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# Inheritance of purple pigmentation in two-line rice hybrids

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Many scientists have systematically studied how purple color is inherited in rice leaves. Three pairs of basic genes (C, A, P) control the inheritance of anthocyanin pigments (Nagao 1951). The C-A-P gene system in japonica rice is suitable for indica rice (Kinoshita 1984). Tongmin et al (1996) studied the inheritance of two purple rice lines and the possibility of their use as morphological markers in hybrid rice breeding.

The experiment was conducted in 2000-03 at ACRI. The genotypes involved in the crosses were aromatic rice varieties (ADT41, Pusa Basmati 1, and Basmati 370), nonaromatic varieties (ADT39 and AD98028), and a nonaromatic TGMS line (TS29) with purple basal nodes.

The plants with purple/green pigmentation on the basal node were counted in the  $P_1$ ,  $P_2$ ,  $F_1$ ,  $F_2$ ,  $B_1$ , and  $B_2$  generations in each of the five crosses and chi-square tests were made crosswise to study the inheritance pattern of purple pigmentation. The number of plants with purple and green pigmentation in the basal nodes of the plants in all generations in each of the five crosses and the chi-square values for the genetic ratios are presented in the table. The parents ADT39, ADT41, Pusa Basmati 1, Basmati 370, and AD98028 were green. The hybrids TS29/ADT39, TS29/ADT41, TS29/Pusa Basmati 1,

TS29/Basmati 370, and TS29/AD98028 showed green plants in the  $F_1$  generation. The  $F_2$  and  $B_2$  generations segregated for green and purple pigmentation in the ratio of 13:3 and 1:1, respectively. The chi-square values for the fitness of these genetic ratios were nonsignificant. The  $B_1$  generation of all five crosses showed green pigmentation.

The inheritance pattern for purple pigmentation at the basal node revealed that purple pigmentation was recessive to green, owing to its absence in the  $F_1$  generation. The segregation pattern observed in the  $F_2$  generation indicated a ratio of 13:3 for green and purple in all crosses—TS29/ADT39, TS29/ADT41, TS29/Pusa Basmati 1, TS29/Basmati 370, and

Segregation for purple pigmentation in five crosses.

Parent/cross	Generation	Number of plants observed			Ratio	$\chi^2$ value	Probability
		Green	Purple	Total			
TS29		—	50	50	—		
ADT39		50	—	50	—		
ADT41		50	—	50	—		
Pusa Basmati 1		50	—	50	—		
Basmati 370		50	—	50	—		
AD98028		50	—	50	—		
TS29/ADT39	$F_1$	25	—	25	—		
	$F_2$	247	53	300	13:3	0.20	0.50–0.70
	$B_1$	80	—	80	—		
	$B_2$	43	37	80	1:1	0.45	0.30–0.50
TS29/ADT41	$F_1$	25	—	25	—		
	$F_2$	246	54	300	13:3	0.11	0.70–0.80
	$B_1$	80	—	80	—		
	$B_2$	48	32	80	1:1	3.20	0.05–0.10
TS29/Pusa Basmati 1	$F_1$	25	—	25	—		
	$F_2$	232	48	300	13:3	1.49	0.20–0.30
	$B_1$	80	—	80	—		
	$B_2$	43	37	80	1:1	0.45	0.30–0.50
TS29/Basmati 370	$F_1$	25	—	25	—		
	$F_2$	250	50	300	13:3	0.85	0.30–0.50
	$B_1$	80	—	80	—		
	$B_2$	46	34	80	1:1	1.80	0.10–0.20
TS29/AD98028	$F_1$	25	—	25	—		
	$F_2$	251	49	300	13:3	1.15	0.20–0.30
	$B_1$	80	—	80	—		
	$B_2$	36	44	80	1:1	0.80	0.30–0.50

TS29/AD98028. The inheritance pattern for purple pigmentation was confirmed by the testcross ratio of 1:1 in the B<sub>2</sub> generation. The 13:3 genetic ratio for green and purple indicated that the difference between parents in all the crosses was based on two-pair genes, one of which was an inhibitory gene. Thus, the gene action for purple pigmentation was observed to be digenic with

inhibitory interaction as shown in these crosses. Tongmin et al (1996) reported two to four genes responsible for pigmentation in leaves, one of which was inhibitory. The results suggest the possibility of using purple pigmentation in the basal node as a gene marker (morphological marker) in hybrid rice breeding programs.

## References

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## Inheritance of scentedness in two-line rice hybrids

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Aroma in scented rice has its unique value, from both consumption and commercial points of view. Knowledge of the inheritance pattern of aroma would help in deciding what breeding methods to use to develop high-yielding rice hybrids. Various techniques to detect and evaluate aroma, in order to study the inheritance of aroma in rice and improve the effectiveness of breeding programs for scented hybrid rice, have been proposed (Sood and Siddiq 1978). A digenic segregation ratio of 9 nonaroma:7 aroma was obtained by Tripathi and Rao (1979) and Hsieh and Wang (1988). The segregation ratios of nonaromatic to aromatic plants in two F<sub>2</sub> populations from crosses between aromatic and nonaromatic and between nonaromatic and aromatic were both 3:1. This indicates the inheritance of a single recessive gene with regard to aroma but that, in one F<sub>2</sub> population, from the cross nonaromatic/aromatic, the ratio was 9:7, indicating that two complementary recessive genes

control aroma in aromatic rice (Dong et al 2001).

We studied the inheritance of aroma in two-line rice hybrids during 2000-03 in experiments conducted at ACRI. The varieties involved in the crosses were aromatic short-duration rice varieties (Pusa Basmati 1, Basmati 370, and ADT41), short-duration nonaromatic rice varieties (ADT39 and AD98028), and a nonaromatic TGMS line (TS29). Aroma was assessed in the leaves of P<sub>1</sub>, P<sub>2</sub>, F<sub>1</sub>, F<sub>2</sub>, B<sub>1</sub>, and B<sub>2</sub> generations in each of the five crosses. Determination of the presence of aroma was made according to the method described by Sood and Siddiq (1978). At tillering stage, 2 g of green leaves were excised into fine pieces and kept in test tubes mixed with 10 mL of 1.7% KOH solution. The test tubes were covered immediately and kept under room temperature for about 10 min. Contents were smelled one by one, and the samples classified into aromatic and nonaromatic.

The number of plants with nonaroma and aroma in all gen-

erations in each of the five crosses, along with the chi-square values for the expected genetic ratios, is presented in the table. The parents TS29, ADT39, and AD98028 and their F<sub>1</sub>, F<sub>2</sub>, B<sub>1</sub>, and B<sub>2</sub> generations (TS29/ADT39 and TS29/AD98028) were nonaromatic. In ADT41, Pusa Basmati 1, and Basmati 370, all the plants tested were aromatic. The hybrids TS29/ADT41, TS29/Pusa Basmati 1, and TS29/Basmati 370 showed nonscentedness in the F<sub>1</sub> generation. The F<sub>2</sub> and B<sub>2</sub> generations segregated for nonscentedness and scentedness in the ratio of 3:1 and 1:1, respectively. The chi-square values for the fitness of these genetic ratios were nonsignificant. The B<sub>1</sub> generation of these three crosses did not segregate and all the plants showed nonscentedness.

The inheritance pattern for scentedness revealed that aroma was recessive to nonaroma owing to its absence in the F<sub>1</sub> generation in all crosses. The segregation pattern indicated that a single recessive allele influences aroma