Journal of Applied Biosciences 32: 2015 - 2019
ISSN 1997–5902

Productivity of okra (*Abelmoschus esculentus* L. Moench) at varying sowing dates in Makurdi, Nigeria

[redacted]
Department of Crop Production, University of Agriculture, Makurdi, P.M.B. 2373, Benue State, Nigeria
*Author for Correspondence e-mail: mikejoy2005@yahoo.com
Original submitted in 3rd June 2010. Published online at www.biosciences.elewa.org on August 8, 2010.

ABSTRACT
Objective: To study the effect of sowing date on productivity of okra (*Abelmoschus esculentus* L. Moench) variety 'V-25' and identify the optimal sowing date.
Methodology and results: The field trial was carried out at the University of Agriculture Research Farm, Makurdi, Nigeria, in 2008 and 2009 cropping seasons. The treatments consisted of three sowing dates (late June, mid-July and early August), replicated three times in a randomized complete block design. The results showed that early flowering and greater pod length, pod diameter, number of pods per plant and pod weight were recorded for the late June sowing. Okra yield was observed to reduce as sowing dates advanced. The yield produced from the late June sowing was significantly ($P \leq 0.05$) greater by 12.3 % and 11.1 % respectively, in 2008 and 2009 compared to that obtained from the mid-July sowing and by 22.8 % and 25.9 % respectively, in 2008 and 2009 compared to that produced from the early August sowing.
Actual or potential application of findings: This study showed that to maximize okra yield, the optimal sowing date would be late June for variety 'V-25'. This should therefore be recommended for Makurdi location, Nigeria. **Key words**: Sowing dates, Okra yield, Guinea Savannah ecology.

INTRODUCTION
Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop in tropical and subtropical parts of the world (Tindall, 1986). It is a semi-woody, fibrous, herbaceous annual plant with an indeterminate growth habit (Balock, 1994). In Nigeria, okra is one of the most important vegetables in terms of consumption and production area (Iremiren and Okiy, 1986). It is used by different people in different ways. The immature pods are consumed as boiled vegetables; they are also dried and used as soup thickeners or in stews (Yadev and Dhankhar, 2002). The green fruits are rich sources of vitamins, calcium, potassium and other minerals (Lee *et al*., 1990). In most parts of the rain forest ecological zone of Nigeria, planting of okra starts after the first rains in April and continues until late July or early August. Iremiren and Okiy (1986) observed progressive yield decreases for each month of delayed sowing of okra variety 'V-25'. Yield decreases of okra variety 'V-25' attributable to sowing dates have also been reported in the rain forest ecological zone by Usman (2001) and Oyolu (2002). Ezeakunne (2004) also reported that the yield components of okra variety 'V-25', such as number of pods, pod length, pod diameter, pod weight and yield were relatively higher when sown early. In Makurdi, Nigeria, which is characterized by varying climatic factors such as rainfall, temperature and relative humidity, okra response to planting date can vary. The objective of the study was to determine the optimal sowing date for the variety to provide a basis for adjusting sowing dates to optimize yield.

MATERIALS AND METHODS

Study site, Climatic information and Soil analysis: The experiment was conducted during the wet seasons of 2008 and 2009 at the Research Farm of the University of Agriculture, Makurdi (7^0 48/N, 8^0 35/E). In the two years of study the month of July recorded the highest amount of rainfall and number of rainy days (Table 1). The average monthly temperature for the two years ranged from 22.1 ^{0}C to 32.2 ^{0}C, while the average relative humidity ranged from 75.3 % to 79.0 % (Table 1). Temperature was taken daily and averaged for the month, using the minimum and maximum thermometer.

Table 1: Meteorological information for Makurdi, Nigeria (June - September) 2008, 2009

Months	Average monthly Rainfall (mm)	Average monthly Temperature (^{0}C)		Average relative humidity (%)
2008		**Maximum**	**Minimum**	
June	180.2 (14)†	30.0	22.1	77.4
July	250.0 (20)	29.8	22.3	77.2
August	237.3 (18)	30.0	22.4	77.8
September	220.0 (13)	29.6	22.2	76.8
2009				
June	224.0(13)	32.2	23.0	77.0
July	230.2 (18)	30.0	22.4	77.2
August	221.5(16)	30.1	23.2	79.0
September	196.0(12)	29.7	22.5	75.3

† Values in parenthesis indicate number of rainy days Source: Air Force Base, Makurdi, Meteorological Station

The top soil of the experimental site was sandy-loam. Soil samples were collected from the study site before planting and soil analysis was carried out at the soil science laboratory, University of Agriculture, Makurdi, to determine the nutrient level of the soil. Nitrogen, phosphorus potassium, calcium and magnesium were obtained using the kjeldahl, flame photometric, oxidation and atomic absorption spectrophotometer methods respectively, while organic matter, % sand, % silt, % clay, pH in calcium chloride and water were obtained using the Walkley-Black, hydrometer and pH meter methods respectively. Total nitrogen and exchangeable potassium were low while available phosphorus was of medium level in both years. Organic matter content was low, while pH in water was near neutral (Table 2).

Experimental set up: The seeds of okra variety 'V-25' were obtained from the National Institute of Horticultural Research and Training (NIHORT) Ibadan, Nigeria. The experimental area (11.8 m^2) was cleared, ploughed, harrowed, ridged and divided into nine plots. Each plot had an area of 3.6 m^2. The plot consisted of four ridges spaced 90 cm apart. The treatments constituted the three sowing dates in a sequential order at 20 day intervals, starting from 27th June (late June), 17th July (mid-July) and 6th August (early August) during each of the two years of study. The treatments were arranged in a randomized complete block design (RCBD) and replicated three times. Okra seeds were sown 2-3 cm deep using 30 cm intra–row spacing on ridges. Two seeds were sown per hole and later thinned to one plant 2 weeks after sowing (WAS). Each ridge had 4 plants giving a total of 16 plants per plot (44,444 plants per hectare equivalent). The plots were manually weeded two times at 6 week intervals after sowing. Mixed fertilizer NPK (15:15:15) at the rate of 100 kg per hectare was applied as described by Ekpete (2000), using the side placement method of application. The fertilizer was applied as a split application to the trial at 3 and 6 WAS. Harvesting was done when the tip of pod was observed to break easily when pressed with the finger tip (Usman, 2001).

Data recording and analysis: Data taken included plant height at first flowering, number of days to first flowering, number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant, pod weight and yield (t/ha). All data were statistically analyzed using the Analysis of variance (ANOVA) and the Least Significant Difference (LSD) was used for mean separation ($P \leq 0.05$) following the procedure of Steel and Torrie (1980).

Table 2: Physico-chemical properties of soil at the Makurdi experimental site in 2008 and 2009.

	Soil analytical data		
Parameter	**2008**	**2009**	**Method of analysis**
Organic matter	2.1 %	1.6 %	Walkley-Black method
N	0.10 %	0.04 %	Kjeldahl method
$P_2 O_5$	11.0 ppm	10.2 ppm	Flame photometric
K	0.19 %	0.10 %	Oxidation method
Ca	3.20 meq/100g	1.62 meq/100g	A. A. S
Mg	3.12 meq/100g	1.01 meq/100g	A. A. S
% Sand	68.0 %	70.4 %	Hydrometer method
% Silt	5.7 %	6.0 %	Hydrometer method
% Clay	13.5 %	10.2 %	Hydrometer method
pH (H_20)	6.3	6.4	pH meter
pH ($CaCl_2$)	5.6	5.2	pH meter

Type of Soil: Sandy – loam, ppm: part per million, A.A.S. Atomic Absorption Spectrophotometer

RESULTS AND DISCUSSION

The average monthly temperature and relative humidity range recorded over the trial period for the two years were considered optimal for the growth and development of okra (Katung, 2007). Rainfall occurred from the months of June to September for the two years of study, decreasing from July as the season progressed. The results of response of okra variety 'V-25' to different sowing dates in Makurdi, Nigeria in years 2008 and 2009 are given in Table 3. Plant height of okra sown in late June was significantly greater than those sown in mid-July and early August. This might be due to the adequate amount of rainfall recorded during the period before flowering. This result agreed with the findings of Iremiren and Okiy (1986) and Ezeakunne (2004) but contradicted those of Gorachand *et al*., (1990) where plant height increased as sowing was delayed. These conflicting results might be due to the differences in rainfall patterns recorded in the Southern part of Nigeria and that recorded in the Southern hilly region of Bangladesh.

Okra sown in early August took a significantly more days to first flowering compared to the late June and mid-July sowings. This might be as a result of the inability of okra sown in early August to accumulate enough thermal units to induce early flowering due to a lower temperature recorded during the period. High rainfall intensity recorded between July and August which fell within the flower initiation period might have induced a heavy cloud cover, low temperature that could have led to low thermal units, thereby prolonging days to first flowering.. This result agreed with the findings of Usman (2001) where the period of days to first flowering increased with each month of delayed sowing.

Although, the number of branches per plant was not significantly affected by the sowing dates, the greatest branch number per plant was obtained from late June sowing, as was also the largest leaf area. This might be attributed to the more efficient use of longer days available.

Pod length and pod diameter significantly reduced as sowing was delayed. Okra plants sown in late June had the highest pod length of 12.12 cm and 10.9 cm in 2008 and 2009, respectively, and largest pod diameter of 15.0 cm and 13.4 cm in 2008 and 2009, respectively. This result agreed with the findings of Alfredo *et al*., (1999) and Hossain *et al*., (2001).

Similarly, the number of pods per plant significantly decreased as sowing was delayed. The greatest number of pods per plant (9.3 and 7.1) recorded in the year 2008 and 2009 respectively, was obtained from the late June sowing. This might be due to the greater number of branches produced and the exuberant vegetative growth of the plants compared to those planted later. The number of pods, therefore, would depend on the intensity of growth of the plants.

Okra sown in late June also gave the greatest pod weight per plant of 33.0 g and 31.8 g in 2008 and 2009 respectively, in addition, to recording the best yield of 5.7 t/ha and 5.4 t/ha in the year 2008 and 2009, respectively. The tallest plants and largest leaf area produced from the late June sowing might have contributed to its greater pod weight and yield. This view supports Moniruzzaman *et al*., (2007) who observed a correlation between the plant height and yield of okra. They noted that in the South Eastern hilly region of Bangladesh, okra sown in April produced the tallest plants which also produced the greatest yield as

compared to that sown in June. The yield produced from the late June sowing was significantly ($P \leq 0.05$) greater by 12.3 % and 11.1 % respectively, in 2008 and 2009 compared to that obtained from the mid-July sowing and by 22.8 % and 25.9 % respectively, in 2008 and 2009 compared to that produced from the early August sowing.

CONCLUSION

From the results obtained, it can be concluded that in Makurdi, Nigeria, which falls within the Guinea Savannah agroecozone, the optimal sowing date for okra variety 'V-25' would be late June. This is associated with a greater plant height, earlier flowering, larger leaf area, greater pod length, pod diameter, number of pods per plant, pod weight and yield. It is however recommended that further investigation be done to evaluate a wider range of okra varieties and across different locations within the Guinea Savannah ecological zone of Nigeria.

ACKNOWLEDGEMENTS: We thank the research technicians of the University of Agriculture Research farm for their assistance in field operations.

REFERENCES

Alfredo SOM.and Arturo DF, 1999. Productivity of okra cultivars in four planting dates at Rio Bravo, Tamaulipas, Mexico. Agrociencia 33: 41-46.

Balock AF, 1994. Vegetable crops: Horticulture. National Book Foundation, Islamabad. Pp 529 – 531.

Ekpete DM, 2000. Analysis of responses to fertilizer by intercrops. *Nigeria Agricultural Journal* 13: 96 - 102.

Ezeakunne CO, 2004. Large scale fruit and vegetable production in Nigeria. Extension Bulletin, Ahmadu Bello University, Zaria, 8pp.

Gorachand M, Malik O, Mondal G, 1990. Growth and yield of bhindi (*Abelmoschus esculentus* L. Moench) as influenced by time of sowing and plant density. *Orissa Journal of Horticulture* 18: 26 – 31.

Hossain MD, Salam MA, Islam MS, Masud MAT, 2001. Yield and quality of okra seed as influenced by time of sowing. *Bangladesh Journal of Seed Science Technology* 3 (1 – 2): 83 – 87

Iremiren GO. and Okiy DA, 1986. Effect of sowing dates on the growth, yield and quality of okra in Southern Nigeria. *Journal of Agricultural Science* 106 (1): 21 – 26.

Katung MD, 2007. Productivity of okra varieties as influenced by seasonal changes in Northern Nigeria. Agrobot. 35(1): 65 – 71.

Lee KH, Cho CY, Yoon ST, Park SK, 1990. The effect of nitrogen fertilizer plant density and sowing date on the yield of okra. *Korean Journal of Crop Science* 35(8): 179-183.

Moniruzzaman M, Uddin MZ, Choudhury AK, 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.

Oyolu C, 2002. Variability in photoperiodic response of okra (*Hibiscus esculentus L.*) *Acta Horticulture* 52: 207-215.

Steel RGD. and Torrie JH,1980. Principles and Procedures of Statistics, McGraw Hill, New York.633pp.

Tindall HD,1986. Vegetables in the Tropics, 1st edition, Macmillan Publishers, Hong kong, pp. 325-327.

Usman SD, 2001. Seed production and quality of okra as affected by sowing time. *Seed Research* 29 (1): 47-51

Yadev SK. and Dhankhar BS, 2002. Performance of Varsha Uphar cultivar of okra as affected by the sowing dates and plant geometry. *Vegetable Science* 27: 70 – 74.

Table 3: Productivity of okra, variety 'V'-25' planted at different dates in Makurdi, Nigeria in years 2008 and 2009

Sowing dates	Plant height at first flowering (cm)		Number of days to first flowering		Number of branches per plant		Leaf area (cm^2)		Pod length (cm)		Pod diameter (cm)		Number of pods per plant		Pod Weight (g)		Yield (t/ha)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
1st Sowing (late June)	101.2	93.1	61.0	60.0	7.2	7.0	476.0	457.6	12.2	10.9	15.0	13.4	9.3	7.1	33.0	31.8	5.7	5.4
2nd Sowing (mid July)	70.8	63.1	64.0	65.0	6.8	6.6	380.2	386.6	8.4	7.7	11.3	9.8	7.0	5.8	24.5	22.9	5.0	4.8
3rd Sowing (early August)	61.3	46.4	66.0	67.0	6.4	6.5	294.3	289.6	6.0	5.4	8.0	6.2	5.2	4.3	22.3	20.4	4.4	4.0
Mean	77.8	67.5	63.7	64.0	6.8	6.7	383.5	377.9	8.9	8.0	11.4	9.8	7.2	5.7	26.6	25.0	5.0	4.7
LSD (0.05)	7.5	10.2	1.7	1.4	1.3	0.7	19.3	22.3	1.8	2.0	2.4	3.2	1.6	0.4	1.6	2.6	00.3	0.4
Cv (%)	12.0	15.6	6.0	10.0	7.8	9.6	12.2	14.5	9.2	10.	8.4	12.0	9.0	8.2	10.2	6.9	12.0	16.2