BREEDING FOR IMPROVED SEED QUALITY TRAITS IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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From the mid-1970s there has been a gradual increase in the use of groundnut as food. Compared to 1970s its food use in the world increased by 34% in 1980s and is expected to increase further. Groundnut seed is a high energy food because of its high oil content. It is also a rich source of minerals and vitamins. A range of various physical, sensory, chemical, and nutritional factors determine the quality of edible groundnut seed. Physical factors include integrity of seed testa, seed size and shape, blanching efficiency, and integrity of seed at the time of processing. Sensory factors include seed color, texture, flavor, and wholesomeness. Chemical and nutritional factors include oil and protein contents, amino acid and fatty acid composition, carbohydrates, minerals and vitamins. Pod color, size, shape, and texture, and its cleanliness and freedom from damage, and absence of blind nuts (pops) also influence the quality of 'in-shell' boiled or roasted nuts. Freedom from aflatoxins and chemical residues in the seed is of paramount importance in food use. Any contamination with toxins/chemicals can override all other desirable factors mentioned earlier. Shelf-life and nutritional quality of the oil and other groundnut products are influenced by fatty acid composition. Oleic (O) and linoleic (L) acids are nutritionally important and together account for 75 to 80% of the total fatty acids in groundnut oil. O/L ratio and iodine value (IV) determine the shelf-life of oil and other groundnut products. The higher the value of O/L ratio, the longer is the shelf-life of groundnut oil and its products. The IV (the number of grams of iodine reacting with 100 g of lipid) measures the susceptibility of fatty acids to oxidation (rancidification). Saturated fatty acids are relatively resistant to rancidification and are stable. The IV of saturated fatty acids is zero; of oleic acid, 90; of linoleic acid, 181; and of linolenic acid, 274. The lower the IV, the higher is the stability of oil.

Evaluation of 8068 germplasm lines at ICRISAT Asia Center (IAC) revealed a range of 32 to 55% for oil content and 16 to 34% for protein content (ICRISAT unpublished data). Two hundred germplasm lines of different botanical groups were also studied for fatty acid composition. The variation for O/L ratio ranged from 0.84 to 1.36 in the spanish/valencia group and from 1.0 to 2.2 in the virginia group. Except for two breeding lines originating from natural mutation in Florida USA, a narrow variation for O/L ratio (1-2) is also reported by other workers (Sekhon *et al.*, 1972, Treadwell *et al.*, 1983, Sykes and Michaels, 1986, Raheja *et al.*, 1987, Branch *et al.*, 1990, and Dwivedi *et al.*, 1993). The two Florida breeding lines have a very high (#40) O/L ratio (Norden *et al.*, 1987). Several studies have revealed significant genotype, environment, and genotype x environment interaction effects for oil and protein contents, and for individual fatty acid contents (Worthington *et al.*, 1972, Holaday and Pearson, 1974, Young *et al.*, 1974, Brown *et* *al.*, 1975 and Dwivedi *et al.*, 1993). Mutation breeding, in collaboration with the Directorate of Oilseeds Research, Rajendranagar, Hyderabad was initiated at IAC to increase the range of variation for O/L ratio in selected groundnut genotypes. Stable mutant lines with an average O/L ratio of 3.5 compared with 2.2 of parent lines ICGVs 88438 and 88448 were isolated from gamma and EMS - treated populations (ICRISAT unpublished data).

Development of groundnut genotypes with large seed size and improved seed quality is an important breeding activity at IAC. Promising lines, derived from crosses between large-seeded germplasm lines and high-yielding adapted varieties, are selected based on pod yield, pod/seed size and shape, seed color, and 100 - seed mass. The selected lines are then assigned ICGV numbers and evaluated for pod yield and seed quality traits (oil, protein and fatty acid contents) for three consecutive years in the rainy and post-rainy seasons in replicated trials at IAC. Several varieties with high pod yield potential, large seed size and good seed quality have been developed and provided to National Agricultural Research System (NARS) for wider testing. ICGV 86564 has been recently released as Walawe in Sri Lanka for cultivation under irrigated conditions. In India, ICGV 86564 has been performing very well for pod yield in Andhra Pradesh, Maharashtra and Tamil Nadu. Several varieties with high pod yield and seed quality are in the advanced stage of testing in Cyprus, Korea, Nepal, Sudan, Vietnam and Zimbabwe. Boiling type groundnuts are important in many East and Southeast Asian countries. The freshly harvested groundnut pods are boiled in saline water (1-2%) or steamed for edible purpose in these countries. Sweet tasting valencia types with 3-4 seeded pods, tan-rose or tan color seeds with relatively high protein and low oil contents are most preferred. Germplasm lines with these desirable traits were identified for use in breeding. These are ICG 335, ICG 408, ICG 1830, ICG 1307, ICG 6224 and ICG 10900.

The main issues involved in confectionery breeding include stability in seed mass, crop duration vs degree of resistance to foliar diseases, crop duration vs seed mass, and shelf-life vs nutritional requirement, and resistance to aflatoxin contamination. Further emphasis in breeding will, therefore, be to select for reduced crop duration coupled with low to moderate resistance to foliar diseases, increased [illegible] seed quality. The promising varieties are then monitored for aflatoxin contamination. With the availability of several high-yielding large-seeded sequentially branched breeding lines maturing earlier than many virginia types, and mutants with improved fatty acid composition (O/L ratio of 3.5), it should now be possible to breed for early maturity with increased seed mass and improved seed quality. Early-maturing large-seeded cultivars will have a prominent place in South and Southeast Asian agriculture. Locally adapted cultivars will be inter-crossed with the elite germplasm lines and the promising bulks will be tested widely to select varieties with stable seed mass and improved seed quality. Emphasis will be given to select genotypes with low fat content.

Aflatoxin contamination is a serious quality problem for edible groundnut. With the identification and availability of sources of resistance to pre-harvest infection and *in vitro* seed colonization by *Aspergillus flavus* and aflatoxin production (Mehan, 1989) it has been possible to develop high yielding varieties which are less prone to aflatoxin contamination (Vasudeva Rao *et al.*, 1989). Such varieties coupled with good crop management will greatly reduce the risk of aflatoxin contamination under field conditions. Current research on aflatoxin in the USA is focussed on understanding its biosynthetic pathway to identify precursors and enzymes that catalyses the conversion of this precursor into aflatoxin B_1. When the gene responsible for the enzyme is located, it could either be removed or altered to stop the production of aflatoxin in groundnut cultivars by using biotechnological tools.

Crop management has a large influence on production and quality of edible groundnut. The crop, therefore, should be grown under high input conditions which include full irrigation, high amount of fertilizers, application of gypsum at peak flowering and protection against insect pests and diseases. Groundnut varieties with low to moderate resistance to major insect pests and diseases coupled with judicious use of pesticides would reduce the risk of chemical residues in groundnut seeds. The crop should not suffer moisture stress during the pod-filling stage and should be grown to its full duration to obtain high grade groundnuts for edible use. Improved post-harvest technology should be applied for curing and drying the produce and the produce should be stored in good storage conditions to avoid post-harvest aflatoxin contamination.

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