

Evolution of White Kernelled Groundnut*

by

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Synopsis: The problem of evolving a white seeded groundnut strain by hybridization was taken up for the first time at the Regional Research Station, Tindivanam and the observations made are summarised.

Introduction: Groundnut kernels have a rich variety of seed coat colours like rose, red, purple, white and mixed colours of white and red with different shades and patterns. However, only rose and red coloured groundnut seeds predominate in all commercial varieties. The problem of evolving a white seeded strain by hybridization was taken up for the first time at the Regional Research Station, Tindivanam.

Materials and Methods: Among a number of varieties maintained at the Regional Research Station, Tindivanam, two white seeded bunch varieties, viz, A. H. 6742, an Argentinian white type and A. H. 6644, an East African white type, were utilised as ovule parents. The seed coat of the former is pure white, while that of the latter is dull white. Twelve direct crosses and six reciprocal crosses were effected between the following purelines:—

Ovule parents

A. H. 6742 (poor yielding) White seeded bunch selection from Argentina)

A. H. 6644 (poor yielding) White seeded bunch selection from East Africa).

Pollen parents

Forma *erecta*, (Rose) seeded, erect type, extracted from a cross between A. H. 45 and Spanish. 10

A. H. 45 (Rose seeded, semi-spreading selection from Hebbal, Mysore)
A. H. 477 (Rose seeded, Semi-spreading selection from 'Bassi').

A. H. 2105 (Rose seeded, high yielding, semi-spreading selection from Tanganyika).

A. H. 698 (Rose seeded, high yielding, spreading selection from 'Bassi').

A. H. 25 (Rose seeded, high yielding, spreading selection from 'Saloum').

In the above sets of crosses, 135 plants were involved. During second and third years, crossed seeds were sown and 3690 hybrids isolated, which formed the basic material for further selection. In addition, 36 hybrid plants were

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back-crossed with high yielding donor plants. A total number of 13152 single plants were studied in detail in F. 2 and F. 3 generations. From these, 709 plants with white seed coat were selected and advanced to progeny row trials. Finally, 10 selections which performed well in the initial yield trials were carried forward to preliminary yield trials.

Of the two ovule parents, A. H. 6644, a bunch pureline from East Africa, though white seeded with no crescent on the standard petal, had very slight anthocyanin on the stem, while the Argentinian white seeded bunch variety A. H. 6742, was characterised by complete absence of the crescent as well as pigmentation. All the purelines utilised as pollen parents had distinct and well defined crescent with anthocyanin pigmentation on the stem.

Results: The nature of inheritance of seed coat colour is furnished in Table I.

TABLE I
Inheritance of seed coat colour

Cross No.	Ovule parent (White seeded)	Pollen parent (Rose seeded)	Seed coat of F1 plants	Seed coat of F2 plants		
				Red	Rose	White
643	A. H. 6644 (East Africa)	A. H. 2106 (N Tanganyika)	Red	137	48	12
646	A. H. 6742 (Argentina)	A. H. 25 (Saloum)	Red	266	69	24
649	A. H. 6742 (Argentina)	A. H. 2105 (N Tanganyika)	Red	197	49	15
Total observed				600	166	51
Expected on 45 : 15 : 4 ratio				574.2	191.4	51.04

Expected on 45 : 15 : 4 ratio $\frac{X^2}{m} = 4.53$ P. = 0.10 to 0.20

Occurrence of abnormal plants in the F2 generation of progenies of crosses involving A. H. 6742 was also observed (vide Table II).

TABLE II
Inheritance of abnormality

Cross No.	Ovule parent (White seeded)	Pollen parent (Rose seeded)	F1 plants	No. of plants under F2.	
				Normal	Abnormal
646	A. H. 6742 (Argentina)	A. H. 25 (Saloum)	Normal plants	316	21
647	A. H. 6742 do.	A. H. 477 (Bassi)		81	5

TABLE II (Contd.)

Cross No.	Ovule parent (White seeded)	Pollen parent (Rose seeded)	F1. plants	No. of plants under F2.	
				Normal	Abnormal
648	A. H. 6742	do.	A. H. 698 (Bassi)	42	3
649	A. H. 6742	do.	A. H. 2105 (N. Tanganyika)	302	21
650	A. H. 6742	do.	A. H. 45 (Hebbal-2)	76	5
Total observed				817	55
Expected on 15:1 ratio				817.50	54.50

$$\frac{X^2}{m} = 0.0049 \quad P = 0.90 \text{ to } 0.95.$$

Economic characters like seed setting, nature of pods (constriction), size of kernels and shelling outturn were studied. Quality tests were conducted for the six selections under yield trials and the results are furnished in Tables III and IV.

TABLE III

Quality of a few white seeded selections

Sl. No.	Selection	Natural test weight of one litre in gm		Shelling outturn %	No. of kernels per kilogram
		Pods	Kernels		
1.	A. H. 7610 (A. H. 6644 x A. H. 45)	323	707	72.7	3208
2.	A. H. 7616 (A. H. 477 x A. H. 6644)	327	689	72.4	2702
3.	A. H. 7612 (A. H. 6742 x A. H. 25)	321	688	72.0	2892
4.	A. H. 7613 (A. H. 6644 x A. H. 2105)	350	667	72.8	2538
5.	A. H. 7614 (A. H. 6644 x A. H. 698)	370	679	71.7	2686
6.	A. H. 7615 (A. H. 6644 x A. H. 698)	363	683	73.5	2876

TABLE IV

Oil-content of white seeded selections

Sl No.	Selections	Oil content %
1.	A. H. 7613 (A. H. 6644 x A. H. 2105)	46.5
2.	A. H. 7615 (A. H. 6644 x A. H. 698)	47.4
3.	A. H. 7614 (A. H. 6644 x A. H. 698)	47.2
4.	A. H. 7610 (A. H. 6644 x A. H. 45)	45.6
5.	A. H. 7616 (A. H. 477 x A. H. 6644)	46.4

Two types in F₂ with new combination of characters as detailed below were isolated.

<i>Characters.</i>	<i>A. H. 7615.</i> (A. H. 6644 x A. H. 698) (E. Africa) (Bassi)	<i>A. H. 7616.</i> (A. H. 477 x A. H. 6644) (Bassi) (E. Africa)
Habit of growth-main stem	Semi-spreading, erect, medium thickness, slight purple, hairy.	Semi-spreading erect, medium thickness, very slight purple tinge at the basal nodes, hairy.
Lateral branches	Prostrate upto 2nd or 3rd node and ascending, moderately branching.	Prostrate upto 2nd or 3rd node and ascending, branching profusely at the basal nodes.
Leaflet	Medium to small size, elliptic, margin entire, ciliate, dark green.	Large size, obovate to elliptic, margin entire, ciliate, dark green.
Flower	Axillary, 1-3 in an axil, medium size.	Axillary, 1-3 in an axil, medium to large size.
Calyx-tube	Short to medium length, very slight purple tinge, hairy.	Medium length, no pigment, light green, hairy.
Standard	Grade III-Outer 1/3rd light orange yellow, yellow at the base of the keel, crescent grade V.	Grade II-outer 2/3rd light orange yellow, yellow at the base of the keel, crescent absent, crescent grade V.
Wings	Light yellow.	Light Yellow.
Peg	Light purple; thin, medium length.	Very light purple tinge, thin, medium length.
Pod	Small size 1 to 2 kernels, one kernelled many, shell of medium thickness, very deep constriction giving headed appearance, distinct beak, slightly distinct veins.	Small size — 1 to 2 kernels, shell thick, medium to deep constriction, prominent beak, distinct veins.
Kernel	Small size, white testa.	Small size white testa.
Natural test weight of one litre of pods	363 grams.	327 grams.
Shelling out-turn percentage	73.5	72.4
Number of kernels per kg	2876	2702

Discussion: The hybrids in all the crosses exhibited crescent, red seed coat and anthocyanin pigmentation, thereby indicating the dominant nature of those characters. In the crosses involving A. H. 6742, segregation in F₂ for presence or absence of crescent and the pigmentation on stem fitted into a double hybrid ratio, showing that the characters were controlled by two factors. This is in agreement with the observation of earlier workers, Srinivasalu and Loganathan (1959) and Patel *et al* (1936).

The seed coat colours, red, rose and white segregated in the ratio of 45: 15: 4. The expression of red testa colour in F₁ indicated the presence of Rd factor in the female parent. This factor cannot be assumed to be present in male parent, since Rd factor together with rose factor must necessarily have been inherited from the white seeded female parent. The genotypes of the female parent, male parent and the F₁ hybrid can thus be assumed as Rd Rd r₁ r₁ r₂ r₂, rd rd R₁ R₁ R₂ R₂ and rd rd R₁ r₁ R₂ r₂ respectively. The rose testa colour is governed by duplicate factors R₁ and R₂. In the absence of Rd factor, R₁ and R₂ either singly or in combination give expression to rose testa, whereas red testa is the manifest effect of Rd factor in combination with the factor for rose colour. The Rd factor has no expression, wherever the factor for rose colour is lacking and thus remains white. Red is dominant to white, the difference being due to two factors. The genotype of the white seeded female parent differs from that of the Phillipine white reported by Patel *et al* (1936) in that the Rd factor is present in the former. But for this difference, the inheritance of the red testa colour in the F₁ hybrid, heterozygous for all the three factors, closely follows that of the earlier observations by Patel *et al* (1932).

In crosses involving A. H. 6644 also, the same pattern of segregation for the above characters was noted with the difference that a tinge of anthocyanin pigmentation replaced the complete absence of this in crosses with A. H. 6742. It was generally observed that plants having crescent and perceptible anthocyanin had coloured testa. Plants with white testa seeds were invariably devoid of crescent, though a tinge of anthocyanin pigmentation was observed on stem and peg of selections extracted from crosses involving A. H. 6644, as one of the parents.

Occurrence of abnormal plants which were short and stunted in growth with congested nodes and crumpled leaves were observed in the F₂ generation of progenies of crosses involving A. H. 6742. The dwarf plants produced few flowers, which were sterile. F₁ plants were normal, while the F₂ plants showed a ratio of 15 normal to 1 abnormal. Similar observations were recorded by Patel *et al* (1936) in crosses involving, Phillipine white and Coricutes - 3.

Besides poor setting in white seeded plants, wide variation in the nature of pods, which were mostly uneconomical were also noticed. Manifestation of deep constriction and a large proportion of one seeded pods were often found associated in 30 per cent of the progenies. The pods had deep constriction presenting beaded appearance. The kernels were small in size and hard with low oil content.

In the course of selection, two types A. H. 7615 and A. H. 7616 with a new combination of characters, *viz.*, Semi-spreading habit with white coloured testa, complete absence of crescent in the standard petal and dark green leaves were isolated.

In the classification of varieties and forms of groundnut by John *et al* (1955), the only white kernelled variety, A. H. 259 (Phillippine white) is a spreading type and is grouped accordingly. The two white kernelled types recognised by Bhavanishankar Rao and Srinivasalu (1959) are bunch in habit and form an addition to the bunch group in the above classification. Among the Semi-spreading types, apart from *Var. nambyquarae* with ruptured testa, all the varieties in the original classification fall under the group having rose testa. Only recently, Bhavanishankar Rao and Raman (1960), suggested the addition of three new types with red and purple coloured testa.

The two types now isolated breed true and cross freely with spreading (A. H. 25), semi-spreading (A. H. 2105 and H. G. 1), bunch (A. H. 32) and erect (*Forma erecta*) forms of groundnut and represent a new combination of characters, *viz*, semi-spreading habit with white testa colour. Hence, they may be included as new sub-groups under semi-spreading group in the classification provided by John *et al* (1955).

Summary: Crosses were effected between two white seeded inbreds and six rose seeded pureline cultures to evolve a white seeded groundnut strain. Dominant characters, such as presence of crescent on the standard petal, red seed coat colour and anthocyanin pigmentation on the stem were expressed in the hybrids. The behaviour of F₂ progenies confirmed the observations of previous workers that presence or absence of crescent and pigmentation on the stem were controlled by duplicate factors. Regarding seed coat colour, F₂ progenies segregated into red, rose and white testa colours in the ratio of 45 : 15 : 4. In crosses involving A. H. 6742, white seeded plants were devoid of anthocyanin pigmentation, while in those involving A. H. 6644, a slight tinge was present. In both cases, the crescent on the standard petal was invariably absent. Types with a new combination of characters, *viz*, semi-spreading habit with white testa colour were isolated. They were found to breed true and cross freely with all other varieties. Uneconomical characters such as poor setting of pods, deep constriction, production of a large proportion of single seeded pods and low oil content were found to be manifested in the white seeded progenies.

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