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Study on association pattern of nutritional and yield traits in groundnut (*Arachis hypogaea* L.) genotypes

Sudhir Kumar, HD Upadhyaya and Nitish De

Abstract
Groundnut (*Arachis hypogaea* L.) is the world's third most important source of oil and fourth most important source of vegetable protein. Oil content, protein content and fatty acid composition (O/L ratio) are the most important quality attributes of groundnut. Investigation was carried out with fifty one advanced breeding lines of groundnut with five checks. These advance breeding lines were developed by crossing and selection at different levels. The phenotypic correlation among the oil, yield, protein, oil quality traits and yield component traits were determined over the season (10 environments). The trend of magnitude and direction of association among the quality traits of groundnut remained almost same in all environments at different location and across the seasons also, similar trend of association was found with minor changes, indicating minor influence of environment on the association of characters.

Keywords: Groundnut, oil, protein, oleic acid, O/L ratio, correlation

Introduction
Cultivated groundnut (*Arachis hypogaea* L.) also known as peanut is an important oilseed crop of the world. Groundnut is cultivated in more than 100 countries in tropical and sub-tropical regions of the world. United Nations Food and Agricultural Organization (UN-FAO) identified it as the third most important source of vegetable protein, fourth most important source of vegetable oil, and twelfth most important food crop. Groundnut was gown in an area of 26.4 m ha worldwide with a total production of 43.9 m tons (*faostat*, 2016) [6]. Groundnut is grown primarily for human consumption either as a whole seed or processed to make peanut butter, oil and other products.

Peanut seeds are rich source of edible oil and contain 45-50% oil, 25-30% protein on a dry weight basis. Oil and protein contents and oil quality with respect to its fatty acid composition are most important quality traits both for oil and confectionary purposes. Seed oxidative stability is directly associated with oil composition. Peanut seeds with high oleic acid content and O/L ratio have improved stability against lipid peroxidation and also higher shelf life can be achieved as compared to low O/L ratio. The plant breeder's role in identifying the individual cultiver that simultaneously meet all the desirable traits is not an easy task, because several of these traits are positive or negatively associated. The development of cultivars in groundnut varies with the purpose for which they are put to use (Bandyopadhyay and Desai, 2000) [2]. Correlation studies provide an opportunity to determine the magnitude and direction of association of yield and oil content with its important traits and also among various components of yield.

Materials and Methods
In order to meet out the objectives of the study the investigation was carried out with fifty one advanced breeding lines of groundnut with five checks (ICGV 91114, ICGV 05155, ICGV06146, ICGV06420 and ICGV06100). These advance breeding lines were developed at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Patancheru Hyderabad by crossing and selection at different levels. Experimental material was evaluated at two distinct locations, one at ICRISAT Patancheru, Hyderabad and at Bihar Agricultural University (BAU) Sabour. At ICRISAT the experiment were conducted during *Kharif*, 2015, *Rabi* 2015-16, *Kharif* 2016, *Rabi* 2016-17. At BAU Sabour the experiment was conducted during summer 2016. Field trials were conducted in five seasons in both irrigated as well as in rainfed conditions. The correlation coefficients were worked out to determine the degree of association of a character with yield and also among the yield components and nutritional quality traits.

Correlations were computed for pooled by using the formula given by Weber and Moorthy (1952) [20].

Result and Discussion

The phenotypic correlation among the oil, yield, protein, oil quality traits and yield component traits were determined over the season (10 environments). The results are presented in Table 1. The phenotypic correlations were calculated for all pairs of characters.

Association analysis determines the direction and extent of association among different characters. Seed yield is a complex character, predominantly governed by a large number of genes and is greatly influenced by environmental factors. Nutritional quality of groundnut is predominately determined by oil content, protein content and fatty acid composition. This quality attributes show interrelationship and it would not be effective if selection is based on a single trait. Better combination of derived traits of nutritional quality can be determined only through knowledge of magnitude and direction of their association.

It was observed that pod yield per plot was significant and positively correlated with number of matured pods per plant and pod yield per plant (gm) in each environment and over environments. In the pooled analysis over environment, there was a positive inter correlation of plot yield with number of primary branches per plant, plant height, number of matured pods per plant, pod yield per plant, shelling percentage, hundred seed weight and oil content. Giri and Hudge (2010) [8] reported significant positive association for pod yield per plant with kernel yield and 100 seed weight. Many reports like Nadaf and Habib (1990) [12], Sharma *et al.* (1992) [17], Rosemary Francies and Setupathi (1997) [16], Bentur (2001) [3], Nagda *et al.* (2001) [14], Kalmeshwar Patil (2004) [10] and John *et al.* (2009) [9], are also in agreement with these result. This may be attributed to the linkage of favourable genes for these traits under consideration and extent of coheritability may perhaps depend on the number of genes involved in a trait particular combination. Therefore these characters can be considered as principal yield determining factor. These traits are also easily measurable traits and can be used as selection criteria to score large number of plants in crop improvement programme.

Table 1: Phenotypic correlation coefficients for yield, oil, protein, oil quality parameter and other quantitative traits over environment (P)

Variables	DF	DH	NPB	PLH	NPPP	PYPP	Kg/ha	SHP	HSW	OIL	PRO	LA	OA	PA	SA	O/L
DF	1															
DH	0.48**	1														
NPB	0.08**	0	1													
PLH	-0.59**	-0.77**	0.06*	1												
NPPP	-0.38**	0.13**	0.15**	0.04	1											
PYPP	-0.41**	0.07*	0.16**	0.08**	0.93**	1										
Kg/ha	-0.46**	-0.10**	0.26**	0.31**	0.64**	0.73**	1									
SHP	-0.13**	0.31**	0.27**	-0.07*	0.44**	0.44**	0.54**	1								
HSW	0.23**	0.46**	0.30**	-0.26**	0.21**	0.20**	0.36**	0.61**	1							
OIL	-0.13**	-0.34**	0.02	0.40**	-0.07*	-0.03	0.19**	-0.06*	-0.05	1						
PRO	0.23**	-0.02	0.10**	0.10**	-0.30**	-0.31**	-0.15**	0.02	0.18**	-0.11**	1					
LA	-0.34**	0.02	0.02	-0.02	0.48**	0.55**	0.58**	0.30**	0.13**	0.06	-0.35**	1				
OA	0.25**	-0.15**	-0.05	0.11**	-0.46**	-0.50**	-0.54**	-0.37**	-0.25**	0.01	0.25**	-0.94**	1			
PA	0.13**	0.37**	0.02	-0.33**	0.16**	0.15**	0.06	0.20**	0.19**	-0.11**	-0.05	0.48**	-0.63**	1		
SA	0.47**	0.21**	0.12**	-0.15**	-0.31**	-0.36**	-0.22**	0.04	0.32**	0.37**	0.44**	-0.35**	0.22**	0.02	1	
O/L	0.25**	-0.12**	-0.01	0.12**	-0.45**	-0.49**	-0.50**	-0.30**	-0.16**	0.03	0.31**	-0.96**	0.97**	-0.59**	0.29**	1

* - Significant at 5% level probability
** - Significant at 1% level probability
DF- Days to 50% flowering, DH- Days to harvest, PLH- Plant height(cm)
NPB- No. of primary branches/plant, NPPP- No. of pod per plant
PYPP- Pod yield/plant(g), kg/ha- Pod yield(kg/ha)
P-Pooled SHP- Shelling %, HSW- Hundred seed weight(g)
OIL- Oil %, PRO- Protein %, LA- Linoleic acid %
OA- Oleic acid %, PA- Palmitic acid %, Stearic acid %
O/L- Oleic acid to Linoleic acid ratio
SCMR- (SCMR) SCMR Chlorophyll meter reading

In pooled analysis, over environment, days to 50 per cent flowering had significant negative association with yield related traits such as number of matured pods per plant, pod yield per plant, shelling percentage and pod yield per plot (kg/ha). This indicates more the days taken for flowering would result in reduced yield probably because if increased crop duration, it may be exposed to several prevailing abiotic stresses like drought and thereby reducing yield (Nagabushanam, 1981) [13]. However the hundred seed (gm) weight was associated positively with days to 50 per cent flowering. Probably with increased crop duration, there will be sufficient seed filling (Manoharan *et al.*, 1990a and Wang *et al.*, 1987) [11, 19].

Oil content had negative association with protein content in in all ten environments and over environment, thus increase in oil content would be at the cost of protein content and vice-a-versa (Dwivedi *et al.*, 1990, Cholin *et al.*, 2010 and Bentur, 2001) [5, 4, 3]. O/L ratio, an important oil quality determinants is expected to be high in the cultivar and depends on the amount of oleic acid and linoleic acid present in the oil (Bachlava *et al.*, 2008) [1]. Oil content has positive association with linoleic acid content, but oleic acid and linoleic acids had inverse relationship. Here desirable traits like protein content, oil content, oleic acid had inverse relationship with among themselves. Hence, it is difficult to get genotypes having these traits in combination (Fayyaz-Ul-Husan *et al.*, 2005 and Parmar *et al.*, 2000) [7, 15]. However, Upadhyaya *et al.*, (2012) [18] had shown that oil and protein content did not show any correlation in the groundnut mini core collection. The association between oleic acid and palmitic acid, oleic acid and stearic acid were negative. Therefore one can effectively

target the palmitic acid and stearic acid content to increase oleic acid content.

Conclusion

The trend of magnitude and direction of association among the quality traits of groundnut remained almost same in all environments at different location and across the seasons also, similar trend of association was found with minor changes, indicating minor influence of environment on the association of characters.

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