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INHERITANCE OF ANTHOCYANIN PIGMENTATION IN STIGMA, OUTER GLUMES AND APICULUS OF RICE (*ORYZA SATIVA* L.)—I[1]

L. N. YADAV[2]

Central Rice Research Station, (J. N. Krishi Vishwa Vidyalaya), Raipur

ABSTRACT

Inheritance studies in seven crosses involving six varieties of rice all possessing chromogen gene were reported. F_2 ratios of-27 half-full purple husk : 21 purple spreading : 16 purple apiculus; 171 half-full purple husk : 36 purple spreading : 49 purple apiculus; and 9 half-full purple husk : 3 purple spreading : 4 purple apiculus were obtained. Five genes were operating; three genes (one particular and two complementary) were involved in the expression of purple spreading apiculus; of the remaining two (HP_1 and HPa_1), one (HP_1) when present with any two or H-spb, developed half-full purple husk. Four new genes were reported, HP_1 and HPa_1 for half-full purple husk and H-spa_2 and H-spb_2 for purple spreading apiculus. These were described as spreader group genes. Spreader genes were epistatic to apiculus group of genes. Half-full purple husk condition extended effect to stigma and outer glumes. Purple spreading apiculus had inhibiting effect on stigma colour.

INTRODUCTION

In a germplasm collection of eleven hundred genotypes of rice (*Oryza sativa* L.) grown at the Central Rice Research Station, Raipur, M. P., it was noted that purple spreading apiculus was associated with green stigma and purple outer glumes. The present study was, therefore, taken up to determine the mode of inheritance of these characters.

MATERIALS AND METHODS

Four rice varieties viz., Barangi-14, R-4 (Surmatia), N-22 and AC-517, all possessing purple spreading (Prspr) apiculus, green stigma and purple outer glumes, and two varieties, Cross 16/19 (Nusahi) and R-3 (Sultugurmatia) having purple pigment in apiculus and stigma were selected for the study. All the six varieties except Nusahi belong to *indica* group. The variety Nusahi was bred from a *japonica* × *indica* cross. Crosses involving following combinations were made during kharif seasons of 1964-65 and 1965-66, and F_1, F_2 and F_3 generations were grown during subsequent years(1965-66—1967-68) at the Central Rice Research Station, Raipur, M.P. and the Regional Research Station, Bagwai (Distt. Gwalior), M.P.

1. Barangi-14 × Nusahi and reciprocal
2. R-4 × Nusahi and reciprocal
3. N-22 × Nusahi and reciprocal
4. R-3 × AC-517.

RESULTS AND DISCUSSION

In all the crosses, F_1 plants showed purple spreading apiculus of varying degree, extending pigment up to middle

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2. Department of Plant Breeding and Genetics, College of Agriculture, Gwalior.

to complete portions of lemma and palea (half-full purple husk). Stigma and outer glumes were also purple (pr). Purple spreading confined to upper part of lemma and palea as in parental lines was not obtained. Results of F_2 and F_3 generations are presented in table-1.

Apiculus—The crosses, R-4 × Nusahi and Barangi-14 × Nusahi and their reciprocals gave an F_2 ratio of 27 half-full purple husk : 21 purple spreading : 16 purple. Three factor pairs were operating in the expression of the trait. Presence of all the three was necessary for the development of half-full purple husk; one of these when present alone could develop purple spreading apiculus.

The cross, N-22 × Nusahi and its reciprocal gave an F_2 ratio of 171 half-full purple husk : 36 purple spreading :

TABLE I

(a) F_2 SEGREGATION FOR ANTHOCYANIN PIGMENTATION IN APICULUS, STIGMA AND OUTER GLUMES OF RICE

Cross		Apiculus				Stigma			Outer glumes		
		Half-full Pr. husk	Pr spr	Pr	X^2	Pr	gr	X^2	Pr	gr	X^2
1. R-4 x Nusahi	F_2 ratio	27	21	16	2.071	43	21	1.507	3	1	0.036
	obs.	124	116	82		206	116		240	82	
2. Nusahi x R-4	F_2 ratio	27	21	16	3.258	43	21	1.075	3	1	0.871
	obs.	142	90	68		210	90		232	68	
3. Barangi-14x Nusahi	F_2 ratio	27	21	16	2.063	43	21	0.080	3	1	1.997
	obs.	160	120	78		238	120		280	78	
4. Nusahi x Barangi-14	F_2 ratio	27	21	16	1.334	43	21	0.323	3	1	0.477
	obs.	280	200	150		430	200		480	150	
5. N-22 x Nusahi	F_2 ratio	171	36	49	0.633	220	36	0.302	207	49	0.452
	obs.	140	32	36		176	32		172	36	
6. Nusahi x N-22	F_2 ratio	171	36	49	0.888	220	36	0.738	207	49	0.044
	obs.	201	49	61		262	49		250	61	
7. R-3 x AC-517	F_2 ratio	9	3	4	0.632	13	3	0.043	3	1	0.460
	obs.	123	38	48		171	38		161	48	

(b) F_2 SEGREGATION FOR ANTHOCYANIN PIGMENTATION IN APICULUS OF RICE.

Cross	Half-full pr husk			Pr spr		Pr		
	3 Half-full : 1 pr spr		Segr like F_1	Pure	3 pr spr : 1 pr	Pure	Pure	X^2
R-3 x AC-517	Exp.	6.22	6.22	1.56*	3.33*	1.67*	6	0.367
	Obs.	7	5	2	2	3	6	

*Classes were merged as frequency was less than 5.

49 purple for apiculus. Four factor pairs found to operate in the expression : of them, two complementary factor pairs developed purple spreading apiculus and of the remaining two, one (particular) when present with any two or one (particular) of the complementary developed half-full purple husk.

In the cross R-3 × AC-517, F_2 ratio of 9 half-full purple : 3 purple spreading: 4 purple apiculus was obtained. Presence of two factor pairs was necessary for the expression of half-full husk and one of them when present alone developed purple spreading pigment in apiculus.

Outer glumes : An F_2 ratio of 3 purple : 1 green was obtained in the crosses R-4 × Nusahi, Barangi-14 × Nusahi and R-3 × AC-517; and a ratio of 207 purple : 49 green in N-22 × Nusahi. Reciprocal crosses also gave similar ratios. It revealed that factors expressing purple spreading apiculus or half-full purple husk have extended their effects to outer glumes.

Stigma : The crosses, R-4 × Nusahi and Barangi-14 × Nusahi including their reciprocals gave an F_2 ratio of 43 purple : 21 green, whereas the crosses N-22 × Nusahi and R-3 × A-C-517 gave respectively, F_2 ratios of 220 purple : 36 green and 13 purple : 3 green. It suggested that factors developing purple spreading apiculus, have shown inhibiting effect on stigma region. F_2 results of the cross R-3 × AC-517 were confirmed by their F_3 results.

Kadam (1976) reported that a gene H-sp acts as a spreader to the upper part of husk; presence of apiculus genes is necessary for the expression of H-sp. The present findings are in confirmation to those reported by him. However, H-sp gene was present only in R-4 and Barangi-14, while in N-22 two complementary genes different from H-sp were operating. Kadam *et al.* (1980) reported a ratio of 27 full-purple to 37 non-purple lemma and palea and designated them HPa, HP*b* and HP*c*. In the present findings, in addition to the purple spreading above genes, two more genes were producing pigment in half to full portion of lemma and palea. They were different from those of Kadam *et al.* (1980) because they were not true complementary to each other. Panda *et al.* (1967), Shrivastava *et al.* (1968), and Kadam and Desale (1972) also reported inheritance of pigmentation in these parts, but it appeared that genes involved in their crosses were different from those reported in the present study.

The results of the present study may by concluded as :

(i) One gene (designated as H-sp_1) acts as a spreader to the upper part.

(ii) Two more genes which are complementary to each other also act like H-sp1; they may be designated as H-spa2 and H-sp *b*2.

(iii) Two genes are involved in the expression of half-full purple husk (they may be designated as HP_1 and HP*a*1) ; HP1 produces half-full purple husk, when present with any two of the remaining genes or with Hsp*b*2.

(iv) Genes, which produces half-full purple husk or purple spreading apiculus extend their effect to outer glumes.

(v) Genes, which produce purple spreading apiculus inhibit pigmentation in stigma region.

(vi) All these genes may be called as spreader group genes to apiculus, which also have their effect on outer glumes and stigma.

(vii) The spreader genes are epistatic over 'Ap' genes (apiculus group of

genes reported by Kadam, 1976) for imparting pigment in these parts.

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