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Effect of Variety and Plant Density on Growth and Yield of Okra (*Abelmoschus Esculentus* (L.) Moench)

Aliyu, U.[1], Ajala, A. A[1].
[1]*Department of Crop Science, Usmanu Danfodiyo University, Sokoto,Nigeria*

Abstract: *Field trials were conducted at the Fruit and Vegetable Teaching and Research Farm, Usmanu Danfodiyo University, Sokoto during the 2013 and 2014 raining seasons, to study the effects of variety and plant population density (in terms of intra-row spacing) on the growth and yield of okra (Abelmoschus esculentus (L.) Moench). The treatments consisted of three plant population densities, 50,000 plants per ha, 66,666 plants per ha and 100,000 plants per ha by varying the intra row spacing at 40cm, 30cm and 20cm respectively and two varieties of okra, namely Dogo(Local variety) and Clemson spineless (improved variety) which were laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The results obtained revealed that variety had significant influence on the growth and yield of okra. Dogo variety was higher in terms of plant height at 5 and 8 weeks after planting whereas Clemson spineless variety was higher in terms of number of branches per plant at 2 and 8 weeks after planting, pod weight, pod length, number of pods per plant and pod yield per hectare. Intra-row spacing of 40cm recorded more number of branches per plant at 5 weeks after planting. It also had heavier pod weight and more number of pods. Intra-row spacing of 20cm had the highest pod yield per hectare but recorded the lowest values in other parameters assessed. Significant interaction effect was observed between variety and intra-row spacing in all the parameters measured except for number of pods per plant and pod yield per hectare. From the results obtained, it can be concluded that in Sokoto, Nigeria which falls within the Sudan Savannah agro-ecological zone, Clemson spineless okra variety yields better than Dogo and the optimal intra-row spacing for Clemson spineless and Dogo okra variety in terms for high yield is 20cm. Therefore, Clemson spineless variety could be selected for increased okra production.*
Keywords*: Variety, Population density, Growth, Yield, Okra*

I. Introduction

Okra (*Abelmoschus esculentus* (L.) Moench), is also known as *guro*, *okwuro* and *ila* in Hausa, Igbo and Yoruba languages of Nigeria respectively. It originates from Ethopia in Africa, but now widely grown all over the world (Khalid *et al.*, 2005). It is an important vegetable grown in the tropics and subtropical part of the world (Absar and Siddique, 1982). It is a member of the Malvaceae family which have about 2,300 species of which cotton (*Gossypium spp.*) and cocoa (*Theobroma cacao*) are inclusive.

Okra produces edible seed pods (Laura and Robert, 2006); which are used fresh, canned or dried and ground as powder (Ayoub and Afra, 2014). Rehn and Espig (1991) stated that okra contain 20% edible oil and protein while its mucilage is utilized for medicinal purposes. Industrially, okra mucilage is usually use for glace paper production and also has a confectionery use. Okra has found medical application as a plasma replacement or blood volume expander (Adetuyi *et al.,* 2008). Its consumption helps the body develop immunity against infectious agents, reduces episodes of cold and cough and protects the body from harmful free radicals (DAFF, 2013). Okra seed may be roasted and ground to form a non caffeinated substitute for coffee (Onyishi, 2011).

In Nigeria, the limiting factors in okra production and other vegetables among others include sub-optimal planting density, weed management, tillage practices and low yielding varieties (Adeyemi *et al.*, 2008). The population of Nigeria is increasing daily. According to NPC (2013) the population of Nigeria has risen to 170 million with a growth rate of 3.2% per annum. The need to increase food production in most developing countries is an ultimate goal to meet the expansion of their population (Nosiru *et al.,* 2012). This research work is carried out to identify an ideal variety and plant population density that will give optimum okra yield which will in turn meet the demand of the growing population.

II. Materials And Methods

Field experiments were carried outduring 2013 and 2014 rainy seasons at the Fruit and Vegetable Teaching and Research Farm, Usmanu Danfodiyo University, Sokoto latitude 13° ^{I}N and longitude 5°15^{I} E with an altitude of about 350m above sea level. Sokoto falls under the Sudan Savannah agro ecological zone of North-west Nigeria. The treatments consisted of factorial combination of three plant population densities,(50,000 plants per ha, 66,666 plants per ha and 100,000 plants per ha) by varying the intra row spacing at 40cm, 30cm and 20cm respectively and two varieties of okra, namely *Dogo* variety and Clemson spineless variety laid out in a Randomized Complete Block Design (RCBD) replicated three times. Data were recorded on plant height, number of branches per plant, number of pods per plant, Pod length, pod weight and Pod Yield. The data collected were subjected to analysis of variance (ANOVA) and treatments were compared using Fisher's least significant difference (FLSD).

III. Results And Discussion

Effect Of Variety:

Results revealed significant effect ($P \leq 0.05$) of variety on plant height at 5 and 8 weeks after planting in both years, (Table 1). *Dogo* variety had the highest plant height (13.75cm and 24.18cm) in 2013 season at 5 and 8 weeks after planting respectively. Similar trend was maintained in the 2014 season. The higher values obtained from *Dogo* variety could be due to genetic factor as *Dogo* is a characteristically tall okra variety. These results correspond with the findings of Ojo *et al.,* (2012) that *Dogo* variety produced taller plants than the improved variety, NH 47-4. Clemson spineless had the lowest plant height at both 5 and 8 weeks after planting.

Significant effect ($P \leq 0.05$) of variety was observed as regards to the number of branches produced at 5 and 8 weeks after planting. (Table 2). At 5 weeks after planting, Clemson spineless had the highest number of branches (3.00) while *Dogo* had the lowest branches (2.00). At 8 weeks after planting, Clemson spineless also recorded the highest number of branches (6.00) whereas *Dogo* recorded the lowest number of branches (5.00). The higher number of branches produced by Clemson spineless variety could be because it is an improved variety. These results correspond with the findings of Jamala *et al.* (2011),where they reported lowest number of branches with local okra variety.

Significant effect ($P<0.05$) of variety was observed as regards to pod weight (Table 3). Clemson spineless variety had the highest pod weight (6.21g) and 7.24g in 2013 and 2014 seasons respectively. Whereas *Dogo* recorded the lowest (5.57g) and (5.32g) for 2013 and 2014 rainy seasons respectively. The higher pod weight recorded by Clemson spineless variety could be because it is an improved variety therefore, more efficient in utilization of photosynthetic materials . This result is in accordance with the findings of Ojo *et al.,* (2012), who observed that *Dogo* variety produces lighter pods compared to NH 47-4(an improved variety).

Significant effect ($P \leq 0.05$) as regards to pod length was observed among the varieties in both years (Table 5). Clemson spineless recorded the highest pod length (6.24cm) in2013 and 7.21in 2014. Whereas *Dogo* had the lowest (4.42cm) in 2013 and 5.63 in 2014. The longer pod length obtained from the Clemson spineless variety could be as a result of its improved nature. These results are in agreement with the findings of Jamala *et al.* (2011) in their work with local and improved varieties of okra where they reported that local variety had the shortest pod length.

Significant effect ($P \leq 0.05$) of variety as regard to number of pods per plant was observed (Table 7). Clemson spineless variety had the highest number of pods (16.67) and (16.82) in 2013 and 2014 respectively. Whereas *Dogo* variety produced the lowest number of pods. The higher number of pods obtained from Clemson spineless variety could be because it is an improved variety and improved varieties are more efficient converters of photosynthetic materials into yield. Ojo *et al.* (2012) reported similar trend on the okra varieties they worked with.

Significant effect ($P \leq 0.05$) of variety as regards to pod yield of okra was observed (Table 8). Clemson spineless variety had the highest pod yield (1111.00 kgha^{-1}) in 2013 and 1320 kg ha^{1} in 2014. *Dogo* variety produced the lowest pod yield (925.00 kgha^{-1}). The high pod yield obtained from Clemson spineless variety could be due to its improved nature which gave it the ability to produce more branches consequently more fruits. Ojo *et al.,* (2012) reported similar findings.

Effect of intra-row spacing: There was no significant effect ($P \leq 0.05$) of intra-row spacing on plant height of okra at 2, 5 and 8 weeks after planting (Table 1). This result contradicts the findings of Moniruzzaman *et al.,* (2007) who reported significant effect of intra-row spacing on the height of okra plant. These conflicting results might be due to the differences in the environmental conditions of the study area and to the variation in the genetic potential of the varieties used.

There was no significant effect ($P \leq 0.05$) of intra row spacing as regards to number of branches produced at 2 weeks after planting (Table 2). However, at 5 and 8 weeks after planting, significant effect ($P<0.05$) was observed. At 5 weeks after planting, 40cm intra-row spacing recorded the highest number of branches (6.43) in 2013 and 6.73 in 2014 season. whereas 30cm and 20cm produced statistically similar results as the lowest number of branches in both years. (5.00 and 4.00 respectively). The higher number of branches obtained from 40cm intra-row spacing at 5and 8 weeks after planting could be as a result of less competition between plants since they are relatively not closely spaced. This result agrees with Ijoyah *et al.,* (2010) where they obtained more number of branches per plant with wider spacing. They maintained that, the reduced competition for light and reduced overlapping from adjacent okra plants within the ridge could have enabled the plants grown at wider intra-row spacing to utilize its energy for maximum branching.

Results indicated significant effect (P≤0.05) of intra-row spacing on pod weight of okra (Table 3). Intra-row spacing of 40cm recorded the highest pod weight (6.50g) and 6.78g in 2013 and 2014 seasons respectively. Whereas 20cm and 30cm spacing recorded statistically similar pod weight in both years of experimentation. The higher pod weight obtained from 40cm intra-row spacing could be as a result of less competition between plants since they are relatively widely spaced. These results agreed with the findings of Moniruzzaman *et al.,* (2007); who obtained lighter pods of okra with closer spacing. They maintained that, the reduction of pod weight from closely spaced plants might be due to competition among plants.

There was no significant effect (P≤0.05) as regards to pod length among the intra-row spacing used in 2013 but found to be significant in 2014. The intra-row spacing of 40cm recorded the longest pods (6.5cm) while 20 and 30cm spacing recorded statistically similar results. (Table 5). These results are in agreement with the findings of Moniruzzaman *et al*., (2007) who reported high pod length with wider intra-row spacing.

Significant effect (P≤0.05) of intra-row spacing as regards to number of pods was observed (Table 7). 40cm intra-row spacing had the highest pod number (17.50) whereas 20cm spacing had the lowest pod number (13.33). 30cm spacing recorded 15.00 pods which is statistically similar to what was obtained with 20cm intra-row spacing. The higher number of pods per plant obtained from 40cm intra-row spacing could be as a result of less competition since they are relatively widely spaced. These results agreed with the findings of Moniruzzaman *et al.,* (2007) who reported lower number of mature pods with closer spacing. They maintained that the lower number of pods obtained from the closer spacing might be due to competition for nutrients and space among the plants owing to high plant population. Ijoyah *et al.* (2010) also obtained a similar results.

Significant effect (P≤0.05) of intra-row spacing as regard to pod yield was observed (Table 8). Intra-row spacing of 20cm had the highest pod yield (14.33 $kgha^{-1}$) whereas 40cm spacing had the lowest pod yield (875.00 $kgha^{-1}$).The higher pod yield obtained with 20cm intra-row spacing was as a result of more number of plants per unit area. These results agrees with the findings of Moniruzzaman *et al.,* (2007)who obtained high pod yield per hectare with closer spacing.

Effect of interaction: Significant interaction effect (P≤0.05) between variety and intra-row spacing was observed as regards to pod weight (Table 4). The highest value was obtained when Clemson spineless variety was planted using 40cm intra-row spacing. Whereas 30cm and 20cm spacing which were both statistically similar gave the lowest pod weight (6.00g and 5.83g respectively). The highest pod weight obtained by Clemson spineless variety at 40cm intra-row spacing could because it is an improved variety planted at a wider spacing, causing minimum competition. These results agrees with the findings of Ijoyah *et al.,* (2010) as the two varieties they worked on have their highest weights with wide spacing. They stated that plants grown at wider intra-row spacing might have received more nutrition and light for optimal growth and development thereby producing the highest pod weights.

Significant interaction effect (P≤0.05) between variety and intra-row spacing was observed on the pod length (Table 6). Clemson spineless produced the highest pod length at 40cm and 30cm intra-row spacing (6.57cm and 6.43cm respectively) whereas 20cm spacing gave the lowest pod length (5.73cm). The longer pods obtained from Clemson spineless variety at 40cm intra-row spacing could be due to wider spacing hence, minimum competition for space, nutrients and water.

IV. Conclusion

From the results obtained, it may be concluded that, Clemson spineless okra variety could be selected using an intra-row spacing of 20cm for increased okra production in Sokoto, Nigeria.

References

[1]. Absar, N. and Siddique, M. A. (1982). Influence of plant density on the yield of three varieties of Okra. Bangladesh Journal of Ageiculture. 7 (3-4): 15-21.

[2]. Adetuyi, F. O., Osagie A. U., Adekunle, A. T. (2008): Effect of Postharvest Storage Techniques on the Nutritional Properties of Benin Indigenous Okra (Abelmoschus esculentus (L) Moench). Pakistan Journal of Nutrtion. 7: 652-657.

[3]. Adeyemi, O. R., Smith, M. A. K. and Ojeniyi, S. O. (2008). Effect of Land Preparation Techniques on Weed Control Effectiveness in Okra (Abelmoschus esculentus (L.) Moench). Nigeria Journal of Weed Science 21: 72-83.

[4]. Ayoub, Z. E. and Afra, A. A. (2014). Effect of cultivar and sowing date on okra (Abelmoschus esculentus (L) Moench) seed yield: Universal Journal of Applied Science 2(3): 64-67.

[5]. DAFF (Department of Agriculture, Forestry and Fisheries), Republic of South Africa (2013). Okra (Hibiscus esculentus). Directorate Commission and Service pp 2-5.

[6]. Ijoyah, M. O., Unah, P. O and Fanen, F. T. (2010). Response of Okra (Abelmoschus esculentus (L.) Moench) to intra-row spacing in Makurdi, Nigeria. Agricultural and Biology Journal of North America 1 (6): 1328-1332.

[7]. Jamala, G. Y., Boni, P. G., Abraham, P. and Musa, A. M. (2011). Soil status and yield response of different varieties of okra (Abelmoschus esculentus (L.) Moench) grown at Mubi Floodplain, North Eastern Nigeria. Journal of Agricultural Biotechnology and Sustainable Development 3(7): 120-125.

[8]. Khalid, U., Ahmed, E. and Muhammad, U. K. (2005). Integrated weed management in okra. Pakistan Weed Science Journal 11 (1 and 2): 55-60.

[9]. Laura, W. R. and Robert, P. R. Jr. (2006). Practical Horticulture, 6th Edition. California Polytechnic State University pp. 26, 141.

[10]. Moniruzzaman, M., Uddin, M. Z. and Choudhury, A. K. (2007). Response of okra to sowing time and plant spacing in Southern Eastern Hilly Region of Bangladesh. Bangladesh Journal of Agricultural Resources. 32 (3): 393-402.
[11]. Nosiru, M. O., Banjo, J. O. S. and Adedeji, (2012). Determinant of Improved Productivity of Okra (Abelmoschus esculentus (L.) Moench) by Farmers in Lowland Areas of Ogun State, Nigeria. American-Eurasian Journal of Agriculture and Environment Science.
[12]. NPC National Population Commission (2013). National Population Census Nigeria. 2013 Bulletin. 1 pp.
[13]. Ojo, G. O. S., Richard, B. I. and Jorlamen, T. (2012). Evaluation of Okra (Abelmoschus esculentus (L.) Moench) cultivar for dry season ecology of Nigeria. International Journal of Agronomy and Agricultural Research pp 13-18.
[14]. Onyishi, G. C. (2011). Growth and Yield of okra (Abelmoschus esculentus (L.) Moench) to different nutrient sources in ultisols of South-Eastern Nigeria. The Nigeria Agricultural Journal 42: 330-333.
[15]. Rehn, S. and Epsig, G. (1991). The cultivated plants of the tropics and subtropics (TAI) Germany 552 pp.

Table 1: Plant height of okra as influenced by variety and intra-row spacing at 5 and 8 weeks after planting (WAP) during 2013and 2014 rainy seasons at Sokoto.

Treatments	**Plant Height (cm)**			
Variety	**5 WAP**		**8 WAP**	
	2013	**2014**	**2013**	**2014**
Dogo	13.75 ^{a}	12.45^{a}	24.17 ^{a}	25.34^{a}
Clemson spineless	10.61^{b}	10.54^{b}	22.16^{b}	21.76^{b}
SE±	0.26	0.31	0.333	0.754
Significance	*	*	*	*
Intra-row spacing (cm)				
20	11.90	12.54^{b}	22.48	24.13^{b}
30	12.03	13.78^{a}	23.23	26.65^{a}
40	12.56	13.89^{a}	23.80	26.76^{a}
SE±	0.258	0.113	0.567	0.473
Significance	Ns	*	ns	*
Interaction	*	ns	*	Ns

Within a treatment group, means in a column followed by the same letter(s) are not significantly different using Fisher's LSD at 5% level of probability. ns = not significant, * = significant.

Table 2: Number of branches of okra plant as influenced by variety and intra-row spacing at 5 and 8 weeks after planting (WAP) during 2013 rainy season at Sokoto.

Treatments	**Number of Branches**			
Variety	**5 WAP**		**8 WAP**	
	2013	**2014**	**2013**	**2014**
Dogo	4.30^{b}	4.82^{b}	5.10^{b}	5.43^{b}
Clemson spineless	5.99^{a}	5.83^{a}	6.00^{a}	6.72^{a}
SE±	0.171	0.134	0.139	0.173
Significance	*	*	*	*
Intra-row spacing(cm)				
20	4.00^{b}	5.12^{b}	4.32^{c}	5.62^{c}
30	5.00^{b}	5.65^{b}	5.41^{b}	6.66^{b}
40	6.00^{a}	6.43^{a}	6.67^{a}	7.45^{a}
SE±	0.195	0.832	0.192	0.132
Significance	*	*	*	*
Interaction	*	ns	*	ns

Within a treatment group, means in a column followed by the same letter(s) are not significantly different using Fisher's LSD at 5% level of probability. NS = not significant*, * = significant.

Table 3. Yield and yield Characteristics of Okra as influenced by variety and intra-row spacing during 2013 dry season at Sokoto.

Treatments	**Pod weight (g)**		**Pod length (cm)**		**Number of pods per plant**		**Pod Yield (kgha^{-1})**	
Variety	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**
		5.32^{b}		5.63^{b}		15.66^{b}		1110^{b}
Dogo	5.56 ^{b}		4.42 ^{b}		13.88^{b}		925.00^{b}	
Clemson Spineless	6.21 ^{a}	7.24^{a}	6.24 ^{a}	7.21a	16.66^{a}	18.82^{a}	1111.00^{a}	1320^{a}
SE±	0.197	0.232	0.192	0.311	1.111	1.212	1.11	**1.212**
Significance	*	*	*	*	*	*	*	*
Intra-row spacing (cm)								
20	5.400 ^{b}	5.53^{c}	4.750	4.93^{b}	13.333^{b}	14.31^{c}	1333.00^{a}	1433a
30	5.767 ^{b}	6.23^{b}	5.450	5.32^{b}	15.000^{ab}	15.62^{b}	1000.00^{ab}	1243b
40	6.500 ^{a}	6.78^{a}	5.800	6.45^{a}	17.500^{a}	17.45^{a}	875.00^{b}	1010c
SE±	0.203	0.242	0.431	0.378	1.351	1.122	1.51	2.362
Significance	*	*	ns	*	*	*	*	*
Interaction	*	*	*	ns	ns	ns	ns	ns

Within a treatment group, means in a column followed by the same letter(s) are not significantly different using Fisher's LSD at 5% level of probability. NS = not significant, * = significant.

Table 4: Interaction between variety and intra-row spacing on Pod weight(g)of okra plant during 2013 rainy season at Sokoto.

Variety	20	Intra-row spacing 30	40
Dogo	4.967 [c]	5.533 [c]	6.200 [b]
Clemson spineless	5.833 [b]	6.000 [b]	6.800 [a]
SE±		0.183	

Within a treatment group, means in a column followed by the same letter(s) are not significantly different using Fisher's LSD at 5% level of probability.

Table 5: Pod length (cm) of okra plant as influenced by interaction between variety and intra-row spacing in 2013 rainy season at Sokoto.

Variety	20	Intra-row spacing 30	40
Dogo	3.767 [d]	4.467 [c]	5.033 [c]
Clemson spineless	5.733 [b]	6.433 [a]	6.567 [a]
SE±		0.207	

Within a treatment group, means in a column followed by the same letter(s) in superscript are not significantly different using Fisher's LSD at 5% level of probability.