

Inheritance of Aroma in Rice (*Oryza sativa* L.)

Tufail Akhtar¹, Chairerg Maneephong¹, Prapa Sripichitt¹, and Onanong Naivikul²

ABSTRACT

The inheritance of aroma in rice (*Oryza sativa* L.) was carried out in crosses among three aromatic varieties and three non-aromatic varieties. In crosses between aromatic and non-aromatic rice, all of the F_1 plants were non-aromatic indicating that the gene controlling aroma in the parents was recessive. The segregating ratio of non-aromatic to aromatic plants was 3:1 in F_2 plants confirming the monogenic inheritance of aroma.

Key words : rice, aroma, inheritance

INTRODUCTION

Aroma is an important characteristic of high quality rice. In most countries aromatic rice command higher price on the domestic market, as for the international markets Basmati and Jasmine rice control the premium price. Aroma in cooked rice adds market value to the product.

Very few improved aromatic varieties have been developed and farmers continue to grow traditional aromatic rice to meet the demand. The higher price of these varieties command compensation for their low productivity. Therefore, rice researchers lay great emphasis on the development of high yielding varieties with quality grain and aroma.

From the past investigations, aroma in rice is known to be genetically controlled and its genetic behavior is summarized as follows: Sood and Siddiq (1978), Berner and Hoff (1986) and Ali *et al.* (1994) reported that aroma was monogenic recessive to

non-aromatic. Kadam and Patankar (1938) found that aroma was monogenic dominant. Tsuzuki and Shimokawa (1989) reported that F_2 segregation ratio of 3 aromatic : 13 non-aromatic indicating a single recessive aroma gene interacting with an inhibitor gene. A digenic segregation of 9 non-aromatic : 7 aromatic (Tripathi and Rao, 1979), 15 : 1 (Dhulappanavar and Mensinkai; 1969 Geetha 1994) and tri-genic ratio of 37 non-aromatic : 27 aromatic (Nagaraju *et al.*, 1975; Reddy and Sathyana Raynaiah, 1980) were also reported. Moreover, Dhulappanavar (1976) showed that four complementary genes were responsible for aroma while Richharia *et al.* (1965) revealed that aroma is a polygenic character.

The review of literature indicates that the information on the nature of inheritance of aroma is still controversial. This might result from the different methods used for evaluation of aroma and the difference in the aromatic varieties used.

The objective of the present study was to

¹ Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand.

² Department of Food Science and Technology, Faculty of Agro-Industry, Kasetsart University, Bangkok 10900, Thailand.

understand the nature of inheritance of aroma that may be useful in breeding and development of aromatic rice varieties.

MATERIALS AND METHODS

This study was conducted from June 1994 to January 1995 at the Department of Agronomy, Kasetsart University. The rice varieties used were KDM 105, Basmati 370, IR 841, IR 42, RD 23 and CT 9155. The KDM 105, a popular aromatic Thai rice variety was used as a common parent in crossing with the others. Basmati 370 and IR 841 were aromatic while IR 42, RD 23 and CT 9155 were non-aromatic. These studies were made on five crosses viz KDM 105 × Basmati 370, KDM 105 × IR 841, KDM 105 × IR 42, KDM 105 × RD 23 and KDM 105 × CT 9155.

The parents and F_1 plants were grown in pots (single hill/pot) until reaching maturity. F_2 seeds were harvested from the F_1 plants and the dormancy was broken by treating them at 50°C for

five days in an incubator. About 100 F_2 seeds of each cross combination were grown in a glasshouse in the aluminium boxes. After 50 days of seeding, determination for the presence or absence of aroma was made according to the method described by Sood and Siddiq (1978). Two grams of green leaves were taken from individual plants, cut into small pieces and kept in the test tubes. About 10 ml of 1.7 % potassium hydroxide (KOH) solution was added to each test tube. The test tubes were covered immediately after the addition of alkali and left under room temperature for about 10 minutes. The test tubes were then opened one by one and the content in each was immediately evaluated by smelling. The samples were classified into two categories in the presence or absence of aroma.

RESULTS AND DISCUSSION

In three crosses of KDM 105 × IR 42, KDM 105 × CT 9155 and KDM 105 × RD 23, the parent KDM 105 was aromatic while IR 42,

Table 1 Number of plants expressing aromatic and non-aromatic grain type according to KOH test.

Entry	No. of plants tested	No. of plants	
		Aromatic	Non-aromatic
Parents			
KDM 105	25	25	0
Basmati 370	25	25	0
IR 841	25	25	0
IR 42	25	0	25
RD 23	25	0	25
CT 9155	25	0	25
F_1			
KDM 105 × Basmati 370	10	10	0
KDM 105 × IR 841	10	10	0
KDM 105 × IR 42	10	0	10
KDM 105 × RD 23	10	0	10
KDM 105 × CT 9155	10	0	10

Table 2 Phenotypic segregation of F₂ plants for aroma in different rice crosses and their respective chi-square values against 3 : 1 expected ratio .

Crosses	No. of plants		No. of plants				Chi-square	P value		
	tested	Observed	Non-aromatic		Aromatic					
			Expected	Observed	Expected	Observed				
KDML 105 × IR 42	102	81	76.5	21	25.5	1.058	.25-.50			
KDML 105 × CT 9155	114	88	85.5	26	28.5	0.292	.50-.75			
KDML 105 × RD 23	96	73	72	23	24	0.0555	.50-.75			
KDML 105 × IR 841	100	-	-	100	-	-	-			
KDML 105 × Basmati 370	100	-	-	100	-	-	-			

CT 9155 and RD 23 were non-aromatic. The F₁ plants from these crosses were found to be non-aromatic while the two aromatic × aromatic crosses, KDML 105 × IR 841 and KDML 105 × Basmati 370, all F₁ hybrids were found to be aromatic (Table 1).

The data obtained on the presence or absence of aroma of F₂ plants in each of the crosses are presented in Table 2. In the cross of KDML 105 × IR 42, 81 from the total of 102 F₂ plants were found to be non-aromatic while 21 were aromatic. In the cross of KDML 105 × CT 9155, 88 from the 114 F₂ plants were found to be non-aromatic while 26 were aromatic. Similarly, in the cross of KDML 105 × RD 23, 73 from the among 96 F₂ plants were found to be non-aromatic while 23 were aromatic.

In the crosses between aromatic and non-aromatic all F₁ hybrids were non-aromatic showing that aroma was a recessive character. The F₂ population segregated into the ratio of 3 non-aromatic : 1 aromatic offspring indicating a monogenic Mendelian ratio. The Chi-square value was between 0.055 and 1.058 and P values were between 0.25 and 0.75 fitting a monogenic Mendelian ratio at a very high level.

In the two aromatic × aromatic crosses of KDML 105 × IR 841 and KDML 105 × Basmati 370,

the F₁ hybrids were aromatic. There was no segregation for aroma in the F₂ population showing that aroma genes from both parents were allelic.

The results obtained showed that the aroma was controlled by a nuclear recessive gene which agreed with those reported by Sood and Siddiq (1978), Berner and Hoff (1986) and Ali *et al.* (1994).

LITERATURE CITED

Ali, S.S., S.J.H. Jafri, M.G. Khan, and M.A. Butt. 1994. Inheritance studies for aroma in two aromatic varieties of Pakistan. IRRN 18 : 2.

Berner, D.K. and B.J. Hoff. 1986. Inheritance of scent in American long grain rice. Crop Sci. 26 : 876-878.

Dhulappanavar, C.V. and S.W. Mensinkai. 1969. Inheritance of scent in rice. Karnataka Univ. J. 14 : 125-129.

Dhulappanavar, C.V. 1976. Inheritance of scent in rice. Euphytica 25 : 659-662.

Greetha, S. 1994. Inheritance of aroma in two rice crosses. IRRN 19 : 2.

Kadam, B.S. and V.K. Patankar. 1938. Inheritance of aroma in rice. Chron. Bot. 6 : 496-497.

Nagaraju, M.D., D. Choudhary, and M.J.B.K. Rao. 1975. A simple technique to identify scent in

rice and inheritance pattern of scent. *Curr. Sci.* 44 : 599.

Reddy, R.P. and K. Sathyanarayanaiah. 1980. Inheritance of aroma in rice. *Indian J. Genet. Plant Breed.* 40 : 327-329.

Richharia, R.H., B. Misro, and V.A. Kulkarni. 1965. Studies on the world genetic stock of rice. Distribution of scented rice. *Oryza* 2:57-59.

Sood, B.C. and E.A. Siddiq. 1978. A rapid technique for scent determination in rice. *Indian J. Genet. Plant Breed.* 38 : 268-271.

Tripathi, R.S. and M.J.B.K. Rao. 1978. Inheritance and linkage relationship of scent in rice. *Euphytica* 28 : 319-323.

Tsuzuki, E. and E. Shimokawa. 1989. Inheritance of aroma in rice. *Euphytica* 46 : 157-159.