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Inheritance of aroma in aromatic rice (*Oryzasativa*L.)genotypes

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ABSTRACT

The inheritance pattern of aroma in rice (OryzasativaL.) was carried out in thecrosses among three non-aromatic and two aromatic varieties. All the F_1 plants of thethree crosses were non-aromatic indicating that the gene controlling aroma in the parentswas recessive. The segregation ratio of non-aromatic to aromatic plants was 3:1 in F_2plants confirming the monogenic inheritance of aroma.

Keywords: rice, aroma, inheritance

INTRODUCTION

India produces some of the best quality rice in the world. Though a high-volumecommodity, a class of aromatic, superfine premium rice has evolved its own marketniches, making rice trade a commercial success internationally. A class of premium ricewith specific grain characteristics, traditionally grown on either side of the Indus River, ispopularly known as the basmati rice and these varieties are also known as “Queen offragrance”. The superiority of basmati cultivars over other premium rice varieties is itssuperfine grains which have a distinct aroma, excellent elongation ability and the soft,flaky texture of the cooked rice[1]. Besides the muchsought after basmati types which get high price in international markets, the country alsoabounds with hundreds of indigenous short grain aromatic cultivars and landraces grownin pockets of different states. Almost every state has its own collection of aromatic ricethat performs well in native areas[2]. These aromaticrice lines also possess exemplary quality traits like aroma, fluffiness and taste.Even though these aromatic rice varieties fetch higher price in the market, theyare susceptible to pest and diseases and are, generally low yielders. Therefore, ricebreeders lay great emphasis on the development of high yielding varieties with qualitygrain and aroma.

From many investigations in the past, aroma in rice is known to be geneticallycontrolled and its genetic behaviour is summarized as follows: Sood&Siddiq[3]reported, aroma is monogenic recessive to non-aromatic and Kadam&Patankar [4]reported it to be monogenic dominant. A digenic segregation of 9 non-aromas: 7 aromaTripathi&Rao, [5], 15: 1 (Geetha, [6]), 13: 3 (Tsuzuki and Shimakawa, [7])and trigenic ratio of 37 non-aroma: 27 aroma (Kadam and Patankar, [4] and Reddy andSathyanarayanaiah, [8]) are also reported. Moreover, Dhulappanavar [9] showedfour complementary genes indicating segregation ratio of 175 non-aroma: 81 aroma.Further, the recent inheritance studies on aroma indicated 3:1 (non-scented: scented)segregation ratio indicating monogenic, recessive gene control (Berner and Hoff, 1986;Vivekanandan and Giridharan, 1994; Lorieux*et al.*,1996)

There is no consensus as yet on the nature of inheritance in aromatic characters asdescribed above. The lack of agreement among many investigators appears to be relatedto the differences in the aromatic varieties used and also the difficulties of the methods onevaluating aroma. The objective of the present study was to understand the nature ofinheritance of aroma that may be useful in breeding and development of aromatic ricevarieties.

MATERIALS AND METHODS

The experimental material for the present investigation comprised of parents, F1and F2 populations of three crosses of rice (Table 1: see salient feature for parents). The rice varieties used were, IRRI 38, BI 33,Moro mutant, Jeerigesanna and Azuvena. The aromatic genotype, Jeerigesanna is anlocal, late maturing, aromatic, low yielding variety whereas, Azucena is an exotic,genotype from Philippines. The non-aromatic genotype, IRRI 38 is an exotic line while BI 33 isan advanced breeding line and Moro mutant is a natural mutant of Moroberekan cultivar.The parents and F1 plants were grown in summer, 2007 at University of Agricultural Sciences, Bangalore, Karnataka, India andthe F2 seeds were harvested, threshed and cleaned. About 300 F2 seeds of each crosscombination were grown in *Kharif*2007 under aerobic condition. After 60 days ofseeding, determination of presence or absence of aroma was made according to themethod described by Sood and Siddiq [3]. Two grams of green leaves were takenfrom 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 werecovered immediately after the addition of alkali and left under room temperature forabout ten minutes. The test tubes were opened one by one and the content in each wasimmediately evaluated b smelling. The samples were classified into two categories in thepresence or absence of aroma.

RESULTS AND DISCUSSION

In the three crosses of IRRI 38 x Jeerigesanna, BI 33 x Jeerigesanna andAzucena x Moro mutant, the parents Jeerigesanna and Azucena were aromatic while,IRRI 38, BI 33 and Moro mutant were non-aromatic. The F1 plants from these crosseswere non-aromatic (Table 1).

The data obtained on the presence and absence of aroma of the F2 plants in eachof the crosses is presented in Table 2. In the cross IRRI 38 x Jeerigesanna, 91 out of347 were aromatic and 256 were non-aromatic. 67 plants of 280 were aromatic in thecross BI 33 x Jeerigesanna while, 213 were non-aromatic. Similarly, 95 out of 378 wérearomatic and 283 were non-aromatic in the crossAzucena x Moro mutant.

Table 1. Salient features of the parents used for the development of F_2 populations

Accession	Pedigree	Plant height	Duration	Grain type	Yield (t ha^{-1})	Salient features
IRRI 38	Line from IRRI, Philippines	Semidwarf	Early	Medium, slender	3.5	Drought tolerant
Jeerigesanna	Local line	Tall	Late	Short, bold	2.5	Aromatic
BI 33	Budda X IR64	Semidwarf	Medium early	Long, slender	4.5	Drought tolerant
Azucena	Exotic line	Tall	Late	Medium, bold	3.2	Aromatic
Moro mutant	Mutant from Moroberikan	Semidwarf	Medium early	Medium, bold	4.2	Drought tolerant

Table 2.Number of plants expressing aromatic and nonaromatic grain type according to KOH test

Parents	No. of plants tested	No. of plants	
		aromatic plants	nonaromatic plants
IRRI 38	10	0	10
BI 33	10	0	10
Moro mutant	10	0	10
Jeerigesanna	10	10	0
Azucena	10	10	0
F_1 hybrids			
IRRI 38 X Jeerigesanna	10	0	10
BI 33 X Jeerigesanna	10	0	10
Azucena X Moro mutant	10	0	10

In all the aromatic x non-aromatic crosses, all F1 hybrids were non-aromaticindicating recessive nature of the character. The F2 population segregated into the ratio of3 non-aromatic: 1 aromatic offspring indicating a monoigenicMendelian ratio. Thecalculated chi-square values were not differing from the table values fitting a monogenicMendelian ratio at a very high level.The results showed that the aroma was controlled by a nuclear recessive genewhich agrred with those reported by Berner and Hoff [10]Vivekanandan andGiridharan [11] and Lorieux*et al.* [12].

Table 3.Inheritance pattern of aroma in all three F_2 populations of rice

Cross	No. of plants tested	No. of plants				Ratio	Chi-square	P value
		Non-aromatic plants		Aromatic plants				
		Observed	Expected	Observed	Expected			
IRRI 38 X Jeerigesanna	347	256	85.75	91	260.25	3:1	0.277	0.598
BI 33 X Jeerigesanna	280	213	70	67	210	3:1	0.171	0.678
Azucena X Moro mutant	378	283	94.50	95	283.50	3:1	0.003	0.952

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