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EFFECTS OF SPACING ON THE GROWTH AND YIELD OF OKRA (ABELMOCHUS ESCULENTUS) L. MOENCH IN OBUBRA, CROSS RIVER STATE

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ABSTRACT

The effects of plant population on growth and yield of Okra (Abelmoschus esculentus L. Moench) was investigated for two planting seasons (2008 and 2009) in the teaching and research farm, Department of Agronomy, Cross River University of Technology, Obubra . Treatments were five Okra plant populations : 111,111, 55,555,35, 714, 27,77 and 23,810 Okra plants/ ha. High plant population significantly(P< 0.05) reduced number of leaf blades per plant, number of branches per plant and dry matter of plant fraction. The highest plant height of 1.01.3cm and leaf area index of 5.1 were obtained from plant population of 111, 111 plants/ha and this was significantly(P<0.05) higher than values obtained from others. The least plant population of 23,810 plant/ha produced more higher okra fresh pods and weight per pod and seeds per plant as compare with other higher plant population of 55, 555 and 35,714 Okra plants /ha. The highest Okra fresh pod yield of 7.36 and 7.43 tons/ha were obtained from plots treated with 111,111/ha during 2008 and 2009 planting seasons respectively ,The lowest yield values of 3.45 and 3ß36 tons/ha were obtained from 23,810 okra plants/ha in the two planting seasons (2008 and2009)respectively.

INTRODUCTION

Okra (Abelmoschus escusletus), is an annual herbaceous plant of the family Malvacea, Indigenous to tropical African and growth all over West Africa (Schipper 2000). Okra is a vegetable of nutritional importance and is cultivated and consumed in Nigeria (Njoku et al., 2006). Akende et al., (2006) described the crop as a very important vegetable food item in human nutrition supplying minerals, vitamins, Vitamins, certain types of hormones in addition to protein and energy.

The crop is grown for its pod, leaves that used as vegetable in preparation of soup and stew. Agboola (1989) reported that plant population obtained by inter and intra row spacing is one of the factors that determined efficient and profitable crop yield and land use. Palanisamy and Ramaswamy (1993) obaserved that higher plant density achieved through a closer spacing (60 x20cm) resulted in higher pods and seed yield in Okra than using a wider spacing. Muoneke and Asiegbu (1997) stated that one of the reasons for the low yield of okra pod in South east Nigeria is plants stands per hectare. They recommended plant population of 111, 111 Okra plants per hectare for south east Nigeria.

Studies by early workers (Ogbaji 2001, Chandrasekharan and George 1999 and Kamalanathan (1989 Asiegbu 1997)have shown that adequate plant density achieved by closer spacing resulted in efficiency of light interception for crops such as okra and egg plant. Also greater light interception often increases dry matter production and crop yield. There is scantly literature information on adequate okra plant density (spacing) in Obubra, Cross River State, South ï South Nigeria .

Therefore, this study aimed to determine the appropriate plant population that will produce optimum okra yield in Obubra central cross river state.

MATERIAL AND METHOD

Experimental Location

Field studies were carried out at the teaching and research farm of the department of agronomy, Cross River University of Technology, Obubra Campus during 2008 and 2009 cropping seasons. Obubra is located at latitude 05^0 59ò and longitude 08^0 16èE. The annual rainfall, relative humidity and temperature ranged between 2200-2500m, 76.8-87.6% and 30.3-33.0^0C (CRADP,1992).

Field Studies

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The experiment comprised five okra plant populations (spacing) in table 1 below.

Table 1: Details of okra population per hectare and spacing used in the study, (Inter X intra row,cm)

Okra Plant	Spacing (Inter x intra row, cm)
1. -111,11	60x15
2. 555,555	60x30
3. 27,777	60x60
4. 35,714	70x40
5. 23,810	70x60

The five okra plant population were laid out in Randomized complete Block Design (RCBD) with three replication (Blocks). The five treatments were assigned randomly to plots in the blocks using a table of random numbers.

The experimental site was cleared ploughed and divided into four Blocks. Each block measure (22.0x5.0m (110m) and was divided into five plots of 4m x 4m (16m). Each block was separated from adjourning plot by a space of one meter soil samples were collected at random from all the plots by auguring to depth of 0 ï 10cm 10 ï 20 cm, and 20 ï 30cm before land preparation. These were bulked together to form a composite sample that was taken for laboratory analysis to determine the physio-chemical properties of the site.

The soil sample were air dried crushed and sieved with 2mm size. Routing analysis were done for particle size distribution using hydrometer method. pH was measure using glass electrode pH meter at 1:1 soil to water ratio. The percent organic carbon was determine by the Walkey Black wet oxidation method. While the percentage total nitrogen was determine by Macrokjedahl Method. The percentage organic mater was estimated by multiplying the percent of organic carbon with a factor of 1.724. available phosphorous was determine by the method of A.O.A.C(1977). While the exchangeable cations where determine by extracting with neutral

Normal NH^4 OAC. The potassium and sodium were then measured with the flame photometer. While Magnessium and calcium were determined on the atomics absorption spectrophotometer. The exchangeable acidity (EA) was determined by the titration method. The effective cayion exchange capacity (ECEC) was thus calcukated as the sum of the exchangeable bases (K + Na + Ca + Mg) and exchangeable Antion (EA) expressed in C mol/kg of soil. The percent base saturation was calculated as thr sum of the exchangeable bases expressed as a percentage of ECEC.

The result of the analysis shoed that the experimental sitr was sandy laon, with pH 5.02 (1.25 soil: water), 4.90 in (KCl) organis matter 1.24% total Nitrogen 0.06%, phosohorus 6.0mg/kg exchangeable potassium 0.10mg/100g soil and CEC of 8.26 mol/kg (Table 2).

SOURCE OF GERMPLASM AND FIELD PLANTING

Maturer Okra seeds (Agwu Early) were collected from the laboratory of the Department of Crop Science, University of Nigeria, Nsukka, Enugu State in March, 2008. The seeds were planted at rate of three seeds per hole in 17th April, 2008 a various spacing as stated above (table 1) and were thinned to one plant per stand two wweeeeks after germination. Seeds for 2009 planting was from the same source and were planted as stated in 2008.

CULTURAL PRACTICES

Weeding was done at 4.8 and 12 weeks after planting to keep the field wed free. Spray of okra plants was done with Vetox-75 insecticide at the rate of 1.5.kg active ingredient (a.i/ha) according to the manufacturerôs recommendation to control flea beetles and other insects. The spraying was stopped one week before harvesting.

DATA COLLECTION

Data collection began from four weeks after planting. Data were collected from all plants in the two middle rows out of the four rows pet plot and the means were collected on the following growth attributes.

NUMBER OF LEAF BLADEL PER PLANT

At 50% flowering, the number of leaf per plant from all the okra plant in the two middle rows was counted and the means calculated and recording as number of leaf per plant. Number of branches per plant was determine using the same procedure for number of leaf per plant.

Okra height was determine using five plant selected from the sampling area and measures from ground stretching the tape to the terminal end of the plant..

Leaf area was determined using a portable leaf area meter (T ï area) meter model (mk-2).

Leaf area index (LA1) was determined by calculated using total leaf area per plant divided by the feeding area of each plant to give the leaf area index of the crops as described by Brown (1984).

LA1 = Leaf Area Index

LA = Leaf Area

P = ground Area (feeding area of the crop)

Days to 50% anthesis

Days to 50% pod formation

Fresh pod yield (number of pods per plant, weight per plot and hectare) were recorded. Also destructive sampling of two plant per plot was done to evaluate dry matter of plant fractions.

STATISTICAL ANALYSIS

All data collected were subjected to statistical analysis using the procedure for analysis of variance (ANOVA) and appropriate computer soft ware Gen stat (R) version. Separation of treatment means for statistical significance was done using the least significant difference (LSD) procedure as outlined by Obi (1986).

RESULTS AND DISCUSSION

The highest plant value of 101.3cm was obtained from plots treated with 111, 111 plants/ha okra population and this was significantly ($P<0.05$) higher than values obtained from all other treatment in both 2008 and 2009 cropping seasons respectively (Table 3) High plant population inversely proportional to vegetative growth attributes (number of leaves and branches per plant) in all the two stages of growth recorded (9-12 weeks after planting) (WAP). This result is in line with the findings of Ariyo et al (1991) and okpara (2000) who observed that high plant population due to close spacing produce taller plants due to competition for sunlight with less branches and number of leave per plant in okra cultivated south east eastern Nigeria.

It was observed in the study that while leaf area per plant decreases as plant population increases, Leaf Area Index (LAI) on the other hand increased significantly ($P<0.05$) with increase in plant population per hectare and the highest LAI value of (5.9) was

Table 2: physochemical properties of the 2008 and 2009 experimental site.

Mechanical Properties	value
Coarse sand	13.3%
Fine sand	64.0%
Clay	4.7%
Silt	18.0%
Textural class	Sandy loam
Chemical properties	
pH in water	5.02%
pH in K C L	4.90
Organic carbon (%)	0.72
Organic matter (%)	1.24
Total Nitrogen (%)	0.06
Total phosphorus (Mg/Kg)	6.0
Base saturation (%)	57.6
Exchangeable cation (meg/100g soil)	
Potassium (k) (Meg/100g)	0.10
Magnesium (mg) (meg/100g)	1.8
Calcium (Ca) (meg/100g)	2.8
Sodium (Na) (meg/100g)	0.06
Aluminum (Al) (meg/100g)	1.5
Hydrogen (H) (Meg/100g)	2.0
Cation exchange capacity (CEC) (Meg/100g)	8.26

Table 3: Effects of Spacing on the vegetative growth of Okra during 2008 and 2009 planting seasons

GROWTH PARAMETER	2008				2009			
Plant Population Okra Plants/ha	No. of leaves per plant at 50% flowering	No. of Branches per plant at 50% flowering	Plant Height at 50% flowering (cm)	Leaf Area Index at 50% flowering	No. of leaves per plant at 50% flowering	No. of Branches per plant at 50% flowering	Plant Height at 50% flowering (cm)	Leaf Area Index at 50% flowering
111, 111 okra plants/ha	6.2	2.2	100.2	5.8	6.4	2.1	101.3	5.9
55, 555 okra plant/ha	8.3	3.3	96.2	5.7	8.5	3.2	97.5	5.3
35, 714 okra plant/ha	10.1	3.5	90.5	4.2	10.3	4.1	90.2	4.4
27, 777 okra plant/ha	12.4	4.2	87.2	3.8	11.7	5.2	86.9	3.7
23,810 okra plant/ha	13.3	5.1	80.3	3.1	12.5	6.1	81.5	3.2
LSD (0.05)	0.4	0.3	2.5	0.1	0.7	0.3	3.1	o.1

This increase in leaf area index as plant population increases was in agreement with the report of Mouneke and Asiegbu (1997), who attributed the high leaf area index to increase ground area occupied by individual okra plant as a result of high plant density.

The was significant effects of plant population on dry matter yield (DMY) accumulation in okra leaf and stem (Table 4). Leaf dry matter yield per plant reduced significantly ($P < 0.05$) with increased in okra plant population and okra plant age (9 ï 12WAP). Sabatu (2002) obtained similar reduction in leaf dry matter yield high plant population density and lower interception of the effect of plant population on stem dry matter yield closely followed similar trend as the leaf dry yield. The least okra plant population of 23,810 plants per hectare produced the highest stem dry matter yield of 14,95g and 13,89g per plant in 2008 and 2009 cropping season respectively. Palanisamy and ramswamy (1993) obtained highest okra plant girth and stem dry matter yield in plot with lower plant population density than others due reduced plant competition for hight and soil nutrients.

Table 4: Effect of spacing on the growth (Dry matter yield (DMY) in okra during 2008 and 2009 planting season

DRY MATTER OF PLANT FRACTIONS (Dry matter yield (DMY)								
	2008				2009			
Plant Population Okra Plants/ha	Leaf dry yield per 9WAP	Matter plant (g) 12 WAP	Stem matter yield per plant9 WAP	Stem dry matter per plant (g) 12 WAP	Leaf dry yield per 9WAP	Matter plant (g) 12 WAP	Stem dry matter yield per plant 9WAP	Stem dry matter yield per plant (g) 12WAP
111, 111 okra plants/ha	11.45	6.52	1.73	25.55	11.73	5.94	1.88	26.37
55, 555 okra plant/ha	15.95	7.61	2.61	30.34	16.16	6.25	2.73	31.41
35, 714 okra plant/ha	20.13	9.48	3.52	42.68	21.45	8.24	3.61	44.27
27, 777 okra plant/ha	27.56	11.36	4.18	53.47	28.25	10.12	4.23	57.36
23,810 okra plant/ha	32.94	14.95	5.35	61.55	35.53	13.89	5.63	65.74
LSD (0.05)	3.21	0.73	0.56	3.11	3.11	0.71	0.58	4.3

Okra fresh pod yield per hectare increased significantly with increases in plant population (Table 5). The highest plant population of 111, 111 plants/ha, produced higher okra yield of 7.36 and 7.29 tons/ha than other treatment in the two cropping season. However, number and weight of okra pods per plant were low in high populated plots. The least pod yield was obtained in plots with 23,810 plants per hectare. Mouneke and Ndukwe (2005) reported high okra fresh pod yied in high plant density plots due tio higher solar radiation interception as compare to others (55,555 and 27,777 okra plants/ha population.

Table 5: Effect of plant population on okra yield during 2008 and 2009 planting season.

YIELD PARAMETERS												
	2008					2009						
Plant Population Okra Plants/ha	Okro pod length (cm)	Okro fresh pod yield per plant (g)	Okro fresh pod yield per ha(t/ha)	No. of fresh pods per plant	Seed yield per plant (g)	100 seeds wt (g)	Okro pod length (cm)	Okro fresh pod yield per plant (g)	Okro fresh pod yield per ha(t/ha)	No. of fresh pods per plant	Seed yield per plant (g)	100 seeds wt (g)
111, 111 okra plants/ha	2.3	65.58	7.36	6.3	46.27	3.56	2.4	63.67	7.29	6.51	45.81	3.47
55, 555 okra plant/ha	3.7	87.43	6.28	8.4	54.35	3.98	3.5	85.5	6.35	8.51	55.24	3.88
35, 714 okra plant/ha	5.4	100.35	5.13	11.2	78.46	4.83	4.9	101.47	5.21	11.31	76.97	4.79
27, 777 okra plant/ha	6.1	123.19	4.37	13.1	91.25	5.41	6.3	127.53	4.23	13.5	93.18	5.36
23,810 okra plant/ha	7.3	198.56	3.45	15.2	103.57	5.94	7.4	201.32	3.36	14.9	104.45	5.87
LSD (0.05)	0.1	11.47	0.11	0.95	6.23	0.2	0.1	11.5	0.11	0.93	6.51	0.2

CONLUSION

Based on the result of this study okra ahould be cultivated using plant population of 55,555, okra plants/ha for optimum growth and yield in Obubra, Cross River State. This recommendation from this study if adopted will bring greater economic returns to the farmers in this area.

REFERENCES

Akande, M. O. Oluwatoyinbo, F. J. Kayode, and Olowokere, F. A., 2006. Responses of maize and okra (*Abelmoschus esculentus)* intercrop relayed with cowpea (Vigna unguculata) to different levels of cow dung, Amended Phosphate Rock. World Journal of Agric Science 2 (1): 111-122.

Agboola, A. A., 1989. Farming systems. In Lathan N. and P. Ann (Eds). Land Development Management of Acid Soils in Africa. Proceedings of second Reginal Workshop on land Development and management of Acid soils in Africa, Lusa, Zambia 9-16 p.

Association of official Analytical chemists (A. O. A. C.), 1977. Official method of analysis, 11th edn. Association of analytical chemists. Washington D. C.. 13p.

Ariyo, A. Pandita, S. and La, M. P., 1991. Effect of spacing and green fruit pickings on the seed production of okra. Vegetable science India 3 (2): 1122-102.

Asiegbu, J. E., 1997. Effects of organic matter substrate sources and timeof photosynthatesink removal on flower and pod production in Okra Abelmoschus esculenthus (L) Moench. East African Africa Forestry J. 52:293-297.

Brown, R. H., 1984. Growth of the green plant. In physiological basic of crop growth and development Amer. Agron 8: 153-173.

Cross River Agricultural Development CRADP, 1992. Report on wet lands of Cross River State. Nigeria 115pp.

ChandrAWKHARM, p. AND George L. M., 1999. Studies on the effect of spacing and NPK on the growth and yield of Okra Res. J. Kerala 109 (2): 93-97.

Kama,anathan, S., 1989. Studies on optimum spacing and manuring for okra (Abelmoschus esculentus L. moenech) Acta. Hort 53:390-395.

Mouneke C. O. and Asiegbu J. E., 1997. Effect of okra planting desity and spatial; arrangement in intercrop with maize on the growth and yield of the component species. Agron. Crop Science 179:2201-2207.

Muoneke, C. O., Asiegbu, J. E and Udeogalanya, A. C. C., 1997. Effect of relative sowing time on the growth and yield of the component crops in okra/maize cowpea intercropping system. Journal of Agriculture and Crop Science 77 (3) 179-185.

Muoneke, C. O. and Ndukwe , O. O., 2005. Effect of plant population and spatial arrangement on the productivity of okra/amaranthus intercropping system. Jounal of Tropical Agriculture, food Environmenta and Extension Vol. 7 No. 1.15-21.

Njoku, S. C. Muoneke, C. O., Okpara D. A and Agbo, F. M. O., 2006. Effectsof intercropping varieties of sweet potato and okra in ultisols of south East Nigeria. Proceedings of the 40th annual conference of agricultural society of Nigeria. Held at National Root Crop Research Institute, Umudike, Abia State.

Ogbaji, M. I., 2001. Response kf okra to nitrogen and Potassium fertilizers in a southern Guinea Savannah Agro-ecological Location. Journal of Sus. Agric and Environ Vol. 3 (1): 17-22.

Obi, I. U., 1986. Statistical methods of detecting differences between treatment means SNAAP press Enugu 45p.

Okpara, D. A., 2000. Productivity of maize and okra intercropping Indian Journal of Agric Sciecne 65 (12):880-882.

Sabatu, U. E., 2002. Studies on growth characteristics and yield of some selected varieties of okra. Journal of Agricultura science. 15:262-274.

Palanisamy and Remaswamy, 1993. Influence of time of sowing and spacing on seed yield and quality in okra *Abelmoschus esculentus L. Moenech.* Seed Research India 11 (20: 182-186.

Sajyan A. S. Shekorgounda M. and Badanur, C., 2002. Infleunce of date of sowing, spacing and levels of Nitrogen and yield attributes and seed yield in okra, Kampada journal of Agric Science 15: 267-174.