EVALUATION FOR YIELD OF SOME SELECTED GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS GROWN AT KEFFI, NASARAWA STATE NIGERIA

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Abstract: Evaluation for yield of selected groundnut cultivars was carried out; nine cultivars were evaluated in a Randomized Complete Block Design (RCBD) with three replication at the Department of Plant Science and Biotechnology Research/ Experimental Garden Nasarawa State University Keffi. Plant nutrient analysis were significantly different ($P<0.05$), Ca (3.35-5.05%), P (0.41-0.49%), N (4.00-4.54%) and K (3.62-5.58%). Fresh mass per plant, dry mass per plant, number of pods per plants, number of seed per plants, pod formation per plants without seeds, 100 seed weight, fresh yield mass and dry yield mass was studied for yield determination were significantly different ($P<0.05$). Two genotypes, ICGV 15-5891 and ICGV 15-07947, displayed a significantly high number of seeds produced per pod. ICGV 15-07999 produced fewer seeds per pod compared to all other genotypes. ICGV 15-5891 was the least performing genotype when compared to ICGV- 15-09932 with respect to dry matter and pods produced. ICGV-12991 produces significantly higher seed yield of 936kg ha^{-1}. Genotype ICGV-12991 has a moderate dry matter and high number of pod per plant at harvest which makes it high yielding for the location to which they were evaluated. Therefore, ICGV-12991 is highly recommended for farmers as well as useful for breeding programme.

Keywords: Cultivars, evaluation, *Arachis hypogea*, yield

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the 13th most important food crop of the world (Taru *et al.*, 2008) belonging to the family Fabaceae. It is a rich source of minerals (phosphorus, calcium, magnesium and potassium) and vitamins (E, K and B group) niacin, falacin, zinc, iron, riboflavin and thiamine (Ingale and Shrivastava, 2011; Stigter and Brunini, 2007). The groundnut kernels are consumed directly as raw, roasted or boiled kernels or oil extracted from the kernel is used as culinary oil. It is also used as animal feed (oil pressings, seeds, green material and straw) and industrial raw material (oil cakes and fertilizer). The crop plays an important role in the dietary requirements and its haulms are used as livestock feed (Pretorius, 2006).

It is a self-pollinated leguminous crop which is believed to have originated from Latin America where it was grown by the Indian communities, but now its cultivation has spread throughout the tropical and temperate climates of the world (Van der Merwe and Joubert, 1995). Two-seeded types originating from Brazil were taken to Africa, whereas three-seeded types originated from Peru and were transported from the west coast of South America to China and islands in the western Pacific Spanish types were introduced to Europe in the late 1700s from Brazil and grown for oil and for human consumption as chocolate-covered peanuts (Stalker, 1997).

Groundnut has contributed immensely to the development of the Nigerian economy. From 1956 to 1967, groundnut products including cake (kulikuli) and oil accounted for about 70% of total Nigeria export earnings, making it the country's most valuable single export crop ahead of other cash crops like cotton, oil palm, cocoa and rubber. Presently, it provides significant sources of cash through the sales of seed, cakes, oil and haulms (Olorunju *et al.,* 1999). This research work is aimed at evaluating the yield performance and identifying the best suited cultivar to be grown under the climatic condition of Keffi LGA of Nasarawa State.

Materials and Methods

Nine groundnut cultivars which includes: ICGV 15-5891, ICGV 15-09994, ICGV-12991, ICGV 15-86024, ICGV 15-07947, ICGV 15-09932, ICGV 15-07803, ICGV 15-09992 and ICGV 15-07999 obtained from the IAR (Institutes of Agricultural Research and Extension Services) Ahmadu Bello University Samaru, Zaria New Bussa were planted in plots measuring 4 x 3.6 m. Each plot were planted with five rows with an inter-row spacing of 90 cm and the intra-row spacing of 7 cm and a planting depth of 6 cm. Three plant samples from each plot, across all replications, were harvested from an area of 0.135 m^2 and taken to the laboratory for determination of above ground dry mass at flowering. Leaves and stems were oven-dried at 60 ºC until constant mass and ground (Jansen van Rensburg *et al.*, 2010). Plant nutrient analysis for Calcium (Ca), Nitrogen (N), Phosphorus (P) and Potassium (K) regarded as most important in groundnut production, was performed. Nitrogen was determined by auto analyzer, Phosphorus was determined by calorimetry, Potassium was determined by flame photometry and Calcium was determined by the oxalate method and titrimetry. The uptake of this macronutrient was calculated by multiplying the nutrient concentration by their respective dry matter (Singh *et al.*, 2007).

At maturity, five plants were randomly harvested per 1.35 m^2 to determine from each plot: number of seeds per pod in five plants (to determine pod filling), average number of seeds per pod, fresh and dry seed mass (kg), pod formation (%), number of pods per plant (in five plants). Seed yield was harvested in each plot. Fresh mass and dry mass for seed yield and pod yield, and 100-seed weight was calculated from harvested bulk.All data were subjected to statistical analysis using Genstat® Version 14. Means were separated using Fisher's unprotected testing least significant differences at 5% level when ANOVA showed significant ($P < 0.05$) difference between treatments.

Results and Discussion

Analysis for Nutrient concentration levels for nine cultivars showed that Calcium concentration levels were significantly different between cultivars ($P<0.05$) Table 1. High concentration of Calcium was observed in ICGV-15-5891 with 5.05% followed by ICGV-15-09994 with 5.023%. Other cultivars ranges from 3.35-4.8%. The lowest calcium concentration was observed in genotype ICGV-15-07999 with 3.35%. Phosphorus concentration levels were significantly different ($P<0.05$), they ranges from 0.41-0.49% for example, high level was observed in genotype ICGV-15-07999 with 0.49% and the lowest were in ICGV-15-5891 and ICGV-15-

07947 with 0.41% respectively. Nitrogen concentration levels were significantly different in genotype evaluated (P<0.05). The Nitrogen concentration ranges from 4.00-4.54%. The genotype ICGV-15-12991 has the highest nitrogen concentration while the lowest nitrogen concentration was observed in ICGV-15-09994 with 4.00%. Potassium concentration levels were also significantly different among all the cultivars evaluated (P<0.05). Genotype ICGV-15-07999 was moderately higher than ICGV-15-07803 with 5.58% and 5.36%, respectively. While the lowest potassium concentration level was observed in genotype ICGV-15-07947 with 3.62% (Table 1). The results of this study for macro elements were not different from those of Hochmuth *et al.* (2010) who reported that groundnut sufficiency levels for macro nutrient as N (2 to 5%), P (0.25 to 0.6%), K (1.5%) and Ca (0.6 to 5%). However, the result for Potassium concentration levels for all the genotypes for the current study were above the sufficiency levels reported by Hochmuth *et al.* (2010). The result obtained for the mean square performance is presented in Table 2.

Table 1: Analysis for nutrient concentration levels in plants above ground for nine genotypes at flowering stage

Concentration	Ca (%)	P (%)	N (%)	K (%)
Genotype				
ICGV-15-5891	5.05_{a}	0.41_{ab}	4.10_{a}	3.86_{bcd}
ICGV-15-09994	5.023_{a}	0.45_{a}	4.00_{a}	3.94_{bcd}
ICGV-12991	4.81_{ab}	0.44_{a}	4.45_{a}	4.42_{abc}
ICGV-15-86024	4.61_{abc}	0.48_{a}	4.14_{a}	4.32_{abc}
ICGV-15-07947	4.59_{abc}	0.41_{ab}	4.16_{a}	3.62_{bcd}
ICGV-15-09932	4.50_{bc}	0.43_{a}	4.29_{a}	4.74_{bc}
ICGV-15-07803	4.28_{cd}	0.42_{ab}	4.06_{a}	5.36_{a}
ICGV-15-09992	3.94_{d}	0.43_{a}	4.23_{a}	4.7_{bc}
ICGV-15-07999	3.35_{e}	0.49_{a}	4.21_{a}	5.58_{a}
CV %	8.3	14.9	5.5	17.7
$LSD_{0.05}$	0.64	0.11	0.42	1.38

Means with same letters in same columns are not significantly different (P<0.05) using Duncan multiples range test.

Table 2: Mean square performance for yield and agronomic parameters of nine groundnut genotypes evaluated

Source of variation	DF	Fresh mass per plant	Dry mass per plant	Dry pod mass per plant	No of pods per plant	No of seeds per plant	Pod formation per plant without seed	100 seeds weight	Fresh yield mass	Dry yield mass
Rep	2	1.58	10.81	12.81	1360	785	50.81	281.9	181.3	308.2
Genotypes	8	13.54**	3.117*	1.167	398.3**	1169**	31.29	23.46	1131**	824.6**
Error	16	3.209	1.195	0.724	68.3	180.6	19.65	43.1	48.08	37.1

**shows the Least Significance differences; DF: degree of freedom

The result revealed a significant difference among all traits studied except for dry mass per plant, pod formation per plant and 100-seed weight. The significance observed in this study indicated that agronomic variation exist across the 9 (nine) groundnut cultivars except for dry mass per plant, pod formation per plant and 100–seed weight. This could be as a results of differences in the genetic composition of this cultivars as such, this finding is very useful for selecting agronomical favorable cultivars for breeding programme. This study is in line with what Upadyaya (2006) asserted that agronomic traits are useful in describing how a particular groundnut genotype is different from others. Above ground biomass, pod mass and pod number of the Nine groundnut cultivars obtained were significantly different in vegetative mass and pod mass (P<0.05). The genotype ICGV 15-07999 produced high biomass of 0.26 kg/plant where as the lowest biomass produced was observed in ICGV 15-5891 0.040 kg/plant. Dry pod mass was significantly different to all genotypes (P<0.05). The highest significant difference was observed in ICGV 15-07999, ICGV 15-07947, and ICGV 15-09932 which is 0.25 kg /plant, respectively. No of pods produced per plant were significantly different from all genotypes (P<0.05) the highest significant differences was observed in ICGV -12991 with 73 per plant while the lowest was observed in ICGV 15-5891 with 27 per plant (Table 3). Basu *et al*. (2008) reported that balancing the nutrients in the soil lead to increased dry matter production and yield. The current study has shown that dry matter production depends on genotype grown in that location when all other factors remain favorable. The number of pods produced per plant was significantly different in genotypes. Genotypes ability to produce pods does not always depend on the dry matter produced but also genetic ability. For example, ICGV 12991 produced low dry mass with high numbers compared with ICGV 15-07999 with high dry mass and a moderate number of pods. The following components of yield such as number of seeds per pod, pop formation percentages and seed dry mass per plant were also used to determine the performance of the planted cultivars. There were no significant difference between genotypes for seed number produced per pod (P<0.05). The highest seed produced per pod were observed for ICGV 15-07947 closely followed by ICGV 15-5891 while the lowest number of seeds produced per pod was observed for the genotypes ICGV 15-07999. The genotypes had a significant difference in pop formation (number of empty pods) (P<0.05). The highest percentage was observed in ICGV 15-07999 (23.11%) while the lowest percentage was observed in ICGV 15-5891 (3.31%). The seed dry mass has significant difference among the genotypes (P<0.05) ICGV 15-09932 had a high significant difference of 0.19kg/plant in seed dry mass and the lowest seed dry weight was observed in ICGV 15-5891 which is 0.063 kg/plant (Table 4). Following the patterns of seed number, pod formation and seed dry mass weight significant variation in shelling were found to be in consistent with the findings of Ghosh (2007). Kamara (2011) reported that genotypes significantly influenced the seeds per pod and this is in agreement with the results of the current study where out of nine genotypes two genotypes, ICGV 15-5891 and ICGV 15-07947, displayed a significantly high number of seeds produced per pod. ICGV 15-07999 produced fewer seeds per pod compared to all other genotypes, despite its good performance in dry matter and pods per plant. The poor performance of other genotypes with regard to seed yield could be due to low calcium available near pod zone (Kamara 2011) or its ability to absorb nutrients during the pod filling (Kamara 2011). The behavior of this genotype might be that it strongly needs more calcium supplementation at flowering stage (Murata, 2003). ICGV 15-5891 was the least performing genotype when compared to ICGV- 15-09932 with respect to dry matter and pods produced, but it did well during pod filling. The pattern of dry matter production and its distribution into component plant parts has been of phenomenal interest to the research workers engaged in yield analysis. In view of this, in the present investigation, it envisaged to know the pattern of dry matter accumulation, its distribution in component parts of plant. In the present investigation, the dry matter accumulation is less than that of other plant parts. The seed yield was generally low due to the heavy rainfall experienced just before harvesting because some seeds were rotten, some were affected by insects and some could not be lifted together with the vegetative part of the plants since the pegs were broken due to wet condition.

Table 3: Comparison of dry mass per plant, dry pods mass per plant and pod number per plant at harvest

Parameters	Dry mass per plant $^{-1}$	Dry pods mass per plant $^{-1}$	No. of pods per plant^{-1}
Cultivars			
ICGV 15-5891	0.040_{bc}	0.12_{a}	27_{c}
ICGV 15-09994	0.085_{bc}	0.23_{a}	53_{bc}
ICGV -12991	0.15_{a}	0.21_{a}	73_{a}
ICGV 15-86024	0.21_{a}	0.15_{a}	35_{bc}
ICGV 15-07947	0.21_{a}	0.25_{a}	64_{ab}
ICGV 15-09932	0.13_{a}	0.25_{a}	70_{a}
ICGV 15-07803	0.14_{a}	0.14_{a}	41_{bc}
ICGV 15-09992	0.081_{b}	0.24_{a}	41_{bc}
ICGV 15-07999	0.26_{a}	0.25_{a}	66_{bc}
CV%	64.7	42.8	52.8
$LSD_{0.05}$	0.038	0.030	46.8

Means with same letters in same columns are not significantly different (P>0.05) using Duncan multiples range test

Table 4: Comparison of number of seeds per pod, pod formation and seed dry mass

Parameters	No. of seed Pod $^{-1}$	Pod formation (%)	Seed dry mass (kg plant^{-1})
Cultivars			
ICGV 15-5891	1.50_{a}	3.31_{c}	0.063_{c}
ICGV 15-09994	1.24_{bc}	17.78_{ab}	0.15_{a}
ICGV -12991	1.13_{bc}	12.35_{bc}	0.13_{bc}
ICGV 15-86024	1.20_{bc}	16.21_{ab}	0.13_{c}
ICGV 15-07947	1.53_{a}	10.05_{c}	0.12_{c}
ICGV 15-09932	1.41_{a}	6.17_{c}	0.19_{a}
ICGV 15-07803	1.18_{bc}	11.22_{bc}	0.10_{b}
ICGV 15-09992	1.45_{a}	15.01_{ab}	0.17_{a}
ICGV 15-07999	0.92_{c}	23.11_{a}	0.11_{b}
CV%	16	59.6	33
$LSD_{0.05}$	0.38	17.30	0.071

Means with same letters in same columns are not significantly different (P>0.05) using Duncan multiples range test

Table 5: Comparison of seed yield and 100-seed weight for the nine cultivars after harvest

Parameters	seed yield (kg ha $^{-1}$)	100 seed weight (kg plot^{-1})
Cultivars		
ICGV 15-5891	545_{c}	0.042_{c}
ICGV 15-09994	779_{c}	0.056_{ab}
ICGV -12991	936_{a}	0.050_{ab}
ICGV 15-86024	692_{bc}	0.045_{bc}
ICGV 15-07947	895_{ab}	0.042_{bc}
ICGV 15-09932	878_{ab}	0.051_{ab}
ICGV 15-07803	817_{bc}	0.041_{bc}
ICGV 15-09992	806_{bc}	0.55_{ab}
ICGV 15-07999	666_{c}	0.058_{ab}
CV%	21.0	7.9
$LSD_{0.05}$	425.4	0.0065

Means with same letters in same columns are not significantly different (P>0.05) using Duncan multiples range test

Therefore the genotypes were significantly different in seed yield (P<0.05) the results shows that, ICGV -12991 produces significantly higher seed yield of 936 kg ha^{-1} while the lowest seed yield is recorded in ICGV 15-5891 545 kg ha $^{-1}$ .The results for 100-seeds weight revealed that, there were significant differences between the cultivars (P<0.05). ICGV 15-07999 has the highest 100-seed weight of 0.058 kg ha $^{-1}$ while the lowest 100- seed weight was recorded in ICGV 15-07803 0.041 kg ha $^{-1}$ (Table 5). Janila *et al.* (2013) maintained that, number of matured pod per plant, pod yield per plant and 100 seed weight are very important yield contributing parameters. This explains the significant and positive correlation between the agronomic traits in this study. Physiologically, pod yield is a function of crop growth rate, duration of reproductive growth, and the proportion of crop growth rate partitioned towards pod yield (Janila *et al.,* 2013). Mishra and Yadav (1992) reported that pod yield showed positive association with pod yield per plant indicating that pod yield per plant could be used as criteria for selecting high yielding genotypes. However, the variations recorded in mean seed weight were strongly influenced by the variation in the Groundnut cultivars studied (Karkannavar *et al.,* 1991) the relatively lower seed yield recorded in the current study were probably attributable to the adverse effect of the climatic factors, whilst the subsequent heavy rain encourage vegetative growth at the expenses of pod formation and filling (Gibbons 2002).

Conclusion

Genotypes evaluated were significantly different in terms of nutrient concentration levels. This strongly supports soil nutrients analysis before planting. Genotype x environment interaction was observed in genotype ICGV-12991 which makes it the best performing genotype among all the genotypes evaluated. Genotype ICGV-12991 has a moderate dry matter and high number of pods per plant at harvest which makes it high yielding for the location to which they were evaluated. The significant differences among the nine cultivars evaluated could be as a result or differences in the genetic composition among the genotypes as such, this finding is very useful for selecting agronomical favorable genotypes for breeding programme.

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Conflict of Interest

The Authors declare that there is no conflict of interest related to this study.

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