Inheritance of White-Spot Testa Color Trait in Peanut[1]

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ABSTRACT

The white-spot testa color trait has occasionally been found among segregating cross populations in the cultivated peanut (*Arachis hypogaea* L.). Crosses involving one such true-breeding white-spot selection were made both between and within subspecies of the cultigen to determine the inheritance of this unusual trait. The F_1, F_2, and F_3 data indicated that two duplicate recessive genes, designated wsp_1 and wsp_2, control the white-spot trait in peanut.

Key Words: *Arachis hypogaea* L., cross combinations, genetics, groundnut, seed coat.

Cultivated peanut (*Arachis hypogaea* L.) testa color is very diverse, with solid seed colors varying from white to tan to pink to red to purple to dark purple (Pittman, 1995). Variegated and striped testa colors also are found within the germplasm (Branch and Hammons, 1979; Branch, 1985).

Occasionally, another unique white-spot testa color trait has been observed as segregants upon crossing normal solid colored testa parental lines. One such F_2 plant selection was made from tan × pink testa cross combination that had a predominantly red testa color and a small singular white spot located on the opposite end of the hilum (Branch, 1995). Subsequent selfing showed that this unusual white-spot testa color trait bred true-to-type.

Hammons (1973) suggested that the occurrence of a similar white spot on the testa may appear when one parent is white-seeded. Srivastava (1968) had previously crossed solid white × red testa color genotypes and detected a 11 solid red: 4 white spotted red: 1 white testa ratio in the F_2 generation which suggests monogenic difference for solid vs. the white-spot trait (11 solid red + 1 solid white = 12 solid : 4 white-spotted or 3:1 ratio).

White-spot testa color trait thus appears to be recessive since it has only occurred in the F_2 or subsequent generation from crosses involving parents with solid testa colors. The objective of this genetic study was to further determine the inheritance of the white-spot trait found in the cultivated peanut.

Materials and Methods

Crosses were made in the greenhouse between the $F_{2:4}$ white-spot selection with red testa (Branch, 1995) and the recessive red cultivar Makulu Red and the tan testa color of krinkle-leaf. Makulu Red × white-spot selection represents crosses within subspecies *hypogaea*, whereas the white-spot selection × krinkle-leaf combination represents crosses between subsp. *hypogaea* and subsp. *fastigiata*.

The F_1, F_2, and F_3 populations were space-planted in field nursery plots during 1994, 1995, and 1996, respectively, at the agronomy research farm near the Univ. of Georgia, Coastal Plain Exp. Sta. in Tifton. During each growing season, phenotypic classification of testa color from all sound mature seed of individual plants was recorded. Segregation data among F_2 plants and F_3 progeny were analyzed by the CHISQA computer program (Hanna *et al.*, 1978).

Results and Discussion

F_1 testa color from both cross combinations did not exhibit the white-spot trait. This suggests that the white-spot trait is recessive to normal solid testa color which confirms previous reports and observations on its occurrence (Srivastava, 1968; Hammons, 1973).

The F_2 testa color segregation from each cross fit a 15 normal : 1 white-spot ratio (Table 1). No significant differences were found among families or crosses. Total, pooled, and homogeneity chi-square values also fit a 15:1 ratio. These results suggest that two duplicate recessive genes control the white-spot trait.

Individual F_2 plant selections were made within these two cross combinations (Makulu Red × white-spot selection and white-spot selection × krinkle-leaf) for subsequent progeny row testing in the F_3 generation. F_3 progeny from F_2 plants with the white-spot trait bred true-to-type. Segregation of $F_{2:3}$ progeny from F_2 plants with normal testa color fit a seven nonsegregating (all normal) to four segregating (15 normal : 1 white-spot) to four segregating (3 normal : 1 white-spot) expected ratio (Table 2). These F_3 results verify the F_2 findings for digenic inheritance.

The white-spot trait thus shows a different inheritance from variegated peanut testa colors. Variegated red with white testa colors have been reported to be controlled by a single incompletely dominant gene, *V* (Branch and Hammons, 1979). An interaction of incompletely and completely dominant loci was found for the two

Table 1. F_2 plant segregation for white-spot testa color trait among two cross combinations.

Cross	No. of families	F_2 Testa color Normal	White-spot	χ^2 (15:1)	P
Makulu Red × white-spot seln.	4	413	30	0.206	0.66
White-spot seln. × krinkle-leaf	3	469	38	1.341	0.25
Total				1.547	0.47
Pooled	7	882	68	1.336	0.25
Homogeneity				0.211	0.66

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Table 2. F_3 progeny segregation for white-spot trait from F_2 normal testa color peanut plants.

Cross	$F_{2:3}$ Testa color progeny Normal	(15:1)	(3:1)	χ^2 (7:4:4)	P
Makulu Red × white-spot seln.	24	9	7	3.046	0.23
White-spot seln. × krinkle-leaf	24	7	7	4.152	0.14
Total				7.198	0.14
Pooled	48	16	14	7.028	0.03*
Homogeneity				0.170	0.92

*Significantly different at $P \leq 0.05$.

purple stripe genes, Vsp_1 and Vsp_2 (Branch, 1985).

The data from this genetic study indicate that two duplicate recessive genes control the white-spot testa color trait. Gene symbols, wsp_1 and wsp_2, are proposed for this unusual white-spot testa color trait found in the cultivated peanut. These results could agree with the previous reports by Srivastava (1968) and Hammons (1973) based upon the following proposed parental genotypes (red = $F_1F_2D_1D_2R_1wsp_1Wsp_2$ × white = $F_1F_2d_1d_2R_1wsp_1wsp_2$). The F_2 segregation should, however, have been for a three-gene model rather than for two genes. The white with white-spot phenotypes could not be distinguished from the solid white testa color class. This particular cross combination would give a 45 solid red : 15 red with white-spot : 4 solid white plus white with white-spot ratio which is very similar to the 11:4:1 dihybrid ratio that was actually reported (Srivastava, 1968).

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