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Research Note

Genetic variability analysis for surrogate traits of water use efficiency in F_8 recombinant inbred lines of the cross NRCG12568 X NRCG12326 in groundnut (*Arachis hypogaea* L.)

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Abstract:
The present investigation was undertaken to study the variability, heritability and character association for 10 yield and physiological traits related to Water Use Efficiency in groundnut during *kharif* 2010. NRCG12568 which has low Carbon isotopic Discrimination value and NRCG 12326 has high Carbon isotopic Discrimination value were crossed to develop 194 F_8 recombinant inbred lines (RILs) through single seed descent method. Phenotypic co-efficient of variation (PCV) was higher than genotypic co-efficient of variation (GCV) for all the characters studied indicating the influence of environment on the characters. Pod yield per plant recorded maximum GCV followed by kernel yield per plant, number of pods per plant, sound mature kernel percentage, Specific Leaf Area, number of branches per plant, shelling percentage, plant height, SCMR and days to fifty per cent flowering indicating individual plant selection can be followed for characters having high GCV. A moderate to high degree of heritability and genetic advance was observed for pod yield per plant, kernel yield per plant, pods per plant, sound mature kernel percentage, plant height, number of branches per plant and SLA indicating involvement of additive gene action in controlling these traits. Low heritability and moderate genetic advance as per cent of mean was observed for SPAD Chlorophyll meter reading (SCMR).

Key words: Variability, Heritability, Genetic advance, SCMR, Carbon Isotopic Discrimination.

Groundnut (*Arachis hypogaea*) is world important oilseed crop. Productivity is low in the arid and semi-arid regions mainly because of drought caused by low and erratic rainfall. Identification of genotypes that have a greater ability to use limited available water is important to enhance productivity of the crop. Water Use Efficiency is one such important trait which is correlated with Specific Leaf Area (SLA), Soil Plant Analysis development (SPAD) Chlorophyll Meter Reading (SCMR), Carbon Isotopic Discrimination ($\Delta^{13}C$) and transpiration efficiency ($\delta^{18}O$) and these traits have been suggested as surrogate traits in selecting for WUE in groundnut. $\Delta^{13}C$ and SLA are inversely related to WUE and yield. SCMR and $\delta^{18}O$ are positively related to yield and WUE (Farquhar *et al*., 1989; Wright, 1994; Nageshwara rao *et al*., 2001)

For effective selection for high yielding Water Use Efficient genotypes, knowledge on genetic parameters such as genetic variability, heritability, genetic advance is essential. Genetic variability for trait of interest in any breeding material is a pre-requisite as it provides basis for selection. Heritability estimates helps in improvement of traits by utilizing heritable components of variation. Possible advance through selection based on phenotypic values can be predicted only from knowledge of the degree of correspondence between phenotypic and genotypic values. Genetic components of variation together with heritability estimates would give the best picture of the amount of advance to be expected from selection. The present study has been undertaken to determine the estimates of variability, heritability and genetic advance for yield and physiological traits related to Water Use Efficiency in 196 F_8 recombinant inbred line populations of groundnut.

The present experimental material consisted of 194 F_8 RIL population developed through single seed descent method using parental lines NRCG12568 and NRCG12326 which are diverse for trait carbon isotopic discrimination and specific leaf area. These were grown in a simple lattice design with two replications with spacing of 45 x 30 cm^2 during *kharif* 2009 in UAS, GKVK, Bengaluru. Observations were recorded on five randomly chosen plants per replication in each line. Ten characters *viz.,* Days to 50 per cent flowering, plant height, number of branches per plant, number of pods per plant,

kernel yield per plant, shelling percentage, sound mature kernel percentage, Specific Leaf Area, SPAD Chlorophyll meter reading and pod yield per plant were recorded. The genotypic and phenotypic co-efficient of variations were computed as suggested by Robinson *et al.* (1949). Heritability and genetic advance were worked out as per the method outlined by Hanson *et al.* (1956).

Analysis of variance in RIL population of the cross NRCG12568 X NRCG12326 revealed significant differences among the lines for all the characters studied indicating the presence of genetic variability. This was further supported by the fact that range has been also quite wider for all the characters pointing out extreme genotypes for selection.

The PCV and GCV estimates were relatively high for total number of pods per plant kernel yield per plant and pod yield per plant suggesting presence of considerable variation. Hence, individual plant selection can be practiced for the above mentioned characters to get higher yields. Similar findings of higher estimates of GCV & PCV were obtained by Veeramani *et al.(*2005), John *et al.* (2007) and Parameshwarappa *et al.* (2007) in groundnut. Moderate estimates of PCV and GCV were observed for the characters like plant height, shelling percentage number of branches per plant, sound mature kernel percentage, specific leaf area indicating presence of variability for these characters. Similar results were observed by Rudraswamy *et al. (*1999) in groundnut. Whereas days to 50 per cent flowering and SPAD chlorophyll meter reading recorded lower PCV and GCV in cross NRCG 12568 X NRCG 12326.

On the whole, co-efficient of variation values indicated considerable amount of variability for most of the characters except for days to 50 per cent flowering and SPAD chlorophyll meter reading. As there is considerable variability in RIL population they can be further used in identification of QTLs related to surrogate traits of WUE and yield attributing traits and to select some good genotypes with high yielding and Water Use Efficiency.

The close correspondence between the estimates of GCV and PCV for traits like sound mature kernel percentage, specific leaf area indicated less environmental influence in expression of these traits and hence these can be used for further selection for higher yields and Water Use Efficiency using SLA as a surrogate trait.Moderate difference between PCV and GCV estimates were observed for yield attributing characters like number of pods per plant and Pod yield per plant and these traits could be used for further selection for higher yield.

High heritability coupled with high genetic advance as per cent of mean was reported for characters like plant height, number of pods per plant, pod yield per plant, shelling percentage, sound mature kernel percentage and kernel yield per plant and specific leaf area (Table 1). This shows that these characters are under the control of additive gene action and hence, there is lot of scope for improvement of these traits in further breeding programme and Single plant selection can be followed to breed for high yielding and Water Use Efficient genotypes in groundnut. Alan *et al.* (2005) reported high heritability coupled with high genetic advance as per cent of mean for kernel yield and pod yield and also Veeramani *et al*. (2005) reported high broad sense heritability coupled with high genetic advance for pod and kernel yield Golakia *et al. (*2005) and John *et al*. (2007) reported high heritability coupled with GAM for sound mature kernel percentage along with kernel yield and pod yield in groundnut.

High heritability coupled with low genetic advance as per cent of mean was observed for days to 50 per cent flowering in both crosses studied indicating the prevalence of narrow range of variability, and the presence of non-additive gene action. This suggests limited scope for further improvement of these characters. Similar result was reported by Makhan *et al.* (2003) and Praveen Kumar (2006) in groundnut. Moderate heritability coupled with high genetic advance as per cent of mean was observed for number of branches per plant in both crosses studied indicating presence of variability and response is more if we go for selection in this character in next generation itself. SPAD chlorophyll meter reading showed low to moderate heritability coupled with low genetic advance indicating that selection will not be effective for these characters in further generation.

Non additive gene action was observed for days to 50 per cent flowering and SPAD chlorophyll meter reading and number of branches per plant which indicates the lower variability in these characters and hence in further breeding program separate hybridization can be followed by selecting superior segregants. Among the surrogate traits studied SLA was found to better trait for selecting high Water Use Efficient genotypes compared to SPAD chlorophyll meter reading because of additive gene action in controlling of this trait and hence could be used in further breeding program.

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Table 1. Genetic parameters for yield and physiological traits related to Water Use Efficiency in F_8 RIL population of a Cross NRCG12568 x NRCG 12326 in Groundnut

Characters	Mean	Range		PCV (%)	GCV (%)	h^2_{bs}	GAM
		Minimum	Maximum				
Days to flowering	36.14	34.00	39.00	2.75	2.20	64.05	7.44
Plant height (cm).	49.28	30.00	57.70	10.29	8.76	72.47	22.67
Number of branches per plant.	5.29	4.20	9.67	14.27	10.78	57.10	40.19
Number of Pods per plant	24.14	8.84	41.00	23.66	19.79	70.02	51.63
Kernel yield per plant (g).	7.89	2.50	20.75	36.52	27.93	58.48	82.64
Shelling percentage (%)	56.47	37.20	83.30	20.61	10.52	26.04	42.92
SMK percentage (%)	66.52	45.50	88.00	15.38	15.00	95.13	33.12
Specific Leaf Area(cm^2/g)	193.72	151.30	223.00	12.01	10.91	88.15	23.12
SPAD Chlorophyll Meter Reading	41.39	36.45	48.07	6.29	3.34	28.26	13.63
Pod yield per plant (g).	14.28	4.50	53.75	40.13	34.69	74.75	87.89