

Quality characterization of advanced generation induced mutant lines in Basmati rice

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ABSTRACT

Twenty seven mutant lines obtained as advanced generation through selection following physical and chemical mutagenesis of Basmati lines viz., Basmati 370, Saanwal Basmati and Ranbir Basmati were characterized for quality traits. Results revealed that mean values for all quantitative and quality traits deviated more towards positive than towards negative direction. Selections on the basis of mean performance in M_3 and M_4 generation led to the isolation of six mutant lines. Two of the mutants were from Basmati 370 and four were Saanwal Basmati derivatives. None of the Ranbir Basmati derivative out performed its control parent.

Key words: Basmati rice, mutant, quality characterization

Basmati rice fetches a premium price in the export as well as domestic market owing to its excellent quality. The bottleneck in the cultivation of traditional basmati rice is its low yield coupled with tall plant height which renders it susceptible to lodging. Most of the Basmati rice breeding programme is directed towards overcoming these problems. Rice being a strictly self pollinated crop is traditionally being used in mutation breeding programs. The prime strategy of mutation based plant breeding is to upgrade well adapted varieties by altering one/two major traits.

Jammu region and the adjoining foothills of Himalayas is believed to be the primary centre of origin/hotspot for the premium quality Basmati rices. Basmati 370 is the conventionally grown landrace in the region, whereas Saanwal Basmati and Ranbir basmati are the improved selections. These need improvement for one or the other trait. Thus, the present study was aimed at advancing the mutagen treated basmati lines originating from Basmati 370, Saanwal Basmati and Ranbir Basmati for the isolation of desirable mutants with quality traits in the M_4 generation of the mutagen treated basmati lines.

MATERIALS AND METHODS

The experimental material comprised of 27 lines in M_4 generation of the mutagen treated Basmati 370, Saanwal Basmati and Ranbir Basmati. The M_4 lines were

obtained by advancing the mutagen treated material of the three Basmati varieties over generations, following selection for desirable traits. The material was generated by treatment of the three Basmati varieties with physical and chemical mutagens. The chemical mutagens used were in three doses each of gamma ray (20, 30 and 40 KR ray) ethyl methane sulphonate (0.5, 1.0 and 1.5 per cent EMS) and sodium azide (0.5, 1.0 and 1.5 per cent SA). The experiment was conducted in the Research Farm of the Division of Plant Breeding and Genetics, SKUAST –J, Chatha during wet season 2005. Data pertaining to the different quality traits viz., Kernel length, Kernel Breadth, L:B ratio, kernel length after cooking (KLAC), amylose content and aroma were recorded in each generation. The lines were advanced particularly on the basis of aroma, keeping the other traits improved or at par.

RESULTS AND DISCUSSION

Data pertaining to the mean performance of the quality traits in M_4 generation have been presented in (Table 1). The results indicated that all Basmati 370 derived lines showed increased kernel length except with 1.5 percent EMS treated line. The maximum increase was obtained in 30 KR ray tillering mutant (7.66) followed by EMS 1.0% tillering mutant (7.54), as compared to control Basmati 370 (7.10). In Saanwal Basmati, the kernel length increased significantly in three derived lines, i.e.,

Table 1. Mean performance of various quality traits in advanced generation (M4) of mutagen treated basmati lines

Genotype/ Derived line	Treatment	Quality traits					
		Kernel length (mm)	Kernel Breadth (mm)	L:B	KLAC (mm)	Amylose content (%)	Aroma
Basmati 370(Dwarf)	40KR » ray	7.2	1.64	4.39	13.36	24.01	SS
Basmati 370(Dwarf)	30KR » ray	7.42	1.6	4.66	13.44	25.3	MS
Basmati 370(Tillering)	30KR » ray	7.66	1.78	4.5	13.7	25.25	SS
Basmati 370(Tillering)	20KR » ray	7.16	1.68	4.44	13.7	25.27	SS
Basmati 370(Tillering)	EMS 0.5%	7.44	1.6	4.66	13.42	25.8	MS
Basmati 370(Tilleringf)	EMS 1.0%	7.54	1.72	4.39	13.7	25.36	NS
Basmati 370(Tillering)	EMS 1.5%	6.94	1.8	4.2	13.04	25.96	MS
Basmati 370(Dwarf)	EMS 1.0%	7.6	1.46	4.28	13.62	25.12	MS
Basmati 370(Dwarf)	Sodium azide 1.5mM	7.5	1.5	4.62	13.52	25.4	SS
Basmati 370(Control)		7.1	1.94	3.66	13.52	25.33	SS
Saanwal Basmati(Dwarf)	40KR » ray	7.62	1.78	4.29	13.78	23.3	MS
Saanwal Basmati(Dwarf)	30KR » ray	7.56	1.6	4.51	13.66	23.4	MS
Saanwal Basmati(Semi dwarf)	20KR » ray	7.2	1.78	4.16	13.18	22.99	MS
Saanwal Basmati(Tillering)	30KR » ray	7.16	1.82	3.93	13.2	23.4	SS
Saanwal Basmati(Tillering)	EMS 0.5%	7.96	1.52	4.59	13	24.03	MS
Saanwal Basmati(Semi dwarf)	EMS 0.5%	7	1.66	4.22	13.38	24.4	MS
Saanwal Basmati(Tillering)	EMS 1.0%	7.24	1.6	4.52	13.24	22.25	SS
Saanwal Basmati(Tillering)	Sodium azide 0.5mM	7	1.58	4.51	13	23.36	SS
Saanwal Basmati(Tillering)	Sodium azide 1.5mM	6.98	1.56	4.49	13.33	22.83	SS
Saanwal Basmati(Control)		7.34	1.9	4.12	12.92	22.34	SS
Ranbir Basmati(Dwarf)	40KR » ray	7.22	1.58	4.58	13.4	24	SS
Ranbir Basmati(Early)	30KR » ray	7.37	1.74	4.24	13.42	23.15	MS
Ranbir Basmati(Dwarf)	30KR » ray	7.62	1.78	4.27	13.8	23.91	NS
Ranbir Basmati(Dwarf)	EMS 0.5%	7.76	1.52	5.15	13.74	25.07	SS
Ranbir Basmati(Dwarf)	EMS 1.0%	7.58	1.7	4.47	13.72	24.62	SS
Ranbir Basmati(Dwarf)	EMS 1.5%	7.62	1.76	4.33	13.7	24.49	MS
Ranbir Basmati(Dwarf)	Sodium azide 0.5mM	7.58	1.6	4.77	13.7	24.8	MS
Ranbir Basmati(Dwarf)	Sodium azide 1.0mM	7.3	1.62	4.12	13.47	25.06	SS
Ranbir Basmati(Dwarf)	Sodium azide 1.5mM	7.04	1.74	4.05	13.22	24.92	SS
Ranbir Basmati(Control)		7.31	1.84	4.46	13.38	24.03	SS

SS- Strong Scented

MS- Medium Scented

NS- Non Scented

30 and 40 KR ray Dwarf mutant and EMS 0.5% tillering mutant. In Ranbir Basmati derived lines, the kernel length increased non significantly except 40 KR ray and sodium azide 1.0 and 1.5 mM derived lines. The mean kernel breadth decreased significantly almost in all the mutagenic treatments, in all the three varieties, over their respective controls. The increase in kernel length along with a significant decrease in kernel

breadth would be a desirable feature towards the isolation of improved mutants. The mean values of (L:B) ratio increased in all mutagenic treatments of Basmati 370 and Saanwal Basmati, whereas it decreased for most of the Ranbir Basmati mutants. This is in agreement with the findings of Bordoloi and Talukdar (1999).

KLAC is one of the most important objectives

of Basmati rice breeding, and is the parameter that apparently decides consumer preference. The mutant selections have been made such that KLAC is increased or at par with control. Since Basmati 370 is till date considered to be one of the finest aromatic rice varieties, the mutant lines which have significant / non significant increase, or at par performance have been selected for the trait KLAC.

The amylose content which determines flakiness/stickiness of cooked rice, increased non significantly in all treatments except three lines which have not been selected further. The amylose content of the selected mutants ranged from 22-25 per cent. The low amylose content results are in conformity with the results of Hissaway and Khush (1994).

Aroma is the most important trait concerning Basmati rice improvement. Any improvement programme directed towards enhanced aroma with improved/at par quality trait performance would be desirable. Data pertaining to aroma of the selected lines reveal medium to strong aroma except for one line each of Basmati 370 and Ranbir Basmati derivatives.

The results of the present investigation reveal that selection were so directed that the quality traits shifted towards desirable positive or negative directions.

The shift in the means might have resulted from induced polygenic mutations with unequal effects (Bateman, 1959), whereas the unchanged means might be due to unmasking of mutated genes by their normal counterparts (Siddiqui, 1971).

The selection in M_4 generation led to the isolation of six mutant lines. Two of them were Basmati 370 derivatives and four Saanwal Basmati derived mutants performed better over generations and were isolated for further advancement.

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