I J PS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume 7 | Issue 2 | July, 2012 | 307-312

RESEARCH ARTICLE

Assessment of genetic variability and inter- relationship among minicore collection of groundnut (*Arachis hypogaea*)

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SUMMARY

An field experiment was conducted by using groundnut minicore set, comprised of 182 accessions representing *hypogaea* bunch (42), *hypogaea* runner (39), Spanish bunch (63) and *fastigiata* (38) obtained from NRCG, Junagad with nine cultivars (GPBD-4, JL-24, Mutant-III, TGLPS-3, DSG-1, Gangapuri, ICGS-44, GAUG-10 and Kadiri-3) during *Kharif* 2005. Data on days to 50 per cent flowering, pod yield per plant, days to maturity, shelling per cent, sound mature kernels, test weight, Oil content (%), days to maturity, late leaf spot, rust and per cent *Sclerotium* was taken. Heritability estimates were high for oil content, test weight and pod yield per plant in all four botanical types, but test weight was moderate in case of Virginia bunch. Moderate heritability was noticed for shelling per cent, sound mature kernels, late leaf spot, rust and *Sclerotium* and low for days to 50 per cent flowering and days to maturity. High genetic advance was observed for test weight pod yield per plant, late leaf spot, rust and per cent of *Sclerotium*, moderate for shelling per cent, sound mature kernel and oil content and for days 50 per cent flowering and days to maturity it was low. Studies on association of different traits revealed that between most of the traits significant correlation was observed. Pod yield per plant had high positive correlation with test weight, oil content, shelling per cent and sound mature kernels, so by improving these characters we can improve the yield. Late leaf spot, rust and per cent of *Sclerotium* are highly associated with each other which is to be considered when breeding for disease resistance.

Key Words : Monicore, Heritability, Genetic advance, Correlation

How to cite this article : Chandrashekar, Madhura and Kenchanagoudar, P.V. (2012). Assessment of genetic variability and inter-relationship among minicore collection of groundnut (*Arachis hypogaea*). *Internat. J. Plant Sci.*, **7** (2) : 307-312.

Article chronicle : Received : 19.03.2012; **Revised :** 10.05.2012; **Accepted :** 25.05.2012

Germplasm resource is a very wide term that covers all the allelic resources spread in types ranging from most primitive wild progenitors to the highly bred cultivated varieties and strains. The main aim of genetic resource maintenance and conservation for their utilization in crop improvement is very important and essential. But the successful utilization of such resources required for the thorough understanding of the genetic diversity, extent of variation and genetic architecture of the plant among these genotypes would help in developing groundnut plant improvement programme. It is a pre-requisite to maintain the genetic variability that allows identification of promising genes in the germplasm collection that can be incorporated in the breeding programmes, to develop promising cultivars.

Germpalsm collection contains a vast reservoir of genetic variability, which would help to broaden the genetic base of the cultivars. The wild *Arachis* species which are not only excellent source of resistance to biotic and abiotic stresses but also provide new gene for yield and yield related attributes (Halward *et al.*, 1991). The utilization of exotic germplasm resources in the breeding programmes also enhances the diversity of cultivars. Upadhyaya *et al.* (2003) suggested a strategy for sampling entire and core collections for developing a mini core subset, which contains about one per cent of total

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accessions but is representative of the entire diversity of the collection. The mini core collection, because of its drastically reduced size, can be evaluated extensively to select useful parents. Mini core collection can be used to improve the efficiency of identifying desirable traits in the core collection.

Low heritability and low genetic advance for shelling per cent and moderate heritability and moderate genetic advance for hundred seed weight (Swamy Rao, 1979). In contrast Upadhyaya *et al.* (2005) reported high heritability for shelling per cent, hundred seed weight, and moderate for days to first flowering and low for pod yield per plant. Lakshmidevamma *et al.* (2004) carried out correlation analysis for pod yield and oil yield with some of their components characters in 81 genotypes of groundnut. Pod yield possessed significant positive association with kernel yield, test weight and oil yield at both genotypic and phenotypic levels.

There was negative correlation of leaf spot resistance with yield and early maturity (Miller and Norden, 1980). Bhagat *et al.* (1986) reported that oil content was positively correlated with majority of scored traits and it was highly significant with shelling percentage. They also reported that only mature pods maintained a strong positive direct effect with pod weight. The direct effect of shelling percentage was also substantial and positive. Mallikarjuna Swamy (2001), reported that days to maturity is strongly associated with pod yield per plant, positive significant correlation for days to maturity and days to initiation of flowering, negative significant correlation for oil content with pod yield per plant, positive significant correlation for days to maturity and days to initiation of flowering, negative significant correlation of oil content with pod yield per plant, test weight, shelling per cent, sound mature kernels, positive significant association of test weight and pod yield per plant.

MATERIALS AND METHODS

The experimental material comprised 182 accessions of groundnut minicore set, representing *hypogaea* bunch (42), *hypogaea* runner (39), Spanish bunch (63) and *fastigiata* (38) obtained from NRCG, Junagad. Besides these accessions, nine cultivars (GPBD-4, JL-24, Mutant-III, TGLPS-3, DSG-1, Gangapuri, ICGS-44, GAUG-10 and Kadiri-3) were also included (Table A).

Data on days to 50 per cent flowering, pod yield per plant, days to maturity, shelling per cent, sound mature kernels, test weight, Oil content (%), days to maturity, late leaf spot, rust and per cent *Sclerotium* was taken. The oil content on dry weight basis (oven dried) was determined with the help of NMR (Nuclear Magnetic Resonance) spectrometer. This was recorded and expressed as per cent seed oil content (Ramamurthi *et al.*, 1985). The data was analyzed by using M-STAT C as statistical software to estimate variable components and their approximate standard error. The format of the model is given below (Sundaraj *et al.*, 1972) and genetic advance was calculated using the model given by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Groundnut (*Arachis hypogaea* L.) is an annual legume and is grown primarily for high quality edible oil and easily digestable protein in its seeds. The main aim of plant breeding programmes is to improve the plant traits for agronomic and economic value. Even though coefficient of variation gives an idea about amount of variability, it does not give true picture about the extent of inheritance of the character. Heritability estimates by separating out the environmental influence from the total variability, indicates accuracy with which a genotype can be assessed by its phenotypic performance. Thus permitting greater effectiveness of phenotypic selection however, its use would be limited as it is influenced to a great extent by environment and genotypes included. The estimation of heritability was a greater role to play in determining the effectiveness of selection of a character provided it was considered in conjunction with the predicted genetic advance as suggested by Johnson *et al.* (1955).

The analysis of data revealed significant variation due to genotypes for test weight, yield per plant, oil content, days to 50 per cent flowering, shelling per cent, sound mature kernel, late leaf spot, rust, per cent of *Sclerotium.* The mean and range for each quantitative characters in mini core and four botanical varieties are presented in Table 1. Coefficient of variation was estimated for all the four botanical types displayed wide range of variation for all the traits. Very high variation was reported in per cent of *Sclerotium* for all the four botanical types particularly in Virginia runner and was low in Valencia. High variation was recorded for pod yield per plant, test weight, late leaf spot and rust in all the four botanical types. Days to 50 per cent flowering, shelling per cent, sound mature kernel, oil content, days to maturity were recorded low coefficient of variation (Table 2).

Genetic parameters like heritability in broadsense (h^2_{bs}) and genetic advance as mean performance (GAM) were estimated for each trait in different botanical types which are presented in the Table 3. In the present study highest heritability was recorded for pod yield per plant and oil content in all the four botanical types and also for test weight but was moderate in Virginia bunch type. Moderate heritability was noticed in case of shelling per cent, sound mature kernel, late leaf spot severity and per cent of *Sclerotium* in all the four botanical types whereas low heritability in case of days to 50 per cent flowering and days to maturity. The genetic advance was observed high for pod yield per plant, test weight, late leaf spot, rust and per cent *Sclerotium* and moderate for shelling per cent, sound mature kernels and oil content whereas, low was observed for days to 50 per cent flowering and days to maturity in all the four botanical types. Result of high heritability has been reported for pod yield per plant and test weight of the present study was matched with the result

Table A : Accessions of groundnut mini core set

Sr. No.	Variety	HBT	ICG	ORG	Sr. No.	Variety	HBT	ICG	ORG
1.	C 50	HYB	111	UN	51	Limdi 219-3	HYR	2777	IND
2.	PB 148/41	HYB	188	IND	52	US 57	HYR	2857	ARG
3.	AH 6857	HYB	532	UN	53	C 145-12-p-16	HYR	2925	IND
4.	NCAC 2730	HYB	1668	USA	54	Local 3	HYR	3992	IND
5.	KNO 50	HYB	2772	NGA	55	AH 7002	HYR	4156	UN
6.	HG 3	HYB	3027	IND	56	NG 268	HYR	4343	IND
7.	# 275	HYB	3053	IND	57	IC 22951	HYR	4389	IND
8.	TESO	HYB	4527	UGA	58	USA 60	HYR	4412	ISA
9.	27-1	HYB	4538	IND	59	K 487	HYR	4998	CHN
10.	Hyderabad	HYB	4598	IND	60	UF 439-16-6	HYR	5827	USA
11.	Line 136	HYB	4746	ISR	61	24-11	HYR	6813	SEN
12.	Makulu Red	HYB	5286	ZMB	62	GA 61-42	HYR	7000	USA
13.	NC FLA 14	HYB	5327	USA	63	VRR 299	HYR	7153	IND
14.	AH 7313	HYB	5662	CHN	64	FLA 268-B-B-B1	HYR	7243	USA
15.	AN 7325	HYB	5663	CHN	65	RG 159	HYR	8490	SOM
16.	FESR 14	HYB	5745	PRI	66	ZM 25	HYR	8760	ZMB
17.	VRR 125	HYB	5891	IND	67	57-295	HYR	9037	CIV
18.	NCAC 17773	HYB	6057	USA	68	ZM 2861	HYR	9905	AMB
19.	Sam Col. 283	HYB	6402	UN	69	EG	HYR	11109	TXN
20.	NCAC 1789	HYB	6667	USA	70	Costales DK/7	HYR	11219	MEX
21.	NCAC 2140	HYB	6766	USA	71	AMR 151	HYR	11457	IND
22.	NCAC 17591	HYB	6892	USA	72	BPZ 71 OVERO	HYR	12276	
23.	NCAC 2396	HYB	6913	USA	73	AKG 280	HYR	12370	IND
24.	NC 10447 LF	HYB	8285	USA	74	US 824-2	HYR	12672	USA
25.	VRR 663	HYB	9666	IND	75	U118	HYR	13099	
26.	RPM 013	HYB	9777	MOZ	76	37 GG2	HYR	13723	
27.	PR 5680	HYB	9842	TZA	77	RS 118	VUL	36	IND
28.	79-6-1	HYB	9961	UN	78	BEFORE	VUL	81	UN
29.	52-32	HYB	10185	USA	79	TG9	VUL	118	IND
30.	CS 27	HYB	11322	IND	80	NCAC751	VUL	334	CHN
31.	CS 2414	HYB	11426	IND	81	Spanish white	VUL	397	USA
32.	SUWEON 45	HYB	11855	KOR	82	GA191	VUL	434	USA
33.	Hwaseongibudo	HYB	11862		83	Sulebhani Bijap	VUL	1137	IND
34.	91 GG2	HYB	13787	CAF	84	DHT 191	VUL	1711	BOL
35.	AK 471C	HYB	14008		85	KOP 3	VUL	1973	IND
36.	AON-772	HYB	14466		86	AH2184	VUL	2019	D
37.	AON-827	HYB	14475		87	Small Japan	VUL	2106	D
38.	AON-857	HYB	14482		88	AH 4515	VUL	2102	D
39.	NFC-6	HYB	14705	CMR	89	U 4-4-23	VUL	3240	UGA
40.		HYB	15190	CRI	90	Four seeded	VUL	3343	IND
41.	T 27	HYR	76	IND	91	NG 268	VUL	3421	D
42.	S 42	HYR	163	UN	92	45-27	VUL	3584	D
43.	AH 2100	HYR	513	IND	93	U 4-47-21	VUL	3746	ARG
44.	6842	HYR	721	USA	94	A 182	VUL	4543	UN
45.	C 121	HYR	862	IND	95	U 4-7-8	VUL	4684	USA
46.	C 143	HYR	875	IND	96	WO RTE STU KEI	VUL	4729	CHN
47.	EC 16690 (PC)	HYR	928	UN	97	ROSADO	VUL	4750	PRY
48.	NCAC 17123	HYR	2381	BRA	98	AH 7786	VUL	4911	MWI
49.	C21	HYR	2511	IND	99	AH 7065	VUL	4955	IND
50.	Kanyoma	HYR	2773	TZA	100	U 4-7-15	VUL	5195	SDN

Table 1 : Mean performance for different quantitative traits in different botanical varieties

Sr. No.	Variables	Mini core			Virginia bunch			Virginia runner			Spanish bunch			Valencia		
		Min.	Max.	Mean	Min.	Max.	Mean.	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
1.	Days to 50% flowering	32.0	43	36.8	35.5	43	38.6	35	43	39.0	32	38.5	35.0	32	41	35.4
2.	Pod yield per plant	2.2	13.7	6.6	2.7	13.7	6.79	2.2	11.5	5.8	2.4	12.8	7.7	4.2	10.8	7.1
3.	Shelling per cent	44.4	76.5	64.6	45.0	59	61.7	44.4	76.5	64.3	48.9	74.5	66.2	54	73.5	65.4
4.	Sound mature kernels	69.0	98.8	90.0	69.0	95.9	88.5	74.5	97.2	90.4	72.6	98.8	91.2	70.4	97.1	89.1
5.	Test weight	24.4	61.1	36.6	25.8	59.2	40.7	26.2	54.3	37.3	24.4	53.0	33.9	25.0	61.1	36.0
6.	Oil content	41.3	49.7	47.20	41.3	49.5	46.6	44.6	48.8	47.0	44.4	49.0	47.1	43.6	49.7	47.3
7.	Days to maturity	101	120	109.4	104	116	109.9	107.5	120	111.1	105	116	108.7	101	118	108.6
8.	Late leaf spot	2	8	4.3	2.5	6.5	3.6	2	8	3.4	3.5	7.5	5.3	2.5	6	4.6
9.	Rust	2	9	5.0	2.0	6.5	3.6	2	7	3.5	2	9	6.7	2.5	8	5.6
10.	Per cent *Sclerotium*	0	77.7	19.6	0.0	25	10.8	0	25.8	3.5	0	77.7	31.1	0	75	27.7

Table 2 : Coefficient of variation for different quantitative traits in different botanical varieties

Sr. No.	Variables	Mini core	Virginia bunch	Virginia runner	Spanish bunch	Valencia
1.	Days to 50% flowering	7.00	7.0	6.9	6.1	7.1
2.	Pod yield per plant	29.50	31.6	27.8	28.6	30.38
3.	Shelling per cent	8.64	11.2	9.4	9.4	9.5
4.	Sound mature kernels	6.29	8.8	5.7	5.8	8.6
5.	Test weight	19.40	17.6	19.0	21.3	21.5
6.	Oil content	3.00	3.9	2.7	2.8	5.0
7.	Days to maturity	4.90	5.9	5.0	5.2	5.0
8.	Late leaf spot	25.18	27.8	29.2	17.4	22.7
9.	Rust	36.70	38.2	31.8	20.65	28.3
10.	Per cent *Sclerotium*	95.06	77.4	160.0	68.65	28.3

Table 3 : Heritability and genetic advance for different quantitative traits in different botanical varieties

Sr. No.	Variables	Mini core		Virginia bunch		Virginia runner		Spanish bunch		Valencia	
		h^2 (%)	GA	h^2 (%)	GA	h^2 (%)	GA	h^2 (%)	GA	h^2 (%)	GA
1.	Days to 50% flowering	78.4	6.54	19.0	3.10	41.9	6.00	19.2	2.63	5.1	1.95
2.	Yield per plant	76.5	48.78	70.0	45.9	86.2	50.52	79.6	47.14	74.2	46.9
3.	Shelling per cent	40.5	3.97	17.1	3.97	60.0	11.75	47.0	9.11	37.2	7.4
4.	Sound mature kernels	43.4	6.56	64.2	11.70	50.0	5.89	47.3	5.63	37.4	6.67
5.	Test weight	70.4	30.63	48.9	17.81	83.0	34.38	64.1	28.08	75.9	33.94
6.	Oil content	79.1	7.52	81.6	6.69	73.3	4.13	74.4	4.43	80.8	5.07
7.	Days to maturity	31.0	1.55	10.2	0.47	13.1	0.74	9.7	1.16	8.3	0.91
8.	Late leaf spot	51.0	159.3	41.9	24.16	73.8	46.18	42.6	14.90	26.5	10.87
9.	Rust	63.5	31.8	32.0	25.28	69.1	44.86	74.1	31.60	53.3	29.82
10.	Per cent *Sclerotium*	78.1	16.17	50.7	43.79	51.3	170.85	61.9	23.50	45.4	20.58

Table 4 : Correlation among various quantitative traits in groundnut core collection

Variables	Test weight	Pod yield/ plant	Oil content	Days to 50% flowering	Shelling (%)	SMK (%)	Days to maturity	LLS	Rust	% *Sclerotium*
Test weight	1.000									
Pod yield/ plant	0.222**	1.000								
Oil content	0.118	0.217**	1.000							
Days to 50% flowering	0.174*	-0.202**	-0.114	1.000						
Shelling (%)	0.077	0.196**	0.333**	-0.174*	1.000					
SMK (%)	0.166*	0.218**	0.330**	-0.024**	0.310**	1.000				
Days to maturity	0.099	-0.10	-0.075	0.261	-0.095	-0.030	1.000			
LLS	-0.261**	0.101	-0.025	-0.358**	0.148**	0.107	-0.114	1.000		
Rust	-0.353**	0.087	0.011	-0.414**	0.127	0.048	-0.104	0.775**	1.000	
% *Sclerotium*	-0.265**	-0.031	-0.030	-0.307**	0.028	-0.046	-0.078	0.427**	0.556**	1.000

**Tabulated r value at 1% level of significance = 0.185
* Tabulated r value at 5% level of significance = 0.141

of Bhagat *et al*. (1985) and Mallikarjuna Swamy (2001). Moderate heritability observed in the present study was similar to the report of Mallikarjuna Swamy (2001) but contrary to the result of low heritability.

A high genetic advance for test weight and moderate for shelling per cent, sound mature kernels has also been observed by Vasanthi *et al*. (1998) and Mallikarjuna Swamy (2001). Low genetic advance for days to 50 per cent flowering was observed by Vasanthi *et al*. (1998). High genetic advance for days to maturity and days to 50 per cent flowering was noticed by Mallikarjuna Swamy (2001), but was contrary to the results of present study but high genetic advance for maturity was noticed by Lakshmidevamma *et al*. (2004).

A reliable value of heritability with high GA offers the most effective condition for selection. Results of present investigation indicated that selection for pod yield per plant and test weight late leaf spot, rust and per cent *Sclerotium* could be effective in improving the pod yield, because environment had least effect on above mentioned characters. The yield in a plant is the sum of effects of several yield related component characters and environment. For a rational approach towards the improvement of yield, selection has to be made for the components of yield. Thus, this assumes a special importance as the basis for selecting desired genotypes. Correlation coefficient helps the breeder in determining relative importance of yield component for indirect selection for yield.

Association of various traits was estimated and the results are presented in the Table 4. In the present investigation, test weight, oil content, shelling per cent, sound mature kernels, showed high positive association with pod yield, thus suggesting that these characters are important yield components and the effective improvement in yield can be achieved through selection based on these characters. Similar result of positive correlation of test weight and oil content was obtained by Vasanthi *et al*. (1998) and Lakshmidevamma *et al*. (2004). Same results for shelling per cent and sound mature kernels was obtained by Vasanthi *et al*. (1998) but contrast to this by Lakshmidevamma *et al*. (2004). Similar results of positive correlation of oil content with sound mature kernels and shelling per cent was obtained by Lakshmidevamma *et al*. (2004) but contrast results were obtained by Vasanthi *et al*. (1998). Positive correlation of shelling per cent and sound mature kernels, days to 50 per cent flowering and days to maturity were observed by Vasanthi *et al*. (1998) and Lakshmidevamma *et al*. (2004).

Late leaf spot, rust and per cent *Sclerotium* were positively correlated with each other. Similar results were noticed by Vasanthi *et al*. (1998) and Lakshmidevamma *et al*. (2004). Pod yield per plant was negatively correlated with per cent *Sclerotium* and positively correlated with late leaf spot and rust. The same result for rust and contrast for leaf spot was expressed by Vasanthi *et al*. (1998) and Lakshmidevamma *et al*. (2004). Hence, the test weight, oil content and sound mature kernels contribute towards the high pod yield per plant while the days to 50 per cent flowering, days to maturity were negatively related.

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