International Journal of Sustainable Agricultural Research
2020 Vol. 7, No. 1, pp. 39-43.
ISSN(e): 2312-6477
ISSN(p): 2313-0393
DOI: 10.18488/journal.70.2020.71.39.43

EVALUATION OF BAMBARA GROUNDNUT (*Vigna Subterranea* (L) *Verdc.*) VARIETIES FOR ADAPTATION TO RAINFOREST AGROECOLOGICAL ZONE OF DELTA STATE, NIGERIA

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Article History
Received: 5 September 2019
Revised: 10 October 2019
Accepted: 20 November 2019
Published: 18 December 2019

Keywords
Varieties
Bambara groundnut
Adaptation
Evaluation
Agro-ecological zone
Yield.

ABSTRACT

Field experiments were carried out to evaluate the adaptability of Bambara groundnut *(Vigna subterranea (L) Verdc)* varieties to rainforest agro-ecological zone of Delta State using selected varieties. The varieties used were: EXMF1, EXMF2, EXMF3, EXMF4, IITA355, IITA182, IITA165, IITA1480, IITA1132, ENZK1 and ENZK2. The aim of this experiment was to identify the varieties of Bambara groundnut that were most suitable in this agro-ecological zone. The design used in this experiment was a Randomized Complete Block Design (RCBD) replicated three times. The parameters collected were: plant height, petiole length, number of leaves, total leaf area, number of pods per plant, pod and seed weights per plant(g), and seed yield (kg/ha). The result showed that varieties EXMF1, EXMF4, IITA165 and ENZK2 performed better than others for growth (plant height, number of leaves and total leaf area) and seed yield. Variety EXMF4 was outstanding in yield with the mean value of 5267kg/ha followed by ENZK2 with the mean value of 5000kg/ha. The least in yield was IITA182 followed by ENZK1 with the values of 2445 and 2600kg/ha respectively.

Contribution/Originality: The paper's primary contribution is finding that some varieties of Bamabra groundnut not only thrived but compete with the yield found elsewhere.

1. INTRODUCTION

Bambara groundnut *(Vigna subterranea* (L) Verde.) is an annual leguminous plant. It belongs to the family *Fabaceae* and sub family of *Faboideae*. It originated from West Africa and is still a traditional food crop in Africa with potential to improve nutrition, food security, foster rural development and support sustainable land care. It is popularly known as "Okpa" in Igbo language in eastern Nigeria and "Epa — kuta" in Yoruba language in western Nigeria. Bambara groundnut is highly cherished by people from eastern, northern and western Nigeria in a variety of ways (Mkandawire, 2007; Omoikhoje, 2008). It is used to make a snack delicacy called 'okpa' by the Igbos of South Eastern Nigeria where it is popularly taken at all time especially as breakfast meal with pap or beverages.

Bambara groundnut is a crop, which is adapted to a wide range of conditions and it is popular with African farmers due to its ability to yield on poor soils where other crops fail. The crop has advantages over more favoured species in terms of nutritional value and tolerance to adverse environmental conditions. In Africa,

Bambara groundnut is the third most important legume after groundnut *(Arachis hypoged)* and cowpea *(Vigna unguiculatd)*, (Asiwe and Kutu, 2007; Mkandawire, 2007; Omoikhoje, 2008). Bambara groundnut is a rich source of protein and its seeds are .valued both for their nutritional and economic importance. Bambara groundnut is used for both human and animal consumption. The seeds command a high market price with demand far out weighing supply in many areas (Mkandawire, 2007). It is an important source of family revenue and cheap protein as well as fodder for livestock. It constitutes a balance ration and complete food to the populace that consume it as sole meal or when supplemented with the cereal based diets. It is one of the most important drought resistant grain legumes.

2. MATERIAL AND METHODS

2.1. Experimental Site

The experiment was carried out in rain forest zone of Delta State Nigeria. The study were conducted during 2011 and 2012 cropping seasons at the Teaching and Research Farm of Department of Agronomy, Delta State University, Asaba Campus. Asaba area is located at (latitude 06°14'N and longitude 06° 49TE) with a hot humid climate, mixed vegetation of forest interspersed with shrubs and grasses. The rainfall pattern is bi-modal with peaks in July and September (1,505 mm); mean temperature of 28±6°C, relative humidity varies from 69-85% (Tobih, 2011).

2.2. Experimental Materials and Methods

The representative soil samples were collected with a tubular sampling auger in varied places within the place. These samples were bulked and composited for the analysis of the physico - chemical parameters of the soils for the research. The samples were analyzed at the Soil Science Laboratory of University of Nigeria Nsukka following the standard routine procedures. Twelve varieties of Bambara groundnut were used. Six varieties were obtained from IITA Ibadan, four from Makarfi - Zaria and two from Enugu - Ezike in Enugu State (as local). The twelve varieties were named as follows: EXMF1, EXMF2, EXMF3 and EXMF4 (from Makarfi-Zaria); ENZK1 and ENZK2 (from Enugu-Ezike in Enugu State). Varieties from International Institute for Tropical Agriculture Ibadan were: IITA355, IITA182, IITA165, IITA1480, IITA1132 and IITA1213. The experiment was on Randomized Complete Block Design replicated three times. The experimental site was cleared manually with machetes' and hoes. The debris was gathered, bundled out and the site measured, marked and divided into three portions (blocks) as replicates. On the whole, there were thirty-six plots in each year and each plot measured 2 m x 2 m separated by 0.5m apart between plots and 1m apart between blocks replicated three times. The marked out plots were filled and made into beds using hoe. The seeds were sown at a depth of 5cm in each plot across the seasons at the rate of one seed per hole, with spacing of 30 x 20cm. the plants were weeded and spray-monitored with insecticide at appropriate time during the experimental periods.

2.3. Data collection

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. On growth parameters, plant height, petiole length, number of leaves and total leaf area at 4, 8, 12 and 16 weeks after sowing were measured from five randomly selected plants within the sampled middle rows. Plant Height (cm) was taken by measuring heights from the ground level to the highest point of the sampled plants with a meter rule; petiole length (cm) was taken by measuring the lengths of leaf petioles from the sampled plants using a meter rule; number of leaves per plant was counted and leaf area (cm^2) per plant was measured by multiplying length and width of three leaves (small, medium and large) from the sampled plants and calculated with an equation. Thus: ALA "0.71 ELA+0.23 (Nguy-Ntamag, 1995). Where ALA is actual leaf area, then ELA = length x width of the leaflets. Collections were made at 4, 8, 12 and 16WAS and the

(average calculated and recorded. On yields, data on number of pods per plant, pods and seed weights (g) per 'plant and seed yields kg/ha were collected.

2.4. Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) and treatment means were separated using Duncan Multiple Range Test (DMRT) (Statistical Analysis System, 2010).

3. RESULTS AND DISCUSSION

3.1. Effects of Variety on Plant Height (cm), Petiole Length (cm) of Bambara Groundnut at Different Sampling Periods

Effects of variety on plant height and petiole length of Bambara groundnut at different sampling periods in 2011 and 2012 planting seasons (mean) is shown in Table 1. In Table 1 there was gradual increase between the varieties across the sampling periods on both plant height and petiole length. At 16WAS, there was decline in both plant height and petiole length in most of the varieties assessed. There were significant differences ($P<0.05$) across the sampling periods but their growth revolved between 15.5 and 24 (plant height), then between 8.17 and 16.7 (petiole length). Varieties EXMF1, EXMF4, IITA355, IITA165 and ENZK2 grew better than others. Variety EXMF3 had the shortest plant height and petiole length in almost of the sampling periods. It showed that there were varietal differences among the assessed varieties on the plant height and petiole length in this study which could be attributed to the genetic make – up of the plants which favoured some varieties over other ones. This is similar to the findings of Majanbu *et al.* (1986); Ibrahim *et al.* (2000); that attributed the differences in growth indices of crops to genetic make - up and constitution.

Table-1. Effects of variety on plant height (cm), petiole length (cm) of Bambara groundnut at different sampling periods.

	Weeks after sowing							
	4	8	12	16	4	8	12	16
Treatments	Plant height (cm)				Petiole length (cm)			
EXMF1	19.0^{ab}	22.3^{ab}	21.7^{a}	21.0^{ac}	9.33^{ab}	14.8^{ab}	15.0^{ab}	15.7^{ad}
EXMF2	16.2^{bc}	21.5^{ab}	20.3^{ac}	18.5^{cd}	10.0^{ab}	15.5^{ab}	13.3^{c}	13.2^{de}
EXMF3	15.3^{c}	18.2^{c}	18.0^{cd}	15.8^{d}	7.50^{b}	10.8^{d}	12.3^{c}	11.8^{e}
EXMF4	19.3^{a}	24.0^{a}	24.0^{a}	22.8^{a}	11.3^{a}	16.3^{a}	16.5^{a}	16.2^{ad}
IITA355	18.3^{ac}	22.8^{ab}	18.8^{bd}	21.3^{ac}	8.83^{ab}	15.7^{ab}	14.2^{ac}	16.0^{ad}
IITA182	16.2^{bc}	20.2^{bc}	17.2^{d}	18.7^{cd}	8.17^{ab}	14.0^{bc}	12.0^{c}	13.5^{ce}
IITA165	16.3^{ac}	22.5^{ab}	22.5^{a}	21.7^{ac}	8.83^{ab}	15.0^{ab}	16.5^{a}	16.7^{ab}
IITA1480	17.3^{ac}	20.5^{bc}	18.8^{bd}	18.5^{cd}	9.50^{ab}	12.7^{cd}	14.4^{ac}	14.2^{ce}
IITA1132	18.0^{ac}	22.8^{ab}	21.3^{ab}	22.5^{ab}	10.2^{ab}	8.17^{ab}	15.7^{ab}	17.2^{ab}
IITA1213	18.0^{ac}	20.3^{bc}	21.7^{a}	19.7^{bc}	9.67^{ab}	12.7^{cd}	15.8^{ab}	14.2^{be}
ENZK1	17.0^{ac}	23.0^{ab}	22.7^{a}	21.5^{ac}	10.2^{ab}	14.8^{ab}	13.5^{bc}	14.4^{ae}
ENZK2	15.5^{c}	24.0^{a}	21.2^{ab}	22.0^{ab}	10.8^{a}	15.5^{ab}	15.3^{ab}	15.8^{ab}

Means with the same letter(s) under the same column and heading are not significantly different at $P>0.05$ using Duncan Multiple Range Test (DMRT).

3.2. Effects of Variety on Number of Leaves and Total Leaf Area (cm^2) of Bambara Groundnut at Different Sampling Periods.

Result in Table 2 showed the effect of varieties on number of leaves and total leaf areas of Bambara groundnut. Significant differences existed between the varieties investigated ($P<0.05$). The same varieties EXMF1, EXMF4, IITA355, IITA165 and ENZK2 had more.

Umber of leaves and total leaf area almost across the sampling periods. Variety EXMF2 had the least total leaf area at 4, and 16WAS with the mean values of 124.9 and 457.3 respectively. The differences observed in the number of leaves and total leaf area of Bambara groundnut may be attributed to differences in growth characters which were being influenced by genetic make-up of the plants. This is consistent with the findings of Adetiloye and Salau (2002) and Sajjan *et al.* (2002) who reported that growth characters of crops varied because of differences in their genetic make-up. Also high number of leaves and large total leaf areas of Bambara groundnut found in this work could be attributed to the differences in leaf arrangement and photo synthetic activity in chlorophyll content.

Table-2. Effects of variety on number of leaves and total leaf area (cm^2) of Bambara groundnut at different sampling periods.

	Weeks after sowing							
	4	8	12	16	4	8	12	16
Variety	Number of leaves				Total leaf area (cm^2)			
EXMF1	23.3^{ab}	90.2^{ac}	115.7^{ad}	64.0^{e}	183.6^{ac}	805.9^{b}	1156^{ab}	835.1^{ce}
EXMF2	18.3^{b}	84.8^{bd}	88.3^{cd}	75.8^{de}	124.9^{de}	539.7^{b}	585.6^{ab}	457.3^{e}
EXMF3	20.8^{b}	75.2^{cd}	68.2^{d}	114.8^{be}	129.2^{ce}	562.8^{b}	453.8^{ab}	652.3^{de}
EXMF4	23.7^{ab}	103.7^{ab}	132.5^{ad}	96.0^{ce}	186.3^{ab}	831.6^{b}	1138^{ab}	1406_{ab}
IITA355	19.2^{b}	78.5^{cd}	93.7^{bd}	124.4^{bd}	231.7^{a}	822.9^{b}	716.5^{ab}	855.5^{be}
IITA182	21.3^{b}	76.5^{cd}	73.5^{d}	76.2^{de}	129.2^{ce}	601.6^{b}	102.6^{ab}	533.9^{e}
IITA165	23.0^{ab}	109.8^{a}	115.2^{ad}	158.2^{ab}	170.9^{bd}	916.4^{b}	961.3^{ab}	1179^{ad}
IITA1480	22.5^{ab}	78.5^{cd}	108.0^{ad}	78.3^{de}	114.0^{e}	587.1^{b}	720.6^{ab}	429.6^{e}
IITA1132	18.8^{b}	88.8^{ac}	113.5^{ad}	163.8^{ab}	166.8^{bd}	642.4^{b}	798.0^{ab}	450.6^{e}
IITA1213	20.2^{b}	62.7^{d}	66.8^{d}	107.0^{be}	143.8^{be}	509.9^{b}	467.8^{b}	728.9^{de}
ENZK1	18.7^{b}	88.7^{ac}	155.5^{a}	184.7^{a}	167.5^{be}	715.7^{b}	1223^{a}	1337^{ac}
ENZK2	27.7^{a}	108.2^{ab}	146.2^{ab}	147.0^{ac}	161.1^{be}	1113.5^{a}	1080^{ab}	1444^{a}

Means with the same letter(s) under the same column and heading are not significantly different at P>0.05 using Duncan Multiple Range Test (DMRT).

3.3. Effects of Variety on the Yield and Yield Related Components of Bambara Groundnut

On yields in Table 3 there was gradual increase in number of pods per plant among the varieties used. At all the sampling periods, variety EMXF4 had the highest number of pods, pod and seed weights and seed yield kg/ha with the mean values of 50.3 (pod number), 33.0 (pod weight), 31.5 (seed weight) and 5267 kg/ha (seed yield). This was followed by three other varieties (ENZK2, IITA165 and ENZK1). These four varieties were outstanding in their yield and were significantly different (PO.05) from other varieties. The variety with the least seed weight and seed yield was IITA182 with the mean weight of 12.0 2445 and was significantly lower than the rest of the assessed varieties. The superiority of these four varieties (EXMF4, ENZK2, IITA165 and EXMF1) over others could be attributed to the ability of these varieties to partition the dry matter into pod filling (sink) at their own pace.

Table-3. Effects of variety on the yield and yield related components of Bambara groundnut.

Treament	Pod/plt (g)	Pod wt/plt (g)	Seed wt/plt (kg)	Yield/heet
EXMF1	43.0^{ac}	26.5^{ab}	25.2^{ab}	4440^{ac}
EXMF2	28.3^{cd}	19.2^{bc}	15.8^{ab}	3223^{bd}
EXMF3	28.8^{cd}	16.7^{c}	14.5^{ab}	3145^{cd}
EXMF4	50.3^{a}	33.0^{a}	31.5^{a}	5267^{a}
IITA355	20.0^{d}	24.7^{b}	15.5^{ab}	2745^{cd}
IITA182	22.3^{d}	12.8^{c}	12.0^{ab}	2445^{cd}
IITA165	42.7^{ac}	30.8^{a}	28.7^{ab}	4634^{ab}
IITA1480	29.5^{bd}	16.5^{c}	16.0^{ab}	3256^{bd}
IITA1132	29.0^{bd}	13.0^{b}	17.3^{ab}	3289^{bd}
IITA1213	23.5^{d}	18.3^{c}	14.8^{ab}	3556^{bd}
ENZK1	22.7^{d}	14.7^{c}	10.3^{b}	2600^{d}
ENZK2	44.2^{ab}	28.0^{a}	27.1^{ab}	5000^{a}

Means with the same letter(s) under the same column and heading are not significantly different at P>0.05 using Duncan Multiple Range Test (DMRT).

This agrees; with the work of Stephen (2009) who attributed differences among the number of pods per plant to varieties respond to diverse environmental conditions. Ibrahim (2011) and Ibraheem (2010) had similar report on number of pods per plant.

4. CONCLUSION

From the results obtained in this study, it could be concluded that out of the twelve varieties of Bambara groundnut evaluated, only four varieties (EXMF4, EXMF1, 1ITA165 and ENZK2) performed well both in growth and in yield parameters. Variety EXMF4 showed superiority over others especially in yield and could be grown in the area. Farmers can as well reach out for varieties EXMF1, IITA165 AND ENZK2.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: All authors contributed equally to the conception and design of the study.

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