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Seed nitrogen and fatty acids reflecting yield variation in groundnut (*Arachis hypogaea*)

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Genotypic variation considerably influences the nutritive quality of groundnut (*Arachis hypogaea* L.), including nitrogen in seed, protein content and fatty acids (Ahmed and Young 1982, Adsule *et al.* 1989). Therefore such quality traits can also reflect genetic variation in pod yield. Rapid and efficient screening techniques of biochemical traits, particularly fatty acid profiles and N content, can permit preliminary selection for productivity potential. This note reports such an attempt with 9 advanced lines and examines the association between pod yield and various biochemical traits.

Six advanced lines with variation in yield performance ('1441 A 1', '1423 VB', 'NFP 140', 'NFG 7', 'RB 90', 'RB 15'), developed in a National Project on groundnut in the past decade, a national control ('Robut 33-1'), a high nitrogen-fixing genotype ('NC Ac 2821') and a non-nodulating derivative from the cross 'NC 17' x 'PI 259747' ('Non-nod') were selected for the study. In yield, 'Non-nod' was the lowest and some of the 6 advanced lines were superior to the national control. The 9 lines were grown at New Delhi in randomized block design with 2 replications during the normal rainy season (July–November) of 1988 in single-row plots of 10 m length spaced 75 cm apart. The plant-to-plant distance was 10 cm. The crop was raised under normal cultural practices including protection against diseases and pests. Nitrogen content in roots, seeds and in the whole plant was estimated using 2 plants sampled near harvest (145 days after sowing) by Kjeldahl method, after taking observations on harvest index, shelling percentage and oil content. Fatty acids (palmitic, stearic, oleic, linoleic, arachidic, eicosenoic and behenic acids) were estimated using a gas-liquid chromatograph (Sen *et al.* 1976) from seeds of the 1987 and 1988 seasons. F-test and t-test were used to determine the genotypic variation for the various traits. The extent of variation in pod yield or oil content accounted for by various traits was estimated by a step-wise regression analysis (Draper and Smith 1981). Oleic : linoleic acid ratio was used as an indicator of oil stability and linoleic : (palmitic + stearic) acid ratio as an indicator of dietary value of oil, following Ahmed and Young (1982).

The variation among the lines for N in seed, palmitic and stearic acids, was significant in addition to oil content and yield/plant, whereas that for oleic, linoleic and arachidic acids was not significant.

Differences between the 9 lines were apparent, particularly for oleic, linoleic and palmitic acids, confirming similar result of

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Ahmed and Young (1982). Up to 97–100% of the total contribution of all the fatty acids was made by the 7 fatty acids alone. Oleic acid contributed the maximum (38.8%), followed by linoleic (38.3%). Oleic, linoleic and palmitic acids together accounted for 90% of the total contribution (Brown *et al.* 1975, Ahmed and Young 1982). The differences in overall mean values (across the 9 genotypes) for oleic : linoleic, and linoleic : (palmitic + stearic) acid ratios were significant, as also most of the individual genotypic differences for those ratios.

Pod yield was positively and significantly correlated with harvest index and N in root (Table 1). The other positive and significant

Table 1 Correlation coefficients between pod yield, oil content and important biochemical traits explaining majority of the variations in groundnut

Character	Harvest index	Oil (%)	N in root	N in seed	N in plant	Palmitic acid	Linoleic acid	Oleic acid	Arachidic acid
Pod yield/plant	0.458*	0.311	0.695*	—0.674*	—0.346	0.027	0.142	—0.013	0.142
Harvest index		0.638*	0.229	—0.611*	—0.331	—0.270	0.013	0.085	0.220
Oil (%)			0.232	—0.397	0.205	0.209	—0.123	0.089	—0.064
N in root				—0.313	—0.317	0.035	0.003	—0.114	—0.130
N in seed					0.260	—0.285	0.245	0.094	—0.399
N in plant						0.343	0.073	—0.173	—0.206
Palmitic acid							—0.402	—0.425	0.291
Linoleic acid								—0.180	—0.291
Oleic acid									—0.427

*P = 0.05

Table 2 Variation in pod yield or oil content as accounted by regression on various biochemical traits

Pod yield		Oil (%)	
Variable	Cumulative R^2	Variable	Cumulative R^2
Root N	48.3	Harvest Index	40.7
Seed N	71.3	Plant N	60.2
Linoleic acid	78.8	Palmitic acid	68.2
Oleic acid	81.2	Root N	84.5
Arachidic acid	84.4	Oleic acid	88.2
Palmitic acid	85.9	Eicosenoic acid	89.9
Shelling (%)	86.8	Linoleic acid	90.7
Harvest index	87.0	Pod yield/plant	90.9
Stearic acid	87.5	Arachidic acid	91.4
Oil (%)	89.1	Behenic acid	91.9
Eicosenoic acid	90.1	Stearic acid	92.3
Behenic acid	93.9	Seed N	93.7
Plant N	96.0	Shelling (%)	97.4

correlation was between harvest index and oil (%). The correlations of N in seed with pod yield and harvest index were negative and significant. The correlations among the fatty acids, N in plant, oil (%) and harvest index were not significant. However, high differences were observed in the magnitudes of correlations, some of which were significant at 10% level. [For example, r (palmitic, oleic) = —0.425; r (oleic, arachidic) = —0.427 when compared with others, eg r (linoleic, N in root) = 0.003; r (harvest index, linoleic) = 0.013; r (pod yield, oleic) = —0.013]. N in root alone accounted for 48% and in combination with N in seed for 71% of the total variation in pod yield, compared with 96% accounted for 13 traits (Table 2). Linoleic, oleic and arachidic acids accounted for another 13% of the variation. Thus the top 5 traits to explain 84% of the variation in pod yield were: N in root, N in seed, linoleic acid, oleic acid and arachidic acid in order.

An analysis with oil content as dependent variable indicated that harvest index, N in plant, palmitic acid, N in root and oleic acid were the top 5 characters (in order) accounting for 88% of the variation in oil content. In this case, all the 13 variables could account for 97% of the variation in pod yield.

Selection for pod yield, as practised, requires individual plant harvest, drying and measurement of pod yield. It involves considerable investment on time and labour. The biochemical traits identified in this study will permit indirect selection before harvest for pod yield, effecting substantial savings on investment. Earlier studies on N fixation (Prabhu *et al.* 1990) underlined the importance of total N (%) in plant and nutrient translocation to roots and nodules for differentiation in yield. Taken along with the biochemical traits identified now, a comprehensive criterion of economic selection for pod yield has become available, which would need large-scale confirmatory tests.

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