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GENETIC VARIABILITY FOR QUANTITATIVE TRAITS IN RECOMBINANT INBRED LINES OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) GROWN UNDER INTERMITTENT DROUGHT STRESS

P. Srivalli* and H. L. Nadaf[1]

Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad-580 005 (Karnataka), India.
[1]AICRP on Groundnut, University of Agricultural Sciences, Dharwad-580 005 (Karnataka), India.

Abstract

The present investigation was undertaken to study the extent of genetic variability for pod yield and other quantitative in groundnut during summer 2012-13 and summer 2013-14. Analysis of variance for individual seasons of summer 2012-13 and 2013-14 indicated that genotypes included in the study differed for all traits in each season. High PCV, GCV and wide range of variation was recorded by most of the quantitative traits *viz*., number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, sound mature kernel per cent and 100 seed weight in both the irrigation levels in each season. Moderate to high heritability and genetic advance as per cent of mean were observed for majority of characters except for days to 50% flowering, days to maturity and number of primary branches per plant indicating that these traits were mainly governed by additive gene action and response to selection could be effected for further improvement of these traits through simple selection under water stress conditions to improve the groundnut for drought tolerance.

Key words : Groundnut, drought tolerance, genetic variability, heritability and genetic advance.

Introduction

Groundnut (*Arachis hypogaea* L.) is an important legume grown for the extraction of edible oil and used as a nutritional ingredient of human and animal foods. It ranks fifth in the world among oilseeds with an area of 24.48 million hectares, production of 42.74 million tonnes (with shell) and productivity of 1.68 tonnes/hectare (FAOSTAT, 2013). China, India and USA are the major producers of the crop, of which India accounts for area of 5.24 million hectares with 9.47 million tonnes of production (FAO, 2013). Though, India is a leading producer of the crop but its productivity is lower (1804 kg/ha) compared to USA (4496 kg/ha) and China (3658 kg/ha). The low productivity of the crop in India and several African countries is ascribed to many biotic and abiotic stresses in the cultivation of the crop.

Drought is by far the most important abiotic stress contributing to crop yield loss in the semi-arid tropics (SAT) characterized by low and erratic rainfall. More than half of the production area, that accounts for 70% of the groundnut growing area fall under arid and semi-arid regions, where crop is frequently subjected to drought stresses for different duration and intensities (Reddy *et al*., 2003). Intermittent drought, which is an episodic water deficit during plant growth, is the most prevalent drought type affecting groundnut production and productivity in the rain-fed regions of SAT, which is evaluated to 500 million US$ every year (Sharma and Lavanya, 2002). Therefore, identification of genotypes that have a better ability to use limited available water is important to enhance crop productivity in the SAT.

For effective selection of high yielding genotypes, knowledge on genetic parameters such as genetic variability, heritability, genetic advance is essential. Genetic variability for trait of interest in any breeding material is a pre-requisite as it provides basis for selection. Heritability estimates helps in improvement of traits by utilizing heritable components of variation. Possible advance through selection based on phenotypic values can be predicted only from knowledge of the degree of correspondence between phenotypic and genotypic values. Genetic components of variation together with

***Author for correspondence :** E-mail- srivalli.pothula@gmail.com

heritability estimates would give the best picture of the amount of advance to be expected from selection. Keeping the aforesaid in view the present study has been undertaken to determine the estimates of genetic variability, heritability and genetic advance for yield and yield components in recombinant inbred line (RIL) population of groundnut under two water regimes.

Materials and Methods

The experimental material for the present study consists of RILs in F_8 generation derived from the TMV-2 × GM 6-1 cross. A total number of 299 RILs were available for present study, which were evaluated along with the parents and eight checks. The experiments were carried out under well watered (WW) as well as water stress (WS) conditions during summer 2012-13 and summer 2013-14 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to evaluate RILs for quantitative traits.

A factorial experiment was planned in a randomized complete block design (RCBD) with two replications. The two water regimes of Well Watered (WW) and Water Stress (WS) conditions were assigned as Factor A, whereas the genotypes (2 parents + 299 RILS + 8 checks) were considered as Factor B. All the entries were sown in one row of 1m length with a spacing of 30 cm between rows and 10 cm between the plants. The recommended packages of practices were followed for raising a good crop. Observations were recorded on randomly chosen ten competitive plants for characters *viz*., plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, pod yield per plant (g), kernel yield per plant (g), shelling per cent, sound mature kernel per cent (%) and hundred seed weight. The characters *viz*., days to 50% flowering and days to maturity were recorded on per plot basis.

Management of irrigation for treatment application

The plants were exposed to intermittent stress in the WS plot from the time of flowering (30-45 DAS) until pod filling stage (75 DAS) in field as well as raised beds. In the field drought stress was imposed by irrigating both the plots (WW and WS) equally upto the time of flowering. Imposition of stress was initiated after the flowering for WS plot while, irrigation was supplied to the WW plot at 7-10 days interval.

The genotypic and phenotypic co-efficient of variations were computed as suggested by Burton and Devane (1953). Heritability in broad sense was computed as suggested by Hanson *et al.* (1956) and expressed as percentage while genetic advance was worked out as per the method outlined by Johnson *et al.* (1955).

Results and Discussion

Analysis of variance (ANOVA)

Pooled ANOVA across the two seasons (table 1) indicated significant difference between genotypes, seasons, irrigation level and also their interactions for all the traits studied.

Mean, range and components of variation

The nature and magnitude of variation for quantitative traits was assessed by phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as per cent of mean along with mean and range for individual irrigation levels during both the seasons were indicated in table 2.

During summer 2012-13, days to 50 per cent flowering recorded low GCV (2.14), PCV (2.54) and high heritability (71.2%) with low genetic advance as per cent of mean (3.72%). Similarly during summer 2013-14, low PCV (2.61), GCV (2.39) and high heritability (83.43) with low genetic advance as per cent of mean (4.49) was recorded for days to 50 % flowering. Days to maturity recorded low GCV (0.51, 0.61), PCV (0.63, 0.71) and high heritability (65.96%, 73.34%) with low genetic advance as per cent of mean (0.86%, 1.07%) during the two seasons respectively. This is in accordance with the reports of Rao *et al*. (2012).

Moderate GCV (10.28, 11.06), PCV (18.79, 20.71), heritability (29.92, 28.51) and GAM (11.58, 12.16) were recorded for plant height in both seasons respectively. During summer 2012-13, number of primary branches per plant recorded moderate PCV (19.11) but low GCV (7.63), heritability (15.96%) and genetic advance as per cent of mean (6.28%). In contrast, moderate GCV (19.81) but high PCV (25.42), heritability (60.76%) and GAM (31.81) was recorded by this trait during summer 2013-14. Similar kind of results plant height was reported by Rao *et al*. (2012) and for number of primary branches per plant by John *et al*. (2011).

High PCV, GCV and heritability with high GAM was recorded by most of the quantitative traits *viz*., number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, pod yield per plant, kernel yield per plant, sound mature kernel per cent and 100 seed weight except shelling per cent during summer 2012-13, where it has recorded moderate GCV and PCV. During summer 2013-14, High PCV, GCV and heritability with

Table 1 : Pooled analysis of variance for pod yield and its component traits in groundnut RILS of TMV-2 x GM 6-1 population over both seasons of summer 2012-13 and 2013-14.

Source of variation	DF	Days to 50% flowering	Days to maturity	Plant height	No of primary branches	No of secondary branches	No of pegs per plant	No of mature pods	No of immature pods	Pod yield per plant	Kernel yield per plant	Shelling per cent	Sound mature kernel %
Season	1	110507.60**	60220.23**	44316.23**	1269.07*	1061.78*	3058.15*	682.29*	12380.67*	128.908**	11.44	11634.2	1092.53*
Genotype	308	1.43**	1.92**	58.19**	2.50**	3.37**	292.78**	115.99**	30.14**	21.70**	9.90**	78.10**	185.34**
Irrigation Level	1	1683.49**	490.37**	58961.37**	333.52**	154.35**	60515.74**	53792.68**	310.36**	18454.59**	10444.46**	91031.19**	112174.00**
Season* Irrigation Level	1	229.98**	46.49**	7153.60**	34.02**	45.32**	1479.94**	5078.30**	1550.40**	228.05**	67.78**	7123.32**	25193.68**
Season* Genotype	308	1.26**	1.32**	60.87**	2.16**	3.29**	244.77**	94.73**	27.14**	8.57**	3.70**	80.33**	147.85**
Irrigation Level* Genotype	308	0.48**	0.49**	36.57**	1.94**	5.56**	458.44**	176.77**	13.80**	11.44**	5.57**	59.53**	83.19**
Season*Irrigation Level*Genotype	308	0.52**	0.46**	33.50**	2.36**	5.31**	421.85**	180.88**	13.50**	9.55**	4.30**	61.36**	74.85**
Pooled Error	1234	0.13	0.14	18.11	0.9	0.33	7.37	3.89	2.27	0.96	0.4	21.19	6.3
General Mean		30.496	102.814	25.667	5.545	2.843	18.482	15.074	7.873	6.147	4.046	62.757	26.783
CD 5%		0.355	0.372	4.174	0.929	0.56	2.663	1.936	1.477	0.962	0.622	4.515	2.462
C.V %		1.187	0.368	16.578	17.08	20.092	14.685	13.09	19.126	15.961	15.667	7.334	9.371

high GAM was recorded by traits *viz*., number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, sound mature kernel per cent and 100 seed weight except pod yield per plant, kernel yield per plant and shelling per cent. Wide range of variation was recorded for all the above traits in both the irrigation levels in each season.

Similarly, high PCV and GCV reported for number of secondary branches per plant by Korat *et al.* (2009); for 100 seed weight and kernel yield per plant by Venkataramana *et al. (*2001); for pod yield per plant by Sudha *et al*. (2012). Shelling per cent has recorded low to moderate GCV and PCV in two seasons. The results were in accordance with the reports of Zaman *et al.* (2011). Similar results of high heritability for these traits were reported by Rao *et al. (*2010) for days to 50 per cent flowering; and Vishnuvardhan *et al. (*2012) for days to maturity; Sudha *et al. (*2012) for number of secondary branches per plant. Low to moderate heritability estimates were recorded for plant height and primary branches per plant in both seasons. Similar kind of results of moderate heritability estimates were reported by Vishnuvardhan *et al. (*2012) for plant height; Sudha *et al*. (2012). These results are in conformity with the observation of high GAM made by Reddy and Gupta (1992) for mature pods per plant; Rao *et al. (*2012) for 100 seed weight. Low to moderate genetic advance as per cent of mean was recorded for days to 50% flowering, days to maturity, plant height and number of primary branches per plant during the two seasons.

In contrast to the above traits, shelling per cent recorded low to moderate GCV, PCV; moderate to high heritability and moderate to high GAM in two seasons. The results were in accordance with the reports of Korat *et al*. (2009) and Azharudheen (2010).

From the foregoing discussion on variability and genetic parameters, it is evident that plant height, number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, pod yield per plant, kernel yield per plant, sound mature kernel per cent and 100 seed weight had moderate to high PCV, GCV, heritability and genetic advance estimates indicating that variation in these traits was most likely due to additive gene effects. Hence, simple directional selection may be effective

Table 2 : Mean, range and genetic parameters for pod yield and its component traits in groundnut RILs during summer 2012-13 and summer 2013-14

Character	Season	Mean of WW	Mean of WS	Range in WW	Range in WS	PCV (%)	GCV (%)	h^2 (Broad Sense)	GA	GAM
Days to 50% flowering	S 2012-13	24.33	23.29	23 - 26	22 - 25	2.54	2.14	71.02	0.89	3.72
	S 2013-14	38.31	36.05	37 - 41	33 - 38	2.61	2.39	83.43	1.67	4.49
Days to maturity	S 2012-13	98.46	97.3	97 - 102	96 - 99	0.63	0.51	65.96	0.84	0.86
	S 2013-14	108.06	107.44	106 - 112	106 - 109	0.71	0.61	73.34	1.16	1.07
Plant height	S 2012-13	33.08	26.72	13 - 55	10 - 51	18.79	10.28	29.92	3.46	11.58
	S 2013-14	28.02	14.85	8.5 - 54	0.5 - 37	20.71	11.06	28.51	2.61	12.16
No of Primary branches	S 2012-13	6.75	5.78	4 - 12	3 - 10	19.11	7.63	15.96	0.39	6.28
	S 2013-14	5.08	4.58	2.4 - 12	1.7 - 9.5	25.42	19.81	60.76	1.54	31.81
No of Secondary branches	S 2012-13	3.88	3.11	0.4 - 13	1 - 9	44.09	39.3	79.48	2.53	72.18
	S 2013-14	2.3	2.07	0 - 9	0 - 6.5	37.99	33.16	76.19	1.3	59.62
No of Pegs per plant	S 2012-13	23.77	15.42	0 - 98	0 - 50	49.79	47.76	92.01	18.49	94.37
	S 2013-14	23.09	11.65	3.4 - 86	1 - 83	51.42	49.06	91.07	16.75	96.45
No of mature pods	S 2012-13	18.83	12.37	1.9 - 76	2 - 31	35.55	32.99	86.11	9.84	63.07
	S 2013-14	20.65	8.45	2 - 40	0 - 35	39.8	37.65	89.51	10.68	73.39
No of immature pods	S 2012-13	8.96	11.26	2 - 21	1 - 24	42.6	38.43	81.35	7.22	71.39
	S 2013-14	6.07	5.2	0.4 - 21	0 - 22	47.64	43.96	85.11	4.71	83.54
Pod yield per plant	S 2012-13	8.8	3.95	0.9 - 20	0.15 - 10	31.04	27.25	77.08	3.14	49.28
	S 2013-14	8.95	2.88	1.4 - 21	0 - 8.6	23.4	15.93	46.39	1.32	22.36
Kernel yield per plant	S 2012-13	6	2.22	0.6 - 13	0 - 6.4	31.61	27.84	77.56	2.08	50.51
	S 2013-14	6.2	1.76	1.05 - 15	0.06 - 5.1	21.54	13.99	42.22	0.75	18.73
Shelling per cent	S 2012-13	68.35	52.63	64.26 - 78	0 - 76	18.43	16.66	81.75	18.8	31.03
	S 2013-14	69.3	60.56	64.37 - 84	13.8 - 75	8.46	5	34.93	3.95	16.09
Sound Mature Kernel %	S 2012-13	66.22	44.63	14.15 - 96	0.73 - 86	33.22	31.36	89.16	33.99	61.01
	S 2013-14	76.67	50.35	39.29 - 98	3.78 - 94	24.3	22.9	88.78	28.23	44.44
100 Seed weight	S 2012-13	30.99	23.9	14.64 - 58	8.74 - 47	25.55	23.81	86.85	12.55	45.71
	S 2013-14	36.04	16.18	11.81 - 64	0.16 - 54	32.69	31.28	91.58	16.11	61.67

to improve these traits. The other traits with low or moderate values for these genetic parameters suggested that the lesser scope of improvement by selection process as non-additive gene effects were found predominant in their genetic control.

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