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RESEARCH PAPER

Genetics and inter-relationship of oil and protein content in crosses involving bunch genotypes of groundnut (*Arachis hypogaea* L.)

L.L. JIVANI, J.H. VACHHANI*, P.M. VAGHASIA, V.H. KACHHADIA, M.B. PATEL AND H.G. SHEKHAT
Main Oilseeds Research Station, Junagadh Agricultural University, JUNAGADH (GUJARAT) INDIA
(Email : lljivani@jau.in)

Abstract : Genetic analysis of oil and protein content was performed in 28 non-reciprocal diallel set of crosses involving eight Spanish bunch groundnut genotypes. Estimates of genetic components of variance indicated that dominance genetic effects were significant for oil and protein contents in F_1 and F_2 generations while additive components were significant only for protein content in F_2 generation. However, the dominance components were greater in magnitude than additive components suggesting the preponderance of dominance in governing these two important quality attributes. The average degree of dominance $(H_1/D)^{1/2}$ was found in the range of over dominance for oil and protein contents having unequal frequency of dominant and recessive genes with more number of dominant genes. Heritability estimates in narrow sense were low for oil and protein content in both the generations. Correlation studies indicated a positive and significant relationship between pod yield and protein content whereas negative between oil content and protein content. Reciprocal recurrent selection scheme for developing confectionery Spanish bunch genotypes having high protein and low oil was suggested.

Key Words : Genetic analysis, Components of variance, Pod yield, Groundnut

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the world's fifth most important source of edible oil and vegetable protein. It contains 31-55 per cent oil and 16-34 per cent protein. More than 80 per cent of groundnut production in the country is used for extraction of oil and about 1 per cent is exported for confectionery (HPS) purpose. In autogamous crops like groundnut, recombination breeding has extensively been used to develop the variability reservoir for exploitation in breeding progamme. In a systemic breeding programme, it is essential to identify the elite parents for hybridization and superior crosses to expand the variability reservoir for selection of superior genotypes. Before formulation of suitable strategies to breed varieties with specific requirement for oil and protein contents in groundnut, understanding the relationship and genetic systems governing oil and protein contents are very essential. Although, several studies have been conducted pertaining to the genetics of these quality parameters (Dwivedi *et al*., 1989). Hence, a study was conducted with 28 non-reciprocal diallel crosses involving Spanish bunch genotypes of groundnut through Hayman's (1954) approach.

MATERIALS AND METHODS

Twenty-eight non-reciprocal diallel crosses involving eight Spanish groundnut genotypes *viz*., GG 2, GG 5, GG 7, TG 19A, SB XI, FeESG 10, JL 24 and Chico were effected during summer of 2002. Few seeds of F_1's produced in summer, 2002, along with their eight parents were grown in *Kharif,* 2002 in

* Author for correspondence.

non-replicated rows to advance the F_2 generation and to get fresh seeds of parents. The F_1's and F_2's were raised along with the parents in a Randomized Block Design with three replications during the summer season of 2003 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh. Each replication in parents and F_1's consisted of single row of 3 m length, whereas the F_2's were raised in 4 rows, the row length being 4 m. A spacing of 10 cm between plants and 30 cm between rows was uniformly maintained for parents, F_1's as well as in F_2's. All the recommended package of practices for raising a good crop was followed.

Data on protein and oil contents were recorded on five randomly selected competitive plants of each parent and F_1 while 50 plants of F_2 generation for each cross. Protein content was estimated based on total nitrogen content of seed by micro-kjeldahl's method (Bremmer, 1965) and oil content was estimated following specific gravity method as proposed by Misra *et al*. (1993). Correlation coefficients were obtained following the method of Dewey and Lu (1959). The data were analyzed by using Hayman's approach. Genetic components of variance; additive (D) and non-additive (H_1 and H_2) were worked out as per the method suggested by Hayman (1954). Heritability estimates (in narrow sense) were carried out for both the traits following the method of Crumpacker and Allard (1962).

RESULTS AND DISCUSSION

Genetic analysis of oil content indicated that non-fixable genetic components of variance (H_1 and H_2) were significant while fixable genetic component (D) was non-significant in both F_1 and F_2 generations indicating the preponderance of non-additive genetic variance in the inheritance of oil content (Table 1). While both additive and non-additive genetic variances were important in the inheritance of protein content in F_2 generation and only non-additive genetic variance was important in F_1 generation. The non-additive genetic variance was higher in magnitude than the additive component for both the characters in both the generations studied.

The negative values of 'F' and KD/KR ratio were less than unity in both the generations indicated that the proportion of dominant genes were less than the recessive once in oil content. While positive values of 'F' and the KD/KR ratio exceeding unity further supported present observation of the preponderance of dominance variance in the inheritance of protein content.

The average degree of dominance $(H_1/D)^{1/2}$ for oil and protein content were in the range of over dominance (values exceeding unity) in both F_1 and F_2 generations. Hayman (1954) indicated that interacting (non-allelic) dominant loci would result in apparent over dominance as observed in the present study. For both oil and protein contents, the genes with positive and negative effects were asymmetrically distributed as seen from the $H_2/4H_1$ ratio, which was less than 0.25.

In the present study, the ratio of h^2/H_2 was nearly to unity for both the characters in both the F_1 and F_2 generation indicating that a few genes or group of genes generally controlled the inheritance of these characters under investigation.

The review of previous studies on genetics of oil and protein contents was conflicting. Predominance of both, additive genetic effects (Bansal *et al.*, 1992) and non-additive gene effects (Mankne and Bhale, 1987) were observed for oil content. Protein content was reported to be governed by additive gene effects (Layrisse *et al*., 1980; Makne and Bhale, 1987 and Bansal *et al*., 1992).

The heritability estimates for oil and protein contents were low in both the generations. Such an observation, where preponderance of dominance genetic effects manifested in the inheritance of these two traits, yielding extreme values of heritabilities may arise due to over dominance or linkage in repulsion phase of favourable or detrimental genes in the partial to complete dominance range or due to epistatic interactions (Layrisse *et al*., 1980). Hence, to isolate superior genotypes with high protein or oil contents, early generation selection may be ineffective and may be postponed to later generations.

Table 1 : Estimation of genetic components of variance for oil and protein contents in groundnut

Characters		Genetic components of variance										
		D	H_1	H_2	h^2	F	$(H_1/D)^{1/2}$	$H_2/4H_1$	KD/KR	h^2/H_2	Heritability% (n. s.)	t^2
Oil	F_1	0.85± 0.39	4.62**± 0.89	4.24**± 0.78	3.85**± 0.52	-0.25± 0.92	2.33	0.23	0.88	0.91	14.37	3.110
	F_2	0.86± 0.36	22.30**± 3.27	20.54**± 2.85	6.95**± 0.48	-0.58± 1.68	5.10	0.23	0.88	0.34	12.39	0.356
Protein	F_1	1.48± 0.76	20.61**± 1.74	17.50**± 1.52	9.45**± 1.02	3.31± 1.79	3.74	0.21	1.86	0.54	7.82	0.245
	F_2	1.47*± 0.56	38.18**± 5.56	32.25**± 4.49	21.35**± 0.75	5.01± 2.65	5.09	0.21	2.00	0.66	17.05	0.001

* and ** indicate significance of values at P=0.05 and 0.01, respectively

The analysis of test of homogeneity (t^2) was non-significant for both the traits in both the generations signifying that the l x t assumptions were fulfilled inducing the absent of epistasis.

Inter relationship estimates ('r' values) between pod yield and protein content indicated a significant positive value (r=0.56), while it was negative (r=-0.60) and significant between pod yield and oil content. Interestingly oil and protein contents exerted a strong negative relationship (r=-0.76). Thereby indicating that conscious selection for the one would automatically results in the reduction in the other. Layrisse *et al*. (1980) obtained significant and positive correlation for pod and kernel yield with oil and protein content. Holley and Hammons (1968), Huang (1975) and Tai and Young (1975) reported negative correlations of pod and kernel yield with oil and protein and between oil and protein contents.

Hence, it is suggested that to breed special purpose varieties having high protein and low oil contents, breeding procedures which effectively mop up non-additive variance like bi-parental mating or reciprocal recurrent selection scheme as followed in soybean (Brim and Burton, 1979) for simultaneous improvement of yield and protein, may be adopted.

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