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EFFECT OF SPACINGS ON THE GROWTH AND YIELD OF BAMBARA GROUNDNUT (VIGNA SUBTERRANANEA (L) VERDE.) IN ASABA DELTA STATE

Obidiebube, E. A[1]., Akparobi, S. O[2]., Erutor, P. G[2]., and Achebe, U. A[3].,
[1]Department of Crop Science and Horticulture, Faculty of Agriculture, Nnamdi Azikiwe University, Awka - Nigeria
[2]Department of Agronomy, Faculty of Agriculture, Delta State University, Asaba – Nigeria
[3]Nwafor Orizu College of Education, Nsugbe , Nigeria

ABSTRACT: *A field experiment was conducted at Teaching and Research Farm of Delta state University, Asaba Campus to study the effect of spacing on the growth and yields of Bambara groundnuts. The design was randomized complete block replicated three times. The spacing were 15x30 cm, 25x30 cm, 35x30 cm and 45x30 cm giving a plant population densities of 22,222, 13,333, 9,524 and 7,407 plants/ha, respectively. Results indicated that the number of pods plants-1 and grain yield/ha^{-1} of Bambara groundnuts increased with increased planting density. The study showed that Bambara groundnuts performed better at high densities for growth and yield than low densities. Plants with population density of 22,222 plants/ha (15x30 cm) had the best yield (3920 kg/ha), followed by 13,333 plants/ha (25x30 cm) with the yield of 3768kg/ha and the least 7,407 plants/ha population density (45x30cm) with yield of 2478kg/ha. It is recommended that Bambara groundnut should be planted at a spacing of 15 x 30 cm in a rain forest zone of Asaba, Delta State for maximum productivity.*

KEYWORDS: spacing, bambara groundnut, yield, rainforest, population.

INTRODUCTION

Bambara groundnut is an indigenous Africa crop that has been cultivated for ages. It is the third most important grain legume after groundnut and cowpea in sub-Sahara Africa. It is an important grain legume, which is mainly grown by subsistence farmers in sub-Saharan Africa in a wide range of agro- ecological zones (Ntundu *et al*., 2006). Bambara groundnut is cultivated primarily for its subterranean pods, which can be boiled, roasted, processed into flour and boiled to a stiff porridge (Swanevelder, 1998).The Bambara groundnut seeds are rich in protein and help to alleviate nutritional disorders in human and livestock lives (Mkandiwire and Sibuga, 2002); even the fodder go a long way to boost animal nutrition. Bambara groundnut has the ability to fix atmospheric nitrogen through symbiosis with *Rhizobium* bacteria and therefore beneficial in rotation and intercropping (Egbe and Bar-Nyam, 2010). The crop is popular in Africa because of its resistance to drought and pests, and its ability to produce reasonable yields when grown on poor soils.

Linnemann (1990) opined that Bambara groundnut could be eaten fresh, or grilled while still immature. In Africa, the beans are roasted, then pulverized and used to make a soup with or without condiments and the fresh pods are boiled with salt and pepper and eaten as snacks. In the Eastern Nigeria, it is ground and made into dough paste delicacy (popularly known as 'okpa') wrapped with banana leaves before cooking which can be consumed as breakfast lunch or supper for an average socio- economic family. The Bambara groundnut contains

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sufficient quantity of carbohydrate, protein and fat. Caroline, (1997) in their findings described nutritional value of Bambara groundnut as follows: carbohydrates (54.4-69.3%), protein (17 – 24.6%), and fat (5.3 – 7.8%), while calories are 367 – 414 cal per 100g. It is good source of fiber, calcium, iron and potassium; usually high in methonine. The little quantity of oil in Bambara groundnut that is less than half the quantity found in peanuts makes it unsuited as an oil seed crop (DPP, 2009).

Planting density of Bambara groundnut varies from one location to another in both Eastern and Western Africa. Mkandiwire and Sibuga (2002) had reported a spacing of 30cm x 30cm in Tanzania and 60cm x 30cm in West Africa while 10cm for intra – row spacing that gave the highest yield in their work. Bambara groundnut information on plant spacing in rainforest zone is scanty because not much work has been done on the crop since cultivation of it is very poor in the rainforest area of study. Thus, a field experiment on the effect of plant spacing on the growth and yields of Bambara groundnut in this zone was done to ascertain the best plant spacing for rainforest zone of Asaba Delta State for recommendation. This will encourage farmers in the area to embark on the cultivation of the crop in question

MATERIALS AND METHOD

The study was conducted at the Teaching and Research Farm of Department of Agronomy, Delta State University Asaba Campus. Asaba area is located at (latitude $06^0$14'N and longitude 06^0 49'E) with a humid climate, mixed vegetation of forest interspersed with shrubs and grasses. The rainfall pattern is bi-modal with peaks in July and September (1,505mm); mean temperature of 22-34^{0c}, relative humidity varies from 69-85% (Tobih, 2011). The variety of Bambara groundnut used was EXMF4.

Samples of soil were collected with a tabular sampling auger, bulked and composited for the analysis of the physico – chemical parameters of the soils for the research. The seeds were sown in July at a depth of 5cm in each plot at the rate of one seed per hole, with spacing of 15x30cm, 25x30cm, 35x30cm and 45x30cm. The plants were weeded and spray- monitored with insecticide at appropriate time during the experimental periods.

Data were collected from the thirty randomly selected plants in the middle of each plot. During each period of data collection, five different plants were uprooted for data collection. On growth parameters, canopy width and fodder fresh and dry weights at 4, 8, 12 and 16 weeks after sowing were measured from five randomly selected plants within the sampled middle rows (destructive analysis involved). Canopy width (cm) was taken by measuring the horizontal distances of canopies from one end to another with meter rule; fodder fresh and dry weights (g) were measured using TANITA KD 200 sensitive scale. The fresh fodder weight was taken when the fodder were still fresh, while the dry fodder weight was taken after air drying for eight days and showed constant weights. On yields, number of pods per plant, pod and seeds weight (g) per plant and seed yield kg/ha^{-1} were collected. On number of pods, pods were counted at harvest per plant. Pods weight per plant were measured with weighing scale and shelled to get seed weight per plant. Total seed yield kg/ha^{-1} was taken after harvest and the dried pods shelled and seeds weighed using sensitive scale then converted to yield kg/$ha^{-1.}$ Data collected were subjected to Analysis of Variance (ANOVA) and treatment means were separated using Duncan Multiple Range Test (DMRT) SAS (2010).

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RESULTS AND DISCUSSION

Results of effect of four plant spacing on the growth and yield of Bambara groundnut varieties are shown in Tables 1 and 2. The results in Table 1 showed that there were significant differences in at all the sampling periods. Spacing of 15 x 30cm had the least canopy width across the sampling periods with the mean values of 21.9, 32.0, 42.0 and 46.0cm at 4, 8, 12 and 16WAS respectively; while spacing 45 x 30cm had the largest canopy width with the mean values of 26.8, 45.5, 55.8 and 63.4cm at 4, 8, 12 and 16WAS respectively. Canopy structure is important for the display of leaves for light interception for photosynthesis in crop plants. This is in consonant with the findings of Alhassan *et al.,* (2012) and Akpalu (2013) who reported that spreading type of Bambara groundnut could have canopy width up to 120cm or more while that of bunched could be on the average of between 24.67cm and 45cm. This study showed that the plants on large spacing had wider canopy width which can be traced to the reduced competition for sunlight and available nutrient. This in consonance to the findings of Malami and Smaila (2012) who reported in his work on cowpea that the intra- row spacing of 50 and 75cm had the widest canopy spread. For fodder fresh and dry weights, there were significant differences ($P<0.05$) almost across the sampling periods with spacing 15cm x 30cm having the largest fodder fresh and dry weights with the mean values of 10.8, 65.4, 77.8 and 52.9 (for fodder fresh^- weights) and mean values of 2.25, 19.0, 32.3 and 30.2 (for fodder dry weights) at 4, 8, 12 and 16WAS respectively. At 12 and 16WAS, spacing 45 x 30cm was significantly ($P<0.05$) lower than other spacing with the mean values of 55.2 and 28.6 for fodder fresh weight. Also it was observed that on the fodder fresh and dry weights, higher population density had greater fodder fresh and dry weights and could be attributed to their struggle over environmental and edaphic materials which might have culminated into competition and ended in reduction on weed interference. This agrees with findings of Famham (2001) and Ibrahim (2012) who indicated that there is intense competition for light and nutrient by closely spaced crops compared to widely spaced crops.

In Table 2, the results revealed that plant spacing 15 x 30cm had the highest number of pod at harvest with the mean value of 40.1 and was significantly different from others. The plant spacing with the least number of pods was 45 x30cm with the mean value of 24.9. Spacing of 15 x 30cxm had the highest pod and seed weights of 44.2g and 34.2g respectively and was significantly different ($P<0.05$) from the other three plant spacing. Finally, plants in the Spacing of 45 x 30cm had the least pod and seed weights per plant with the mean value of 23.3g and 21.7g respectively. On the seed yield kg/ha^{-1}, spacing 15 x 30cm had the highest yield of 3920kg/ha^{-1}, while 45 x 30cm had the least yield with the mean value of 2478kg/ha. The close spacing had greater number of pods, pod and seed weight per plant and seed yield kg/ha^{-1} in this work and could be due to non interference of the weed for the weeds were suppressed by the canopy width. This is in agreement with the findings of Anil (2004) and Gunri *et al.,* (2010) who reported that plant spacing of 30cm x 10cm significantly increased both the pod and kernel yield of Bambara groundnut. Yield with increased plant density was similar to the findings of Asiwe and Kutu (2007); Akpalu (2010); Kouassi and Zorobi (2011). These researchers observed that increasing plant production density resulted in high pod and grain yield.

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Implication to Research and Practice

This study is a guide to both researchers and practitioners. The researchers will start from where this study ended to go on with other areas of the crop that need further attention in research; while the practitioners will cultivate within the time frame for optimal yield without guessing.

CONCLUSION

Based on this study, it could be concluded that Bambara groundnut could be planted in July in the area and those who do not meet up with the time can as well pant in early August for good yield. Also variety EXMF4 used in the research could be adopted in the area.

Future Research

There is need to carry out more research on Bambara groundnut on areas of accurate time it should be planted in July and on best spacing to be used for excellent harvest

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Table 1.

Weeks after sowing

	4			8			12			16		
Treatment	CW	FFW	FDW	CW	FFW	FDW	CW	FFW	FDW	CW	FWD	FFW
15 X 30	21.9^{c}	10.8^{a}	2.25^{a}	32.0^{c}	65.4^{a}	19.0^{a}	42.0^{c}	77.8^{a}	32.3^{a}	46.0^{c}	52.9^{a}	30.2^{a}
25 X 30	23.7^{bc}	8.83^{b}	2.00^{a}	37.8^{b}	60.6^{ab}	17.3^{a}	47.8^{b}	68.0^{ab}	30.5^{a}	53.8^{b}	51.3^{a}	28.8
35 X 30	25.3^{ab}	8.58^{b}	1.92^{a}	41.2^{ab}	59.6^{b}	15.9^{ab}	52.5^{a}	60.4^{b}	30.1^{a}	58.7^{a}	39.8^{b}	24.0^{c}
45 X 30	26.8^{a}	7.92^{b}	1.92^{a}	45.4^{a}	43.6^{b}	11.8^{b}	55.8^{a}	55.2^{c}	31.1^{a}	63.4^{a}	28.6^{c}	18.0^{d}

: Effect of plant spacing on canopy width (cm), fodder fresh and dry weight (g) of Bambara groundnut at different sampling periods

Table 2.

Treatment	Pod/plt	Pod wt/plt	Seed wt/plt	
Yield/ha-^{1}		(g)	(g)	(kg)
15 x 30	40.1^{a}	44.2^{a}	34.2^{a}	3920^{a}
25 x30	31.5^{b}	33.2^{b}	28.3^{b}	3768^{b}
35 x30	27.3^{c}	26.3^{c}	24.1^{c}	2690^{c}
45 x30	24.9^{c}	23.3^{d}	21.7^{d}	2478^{d}

Effects of plant spacing on yield and yield components of Bambara groundnut.

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