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Estimation of genetic parameters for morpho-physiological responses in groundnut under rainfed condition

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Abstract
Groundnut (*Arachis hypogaea* L.) is an important legume and oilseed crop as its seed contains 44–56% oil and 22–30% protein on a dry seed basis. The present research work was conducted on 18 genotypes of groundnut including checks during *kharif*, 2018 at the research farm of Birsa Agricultural University, Ranchi, Jharkhand. The objective of this research was to evaluate the performance of genotypes under rainfed condition in the field through morphological and physiological traits. The genotypes were sown in randomized block design with three replications in field and were statistically analyzed. The analysis of variance revealed significant genotypic differences among all the characters under study in rainfed condition suggesting high degree of variability among the genotypes grown. The GCV and PCV was recorded high for the characters such as kernel yield per plant, root weight per plot, pod yield per plant and proline content. Moderate GCV and PCV were observed for pod yield per plot, kernel yield per plot, SLA, SLW and harvest index. In this experiment, the characters which showed high heritability along with high genetic advance are kernel yield per plot, pod yield per plot, root weight, shoot weight, specific leaf area and proline content. Therefore these, traits might be useful in breeding and selection programme for further improvement of groundnut pod yield in the areas of Jharkhand state.

Keywords: *Arachis hypogaea* L., variability, genetic advance, heritability, GCV, PCV

Introduction
Groundnut (*Arachis hypogaea* L.) is an important legume and oilseed crop as its seed contains 44–56% oil and 22–30% protein on a dry seed basis (Savage and Keenam, 1994) [1]. It belongs to the family Leguminosae and is allo-tetraploid species with 2n=40 (Dwivedi *et al.*, 2001) [2], indeterminate and cleistogamous (Gregory *et al.*, 1973) [3]. Groundnut contains 46 per cent oil and 32 per cent of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), respectively (USDA, 2009) [4]. It is also good source of all type of vitamin B, except vitamin B-12, and contains vitamin-E. However, groundnut is predominantly grown as a rainfed crop and frequently subjected to drought stress of varied duration and intensity. Due to erratic rain fall and frequent drought during the crop growth period groundnut yields are generally low and unstable under rain-dependent conditions due to poor adaptation of improved varieties and the influence of drought stress depends on the magnitude of stress, its duration, growth stage and type of genotype. Moreover, Groundnut is unpredictable crop due to its underground pods development and Jharkhand occupied an area of about 23 thousand hectare, and productivity 1194 kg/ hectare (Argil. Deptt. GOJ, 2013-14) [5]. Therefore area and production of groundnut should be enhanced and pod yield is not only polygenically controlled but also influenced by its component characters, hence study of heritability and genetic advance is essential to further clarify the nature of character which can be improved through selection. Moreover, genetic variation among the genotypes is crucial for initiating an effective & successful breeding programme and it became important to study the level of genetic variability, genetic advance and heritability available in the existing genotype to evaluate the same for yield and its component.

Materials and Method

The field experiment was conducted in Randomized Block Design (RBD) with 18 virginia groundnut entries under rainfed situation of Jharkhand at Birsa Agricultural University Experimental Plot, Ranchi during *Kharif* 2018. The date of sowing was 5th July, 2018 and the entries were sown in three replications. Under natural field condition each plot in the replications consisted of five rows occupying the area of 11.25 m^2 (5 x 2.25) per row with the spacing of 45 cm and 15 cm between the rows and between the plants respectively. Thus the total experimental area was 818.55 m^2 (48.15 x 17). Recommended agronomic practices were followed to raise good crop.

The characters under observation in natural condition were days to first flowering, days to maturity, pod yield per plant, kernel yield per plot, kernel yield per plant, shelling per cent, 100 seed weight, SMK per cent, number of branches, oil content, protein content, plant height, specific leaf area, relative water content, specific leaf weight, root weight, shoot weight, total dry matter, harvest index, proline content and pod yield per plot. The data were subjected to statistical analysis using for various genetical parameter using INDOSTAT software.

Experimental Results & Discussion

The mean performance of 18 groundnut entries under rainfed condition in three replication for 22 characters have been presented in the tabulated form (table 1). From table 1, it has been observed that two genotypes RG-625 and RTNG-29 were found to be the earliest to flower among all the genotypes and early maturity was observed in the genotypes JSP-62, BAU-26, K-1802, BAU-29, JSP-63, BG-4, BAU-31, RG-625, PBS-212067 and RTNG-29. Highest pod yield and kernel yield per plot was observed in the genotype RG-625. Oil content was found highest in JSP-63 and GJG-18 among all the genotypes grown but proline content was found high only in the genotype GJG-18. Number of branches was found significantly superior in the genotypes BAU-29, BAU-31 and BAU-32. Specific leaf area was found higher in the genotypes JSP-62, BAU-26 and BAU-32 and relative water content was found highest in BAU-26. Harvest index was found significantly superior in the genotypes BAU-29, BG-4, RG-625, JSSP-50.

From the table 2, it is revealed that the genotypic coefficient of variation ranged from 2.53 for days to maturity to 69.20 for proline content and the estimate of phenotypic coefficient of variation ranged from 3.17 for RWC to 78.54 for proline content. High genotypic coefficient of variation was observed for the characters like proline content (69.20), root weight per plot (42.37), pod yield per plant (22.07), and kernel yield per plant (22.99) indicating that these characters are heritable in nature and the selection based on these characters would give appropriate results as compared to other characters. High phenotypic coefficient of variation was observed for proline content (78.54), root weight per plot (46.97), kernel yield per plant (42.66), pod yield per plant (29.56), kernel yield per plot (26.03) and pod yield per plot (25.03). Generally the phenotypic coefficient of variation is generally found higher than the genotypic coefficient of variation essentially due to the environmental influences. Moreover if the difference observed is wider between GCV and PCV the environmental influence on the expression of traits is greater and vice-versa. Similar results were reported by Prabhu *et al.* (2015) [6], John *et al.* (2008) [7], Tirkey *et al.* (2018) [8] and Parameswarappa and Girish (2007) [9]. In this experiment, the characters which showed high heritability along with high genetic advance are kernel yield per plot, pod yield per plot, root weight, shoot weight, specific leaf area and proline content in the natural condition which concludes that these characters are governed by additive genes for which the selection will be effective for further crop improvement, also referred as fixable genetic variance. The results were supported by Songsri *et al.* (2008) [10], Alan *et al.* (2005) [11], Hamidou *et al*. (2012) [12], Golakia *et al*. (2005) [13], Nandini *et al.* (2010) [14], Girdthai *et al.* (2012) [15], Zaman *et al.* (2011) [16], Narasimhulu *et al*. (2012) [17], Mukesh *et al.* (2014) [18], Salih *et al*. (2014) [19], Yadav *et al.* (2014) [20] and Vasanti *et al.* (2015) [21] in different groundnut genotypes.

Table 1: Mean performance of different characters in 18 Genotypes of Groundnut (*Arachis hypogaea* L.) under rainfed condition

Sl. No.	Genotypes	Days to first flowering	Days to maturity	Pod yield /plant (g)	Kernel yield /plant (g)	Pod yield/ plot	Kernel yield /plot (g)	Shelling per cent (%)	100 kernel weight (g)	SMK (%)	Oil content (%)	Protein content (%)
1	JSP62	26	117*	36.42	21.73	2145	1270	59.31	59.98	85.16	46.00	26.53
2	BAU-26	26	115*	31.46	21.01	2213	1467	66.37	63.45	93.51	44.7	28.18
3	K-1802	27	116*	36.48	23.09	2081	1322	63.44	64.47	87.51	46.33	28.69
4	BAU-29	26	117*	36.05	23.49	2428	1568	64.54	64.45	91.35	49.00	27.57
5	JSP-63	25	117*	32.21	22.11	1849	1270	68.73	58.60	93.05	49.99*	29.10
6	BG-4	27	118*	34.25	23.09	2582	1744	67.49	72.05	90.82	44.17	27.88
7	GJG-18	23	120	32.36	19.07	2150	1061	67.54	65.50	90.06	49.83*	28.65
8	BAU-31	27	117*	25.02	16.86	1926	1298	67.31	66.86	88.98	46.00	27.96
9	RG-625	22*	118*	43.71	28.94	2946*	1949*	66.24	68.63	81.03	46.50	26.69
10	PBS-212067	26	118*	24.38	15.61	2246	1439	63.97	55.39	86.72	44.83	29.27
11	BAU-32	27	123	29.36	17.62	2319	1403	60.08	57.03	84.63	43.67	28.06
12	RTNG-29	21*	117*	21.06	13.68	1625	1059	65.26	57.64	90.73	46.50	26.73
13	JSSP-50	27	119	34.26	26.87	2501	1729	69.07	62.99	86.39	45.17	27.09
14	BG-3 (C)	26	122	27.85	11.79	1737	1127	65.08	59.96	84.56	44.83	29.00
15	Birsa Bold (C)	26	125	27.14	18.34	2205	1492	67.65	78.64	86.37	39.00	29.08
16	Rajmungfali-2 (C)	25	121	39.69	25.60	2365	1533	64.70	62.37	91.18	42.83	24.80
17	ICGS-76 (C)	24	123	21.66	14.24	1550	1029	66.51	55.31	91.73	48.00	32.99
18	M-335 (C)	26	124	23.85	15.16	1913	1212	63.62	54.17	90.5	46.50	29.46
	C.V.	3.51	1.09	12.85	14.08	12.26	12.39	3.12	4.89	4.18	1.86	5.40
	S.E.	0.50	0.75	3.72	2.29	150.18	99.22	1.18	1.77	2.14	0.49	0.88
	C.D. 5%	1.45	2.14	6.44	4.65	431.62	285.16	3.38	5.08	6.14	1.41	2.53

*,**: Significant at 5% and 1% respectively

Table 1: Mean performance of different characters in 18 Genotypes of Groundnut (*Arachis hypogaea* L.) under rainfed condition contd….

Sl. No.	Genotypes	Proline content (µmol/g)	Pod yield (Kg/ha)	No. of branches	Plant Height (cm)	SLA (cm^2g^{-1})	RWC (%)	SLW (gcm^{-2})	Root weight (g)	Shoot weight (g)	TDM (g)	Harvest Index (%)	ELS
1	**JSP-62**	1.25	1904	7	45.61	296.29*	91.57	0.0036	1251	3898	5149	29.33	1
2	**BAU-26**	2.94	1965	7	50.93	339.45*	94.77*	0.0031	382	4921	5303	29.35	1
3	**K-1802**	6.41	1848	7	42.33	265.95	93.42	0.0039	575	4431	5006	20.03	1
4	**BAU-29**	8.07	2156	8*	41.53	254.42	87.79	0.0042	793	4492	5285	31.37*	2
5	**JSP-63**	7.62	1642	7	40.97	216.41	92.23	0.0046	699	4425	5124	26.50	2
6	**BG-4**	5.54	2293	7	47.03	256.77	94.35	0.0039	1197	3916	5113	33.55*	1
7	**GJG-18**	13.59*	1893	7	45.30	242.91	92.34	0.0044	1088	3352	4440	25.55	3
8	**BAU-31**	8.34	1710	8*	43.07	295.31*	94.56	0.0034	1119	4108	5227	26.92	1
9	**RG-625**	2.53	2616*	7	51.33	223.67	93.66	0.0046	1686	3341	5027	36.75*	1
10	**PBS-212067**	2.02	1995	7	45.47	247.15	88.27	0.0042	1670	3602	5272	29.52	2
11	**BAU-32**	1.63	2060	8*	44.13	272.21	93.61	0.0038	1286	3829	5115	31.02	1
12	**RTNG-29**	10.78	1443	7	31.67	208.78	93.47	0.0047	545	4364	4908	24.82	3
13	**JSSP-50**	4.30	2221	7	45.53	254.11	92.49	0.0038	1125	3903	5028	32.96*	1
14	**BG-3 (C)**	**11.39**	1842	6	**51.40**	**283.85**	**93.17**	0.0036	507	4550	5057	25.27	1
15	**Birsa Bold (C)**	0.97	1958	7	46.07	214.59	92.07	**0.0046**	1481	3677	5157	29.78	1
16	**Rajmungfali-2 (C)**	3.90	**2100**	**7**	42.67	252.51	88.42	0.0042	**1929**	3314	**5242**	**31.11**	1
17	**ICGS-76 (C)**	1.94	1776	7	43.90	283.15	86.63	0.0037	1107	3722	4829	24.61	1
18	**M-335 (C)**	3.96	1698	6	48.13	276.20	88.24	0.0037	563	**4633.70**	5197	26.99	2
	C.V.	7.64	12.26	7.54	9.32	2.38	1.02	2.45	8.63	6.93	5.04	16.13	
	S.E.	0.46	133.36	0.31	2.41	3.57	0.54	0.0001	52.59	161.02	147.87	2.67	
	C.D. 5%	1.34	383.28	0.88	6.94	10.26	1.55	0.0002	151.13	462.77	424.99	7.67	

*,**: Significant at 5% and 1% respectively

Table 2: Estimates of PCV, GCV, Heritability, and Genetic Advance & Genetic Advance as percent of mean for different characters in groundnut (*Arachis hypogaea* L.) genotypes under rainfed condition

Characters	GCV%	PCV%	h^2%	GA	GA % of Mean
Days to first flowering	6.06	9.78	61.98	2.48	9.83
Days to maturity	2.53	3.53	71.72	5.26	4.41
Pod yield /plant (g)	22.07	29.56	74.67	11.86	39.28
Kernel yield /plant (g)	20.00	42.66	46.88	5.56	28.21
Pod yield/ plot	14.77	25.03	59.01	503.54	23.37
Kernel yield /plot (g)	17.01	26.03	65.34	392.85	28.32
Shelling per cent (%)	3.66	6.31	57.99	3.75	5.74
100 Kernel Weight (g)	9.69	12.16	79.67	11.16	17.81
SMK (%)	3.02	8.79	34.35	3.23	3.65
Oil content (%)	5.37	6.42	83.69	4.62	10.12
Protein content (%)	5.14	10.89	47.22	2.05	7.27
Proline (µmol/g)	69.20	78.54	88.11	7.22	133.80
No. of branches	6.47	15.25	42.44	0.61	8.69
Plant Height(cm)	8.67	18.68	46.41	5.45	12.17
SLA (cm^2/g)	12.75	13.19	96.64	67.18	25.82
RWC (%)	2.80	3.17	88.37	4.98	5.43
SLW (g/cm^2)	11.63	12.33	94.30	0.00	23.27
Root weight (g)	42.37	46.97	90.20	874.76	82.86
Shoot weight (g)	11.38	15.59	72.98	806.66	20.03
TDM (g)	2.81	11.84	23.73	143.37	2.82
Harvest Index (%)	10.20	18.03	56.56	4.46	15.80

Conclusion

Thus, it may be concluded from the above results that among the five checks grown, Rajmungfali-2 yielded higher than other checks and was found best. Therefore, the genotype RG-625 was found significantly superior to the best check and the genotypes JSP-62, BAU-26, K-1802, BAU-29, JSP-63, BG-4, PBS-212067, BAU-32 and JSSP-5O were found at par to the best check (Table 1). Moreover, the characters pod yield per plant, proline, SLA, root weight and shoot weight may be effective for selection of high pod yield genotypes since it had high heritability along with high genetic advance.

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