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Effects of Planting Spacing and Harvest Intervals on Growth, Yield and Quality of Okra (*Abelmoschus esculentus* (L) Moench)

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ABSTRACT

Field experiment was carried out in (April - July, 2015) to assess the response of planting spacing and harvest intervals on growth, yield and proximate composition of okra at the Teaching and Research Farm of the Faculty of Agriculture, University of Benin, Benin City, Nigeria. The experiment was laid out in a 4×3 factorial experiment in a randomized complete block design and replicated three times. The treatments consisted of four planting spacing, 40 cm x 30 cm, 50 cm x 30 cm, 60 cm x 30 cm and 70 cm x 30 cm) and three harvest intervals of (1 day, 2 days and 3days). Data were collected on growth and reproductive parameters as well as on fruit proximate compositions. The results obtained showed that plant height and leaf area were not significantly affected by planting spacing and harvest intervals. However, number of leaves and stem diameter per plant were significantly ($p < 0.05$) affected by planting spacing and ranged from 7.10 - 9.74 and 0.36 cm - 0.60 cm respectively, with the planting spacing of 70 cm × 30 cm producing the lowest number of leaves (7.10) and stem diameter (0.36 cm). There was a significant interaction of plant spacing and harvest frequency on leaf area. The pod length, pod diameter, pod weight and number of pods of okra were significantly ($p < 0.05$) affected by plant spacing. The spacing of 40 cm × 30 cm gave the highest pod yield (0.58 t/ha) while a further increase in spacing to 70 cm × 30 cm resulted in a decrease in pod yield (0.20 t/ha) of okra. Two days' harvest interval produced the maximum value for pod weight per plant (8.57 g), number of pods (1.61) and pod yield (0.54 t/ha), while the lowest pod yields of 0.35 t/ha and 0.33 t/ha were recorded for 1 and 2 days harvest intervals respectively. The proximate composition (g/100 g) in dry weight basis of moisture content, ash content and crude fibre did not follow a particular trend with the different spacing studied. However, 2 days harvest interval favoured most of the proximate composition of okra fruits.

Keywords: Spacing, pod diameter, harvest intervals, yield, okra

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is a popular vegetable which is cultivated in the tropical and sub tropical regions of the world (Baloch, 1994). Okra belongs to the Malvaceae family (Ahmed, 1995). The species is a nutritious vegetable that plays an important role in meeting the demand for vegetables in many tropical countries. Industrially, okra mucilage is usually used in glaring certain papers and also useful in confectionaries among other uses (Markose and Peter, 1990). Okra's medicinal value has also been reported in curing ulcers and relief of haemorrhoids. Okra is useful against chronic dysentery and genito-urinary disorders (Hilou, *et al.,* 2006). Leaves are sometimes used as poultices (Maurya *et al*., 2013). Several reasons are responsible for low yield per hectare of okra, among which are planting spacing and fruit harvest intervals. It has been observed that suitable planting spacing can lead to optimum okra fruit yield while wrong planting spacing could result in relatively low yield and poor quality fruits (Maurya *et al*., 2013). Harvest interval is also an important index in crop yield as well as vegetative growth (e.g okra) as it is indeterminate intra-row spacing play an important role (Yadev and Dhankhar, 2005). Hossain *et al*., (2001) recommended that intra-row spacing for optimal okra fruit yield ranged from 20 cm to 40cm. Harvest interval can also influence the yield of okra since it is a quick growing crop (Talukder *et al*., 2003). Earlier harvests depress yield because of low fruit weight, but delayed harvesting depresses marketable yield because over-aged fruits become fibrous.

Talukder *et al*., (2003) observed that okra yield was gradually decreased with increasing harvest interval and the highest pod yield was obtained at two days harvest interval. This variation arises because short harvest interval encouraged the plants to produce higher number of fruits per plant and long harvest interval increased the fruit size and weight, which in turn produced highest fruit yield per plant as well as per hectare (Talukder *et al*., 2003). Proximate and nutrient analysis of edible fruits and vegetables plays a crucial role in assessing their nutritional significance (Pandey *et al*., 2006). The green fruits are rich and affordable sources of vitamins, calcium, potassium, and other minerals (Lee *et al*., 2000). Okra contains carbohydrate, protein and vitamin C in large quantities

(Adeboye and Oputa, 1996), and dietary fiber (Habtamu *et al*., 2014). Therefore, promoting the consumption of Okra pods could provide cheap sources of nutrients that can improve the nutritional status and reducing malnutrition especially among resource-constrained households and can also be used as a means of dietary diversification. Suitable planting spacing and harvest interval can lead to optimum okra fruit yield while wrong planting spacing could result in relatively low yield and poor quality fruits (Maurya *et al*., 2013). Therefore, this study is aimed at investigating the effects of planting spacing and harvest intervals on the growth, yield and quality of okra.

MATERIALS AND METHODS

The experiment was carried out during the rainy season of (April - July, 2015) at the Teaching and Research Farm, of the Department of Crop Science, University of Benin, Nigeria. Benin City is located between Latitude ($5^0$45'N and $7^0$34'N) and Longitude (5^0 04' and 6^0 43'E) on elevation of 162 m above sea level. Climatic data (January-July, 2015) at the Nigerian institute for oil palm research (NIFOR), Benin City indicated an average monthly rainfall of 142mm and sunshine of 4.3hours for the duration of the study (Table 1).

The rainy season in the study area occurs between March and October with peak rainfall in the month of July. Seeds of the early-maturing okra cultivar (V35) were acquired from the Agricultural development programme (ADP), Benin zonal office, Edo State. Inorganic fertilizer (NPK 15-15-15) was obtained from the Department of Crop Science, University of Benin, Benin City, Edo state. The experiment was laid out in a 3 x 4 factorial experiment in a randomized complete block design (RCBD) and replicated three times. The different planting spacing were S_1 (40 cm x 30 cm), with plant density of 83,333 plants/ha, S_2 (50 cm x 30 cm), with plant density of 66,667 plants/ha, S_3 (60 cm x 30 cm) with plant density of 55,000 plants/ha and S_4 (70 cm x 30cm), with plant density of 48,333 plants/ha. The different harvest intervals were H_1 (1-day harvest interval), H_2 (2-days harvest interval) and H_3 (3-days harvest interval). Weeding commenced at two weeks after seed sowing (WAS) and subsequent weeding was carried out as soon as weeds emerged. Grasshoppers were hand-picked when necessary. Data collection on vegetative character started 2 - 8 WAS on four randomly selected and tagged plants. The parameters measured were; plant height (cm), Number of leaves, stem collar diameter (cm) and Leaf area (cm^2) Leaf area was estimated through the measurement of the midrib length of the leaf and fitted into equation for Okra leaf area thus:

$$Y = 135.47 + 22.06 (X) \text{ (Asif, 1977)}$$

Where y = leaf area (cm^2); X = midrib length.

The reproductive parameters data that were collected were: number of pods, pod length (cm), pod diameter (cm) and fresh pod weight (g). Fresh okra pods were collected and coded depending on the treatments and were taken to the laboratory. In the laboratory, the Okra pod samples were washed by distilled water and sliced to uniform thickness 5 mm using a stainless steel knife. The moisture content of each Okra pod was determined immediate after sliced to uniform thickness. The sliced Okra Pod were sun dried, followed by oven drying at 45°C. The dried Okra pod samples were milled separately into fine powder using electric grinder until to pass through 0.425 mm sieve mesh size, and finally packed into airtight polyethylene plastic bags to minimize heat build-up and stored in the desiccator until required for analysis.

Moisture content, total ash, crude protein, crude fiber, and crude fat of the Okra pod were determined according to AOAC, (2000) using sub components 925.09, 923.03, 979.09, 962.09, and 920.39, respectively. Data were subjected to analysis of variance (ANOVA) using SAS (Statistical Analysis Software) program. Least Significant Difference (LSD) test at 5% level of probability was used to separate the treatment means that differs significantly.

RESULTS

The effect of planting spacing and harvest interval on plant height was not significant (Table 2). However, number of leaves was significantly affected by planting spacing. For example, S_2 (50 cm x 30 cm) and S_3 (60 cm x 30 cm) produced the significantly highest number of leaves (9.57) and (9.74) respectively while S_4 (70 cm x 30 cm) produced the significantly lowest number of leaves (7.10). Harvest interval had no significant effect on number of leaves (Table 2).

Table 1: Meteorological data of experimental site (January – July) 2015

Month	Rainfall (mm)	Relative Humidity (%)		Sunshine (hr)
		0900	1500	
January	17.8	80.7	74.4	5.2
February	38.2	82.7	58.0	5.3
March	135.1	82.5	61.2	4.4
April	38.7	80.9	63.8	4.7
May	157.4	81.0	69.4	5.2
June	320.0	85.0	80.1	3.0
July	289.7	87.3	84.3	2.1

Table 2: Effect of spacing and harvest intervals on growth components of okra

Treatments	Plant height(cm)	Number of leaves	Stem diameter (cm)	Leaf area (cm^2)
Plant spacing				
S_1 (40cm x 30cm)	22.19[a]	9.04[ab]	0.60[a]	384.28[a]
S_2 (50cm x 30cm)	22.04[a]	9.57[a]	0.59[a]	391.19[a]
S_3 (60cm x 30cm)	21.23[a]	9.74[a]	0.57[a]	396.33[a]
S_4 (70cm x 30cm)	18.08[a]	7.10[b]	0.36[b]	349.75[a]
LSD (5%)	5.431	2.2296	0.1818	50.188
Significance	NS	*	*	NS
Harvest frequency				
H_1 (one day interval)	22.66a	9.44a	0.57a	396.93a
H_2 (two days interval)	21.26[a]	9.07[a]	0.56[a]	379.53[a]
H_3 (three days interval)	18.74[a]	8.07[a]	0.47[a]	364.71[a]
LSD (5%)	4.7034	1.9309	0.1574	43.464
Significance	NS	NS	NS	NS
Interaction (plant spacing and harvest S x H)	NS	NS	NS	*

Table 3: Interaction of plant spacing and harvest frequency on leaf area of okra

	Harvest frequency		
Plant spacing	**H_1**	**H_2**	**H_3**
S_1 (40cm x 30cm)	409.00[ab]	444.04[a]	299.79[b]
S_2 (50cm x 30cm)	413.04[ab]	350.42[ab]	410.13[ab]
S_3 (60cm x 30cm)	432.71[a]	362.21[ab]	394.08[ab]
S_4 (70cm x 30cm)	332.96[b]	361.46[b]	354.83[b]
SE		43.427	

Table 4: Effect of spacing and harvest frequency on yield and yield components of okra

Treatments	Pod length (cm)	Pod diameter (cm)	Pod weight/ plant (g)	Number of pods	Pod yield (t/ha)
Plant spacing					
S_1(40cmx30cm)	3.00[a]	2.08[a]	6.99[ab]	1.68[a]	0.58[a]
S_2(50cmx30cm)	2.94[ab]	1.98[ab]	6.78[ab]	1.50[ab]	0.45[a]
S_3(60cmx30cm)	3.42[a]	2.15[a]	8.03[a]	1.58[a]	0.44[a]
S_4(70cmx30cm)	2.14[b]	1.62[b]	4.17[b]	1.32[b]	0.20[b]
LSD (5%)	0.8542	0.4366	2.9213	0.221	0.15
Significance	*	*	*	*	*
Harvest frequency					
H_1 (one day interval)	2.68[a]	1.82[a]	5.31[b]	1.46[ab]	0.35[b]
H_2 (two days interval)	3.04[a]	2.10[a]	8.57[a]	1.61[a]	0.54[a]
H_3 (three days interval)	2.91[a]	1.96[a]	5.59[b]	1.42[b]	0.33[b]
LSD (5%)	0.7398	0.3781	2.5299	0.1914	0.12
Significance	NS	NS	*	*	*

Table 5: Effect of plant spacing and harvest intervals on proximate composition of okra

Treatment	Crude protein (g/100g)	Moisture content (%)	Ash (g/100g)	Ethyl extract (g/100g)	Crude fibre (g/100g)
Plant spacing					
S_1(40cmX30cm)	5.72c	94.37a	1.18c	0.58b	1.93a
S_2(50cmX30cm)	7.85b	94.05a	1.45b	0.70a	2.02a
S_3(60cmX30cm)	8.71a	94.23a	1.23bc	0.50b	1.97a
S_4(70cmX30cm)	4.66d	94.17a	1.68a	0.48b	2.07a
Harvest frequency					
H_1(one-day interval)	6.83ab	94.50b	1.50a	0.50b	2.08a
H_2(two-days interval)	6.93a	93.96a	1.42ab	0.63a	1.98a
H_3(three-days interval)	6.45b	94.15a	1.23b	0.57ab	1.94a

Stem collar diameter decreased as planting spacing increased. The planting spacing S_1 (40 cm x 30 cm) produced plants with the thickest diameter (0.60cm) while S_4 (70cm x 30cm) produced plants with the thinnest diameter (0.36cm). The result of analysis of variance indicated that S_4 (70 cm x 30 cm) produced plants with significantly lower collar stem diameter compared to other planting spacing whose plants has statistically similar stem diameter (Table 2). There was no significant difference in the leaf area of the plants under all the planting spacings.

There was a significant interaction between spacing and harvest interval on leaf area. A planting spacing of S_1 (40 cm x 30 cm) and H_2 (2 days harvest interval) had the highest leaf area (444.04 cm) (Table 3). Highest pod yield was recorded for H_2 (2 days harvest interval) while the lowest pod yield was obtained under H_1 (1 day harvest interval) and H_3 (3 days harvest interval) Table 4. The spacing of S_1 (40 cm x 30 cm) S_2 (50 cm x 30 cm) and S_3 (60 cm x 30 cm) produced statistically similar number of pods, which were significantly higher than the number of pods and pod yield of the plants under the widest spacing of (70 cm x 30 cm) S_4 which produced the significantly lowest pod yield. Proximate composition of okra was significantly affected by planting spacing (Table 5).

Crude protein increased with increase in spacing up to S_3 (60 cm x 30 cm) and decreased in S_4 (70 cm x 30 cm). Moisture content of okra pods shows that okra pod moisture content was not significantly affected by spacing, however it was significant for harvest interval and ranged from (94.50 - 93.96) (%) and this indicate that the okra pods have a high moisture content. Table 5 shows the crude protein contents of okra pod used in the study. The protein content of the okra pod was significantly affected by spacing and harvest intervals ($P < 0.05$) and ranged from (4.66 - 8.71 g/100 g) and (6.45 - 6.83g/100 g) respectively. However, crude fibre content was not significantly affected by planting spacing and harvest interval. There was no discernible pattern observed for ash, ethyl and Nitrogen extract content with planting spacing H_2 (2 days harvest interval) tends to favour most of the proximate parameters measured except percentage Nitrogen free extract (Table 5).

DISCUSSION

The decrease in the number of leaves and stem diameter observed in the widest spaced plants (70 cm x 30 cm) contradicts the findings of Maurya *et al*., (2013) who recorded maximum values at the widely spaced plant and minimum values in the narrowly spaced plants. This lowest values recorded in this study could probably due to loss of plant nutrients as a result of competition from weeds and through volatilisation of some of these nutrients from the soil as a result of inadequate ground cover as well as genetic potential of variety used. The decline in reproductive parameter especially pod yield, observed when planting spacing increased to (70 cm x 30 cm) could be an indication that the planting spacing of (70 cm x 30 cm) may not be economically viable in the production of okra pods. On the other hand, the better yield obtained under the narrower planting spacings could possibly imply that these spacing are adequate for okra production and that the plants had adequate ground cover and had higher plant biomass which aid in the reduction of soil moisture and nutrient loss. This result agreed with the findings of Moniruzzaman *et al.*, (2007), who reported higher seed yield of okra at the narrowest spacing of 60 cm x 30 cm compared to 60 cm x 40 cm and 60 cm x 40 cm spacing.

Harvest interval did not have any significant effect on plant height, number of leaves, stem diameter and leaf area, which is in agreement with that obtained by Maurya *et al.*, (2013) who reported no significant differences between harvest intervals of (1 and 2 days regime) in some vegetative characters studied. However, harvest frequency significantly affected yield of okra, with maximum value of yield recorded in 2 days harvest interval and minimum value recorded in 1 and 3 days harvest interval. Frequent harvesting of 1 day harvest interval resulted in smaller sizes of fruits harvested while longer harvesting intervals of 3 day resulted in fewer pod harvested. The lower number of pods harvested under 3 days could probably be attributed to the reduction in the production of additional pods occasioned by delayed pod harvesting as opined by (Talukder *et al*., 2003).

Moisture content determination is an integral part of the proximate composition analysis of food. The high moisture content in okra pods (93.96 - 94.50 %) is in agreement with the finding of Adetuyi *et al*., (2011). Also this is in accordance with the finding of Gopalan *et al*. (2007) (89%) and (Nwachukwu *et al.*, 2014) (88.47 %). Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Uyoh *et al*., 2013). The high moisture content in vegetables makes them vulnerable to microbial attack, hence spoilage (Nwofia *et al*., 2012). This high moisture content also implies that dehydration would increase the relative concentrations of other food nutrient and therefore improve the shelf-life and preservation of the fruits (Aruah *et al*., 2012). There is also need to store the fruit in cool condition if they are to be kept for a long period without spoilage especially in the tropics were wastage of vegetable crops is estimated to be around 50% due to high moisture content (Nwofia, *et al*., 2012). The crude protein value of okra pods obtained in the study is almost comparable with the findings of Nwachukwu *et al*., (2014) (4.81 g/100 g) while higher than the value reported by Adetuyi *et al*., (2011) (13.61–16.27 g/100 g). Ogungbenle and Omosola (2015) also reported that the crude protein content of okra pod is (23.4 g/100 g) which is higher than all the treatments in the present study. okra can be considered a high protein vegetable when compared with *moringa oliefera* (4.2 g/100 g), *Gnetum Africanum* (1.5 g/100 g), and *Pterocarpus* (2.0 g/100 g) (Nzikou *et al.*, 2006) and this implies that okra pod can serve as a good source of protein. Nwofia *et al*. (2012) reported that diet is nutritionally satisfactory, if it contains high caloric value and a sufficient amount of protein. The ash content is a measure of the nutritionally important mineral contents present in the food material. The level of ash content was ranged from 1.18 g/100 g to 1.23 g/100 g) on dry weight basis. The results showed that the sample contains considerable amount of ash which indicates that the okra pods would provide essential valuable and useful minerals needed for body development. The mean ash content in this result is lower than that reported by Adetuyi *et al*., (2011) (7.19 - 9.63 g/100 g), higher than the value reported by Nwachukwu *et al*. (2014) (0.18 g/100 g). Dietary fats function in the increase of palatability of food by absorbing and retaining flavors (Antia *et al*., 2006). Excess consumption of fat has been implicated in certain cardiovascular disorders such as atherosclerosis, cancer, and aging, in this regard, the consumption of okra pod diet should be encouraged to reduce the risk of above diseases in man.

Dietary fiber promotes the growth and protects the beneficial intestinal flora. Moreover, high intake of fiber reduces the risk of colon cancer (Dawczynski *et al*). Adetuya *et al*., (2011) reported that the fiber content of Okra pod ranges from 10.15 to 11.63 g/100 g which is higher than the crude fiber obtained in this study. The fiber content of okra in this study is high when compared with *Amarantus hybridus* (1.6 g/100 g) which may suggest that consumption of okra will improve digestibility and absorption processes in large intestine, helping to stimulate peristalsis, thereby preventing constipation.

CONCLUSION

The study revealed that the closest planting spacing of (40cm x 30cm) S_1 could be adopted as it increased number of plants per hectare without significantly reducing yield of okra, subsequently maximising planting space compared to other spacing regimes of (50cm x 30cm) S_2 (60cm x 30cm) S_3 of (70 cm x 30 cm) S_4. The lowest pod yield was obtained under the (70 cm x 30 cm) $S_{4,}$ implying that this spacing or those wider than it should not be used in growing okra as their yield may not be economically viable. In terms of quality of okra pod, any of the spacing regimes may be adopted. Similarly, the 2 days harvest intervals produced the highest value for pod yield and enhanced the quality of okra of okra produced.

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REFERENCES

Adeboye, O.C. and Oputa, C.O., 1996. Effect of galex on growth and fruit nutrition composition of okra (*Abelmoschus esculentus*). *Ife Journal of Agriculture,* 18 (1 and 2), 1-9.

Adetuyi F.O., Osagie A.U., and Adekunle A.T., 2011. Nutrient, antinutrient, mineral and bioavailability of okra *Abelmoschus esculentus* (L) Moench. *American Journal of Food Nutrition* 1:49-54.

Ahmed, K.U. 1995. Vegetables crop business in Bangladesh. A consultancy report under AVRDC-BARC/BARI-USAID Bangladesh project, BARI,GAZIPUR, Bangladesh, 400pp.

Antia B. S., Akpan E. J., Okon P. A., and Umoren I. U., 2006. Nutritive and anti-nutritive evaluation of sweet potatoes (*Ipomoea batatas*) leaves. *Pakistan Journal of Nutrition*. 5:166-168.

AOAC, 2000. Association of Official Analytical Chemists. Official methods of Analysis (Vol. II 17th edition) of AOAC International. Washington, DC, USA. Official methods 925.09, 923.03,979.09, 962.09, 4.5.01 and 923.05.

Aruah B.C., Uguru M.I., and Oyiga B.C., 2011. Nutritional evaluation of some Nigerian pumpkins (*Cucurbita* spp.). Fruit, Vegetable Cereal Science. *Biotechnology*. 5:64-71.

Asif, M.I., 1977. Estimation of leaf area in okra (*Abelmosclus esculentus* (L.) Moench). *Tropical Agriculture (Trinidad)* 54:192.

Baloch, A.F. 1994. *Vegetable crops*. *Horticulture*. National book foundation, ed. Elena Bashir and Robyn Bantel, Islamabad. pp 529-531.

Dawczynski C., Schubert R., and Jahreis G.. 2007. Amino acids, fatty acids, and dietary fibre in edible seaweed products. *Food Chemistry*. 103:891-899.

Gopalan C., Sastri S.B.V., and Balasubramanian S., 2007. Nutritive value of Indian foods. National Institute of Nutrition (NIN), ICMR, India .

Habtamu F., Ratta N., Haki G. D., Woldegiorgis A. Z., and Beyene F., 2014. Nutritional quality and health benefits of okra (Abelmoschus esculentus): A review. *Journal of Food Science Quality Managagement* 33:87-96.

Hilou A., Nacoulma O.G., and Guiguemde T.R., 2006. In vivo antimalarial activities of extract from *Amaranthus spinosus* L., and *Boerhaavia erecta* L. *Journal of Ethnopharmacol.* 103:236-240.

Hossain, M.D., Rahman, M.A., Hoque, M.M. and Salem, M.A., 2001.Year round okra production and economic return as influenced by spacing in Bavisal region. Bangladesh *Journal of Agricultural Research*, 25: 319 - 328.

Lee K.H., Cho, C.Y., Yoon S.T. and Park, S.K., 2000. The effect of nitrogen fertilizer, plant density and sowing date on the yield of okra. *Korean Journal of Crop Science*. 35(8): 179- 183.

Markose, B.L. and Peter, K.V. 1990. Okra, review of research on vegetable and tuber crops. Technical Bulletin, 16. Kerala Agricultural University Press, Mannuthy Kerala, pp. 109.

Maurya R.P., Bailey J.A., Chandler, J.S.A., 2013. 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.

Moniruzzaman, M., Uddin M.Z., and Choudhury A.K., 2007. Response of Okra seed crop to sowing time and plant spacing in South Eastern hilly region of Bangladesh. Bangladesh *Journal of Agricultural Research*, 32 (3): 393-402.

Nwachukwu E.C., Nulit R., and Go R., 2014. Nutritional and biochemical properties of Malaysian okra variety. *Advanced Medicinal Plant Research*. 2:16-19.

Nwofia G.E., Nwogu Victoria N., and Nwofia B.K., 2012. Nutritional variation in fruits and seeds of pumpkins (*Cucurbita* Spp) accessions from Nigeria. *Pakistan Journal of Nutrition*. 11: 946-956.

Nzikou J.M., Mioula-Tsieri M., Matouba E., Ouamba J.M., Kapser C., Parmentier M., et al. 2006. Study on gumbo seed grown in Congo brazzaville for its food and industrial applications. *African Journal of Biotechnology* 5:2469-2475.

Pandey M., Abidi A.B., Singh S., Singh R.P., 2006. Nutritional Evaluation of Leafy Vegetable Paratha. *Journal of Human Ecology*. 19(2):155-156.

Talukder M.A.H., Munnaf M.A., Alam M.K., Salam M.A., Amin M.M.U., 2003. Influence of sowing time, plant spacing and picking interval on the growth and the yield of Okra. *Pakistan Journal of Biological sciences* 6 (18), 1626-1630.

Uyoh E.A., Ita E.E., and Nwofia G.E., 2013. Evaluation of the chemical composition of *Tetrapleura tetraptera* (Schum and Thonn.) Tuab. accessions from Cross River State, Nigeria. *International Journal of Medicinal and Aromatic Plants* 3:386-394.

Yadev, S.K. and Dhankhar, B.S. 2005. Performance of Varsha Uphar cultivar of okra as affected by plant spacing. *Vegetable Science*, 26 (3): 180-182.

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