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Estimates of Genetic Parameters for Morphological, Yield and Yield Attributes and Disease Reaction in Groundnut

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ABSTRACT

The cultivated Groundnut or peanut is an annual self pollinated legume crop. It is the major oilseed crop in India and in Andhra Pradesh. The genotypes *viz.*, TCGS-1865 showed higher performance for pod yield per plant and number of mature pods per plant. TCGS-1868 performed better for shelling per cent, kernel yield per plant and 100 kernel weight. The genotype, TCGS-1858 had short stature plant type. Greeshma came to flowering early and also matured in early. TCGS-1875 had recorded more number of primary branches per plant. The genotype, TCGS-1873 had shown low incidence of 2.0% followed by TCGS-1862 (2.1%) for stem rot. Hence these genotypes were found as promising donors and these genotypes could be exploited for improvement of yield and its contributing characters in the breeding programme as donors. High heritability was recorded by days to 50% flowering, days maturity, sound mature kernel per cent and rust incidence. Higher genetic advance as per cent of mean was recorded for number of secondary branches per plant, number of mature pods per plant, 100 pod weight, 100-kernel weight, late leaf spot disease, rust disease, stem rot, kernel yield per plan and pod yield per plant indicating that the effect of environment is least in expression of these characters.

Keywords: Genetic parameters, Groundnut, Heritability, Genetic advance

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an allotetraploid (2n = 4x = 40) and is an important annual oilseed legume crop, valued as a rich source of protein, minerals and vitamins. It belongs to the family fabaceae. It is a self pollinated, annual, herbaceous legume and is a king of vegetable oil seeds in India which occupies pre - eminent position in national edible oil economy. It is the major oilseed crop in India and in Andhra Pradesh. It is grown in both rainfed as well as irrigated conditions in *kharif* and *rabi/summer* seasons. In rainfed situation, the crop is exposed to moisture stress of varying intensities at different stages. It is necessary to develop genotypes with shorter duration with higher yield potential in order to stabilize production in rainfed situation.

In breeding programme, to improve pod yield in groundnut, it is essential that plant characters that determine productivity must be identified. Therefore, the information on the nature and extent of genetic variability and transmission of traits is of paramount importance in enhancing the efficiency of selection for kernel and pod yield. Genetic variability is an essential prerequisite for crop improvement programme for obtaining high yielding varieties, through the estimation of different genetic parameters

like components of variances, genotypic and phenotypic coefficient of variability, heritability and genetic advance (Younis *et al.,* 2008). The observed variability is a combined measure of genetic and environmental causes (Patel *et al*., 2009). In genetic studies, characters with high genotypic coefficient of variation indicate the potential for an effective selection (Sadiq *et al.,* 1986). Heritability and genetic advance is a useful tool for breeders in determining the direction and magnitude of selection. Therefore, heritability combined with genetic advance will bring out the genetic gain expected from selection. Hence, to stabilize the yields of groundnut crop under rainfed environments, it is necessary to identify donor parents/ high yielding genotypes for the yield attributes conferring for yield.

MATERIALS AND METHODS

The field experiment was conducted at Regional Agricultural Research Station (RARS), Tirupati. The material used in the present study consisted of 29 genotypes of peanut and were sown in a Randomized Block Design (RBD) with three replications. In each replication every genotype was sown in seven rows of 5 m length with a spacing of 30 cm between the rows and 10 cm between the plants within the row. The field was ploughed and harrowed until a fine tilth of soil was obtained FYM @ 10 t ha^{-1} was applied at the time of field preparation. Seed treatment was done with Bavistin @ 3 g kg^{-1}. The crop was raised under rainfed irrigation and recommended dose of chemical fertilizers at the rate of 20 kg N, 40 kg P_2O5 and 50 kg K_2O per hectare in the form of urea, single super phosphate, murate of potash and 500 kg of gypsum ha^{-1} was applied at peak flowering stage. Cultural practices like weeding were followed to maintain good crop growth apart from need based plant protection measures adopted during the crop season for controlling diseases and pests. The observations were recorded for all the genotypes separately on randomly chosen five competitive plants in each genotype in each replication for all the characters except days to 50 % flowering, days to maturity were recorded on plot basis.

RESULTS AND DISCUSSION

Per se performance

The *per se* performance of 29 advanced breeding lines of peanut for physiological, yield and quality traits was furnished in Table 1. For plant height mean values are ranged from 24.2 cm (TCGS-1858) to 36.8 cm (K-6) with the general mean of 29.7 cm. The *per se* performance for days to 50 % flowering ranged from 29.0 days (Greeshma) to 33.0 days (TCGS-1855). Seventeen genotypes were came to flowering early when compared to general mean (27.62 days). The *per se* performance for days to maturity ranged from 114 days (Greeshma) to 122 days (TCGS-1854). The number of primary branches per plant ranged from 3.6 (TCGS-1874) to 11.8 (TCGS-1875). The number of secondary branches per plant ranged from 0.2 (K-6 to 5.4 (TCGS-1864). The number of mature pods per plant ranged from 4.4 (TCGS-1863) to 11.8 (TCGS-1865).For 100-pod weight, the mean values are varied from 49.0 g (TCGS-1873) to 86.0 g (TGCS-1861). For 100-kernel weight, the mean values are varied from 21.0 g (TCGS-1873) to 40 g (TGCS-1868). The mean values for the shelling per cent ranged from 54.0 % (TCGS-21870) to 71.0 % (TCGS-1868). The mean values for this character ranged from 78.0 % (TCGS-1874) to 97.00 % (TCGS-1866). The mean values for dry haulms yield per plant ranged from 9.4g (Greeshma) to 25.2g (K-6). The mean values for late leaf spot disease ranged from 1.0 (TCGS-1862, TCGS-1864, TCGS-1872, TCGS-1873) to 8.0 % (K-6). The mean values for rust disease ranged from 1.0 (15 genotypes) to 4.0 % (six genotypes). The mean values for rust disease ranged from 3.4 % (TCGS-1864) to 29.5% (K-6). The mean values of genotypes for kernel yield per plant varied from 2.0g

(TCGS-1857) to 12.2g (TCGS-1868). For pod yield per plant the mean values ranged from 3.6g (TCGS-1857) to 19.0 g (TCGS-1865).

The genotypes *viz.*, TCGS-1865 showed higher performance for pod yield per plant and number of mature pods per plant. TCGS-1868 performed better for shelling per cent, kernel yield per plant and 100 kernel weight. The genotype, TCGS-1858 had short stature plant type. Greeshma came to flowering early and also matured in early. TCGS-1875 had recorded more number of primary branches per plant. The least score of 1.0 for late leaf spot was recorded by the genotypes, TCGS-1862, TCGS-1864, TCGS-1872 and TCGS-1873. The genotypes, TCGS-1855, TCGS-1857, TCGS-1858, TCGS-1862, TCGS-1864, TCGS-1865, TCGS-1867, TCGS-1869, TCGS-1871, TCGS-1872, TCGS-1873, TCGS-1875, TCGS-1876, TCGS-1877 and TCGS-1879 recorded least score of 1.0 for rust on 1-9 scale. The genotypes, TCGS-1873 (2.0 %), TCGS-1857 (2.0%), TCGS-1862 (2.1%), TCGS-1859 (2.7%), TCGS-1856, (2.9%), TCGS-1874 (3.1 %), TCGS-1875 (3.2%), TCGS-1866 (3.3%), TCGS-1872 (3.3%), TCGS-1864 (3.4%), TCGS-1877 (3.4 %) and TCGS-1878 (3.5 %) had shown low incidence of disease for stem rot. Hence these genotypes were found as promising donors and these genotypes could be exploited for improvement of yield and its contributing characters in the breeding programme as donors (Table 2).

Variability and genetic parameters

In any breeding programmes the genetic variability present in the population helps in selection of desirable genotypes. Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are useful in detecting the amount of variability present in the genotypes. Heritability estimates along with genetic advance are more helpful in predicting the gain under selection than heritability estimates alone. Phenotypic and genotypic coefficients of variation, heritability in broad sense, genetic advance and genetic advance as per cent of mean for 16 characters involving 29 advanced breeding lines of peanut were presented in Table 3.

For all the characters studied phenotypic coefficient of variation is greater than genotypic coefficient of variation indicating the effect of environment on these traits. These results are in accordance with the results obtained by Narasimhulu *et al.* (2012), John *et al*. (2013), Kamdi *et al*. (2017), Mahesh *et al*. (2018) and Nagaveni and Hasan (2019).

The characters, number of secondary branches per plant, number of mature pods per plant, kernel yield per plant and pod yield per plant exhibited high GCV and PCV indicating ample amount of variation among the genotypes and selection would be effective for further improvement of these characters. High estimates of GCV and PCV for number of primary branches per plant was reported by Mahesh *et al.* (2018), Kamdi *et al.* (2017), Bhargavi *et al.* (2017) and Gupta *et al.* (2015). Moderate GCV and high PCV was exhibited by 100 pod weight. Low GCV and moderate PCV was exhibited by plant height, shelling per cent and dry haulms yield per plant. Lower estimates of GCV and PCV for days to 50 % flowering, days maturity, number of primary branches per plant and sound mature kernel per cent. These results were in accordance with the results of Nagaveni and Hasan (2019), Gonya *et al*. (2018), Vasanthi *et al*. (2015a), Chavadhari *et al.* (2017) and Mahesh *et al*. (2018). Rathord and Toprope (2018) and Gonyanayak *et al*. (2018)

High heritability was recorded by days to 50% flowering (62.1%), days maturity (69.1%), sound mature kernel per cent (72.7%) and rust incidence (62.7%) indicating that the effect of environment is least in expression of these characters. Moderate heritability was registered for the

characters *viz.*, 100 pod weight (48.#%), 100 kernel weight (55.6), shelling percentage (57.6), dry haulms yield per plant (40.6%), incidence of LLS (52.2%), stem rot incidence (49.5%), kernel yield per plant (45.7%) and pod yield per plant (51.3%).

Higher genetic advance as per cent of mean was recorded for number of secondary branches per plant (24.5 %), number of mature pods per plant (34.6 %), 100 pod weight (21.3%), 100-kernel weight (23.6 %), late leaf spot disease (62.5 %), rust disease (165.3 %), stem rot (32.7%), kernel yield per plant (46.5 %) and pod yield per plant (46.9 %). Moderate genetic advance as per cent of mean was exhibited by plant height (12.8 %) and, dry haulm yield per plant (15.5%). High heritability coupled with high genetic advance as per cent of mean were recorded for the character *viz.*, late leaf spot disease (h^2_{bs}= 62.7 %, GAM= 165.3 %).

Moderate heritability coupled with high genetic advance as per cent of mean was exhibited by the characters *viz.*, 100 pod weight (h^2_{bs}= 48.3 %, GAM= 21.3 %), 100 kernel weight (h^2_{bs}= 55.6 %, GAM= 23.6 %), late leaf spot disease (h^2_{bs}= 52.2 %, GAM= 62.5 %), stem rot incidence (h^2_{bs}= 49.5 %, GAM= 32.7 %), kernel yield per plant (h^2_{bs}= 45.7 %, GAM= 46.5 %) and pod yield per plant (h^2_{bs}= 51.3 %, GAM= 46.9 %) suggesting that pedigree method of breeding and phenotypic selection can be used for improvement of these characters. Moderate heritability coupled with high genetic advance as per cent of mean was also reported by Meghala *et al.* (2019), Vasanthi *et al.* (2015a) and Kumar *et al.* (2019) for pod yield per plant and Nagaveni and Hasan (2019) and Goyna *et al.* (2018) for kernel yield per plant. Waidkar *et al.* (2019) reported similar kind of results for moderate heritability coupled with high genetic advance as per cent of mean for plant height.

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Table 1. *Per se* performance groundnut genotypes for yield, yield attributes and diseases

S. No	Entry	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of primary branches per plant Primary	No. of secondary branches per plant Primary	No. of mature pods per plant	Shelling %	100 pod weight (g)	100 kernel weight (g)	Sound mature kernel percent	Haulms yield per plant (g)	Reaction to (1- 9 scale)		Stem rot incidence (%)	Kernel yield per plant (g)	Pod yield per plant (g)
													LLS	Rust			

					y												
1	TCGS-1854	25.4	32	122	5.4	1.4	7.4	60	68	35	89	19.2	2	3	3.5	4.6	7.6
2	TCGS-1855	28.6	33	116	7.6	3.4	6.6	62	57	22	83	19.6	2	1	6.0	7.8	12.5
3	TCGS-1856	28.4	33	115	5.6	0.8	4.4	64	76	33	91	9.2	2	2	2.9	5.9	9.2
4	TCGS-1857	27.4	34	120	7.4	3.0	7.8	55	59	26	81	14.0	3	1	2.0	4.2	7.6
5	TCGS-1858	24.2	32	115	5.8	2.0	11.6	65	55	22	82	22.5	2	1	6.6	6.6	10.2
6	TCGS-1859	29.0	31	121	6.0	1.4	4.4	68	82	37	89	10.0	4	4	2.7	2.7	3.9
7	TCGS-1860	34.6	33	115	7.4	2.2	7.2	61	73	36	81	22.0	3	4	4.0	3.0	4.9
8	TCGS-1861	34.8	31	118	8.4	1.6	8.6	71	86	34	80	22.0	2	4	12.1	7.5	10.5
9	TCGS-1862	26.6	32	120	8.8	3.2	4.4	59	54	22	82	15.6	1	1	2.1	9.2	15.6
10	TCGS-1863	33.6	32	122	4.0	0.6	4.4	62	72	35	91	17.2	3	2	6.8	3.7	5.9
11	TCGS-	28.6	33	117	8.6	4.0	7.2	59	54	24	80	18.8	1	1	3.4	2.0	3.4

	1864																
12	TCGS-1865	34.2	32	120	4.4	3.4	11.8	62	73	33	82	21.2	2	1	11.8	7.6	12.3
13	TCGS-1866	33.4	33	116	4.6	0.8	6.4	64	70	33	97	13.4	2	2	3.3	6.0	9.4
14	TCGS-1867	26.2	31	120	6.0	5.4	10.4	58	58	25	81	21.4	2	1	9.9	5.9	10.1
15	TCGS-1868	34.2	31	116	4.0	0.6	6.6	72	60	40	95	24.0	4	4	12.2	5.3	7.4
16	TCGS-1869	26.6	30	120	8.2	1.2	9.0	66	58	23	83	23.0	2	1	4.8	5.4	8.2
17	TCGS-1870	30.6	32	118	6.0	2.4	9.2	54	68	24	88	18.4	3	4	6.6	4.3	7.9
18	TCGS-1871	32.0	30	117	9.2	2.4	11.2	65	70	34	80	19.6	2	1	6.2	6.7	10.3
19	TCGS-1872	30.4	31	120	5.6	3.4	4.6	62	61	25	84	19.2	1	1	3.3	3.0	4.9
20	TCGS-1873	26.8	30	120	8.6	2.8	4.0	56	49	21	86	14.8	1	1	2.0	3.2	5.7
21	TCGS-1874	29.4	31	117	3.6	0.8	7.0	56	71	27	78	15.2	2	3	3.1	4.4	7.8
2	TC	26	31	115	11.	4.0	8.8	58	52	23	87	21.	3	1	3.2	4.8	8.

2	GS-1875	.4			8							2				2
23	TCGS-1876	31.8	30	115	5.8	0.8	10.0	65	63	30	87	17.8	2	1	6.8	5.1	7.9
24	TCGS-1877	32.6	32	117	7.2	1.2	9.2	60	54	24	83	20.4	2	1	3.4	5.0	8.4
25	TCGS-1878	28.6	33	117	5.2	1.0	11.0	60	66	26	85	11.6	3	3	3.5	5.8	9.6
26	TCGS-1879	26.6	30	115	8.2	1.2	9.0	65	61	35	89	12.2	2	1	4.7	10.0	15.4
27	Greeshma	22.8	29	114	4.0	0.8	7.6	69	72	34	88	9.4	2	4	4.6	4.6	6.6
28	Dharani	30.6	31	119	5.8	1.6	8.2	71	80	36	92	18.2	6	2	5.0	5.4	7.6
29	K-6	36.8	29	114	4.0	0.2	5.4	66	77	32	84	25.2	8	2	4.8	7.4	11.2
	GM	29.7	31.4	117.6	6.5	2.0	7.7	62.6	65.5	29.3	85.4	17.8	2.6	2.0	5.2	8.3	9.6
	SE	0.65	0.23	0.61	0.23	0.24	0.30	0.88	1.79	1.05	0.87	0.81	0.26	0.35	1.04	0.54	0.80
	C.V (%)	11.82	6.88	2.79	19.08	63.5	30.13	7059	14.72	19.38	5.52	24.44	56.62	93.00	58.65	55.58	51.93

Table 2: The following promising groundnut genotypes were identified for different traits

S.No	Character	Promising genotypes
1	Plant height (cm)	TCGS-1854, TCGS-1858, TCGS-1862,TCGS-TCGS-1867,TCGS-1868, TCGS-1869,TCGS-1873,TCGS-1875,
2	Days to 50% flowering	TCGS-1854, TCGS-1855, TCGS-1856, TCGS-1857, TCGS-1858, TCGS-1859, TCGS-1862, TCGS-1864, TCGS-1867, TCGS-1869, TCGS-1873, TCGS-1874, TCGS-1875, TCGS-1878, TCGS-1879, Greeshma, K-6
3	Days to maturity	TCGS-1854, TCGS-1855, TCGS-1856, TCGS-1858, TCGS-1860, TCGS-1861, TCGS-1864, TCGS-1866, , TCGS-1868, TCGS-1870, TCGS-1871, TCGS-1874, TCGS-1875, TCGS-1876, TCGS-1877, TCGS-1878, TCGS-1879, Greeshma, Dharani, K-6
4	No. of branches primary per plant	TCGS-1861, TCGS-1862, TCGS-1864, TCGS-1869, TCGS-1871, TCGS-1873, TCGS-1875
5	No. of branches secondary per plant	TCGS-1855, TCGS-1864, TCGS-1865, TCGS-1867, TCGS-1872
6	No. of mature pods per plant	TCGS-1858, TCGS-1865, TCGS-1867, TCGS-1871, TCGS-1878
7	Pod yield per plant (g)	TCGS-1859, TCGS-1861, TCGS-1868, Greeshma, Dharani
8	Shelling %	TCGS-1854, TCGS-1855, TCGS-1856, TCGS-1857, TCGS-1858, TCGS-1860, TCGS-1861, TCGS-1862, TCGS-1863, TCGS-1864, TCGS-1865, TCGS-1866, TCGS-1867, TCGS-1869, TCGS-1870, TCGS-1871, TCGS-1872, TCGS-1873, TCGS-1874, TCGS-1875, TCGS-1876, TCGS-1877, TCGS-1878, TCGS-1879, Greeshma,
9	Kernel yield per plant (g)	TCGS-1854, TCGS-1855, TCGS-1856, TCGS-1857, TCGS-1858, TCGS-1860, TCGS-1861, TCGS-1862, TCGS-1863, TCGS-1864, TCGS-1865, TCGS-1866, TCGS-1867, TCGS-1869, TCGS-1870, TCGS-1871, TCGS-1872, TCGS-1873, TCGS-1874, TCGS-1875, TCGS-1876, TCGS-1877, TCGS-1878, TCGS-1879, Greeshma,
10	100 pod weight (g)	TCGS-1856, TCGS-1859, TCGS-1861, Dharani, K-6
11	100 kernel weight (g)	TCGS-1859, TCGS-1860, TCGS-1868, TCGS-1879
12	SMK %	TCGS-1856, TCGS-1863, TCGS-1866, TCGS-1868 Dharani
13	Haulm yield per plant (g)	TCGS-1858, TCGS-1868, TCGS-1869, K-6
14	Incidence of LLS (1-9 scale)	TCGS-1854, TCGS-1855, TCGS-1856, TCGS-1857, TCGS-1858, TCGS-1859, TCGS-1860, TCGS-1861, TCGS-1862, TCGS-1863, TCGS-1864, TCGS-1865, TCGS-1866, TCGS-1867, TCGS-1869, TCGS-1870, TCGS-1871, TCGS-1872, TCGS-1873, TCGS-1874, TCGS-1875, TCGS-1876, TCGS-1877, TCGS-1878, TCGS-1879, Greeshma,

15	Incidence of rust (1-9 scale)	TCGS-1859, TCGS-1862, TCGS-1864, TCGS-1872
16	Stem rot incidence (%)	TCGS-1873, TCGS-1857, TCGS-1862, TCGS-1859, TCGS-1856, TCGS-1874, TCGS-1875, TCGS-1866, TCGS-1872, TCGS-1864, TCGS-1877 and TCGS-1878.

Table 3. Mean, range, coefficient of variation, heritability (broad sense) and genetic advance as per cent of mean for yield, yield attributes and disease reaction in groundnut genotypes

Sl. No.	Character	Mean	Range		Variance		Coefficient of Variation		Heritability (Broad sense) (%)	Genetic advance (GA)	Genetic advance as percent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Plant height (cm)	29.7	24.2	36.8	7.4	16.4	9.1	13.6	45.0	3.8	12.8
2.	Days to 50% flowering	31.4	29	33.0	1.3	2.1	3.7	4.7	62.1	1.87	6.0
3.	Days to Maturity	117.6	114	122	16.4	23.7	3.4	4.1	69.1	6.9	5.9
4.	No. of primary branches per plant	6.5	3.6	11.8	0.3	0.9	7.8	14.3	30.2	0.6	8.8
5.	No. of secondary branches per plant	2.0	0.2	5.4	0.2	0.5	20.6	36.1	32.7	0.5	24.5
6	No. of mature pods per plant	7.7	4.0	11.8	6.1	21.3	31.9	59.9	28.4	2.7	34.6
7	100 pod weight (g)	65.5	49.0	86	96.5	199.9	15.0	21.6	48.3	14.0	21.3
8	100 kernel	29.3	21.0	40.0	20.6	37.1	5.5	20.8	55.6	6.9	23.6

	Weight (g)										
9	Shelling percentage (%)	62.6	54.0	72.0	11.1	19.2	5.3	15.0	57.6	5.1	8.2
10	Sound mature kernel percent	85.4	78.0	97.0	0.8	1.1	1.0	1.2	72.7	1.6	1.9
11	Dry haulms yield per plant (g)	17.8	9.4	25.2	4.6	11.2	3.8	18.8	40.6	2.8	15.5
12	Incidence of LLS (1-9 scale)	2.6	1.0	8.0	1.2	2.3	42.1	58.5	52.2	1.6	62.5
13	Incidence of rust (1-9 scale)	2.0	1.0	4.0	4.2	6.7	102.5	129.4	62.7	3.3	165.3
14	Stem rot incidence (%)	9.6	3.4	29.5	4.8	9.7	22.8	32.4	49.5	3.1	32.7
15	Kernel yield per plant (g)	5.2	2.0	12.2	3.1	6.8	33.9	50.1	45.7	2.4	46.5
16	Pod yield per plant (g)	8.3	3.6	19.0	7.0	13.7	31.9	44.6	51.3	3.9	46.9