Electronic Journal of Plant Breeding, 5(4): 834-838 (Sep 2014)
ISSN 0975-928X

Research Note

Genetic parameters for drought tolerant related traits in groundnut (*Arachis hypogaea* L.)

Shreya[1], R.P. Vasanthi[2], M, Shanthi Priya[1] and P. Sudhakar [2]
[1]Dept. of Genetics and Plant Breeding. S.V. Agricultural College, Tirupati-517202 India.
[2]Regional Agricultural Research Station, Tirupati- 517202
Email: vasanthi.rrs@gmail.com

(Received: 30 June 2014; Accepted: 14 Aug 2014)

Abstract
In order to study the genetic parameters for drought tolerant related traits in groundnut, TCGS 1043 was crossed with ICGV 05163, ICGV 06045, ICGV 93261 and TCGS 913. Genotypic co-efficient of variation (GCV), heritability (h^2) and genetic advance as percentage of mean were estimated for these characters in F_3 populations of four crosses.The results indicated that the traits, total biomass, shoot weight, root weight and shoot to root ratio were largely governed by additive genetic variance and hence, selection would be effective in early generations. The traits SCMR and harvest index were predominantly governed by non-additive genetic variance and selection has to be postponed to later generations The trait, SLA was influenced by both additive and non-additive gene action and selection would be moderately effective in early generations.

Key word: Groundnut, Genetic variance, heritability, genetic advance.

Groundnut is an important oilseed, food and feed crop of India. About 80 % of the area of the crop is under rainfed situation. Drought is the most important abiotic stress factor that influences the productivity of crop. Many physiological attributes like specific leaf area (SLA) and SPAD chlorophyll meter reading (SCMR) were found to be correlated to drought resistance and water use efficiency(WUE) (Nigam *et al.*, 2005, Nageswara Rao *et al.*, 2001, Bindhu Madhava *et al.*, 2003, Latha and Reddy, 2007, Sudhakar *et al.*, 2006, Painawadee *et al.*, 2009). These traits can be recorded with ease in segregating populations. Hence, selection for drought resistance can be effected through these traits. In rainfed situation, in addition to these leaf traits, it is necessary to consider root characters as they influence the uptake of water and nutrients during the period of moisture stress (Wright and Nageswara Rao,1994; Painawadee *et al.*, 2009). Hence, the present study was undertaken to get information on inheritance of WUE related traits through analysis of genetic parameters, genotypic co-efficient of variation, heritability and genetic advance as percentage of the mean. The information on the pattern of inheritance helps the breeder in making decisions about selection procedures to be followed in segregating generations for improvement of respective traits in groundnut.

The present investigation was carried out during rainy season (July-October) 2013 at Regional Agricultural Research Station, Tirupati. The experimental material consisted of four F_3 populations derived from TCGS 1043 × ICGV 05163, TCGS 1043 × ICGV 06045, TCGS 1043 × ICGV 93261 and TCGS 1043 × ICGV 913 and five parents *viz*, ICGV 05163, ICGV 06045, ICGV 93261, TCGS 913 and TCGS 1043. F_3 population in each cross was derived from raising seeds obtained from single pods picked up from each plant in F_2 population. The common female parent, TCGS 1043 is a drought tolerant high yielding variety released from Regional Agricultural Research Station, Tirupati (Vasanthi *et al.*, 2012). The male parents, ICGV 05163, ICGV 06045 and ICGV 93261 are advanced breeding lines developed at ICRISAT, Hyderabad. They possess high pod yielding ability with undesirable pod and seed attributes. They produce higher biomass and belong to *A. hypogaea* ssp. *hypogaea*. Recommended cultural practices were followed throughout the crop period. Each F_3 population was grown in 15 rows of 5 m length and each parent in 4 rows of 5 m length following a spacing of 30 cm between the rows and 10 cm between the plants within a row. Seven characters *viz*, SCMR, SLA, total biomass per plant (g), shoot weight per plant (g), root weigh per plant (g), shoot to root ratio and harvest index (%) and observations were recorded in each cross for 250 plants and in parents for 30 plants. Leaf area was recorded at 60 DAS using leaf area meter (Li-COR Model-3100). SPAD chlorophyll meter reading (SCMR) was recorded using SPAD meter (SPAD-502, Minotla Corporation, Ramsey, NJ) on 3^{rd} leaf from the top of main axis of each individual plant. Specific leaf area is the ratio of leaf area to the leaf dry weight of third leaf of each individual plant recorded at 55-60 days after sowing. The genetic parameters, genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV) were calculated as per Burton (1952); heritability in broad sense and genetic advance as percent of mean were estimated as per Allard (1960) and Johnson *et al.* (1955), respectively.

SCMR: SCMR ranged from 38.88 (TCGS 1043 × TCGS 913) to 41.55 (TCGS 1043 × ICGV 05163). Mean values in F_3 populations were towards lower SCMR parent (Table 1). Genotypic co-efficient of variation (GCV) was low in all the crosses which ranged from 2.90 to 5.11. Heritability estimates ranged from 13 % (TCGS 1043 × TCGS 913) to 36 % (TCGS 1043 × ICGV 05163). GAM was low i.e., from 2.18 to 6.29 which indicats that this trait was governed by non-additive variance. Hence selection has to be postponed to later generations to improve the trait. Vasanthi *et al*. (2004) reported moderate GCV, heritability and GAM for SCMR. John *et al*. (2008) reported low GCV and high heritability for SCMR. Upadhyaya *et al*. (2010) from their studies on gene action in two crosses reported that SCMR at 60 DAS was predominantly influenced by dominant effects with duplicate epistasis.

SLA: Mean SLA values ranged from 158.9 (TCGS 1043 × ICGV 05163) to 266.5 (TCGS 1043 × ICGV 06045). In TCGS 1043 × ICGV 05163 and TCGS 1043 × ICGV 93261, SLA was lower than higher SLA parent while in TCGS 1043 × ICGV 06045, it was higher than higher SLA parent. In TCGS 1043 × TCGS 913, it was almost similar both in parents and crosses (Table 1). GCV ranged from 4.59 (TCGS 1043 × TCGS 913) to 24.02 (TCGS 1043 × ICGV 05163). In two crosses, TCGS 1043 × ICGV 05163 and TCGS 1043 × ICGV 05163, heritability and GAM were high with moderate GCV. From this, it can be inferred that both additive and non-additive genetic variances govern the trait and phenotypic selection will be effective in early generations. Girthai *et al.* (2012) reported high heritability for SLA in their studies in 140 peanut lines obtained from four crosses.

Total biomass: Mean total biomass values ranged from 16.31 g (TCGS 1043 × TCGS 913) to 26.44 g (TCGS 1043 × ICGV 05163). In F_3 generation, the mean total biomass was lower than the parent (Table 1). Heritability estimates ranged from 22 to 60 % . GCV was high in all the crosses which ranged from 22.93 to 41.27. GAM was high in all the crosses i.e., 22.32 to 65.96. The estimates indicated that the trait is governed by additive genetic variance. The low to moderate heritability might be due to larger influence of environment. Hence, phenotypic selection would be effective in early generations.

Shoot weight per plant: Mean shoot weight per plant values ranged from 7.3 g (TCGS 1043 × TCGS 913) to 13.53 (TCGS 1043 × ICGV 05163). In all the F_3 populations, the mean of shoot weight was lower than the parents (Table 1). GCV was high in all the crosses and ranged from 21.13 (TCGS 1043 × TCGS 913) to 52 (TCGS 1043 × ICGV 06045). Heritability estimates ranged from 13 % to 72 %. It was highest in TCGS 1043 × ICGV 05163 (72 %). GAM value ranged from 15.53 to 79.33. From the estimates, the trait appears to be predominantly governed by additive genetic variance in the first three crosses. In TCGS 1043 × TCGS 913, all the genetic parameters were low which might be due to presence of similar alleles in both the parents governing this trait. Vasanthi *et al.* (2004) reported moderate GCV, heritability and GAM.

Root weight per plant: Mean root weight per plant value ranged from 0.36 g (TCGS 1043 × TCGS 913) to 0.61 g (TCGS 1043 × ICGV 05163). Except in one cross, TCGS 1043 × ICGV 06045, all other crosses had lower mean values than the parents. Among the crosses, GCV ranged from 28.72 (TCGS 1043 × ICGV 93261) to 42.51 (TCGS 1043 × ICGV 05163). Heritability ranged from 26 % (TCGS 1043 × ICGV 93261) to 71 % (TCGS 1043 × TCGS 913). GAM was high in TCGS 1043 × TCGS 913 (69.10) followed by TCGS 1043 × ICGV 05163 (66.30). From the results, it was obvious that the trait was largely under the influence of additive gene action and phenotypic selection would be effective in the improvement of the trait. The results in the present study corroborate with the earlier report of Jayalaxmi (1997) who reported high heritability and GCV for this trait.

Shoot to root ratio: Mean shoot to root ratio ranged from 22.35 g (TCGS 1043 × TCGS 913) to 28.82 g (TCGS 1043 × ICGV 93261). Almost similar mean performance was recorded by crosses and parents. GCV, heritability and genetic advance as percent of mean were moderate to high indicating the role of additive genetic variance and the scope for improvement of the trait in early generations.

Harvest index: Mean harvest index ranged from 37.87 (TCGS 1043 × ICGV 93261) to 47.66 % (TCGS 1043 × TCGS 913). F_3 population mean was lower than the parents in all the crosses except in TCGS 1043 × TCGS 913. GCV was moderate which ranged from 10.07 (TCGS 1043 × TCGS 913) to 14.09 (TCGS 1043 × ICGV 06045). Heritability ranged from 31 (TCGS 1043 × TCGS 913) to 52 % (TCGS 1043 × ICGV 06045). GAM values were moderate to high. Hence, it can be inferred that the trait was governed by non-additive gene action and selection has to be postponed to later generations. Seethala Devi (2004) reported moderate to high heritability and genetic advance as percent of mean for harvest index. Vishnuvardhan *et al*. (2012) reported moderate GCV, heritability and GAM for harvest index.

Based on the foregoing discussion, it may be concluded that total biomass, root weight, shoot weight and shoot to root ratio were predominantly governed by additive genetic variance. Hence, improvement in these traits can be made through phenotypic selection in early generations whereas the traits, SLA and HI were governed by both additive and non additive gene action and phenotypic selection has to be postponed to later generations.

References:

Allard, R.W.1960. Principles of Plant Breeding. John Wiley and Sons Inc. New York. 485.

Bindhu Madhava, H., Sheshasayee,M. S., Shankar, A.G., Prasad, T.G., and Uday Kumar, M. 2003,Use of SPAD Chlorophyll meter to assess transpiration efficiency of peanut. Breeding of drought resistant peanuts .ACIAR Proceed., **112**:3-9.

Burton, G. W. 1952. Quantitative inheritance in grass. *Proceedings of 6 th International Grassland Congress*, **1**: 277-283.

Girdthai, T., Jogloy, S., Vorasoot, N., Akkasaeng, C., Wongkaew, S., Patanothai, A., and Holbrook, C. C.2012. Inheritance of the physiological traits for drought resistance under terminal drought conditions and genotypic correlations with agronomic traits in peanut. *SABRAO J. Breeding and Genet.*, 44(2):240-262.

Johnson, H. W., Robinson, H.F and Comstock, R. E. 1955.Genotypic and phenoyupic correlations in soybean and other implications in selection. *Agron. J.*,. **47**: 477-483.

John, K., Vasanthi, R. P., Venkateswarulu, O., Muralikrishna, T and Harinath Naidu, P. 2008. Genetic analysis and regression studies for yield and yield attributes in F_2 segregating populations of groundnut crosses. *Legume Res.*, **31**(1): 225-227.

Jayalakshmi, V. 1997 . Genetic analysis of certain morphological and physiological attributes for yield and drought tolerance in a 7 x 7 diallel cross of groundnut (*Arachis hypogaea* L.) *Ph.D. Thesis.* Acharya N. G. Ranga Agricultural University, Hyderabad, India.

Latha, P.and Reddy, P.V., Water use efficiency &its relation to specific leaf area , carbon isotope discrimination &total soluble proteins under mid season moisture stress conditions in groundnut ,*Arachis hypogea* L. genotypes. *J. Oilseeds Res.*, **24**(1):77-80,2007

Nageswara Rao ,R.C., Talwar, H.S.,and Wright, G.C.,2001. Rapid assessement of specific leaf area and leaf nitrogen in peanut (Arachis hypogea L.) cholorophyll meter . *J. Argon. Crop Sci.*,**189**: 175-182

Nigam , S.N., Chandra S., Rupa-Sridevi, K., Manoha Bhukta, A., and Reddy G.S. 2005. Efficiency of physiological traiy-based and empirical selection approaches for drought tolerance in groundnut . *Ann.Applied.Biol.*,**146**:433-439.

Painawadee ,M., Jogloy, S., Kesmala, T., et al. 2009.Identification of Traits Related to Drought Resistance in Peanut (*Arachis hypogea* L). *Asian J. Plant Sci.*, **8**(2):120-128.

Seethala Devi, G. 2004. Genetic studies on certain morphological and physiological attributes in 10 F_2 populations of groundnut (*Arachis hypogaea* L.) *M.Sc. (Ag.) Thesis*, Acharya N. G. Ranga Agricultural University, Hyderabad. India

Sudhakar, P., Latha, P., Babitha, M., Prashanthi, L.and Reddy, P.V. 2006. Physiological traits contributing to grain yields under drought in black gram & green gram . *Indian J. Plant Physiol.*, **11** (4) :391-396.

Upadhyaya, H.D.,Shivali Sharma., Sube Singh and Murari Singh. 2010. Inheritance of drought resistance related traits in two crosses of groundnut (*Arachis hypogaea* L.). *Euphytica*, **177**:55-66

Vishnuvardhan, K.M., Vasanthi, R.P., Hariprasad Reddy ,K., and Bhaskar Reddy, B.V., 2012.Genetic variability studies for yield attributes and resistance to foliar disease in groundnut (Arachis hypogaeaL.).*Int. J. Applied Biol. Pharmaceutical Technol.*, **3**(1):390- 394

Vasanthi, R .P., Babitha, M., Sudhakar, P., Reddy, P.V., and John, K. 2004. Heritability studies for water use efficiency traits in groundnut (*Arachis hypogaea* L.). *Proceeding of National Seminars: Physiological Interventions for Improved Crop Productivity and Quality: Opportunities and Constraints.* 12-14 December, 2003, S.V. Agricultural College, ANGRAU, Tirupati.

Wright ,G.C., Nageswara Rao, R.C.,1994a. Peanut Water Relations .In: The Peanut Crop, Smartt,J. (Ed).Chapman and Hall ,London ,ISBN:0 412 408201.PP:281-325

Electronic Journal of Plant Breeding, 5(4): 834-838 (Sep 2014)
ISSN 0975-928X

Table. 1 Mean of characters in four F_3 populations and five parents in groundnut

Crosses	SPAD chlorophyll meter reading	Specific Leaf Area	Total Biomass (g)	Shoot weight (g)	Root weight (g)	Shoot to root ratio	Harvest Index (%)
TCGS1043×ICGV05163	41.55	158.9	26.44	13.53	0.61	24.97	39
TCGS1043×ICGV06045	40.42	266.5	22.63	12.45	0.51	28.03	38.7
TCGS1043×ICGV93261	40.54	197.8	18.77	10.07	0.41	28.82	37.87
TCGS1043×TCGS913	38.88	177.3	16.31	7.39	0.36	22.35	47.66
Parents							
ICGV05163	44.61	171.65	36.92	16.92	0.74	23.91	44.55
ICGV06045	43.78	191.00	25.06	13.19	0.43	40	40.9
ICGV93261	41.63	212.62	27.68	13.12	0.49	28.06	46.86
TCGS913	39.24	189.71	20.25	9.64	0.58	20.79	47.05
TCGS1043	41.17	177.39	16.60	7.40	0.38	27.63	51.8

Electronic Journal of Plant Breeding, 5(4): 834-838 (Sep 2014)
ISSN 0975-928X

Table 2. Estimates of variability parameters in F_3 populations for various charactes in groundnut

Characters	Crosses	PCV %	GCV%	H^2 %	GA	GAM
SPAD chlorophyll meter reading	TCGS1043 x ICGV05163	6.76	3.80	32	1.83	4.39
	TCGS1043 x ICGV06045	8.54	5.11	36	2.54	6.29
	TCGS1043 x ICGV93261	6.99	3.49	25	1.45	3.59
	TCGS1043 x TCGS913	7.93	2.90	13	0.85	2.18
Specific Leaf Area	TCGS1043 x ICGV05163	29.33	24.02	67	64.38	40.52
	TCGS1043 x ICGV06045	20.30	15.92	61	68.52	25.71
	TCGS1043 x ICGV93261	22.48	14.06	39	35.85	18.13
	TCGS1043 x TCGS913	17.96	4.59	7	4.29	2.42
Total biomass per plant	TCGS1043 x ICGV05163	43.62	30.34	48	11.49	43.48
	TCGS1043 x ICGV06045	53.19	41.27	60	14.93	65.96
	TCGS1043 x ICGV93261	49.10	31.05	40	7.59	40.44
	TCGS1043 x TCGS913	48.53	22.93	22	3.64	22.32
Shoot weight per plant	TCGS1043 x ICGV05	53.51	45.39	72	10.73	79.33
	TCGS1043 x ICGV06045	63.97	52.00	66	10.84	87.09
	TCGS1043 x ICGV93261	57.43	42.16	54	6.42	63.74
	TCGS1043 x TCGS913	59.24	21.13	13	1.15	15.53
Root weight	TCGS1043 x ICGV05163	56.15	42.51	57	0.40	66.30
	TCGS1043 x ICGV06045	64.17	40.27	39	0.26	52.06
	TCGS1043 x ICGV93261	56.29	28.72	26	0.12	30.18
	TCGS1043 x TCGS913	47.15	39.77	71	0.25	69.10
Shoot/Root	TCGS1043 x ICGV05163	25.02	20.03	64	9.76	33.03
	TCGS1043 x ICGV06045	30.77	26.65	75	14.93	47.55
	TCGS1043 x ICGV93261	28.82	13.56	22	4.19	13.15
	TCGS1043 x TCGS913	27.80	19.85	51	8.05	29.18
Harvest index	TCGS1043×ICGV05163	18.69	12.26	43	6.37	16.57
	TCGS1043 x ICGV06045	19.55	14.09	52	8.00	20.91
	TCGS1043 x ICGV93261	18.37	11.58	40	5.68	15.03
	TCGS1043 x TCGS913	17.95	10.07	31	5.07	11.63