Yield Responses of Selected Groundnut *(Arachis hypogaea* L.) Cultivars at Two Locations for Adoption in the Southern Guinea Savannah of Nigeria

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***Abstract*: Field studies were conducted at the Teaching and Research Farm, University of Agriculture Makurdi, and National Cereals Research Institute (NCRI) Substation, Yandev during 2017 and 2018 cropping seasons. The objective was to identify the location and cultivar with optimum yield response for adoption. The experiments were laid out in randomized complete block design (RCBD) with three replications. The cultivars evaluated included *Borno Red, Dan-Bomboyo, Ebunaigbaji, Ijiwanda, Samnut-16, Samnut 21,* and *Samnut 22*. Yield components *viz,* number of mature and immature pods, haulm weight, 100 seed weight, length of primary branches, number of secondary branches, weight of 100 mature pods and seeds from 100 mature pods, shelling percentage and seed yield were recorded. Results showed that *Samnut* 21 x Makurdi location interaction gave significantly higher number of mature pods (44.0), number of secondary branches (29) and number of immature pods (45.00). One hundred (100) seed weight was highest (67.00 g) under Samnut 22 x Makurdi interaction followed by Samnut 21 x Makurdi interaction (66.20 g). Ebunaigbaji at Makurdi recorded significantly longer branches (47.00 cm). Samnut 16 x Yandev and Samnut 22 x Yandev interactions produced significantly higher seed yields of 1646.00 kg/ha and 1102.00 kg/ha respectively. For Makurdi farmers interested in fodder, *Ebunaigbaji* at Makurdi with longer primary branches and *Samnut* 21 at Makurdi with higher number of secondary branches gave better results. The environmental conditions at Yandev were more favourable to the seed production of *Samnut* 16 followed by *Samnut* 22.**

***Keywords*: Ground nut, cultivars, yield, and locations**

I. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leguminous crop which belongs to the family Fabaceae (Gregory *et al*., 1973).Cultivated groundnut originated from South Africa (Naidu *et al.*, 2006). Groundnut is the 13th most important food crop and 4th most important oil seed crop of the world (Kees, 2011). It is grown in 23.95 million hectares with a total production of 36.45 million metric tons and average yield of 1520 kg/ha in 2009 (FAO,2006). Major groundnut producing countries are China, 40%; India, 16.4%; Nigeria, 8.2%; USA, 5.9% and Indonesia, 4.1%. Biotic and abiotic factors are major production constraints of groundnut in Nigeria and elsewhere.

Groundnut is a cash grain legume grown for its high quality digestible oil and protein-rich seeds (Kamara *et al*., 2010). Groundnut seeds contain 40-50% fat, 20-50% protein and 10-20% carbohydrate. The seeds are also nutritional source of vitamins E, niacin, folacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium (Asibuo *et al*., 2008).Groundnut seeds are consumed directly in raw, roasted or boiled form, oil extracted from kernels is used as culinary oil, animal feed and industrial raw material (oil cakes and fertilizer). These multiple uses of the crop make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries (Kees, 2011). Groundnut is one of the most popular commercial crops in Nigeria. Its kernels, cake and oil, account for 20% of total Nigerian export earnings. One million hectares of groundnut are grown in Nigeria, with an average annual yield of 1214 kg/ha (FAO, 2006) while satisfying the local requirements for edible nut.

A large proportion of farmers still depend on the informal seed system, using farm-saved seeds or seeds obtained from their neighbors. Improved groundnut cultivars have been developed and released for use in Nigeria. These include *Samnut 10, Samnut 11, Samnu*t 16, *Samnut 19, Samnut 21, Samnut 22, Borno-Red* and *Dan-Bomboyo*. The performance of these groundnut cultivars need to be tested across locations in the Ssouthern guinea savannah representing eco-typic environments of the Southern Guinea Savannah agro-ecological zone. With increasing consumer preference for high quality edible oils and the desire to increase groundnut export to the world market, there is need to investigate the yield responses of groundnut cultivars under the environmental settings of locations in the Southern Guinea Savannah agro-ecological zone of Nigeria.

The objective of this study was therefore to determine the best yield responses of groundnut at Makurdi and Yandev

locations for adoption by farmers (best cultivar x location interaction).

II. MATERIALS AND METHODS

Experimental Site

Field studies on yield responses were conducted at the Teaching and Research Farm, University of Agriculture Makurdi, and at the National Cereal Research Institute (NCRI) substation, Yandev, Benue State. These locations fall within the Southern Guinea Savannah agro-ecological zone of Nigeria (Agboola, 1979). Weather conditions at the two study locations in 2017 and 2018 cropping seasons were recorded. Random soil samples taken from the experimental plots before sowing were dried under sun and run through a 2 mm sieve and intimately mixed for mechanical and chemical analysis according to the procedure of IITA (1995) at Nigerian and Canadian Soil Laboratory (NICANSOL), University of Agriculture, Makurdi.

Materials

Seeds of the groundnut cultivars; *Samnut-16, Samnut-21, Samnut-22* were obtained from Institute of Agricultural Research (IAR) Samaru-Zaria; *Borno-Red* and *Dan-Bomboyo* from NCR I; *Ebunaigbaji and Ijiwanda* from farmers in Oju Local Government Area of Benue state. These were obtained in 2017 and kept in a well ventilated store for use in 2018.

Methods

Land Preparation and Planting

The experimental sites were cleared, ploughed, harrowed and ridged in April, 2017 and 2018, and planting was done in May, 2017 and 2018 in Makurdi and Yandev locations respectively.

III. RESULTS

Length of Primary Branches

Results on effects of location and cultivar on length of primary branches at different days after sowing (DAS) are presented in Table 1. The variation in length of primary branches among the cultivars was significant at 20 ,40 and 60 DAS. *Samnut 22* produced significantly longer primary branches at 20 DAS (22.67 cm) and *Samnut 16* at 40 DAS (31.78cm). At 60 DAS, *Ebunaigbaji* gave significantly longer primary branches (44.58cm) compared to other cultivars.

The effect of location on length of primary branches was not significant at 20 and 60 DAS. Yandev location was significantly higher than Makurdi location in length of primary branches (35.80cm) at 40 DAS.

Location x cultivar interaction on number of secondary branches was significant at 40 and 60 DAS (Table 2). Makurdi x Samnut 21 and Makurdi x Samnut 22 interactions produced significantly higher number of secondary branches

Two seeds were planted per hole and spaced 75cm x 25cm with a population density of 66,600 plants per hectare. Thinning to one seedling per hole was done two weeks after sowing. The gross plot size was 25m x 12m ($300m^2$), with net plot size of 3m x 3m ($9m^2$). The plots were weeded manually twice, at 4 and 8 weeks after sowing. The plants were sprayed fortnightly with Permethrin (sheper) insecticide at the rate of 1.1 kg a i chemical per 15 litres of water per hectare starting from 4 WAS to 9WAS to minimize insect damage by leaf rollers, grasshoppers and aphids.

Observations Recorded

Five plants from each net plot were tagged randomly for recording various yield parameters for Makurdi and Yandev locations which include : number of mature pods per plant, number of immature pods per plant, number of unproductive pegs, weight of haulms per plot, weight of 100 pods, weight of seeds from 100 pods, 100 seed weight and pod yield were recorded for each cultivar.The location x cultivar interactions on all the yield parameters were recorded accordingly.

Treatments and Experimental Design

The experiments were laid out in randomized complete block design (RCBD) with three replications. Five improved groundnut cultivars viz: *Samnut-16, Samnut-21, Samnut-22, Borno-red, Dan-Bomboyo* and two local cultivars namely: *Ebunaigbaj*i and *Ijiwanda* constituted the treatments.

Data Analysis

The collected data were analyzed statistically using the Analysis of Variance Procedure described by Steele and Torrie (1980). Treatment means were compared by Fisher's Least Significant Difference Procedure (F-LSD) at 5% level of probability. Procedure by Gen Stat Release Copy right 2009, VSN International Limited was used.
(21.00) at 40 DAS; Makurdi x Samnut 21 at 60 DAS (29.33).

Length of Mature Pods, Immature Pods and Unproductive Pegs

Table 3 shows that location effects on mature and immature pods were not significant. Makurdi location yielded significantly higher unproductive pegs than Yandev location.

Cultivars exerted significant effects on number of immature pods and unproductive pegs. Samnut 21 gave higher number of immature pods which differed significantly (29.83) from other cultivars. Significantly higher unproductive pegs were produced by Ijiawanda cultivar (45.50) .

Weight of Haulms and Yield of Groundnut

Effects of location x cultivar interaction on haulm weight and yield were not significant (Table 4). Nevertheless, higher haulm weight (11.17 kg) and yield (1646.00 kg/ha) were observed under Makurdi x Samnut 16 and Yandev x Samnut 16 interactions respectively.

Weight of 100 Mature Pods and Weight of Seeds From 100 Mature Pods

Results on 100 pod weight and seed weight from 100 pods are summarized in Table 5. Makurdi location was significantly higher in weight of 100 mature pods (146.80 g) and weight of seeds from 100 pods than Yandev location. The effects of Dan-Bomboyo were significantly different on weight of 100 pods (140.98g) and weight of seeds from 100 pods (102.22g) than that of other cultivars. s

100 Seed Weight and Shelling Percentage

Table 6 shows that Makurdi x Samnut 22 interaction produced significantly higher 100 seed weight (67.00g). Location x cultivar interaction on shelling percentage was not significant, but Makurdi x Samnut 21 and Yandev x Borno-red interactions yielded higher shelling percentage of 72.45.

Table 1: Effects of Location and Cultivar on Length of Primary Branches (cm) At Different Sampling Times in 2017 and 2018 Cropping Seasons (combined data)

Days After Sowing

Treatments	20DAS	40DAS	60DAS
Location			
Makurdi	21.26	21.26	42.02
Yandev	20.89	35.80	38.16
LSD (0.05%)	N.S	2.84	N.S
C.V%	1.40	1.10	3.60
Cultivars			
Borno red	19.15	24.90	35.17
Dan-Bomboyo	19.03	27.23	37.52
Ebunaigbaji	22.17	31.17	44.58
Ijiwanda	22.00	30.77	42.33
Samnut 16	21.83	31.78	43.52
Samnut 21	20.67	22.85	33.80
Samnut 22	22.67	31.00	43.70
LSD (0.05%)	2.44	2.55	4.23
C.V(%)	3.50	2.80	4.60

Table 2: Effects of Location x Cultivar Interactions on Number of Secondary Branches at Different Sampling Times in 2017 and 2018 Cropping Seasons (combined data)

Days After Sowing(DAS)

Location x cultivar	20DAS	40DAS	60DAS
Makurdi x Borno red	2.70	2.67	3.67
Makurdi x Dan-Bomboyo	1.30	2.33	4.67
Makurdi x Ebunaigbaji	10.50	12.33	14.67
Makurdi x Ijiwanda	6.70	5.00	3.00
Makurdi x Samnut 16	28.70	20.00	23.00
Makurdi x Samnut 21	13.30	21.00	29.33
Makurdi x Samnut 22	12.30	21.00	25.00
Yandev x Borno red	5.30	5.00	5.00
Yandev i x Dan-Bomboyo	3.00	3.00	3.00
Yandev x Ebunaigbaji	14.70	12.67	14.00
Yandev x Ijiwanda	2.00	1.00	2.00
Yandev x Samnut 16	13.00	13.67	16.00
Yandev x Samnut 21	13.00	14.00	15.00
Yandev x Samnut 22	11.70	12.00	12.67
LSD (0.05%)	N.S	3.99	7.54
C.V	99.50	22.90	33.10

NS: Not Significant

Table 3: Effects of Location and Cultivar on Number of Mature Pods, Immature Pods and Unproductive Pegs Per Plant in 2017 and 2018 Cropping Seasons (combined data)

Treatments	No. of Mature pods	No. of Immature pods	No. of Unproductive pegs
Location			
Makurdi	21.20	19.76	26.00
Yandev	23.80	19.00	19.90
LSD (0.05%)	NS	NS	1.68
C.V%	13.40	0.20	0.60
Cultivars			
Borno red	18.30	16.50	16.50
Dan-Bomboyo	24.70	21.17	34.00
Ebunaigbaji	18.70	14.50	16.17
Ijiwanda	21.20	12.00	45.50
Samnut 16	29.30	23.83	15.00
Samnut 21	31.50	29.83	17.83
Samnut 22	18.00	17.83	15.67
LSD (0.05%)	NS	1.34	1.04
C.V(%)	8.20	0.08	2.10

Table 4: Effects of Location x Cultivar Interactions on Weight of Groundnut Haulms (kg) and Groundnut Yield (kg/ha) in 2017 and2018 Cropping Seasons (combined data).

Location x Cultivar	Haulm weight (kg/ha)	Yield (kg/ha)
Makurdi x Borno red	4.13	792.00
Makurdi x Dan-Bomboyo	4.73	898.00
Makurdi x Ebunaigbaji	9.57	885.00
Makurdi x Ijiwanda	6.07	728.00
Makurdi x Samnut 16	11.17	1049.00
Makurdi x Samnut 21	9.83	1064.00
Makurdi x Samnut 22	9.67	974.00
Yandev x Borno red	3.20	627.00
Yandev i x Dan-Bomboyo	3.57	904.00

Yandev x Ebunaigbaji	7.20	869.00
Yandev x Ijiwanda	3.07	855.00
Yandev x Samnut 16	8.70	1646.00
Yandev x Samnut 21	7.60	1087.00
Yandev x Samnut 22	8.67	1102.00
LSD (0.05%)	N.S	N.S
C.V	19.30	22.20

NS: Not Significant

Table 5: Effects of Location and Cultivar on Weight of 100 Pods (g) and Weight of Seeds from 100 Pods (g) in 2017 and 2018 Cropping Seasons (combined data).

Location	weight of 100 pods (g)	weight of seeds from 100 pods (g)
Makurdi	146.80	106.60
Yandev	107.63	77.27
LSD (0.05%)	0.92	5.16
C.V%	0.40	1.70
Cultivars		
Borno red	96.08	72.87
Dan-Bomboyo	140.98	102.22
Ebunaigbaji	116.48	86.70
Ijiwanda	131.85	95.32
Samnut 16	131.20	92.18
Samnut 21	137.55	97.62
Samnut 22	136.35	96.63
LSD (0.05%)	2.36	3.60
C.V(%)	0.20	1.60

Table 6: Effects of Location x Cultivar Interactions on 100 Seed Weight (g) and Shelling Percentage (%) in 2017 and 2018 Cropping Seasons (combined data)

Location x Cultivar	100 seed wt (g)	Shelling %
Makurdi x Borno red	40.80	71.60
Makurdi x Dan-Bomboyo	57.77	71.79
Makurdi x Ebunaigbaji	53.93	71.65
Makurdi x Ijiwanda	41.83	71.02
Makurdi x Samnut 16	57.77	71.45
Makurdi x Samnut 21	66.20	72.45
Makurdi x Samnut 22	67.00	72.28
Yandev x Borno red	39.43	72.45
Yandev i x Dan-Bomboyo	51.17	72.17
Yandev x Ebunaigbaji	53.50	70.00
Yandev x Ijiwanda	46.00	70.37
Yandev x Samnut 16	55.43	71.03
Yandev x Samnut 21	54.13	69.75
Yandev x Samnut 22	53.13	69.77
LSD (0.05%)	4.35	NS
C.V (%)	4.40	2.60

NS: Not Significant

IV. DISCUSSION

Growth, development and yield of crop plants, together with factors affecting them occupy a position of primary importance in crop production. Hudson (1984) reported that growth and development of crops are products of interplay between its genetic constitution and the environment (genotype x environment interaction). While the genetic makeup of a crop is a fixed entity that delimits the extent to which that crop can develop and yield, the actual performance of the crop is regulated by the environment in which it grows.

Arkley and Ulrich (1962) suggested that of the three factors on which plant growth depends, namely: soil, climate and cultural practices, the effect of climate is the most complex. According to Watson (1952), net assimilation rate of a field crop is determined by the prevailing weather conditions at a given time, as well as the genetic constitution of the plant, but not age or nutrition. Variations in weather conditions significantly influenced net assimilation rate, weight and number of pods, seed weight, leaf area, yield and dry matter accumulation of cowpea seedlings in Southern Nigeria (Ezedinma, 1967).

Significantly higher number of secondary branches and mature pods, weight of haulms, weight of seeds from 100 pods, weight of 100 mature pods, 100 seed weight and shelling % were produced when the groundnut cultivars were planted in Makurdi location (cultivar x location interaction). The favourable weather conditions of rainfall and temperature gave higher seed yield of 1646 kg/ha with *Samnut 16* under Yandev weather conditions. This implies of all the cultivars evaluated, *Samnut 16* is better adopted to Yandev environment for optimum growth and yield performance and should be adopted by farmers in Yandev.

There was sufficient rainfall at Yandev from April to September (144.7mm to 225.6mm), but inadequate rainfall at Makurdi from April to August (78.0mm to 21.74mm). At Makurdi, rainfall was 60.40mm in June, 87.00mm in July and 21.74mm in August. The low seed yield in Makurdi with *Samnut 16* (1049.00 kg/ha) and *Samnut 21* (1064.00 kg/ha) was probably attributed to low rainfall distribution from April to August. Farmers in Benue State plant groundnut in the month of April/May and harvest in August.

V. CONCLUSION

Results of the study conducted in 2017 and 2018 cropping seasons had identified groundnut cultivars x location interactions with better yield responses .From the interactions, the cultivars that were more adapted to Makurdi and Yandev locations in the Southern Guinea Savannah agro-ecological zone of Nigeria were also identified.The highest yielding cultivars were: *Samnut 16* (1645.00 kg/ha) and *Samnut 22*

(1102.00 kg/ha) from Yandev location.While *Samnut 21* (1064.00 kg/ha) and *Samnut 16* (1049.00 kg/ha) produced higher yield at Makurdi, but lower compared to Yandev location.*Samnut 16* and *Samnut 21* showed better yield responses (1646.00 kg/ha and 1064.00 kg/ha) at Yandev and Makurdi locations respectively and may be adopted by farmers under Yandev and Makurdi locations.

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