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Evaluation of Yield Attributing Traits in a Set of Advanced Breeding Lines of Groundnut *(Arachis hypogaea* L.)

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ABSTRACT: Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in the arid and semi-arid tropics of Asia and Africa. In this study, we analysed genetic variability, heritability, and identified lines for high yield and yield-attributing traits. Two sets of advanced breeding lines (ABLs) with product concepts PC31 HOA V and PC31 D2S, consisting of 13 ABLs each, were planted in a randomized complete block design (RBD) in two replications. The pod yield, shelling percentage, and 100-seed weight were recorded at both locations. For PC31 HOA V, pod yield ranged from 861.25 to 1602 kg/ha, shell % ranged between 60.60 to 68.84 %, and 100 kernel weight was between 30.31% and 49.27 grams. For PC31 HOA D2S, pod yield ranged between 2439.11 kg/ha to 3569.422 kg/ha, shelling % ranged from 64.77% to 72.35 %. The hundred kernel weight ranged between 36.65 to 45 grams. Among Spanish type groundnut, ICGV 201088, ICGV 201087, ICGV 201137 and ICGV 201163 with more than 2.9 tons/ha yield can serve as a superior performing groundnut variety. Virginia groundnut lines ICGV 201089 and ICGV 201170 with more than 1.3 tons/ha yield are comparable to the checks and can be potential genotypes to move them forward in the breeding pipeline.

Keywords: Groundnut, yield, heritability, Spanish and Virginia.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in the arid and semi-arid tropics of Asia and Africa. Groundnut is a rich source of oil, protein, dietary fibers, vitamins, and minerals and is regarded as a highly nutritious crop (Ojiewo *et al.*, 2020). In a global scenario, 32.72 mn ha area of 113 countries is under groundnut cultivation with a production of 53.92 mntn and productivity of 1648.1 kg/ha (FAOSTAT, 2021). USA, Myanmar, China, mainland China, Israel, and the Netherlands are leading exporters of groundnuts. India is a major groundnut-producing country, with an area, production, and productivity of 5.96 mnha, 10.24 mntn and 1716.2 kg/ha respectively (FAOSTAT, 2021).

Groundnut kernels are predominantly utilized for food and confectionary purposes, or for extracting edible oil via crushing. The selection of promising breeding lines through a phenotype-based procedure, followed by an evaluation of yield-related traits, has resulted in more than double production in the past (Pramanik *et al.*, 2019). Yield and yield-contributing parameters are the most widely targeted traits in groundnut improvement programmes worldwide. Selection for yield has been the primary basis for improving groundnut productivity globally (Nigam *et al.*, 1991). Pod yield is influenced by crop growth rate, duration of reproductive growth, and the proportion of crop growth rate allocated to pod yield. The essential yield-contributing parameters included pod yield per plant, number of pods per plant, shelling outturn, and 100-seed weight. Recently, breeding programs have also focused on physiological traits associated with yield, such as harvest index and transpiration-use efficiency, with the necessary infrastructure and resources (Janila *et al.*, 2013).

MATERIALS AND METHODS

Two different sets of advanced breeding lines (ABLs) with product concepts PC31 HOA V and PC31 HOA D2S, consisting of 13 ABLs each, were planted in a randomized complete block design (RBD) in two replicates. These trials were conducted in Patancheru and Junagarh. All the recommended practices were followed to ensure good crop establishment. Planting was performed with a plot size of 2m × 2 rows, 30 cm apart, grown on a broad bed. Plant-to-plant distance in each row was 10 cm. After harvesting, pod weight, kernel weight and hundred kernel weight per plot were recorded.

Statistical analysis: Combined means and statistical parameters were analyzed using INDOSTAT software.

RESULTS AND DISCUSSION

A combined analysis of variance (ANOVA) suggested significant differences among genotypes for all traits investigated in both trials (Tables 3 and 4). For the PC 31 HOA V trial, the combined mean values at both locations for pod yield, shelling percentage, and hundred kernel weight were 1247.7120 kg/ha, 66.21% and 36.90 grams. Pod yield ranged from 861.25 kg/ha to 1602 kg/ha, shelling % ranged between 60.60 to 68.84 %, and hundred kernel weights ranged between 30.31 to 49.27 grams (Table 1). "ICGV 15083" recorded maximum pod yield, "ICGV 201356" had maximum shelling % of 68.84 % and maximum hundred kernel weight of 49.27 grams. Pod yield and hundred kernel weight recorded very high heritability of more than 97%, whereas shelling percentage showed moderate heritability of 50.86 % (Table 5).

For PC 31 HOA D2S trial, combined mean values at both the locations for pod yield, shelling percentage and hundred kernel weight were 2872.26 kg/ha, 67.64% and 40.81 grams. Pod weight ranged between 2439.11 kg/ha in "ICGV 00440" to 3569.422 kg/ha in "ICGV 201088". Shelling % ranged from 64.77% in ICGV 00440 to 72.35 % in "Kadiri Lepakshi". Hundred kernel weight ranged between 36.65 gms in "ICGV 201163" to 45 gms in "ICGV 201088" (Table 2). Pod yield (91.95%) and hundred kernel weight (76.43 %) were highly heritable, whereas shelling percentage was moderately heritable (50.03%) (Table 5).

Table 1: Combined Mean and statistical parameters of blanchability traits in PC 31 HOA V trial.

Genotypes	Pod weight (kg/ha)	Shelling %	HKW(g)
ICGV 201089	1376.0000	60.6050	34.3125
ICGV 201090	1108.5000	64.6750	35.2400
ICGV 201170	1548.7500	67.1650	33.6375
ICGV 201351	969.7500	62.4900	33.2750
ICGV 201355	1002.7500	66.8000	45.5575
ICGV 201356	1083.7500	68.8400	49.2700
ICGV 201357	861.2500	68.0450	41.0275
ICGV 15083	1602.0000	66.9150	32.5950
ICGV 03043	1513.7500	68.2800	31.0750
HNG 123	1579.2500	67.6200	35.4000
ICGV 00440	1241.2500	67.2950	42.6975
GJG HPS-1	1080.7500	65.6700	35.3850
ICGV 15090	1252.5000	66.4250	30.3150
Mean	1247.7120	66.2173	36.9067
C.V.	3.3659	3.1583	2.5470
F ratio	146.3085	5.1396	155.5099
F Prob.	0.0000	0.0001	0.0000
S.E.	20.9981	1.0457	0.4700
C.D. 5%	60.2259	2.9992	1.3480
C.D. 1%	80.7573	4.0216	1.8076
Range Lowest	861.2500	60.6050	30.3150
Range Highest	1602.0000	68.8400	49.2700

Table 2: Combined Mean and statistical parameters of blanchability traits in PC 31 HOA D2S trial.

Genotypes	(Pod yield/ha)	Shelling %	HKW(g)
ICGV 201084	2736.8800	65.4250	38.3500
ICGV 201087	2971.1950	65.8500	37.8500
ICGV 201088	3569.4220	67.5000	45.0000
ICGV 201096	2492.6150	68.4000	40.3250
ICGV 201137	2983.8870	69.1250	43.3250
ICGV 201158	2758.9480	67.2000	43.8000
ICGV 201163	2985.5870	67.2750	36.6500
ICGV 201192	2575.6370	65.3250	42.2750
ICGV 15083	2819.0250	67.2250	42.7000
ICGV 03043	3307.3170	71.7000	39.2000
Kadiri Lepakshi	2746.1370	72.3250	38.5000
ICGV 00440	2439.1150	64.7750	41.2000
ICGV 15090	2953.6300	67.3000	41.4750
Mean	2872.2610	67.6481	40.8192
C.V.	3.2039	3.0408	3.3725
F ratio	46.7094	5.0042	13.9688
F Prob.	0.0000	0.0001	0.0000
S.E.	46.0120	1.0285	0.6883
C.D. 5%	131.9699	2.9500	1.9742
C.D. 1%	176.9591	3.9557	2.6472
Range Lowest	2439.1150	64.7750	36.6500
Range Highest	3569.4220	72.3250	45.0000

Table 3: Combined analysis of variance (ANOVA) for yield traits in PC31 HOA V trial.

Trait	Source of Variations	df	Sum of Squares	Mean Squares	F Ratio	Probability
Pod yield	Replicate	1	91.803090	91.803090	0.0521	0.8208
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	7039.030000	7039.030000	3.9911	0.0533
	Overall Sum	3	7130.833454	2376.944485	1.3477	0.2743
	Treatments	12	3096487.923077	258040.660256	146.3085	0.0000
	Error	36	63492.304016	1763.675112		
Shelling %	Replicate	1	13.873510	13.873510	3.1719	0.0834
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	0.121944	0.121944	0.0279	0.8683
	Overall Sum	3	13.995454	4.665151	1.0666	0.3754
	Treatments	12	269.757058	22.479755	5.1396	0.0001 ***
	Error	36	157.457230	4.373812		
HKW	Replicate	1	1.728318	1.728318	1.9560	0.1705
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	0.083561	0.083561	0.0946	0.7602
	Overall Sum	3	1.811879	0.603960	0.6835	0.5679
	Treatments	12	1648.889078	137.407423	155.5099	0.0000 ***
	Error	36	31.809346	0.883593		

Table 4: Combined analysis of variance (ANOVA) for yield traits in PC31 HOA D2S trial:

Trait	Source of Variations	df	Sum of Squares	Mean Squares	F Ratio	Probability
Pod yield	Replicate	1	3420.014000	3420.014000	0.4039	0.5291
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	112.851600	112.851600	0.0133	0.9087
	Overall Sum	3	3532.865734	1177.621911	0.1391	0.9360
	Treatments	12	4746646.765790	395553.897149	46.7094	0.0000***
	Error	36	304862.431855	8468.400885		
Shelling %	Replicate	1	1.514753	1.514753	0.3580	0.5534
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	3.917718	3.917718	0.9258	0.3424
	Overall Sum	3	5.432471	1.810824	0.4279	0.7342
	Treatments	12	254.107328	21.175611	5.0042	0.0001 ***
	Error	36	152.335533	4.231543		
HKW	Replicate	1	7.973910	7.973910	4.2077	0.0476 *
	Locations	1	0.000000	0.000000	0.0000	1.0000
	Interactions	1	1.141258	1.141258	0.6022	0.4428
	Overall Sum	3	9.115168	3.038389	1.6033	0.2056
	Treatments	12	317.660799	26.471733	13.9688	0.0000 ***
	Error	36	68.222260	1.895063		

Table 5: Genetic parameters of yield attributing traits in two trials:

	PC31 HOA V			PC31 HOA D2S		
Parameters	**PY**	**SH%**	**HKW**	**PY**	**SH%**	**HKW**
General Mean	1247.7115	66.2173	36.9067	2872.2613	67.6481	40.8192
ECV	3.3659 %	3.1583 %	2.5470 %	3.2039 %	3.0408 %	3.3725 %
GCV	20.2867 %	3.2130 %	15.8296 %	10.8305 %	3.0424 %	6.0725 %
PCV	20.5640 %	4.5054 %	16.0331 %	11.2945 %	4.3015 %	6.9461 %
h^2 (Broad Sense)	0.9732	0.5086	0.9748	0.9195	0.5003	0.7643
Genetic Advancement	514.3933	3.1255	11.8821	21.3944%	4.4329%	10.9360%
Critical Diff. (95%)	60.2259	2.9992	1.3480	131.9699	2.9500	1.9742

High heritability for yield and hundred kernel weight, and moderate heritability for shelling percentage in groundnut have been reported in previous studies (Khan *et al.,* 2002). Similar results were reported in the current study. "ICGV 201088" with a pod yield of 3569.422 kg/ha can serve as a superior performing groundnut variety.

A popular variety "Kadiri Lepakshi" with a high shelling percentage of 72.35 % has been observed with good filling. A wide range of variability coupled with high heritability is important for effective selection for yield traits.

CONCLUSIONS

Among Spanish type groundnut, ICGV 201088, ICGV 201087, ICGV 201137 and ICGV 201163 with more than 2.9 tons/ha yield can serve as a superior performing groundnut variety. Virginia groundnut lines

ICGV 201089 and ICGV 201170 with more than 1.3 tons/ha yield are as comparable with the checks and can be potential genotypes to move them forward in the breeding pipeline.

FUTURE SCOPE

Identified genotypes with superior yield performance can be further utilized as parents in the breeding programme.

Conflict of Interest. None.

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