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Genetic variability studies in terminal drought tolerant groundnut (*Arachis hypogaea* L.)

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Abstract
Forty nine terminal drought tolerant groundnut genotypes of groundnut were evaluated during *Kharif* 2016 for genetic parameter *viz*., variability, heritability and genetic advance. The estimates of PCV and GCV were high for immature pods per plant, dry pod yield (kg/ha), haulm yield, root volume and root dry weight under both normal and control condition. High heritability coupled with high genetic advance expressed as percentage of mean was observed for plant height, primary branches per plant, matured pods per plant, haulm yield, dry pod yield (kg/ha), hundred kernels weight, root length, average root diameter, specific leaf area, SPAD chlorophyll meter reading and harvest index indicating that these traits were mainly governed by additive gene action and responsive for further improvement of these traits.

Keywords: Genetic variability, heritability, genetic advance, PCV, GCV

Introduction
Groundnut is an important oilseed crop of India. Groundnut kernels are the rich source of edible oil (40-55%) and proteins (22-28%). India occupied more area but its productivity has remained low which can be attributed to cultivation of crop predominantly under rainfed conditions. Breeding and selection of drought tolerant genotypes offers the best long term solution to minimize the risks and impact of limited water availability. Terminal drought affects the yield, seed quality and increases aflotoxin contamination in groundnut (Girdthai *et al*., 2010) [5]. The success of any crop improvement program largely depends on the genetic variability present in the population. Heritability estimates are used to determine the amount of heritable variation present in the population. Heritability combined with genetic advance will bring out the genetic gain expected from selection.

Hence, in present investigation an attempt was made to assess the variability of important morphological and physiological traits, along with the indices of variability *i.e.* genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense (h^2_{bs}) and genetic advance as percentage of mean (GAM). This study will facilitate an understanding behind expression of character and also role of environment in that characters.

Material and Methods
The present investigation was carried out during *kharif*, 2016 at Main Agricultural Research Station, University of Agricultural Sciences, Raichur. The experimental material consist of forty nine terminal drought tolerant groundnut genotypes (Table 1). The line-source sprinkler irrigation system was used for screening the terminal drought tolerance in groundnut genotypes.

Table 1. List of groundnut (*Arachis hypogaea* L.) genotypes used for investigation

Source	Genotypes	No.
ICRISAT, Patancheru, Hyderbad, Telangana. India	Spanish types: series of ICGVs- 97058, 02242, 01274, 01464, 03043, 95440, 13245, 05198, 13241, 07235, 06188, 05057, 07390, 97092, 3343, 98184, 4729, 97182, 07213, 3102, 99161, 99206, 96155, 91114, 07408, 02317, 07120, 07273, 05193, 00351.	31
	Virginia type: CS-39.	
BARC, Trombay, Mumbai, India	Spanish types: TAG-24, TG-37A, TG-47, TG-72, TG-80, and TG36.	7
	Virginia type: Somanatha.	
PAU, Ludhian, Punjab, India	Spanish types: 49-M-16.	1
ARS, Kadiri India	Spanish types: Kadiri-6.	1
UAS Dharawad, Karnataka, India	Spanish types: GPBD-5, Mutant-3 and Dh-216.	5
	Virginia types: DSG-41 and TDG-39.	
UAS Raichur, Karnataka, India	Spanish types: R-2001-2, Kadiri-9, R-8808 and TMV-2.	4
Total		49

The experiment was laid out in a simple lattice design with two replications. In each replication every genotype was sown in two rows of 5 m length with a spacing of 30 cm between the rows and 10 cm between the plants within the rows. Standard agronomic practices as per recommendations in package of practices were followed. Observations were recorded on five randomly labelled plants for quantitative and physiological traits.

The analysis of variance was calculated by using by Cochran and Cox (1957) [4] method. The genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) was estimated by the formulae given by Burton (1952) [3]. Heritability in broad sense was computed by the formulae given by Allard (1960) [1]. The genetic advance over mean was determined as per the procedure of Johnson *et al.* (1955) [7].

Results and Discussion

Analysis of variance revealed that there were significant differences among the genotypes for all the traits studied, indicating variability present in the material studied. Phenotypic coefficient of variation was found to be higher than genotypic coefficient of variation for all the traits indicating the role of environment in the expression of characters (Table 2).

The estimates of PCV and GCV values were high for immature pods per plant, dry pod yield (kg/ha), haulm yield (kg/ha), haulm yield (g/plant), root volume (cm^3) and root dry weight (g) under both control and terminal drought conditions. The high PCV and GCV indicates that there is presence of considerable variability and hence, individual plant selection can be practiced for the above mentioned characters to get higher yields. Similar findings of higher estimates of GCV and PCV for immature pods per plant were observed by John *et al*. (2013) [6] and Vasanthi *et al.* (2015) [12]. Vekariya *et al*. (2011) [13] and Thirumala Rao (2016) [11] were reported similar results for haulm yield (g/plant). Yadav *et al.* (2014) [14] and Maurya *et al.* (2014) [9] were reported similar findings for haulm yield (kg/ha).

The characters like plant height (cm), matured pods per plant, hundred kernels weight (g) root length (cm), number of lateral roots harvest index (%), SPAD chlorophyll meter reading and specific leaf area showed moderate estimates of GCV and PCV under both conditions. Moderate GCV and PCV were observed by Yadlapalli (2014) [15], Kadam *et al*. (2016) [8], Balaraju and Kenchangoudar (2016) [2] and Thirumala Rao (2016) [11] (Table 2).

Table 2: Estimation of mean and variability genetic parameters for 14 quantitative traits in groundnut genotypes

Sl. No.	Characters	Condition	Mean	Range		PCV (%)	GCV (%)	$H^2_{(bs)}$ (%)	GA as % of mean 5%
				Min.	Max.				
1	Days to 50 per cent flowering	C	29.00	24.00	32.00	7.20	7.02	95.22	14.22
		TD	29.00	25.00	32.00	6.49	6.07	87.59	11.71
2	Days to physiological maturity	C	113.00	108.00	118.00	2.59	2.50	93.87	5.00
		TD	112.00	106.00	118.00	2.39	2.33	94.67	4.67
3	Plant height (cm)	C	30.24	18.55	37.60	16.18	14.24	77.18	25.83
		TD	26.10	12.00	33.35	18.55	16.95	83.45	31.9
4	Primary branches per plant	C	6.00	4.00	9.00	20.24	19.74	95.10	39.66
		TD	5.00	3.00	8.00	21.38	18.51	74.93	33.01
5	Matured pods/plant	C	18.00	13.00	30.00	18.67	15.28	67.03	25.78
		TD	15.00	10.00	27.00	18.54	15.27	67.85	25.91
6	Immature pods/plant	C	2.00	1.00	3.00	34.08	23.42	47.23	33.16
		TD	3.00	1.00	5.00	33.79	30.92	83.71	58.28
7	Shelling outturn (%)	C	65.67	54.50	72.05	8.01	5.93	54.78	9.04
		TD	60.55	47.70	70.75	9.36	8.44	81.20	15.67
8	Hundred kernels weight (g)	C	35.77	24.57	53.14	18.42	17.29	88.15	33.45
		TD	31.88	25.26	48.82	18.61	17.07	84.08	32.24
9	Sound mature kernel (%)	C	87.63	82.50	91.50	2.73	1.99	53.25	3.00
		TD	84.94	80.00	90.00	3.28	2.18	44.43	3.00
10	Dry pod yield (g/plant)	C	13.23	9.03	21.61	23.50	18.22	60.12	29.10
		TD	10.90	5.31	18.43	24.14	17.54	52.84	26.27
11	Dry pod yield (kg/ha)	C	2335.00	1243.00	4277.00	29.21	26.76	83.93	50.51
		TD	2003.00	1111.00	3714.00	30.85	27.29	78.25	49.73
12	Kernel yield (g/plant)	C	8.63	5.54	12.92	22.36	15.41	47.50	21.88
		TD	6.20	3.06	10.53	25.74	17.71	47.64	25.26
13	Haulm yield (g/plant)	C	29.22	15.30	45.84	29.74	28.56	92.27	56.53
		TD	23.63	10.32	37.28	32.37	30.36	87.96	58.66
14	Haulm yield (kg/ha)	C	4976.00	3092.00	8146.00	24.18	23.70	96.03	47.84
		TD	4241.00	2052.00	7450.50	25.93	25.28	95.09	50.79

Where, C =Control, TD=Terminal drought condition.

Table 3: Estimation of mean and variability genetic parameters for root and physiological traits in groundnut genotype

Sl. No.	Characters	Condition	Mean	Range		PCV (%)	GCV (%)	$H^2_{(bs)}$ (%)	GA as % of mean 5%
				Min.	Max.				
1	Root length (cm)	C	13.21	10.75	22.05	15.07	13.36	78.64	24.41
		TD	12.43	9.80	20.45	14.78	11.77	63.35	19.29
2	Average root diameter (cm)	C	1.72	1.20	2.55	20.49	16.06	61.45	25.94
		TD	1.46	1.15	1.95	12.58	9.97	62.82	16.28
3	Lateral roots/plant	C	26.00	21.00	35.00	15.26	11.05	52.47	16.49
		TD	25.00	19.00	34.00	14.02	12.57	80.33	23.20

4	Root volume (m^3)	C	1.10	0.60	2.32	31.57	24.04	57.99	37.71
		TD	0.92	0.50	1.75	29.26	25.38	75.29	45.37
5	Root dry weight (g/plant)	C	1.36	0.65	2.25	33.59	32.22	92.00	63.33
		TD	1.15	0.45	2.15	36.73	35.13	91.47	69.23
6	Harvest Index (%)	C	31.88	22.09	42.64	15.61	12.55	64.64	20.79
		TD	32.03	24.84	47.51	17.03	12.06	50.19	17.61
7	Canopy temperature (^{0}C) @80 DAS	C	29.07	25.58	33.42	7.65	7.04	84.66	13.34
		TD	29.69	25.64	34.29	7.60	6.83	80.76	12.64
8	Canopy temperature (^{0}C) @100 DAS	C	32.54	28.00	42.55	8.67	8.04	85.87	15.35
		TD	35.53	30.80	45.70	7.61	6.77	79.16	12.41
9	Specific Leaf Area (cm^2/g) @ 80 DAS	C	169.86	120.75	196.15	11.34	11.19	97.35	22.75
		TD	159.93	110.50	191.25	12.59	12.36	96.36	25.01
10	Specific Leaf Area (cm^2/g) @100 DAS	C	149.57	115.90	185.95	15.68	11.68	55.51	17.93
		TD	133.98	103.80	170.45	12.61	12.38	96.34	25.03
11	SPAD Chlorophyll Meter Reading @80 DAS	C	33.79	25.85	40.85	12.80	12.42	94.16	24.83
		TD	35.45	27.00	44.15	13.18	12.88	95.37	25.91
12	SPAD Chlorophyll Meter Reading @100 DAS	C	38.44	29.30	46.50	11.91	11.24	89.18	21.88
		TD	41.51	30.30	48.40	11.17	10.46	87.65	20.17
13	Relative water content (%) @80 DAS	C	84.22	70.42	91.46	5.32	5.12	92.50	10.15
		TD	82.89	69.64	90.81	5.59	5.30	89.80	10.35
14	Relative water content (%) @100 DAS	C	79.81	61.68	88.66	8.02	7.69	91.76	15.17
		TD	69.78	56.81	79.87	9.77	9.43	93.17	18.75

Where, C =Control, TD=Terminal drought condition

Low GCV and PCV estimates observed for days to physiological maturity, days to 50 per cent flowering, shelling outturn (%), sound mature kernel (%), relative water content (%) and canopy temperature (^{0}C) indicating low genetic variability among the genotypes studied and limited scope of selection of these traits. The similar results were observed for above characters except sound mature kernel by Balaraju and kenchangoudar *et al*. (2016) [12], Kadam *et al*. (2016) [8] and Thirumala Rao (2016) [11].

High heritability coupled with high genetic advance as per cent of mean was reported for plant height (cm), primary branches per plant, matured pods per plant, haulm yield (kg/ha), dry pod yield (kg/ha), haulm yield (g/plant), hundred kernels weight (g), root length, average root diameter, specific leaf area (cm^2/g), SPAD chlorophyll meter reading and harvest index (%) under control and terminal drought condition (Table 3). These results were in accordance with the reports of Balaraju and Kenchangoudar (2016) [2], Kadam *et al*. (2016) [8], Thirumala Rao (2016) [11] and Shashikumara *et al.* (2016) [10]. High heritability and high genetic advance as per cent of mean for these characters indicating the role of additive gene action in the inheritance of these traits and hence, simple selection for the improvement of these characters would be very effective as these traits were less influenced by environment.

High heritability coupled with moderate or low genetic advance as per cent of mean was observed for days to physiological maturity, days to 50 per cent flowering, root length and average root diameter under both conditions. The similar results were observed by Balaraju and Kenchangoudar (2016) [2] and Thirumala Rao (2016) [11]. This indicates presence non-additive gene action and influence of environment in the expression of these characters and thus, the selection would be less effective.

Conclusions

From the results, it can be concluded that phenotypic selection would be more effective for improvement of immature pods per plant, dry pod yield, haulm yield because above characters had high GCV and PCV. High heritability coupled with high genetic advance as per cent of mean was reported for root traits and physiological traits under both conditions, indicates these can be used as indirect selection indices for drought tolerant breeding programme.

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