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Genetic and biochemical basis of scent in rice (*Oryza sativa* L.)

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Summary. The inheritance and biochemical basis of scent in rice was studied in the F_2 population along with the F_1 and its two parents, scented and non-scented 'Pokura' rice strains. The F_1 plants were found to be non-scented while the F_2 plants seggregated into a 3:1 ratio (non-scented: scented). In scented F_2 seggregants and in the scented parental strain, a fast moving esterase isozyme, Rf 0.9, is missing whereas it is present in all non-scented F_2 seggregants, F_1s, and in the non-scented parent. This suggests that the absence of a specific esterase isozyme is associated with the scent character in rice.

Key words: Rice – Scent – Esterase – Isozymes

Introduction

Scented rices are preferred over non-scented rices due to their pleasant aroma and desirable elongation qualities upon cooking. Studies on the inheritance of rice scent are limited and there is conflicting data with regard to the genetics of this trait (Ramaiah 1937; Dhulappanavar 1976; Nagaraju et. al. 1975; Tripathi and Rao 1979). Shekar and Reddy (unpublished) observed that specific esterase isozymes were absent in scented germplasm of five-day-old seedlings as compared to non-scented varieties. The present study deals mainly with the inheritance of scent and attempts to establish the relationship, if any, between the esterase isozymes and scent in rice.

Materials and methods

'Pokura', a local rice cultivar having two types of strains, one with scented features and the second lacking them, both displaying the same genetic background, were used in the study. Crosses were made between scented and non-scented 'Pokura'. The F_1 seed was sown in the field to raise the F_1 population; F_2 seed collected on F_1 plants were used to raise the F_2 population. In the F_2 generation, a sixty-day-old population was separated into scented and non-scented groups following the method of Sood and Siddiq (1978). By the same method, F_1 plants were also scored for this trait. Boot leaf of single plants were used for the disc gel electrophoretic study of esterase isozymes. Extraction and staining procedures were those of Payne and Koszykowsia (1978). The gels were scanned for enzyme activity at 400 nm in a spectrophotometer.

Results and discussion

All F_1 plants were found to be non-scented. The F_2 population seggregated into 320 non-scented to 96 scented. The seggregation ratio fitted into 3:1 (non-scented: scented) as evidenced by the χ^2 value of 0.89. The above results suggest that the scent trait is controlled by a single monogenic recessive gene. All the F_1s and non-scented F_2 plants had an esterase isozyme at Rf 0.9 which was specific to the non-scented strain (Fig. 1).

Table 1. Esterase isozyme activity, units/mg protein of 'Pokura' rice

Bond no.	Rf	Non-scented 'Pokura'	F_1	Scented 'Pokura'
1	0.2	0.32	0.32	0.32
2	0.27	0.46	0.46	0.46
3	0.36	0.43	0.43	0.43
4	0.39	0.29	0.29	0.29
5	0.45	0.59	0.59	0.59
6	0.76	0.69	0.69	0.69
7	0.8	0.55	0.55	0.55
8	0.9	0.50	0.30	0.00

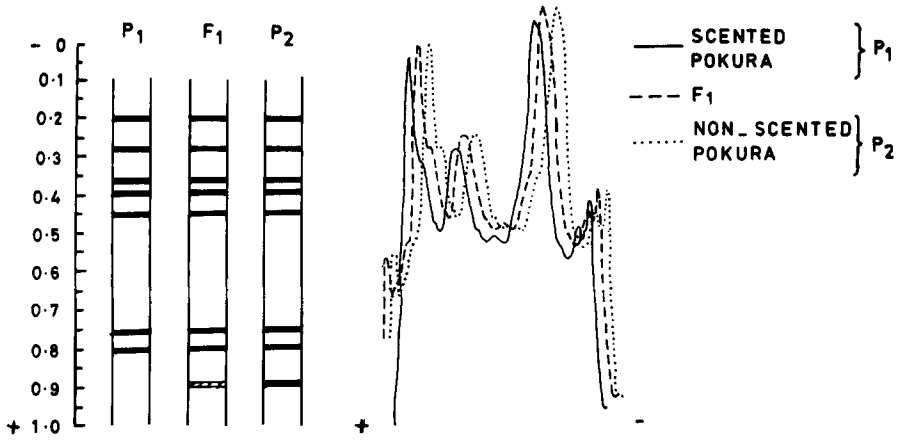

Fig. 1. Zymograms and gel scans of esterase isozymes of parents and F_1 of the cross scented 'Pokura' (P_1) × non-scented 'Pokura' (P_2)

The specific activity of the esterase isozyme at Rf 0.9 was higher in the non-scented parent than in the hybrid (Table 1) whereas in the scented strain, the activity of this isozyme was nil, suggesting the presence of a null allele in the scented strain.

Based on these enzyme studies, it can be assummed that, due to the absence of a specific isozyme at Rf 0.9 in scented F_2 seggregants and the scented parent, some of the esters might be accumulated and these may be responsible for the production of certain volatile flavor components, possibly acting as precursors. On the contrary, in the non-scented strain, the presence of this specific isozyme may result in the degredation of the specific esters which probably are not available for the synthesis of flavor compounds.

In conclusion, the scent trait in rice is controlled by a monogenic recessive gene and is associated with the null allele of a fast moving esterase isozyme.

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