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EFFECT OF PLANTING DATE ON GROWTH AND YIELD OF BAMBARA GROUNDNUT (*Vigna subtermnea* (L) *Verdc.*) VARIETIES IN RAINFOREST ZONE OF DELTA STATE

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ABSTRACT

The effect of planting date on growth and yield of Bambara groundnut (Vigna subteranea (L) verdc) varieties was carried out in Asaba area of Delta State. It was aimed to determine the most appropriate planting date for the growth and yield of Bambara groundnut in the rainforest zone of Delta State. The design for this experiment was split-plot carried out in a Randomized Complete Block Design. Bambara varieties EXMF1, EXMF4, IITA165, and ENZK2 were used with planting date May – September. The main plot was assigned to variety while the sub – plot was the planting date with three replicates. Plants cultivated in May and June performed better in growth (plant height, canopy width, number of leaves and total leaf area) than those planted in July, August and September. In yield, those plants cultivated in July had the highest yield with the value of 4289kg/ha with variety EXMF4 performing best. The study therefore recommended that variety EXMF4 should be planted by farmers and month of July is the appropriate time for planting Bambara groundnut in the rainforest zone for maximum productivity.

Contribution/Originality: This study is one of the very few studies which have investigated on planting date of Bambara groundnut. The paper's primary contribution is finding that month of July is most suitable in planting of Bambara groundnut in the area.

1. INTRODUCTION

Inadequate supplies and high shortage of food protein in the world particularly in developing countries necessitated the search for cheaper sources of proteins to augment the existing source of production (Mkandiwire, 2007). Bambara groundnut has been under-utilized and under researched although it is highly nutritious. Bambara groundnut is a crop that is grown mainly at subsistence level for food. Its yield varies considerably with environment, seasons and genotype (Linnemann and Azam, 1993). Collinson *et al.* (1996) opined that yield are up to 4.1 t/ha; and its annual production level is estimated around 330,000 tons and that 45-50% of it was produced in West Africa (DPP, 2009). Swanevelder (1998) reported that Bambara groundnut can be planted from late October, through November to early December; while Tanimu (1996) reported highest yield on 28th July than other dates chosen at Samaru. Planting dates depend on the time of rain, it should be planted in such a way that the maturity

and harvest period should be in dry season and not too late to avoid danger of an early end to rains (Dugie *et al.*, 2009). The information on effect of planting date on growth and yield of Bambara groundnut (*Vigna subterranea* (L) Verdc) has been scanty in the rainforest zone of Delta State. Thus, this study was aimed to determine the most appropriate planting date for the growth and yield of some Bambara groundnut varieties in the rainforest zones of Delta State.

2. MATERIALS AND METHODS

2.1. *Study Area*

Then study was carried out at the Teaching and Research Farm of Delta State University, Asaba Campus. Asaba area is in Oshimili South Local Government of Delta State. It is located in latitude $06^0 14^0$N and longitude 06^0 49^0E of equator.

2.2. Planting Materials and Methods

Four varieties of Bambara groundnut (EXMF1, EXMF4, IITA165 and ENZK2) were used and planted on a spilt – plot layout in a randomized complete block design (RCBD) replicated three times. The main plots were the four varieties of Bambara groundnut, while the sub – plots were the five planting dates (May, June, July, August and September). The crops were planted during 2011 and 2012 planting season. The soil- physico – chemical properties were analyzed at Soil Science Department of University of Nigeria, Nsukka, Enugu State. The size of each plot was 2m x 2m separated by 0.5m apart between plots and 1m between blocks replicated three times. On the whole, sixty plots were used (i.e. five planting date x four varieties x three replicates) and a total of $460m^2$ area of land was used. The seeds were sown at a depth of 5cm in each plot across the locations at the rate of one seed per hole, with spacing of 20 x 30cm. In this experiment, the seeds were sown on every first week of the five months chosen according to the reviewed literature. The crops were weeded every month manually and sprayed forth nightly with insecticide against insect attacks during the period of the experiment. Data were collected from the thirty randomly selected plants in the middle from each plot. During each period of data collection, five different plants were uprooted for data collection. The parameters measured on growth were: plant height (cm), petiole length (cm) and canopy width (cm) at 4,8,12, and 16 weeks after planting (WAS). The plant height of the five sampled plants were measured from the ground to the highest point, petiole length was measured from the base attachment on the plant to the last point of the leaf. Three petioles from each five sampled plants were measured and the mean taken. Canopy width (cm) was measured also with meter rule and the mean recorded. On yield, number of pod per plant across the sampling periods were counted, days to physical maturity was taken also. Total seed yield kg/ha was taken after harvest and the dried pods shelled and seeds weighed using sensitive scale then converted to yield kg/ha. Shelling percentage was computed thus:

$$\frac{\text{Weight of dry seeds (g) x 100}}{\text{Weight of dry pods (g)}} \rightarrow$$

2.3. Data Analysis

Data collected were subjected to analysis of variance (ANOVA) and treatment means separated using (SAS (Stastical Analysis System), 2010).

3. RESULT AND DISCUSSIONS

3.1. Growth Parameters

The result of response of Bambara groundnut to planting dates as per the growth parameters was recorded in Table 1 and there were variations on the plant height and petiole length. The results showed that variety EXMF4

grew better than other varieties both in plant height, and petiole length and was significantly (P< 0.05) higher than other varieties at all almost all the sampling periods. For plant height, variety EXMF4 had the mean values of 21.7, 21.9, 22.9 and 21.3 at 4, 8, 12 and 16WAS respectively, also on petiole length, it had the mean values of 13.6, 14.9, 16.3 and 17.5 at 8, 12 and 16WAS respectively. These variations were also observed by Onwubiko *et al.* (2011); Ahmed *et al.* (2010) and Saijan *et al.* (2002) in their works on legumes and vegetables and declared significant differences in the morphological characters of accessions studied which they attributed to their genetic make-up. On canopy width Table 1 the result showed no significant differences (P> 0.05) between the varieties at 4WAS. The varieties used had similar canopy width on the different dates. This could be traced to these varieties belonging to the same group (bunched type) with exception of ENZK2 which behaved as semi – spreading type. It is consistent with the observation of Ahmed *et al.* (2010); Alhassan *et al.* (2012) and Akpalu (2010) who had similar result on the canopy size and classified the accessions used under bunched and spreading type due to their growth indices.

Similarly in Table 1 Bambara groundnut planted in May, June and July had the highest mean values on plant height, petiole length and canopy width at all the sampling periods. The planting date with the least plant height and canopy width was September in across the sampling periods and could be attributed to shortage of soil moisture during the period (dry season). The canopy width was significantly different (P<0.05) as it decreases with planting date after May planting. This is similar with the findings of Bala *et al.* (2011) who reported decline in the canopy spread of Bambara groundnut when sowing was delayed from mid June and attributed it to in ability of late sown crops to fully harness and utilize available natural resources.

Table-1. Effects of Variety and planting date and their interactions on plant height (cm), petiole length and canopy width of Bambara groundnut.

	4			8			12			16		
Variety/ Spacing	**PH**	**PH**	**CW**	**PH**	**PH**	**CW**	**PH**	**PH**	**CW**	**PH**	**PH**	**CW**
EXMF1	20.0^{b}	11.7^{b}	26.5^{a}	20.0^{b}	14.0^{ab}	33.5^{a}	20.9^{ab}	14.8^{ab}	39.1^{a}	20.5^{ab}	14.7^{ab}	38.7^{a}
EXMF4	21.7^{a}	13.6^{a}	26.5^{a}	21.9^{a}	14.9^{a}	33.9^{a}	22.9^{a}	16.3^{a}	46.4^{a}	21.3^{a}	17.5^{a}	42.1^{a}
IITA165	20.1^{a}	11.8^{b}	22.6^{b}	18.7^{b}	13.5^{b}	32.9^{a}	19.9^{b}	14.7^{a}	41.5^{a}	18.4^{a}	13.4^{b}	39.9^{a}
ENZK2	20.3^{ab}	11.5^{b}	24.3^{ab}	19.3^{b}	13.1^{b}	34.2^{a}	20.0^{b}	14.2^{b}	45.1^{a}	18.7^{b}	13.7^{b}	42.2^{a}
Planting date												
May	21.3^{ab}	12.8^{ab}	31.9^{a}	23.1^{a}	16.5^{a}	44.1^{a}	26.4^{a}	19.7^{a}	57.5^{a}	23.5^{a}	18.9^{a}	54.7^{a}
June	21.2^{ab}	12.3^{ab}	27.8^{b}	23.3^{a}	15.4^{a}	28.3^{b}	24.8^{a}	18.4^{a}	51.4^{a}	21.0^{b}	14.8^{b}	50.5^{a}
July	21.5^{a}	11.5^{ab}	22.1^{c}	21.0^{b}	15.4^{a}	45.5^{a}	18.8^{b}	14.6^{b}	48.3^{b}	20.3^{b}	13.6^{c}	39.1^{b}
August	19.5^{c}	11.2^{b}	21.8^{c}	17.7^{c}	11.7^{b}	27.1^{bc}	18.6^{b}	12.2^{c}	39.8^{c}	17.5^{c}	12.5^{c}	32.5^{c}
September	19.2^{c}	13.0^{a}	21.5^{c}	14.8^{d}	10.3^{d}	23.1^{c}	16.1^{c}	10.3^{c}	24.2^{d}	16.5^{c}	12.0^{c}	26.9^{a}
PD	*	*	*	*	*	*	*	*	*	*	*	*
Variety	*	*	*	*	*	NS	*	*	NS	*	**	NS
PD x Var	*	*	*	NS	NS	*	NS	NS	NS	NS	**	*

Legend** = highly significant at 0.01 and 0.05 level of probability, NS = not significant, Sp= spacing, var = variety. PH= plant height, PEL=petiole length, CW= canopy width. Means with the same letter(s) in the same column and under same heading are not significantly different at P>0.05 using duncan multiple range test (DMRT).

3.2. Yield and Parameters

The results in Table 2 on the number of pods across the sampling periods indicated no significant differences between the varieties. The varieties were found to have similar number of pods per plant but variety EXMF4 had more number of pods per plant but not significantly different (P>0.05). This could be attributed to the ability of this variety to partition the dry matter into pod filling (sink) at their own pace. This agrees; with the work of Collinson *et al.* (1996) who attributed differences among the number of pods per plant to varieties respond to diverse environmental conditions, Ibrahim (2011) had similar report on number of pods per plant. With planting date, Table 2 the number of pods per plant varied between the planting dates with May and June having large numbers

at the growing periods. At maturity, July planting had the highest number of pods per plant followed by August (53.6 and 48.8 respectively). Most of the pods from May and June cultivations got decayed due to high moisture content of the soil. September planting was drastically affected by climatic factors which led to its poor number of pods and other yield components. It had the least mean number of pods per plant at all the sampling periods with the values of 12.3, 19.9, 24.6, at 12, 16 and 20 WAS respectively. Some flowers were aborted and could not reach fruiting and could be attributed to poor moisture content of the soil. This agrees with the findings of Stephen (2009) who reported that pod filling in legumes is the most crucial process in the crops and can be hindered. Futuless *et al.* (2011) had similar observation and reported that differences observed in number of pods per plant on different planting dates could be explained in terms of fewer flowering nodes, rainfall pattern and suppression of both primary and secondary branches.

On maturity date, the result in Table 3 showed that two varieties (EXMF 1 and EXMF4) matured early with the mean values days of 116.8 and 118.4 respectively and were significantly different ($P<0.05$) from the other two varieties, though they all matured within 127 days. This showed that they are early maturing and could also be attributed to early maturing and could also be attributed to early germination and flowering of the varieties used which culminated from their genetic – constitution. This is in agreement with the findings of Berchie (2010) who reported that the landraces used matured within 126 days and 120 days respectively and were early maturing. Shelling percentage was significantly affected ($P<0.05$) by Bambara groundnut variety with IITA165 producing the highest mean value of 72.2% which was significantly higher than those of other varieties that had 64.3% (ENZK2), 66.0% (EXMF 1) and 57.2% (EXMF4).

On seed yield per hectare, there were significant differences ($P<0.05$) between the varieties with variety EXMF4 producing the highest seed yield with the mean value of 3738 kg/ha followed by IITA165 with the mean of 3075 kg/ha. The least in yield was EXMF 1 with the mean of 2419kg/ha. Significant differences on shelling % was also recorded by Njoku *et al.* (2009) on cowpea and reported that Ife Brown had highest shelling percentage. This performance could be traced to the genetic ability in pod filing. Furthermore, the observation of Saijan *et al.* (2002) supported the findings in this study who found that genotype had significant effect on seed yield.

Based on planting date, May and June plantings matured late at 121.7 and was significantly different ($P<0.05$) from those of July, August and September. The July, August and September plantings matured earlier with the mean values of 120.2, 119.8 and 119.3 respectively.

Also shelling % was significantly affected ($P<0.05$) by planting date with July planting having the highest shelling % of 70.3, followed by planting of August with the value of 69.5. For seed yield, July and August planting were significantly higher ($P<0.05$) than those of other months planting with the mean yield of 4289 kg/ha and 3893 kg/ha respectively. The least in yield was September planting with the value of 1278kg/ha. Date of planting is found to be one of the most important factors affecting yield coupled with some other traits. It was observed in this study that during the harvest, only the pods that matured in the dry periods were healthy and sound.

The pods of plants planted in July and August were in good conditions when harvested. May and June plantings even though they had reasonable number of pods per plant at the productive stage, before they mature, some pods decayed while their seeds sprouted to begin another cycle before harvest. These could be attributed to heavy rains and excess moisture which affected the number of pods I the said periods and seed yield as well. This observation is consistent with the findings (Mkandiwire, 2007) who opined that Bambara groundnut should be planted in such a way that they mature into dry periods to avoid decay of pods and seeds. Ibrahim (2011) reported that total pod yield of groundnut was influenced significantly by factors such as soil moisture.

Table-2. Effects of variety and planting date and their interactions on number of pod per plant of Bambara groundnut at different sampling periods.

	Weeks after sowing			
Variety	**8**	**12**	**16**	**20**
Planting date variety				
EXMF1	12.1[a]	25.9[b]	31.9[a]	37.5[a]
EXMF4	13.3[a]	26.3[a]	39.9[a]	41.9[a]
IITA165	13.7[a]	25.7[a]	33.1[a]	39.5[a]
ENZK2	13.3[a]	26.1[a]	32.5[a]	39.8[a]
Planting date				
May	12.5[b]	23.5[bc]	37.3[a]	39.2[b]
June	11.7[b]	22.8[bc]	31.2[ab]	33.4[bc]
July	16.8[a]	34.0[a]	39.7[a]	53.6[a]
August	12.4[b]	29.6[ab]	39.5[a]	48.8[a]
September	12.3[b]	19.9[c]	24.8[b]	24.6[c]
PD	*	*	*	*
Variety	NS	NS	*	NS
PD x Var	NS	*	NS	*

Length **= highly significant, * = significant at 0.01 and 0.05 level of probability, NS = not significant, PD = Planting date, Var = Variety. Means with the same letter (s) in the same column and under same heading are not significantly different at P> 0.05 using duncan multiple range test (DMRT).

Table-3. Effects of variety and planting date and their interactions on yield and yield related components of Bambara groundnut varieties.

Variety/Planting date	Maturity date	Pods/Plt	Shelling %	Yield (kg/ha)
Variety				
EXMF1	116.8[d]	40.7[a]	66.0[a]	2419[d]
EXMF4	118.4[c]	41.9[a]	57.2[d]	3738[a]
IITA165	119.7[b]	39.5[a]	72.2[a]	3075[b]
ENZK2	127.1[a]	39.8[a]	64.3[c]	2794[c]
Planting date			65.5[c]	2892
May	121.7[a]	39.2[b]		
June	121.7[a]	33.4[bc]	60.3[d]	2590
July	120.2[b]	56.3[a]	70.3[a]	4289
August	119.8[b]	48.8[a]	69.5[b]	3893
September	119.3[b]	24.6[c]	59.3[e]	1278
PD	*	*	*	*
Variety	*	NS	*	*
PD x Var	*	*	*	*

Legend: ** = highly significant, * = significant at 0.01 and 0.05 level of probability, NS = not significant, PD = planting date, Var = variety. Means with the same letter(s) in the same column and under same heading are not significantly different at P>0.05 using duncan multiple range test (DMRT).

4. CONCLUSION

Bambaraa groundnut variety EXMF4 proved superior to other varieties used in the study and was recommended for cultivation in the area with planting date of July which also favoured the yield according to the result of the research.

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