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Effect of Nitrogen and Spacing on Vegetative Growth and Pod Characters of Okra *Abelmoschus esculantus (L.) Moench* Cv Al Hindi

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Abstract Nitrogen is the most important nutrient to the plant, and its dose depends on the amount, availability to the plant and the plant density. This study was conducted in 20 September 2021 to the end of the year, to investigate the effect of nitrogen fertilizer and plant spacing on Okra *Abelmoschus esculanntus (L.) Moennch* vegetative growth and pod characters. The treatments were laid out as factorial arrangement in a Split Randomized Blocked Design, and replicated four times. Four nitrogen doses: N_0; 0, N_1; 119, N_2; 238 and N_3; 357 Kg ha^{-1} and three plant spacing: S_1; 30, S_2; 40 and S_3; 50 cm plant apart, were examined. The analyses of variance reflected that the growth parameters significantly increased with increased plant spacing, while pod attributes were not affected except pod dry weight, which is weighty in middle plant spacing. Increasing nitrogen fertilizer increased plant fresh and dry weight, while decreasing nitrogen increased plant and pod dry weight and pod dry matter, moreover the middle dose of nitrogen gave the heavies pod fresh weight, while pod length and girth were not affected. The combination between higher dose of nitrogen and plant spacing donates the heaviest plant fresh and dry weight, while the higher plant dry matter is presented by the lower dose of nitrogen with higher plant spacing, which also increased plant dry weight. Overall plant spacing, the minimum fertilizer dose maximized plant dry matter, while this dose with both narrowest plant spacing gave the heaviest pod dry weight and widest pod girth, pod girth is also the biggest with the narrowest plant spacing having no fertilizer. Lowering plant spacing received nitrogen in a middle amount increased pod length. It could be concluded that optimum green pod quality of pod fresh weight may be considered with interaction effects of higher density with middle dose of nitrogen. The lower and middle densities with minimum dose of nitrogen may be considered optimal for the heaviest pod dry weight and widest pod girth. Regardless of plant density, the lower dose of nitrogen is optimal for the pod dry matter.

Keywords Abelmoschus Esculentus, Okra, Nitrogen Spacing, Vegetative Growth, Pod Character

1. Introduction

Okra *Abelmoschus esculentus (L.) Moench*. is a member of the family Malvaceae. In Sudan, it is grown almost all over the country and around the year except the cold periods in winter under both irrigation and rains. The annual average area is fifty to sixty thousands hectares [1]. The growing season (March – June) can be devoted mainly for fresh production due to the high returns obtained during this period and to avoid rain damage of mature pods [2]. To get good quality green fruit, okra is required to be sown at optimum plant spacing [3]. They mentioned that the optimum number of plant per unit area is required to utilize efficiently the available production factors such as water,

nutrients, light and CO_2. Most plants require nitrogen for normal growth and production, yet very few soils contain enough native nitrogen to sustain high yields in most crops [2]. Appropriate plant spacing can lead to optimum fruit yield whereas too high or low plant spacing could result in relatively low yields and quality [8]. Birbal *et al.,* [3] observed that the tallest plant under closer spacing and the highest pod weight were found at wider spacing. Sudan as one of the origin of Okra, is very rich by many types of this vegetable plant, but the production often suffers a setback due to unavailability of high yielding good quality seeds in the market. As the seed is very important input on which ultimately the growth and yield of the crop depends, recently their introducing of new cultivars, further, to obtain the strongest growth of better yield quality, the proper growth of the plant and its fruits is desired. This can be achieved to great extent by the use of optimum plant spacing and nitrogen levels. The objective of this study is to determine the optimal nitrogen fertilizer dose and better distance for Okra plant Cv. Al Hindi to and their reflection in growth and pod characters.

2. Materials and Methods

2.1. Location, Soil and Climate of the Experiment

A field experiment was carried out in 20 September 2021, to the end of the year, at the Faculty of Agriculture and Natural Resources, University of Kassala, Sudan. Longitude 35^{o} – 36′ E, Latitude 15^{o}- 18′ N and altitude 450 meters asl. The soil is heavy clay, presents a dark brown surface, and covers the larger part, 75% of the irrigable area of New Halfa Agricultural Scheme. Its content of a clay with percentage around 69% and pH in the range of 4.8 to 8.8. The climate of this area is semi-arid with a summer season of mean daily temperature of 23 °C and winter season of mean daily temperature of 15.7 °C. The hottest month is June and the coldest month is January, while the rainy season is during June to September [4].

2.2. Treatments and Experimental Design

Three seeds were sown and immediately irrigated. After twenty days from sowing, the plants thin to two plants per hole and the second irrigation gets place. The third and fourth watering applied with an interval of ten days each one. The late three supplying of water was preceded by the soil movement to control weeds. The watering continued after that according to plant needs. The treatments consisting of four doses of nitrogen referred to as; N_0; 0, N_1; 119, N_2; 238 and N_3; 357 Kg ha^{-1}, used as main plot, and three plant spaces as; S_1; 30, S_2; 40, and S_3; 50 cm plant apart, used as sub plot. As equal amount of 119 Kg ha^{-1}, nitrogen fertilizer added before twenty days from sowing and the two other doses applied with interval of teen days. The experiment was laid out in Split Randomized Complete Blocked Design (SRCBD), with Four times, an experimental unit of four meters in length and width, containing four rows of three meters and half in length, with seventy cm apart.

2.3. Measurements and Data Analyses

Six plants were randomly selected and up rooted after sixty days from sowing, to evaluate the vegetative growth of plant fresh weight, plant dry weight and plant dry matter were measured, and ten plants were used to measure assess the pod fresh and dry weight, pod length and girth an d pod dry matter. The data were statistically analyzed using computer software program (MSTAT-C). The means were compared using Least Significant Difference (LSD) to test the level of significance, at probability of ≤ 0.05.

3. Results and Discussion

3.1. Effect of Nitrogen Fertilizer and Plant Spacing on Plant Fresh and Dry Weight and Plant Dry Matter

As in Table 1, the gradual increase in nitrogen fertilizer, gradually increased the plant fresh and dry weight. Despite, the lower dose of nitrogen decreased the plant fresh and dry weight, and significantly maximized the percentage of the plant dry matter. There was a markedly increase with the increasing distance between the plants. The wider plant space significantly provides the heaviest fresh and dry weight of the plant and higher accumulation of the plant dry matter percentage compared by the two narrow distances, which were statistically similar. The significance effect of the interaction between higher dose of nitrogen and wider plant spacing appeared in the higher value of the plant fresh weight, in addition to the plant dry weight, which is at par with the two wider distances and receives no fertilizer and lower dose of nitrogen. The feathery fresh weight of the plant is given by the application of minimum amount of nitrogen in the smaller plant spacing, while the corky dry weight of the plant appearing by both middles plant spacing received no fertilizer and lower dose of nitrogen. The plant dry matter percentage increased by the wider plant distances received lower dose of nitrogen, and declined with both, wider spacing received no fertilizer and the narrowest distance between plants is treated by the lower dose of nitrogen. The existent result is shoring by the result of Parmar et al., [5], who mentioned that the nitrogen influenced all growth attributes significantly and it increased gradually with increasing levels of nitrogen. The spacing allowed to individual plant is one of the most important factors which control their development and yield. Appropriate plant density can lead to optimum vegetative growth,

the lowest values recorded in this study could probably be due to loss of plant nutrients as a result of competition. This result is confirmed by the findings of the authors [9] who recorded maximum values at the widely spaced plant and minimum values in the narrowly spaced plants and the researchers [6] they found that the high plant population significantly reduced dry matter of plant fraction.

Table 1. Effect of nitrogen fertilizer and plant Spacing on plant fresh and dry weight and plant dry matter

Attribute / Treatment		Plant fresh weight (gm)	Plant dry weight (gm)	Plant dry matter (%)
N_0		202.8^{c}	46.61^{b}	23.06^{b}
N_1		187.2^{d}	46.19^{b}	24.63^{a}
N_2		211.5^{b}	46.89^{b}	22.26^{b}
N_3		221.9^{a}	49.87^{a}	22.49^{b}
LSD		8.669	2.12	1.41
S_1		197.7^{b}	44.64^{b}	22.75^{b}
S_2		204.8^{b}	44.77^{b}	21.94^{b}
S_3		215.1^{a}	52.77^{a}	24.65^{a}
LSD		7.507	1.83	1.22
N_0	S_1	191.7^{fg}	45.83^{bc}	23.94^{bc}
N_0	S_2	199.7^{efg}	41.08^{d}	20.85^{de}
N_0	S_3	216.9^{bcd}	52.92^{a}	24.41^{b}
N_1	S_1	176.4^{h}	42.92^{cd}	24.34^{b}
N_1	S_2	189.4^{gh}	41.08^{d}	21.71^{cde}
N_1	S_3	195.8^{efg}	54.68^{a}	27.84^{a}
N_2	S_1	220.3^{bc}	43.75^{cd}	19.93^{e}
N_2	S_2	206.1^{cdf}	47.75^{b}	23.23^{bcd}
N_2	S_3	208.2^{cde}	49.17^{b}	23.62^{bc}
N_3	S_1	202.5^{deg}	46.04^{bc}	22.77^{bcd}
N_3	S_2	224.0^{b}	49.17^{b}	21.98^{bcde}
N_3	S_3	239.4^{a}	54.42^{a}	22.72^{bcd}
LSD		15.01	3.67	2.44
CV%		5.00	5.30	7.24

Differences between means as indicated by the same letters for the different treatments are not statistically significant at probability ≤ 0.05.

The treatments N_0; N_1; N_2; N_3 indicated to the different levels of nitrogen, while the treatments S_1; S_2; S_3 indicated to the different plant spacing.

Table 2. Effect of nitrogen fertilizer and plant Spacing on pod fresh and dry weight and pod length and girth and pod dry matter

Attribute / Treatment		Pod fresh weight (gm)	Pod dry weight (gm)	Pod Length (cm)	Pod girth (cm)	Pod dry matter (%)
N_0		5.24b	0.45b	6.95a	8.63a	1.23b
N_1		5.52ab	0.48a	7.18a	8.81a	1.27a
N_2		5.59a	0.45b	7.02a	8.21a	1.24b
N_3		5.33ab	0.46ab	6.97a	8.67a	1.23b
LSD		0.3127	0.027	0.3164	0.612	0.0266
S_1		5.42a	0.45b	6.95a	8.68a	1.24a
S_2		5.41a	0.48a	7.18a	8.56a	1.24a
S_3		5.43a	0.45b	7.02a	8.50a	1.24a
LSD		0.2721	0.023	0.2740	0.531	0.023
N_0	S_1	5.30bc	0.47ab	7.07ab	8.86a	1.22b
N_0	S_2	5.32abc	0.44b	7.07ab	8.35ab	1.24ab
N_0	S_3	5.11c	0.44b	6.72b	8.68ab	1.24ab
N_1	S_1	5.38abc	0.49a	7.07ab	9.08a	1.27a
N_1	S_2	5.52abc	0.49a	7.05ab	8.89a	1.27a
N_1	S_3	5.66ab	0.47ab	7.41a	8.47ab	1.27a
N_2	S_1	5.84a	0.44ab	7.25ab	7.63b	1.24ab
N_2	S_2	5.48abc	0.45ab	6.82b	8.34ab	1.23ab
N_2	S_3	5.44abc	0.46ab	7.00ab	8.66ab	1.25ab
N_3	S_1	5.16bc	0.47ab	6.795b	9.14a	1.24ab
N_3	S_2	5.3abc	0.46ab	6.98ab	8.67ab	1.24ab
N_3	S_3	5.50abc	0.45ab	7.14ab	8.20ab	1.23ab
LSD		0.5441	0.046	0.5480	1.06	0.0462
CV%		6.88	8.26	5.33	8.46	2.19

Differences between means as indicated by the same letters for the different treatments are not statistically significant at probability ≤ 0.05.

The treatments N_0; N_1; N_2; N_3 indicated to the different levels of nitrogen, while the treatments S_1; S_2; S_3 indicated to the different plant spacing.

3.2. Effect of Nitrogen Fertilizer and Plant Spacing on Pod Fresh and Dry Weight and Pod Length and Girth and Pod Matter

Pod characters revealed no significance difference due to the plant spacing except pod dry weight, whereas the heaviest dry pod is presented by the middle spacing, and a significance differences was noticed among nitrogen fertilizers (except pod length and girth) and the interaction (Table 2). The temperance dose of nitrogen increases pod fresh weight, while the lower amount increases pod dry weight and pod matter. The slight weight of the fresh pod appears by control, while the slight pod dry weight and dry matter present by control and the virtues dose of nitrogen. Pod dry matter was also sparse with higher dose of nitrogen. The interaction between the middle dose of nitrogen and the narrowest plant spacing gave the heaviest pod fresh weight, while between control and wider distance donated the minimum fresh weight. The two lower plant spacing received the lower dose of nitrogen positively increased pod dry weight compared with the other treatments and significantly compared with two higher distances received no fertilizer. The increase in pod length is related with minimum nitrogen amount received by the lower plant density, while the shortest pod length distributed between the treatments of lower plant density received no fertilizer, the both middle plant spacing and middle dose of nitrogen in addition to lower plant spacing treated with higher dose of nitrogen. The widest pod girth presented by the narrowest plant spacing is treated by the higher dose of nitrogen, this treatment is statically similar with the other treatments, and has a significant increase compared with lower plant spacing received nitrogen in a middle dose. The higher pod dry matter given by the different plant spacing treated with lower dose of nitrogen, while the minimum content of the pod matter shown by narrowest plant spacing received no fertilizer. Despite that the many researchers reported significance differences on some pod

attributes due to the spacing (except pod dry weight), and nitrogen (especially pod length and girth), however this result is in contrary, and this may be due to the hybrid, which produces uniform pods. A similar results is noticed by Parmar et al., [5], their results revealed that spacing remained no significant on yield attributes i.e. pod length, pod girth and test weight. The result of Amanga et al., [7] indicated that, plant population and nitrogen rate had a significant influence on growth and yield components of okra. Maximum pod length dry pod was obtained from the interaction of spacing sixty cm × forty cm and at minimum amount of nitrogen. The interaction effect between spacing and nitrogen levels was found significant with respect to yield attributes. The temperance treatment of nitrogen resulted in a good quality of pod parameters [10].

4. Conclusions

On the basis of both individuals of higher dose of nitrogen fertilizer, higher plant spacing and their combined effects may be considered better for vigorousness vegetative growth, which is reflected in plant fresh and dry weight and dry matter, while both individuals of lower and middle doses of nitrogen, may be considered a preferable for pod dry and fresh weight, respectively. Moreover the middle plant spacing is a best for pod dry weight. The unique characters of pod fresh weight may be considered with interaction effects of middle dose of nitrogen applied in higher plant density, while the higher both densities that received the minimum dose of nitrogen may be considered optimal for the heaviest pod dry weight and widest girth, in addition to the accumulation of pod dry matter.

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REFERENCES

[1] N. M Abd-El Rahman,. and M. O Warrag,. Effect of Sowing Date and Nitrogen Fertilizer on Vegetative and Reproductive Growth of Okra (Abelmoschus esculentus (L.) Meonch.). M.Sc. Thesis, Sudan University of Science and Technology College of Graduate Studies. 2012.

[2] Z Elhag,. and A. A. Ahmed. Effect of Cultivar and Sowing Date on Okra (Abelmoschus Esculentus L. Moench.) Seed Yield. Universal Journal of Applied Science 2(3): 64-67, 2014. http://www.hrpub.org DOI: 10.13189/ujas.2014.020302

[3] K Birbal Nehra,. and Y Malik,. SEffect of spacing and nitrogen on fruit yield of okra (Abelmoschus esculentus L.) cv. Varsha Uphar. Haryana Agri J Res 25: 47-51. 1995.

[4] M. H. H. Alsofi Ali Z. A. Effect of bradyrizobium races and verities of groundnut (Arachis hypogaea L.) on growth and yield in two soil types in New Halfa and Kassala area. M. Sc. thesis (Agric), 2014, Uni, Kassala, Sudan.

[5] P.N, Parmar., A.S. Bhanvadia, M.M. Chaudhary, and A.P. Patel. Effect of Spacing and Levels of Nitrogen on Growth and Seed Yield of Okra (Abelmoschus esculentus L. Moench) During Kharif Season. Journal of Pure and Applied Microbiology, Vol. 10, No 1. 2016.

[6] A., Agba,, B. N., J. E. MbahAsiegbu, and I. B. Adinya,. Effects of spacing on the growth and yield of okra (Abelmochus esculentus L. Moench) in obubra, cross river state. Global journal of agricultural sciences, Vol 10, No. 1, 2011: 57-61. Issn 1596-2903. www.globaljournalseries.com

[7] B., Amanga, G Fikreyohannes,. and D Nigussie,. Effect of plant population and nitrogen rates on growth and yield of okra [Abelmoscus esculentus (L). Moench] in Gambella region, Western Ethiopia. Gambella Agricultural Technical and Vocational and Education Training College, Gambela, Ethiopia. School of Plant Sciences College of Agriculture and Environmental Sciences, Haramaya University, Ethiopia. African Journal of Agricultural Researc. Vol. 12(16), pp. 1395-1403, 20 April, 2017. DOI: 10.5897/AJAR2016.11856. ISSN 1991-637X. http://www.academicjournals.org/AJAR

[8] M., Amjad, M., Sultan, M. A. Anjum, and C. M. Ayyub, Response of okra (Abelmoschus esculentus L. Moench.) to various doses of N & P and different plant spacings. Pakistan J. Res.(Sci.); 13(1): 1929. 2002.

[9] R.P. Maurya., J.A.Bailey and, J.S.A., Chandler. Impact of plant spacing and picking interval on the growth, fruit quality and yield of Okra. American Journal of Agriculture and forestry 1 (4), 48-54. 2013.

[10] J. C. Jana, S. Guha and R. Chatterjee. Effect of planting geometry and nitrogen levels on crop growth, fruit yield and quality in okra grown during early winter in terai zone of West Bengal. J. Hortl. Sci. Vol. 5 (1): 30-33, 2010.