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TESTA COLOUR INHERITANCE IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

R. P. VASANTHI

Regional Agricultural Research Station, Tirupati 517 502

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ABSTRACT

Inheritance of testa colour was studied in six crosses of groundnut namely Tirupati - 1 (rose) × ICCV 86699 (red), JL-24 (rose) × ICCV 86699 (red), TCGS-37 (red) × ICCV 86699 (red), Tirupati - 1 (rose) × NcAc 343 (rose), JL-24 (rose) × NcAc 343 (rose) and TCCS-37 (red) × NcAc 343 (rose) and TCGS-37 (red) × NcAc 343 (rose). F_2 segregation gave an acceptable fit to a phenotypic ratio of 12 rose : 3 red : 1 light tan in former two crosses which shows epistatic interaction between two loci. In the cross, TCGS-37 (red) × ICGV 86699 (red), F_2 segregation fitted well to an expected phenotypic ratio of 51 red: 12 rose : 1 light fan. This indicates the involvement of two gene loci for red testa interacting with rose testa colour locus in epistatic fashion. F_2 segregation ratios in crosses Tirupati-1 (rose) × NcAc 343 (rose) and JL-24 (rose) × NcAc 343 (rose) fitted well to an expected phenotypic ratio of 60 rose: 3 red: 1 white indicating trigenic inheritance with two epistatic gene loci governing rose testa interacting with one red test acolour locus that is hypostatic to both the rose testa loci. The segregation pattern in cross TCGS-37 (red) × NcAc 343 (rose) showed tetragenic inheritance with duplicate loci for rose as well as red testa colours interacting in epistatic manner. This needs to be confirmed further through F_3 studies.

Key words : Testa colour, inheritance, epistatic interactions

Variability in testa colour of groundnut is considerable ranging from white, tan, rose, pink, wine, red to deep purple. However, only rose testa and to some extent red testa colour is acceptable to consumers as well as millers. Thus a better understanding of the inheritance of testa colour would be very useful in groundnut breeding programmes.

Increasing evidence on inheritance of qualitative traits in groundnut indicates the involvement of atleast two duplicate genes. This is largely due to the alloploid nature of the groundnut and tends to confirm the theory of two genomes in *Aracihs hypogaea*. The number of genes may vary greatly among the parental lines used in an inheritance study. Only fewer genes will be detected to control a trait among closely related parents while the number of different genes or alleles found controlling a trait will increase among more divergent parents [1].

MATERIALS AND METHODS

Two popular groundnut varieties, Tirupati-1 and JL-24 with rose testa and one promising breeding line, TCGS-37 with red testa were used as female parents. One rose testa colour line, NcAc 343, a germplasm accession from North Carolina, U.S.A. and red testa coloured line, ICCV 86699, an interspecific cross derivative from ICRISAT were used as male parents. The breeding line, TCGS-37 is derived from JL-24 × Ah 316/S cross. Six single crosses were made during 1993-94 rabi. These intra-specific combinations provide a wide range of genetic diversity and subsequent recombination. The details of parents are given below :

Tirupati-1 : A selection from germplasm accession EC 106983/3; Spanish bunch group maturing in 100-105 days; possesses rose testa.

JL-24 : A selection from EC 949493; Spanish bunch group maturing in 105 days; possesses rose testa.

TCGS-37 : A selection from JL-24 × Ah 316/S; Spanish bunch group maturing in 105-115 days; possesses red testa.

ICGV 86699 : A selection from interspecific cross; Virginia bunch group maturing in 105-115 days; possesses red testa.

NcAc 343 : A germplasm accession from North Carolina, U.S.A. Virgina bunch group maturing in 120-125 days; possesses rose testa.

F_{1s}' were raised during 1994 kharif at Regional Agricultural Research Station, Tirupati. F_2 populations were space planted in the field during 1994-95 rabi. Recommended production practices were followed during the growing season. Phenotypic classification of individual plant testa colour was based on mature unblemished seed. Segregation data were analysed using Chi-square test.

RESULTS AND DISCUSSION

F_1 testa colour of Tirupati-1 (rose) × ICGV 86699 (red) and JL-24 (rose) × ICGV 86699 (red) was rose. Segregation in F_2 generation gave a good fit to an expected phenotypic ratio of 12 rose : 3 red : 1 light tan (Table 1). Parents seem to differ at two gene loci with epistatic interaction (Table 2). F1 testa colour of TCGS-37 (red) × ICGV 86699 (red) was red. F_2 segregation fitted well to an expected phenotypic ratio of 51 red: 12 rose: 1 light tan. In this cross parents appear to differ at three gene loci with epistatic interaction i.e., two gene loci for red interacting with one locus for rose testa. The assigned gene symbols for parents and phenotypes in F_2 are given in Table 2.

Table 1. Segregation of testa colour in six crosses of groundnut (*Arachis hypogaea* L.) in F_2 generation

Cross	F_1 phenotype	F_2 Phenotypes				Ratio	X^2	P
		Red	Rose	Light tan	White			
Tirupati-1 × ICGV 86699 (rose) (red)	Rose	78	252	29	-	3:12:1	4.721	0.05-0.10
JL-24 × ICGV 86699 (rose) (red)	Rose	42	181	8	-	3:12:1	3.257	0.10-0.25
TCGS-37 × ICGV 86699 (red) (red)	Red	304	56	9	-	51:12:1	4.665	0.05-0.10
Tirupati-1 × NcAc 343 (rose) (rose)	Rose	6	157	-	3	3:60:1	0.484	0.75-0.90
JL-24 × NcAc 343 (rose) (rose)	Rose	16	269	-	5	3:60:1	4.222	0.10-0.25
TCGS-37 × NcAc 343 (red) (rose)	Red	235	74	-	3	195:60:1	2.675	0.25-0.50

Table 2. Assigned gene symbols for parents, F1's and F2's for testa colour

Parent/F_1/F_2		Genotype	Phenotype
Tirupati-1 and JL-24		rr Rs_1Rs_1 rs_2rs_2 r_1r_1	Rose
TCGS-37		RR Rs_1Rs_1 rs_2rs_2 r_1r_1	Red
ICGV 86699		rr rs_1rs_1 rs_2rs_2 R_1R_1	Red
NcAc 343		rr rs_1rs_1 Rs_2Rs_2 R_1R_1	Rose
Titupati-1/JL-24 ICGV 86699	F_1	rr Rs_1rs_1 rs_2rs_2 R_1r_1	Rose
	F_2	rr Rs_1- rs_2rs_2 R_1-	Rose
		rr Rs_1- rs_2rs_2 r_1r_1	Rose
		rr rs_1rs_1 rs_2rs_2 R_1-	Red
		rr rs_1rs_1 rs_2rs_2 r_1r_1	Light tan
TCGS-37 × ICGV 86699	F_1	Rr Rs_1rs_1 rs_2rs_2 R_1r_1	Red
	F_2	R- Rs_1- rs_2rs_2 R_1-	Red
		R- rs_1rs_1 rs_2rs_2 R_1-	Red

		R- Rs_1- rs_2rs_2 r_1r_1	Red
		R- rs_1rs_1 rs_2rs_2 r_1r_1	Red
		rr rs_1rs_1 rs_2rs_2 R_1-	Red
		rr Rs_1- rs_2rs_2 R_1-	Rose
		rr Rs_1-rs_2rs_2 r_1r_1	Rose
		rr rs_1rs_1 rs_2rs_2 r_1r_1	Light tan
Tirupati-1 × NcAc 343	F_1	rr Rs_1rs_1 Rs_2rs_2 R_1r_1	Rose
JL-24 × NcAc 343	F_2	rr Rs_1- Rs_2 - R_1-	Rose
		rr Rs_1- Rs_2- r_1r_1	Rose
		rr rs_1rs_1 Rs_2- R_1-	Rose
		rr Rs_1- rs_2rs_2 R_1	Rose
		rr Rs_1- rs_2rs_2 r_1r_1	Rose
		rr rs_1rs_1 Rs_2- R_1	Rose
		rr rs_1rs_1 rs_2rs_2 r_1r_1	Red
		rr rs_1rs_1 rs_2rs_2 r_1r_1	White
TCGS-37 × NcAc 343	F_1	Rr Rs_1 Rs_1 rs_1 Rs_2rs_2 R_1r_1	Red
	F_2	R-Rs1-Rs_2-R_1	Red
		R-Rs_1 -Rs_2-r_1r_1	Red
		R-Rs_1-rs_2rs_2-R_1-	Red
		R-rs_1-rs_1Rs_2-R_1	Red
		R-Rs_1-$rs_2rs_2r_1r_1$	Red
		R-rs_1rs_1 Rs_2-r_1r_1	Red
		R-rs_1rs_1 rs_2rs_2 R_1-	Red
		R-rs_1rs_1 rs_2rs_2 r_1r_1	Red
		rr rs_1rs_1 rs_2rs_2 R_1-	Red
		rr Rs_1 -Rs_2 -R_1-	Red
		rr Rs_1 -Rs_2-r_1r_1	Red
		rr Rs_1 -rs_2rs_2 R_1-	Red
		rr rs_1rs_1 Rs_2-R_1-	Rose
		rr rs_1rs_1 Rs_2-r_1r_1	Rose
		rr Rs_1-rs_2rs_2 r_1r_1	Rose
		rr rs_1rs_1 rs_2rs_2 r_1r_1	White

Testa colour in F_1 of Tirupati - 1 (rose) × NcAc 343 (red) and JL-24 (rose) × NcAc 343 (rose) was rose. In F_2 the pattern of segregation fitted to a phenotypic ratio of 60 rose : 3 red : 1 white. This indicates that the parents differ at three loci with two duplicate loci for rose testa interacting with another locus for red testa in epistatic manner. Krapovickas and Rigoni [2] suspected an epsitatic factor for red inhibition from the occurrence of red testa in F_2 and F_3 of crosses between 2 flesh (pink or rose) testa colour lines. F_1 testa colour of TCGS-37 (red) × NcAc 343 (rose) was red. F_2 segregation pattern gave a good fit to an expected phenotypic ratio of 195 red : 60 rose : 1 white showing involvement of four gene loci in inheritance of testa colour. These results have to be confirmed further through F3 segregation studies. Two duplicate loci for rose testa seem to interact with two loci for red testa in epistatic fashion. In this cross, red testa colour locus in TCGS-37 is epistatic over both the loci for rose testa colour in TCGS-37 and NcAc 343. But these loci for rose testa are both epistatic over another locus for red testa present in ICGV 86699 and NcAc 343. Branch and Hammons [3] reported incomplete dominance of red testa in crosses of nine flesh coloured lines with red testa coloured line, Makulu Red. From their studies they propsoed two loci controlling red testa. The first (R_1 r_1) was dominant to flesh. The R_2 r_2 was recessive to flesh and does not interact with F alleles. In the preset study, the recessive alleles of all the genes resulted in light tan (whitish yellow) or white testa colour. The difference in this expression is due to the different genetic backgrounds i.e., different male parents used. Modifying factors may also be involved in the expression of testa colour resulting in difference in expressivity of testa colour.

The testa colour inheritance seems to be complicated. In the present study itself digenic to tetragenic inheritanc is being observed. Hammons [1] opined that the number of genes may vary greatly among the parental lines used in an inheritance study depending on the relationship between parents. Among the more divergent parents the number of genes controlling a trait will increase.

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