Pakistan J. Sci. Ind. Res., Vol. 29, No. 1, February 1986

EVALUATION OF EARLY FLOWERING MUTANTS OF BASMATI VARIETIES FOR GRAIN QUALITY CHARACTERISTICS

Maqbool Ahmad*

Nuclear Institute for Agriculture and Biology, Faisalabad

(Received May 23, 1985; revised September 12, 1985)

Physical (size, shape, quality index), chemical (amylose content) and cooking (water absorption, volume expansion and elongation ratios) characteristics of early flowering mutants of rice are reported. Early flowering mutants of Basmati 370 (EF-27-73-1 and EF-27-73-2) were comparable with their parent except that they elongated less during cooking. The amylose contents of raw kernels and elongation ratio of cooked rice of EF-1 and EF-II were lesser than in the parent Basmati-Pak. EF-76-1, an early flowering mutant of Basmati-198, did not differ signficantly with its parent in these features.

INTRODUCTION

The demand for Pakistani rice in foreign markets is mainly due to the superior quality Basmati rice produced in the rice tract of the Punjab. The use of induced mutations has played an important role in plant breeding for the improvement of plant stature, yield and quality; and induction of earliness and resistance to insect pest and diseases [1-5]. Short stature [6], early flowering [7] and fine grain [8] mutants of rice have been successfully evolved by the use of induced mutation in the country. In view of the importance of the quality of Basmati rice, the present investigation was undertaken to evaluate the early flowering mutants of Basmati background for physicochemical and cooking characteristics.

MATERIALS AND METHODS

Milled rice kernels of the early flowering mutants of Basmati-370 (EF-27-73-1 and EF-27-73-2), Basmati-Pak (EF-1 and EF-II) and Basmati-198 (EF-76-1) along with their parents were procured from the Mutation Breeding Division of the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, where they were produced under standard cultural practices. Length, width and thickness were determined as average of 10 uniformally milled rice kernels. Size and shape classification of milled rice kernels was carried out according to the standards based on the list published by the consultative sub-committee of the FAO and reported by Grist [9]. The quality index of raw rice kernel was calculated according to the formula of Aziz [10]. Rice kernels were ground in a Retsch mill equipped with a 60-mesh screen and the amylose contents were determined according to the method of Juliano [11]. The intensity of blue colour was read in a Spectronic-21 (Baush and Lomb) at 620 nm. The volume expansion ratio was calculated as the volume of cooked rice to that of raw rice, and water-absorption ratio was determined from the weight of cooked rice per weight of raw rice [12]. Elongation-ratio was determined by the formula used by Aziz and Shafi [13].

RESULTS AND DISCUSSION

The market value of rice is largely dependant on the physical appearance of rice grain with reference to its size, shape and fineness. Basmati-370 and Basmati-198, and their early flowering mutants (EF-27-73-1, EF-27-73-2 and EF-76-1) were classified as long, slender and fine as the grain length was between 6 and 7 mm, length/width ratio was over 3 and quality index was above2 in all the cases (Table 1). The shape and quality index of Basmati-Pak and its mutants EF-1 and EF-II were slender and fine but they were extra long as far as their size was concerned. Results indicate that all mutants were comparable with their parent Basmati varieties as far as size, shape and fineness were concerned.

Rice quality is related mainly to starch fraction, which makes upto 90% of the dry matter of the kernel. Amylose content or more correctly the ratio of amylose (linear) fraction to the amylopectin (branched) fraction of starch has major influence on the taste panel scores for cohesiveness, tenderness and gloss of cooked rice [12]. It also directly

*Present Address: Nuclear Institute for Food and Agriculture, Peshawar.

Table 1. Grain quality characteristics of some standard varieities and early flowering mutants.

Varieties/ Features Mutants	Physical			Cooking			Biochemical
	Size (length (mm)	Shape (length/ width) (ratio)	Quality index length/width thickness (ratio)	Water absorption (ratio	Volume expansion (ratio)	Elongation (ratio)	Amylose (%)
Basmati-370	6.53	3.86	2.66	4.18	5.89	1.71	20.67
EF-27-73-1	6.91	4.06	2.71	3.84	4.96	1.58	20.17
EF-27-73-2	7.02	4.17	2.78	4.25	5.52	1.50	20.26
L.S.D.							
5%	–	–	–	N.S	N.S	0.107	N.S
1%	–	–	–	N.S.	N.S	N.S	N.S
Basmati-Pak	7.20	4.26	2.79	3.91	5.40	1.77	22.44
EF-I	7.03	3.78	2.54	4.12	5.47	1.60	17.53
EF-II	7.37	4.44	3.04	3.85	5.03	1.50	19.47
L.S.D.							
5%	–	–	–	N.S	N.S	0.139	0.527
1%	–	–	–	N.S	N.S	N.S	1.216
Basmati-198	6.44	3.66	2.44	4.33	5.69	1.69	20.93
EF-76-1	6.61	3.76	2.49	4.27	5.67	1.74	20.37
L.S.D.							
5%	–	–	–	N.S	N.S	N.S	N.S
1%	–	–	–	N.S	N.S	N.S	N.S

N.S. = Nonsignificant.

affects water absorption and the volume expansion of rice during cooking [15]. As regards the amylose content, EF-27-73-1, EF-27-73-2 and EF-76-1 did not differ significantly with their respective parent (Table 1). However, a significant ($P < 0.01$) decrease in amylose content was observed in EF-1 and EF-II as compared to their parent Basmati-Pak.

Indices of volume expansion and water absorption are considered to be comparable in importance to the physico-chemical properties of starch in deciding the cooking quality and consumer acceptance of rice [16, 17]. In the Indo-Pak subcontinent varieities having relatively high water absorption, volume expansion and elongation ratios are considered superior [18, 19, 20]. There was no significant difference in the water absorption and volume expansion ratios of Basmati varieities and their mutants (Table 1). Basmati-370 and Basmati-Pak elongated more ($P < 0.05$) during cooking as compared to their mutants studied. However, there was no significant difference in the proportionate increase in length during the cooking of the kernels of Basmati-198 and its mutant EF-76-1.

REFERENCES

1. T.P. Reddy, A. Padma, and G.M. Reddy, Indian J. Genet. Plant Breed., **35**, 31 (1975).
2. M.A. Awan, and A.A. Cheema, Mutation Breed. Newslett. 7, 4 (1976).
3. S.S. Saini, M.R. Gagneja and G.S. Brar, Sci. Cult., **43**, 259 (1977).
4. A.K. Ghosh and P.K. Battacharya, Curr. Sci., **47**, 164 (1978).
5. A. Micke, Gamma Field Symp., **18**, 1 (1979).
6. M.A. Awan, M. Ahmad, and A.A. Cheema, Pakistan J. Sci. Ind. Res., **25**, 67 (1982).
7. M.A. Awan, G. Bari, A.A. Cheema, and M. Akbar, Mutation Breed. Newslett., **10**, 5 (1977).
8. A.A. Cheema, A. Awan, and M. Ahmad, Pakistan J. Sci. Ind. Res., **25**, 80 (1982).
9. D.H. Grist, *Varieties and their Classification in "Rice"* (Longmans, Green and Co. Ltd., London 1965) pp. 81.
10. M.A. Aziz, Cereals and Pulses in "Fifty years of Agricultural Education and Research at Punjab Agriculture College and Research Institute" (Lyallpur, West Pakistan, Dep. Agr., p. 62 1960).

11. B.O. Juliano, Cereal Sci. Today, **16**, 334 (1971).
12. B.O. Juliano, L.U. Onate, and A.M. Del Mundo, Fd. Technol., **19**, 1006 (1965).
13. M.A. Aziz, and M. Shafi, Dep. Agr. Tech. Bull., West Pakistan, 1? (1966).
14. W.G. Cochran, and G.M. Cox, *Experimental Designs* (J. Wiley, New York, 2nd ed., p. 95, 1965).
15. B.O. Juliano, Physicochemical properties of starch and protein and their relation to grain quality and nutritional value, in "Rice Breeding" (International Rice Research Institute, Los Banos, Philippines 1972) pp. 309-405.
16. B. Sanjiva Rao, A.R. Vasudeva Murthy and R.S. Subrahmanya, Proc. Indian Acad. Sci., **36B**, 70 (1952).
17. B.O. Juliano, M.B. Nazareno and N.B. Ramos, J. Agr. Fd. Chem., **17**, 1364 (1969).
18. A.K. Kaul, Indian J. Genet. Plant Breed., **30**, 237 (1970).
19. B.C. Sood and E.A. Siddiq, Z. Pflanzenzuchtg, **84**, 294 (1980).
20. K.R. Bhattacharya, C.M. Sowbhagya and Y.M.I. Swamy, J. food. Sci., **47**, 564 (1982).