Plant Archives Vol. 18 No. 2, 2018 pp. 1830-1834 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

PROGENIES SELECTION FOR DROUGHT TOLERANCE IN PEANUT (*ARACHIS HYPOGAEA* L.) THROUGH INDIRECT (TRAIT BASED) SELECTION METHOD

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Abstract

Peanut (*Arachis hypogaea* L.) is grown as an important oil-seed, food legume and cash crop mainly in rain-fed conditions between 40°N and 40°S latitudes. Over two third of the global peanut production occurs in seasonally rain-fed regions where drought is a potential constraint for crop production (Smartt 1994). Genetic management which leads development of drought tolerant varieties is one of the important options to get rid of the situation. Genetic enhancement to maximize crop production per unit input of water has been a major research thrust of crop improvement programs throughout the world. In field crops where breeding for drought tolerance has been a focus for many years, empirical breeding methods have been the most successful. An alternative approach is traits based selection in which lines are selected on the bases of specific traits determined to be beneficial under water deficit conditions (Bidinger and Witcombe, 1989). In the present study promising progenies for drought tolerance through traits based selection approach have been identified.

Key words : Peanut, *Arachis hypogaea* L., trait based selection method, drought resistance.

The experimental materials consisted of eight parents and 192 progenies (Yadav, 2002) derived from seven hybrids. There were originally three crosses *viz.,* ICGS-76 × CSMG-84-1, ICGS-44×CSMG-84-1 and ICGV-86031×TAG-24 common at all the four centres and one each was location specific *i.e.* ICGS-76×ICGS-44 at ICRISAT, K-134×TAG-24 at Tirupati, JL-220×TAG-24 at Jalgaon and GG-2×ICGV-86031 at Junagadh and Udaipur which were selected on the basis of their traits related to water use efficiency (WUE). Indirect selection scheme, based on traits related to WUE, harvest index and Soil-Plant Analyses Development (SPAD) Chlorophyll meter reading was formulated. It was termed as trait based selection (M_1). This selection was exercised under drought (E_1) and irrigated condition (E_2) at four respective centers (table 1) and another method was empirical selection approach (M_2).

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The experiment was laid out in a resolvable incomplete block (Alpha) design (Patterson and Williams, 1976) with three replications during 2000-01. Each replication had 50 blocks, 48 for selections and two for parents, each with four plots. Each plot consisted of four 4-meter rows. The inter-row and intra-row spacing were 30 and 10 cm, respectively. The observations for all the traits i.e. harvest index, pod yield per plant, shelling percentage, kernel yield per plant, 100-kernel weight, oil content percentage, protein content, soil plant analysis development (SPAD) chlorophyll meter reading (SPAD-502, Minolta) were recorded on one meter row length, having competitive plants for each treatment in each replication. The data were analysed through statistical software Gen state var. 6.0

Analysis of variance of alpha design (table 1) revealed that adjusted as well as unadjusted mean squares due to genotypes were significant for all the traits. The unadjusted mean square due to block was significant for

Table 1 : Analysis of variance of Alpha design for various traits in peanut.

Source \ Traits		Harvesting index	Pod yield/plant	Shelling percentage	Kernel yield/plant	100-Kernal weight	Oil content	Protein content	SPAD reading
Replication (2)		1.2	9.865	2.472	8.569	237.395**	0.045	0.231	617.250**
Genotypes (Adjusted)(199)		48.956**	27.342**	33.782**	14.151**	89.213**	10.067**	8.904**	3.612**
Genotypes (Unadjusted)(199)		67.174**	36.347**	45.792**	18.951**	128.814**	14.360**	11.993**	14.214**
Block/Replication (Adjusted)(147)		5.822	7.602	4.046	3.687	10.728	0.188	0.12	7.098
Block/ Replication (Unadjusted)(147)		30.485**	19.793**	20.304**	10.186**	64.338**	5.998**	4.302**	21.450**
Error(151)		5.354	6.066	3.457	2.901	9.143	0.178	0.123	7.517
C.V.	Alpha	10.35	40.15	4.89	28.18	16.59	0.37	0.53	17.69
	RBD	4.55	17.05	2.71	17.35	5.66	0.88	1.5	6.39

( ) Figures in parenthesis are degrees of freedom., *** Significant at 1 and 5 per cent level of significance, respectively.

all the traits, whereas, adjusted mean square were not significant. In these conditions neither block effect nor adjustment of genotype mean was necessary. Therefore, further analysis was carried out in Randomised Block Design (RBD). Analysis of variance revealed significant difference among parents and progenies for all characters. TAG 24 appeared to be the best parent for harvest index, shelling percentage and pod yield, whereas, parent ICGV 86031 for oil content and SPAD reading and parents ICGS 44, ICGS 84-1 and JL 220 were the best for protein content, kernal yield and 100-kernel weight, respectively (table 2). Average performance of progenies was higher than the average of parents for shelling percentage, protein content and SPAD reading (tables 2, 3). Neither of the methods showed consistent superiority (table 3). These results are in correspondence with earlier reports as well Basu *et al.* (2003), Yadav *et al.* (2004).

Effects of methods differed from centre to centre and character to character. Average mean performance of trait based selection method was high than empirical selection methods for most of the characters *i.e.* harvest index, pod yield per plant, 100-kernel weight, oil content and SPAD reading (table 4). Differences between crosses were significant in both the methods for progenies from all the centers for 100-kernel weight, oil content and protein content but superiority of cross varied from center to center and method to method. This is in conformity with the earlier report by Nigam *et al*. (2003). For rest of the traits the difference was significant at some centers and in some methods with differential superiority except SPAD reading, which was superior in cross ICGS-76 × CSMG-84-1 at all the centers where difference was significant.

On the basis of average performance and restriction up to the group one can't identify superior progenies. Therefore, the number of progenies having superiority over the best parent was considered a criterion of selection. Conclusively, out of 192 progenies 22 were identified for six traits for drought tolerance through trait based selection method only (table 4) and empirical selection method could be proved unable to yield any promising material for moisture stress conditions. Therefore, on the basis of this investigation it may said in essence that trait based selection method appeared to have an edge over empirical selection method for breeding varieties for drought conditions in peanut.

Summary

One hundred ninety two progenies of peanut (*Arachis hypogaea* L.) derived from seven crosses out of which derivatives of three crosses were from common

Table 2 : Mean values of parents for various characters in peanut.

Parents and their selection based traits		Harvest index (%)	Pod yield/ plant (g)	Shelling (%)	Kernal yield plant (g)	100-kernel weight (g)	Oil content (%)	Protein content (%)	SPAD reading
ICGS-44	High HI	51.80c	15.27b,c	71.33a,b	10.47c,d	57.00a,b	44.95f	26.85a	39.90b
ICGS-76	High T and HI	49.35c	15.96b	63.33d	9.81b,c	57.00a,b	50.39b	21.39d	44.87a
CSMG-84-1	High TE,T and Low HI	56.96b	21.89a	71.33a,b	15.12a	56.00b	48.94c	23.94c	39.63b
ICGV-86031	High TE & WUE	54.68b	20.35a	68.00c	13.44a,b	55.67b	51.84a	20.84e	44.40a
TAG-24	High TE & HI	62.23a	20.69a	74.33a	14.85a	55.67b	45.39e,f	24.05c	41.10a,b
JL-220	Locally adapted line	57.72b	16.54b	72.67a	11.57b	61.67a	50.28b	21.28d	37.17b
GG-2	Locally adapted line	58.72a,b	17.54b	68.67b,c	11.70b	51.33b,c	47.92d	21.56d	39.07b
K-134	Locally adapted line	48.13c	11.91c	72.67a	8.27d	46.33c	45.80e	25.78b	37.17b
Mean		54.95	17.52	70.29	11.90	55.08	48.19	23.21	40.41
Sed		1.36	1.49	1.11	1.03	1.80	0.25	0.20	1.57
CD 5%		3.78	4.13	3.08	2.87	5.01	0.68	0.56	4.36

Means having different alphabets differ significantly.

Table 3 : Mean values of trait based and empirical selection methods for various characters in Peanut.

Methods	Harvest index (%)	Pod yield/ plant (g)	Shelling (%)	Kernal yield/ plant (g)	100-kernel weight (g)	Oil content (%)	Protein content (%)	SPAD reading
C1 M1	51.72a	14.84	70.37	10.03	57.38a	48.40	23.34a	43.54a
M2	50.70b	14.93	70.43	10.17	53.25b	48.35	23.12b	42.46b
C2 M1	52.31b	15.30b	71.18	10.63	56.06b	48.93a	22.74b	42.46
M2	53.53a	16.34a	70.76	11.10	57.24a	47.86b	23.11a	42.46
C3 M1	52.00	15.82	71.40a	10.86a	51.43	48.42a	23.00b	42.51
M2	52.11	15.17	70.35b	10.26b	52.07	47.69b	23.80a	42.21
C4 M1	50.66a	13.49	69.83b	9.14	56.89	48.36a	23.59	42.62
M2	49.64b	14.19	71.72a	9.64	56.38	48.09b	23.68	42.30
Mean of M1	51.67	14.86	70.69	10.16	55.44	48.53	23.17	42.78
Mean of M2	51.50	15.16	70.81	10.29	54.74	47.99	23.43	42.36
Mean	51.58	15.01	70.76	10.23	55.09	48.26	23.30	42.57
SEd.	0.28	0.30	0.23	0.21	0.37	0.05	0.04	0.32
CD 5%	0.77	0.84	0.63	0.59	1.02	0.14	0.11	0.89

Means having different alphabets differ significantly

C1 = ICRISAT, C2 = Jalgaon, C3 = Junagadh, C4 = Tirupati and M1 = trait based, M2 = Empirical

Table 4 : Progenies selected under drought environment through trait based selection method in peanut.

S.No.	Progeny	Hybrid symbol(Parentage)	Selected Traits	value	Methods
1	JUG- 09	XC(ICGV 86031 X TAG 24)	Shelling Percentage (%)	75.00	Trait based
2	TIR- 09	XA(ICGS 76 X CSMG 84-1)	100 Kernel weight (g)	63.00	Trait based
3	JAL- 02	XA(ICGS 76 X CSMG 84-1)	Shelling Percentage (%)	75.00	Trait based
4	JUG -01	XA(ICGS 76 X CSMG 84-1)	Shelling Percentage (%)	75.00	Trait based
5	JAL- 12	XE (JL-220 X TAG 24)	100 Kernel weight (g)	64.00	Trait based
6	JAL- 04	XB(ICGS 44 X CSNG 84-1)	100 Kernel weight (g)	67.67	Trait based
7	JUG- 11	XD (GG02 X ICGV 86031)	Shelling Percentage (%) Pod yield (g) Kernel yield (g)	76.00 26.01 18.98	Trait based
8	ICR- 01	XA(ICGS 76 X CSMG 84-1)	100 Kernel weight (g)	63.00	Trait based
9	JUG- 02	XA(ICGS 76 X CSMG 84-1)	SPAD Reading	46.43	Trait based
10	JAL- 07	XC(ICGV 86031 X TAG 24)	Shelling Percentage (%)SPAD Reading	74.6745.23	Trait based
11	JAL -03	XA(ICGS 76 X CSMG 84-1)	100 Kernel weight (g)	62.00	Trait based
12	TIR- 01	XB(ICGS 44 X CSNG 84-1)	100 Kernel weight (g)	64.00	Trait based
13	ICR -09	XC(ICGV 86031 X TAG 24)	SPAD Reading	46.63	Trait based
14	ICR -11	XG (ICGS 44 X ICGS 76)	Shelling Percentage (%)	74.67	Trait based
15	JAL- 11	XE (JL-220 X TAG 24)	100 Kernel weight (g)	64.33	Trait based
16	ICR- 08	XC(ICGV 86031 X TAG 24)	100 Kernel weight (g)	62.33	Trait based
17	JUG- 10	XD (GG02 X ICGV 86031)	Shelling Percentage (%)	75.00	Trait based
18	TIR- 13	XC(ICGV 86031 X TAG 24)	100 Kernel weight (g)	64.67	Trait based
19	TIR -19	XF (K134 X TAG 24)	Shelling Percentage (%)100 Kernel weight (g)	75.3370.33	Trait based
20	ICR- 60	XC(ICGV 86031 X TAG 24)	Protein Percentage (%)	27.81	Trait based
21	JAL- 10	XE (JL-220 X TAG 24)	Shelling Percentage (%)	76.00	Trait based
22	ICR -03	XA(ICGS 76 X CSMG 84-1)	SPAD Reading	47.80	Trait based

breeding programme run at four breeding stations and derivatives of one cross (as a location specific cross) from each of the four stations separately. The materials were evaluated for drought tolerance under two methods, empirical and trait based selection exploiting eight variables in Alpha Design. Since, unadjusted mean squares due to blocks and progenies were significant further analysis was, therefore, carried out in Randomized Block Design (RBD). Average mean performance of trait based selection method was higher to that of empirical selection method for harvest index, pod yield per plant, 100 kernel weight, oil content and SPAD reading. The number of progenies having superiority over the best parent was considered a criterion of selection. Eventually, twenty two progenies for six traits were identified promising for drought tolerance through trait based selection method only. Empirical selection method could not be proved to be of use to detect a promising progenies for drought tolerance/ moisture stress conditions. Out of twenty two selected progenies six were the derivatives from ICRISAT, five from Junagarh, four Tirupati and seven from Jalgaon.

Acknowledgement

The material was developed under ACIAR Funded ACIAR-ICRISAT-ICAR collaborative project on, “More Efficient Breeding of Drought Resistant Peanuts in India & Australia”. Authors duly acknowledge the project and its workers. Facilities extended by AICRP (Groundnut) under which the present research work was carried out are also gratefully acknowledged.

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