Genetic Relationship between Purple and Wine Testa Color in Peanut[1]

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ABSTRACT

A better understanding of the genetic relationship among different testa colors is needed in peanut (*Arachis hypogaea* L.) breeding programs. Numerous genes are involved in this important U.S. market quality trait. However, the relationship among some of these genes is not yet known. The objective of this study was to determine the interaction among the three genes (P, w_1, and w_2) controlling purple and wine testa color. No maternal or cytoplasmic differences were found among three reciprocal purple × wine testcrosses. The F_1, F_2, and F_3 segregation results suggest that purple testa color of PI 331334 differs from that of wine testa color parental lines (PI 264549, Wine-Frr 1 and Wine-Frr 2) by only two genes. These findings illustrate that the dominant purple testa color gene (P) is independent from at least one of the two recessive wine genes ($w_1 w_1$ or $w_2 w_2$).

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

In the cultivated peanut (*Arachis hypogaea* L.), two sets of duplicate dominant genes (F_1F_2 and D_1D_2) have long been known to interact in the basic development of testa colors, pink and tan (Higgins, 1940). It takes at least one dominant F and one dominant D gene for color to be expressed (Wynne and Coffelt, 1982; Murphy and Reddy, 1993). Otherwise, if either or both sets of these two genes are homozygeously recessive, the result is white testa color (Hammons, 1973). Two dominant genes, Wh_1 and Wh_2, have been found that also control white testa color (Norden *et al.*, 1988; Branch, 1989; Knauft *et al.*, 1991).

Branch and Holbrook (1988) reported on the genetic relationship between the R_1, r_2, and r_3 genes for red peanut testa color. The dominant R_1 gene was found to be inherited independently from at least one of the two recessive genes ($r_2 r_2$, or $r_3 r_3$) controlling red testa color.

Purple testa color is controlled by a single dominant gene, P (Branch, 1985). Wine testa color has been shown to be controlled by two recessive genes, w_1 and w_2 (Branch, 1997). However, the genetic relationship among these genes is not known. The objective of this genetic study was to determine the interaction among the three genes (P, w_1, and w_2) controlling purple and wine peanut testa color.

Materials and Methods

Three reciprocal testcrosses were made in the greenhouse between purple and wine testa colors. The purple testa color parental line PI 331334 was used as the common parent in each cross combination. This particular purple genotype had been found previously to be controlled by the single dominant gene, P (Branch, 1985). The wine testa color parental lines were PI 264549 and two true breeding natural-cross derived wine genotypes (Wine-Frr 1 and Wine-Frr 2) from the Florunner cultivar. Each had been found previously to be

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controlled by duplicate recessive genes, w_1 and w_2 (Branch, 1997).

The F_1, F_2, and F_3 cross populations were all space-planted in field nursery plots at the agronomy research farm near the Univ. of Georgia, Coastal Plain Exp. Sta. at Tifton during 1995, 1996, and 1997, respectively. During each growing season the phenotypic classification of testa color from individual plants was based on sound mature seed. Segregation data among F_2 plants and F_3 progenies were analyzed by the CHISQA computer program of Hanna *et al.* (1978).

Results and Discussion

The F_1 testa color from all three reciprocal purple × wine testcrosses was classified as a dull purplish tan color. This suggests that purple is completely dominant to wine and incompletely dominant to the basic tan or pink testa color which agrees with earlier reports (Branch, 1985, 1997).

Because of the visual difficulties in separating purple and wine as well as pink and tan peanut seed, these two sets of testa colors were grouped together for F_2 and F_3 classification. The F_2 segregation from the three testcrosses showed a very good fit to 13 purple + wine : 3 tan + pink ratio for testa color (Table 1). Total, pooled, and homogeneity chi-square values also were found acceptable for the 13:3 ratio. No maternal or cytoplasmic differences were detected among each of the three reciprocal testcrosses. These results suggest only two gene differences among the purple and wine testa color parental lines used in this study and implies that the purple testa color of PI 331334 also is independent of one of the two duplicate recessive wine testa color genes, w_1 or w_2. Similar findings were likewise found among the three genes (R_1, r_2, and r_3) for red peanut testa color (Branch and Holbrook, 1988).

F_3 progeny segregation from individual F_2 plants with purple or wine testa colors fit a seven nonsegregating (all purple or wine) to six segregating (13 purple + wine : 3 tan + pink; or 3 purple + wine : 1 tan + pink) ratio (Table 2). Likewise, F_3 progeny segregation from individual F_2 plants with tan and pink testa colors fit a two segregating (3 tan + pink : 1 wine) to one nonsegregating (all tan + pink) ratio (Table 3). The F_3 data thus support the F_2 results for a 13: 3 dihybrid genetic model.

Such genetic interaction would be expected based upon the following parental testa color genotypes: purple = $P\ W_1 w_2$ and wine = $p\ w_1 w_2$. These findings also illustrate that the dominant purple testa color gene (P) is independent from at least one of the two recessive wine genes (w_1w_1 or w_2w_2).

Table 1. F_2 plant segregation for testa color among three peanut reciprocal purple × wine testcrosses.

Testcross	No. families	F_2 testa color Wine+Purple	Pink+Tan	χ^2 (13:3)	P
PI 331334 × PI 264549	4	377	99	1.311	0.25
PI 331334 × Wine-Frr 1	4	520	137	1.906	0.17
PI 331334 × Wine-Frr 2	4	606	141	0.008	0.93
Total				3.225	0.36
Pooled		1503	377	2.096	0.15
Homogeneity				1.129	0.57

Table 2. F_3 progeny segregation among F_2 peanut plants with purple and wine testa colors from three purple × wine testcrosses.

Testcross	$F_{2:3}$ testa color Nonsegregating (all purple+wine)	Segregating (13:3 & 3:1)[a]	χ^2 (7:6)	P
PI 331334 × PI 264549	19	12	0.691	0.42
PI 331334 × Wine-Frr 1	14	14	0.167	0.69
PI 331334 × Wine-Frr 2	15	15	0.179	0.68
Total			1.037	0.79
Pooled	48	41	0.000	0.99
Homogeneity			1.037	0.61

[a]13 purple + wine: 3 tan + pink; or 3 purple + wine : 1 tan + pink.

Table 3. F_3 progeny segregation among F_2 peanut plants with tan and pink testa colors from three purple × wine testcrosses.

Testcross	$F_{2:3}$ testa color Segregating (3 tan+pink: 1 wine)	Nonsegregating (all tan+pink)	χ^2 (2:1)	P
PI 331334 × PI 264549	6	3	0.000	1.00
PI 331334 × Wine-Frr 1	6	4	0.200	0.67
PI 331334 × Wine-Frr 2	7	3	0.050	0.83
Total			0.250	0.97
Pooled	19	10	0.017	0.90
Homogeneity			0.233	0.89

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