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Bambara Groundnut *(Vigna subterranea* (L) Verdc.) Varieties as Affected by Planting Dates in Ogbakuba, South Eastern Nigeria.

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Abstract: An experiment on different planting dates on Bambara groundnut (Vigna subterranea (L) Verdc) varieties was carried out in Ogbakuba in South Eastern Nigeria during 2011 and 2012 planting seasons. The design for this experiment was split - plot carried out in a Randomized Complete Block Design (RCBD). Bambara groundnut varieties (EXMF1, EXMF4, IITA165 and ENZK2) were used as main plot, while planting dates May, June, July, August and September were on the sub-plot. The results showed that those Bambara groundnut planted in July performed better in growth (plant height, canopy width, number of leaves and total leaf area) than those planted in other months. In yield also, those planted in the month of July had the highest seed yield with the value of 3995kg/ha and variety EXMF4 performing best. The treatment variety x planting date interaction effects were significant for some growth and yield parameters evaluated. Thus, the best time to grow Bambara groundnut in the area is July and variety EXMF4 recommended for this locality.

Keywords: Bambara groundnut, growth, planting date, response, yield.

1. Introduction

Bambara groundnut (*Vigna subterranea (L) Verdc*) is one of the world's most popular edible legumes cultivated in the tropical and sub-tropical areas. Bambara groundnut is a crop that is grown mainly at subsistence level for food. Its yield varies considerably with environment, seasons and genotypes (Linnemann and Azam - Ali, 1993). Collinson, *et al.*, (1996) opined that yields 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). The major producers of Bambara groundnut are: Nigeria, Burkina Faso, Chad, Coted'lvore, Ghana, Mali and Niger. The worldwide demand of the crop is much higher than its production (Swanevelder, 1998). Bambara groundnut is probably one of the most drought-resistant of the grain legumes and may be found growing successfully where annual rainfall is below 500mm and optimum between 900-1000 mm per year (Ocran *et al.*, l998), The plant can be grown under dry climatic conditions where the rainfall during the rainy season would be adequate to enable them to accomplish their vegetative cycle (Shiyam, 2010) and is more tolerant to infertile soil than any other legumes, (Chomchalow, 1993). It grows on a well-drained soil with pH of 5.0-6.5 but light sandy loams are most suitable (Mkandiwire, 2007 DPP, 2009). Swanvelder (1998) reported that Bambara groundnut can be planted from late October, through November to early December in the area while Tanimu, (1996) reported highest yield on 28th July than other dates chosen at Samaru. People from Enugu-Ezike in Enugu State cultivate between 2nd week of July and 2nd week of August. Masindeni (2006) in a research planted in the months of April and May when stated that plants were sampled from the experimental plots at different planting dates (19, 20 and 21 April) and (4, 5 and 6 May) in the areas used. Planting dates depend on the

time of rain and 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)); while ICS-Nigeria funded by USAID recommended mid August to early September for cowpea depending on the onset of late season rains in rain forest zone. Planting of Bambara groundnut is dependent on the type of rain in an area which differs from place to place. Thus this study examines the effect of different planting dates (May, June, July, August and September) on Bambara groundnut varieties (EXMF1, EXMF4, IITA165 and ENZK2) was carried out in Ogbakuba in South Eastern Nigeria.

2. Material and methods

2.1 *Experimental site*:

The study was conducted at the School Farm of Ogbaru High School, Ogbakuba in Anambra State. Ogbaru Local Government Area is located in the South Western part of Anambra State and lies between latitudes 5°42' and 6°08'N and Longitudes 6°42' and 6°50'E. The climate is hot wet equatorial with average maximum temperature of 30°C and the average minimum of 24°C depending on the season of the year. Rainfall is experienced for 7 months of the year; with a total annual value of about 1,900mm (Ezenwaji *et al*., 2014).

2. 2 *Experimental design and planting:*

It was a split - 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 - sub - plots the five planting dates (May, June, July, August and September). The crops were planted during 2011 and 2012 planting season. Four varieties of Bambara groundnut were used (EXMF1, EXMF4, IITA165 and ENZK2). 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 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.

2.3 *Data collection:*

The soil physio – chemical properties were analyzed at the Soil Science Laboratory of University of Nigeria Nsukka, Enugu State. 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), number of leaves and total leaf area (cm2) at 4,8,12, and 16WAS. 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. Then number of leaves per plant was counted and leaf area (cm2) per plant was measured by multiplying length and width of three leaves from the sampled plants and calculated with an equation. Thus; ALA =0.71 ELA+0.23 (F.C. Nguy-Ntamag, 1995). Where ALA is actual leaf area, then ELA = length x width of the leaflets. On yield number of pods per plant were counted and recorded. One hundred dry pods from the various varieties were randomly selected and their weights (g) taken using TANITA KD 200 sensitive scale. The hundred dried pods were shelled and weighed for hundred dry seed weights (g). Total seed yield kg/ha was taken after harvest and the dried pods shelled and seeds weighed using sensitive scale the converted to yield kg/ha.

2.4 *Data analysis*:

Data collected were subjected to analysis of variance (ANOVA) and treatment means separated using Duncan Multiple Range Test (DMRT) SAS (2010).

3. Results and discussion

3.1 Effects of variety and planting date and their interactions on some growth parameters of Bambara groundnut.

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Results are presented in Table 1 which showed the effect of variety and planting date on growth of Bambara groundnut. The results showed that varieties had similar growth (plant height, number of leaves and total leaf area) with exception of variety ENZK2 that had highest number of leaves and total leaf area from 8 - 16WAS. None of the variety was solely superior in height across the sampling period. At 4 and 8WAS, EXMF4 had the highest plant height (20.7 and 20.5) and was significantly higher (P<0.05) than other varieties. The least in plant height in almost all the sampling periods was EXMF1. On number of leaves and total leaf area, there were no significant differences (P<0.05) between the varieties except at 16WAS where variety ENZK2 had the largest total leaf area with the mean value of 841.4 and significantly different (P<0.05) from other varieties. These showed that varieties used had similar number of leaves and total leaf areas 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) and Ibraheem (2010) who reported that number of leaves of the varieties planted were not significantly different from each other.

.Table 1: Effects of variety and planting date and their interactions on some growth parameters of Bambara groundnut.

	Weeks after sowing											
Variety/	**4**			**8**			**12**			**16**		
Spacing	**PH**	**NLV**	**TLA**	**PH**	**NLV**	**TLA**	**PH**	**NLV**	**TLA**	**PH**	**NLV**	**TLA**
Variety												
EXMF1	17.3^{ab}	16.5^{a}	158.6^{a}	17.7^{b}	45.1^{a}	416.1^{a}	18.7^{a}	81.7^{a}	608.4^{a}	19.5^{a}	87.0^{a}	545.0^{b}
EXMF4	20.7^{a}	16.0^{a}	149.6^{a}	20.5^{a}	45.3^{a}	491.3^{a}	19.6^{a}	82.9^{a}	711.3^{a}	21.5^{a}	84.9^{a}	614.4^{ab}
IITA165	19.0^{b}	12.4^{a}	125.6^{a}	18.6^{ab}	51.9^{a}	375.9^{a}	17.8^{a}	77.7^{a}	721.6^{a}	21.0^{a}	86.0^{a}	636.6^{ab}
ENZK2	19.8^{c}	13.6^{a}	134.1^{a}	19.7^{b}	53.6^{a}	482.8^{a}	19.7^{a}	87.2^{a}	784.0^{a}	21.9^{a}	95.9^{a}	841.4^{a}
Planting Date												
May	21.1^{a}	14.1^{ab}	149.5^{ab}	22.7^{a}	70.3^{a}	642.8^{a}	22.8^{a}	110.6^{a}	1263.1^{a}	23.4^{a}	140.8^{a}	1125.1^{a}
June	20.2^{a}	10.1^{a}	135.6^{ab}	20.3^{ab}	53.7^{b}	542.4^{a}	19.6^{b}	96.1^{ab}	800.8^{b}	23.3^{a}	102.2^{b}	799.2^{b}
July	19.7^{ab}	18.17^{a}	204.6^{a}	19.8^{b}	62.0^{ab}	529.0^{a}	18.7^{b}	79.3^{b}	622.2^{b}	21.0^{ab}	84.6^{bc}	704.6^{b}
August	18.3^{bc}	14.2^{ab}	112.5^{ab}	17.2^{c}	30.9^{c}	306.5^{b}	17.5^{b}	78.6^{b}	569.8^{bc}	18.8^{bc}	58.5^{cd}	343.3^{c}
September	16.8^{c}	15.8^{ab}	106.7^{b}	15.6^{c}	28.0^{c}	187.0^{b}	15.1^{c}	47.3^{c}	269.8^{c}	17.2^{c}	54.9^{d}	324.8^{c}
PD	*	NS	*	*	*	*	*	*	*	*	*	*
Variety	*	NS	NS	*	*	NS	*	*	*	*	*	NS
PD x Var	*	NS	NS	NS	NS	NS	NS	NS	*	NS	*	NS

Legend ** = highly significant, * = significant at 0.01 and 0.05 level of probability, NS = not significant, PD = planting date, var = variety. PH = plant height, PEL = petiole length, RN = root nodules. 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).

Also the results in Table 1, revealed that crops planted in May had the highest mean value on plant height, number of leaves and total leaf areas at almost all the sampling periods except at 4WAS. On plant height, it had the

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mean values of 22.7, 22.8, and 23.4 at 8, 12 and 16WAS respectively; on number of leaves, it had the mean values of 70.3 (8WAS), 110.6 (12WAS) and 140.8 (16WAS), while on leaf area, it had the mean values of 642.8, 1263.1 and 1125 at 8, 12 and 16WAS respectively. The planting date with the least mean value on plant height, number of leaves and total leaf area was September across the sampling periods (Table 1). Bambara groundnut planted earlier (May - July) grew better than those planted between August and September and could be attributed to the moisture content of the soil and other favourable climatic conditions. This was similar to the findings of Berchie (2010) and Masindeni (2006) who reported significant differences on planting dates of Bambara groundnut. It also agrees with the findings of Swanevelder (1998) and Oyiga *et al*., (2010) who reported that Bambara groundnut should be planted with enough soil moisture

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

The available results presented in Table 2 on yield and yield components showed that there were no significant differences between the varieties on number of pods per plant. On 100 pods and seed weights, variety EXMF4 had the highest mean weight values of 104.0(g) and 61.0(g) respectively, and was significantly different (P<0.05) from other varieties except ENKZ2 on seed weight which had the mean value of 60.4(g). On seed yield per hectare, there were significant differences (P<0.05) between the varieties with variety EXMF4 producing the largest seed yield with the mean of 3324 kg/ha followed by ENZK2 with the mean of 2809 kg/ha. The least in yield was EXMF1 with the mean value of 2357kg/ha. The varieties were found to have similar number of pods per plant but EXMF4 and ENZK2 excelled both in yield and yield - related components (100 pods and seed weights and yield kg/ha). This could be traced to their genetic variations and their ability to convert most of their photosythates into sink. The findings in this study were in agreement with the observations of Akpalu (2010); Futuless *et al* (2011) and Ibrahim (2011) who worked on Bambara groundnut, Cowpea and Groundnut respectively and reported that some varieties had heavier seed weight and attributed it to the ability of the varieties to convert most of photosynthate produced into seed production than husk

Also the results on effect of planting date on pod and seed characteristics were shown in Table 2. Bambara groundnut planted in July and August had the highest number of pods per plant and seed yield kg/ha with the mean values of 44.4 and 44.2 (number of pods/plant) and

Table 2: Effects of variety and planting date and their interactions on yield and yield related components of Bambara groundnut varieties.

Variety/Planting date	Pods/plt	100 pod wt (g)	100 seed wt (g)	Yield ha (kg)
Variety				
EXMF1	33.8^{a}	78.0^{d}	48.6^{d}	2357^{d}
EXMF4	37.6^{a}	104.0^{a}	61.0^{a}	3324^{a}
IITA165	34.8^{a}	81.4^{c}	55.6^{c}	2534^{c}
ENZK2	37.5^{a}	90.6^{b}	60.4^{b}	2809^{b}
Planting Date				
May	36.3^{ab}	81.0^{c}	47.0^{e}	2740^{c}
June	31.6^{bc}	80.0^{d}	49.8^{d}	2350^{d}
July	44.4^{a}	115.5^{a}	76.3^{a}	3995^{a}

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August	44.2[a]	87.3[b]	55.0[b]	3693[b]
September	23.1[c]	78.8[e]	54.0[c]	1001
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. PH = plant height, PEL = petiole length, RN = root nodules. 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).

3995kg/ha and 3693kg/ha (July and August respectively) and were significantly different (P<0.05) from other planting dates. The weights of 100 pods and seeds for Bambara ground planted in July were highest with mean values of 115.5(g) and 76,3(g) respectively and was significantly higher (P<0.05) than other planting dates. This was followed by those planted in August with the mean values of 87.3(g) (100 pods weight) and 55.0(g) (100 seeds weight). The least in yield was Bambara groundnut planted in September which had mean the value of 1001kg/ha. Date of planting was 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 sound others had element of decaying and germination due to the moisture content of the soil. Those Bambara groundnut planted in July and August had healthy and sound pods and with high yield both in 100 pods and seed weights and seed yield kg/ha. This is consistence with other reports (oral communication – Enugu-ezike) who reported that Bambara groundnuts are better planted between first week in July and second week in August at their place. Berchie (2010) reported significant differences with planting dates on seed yield and recorded between 378-4631kg ha^{-1}. Stephen (2009) observed that the groundnut yield in major season yielded higher (5498-7147kg ha^{-1}) than in minor season (1652 - 3560kgha^{-1}).This study is a guide to both researchers and practitioners. Researchers will start from where this study ended to go on with other areas of the crop that need further attention in research (especially the particular time in July that is most suitable), to enable the practitioners to 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 plant early August with variety EXMF4 for good yield.

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