environmental Sciences Journal for the Tropics: 12:2*

Elkhalifa, A. E. O., Alshammari, E., Adnan, M., Alcantara, J. C., Awadelkareem, A. M., Eltoum, N. E. and Ashraf, S. A. (2021). Okra (Abelmoschus esculentus) as a potential dietary medicine with nutraceutical importance for sustainable health applications. *Molecules*, *26*(3), 696.

Garba, A., Salami, K. D. and Akanbi, W. B. (2021) Assessment of Endangered economic tree species and conservation Techniques in Jigawa state *FUDMA Journal of Agriculture and Agricultural Technology* V 7(2)116-123

Ilu, K. J., Salami, K.D., Gidado, A. H., Muhammad, Y. K. and Bello Ahmed (2021) Household's Responses to the Roles of Trees as Wind Breaker in Dutse Local Government Area of Jigawa State, Nigeria. *FUDMA Journal of science* 4(1):246-249

Jibo, A.U., Salami, K.D and Inuha, I.M (2018). Effects of Organic manure on growth Performance of *Azadirachta indica* (A.Juss) seedlings during early growth in the Nursery. *FUDMA Journal of Sciences (FJS)*. Vol 2 (4):99-104

Olanipekun, S. O., Adeniyi, O. R., and Adejoro, S. A. (2015). Optimal spacing for okra (Abelmoschus esculentus L.) production in Nigeria. Nigerian Journal of Agricultural Science, 13(2), 145-153.

Omotoso, S. O., and Shittu, O. S, (2008). Soil properties, leaf nutrient composition and yield of okra (*Abelmoschus esculentus)* (L.) Moench] as affected by Broiler litter and NPK 15:15:15 fertilizers in Ekiti State, *Nigerian International Journal of Agric Research.* 3, 140-147.

Salami, K. D., Akinyele, A. O. and Folorunso, W.O. (2020). Effect of Pre-Treatments, Inorganic Fertilizer and Varying Soil Volumes on the Early Growth Performance of *Adansonia digitata* (Linn) Baobab. Nigeria *Journal of Horticultural Science*, *Horticultural Society of Nigeria*. Vol 25 (1):1-10.

Tiamiyu, R.A., Ahmed H. G. and Muhammad A.S. (2012). Effect of sources of organic manure on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench) in Sokoto, Nigeria. *Nigerian Journal of Basic and Applied Science* 20(3), 213 -216.