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Research Article

Genetic characterization, character association for yield and yield component traits in groundnut (*Arachis hypogaea* L)

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Abstract

The study was undertaken to estimate genetic characterization, character association direct and indirect effects by path analysis for pod yield per plant and its components by using 15 groundnut genotypes. Dry pod yield per plant shown to have maximum genotypic coefficient of variation followed by kernel per plant suggesting substantial amount of genetic variability. Dry pod yield per plant, kernel yield per plant, 100- kernel weight, days to maturity was observed high heritability and high genetic advance these traits were controlled by additive genes and can easily be transferred to succeeding generations. Dry pods per plant registered positive and significant genotypic and phenotypic correlations with kernel yield per plant and 100-kernel weight. It indicated that the selection for increased dry pods per plant may give higher kernel yield per plant and 100-kernel weight and thus, may contribute in increasing the dry pods per plant. The path coefficient analysis revealed that the kernel yield per plant, oil content and shelling percentage exhibited high and positive direct effect on dry pod yield per plant. Thus, these characters turned out to be the major components of pod yield and direct selection for these traits may be rewarding for yield improvement.

Key words: Groundnut, Correlation, Genetic variability, Path coefficient, pod yield

Introduction

Groundnut is an allotetraploid (2n=4x = 40) with a basic chromosome number of x=10 (Stalker, 1997). It is highly self-pollinated crop and has cleistogamous flowers (Korat et al.2010). Groundnut is known as a "wonder legume" for its flowering, pegging and pod formation pattern (Boraiah et al., 2012). It is a valuable cash crop cultivated by millions of small farmers throughout the world, because of its economic and nutritional value (Saha et al., 2015). The groundnut kernels contain about 44-55% oil, 22-32% protein and 8-14% carbohydrates in addition to minerals and vitamins (Babariya and Dobariya 2012). Its seed is used as a source of cooking oil and in confectionary products for human consumption (Naab et al., 2005). Groundnut oil contains 46 and 32 per cent of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), respectively (USDA, 2009). Groundnut crop has enough morphological, biochemical, physiological variability. It has narrow genetic base because of its monophyletic origin, lack of gene flow due to ploidy barrier and self-pollination (Mondal et al., 2007). Since the economic yield is contributed by the pods formed under the ground, the yield potential of groundnut is known only when the crop is harvested. It is almost difficult to predict pod yield based on aerial morphological characters (Weiss, 2000). Therefore, the choice of directly or indirectly yield-related traits is highly useful for breeders. Pod yield, a polygenic trait, is influenced by its various components directly as well as indirectly via other traits, which create a complex situation before a breeder for making selection. Therefore, path coefficient analysis could provide a more realistic picture of the interrelationship, as it considers direct as well as indirect effects of the variables by partitioning the correlation coefficient. The present investigation was undertaken to analyze the association between yield and its attributes in groundnut

Materials and Methods

The experimental material comprised of 15 201 6, INS-I-2014-7, INS-I-2014-8, INS-I-2014-9, INS-I-2014-10, INS-I-2014-11, INS-I-2014-17, INS-I-2014-20, INS-I-2014-21 and INS-I-2014-22. The experiment was laid out in randomized block design with four replications at the Experimental Farm, Department of Plant Breeding and Genetics, Rajasthan College

of Agriculture, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, during Kharif (June to September) 2014-15. Each entry was accommodated in a single row of four meter length spaced 30 cm apart with a plant to plant distance of 10 cm. The crop was well managed for optimum growth and yield. Observations on five random plants were recorded for nine quantitative traits such germination (%), sound mature kernel (%), shelling percentage, kernel yield per plant, 100- kernel weight, dry pod yield per plant and oil content. However, days to 50% flowering and days to maturity were recorded on plot basis, while oil content was estimated by using AOAC (1965) and mean values were used for statistical analysis. Data were subjected for analysis of variance (Panse and Sukhatme, 1989) and genetic parameters viz., genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance were estimated as per Lush (1940), Burton (1952), Allard (1960) and Johnson et al. (1955). The genotypic and phenotypic correlation coefficients were calculated from the phenotypic and genotypic components of variances and co-variances as per the procedure suggested by Fisher (1954) and Al-Jibouri et al. (1958). The direct and indirect effects of the yield components on the yield were estimated by path co-efficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959). The path coefficients were obtained by solving the 'p' normal equations following the matrix method given by Singh and Chaudhary (1977).given
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Result and Discussion

In the present study the analysis of variance revealed highly significant differences for all nine characters among the genotypes, indicating existence of sufficient variation in the material studied (Table1). The magnitude of PCV was higher than GCV for all the traits under study (Table 2). These results in accordance with the findings of Dolma et al. (2010) Zaman et al. (2011) Vishnuvardhan, et al. (2013) and Rao (2016). The magnitude of difference in GCV and PCV were maximum in case of germination % and days to 50% flowering suggesting that the role of environment in the expression of above said traits were maximum. In the present study, dry pod yield per plant shown to have maximum GCV (29.52%) followed by kernel yield per plant (24.62%) suggesting substantial amount of genetic variability and are in accordance with the findings of Giri et al. 2010), Zaman et al. (2011), Upadhyaya et al. (2012), Kavera and Nadaf (2017).

High estimates of heritability (in broad sense) was observed in dry pod yield (93.34%), kernel yield per plant (91.29%), 100- kernel weight (88.63%), days to maturity (85.06%) and oil content (80.41%) (Table. 2) which indicates preponderance of additive gene action in the expression of these traits and they can be improved through individual plant selection. These findings are in agreement with the findings of Upadhyaya et al. (2012), Rao et al. (2014) and Kavera and Nadaf (2017).

High genetic advance (as per cent of mean) were observed for dry pod yield per plant (58.75%), kernel yield per plant, 100- kernel weight and days to maturity. Similar findings of high genetic advance were reported by Vishnuvardhan, et al. (2013) and Rao (2016).

In the present study, high heritability and high genetic advance were observed for dry pod yield per plant, kernel yield per plant, 100- kernel weight and days to maturity which are comparable to the findings of Upadhyaya et al. (2012) and Rao et al. (2014). Further these results suggest that these traits were controlled by additive genes and can easily be transferred to succeeding generations.

The degree of correlation observable among attributes will depend on the development relations between them and on genes which contribute to the variation. Positive correlation occurs due to changes of genes supplying precursors. A perusal of results (Table 3) revealed greater genotypic correlations than their corresponding phenotypic correlations indicating the preponderance of genetic variance on expression of characters Vekariya et al. (2010), Kwaga (2014), Prabhu et al. (2015) and Gupta et al. (2015).

In the present study, dry pods per plant registered positive and significant genotypic and phenotypic correlations with kernel yield per plant and 100-kernel weight, while its association was found significantly negative with oil content. It indicated that the selection for increased dry pods per plant may give higher kernel yield per plant and 100-kernel weight and thus, may contribute in increasing the dry pods per plant but, will result in reduced oil content. Similar results were reported by Meta and Monpara (2010), Raut et al. (2010), Vekariya et al. (2010), Rao et al. (2013), Kwaga (2014) and Prabhu et al . (2015) and Gupta et al. (2015).

A strong relationship was also observed between kernel yield per plant and 100- kernel weight at both genotypic and phenotypic levels. As these two characters are interrelated and also had strong genotypic association with dry pod yield per plant, the improvement in one component will automatically result in improvement in another component and finally the dry pod yield. Similar results have been reported by Meta and Monpara (2010), Vekariya et al. (2010), Pradhan et al. (2011), Kavera and Nadaf (2017). Oil content was showed positive and significant correlation with days to maturity at genotypic level. In the present study, positive significant relationship was established between days to maturity and sound mature kernel. Whereas, days to 50% flowering and days to maturity had strong negative significant correlation with dry pod yield per plant at both genotypic and phenotypic level. The results thus, suggested that decrease in days to 50% flowering and days to maturity may give rise to higher pod yield. Sound mature kernel showed negative significant correlation with dry pod yield per plant at only genotypic level. Similarly shelling % exhibited positive and significant correlation with 100- kernel weight. Similar findings have been reported by Mane et al. (2008) and Sadeghi et al. (2012). The present results on correlation coefficient thus, revealed that the kernel yield per plant, 100- kernel weight, days to maturity and sound mature kernel were the most important yield attributes and may contribute considerably towards higher pod yield in groundnut. The interrelationship among yield components would help in increasing the yield levels and therefore, more emphasis should be given to these components while selecting better plant types in groundnut.

In view of the fact that correlation coefficients do not take into account extremely complex interrelationships between various characters., Path coefficient analysis was applied to partition the correlation into direct and indirect effects. The path coefficient analysis revealed that the kernel yield per plant (0.573), oil content (0.174) and shelling percentage (0.155) exhibited high and positive direct effect on dry pod yield per plant (Table-4). Thus, these characters turned-out to be the major components of pod yield and direct selection for these traits may be rewarding for yield improvement. Similar results had been reported by Vekariya et al. (2010), Pradhan et al. (2011) Kwaga (2014), Prabhu et al. (2015). The trait viz. sound mature kernel (0.043) exhibited low and positive direct effect toward the pod yield. Low and positive direct effect of sound mature kernel on pod yield had been reported by Kwaga (2014) and Prabhu et al. (2015) and Gupta et al. (2015). Negative direct effect on pod yield was shown by days to maturity (-0.492), days to 5% flowering (-0.431) and germination % (-0.254). Similar results have been reported by Vishnuvardhan, et al. (2013), Rao (2016) and Kavera and Nadaf (2017).

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Table-1 Analysis of variance for seed yield an its component traits in groundnut

SI.NO.	Characters / Source of variation	Mean sum of squares: Replication	Treatment	Error
	d. f.	**3**	**14**	**42**
1	Germination (%)	24.74	173.33**	47.66
2	Days to 50% flowering	4.33	29.69**	3.70
3	Days to maturity	25.53	490.64**	20.63
4	Sound mature kernel (%)	12.20	52.35**	6.30
5	Shelling (%)	7.31	13.88**	2.86
6	Kernel yield/plant (g)		13.70**	0.32
7	100- kernel weight (g)	2.06	84.34**	2.62
8	Dry pod yield/plant (g)	0.28	45.24**	0.79
9	Oil content (%)	0.29	7.25**	0.42

*, **Significant at 1% and 5% probability level respectively

Table 2 Estimates of variability, heritability and genetic advance as percentage of mean

Characters	Range: Lowest	Range: Highest	Grand mean ($\bar{X}$) ± SE	Coefficients of variability: GCV	Coefficients of variability: PCV	Heritability (b s) (%)	Genetic advance (GA)	Gen. adv. as % of mean (5%)
Germination (%)	60.24	82.99	71.29±4.88	7.86	12.47	39.73	7.28	10.21
Days to 50% flowering	37.50	46.5	41.13±1.36	6.20	7.76	63.72	4.19	10.19
Days to maturity	96.00	127.50	112.38±3.21	9.65	10.46	85.06	20.59	18.33
Sound mature kernel (%)	82.00	95.00	90.03±1.77	3.77	4.69	64.65	5.62	6.24
Shelling (%)	62.75	69.00	66.17±1.20	2.51	3.58	49.08	2.40	3.62
Kernel yield/plant (g)	5.24	12.39	7.43±0.40	24.62	25.77	91.29	3.60	48.46
100- kernel weight (g)	39.50	54.75	46.98±1.14	9.62	10.22	88.63	8.77	18.66
Dry pod yield/ plant (g)	8.11	18.84	11.29±0.63	29.52	30.55	93.34	6.63	58.75
Oil content (%)	44.75	48.53	46.64+0.46	2.80	3.13	80.41	2.41	5.18

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Table -3 Genotypic and phenotypic correlation for dry pod yield and its component traits in groundnut

Characters	r	Days to50% flowering	Days to maturity	Sound mature kernel (%)	Shelling (%)	Kernel yield/plant (g)	100- kernel weight (g)	Oil content (%)	Dry pod yield/ plant (g)
Germination (%)	G	-0.212	0.209	0.077	-0.480**	-0.138	-0.814**	0.081	-0.054
	P	0.036	0.170	0.229	-0.163	-0.125	-0.483**	0.094	-0.088
Days to 50% flowering	G		0.229	0.093	0.016	-0.487**	-0.223	0.147	-0.641**
	P		0.094	0.061	-0.075	-0.359**	-0.134	0.181	-0.527**
Days to maturity	G			0.350**	-0.212	-0.684**	-0.545**	0.336**	-0.762**
	P			0.260*	-0.068	-0.618**	-0.438**	0.238	-0.696**
Sound mature kernel (%)	G				-0.645**	-0.048	-0.117	-0.044	-0.274*
	P				-0.377**	-0.067	-0.086	0.006	-0.199
Shelling (%)	G					0.018	0.293*	-0.397**	0.163
	P					0.033	0.222	-0.289*	0.077
Kernel yield/plant (g)	G						0.323*	-0.575**	0.917**
	P						0.300*	-0.526**	0.865**
100- kernel weight (g)	G							-0.104	0.351**
	P							-0.074	0.325*
Oil content (%)	G								-0.424**
	P								-0.345**

*' ** Significant at 5% and 1% level of significance, respectively.

Table -4 Direct (diagonal) indirect (off diagonal) effects of genotypic and phenotypic path for dry pod yield and its component traits in groundnut

Characters	Path	Germination (%)	Days to 50% flowering	Days to maturity	Sound mature Kernel (%)	Shelling (%)	Kernel Yield/plant (g)	100-kernel weight (g)	Oil content (%)	r with dry pod yield per plant (g)
Germination (%)	G	-0.254	0.091	-0.103	0.003	-0.074	-0.079	0.348	0.014	-0.054
	P	0.055	-0.010	-0.050	-0.014	-0.007	-0.082	0.008	0.012	-0.088
Days to 50% flowering	G	0.054	-0.431	-0.113	0.004	0.002	-0.279	0.095	0.026	-0.641**
	P	0.002	-0.285	-0.027	-0.004	-0.003	-0.235	0.002	0.023	-0.527**
Days to maturity	G	-0.053	-0.099	-0.492	0.015	-0.033	-0.392	0.233	0.058	-0.762**
	P	0.009	-0.027	-0.292	-0.016	-0.003	-0.405	0.007	0.030	-0.696**
Sound Mature Kernel %	G	-0.020	-0.040	-0.172	0.043	-0.100	-0.028	0.050	-0.008	-0.274*
	P	0.013	-0.017	-0.076	-0.061	-0.015	-0.044	0.001	0.001	-0.199
Shelling %	G	0.122	-0.007	0.104	-0.028	0.155	0.010	-0.125	-0.069	0.163
	P	-0.009	0.021	0.020	0.023	0.040	0.022	-0.004	-0.036	0.077
Kernel Yield/plant (g)	G	0.035	0.210	0.336	-0.002	0.003	0.573	-0.138	-0.100	0.917**
	P	-0.007	0.102	0.181	0.004	0.001	0.655	-0.005	-0.066	0.865**
100- Kernel Wt. (g)	G	0.207	0.096	0.268	-0.005	0.045	0.185	-0.428	-0.018	0.351**
	P	-0.026	0.038	0.128	0.005	0.009	0.196	-0.016	-0.009	0.325*
Oil content (%)	G	-0.021	-0.063	-0.165	-0.002	-0.062	-0.329	0.044	0.174	-0.424**
	P	0.005	-0.052	-0.070	0.000	-0.012	-0.344	0.001	0.126	-0.345**

Genotypic residual value are 0.142 and phenotypic residual value are 0.344