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INHERITANCE OF GOLDEN YELLOW MUTANT IN GROUNDNUT (*ARACHIS HYPOGAEA* (L.)

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ABSTRACT

The parents, F_1s, F_2s, and F_3 progenies of six crosses, including three reciprocal crosses, were studied for the inheritance of golden yellow foliage in groundnut (*Arachis hypogaea* L.). The golden yellow foliage character was recessive, and it was controlled by independent duplicate genes, giving a ratio of 15 normal green : 1 golden yellow foliage in the F_2 generation.

Key words : Peanut, Aureus mutant, Genetic studies

INTRODUCTION

The aureus mutant, possessing Golden yellow colored foliage (leaves and stems) in groundnut, was first reported in a population of PI 268637 grown in an experimental plot at Oklahama Agricultural Experiment Station in Stillwater, Oklahama (Stone, 1968). The aureus cotyledons were reported to be golden yellow in color initially during cracking time, but after exposure to light they turned green. However, the chlorophyll pigment decomposed in 2 weeks, resulting in a whole plant with golden yellow foliage till maturity. A groundnut genotype, ICG 10148, maintained in the germplasm collection at ICRISAT Centre, possesses similar characteristics; it probably was brought to India and ICRISAT Centre from USA. ICG 10148 has leaves and branches of golden yellow color, In limited genetic studies, (Tai et al., 1970, 1977) reported duplicate recessive inheritance for this character in the F_2 population in a cross of Aureus x Green Krinkled mutant.

In the present study, the inheritance of golden yellow foliage of the mutant was further studied in the F_1, F_2, and F_3 generations of six crosses, including three reciprocal crosses.

MATERIALS AND METHODS

Three groundnut genotypes, ICG 221, ICG 799, and ICG 2405 were crossed reciprocally with ICG 10148. While ICG 221 belongs to subsp. *fastigiata* var. *vulgaris*, the other two genotypes are from subsp. *hypogaea* var. *hypogaea*. ICG 799 has a spreading bunch growth habit, and ICG 2405 is a runner type. ICG 10148 is erect in growth habit and belongs to subsp. *fastigiata* var. *vulgaris*.

Parents, F_1s, and F_2s of the six crosses were grown together during the 1986 rainy season at ICRISAT Center. Observations on the foliage color (golden yellow or green) were recorded in the F_1 and F_2 generations. All the plants with golden yellow foliage, and a random sample of 50 plants with green foliage in the F_2 generation in each cross, were individually harvested and grown as F_3 plant progenies in the 1987 rainy season. Individual plants in the F_3 progenies were observed for foliage color.

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x^2 test was applied to test the validity of different genetic ratios. Wherever the frequency in a particular class was less than five, the Yates (1934) correction factor was applied before estimating X^2 values.

RESULTS AND DISCUSSION

The F_1s of the six crosses, including reciprocals, had normal green foliage, indicating that the golden yellow foliage character is recessive in nature.

The F_2 plant data on green and golden yellow foliage were subjected to chi-square test to various digenic ratios, and the X^2 values for the genetic ratio showing best fit are presented (Table 1). The X^2 value in five crosses showed a good fit to a 15:1 digenic ratio for greenversus golden yellow foliage, whereas in the case of ICG 10148 x ICG 799 the fit was not good at 0.05 probability. However, the total and pooled X^2 values were nonsignificant, which indicated an overall good fit to a 15.:1 genetic ratio.

TABLE 1. Chi-square tests for the segregation of normal (green) and golden yellow foliage in F_2 generation of six crosses in groundnut.

Crosses	Frequency of F_2 phenotypes		X^2	
	Normal plant	Golden yellow	(15:1 ratio)	Probability
ICG 221 x ICG 10148	133	11	0.47	0.492
ICG 10148 x ICG 221	812	46	1.16	0.281
ICG 799 x ICG 10148	1294	77	0.94	0.332
ICG 10148 x ICG 799	984	49	4.00*	0.045
ICG 2405 x ICG 10148	782	59	0.84	0.359
ICG 10148 x ICG 2405	822	50	0.39	0.532
Total (6 d.f)	—		7.80	0.252
Pooled (1 d.f.)	4827	292	2.60	0.106
Heterogeniety (5 d.f.)	—	—	5.20	0.392

* Significant at 0.05 probability

Tai et al., (1970) reported the gene symbol, au_1 au_1 au_2 au_2, for aureus mutant (golden yellow foliage), and $AU_1AU_1AU_2AU_2$ for the krinkled green color genotype. Based on a 15:1 F_2 ratio and the gene symbols as assigned for the genotypes of the aureus and green plant, the F_3 progenies having green foliage with the genotype, AU_1 $au_1AU_2au_2$, $AU_1au_1au_2au_2$ and $au_1au_1AU_2au_2$ will segregate, whereas progenies with other genotypes will breed true. The green color F_3 progenies with AU_1au_1 AU_2au_2 will segregate in a 15:1 ratio of green versus golden yellow foliage, whereas those having $AU_1au_1au_2au_2$ and $au_1au_1AU_2au_2$ will segregate into a 3:1 ratio.

F_3 families derived from golden yellow F_2 plants bred true. Among the F_3 families derived from green F_2 plants, a good fit to 7:8 ratio of true breeding (green) versus segregating (green and golden yellow) was observed (Table 2).

TABLE 2. Chi-square test of F3 green families breeding true and those segregating for green and golden yellow foliage in a 7:8 ratio.

Cross	F_3 green families breeding true (NSG) and those segregating (SG)		X^2	Probability
	NSG	SG	(7:8 ratio)	
ICG 799 x ICG 10148	21	19	0.540	0.538
ICG 10148 x ICG 799	14	25	1.817	0.822
ICG 2405 x ICG 10148	20	20	0.000	0.000
ICG 10148 x ICG 2405	15	25	1.350	0.755
ICG 221 x ICG 10148	24	15	3.465	0.937
ICG 10148 x ICG 221	29	19	3.641	0.944
Total	123	123	0.00	

The individual segregating F_3 plant progenies (derived from green F_2 plants) in each cross were subjected to X^2 tests for both ratios and were separated to the class showing best fit to either the 15:1 or the 3:1 ratio. Under situations where X^2 value was nonsignificant for both the ratios, the best fit was considered to be the ratio that had the least X^2 value. Seventy-two F_3 progenies gave a good fit to a 15:1 ratio of green versus golden yellow foliage, and 51 progenies to the ratio of 3:1, which did not show significant deviation from a 1:1 ratio of lines segregating into the two categories. X^2 values for the above segregating progenies for a 15:1 or a 3:1 ratio ranged from 0.0 to 3.6. The pooled analysis also showed a good fit for the respective ratios, except for cross ICG 10148 x ICG 221, which had less recovery of golden yellow foliage plants.

These results confirm the earlier observation of Tai et al., (1970, 1977) that the golden yellow foliage character is recessive in nature and is controlled by a pair of independent duplicate genes. However, the present study confirms this using larger populations as well as normal parents (not mutants). The golden yellow foliage trait as such may not have practical significance in applied plant breeding because the yield potential of the mutant is inherently low due to its lack of chlorophyll pigmentation. But it may have a limited use as a marker trait in genetic studies because of its recessive nature.

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