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VARIABILITY STUDIES AMONG GENOTYPES OF GROUNDNUT (*Arachis Hypogaea* L.) IN MUBI, ADAMAWA STATE

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Abstract
The study was conducted at the Adamawa State University Farm, Mubi during 2021 and 2022 cropping seasons to determine the difference in pattern of variations among eighteen genotypes of groundnut; to identify and select the most promising genotypes of groundnut. The Eighteen genotypes of groundnut were evaluated using Randomized Complete Block Design replicated three times. Agronomic parameters collected include: days to first and 50% flowering, plant height, branches/plant, days to maturity, matured pods/plant, weight of haulm, 100 nut weight, 100 pod weight and kernel yield. Qualitative parameters include: flower colour, stem branching pattern, stem pigmentation, stem hairiness, leaflet shape and peg pigmentation. Others are: pod reticulation, seed colour, pod constriction, leaflet margin and pod beak. The agronomic parameters were subjected to analysis of variance and treatment means that showed significant difference were separated using Duncan's Multiple Range Test. Results revealed that sufficient genetic variability exist among the groundnut genotypes. Michika-6 (2,256.40 kg/ha) and Samnut-24 (2,184.50 kg/ha) outperformed the other genotypes with respect to kernel yield. These two genotypes including Michika-2 showed earliness. High genotypic and phenotypic coefficients of variation were recorded for branches/plant (40.49 and 49.96 respectively) and haulm weight (27.30 and 31.26 respectively). Furthermore, branches/plant (84.83 and 9.84 respectively) and haulms weight (76.26 and 270.81 respectively) recorded high heritability and high genetic advance; suggesting that improvement of groundnut could be possible through selection procedure.

Keywords: Variability, Agronomic traits, Qualitative traits, Genotypes and Groundnut

Introduction
Groundnut (*Arachis hypogaea* L.) is an annual leguminous oilseed crop cultivated in the semi-arid and subtropical regions of the world. The crop is rich in protein (27 – 33%) and the seed contains about 45 – 55% oil (**Janila *et al.*, 2013; Ajeigbe *et al*., 2015)**.

In 2014, groundnut was grown in more than 115 countries around the world, covering a total land area of about 24.31 million hectares with a global production of about 42.4 million tons (FAO, 2016). The major producers were China and India with 15.7 million and 6.5 million tons, respectively, followed by Nigeria (3.4 million tons), the USA (2.4 million tons), and Sudan (1.8 million tons). Furthermore, FAO (2016) reported that Africa ranks second, accounting for over 29.8% of global production after Asia (59.8% of global production). However, Africa has the lowest average yield (964.8 kg/ha) compared to America (3,333.4 kg/ha), Asia (2,370.6 kg/ha), Oceania (1847.9 kg/ha), Europe (1,158.5 kg/ha), while the global average yield (1,654.6 kg/ha).

The groundnut kernels contain many health enhancing nutrients namely vitamins:

vitamin E, niacin, riboflavin, thiamine, pantothenic acid and vitamin B-6. Minerals like calcium, phosphorus, magnesium, zinc, iron, potassium; antioxidants (p-coumaric acid) and resveratrol in groundnut are rich in mono-unsaturated fatty acids (Janila *et al*., 2013). Groundnut is a dietary source of biologically active polyphenols, flavonoids, and isoflavones which are highly nutritious, their products can be provided energy, protein, and micronutrient needed among the poor rural farmers. The haulm is used as animal feed and industrial raw material (Janila *et al*., 2013 and **Ajeigbe *et al*., 2015**), while the oil is use for cooking.

Statement of the Problem

There has not been much breeding work on groundnut in the Northeastern Nigeria especially in Mubi environs and the under-utilization of vast potential of groundnut landraces has led to low genetic variability among varieties available to farmers. This low genetic variability remain one of the main challenges to groundnut improvement (Pasupuleti *et al*., 2013). The cultivation of low yielding varieties and poor seed supply are among the major constraints to increasing groundnut production. Furthermore, in Mubi, Adamawa State, not much attention has been given to the collection and evaluation of the available groundnut landraces on information on the agronomic and qualitative traits of the cultivars grown. To overcome these challenges, the development of high yielding groundnut genotypes through evaluation and selection of landraces for the improvement of yield and yield related traits cannot be over-emphasized in Mubi environs. In this context, the present investigation was carried out to unravel the components of genetic variability among eighteen genotypes of groundnut with respect to ten agronomic and eleven qualitative traits.

The specific objectives are to:

i. determine difference in pattern of variation among the eighteen genotypes of groundnut.
ii. identify and select the most promising genotypes of groundnut for future breeding programme.

Materials and Methods

Experimental Site

Studies on the genetic parameters on some genotypes of groundnut was carried out at the Adamawa State University Farm, Mubi during 2021 and 2022 cropping seasons. Eighteen genotypes of groundnut were collected for the study; of which three genotypes were obtained from Mubi, nine from Michika, three from Institute of Agricultural Research (IAR), while two genotypes from Gombi and one from Madagali (Table 1).

Land Preparation, Seed Sowing and Experimental Design

For each of cropping seasons**,** the farmland was cleared using cutlass and hoe, then ploughed and harrowed using a tractor to break large clods of soil. The field was properly leveled using hand hoe in order to obtain a fine soil tilt for easy emergence of groundnut seeds. The sowing of groundnut genotypes was done at the establishment of rains.

In 2021 and 2022 cropping seasons, eighteen groundnut genotypes were grown in a Randomized Complete Block Design (RCBD) replicated three times. In each replication, each genotype was planted in five rows of 3 m long with rows spaced at 50 cm apart and intra-row spaced at 30 cm apart. Two to three seeds of each genotype was planted per hole and later thinned to one plant per stand at two Weeks After Sowing (WAS). The experimental field measured 58 m x 8 m (464 m^2), gross plot (2 m x 3 m = 6 m^2) and net plot (3 m x 1 m = 3 m^2). At 3, 5 and 9 WAS, weeding of the plots was carried out to free the groundnut plants from weed competition for nutrients and sunlight needed by the plants for photosynthesis.

Data Collection

The ten agronomic parameters collected from eight tagged plants from the net plot are: days to first and 50% flowering, days to maturity, plant height (cm), branches/plant and matured pods/plant. Others include: 100 pod weight (g), 100 nut weight (g), kernel yield (kg/ha) and dry haulm yield (kg/ha).

Eleven qualitative characters were collected using International Board for Plant Genetic Resources (IBPGR)(1985) guidelines and IBPGR (1992) Descriptors for groundnut. They are: flower colour, stem branching pattern, stem pigmentation, stem hairiness, leaflet shape and peg pigmentation. Others are: pod reticulation, seed colour, pod constriction, leaflet margin and pod beak.

Statistical Analysis

Data collected on agronomic traits were subjected to analysis of variance using the R Foundation for Statistical Computing Platform (RStudio Team, 2021) and treatment means that showed significant difference were separated using Duncan's Multiple Range Test (Statistics for Agricultural Research (STAR, 2014).

Estimation of Genetic Parameters

The genetic parameters were calculated using Burton and Davane (1953), Singh and Chaudhary (1985) method.

Genetic variance $\delta^2_g = \frac{MSg - MSe}{r}$

Phenotypic Variance $\delta^2_p = \sigma^2_g + \sigma^2_e$

Variance due to error = MS_e

Where

MS_g and MS_e are genotype and error mean square and r = number of replications

The phenotypic coefficient of variation (PVC)

$PCV = \frac{\sqrt{\sigma^2 p}}{\bar{X}} \times 100$ and the

$\bar{X}$ = Mean

Genotypic Coefficient of Variance (GCV)

$GCV = \frac{\sqrt{\sigma^2 g}}{\bar{X}} \times 100$

Heritability broad sense was computed by the formula

$H = \frac{\sigma^2 g}{\sigma^2 p} \times \frac{100}{1}$

The Genetic Advance (GA) was calculated using percentage of the grand mean

$GA = \frac{h^{2} \times k\sigma^2_p}{x} \times 100$

Where:

H = heritability

K = selection differential =2.06, h^2 = heritability and

σ^2_p= standard deviation of phenotypic variance.

Results and Disussion

Analysis of Variance for Agronomic Traits of Groundnuts studied

The combined analysis of variance for ten agronomic traits of groundnut (Table 2) evaluated indicated highly significant ($P<0.01$) mean squares due genotypes with respect to all the studies traits (days to first and 50% flowering, days to maturity, plant height, number of branches/plant, number of mature pods/plant, 100 pod weight, 100 nut weight, weight of dry haulm and kernel yield). The highly significant mean square differences for the eighteen genotypes implies that there is a clear evidence of inherent genetic variability among the groundnut genotypes with respect to all the characters studied. These results are in general agreement with the findings of Nath and Alam (2002); Narasimhulu *et al.* (2012); Makinde and Ariyo (2013); Kadams *et al*. (2013); Chavadhari *et al.* (2017); Omima *et al*. (2018); and Javed *et al*.(2020). Furthermore, the highly significant genotype x year interaction effect for the flowering traits, pods/plants, haulms weigh, 100 pod weight including kernel yield traits indicated the diversity of the genotypes and their differences with respect to these characters across the two years of evaluation as earlier reported by Jonah and Toungos (2017) and Jonah *et al*. (2019) okra.

Mean Performance of Agronomic Traits of Groundnut

The mean performance of the ten agronomic traits evaluated across the years is presented in Table 3. The results showed that Michika-3 was late maturing groundnut, having 33 days to produce its first flower, followed by Samnut-23 (29.17), while Samnut-24 was early maturing (25.17 days). Similarly, Michika-3 (late maturing) also produced its days to 50% flowering at 38 days after sowing, followed by Michika-8 (37.33 days). Although, the two accessions were statistically not different. Samnut-24 produced 50% flowers at 27 days (early maturing) after sowing. Mubi-1 took 133 days to reach its days to maturity, followed by Michika-4 and Madagali, each took 120 days to reach their maturity. For plant height traits, Michika-5 recorded the highest plant height (52.54 cm), followed by Michika-9 (47 cm), while the least groundnut plant height was recorded by Michika-3 (29.62 cm). Branches/plant was highest for Michika-3 (48.77), followed by Michika-4 having 40.27 branches and the least number of branches was recorded by Michika-6 (8.90). For matured pods/plant, Michika-8 (42.43) was the highest, followed by Mubi-2 (41.83). These two accessions were statistically at par and the least with respect to number of matured pods/plant was Gombi-1. For haulm weight trait, Michika-5 was most superior recording 2,749 Kg/ha, followed by Michika-9 (2,430.70 kg/ha), while Michika-2 (952.20 kg/ha) was the least. Furthermore, for 100 nut weight of groundnut, Samnut-24 had the highest estimate (52.62 g). Although it was not statistically different from Samnut-22 (51.37 g), Mubi-1 (50.44 g) and Michika-6 (49.97 g). Mubi-1 recorded the highest 100 pod weight of 152.44 g, followed by Samnut-23 (146.60 g), while the least was Michika-3 (92.28 g). For groundnut kernel yield (kg/ha), Michika-6 was most superior (2,256.40 kg/ha), followed by Samnut-24 having 2,184.50 kg/ha. Although these genotypes were statistically similar with most of the genotypes studied. The present study revealed that wide variation exist among the genotypes for all the parameters studied. For days to 50% flowering, Samnut-24 showed earliness as it produced 50% flowers at 27 days after sowing. Similar results for days to 50% flowering in groundnut were obtained by Kadams *et al*. (2013) and Engin *et al*. (2018). For plant height Michika-5 and Michika-9, recorded the tallest plants, which agreed with the findings of the following researchers: Kadams and Sajo, (1998) in bambara groundnut, Kadams *et al.* (2013) and Yusuf *et al.* (2017) in groundnut. Michika-3 and Michika-4 which recorded the highest

number of branches/plant corroborates with the findings of Nath and Alam (2002), Yusuf *et al.* (2017) and Engin *et al.* (2018) in groundnut trials. The results of this study which also revealed wide variation for matured pods/plant for Michika-8 and Mubi-2 is in agreement with the following researchers (Yusuf *et al.,* 2017; Kadams *et al.,* 2013; Nath and Alam, 2002 and Engin *et al.,* 2018) in groundnut. The estimates of 100 pod weight were variable with respect to the studied genotypes as earlier reported in groundnut by Nath and Alam (2002). In this study, high kernel yield were recorded by Michika-6 and Samnut-24, as similarly obtained by Engin *et al.* (2018) in groundnut trial.

Estimates of Coefficients of Variance for Traits of Groundnut Studied

The estimates of genetic parameters for ten traits of groundnut is presented in Table 4. High estimates of genotypic and phenotypic variances were observed for weight of haulms (231,984.01 and 304,185.01 respectively) and kernel yield (22,524.04 and 153,145.51 respectively). Lowest estimates of genotypic and phenotypic variances were recorded by days to first flower (3.10 and 3.70 respectively). Generally, the Phenotypic Coefficient of Variance (PCV) estimates were higher than their corresponding Genotypic Coefficient of Variance (GCV).

The GCV ranged from 6.27 for days to first flowering to 40.49 for branches/plant. Similarly, the PCV ranged from 6.85 for days to first flowering to 49.96 for branches/plant.

High GCV and PCV were recorded by branches/plant (40.49 and 49.96 respectively), then followed by weight of haulms (27.30 and 31.26 respectively). The least estimates of GCV and PCV were recorded by days to first flowering (6.27 and 6.85 respectively). Broad sense heritability was highest (0.90) days to 50% flowering, followed by branches/plant (0.84), while the lowest heritability estimates was recorded by kernel yield (0.14). The estimates of phenotypic variances were greater in magnitude as compared with their corresponding genotypic variances for all the characters evaluated. This agrees with the work of the following researchers (Nath and Alam, 2002; Narasimhulu *et al.,* 2012; Chavadhari *et al.,* 2017 and Omima *et al.,* 2018) in groundnut. High genotypic and phenotypic variances that was recorded for kernel yield in this study corroborates with the findings of Yusuf *et al.* (2017) in groundnut. In this present study there was a close correspondence between genotypic and phenotypic coefficients of variation for all studied traits. These revealed that the traits are less influenced by the environment. The high GCV and PCV recorded by number of branches/plant and haulm weight of this study is similar with the findings of Zaman *et al*. (2011); Kadams *et al.* (2013); Yusuf *et al.* (2017) and Omima *et al.* (2018). This indicates that selection can be applied on the traits to isolate more promising genotypes. Broad sense heritability estimates that was high for branches/plant was earlier reported by the following researchers Zaman *et al*. (2011) and Chavadhari *et al.* (2017). The high GCV and PCV including high heritability and high genetic advance observed for branches/plant and haulm weight indicated the presence of additive gene effects (Rashwan, 2010 and Manggoel *et al*., 2012). This suggest the possibility of effective progress in groundnut improvement through selection could be achievable. High heritability coupled with high genetic advance that were recorded in this study for branches/plant and haulm weight corroborates with the work of Yusuf *et al.* (2017) and Kadams *et al*. (2013).

Variation in Eleven Qualitative Characters of Groundnut genotypes

Variations in eleven qualitative characters of groundnut are summarized in frequency distribution (Table 5). From the Table,

flower colour showed 100% yellow flowers for all the genotypes studied. Three different stem branching patterns were observed in the accessions of which (50%) were sequential in pattern, (44%) were alternate and (6%) were irregular with flowers on the main stem. Nine (50%) had stem pigmentation while nine (50%) of the accessions had no pigmentation colour. For stem hairiness twelve of the accessions (67%) were scares and six (33%) were abundant. Four different leaflet shape were observed of which seven (39%) of the accessions had oblong-elliptic, six of them (33%) had wide-elliptic, three accessions (17%) had elliptic and two (11%) had narrow-elliptic leaflet shape. All the accessions show (100%) in peg

Traits such as growth habit, branching pattern, stem pigmentation, pod characteristics and seed colour can help differentiate cultivars (Olasan *et al*., 2018). Among the qualitative character flower colour showed 100% yellow flowers for all the genotypes studied. Three different stem branching patterns were observed in the accessions of which (50%) were sequential in pattern, (44%) were alternate and (6%) were irregular with flowers on the main stem. Nine (50%) had stem pigmentation while nine (50%) of the accessions had no pigmentation colour. Esquivel *et al*. (1993) trial on 130 accessions of groundnut revealed that most of the genotypes they studied had stem pigmentation. For stem hairiness twelve of the accessions (67%) were scarce and six (33%) were abundant as earlier reported by Khan *et al*. (2021) and Esan *et al*. (2023) in Bambara groundnut. Four different leaflet shape were observed of which seven (39%) of the accessions had oblong-elliptic, six of them (33%) had wide-elliptic, three accessions (17%) had elliptic and two (11%) had narrow-elliptic leaflet shape as reported by Khan *et al.* (2021) in Bambara groundnut. All the accessions show (100%) in peg pigmentation colour, also all the groundnut accessions had (100%) smooth pod reticulation. For the seed colour, (72%) of the accessions had one seed colour and 5 accessions (28%) had variegated seed colour.

Furthermore, one of the accession had (6%) slight pod constriction. For leaflet margin 72% of the accessions had entire and 28% of the accessions had hairy leaflet margin. For pod beak eleven of the accessions (61%) were moderate, five of them (28%) prominent, while two of them (11%) were slight in pod beak. Similarly, eight of the accessions (44%) had none pod constriction, eight of them (44%) had moderate pod constriction with one of them (6%) having deep pod constriction.

and also all the groundnut accessions had (100%) smooth pod reticulation. For the seed colour, (72%) of the accessions had one seed colour and 5 accessions (28%) had variegated seed colour (Khan *et al.*, 2021). Similarly, eight of the accessions (44%) had none pod constriction, eight of them (44%) had moderate pod constriction with one of them (6%) having deep pod constriction. Furthermore, one of the accession had (6%) slight pod constriction. For leaflet margin 72% of the accessions had entire and 28% of the accessions had hairy leaflet margin. For pod beak eleven of the accessions were moderate, five of them prominent, while two of them were slight in pod beak which studies agreed with the findings of Esquivel *et al.* (1993) in groundnut.

Recommendations

Michika-6 and Samnut-24 outperformed the other genotypes with respect to earliness, 100 nut weight, 100 pod weight and kernel yield/ha.. Therefore, possible exploitation of these genotypes for groundnut improvement could be carried out through multi-locational trials for several years in order to ascertain results obtained in this study.

Table 1: List of Genotypes Evaluated

S/N	Genotypes name	Genotypes code	Source
1	Mubi – 1	ADSUM/001	Mubi, Adamawa State
2	Gombi – 1	ADSUM/002	Gombi, Adamawa State
3	Michika – 1	ADSUM/003	Michika, Adamawa State
4	Michika – 2	ADSUM/004	Michika, Adamawa State
5	Gombi – 2	ADSUM/005	Gombi, Adamawa State
6	Michika – 3	ADSUM/006	Michika, Adamawa State
7	Michika – 4	ADSUM/007	Michika, Adamawa State
8	Madagali	ADSUM/008	Madagali, Adamawa State
9	Michika – 5	ADSUM/009	Michika, Adamawa State
10	Michika – 6	ADSUM/010	Michika, Adamawa State
11	Mubi – 2	ADSUM/011	Mubi, Adamawa State
12	Michika – 7	ADSUM/012	Michika, Adamawa State
13	Michika – 8	ADSUM/013	Michika, Adamawa State
14	Michika – 9	ADSUM/014	Michika Adamawa State
15	Samnut – 22	ADSUM/015	IAR, Samnut, Zaria
16	Samnut – 23	ADSUM/016	IAR, Samnut, Zaria
17	Samnut – 24	ADSUM/017	IAR, Samnut, Zaria
18	Mubi – 3	ADSUM/018	Mubi, Adamawa State

ADSUM: Adamawa State University, Mubi 2022.
IAR: Institute for Agriculture Research, Samaru, Zaria.

Table 2: Combined ANOVA for 10 Agronomic Characters of Groundnut across Years (2021 and 2022) of Evaluation in Mubi

Source of Variation	Df	DFF	D50%F	PHt	NOB	DTM	NMP	HAW	100NW	100PW	KEY
Year (Y)	1	87.12**	255.33**	168.55**	320.68**	52.08^{ns}	1292.38**	1759.77**	3346.57**	17866.14**	138,096.65**
Rep (Year)	4	3.47**	1.49^{ns}	74.17**	183.26**	59.44^{ns}	271.58**	38.72**	44.11**	132.33^{ns}	3,939.94**
Genotype (G)	17	19.20**	52.31**	176.25**	858.80**	991.05**	110.45**	292.82**	227.81**	2070.85**	531.53**
G x Y	17	1.06**	1.59**	29.89^{ns}	37.33^{ns}	56.38^{ns}	140.75**	33.01**	14.70^{ns}	401.02**	898.98**
Error	68	0.60**	0.85**	27.28**	24.86**	59.41**	45.96**	14.44**	12.65**	73.67**	261.24**
Total	107										

DFF = Days to first flowering, D50%F = Days to 50% flowering, DTM = Days to maturity, PHT = Plant height (cm), NOB = Number of branches/plant, NMP = Number of mature pods/plant, 100 PW = 100 Pod weight (g), 100 NW = 100 nut weight (g), HAW = Weight of hualm/hectare, KEY = Kernel yield/hectare.

Table 3: Mean Square from combined Analysis (Year 2021 and 2022) for 10 Agronomic Characters of Groundnut

S/No.	Genotype Name	Accession Code	DFF	D50%F	PHT	NOB	DTM	NMP	HAW	100NW	100PW	KEY
1	Mubi – 1	ADSUM/001	28.33b-d	30.67d	41.44b-d	26.67f	133.17a	30.00de	1936.60c-f	50.44a	152.44a	1913.20a-d
2	Gombi – 1	ADSUM/002	28.33b-d	32.00c	37.88c-e	36.87b-d	118.00b	28.40e	2100.80cd	42.16c	139.85b-d	1724.50b-d
3	Michika – 1	ADSUM/003	28.50bc	32.00c	38.65c-e	39.37bc	118.17b	35.97a-d	2281.10bc	44.35c	139.97b-d	1676.00d
4	Michika – 2	ADSUM/004	25.67ef	28.50f	36.32de	10.17g	90.17c	32.27c-e	952.20h	49.01ab	137.91b-d	2063.2a-d
5	Gombi – 2	ADSUM/005	28.33b-d	30.33de	40.63b-d	31.83d-f	117.50b	34.80a-e	1608.00fg	45.66bc	130.84d	1608.2d
6	Michika – 3	ADSUM/006	33.33a	38.33a	29.62f	48.77a	118.83b	40.37a-c	1978.10c-e	32.98de	92.28e	1982.50a-d
7	Michika – 4	ADSUM/007	29.00b	32.83c	32.78ef	40.27b	120.00b	37.27a-d	1510.10g	37.14d	102.98e	1882.40a-d
8	Madagali	ADSUM/008	28.67b	33.00bc	35.85d-f	32.43d-f	120.00b	34.97a-d	1798.90d-g	44.10c	131.20cd	2217.20ab
9	Michika – 5	ADSUM/009	27.50cd	29.5ef	52.54a	33.37c-e	117.50b	38.57a-d	2749.00a	43.87c	130.05d	1685.70cd
10	Michika – 6	ADSUM/010	26.17e	28.67f	38.53c-e	8.90g	91.83c	29.67de	989.00h	49.97a	138.18b-d	2256.40a
11	Mubi – 2	ADSUM/011	28.33b-d	34.00b	44.5bc	28.40ef	118.17b	41.83ab	1744.90d-g	31.29e	95.67e	2082.60a-d
12	Michika – 7	ADSUM/012	28.83b	32.00c	43.67bc	33.68c-e	117.50b	35.50a-d	1999.60c-e	44.87bc	136.09b-d	1780.60a-d
13	Michika – 8	ADSUM/013	28.33b-d	37.33a	32.45ef	38.87bc	119.83b	42.43a	1688.10e-g	35.24de	96.63e	1717.60b-d
14	Michika – 9	ADSUM/014	27.33d	30.17de	47.00ab	27.83ef	118.00b	33.03b-e	2430.70b	44.81bc	132.52cd	1895.50a-d
15	Samnut – 22	ADSUM/015	26ef	28.50f	37.96c-e	10.37g	90.17c	34.83a-e	1070.40h	51.37a	137.95b-d	2104.90a-d
16	Samnut – 23	ADSUM/016	29.17b	32.33c	37.71c-e	39.10bc	118.00b	30.77de	1974.50c-e	42.65c	146.60ab	1639.10d
17	Samnut – 24	ADSUM/017	25.17f	27.17g	39.98c-e	9.73g	90.67c	30.20de	1180.40h	52.62a	142.83a-c	2184.50a-c
18	Mubi – 3	ADSUM/018	28.50bc	32.33c	38.10c-e	27.57ef	119.67b	30.80de	1769.80d-g	44.01c	137.86b-d	2000.10a-d
	Mean		28.08	31.65	39.15	29.12	113.18	34.54	1764.56	43.70	128.99	1911.90
	CV		2.76	2.92	13.34	17.12	6.81	19.63	15.23	8.14	6.65	18.90

Means with the same letter are not significant different. DFF = Days to first flowering, D50%F = Days to 50% flowering, DTM = Days to maturity, PHT = Plant height (cm), NOB = Number of branches/plant, NMP = Number of mature pods/plant, 100 PW = 100 Pod weight (g), 100 NW = 100 nut weight (g), HAW = Weight of hualm/hectare, KEY = Kernel yield/hectare and ADSU = Adamawa State University.

Table 4: Genetic Parameters among 10 traits of groundnut across two years (2021 and 2022)

Traits	δ_g^2	δ_p^2	GCV	PCV	h^2	GA
DFF	3.10	3.70	6.27	6.85	83.78	0.23
D50F	8.58	9.43	9.25	9.61	90.99	0.56
DTM	155.27	214.68	11.01	12.95	72.33	2.83
PHT	24.83	52.11	12.73	18.44	47.65	1.31
NOB	138.99	163.85	40.49	49.96	84.83	9.84
NMP	10.75	56.51	9.49	21.76	19.06	0.64
HAW	231,984.01	304,185.01	27.30	31.26	76.26	270.81
100NW	35.86	48.51	13.70	15.94	73.92	1.69
100PW	332.86	406.53	14.14	15.63	81.88	5.32
KEY	22,524.04	153,145.51	7.85	20.47	14.71	24.27

δ_g^2 = Genotypic variance, δ_p^2 = Phenotypic variance, GCV = Genotypic coefficient of variance, PCV = Phenotypic coefficient of variance, h^2 = Heritability (broad sense), GA = Genetic Advance, GA (as % of mean) = Genetic advance as percentage of mean, DFF = Days to first flowering, D50%F = Days to 50% flowering, DTM = Days to maturity, PHT = Plant height (cm), NOB = Number of branches/plant, NMP = Number of mature pods/plant, 100 PW = 100 Pod weight (g), 100 NW = 100 nut weight (g), HAW = Weight of haulm/hectare, KEY = Kernel yield/hectare.

Table 5: Eleven Qualitative Characters studied among Eighteen Groundnut Genotypes during the Cropping Seasons

Genotype	FC	SBP	SP	SH	LS	PP	PR	SC	PC	LM	PB
1	2	1	3	7	5	3	0	2	7	1	7
2	2	1	1	3	6	3	0	1	0	1	5
3	2	2	3	3	4	3	0	1	0	1	7
4	2	2	3	7	4	3	0	1	5	2	5
5	2	2	1	3	3	3	0	1	5	2	7
6	2	1	3	3	3	3	0	1	0	2	3
7	2	3	1	7	6	3	0	2	0	1	5
8	2	1	3	3	6	3	0	2	5	1	7
9	2	1	1	7	3	3	0	2	0	1	7
10	2	2	1	3	4	3	0	1	5	1	5
11	2	1	1	7	4	3	0	1	0	2	3
12	2	1	3	3	4	3	0	1	5	1	5
13	2	2	1	3	6	3	0	1	0	1	5
14	2	2	3	3	5	3	0	2	0	1	5
15	2	2	3	3	4	3	0	1	5	2	5
16	2	2	1	3	4	3	0	1	3	1	5
17	2	2	3	7	6	3	0	1	5	1	5
18	2	1	1	3	6	3	0	1	5	1	5

FC = Flower Colour: (1) white, (2) yellow, (3) red, (4) purple
SBP = Stem Branching Pattern: (1) alternate, (2) sequential, (3) irregular with flowers on the main stem, (4) irregular without flower on main stem
SP = Stem Pigmentation: (1) absent, (3) present
SH = Stem Hairiness: (3) scarce, (7) abundant
LS = Leaflet Shape: (1) cuneate, (2) obcuneate, (3) elliptic, (4) oblong-elliptic, (5) narrow-elliptic, (6) wide-elliptic
PP = Peg Pigmentation: (1) absent (3) present
PR = Pod Reticulation: (0) smooth, (3) slight, (5) moderate, (7) prominent
SC = Seed Colour: (1) one colour, (2) variegated
PC = Pod Constriction: (0) none, (3) slight, (5) moderate, (7) deep, (9) very deep
LM = Leaflet margin: (1) entire, (2) hairy, (3) wavy
PB = Pod Beak: (0) absent, (3) slight, (5) moderate, (7) prominent, (9) very prominent

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