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EXPLOITATION OF AROMATIC RICE GERMPLASM FOR YIELD AND QUALITY*

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One hundred and twenty genotypes of aromatic rice collected from diverse geographical sources were evaluated in replicated plots under transplanted conditions during *Kharif* 1990 for agronomic and quality traits. Most of the aromatic rices originating in the Indian sub-continent were good donors for quality components but poor agronomic types. On the other hand, collections from Philippines China, Indonesia and Thailand were good donors for agronomic traits. Few donors for biotic stresses were also identified. The promising donors are being exploited in basmati breeding programmes.

Key words : *Oryza* species, aromatic rice, germplasm, yield, quality

A large number of aromatic rice varieties are grown and consumed in many countries of south-east Asia. The cultivation of these varieties is limited to specific pockets depending upon the climatic conditions and requirements of the local consumers. Being agronomically poor and susceptible to various biotic stresses, these have remained unexploited in the breeding programmes. With increasing emphasis on quality improvement of high yielding rice varieties, the exploitation of this group of rices has become essential. The present study, therefore was undertaken to assess the variability present in some of the indigenous and exotic aromatic rice germplasm collections for possible utilization as donors.

MATERIALS AND METHODS

The experimental material comprising 120 genotypes of aromatic rice collected from diverse geographical sources (Bangladesh-2; China-5; India-33; Indonesia-4; Iran-2; IRRI-14; Myanmar-2; Nepal-1; Pakistan-46; Philippines-8; Thailand-1 and Vietnam-2) were grown in a randomized complete block design in two replications during *kharif* 1990 at the Crop Research Centre, G.B. Pant

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University of Agriculture & Technology, Pantnagar under irrigated conditions in two row plots of 3 m length. Row to row distance was kept at 25 cm, while plants in a row were spaced at 15 cm apart. One month old seedlings were transplanted in well puddled field @ one seedling per hill. The crop was grown under good management conditions and all the recommended package of practices for basmati group of varieties were followed. Data were recorded on five randomly selected plants in each replication to study days to 50 per cent flowering, plant height (cm), number of effective tillers per plant, panicle length (cm), number of grains per panicle, spikelet fertility (%), panicle exsertion (scored on 1-9 scale), 1000-grain weight (g) and grain yield per plant (g).

For the study of quality components, the grain samples were dried to a moisture level ranging between 12-14 per cent and observations were recorded on hulling recovery (%), milling recovery (%), kernel L/B ratio, chalkiness of endosperm (scored on 0-9 scale), amylose content (%), alkali digestion value (scored on 1-7 scale), water uptake number, volume expansion gel consistency and presence of aroma (scored on 0-3 scale) as per the Standard Evaluation System for Rice (IRRI, 1988). The standard statistical methods were used to estimate various parameters.

RESULTS AND DISCUSSION

The analysis of variance of means for different characters showed highly significant differences among genotypes. The range of treatment means presented in Table 1 alongwith the general mean for various agronomic traits gives an idea of the extent of variability present in the germplasm. A wide range of variability was observed for flowering duration. The germplasm included a mutant line of basmati 370 which flowered in 92 days and some photosensitive landraces which took as long as 157 days to flower. The plant height ranged from 74.4 cm to 176.0 cm and most of the lines were tall as evidenced by the general population mean of 132.7 cm. Dwarf and early cultures possessing basmati grain do not exist in the germplasm. Number of tillers per plant ranged from 3.2 to 17.5. However, majority of the cultures screened were low tillering type and very few could be exploited in breeding programmes aimed at increasing tiller number. The spikelet fertility ranged from 18.3 per cent to 97.0 per cent with a general mean of 81.0 per cent while the number of filled grains per panicle ranged from 20.0 to 165.0 with a general mean of 105.2. Delayed flowering exposed the crop to lower atmospheric temperatures and was mainly responsible for reduced fertility of the spikelets. Decrease in fertility percentage with increasing length of cooling treatment has been reported by Satake and Koike (1983). Panicle length in the germplasm ranged from 20.6 cm to 39.6 cm and there were many genotypes which possessed significantly longer panicles than Basmati 370 and T3 (Table 1). In general, short panicles

showed poor panicle exsertion. However, some genotypes like Basmati 136, Basmati 6113, Basmati 436 and Basmati 6129 showed poor exsertion inspite of long panicles. The magnitude

Table 1. Range, mean and promising cultures for agronomic traits

Character	Range	Mean	Promising cultures
Days to 50% flowering	92.0-157.5	114.9	Basmati 208, Basmati 334, Ayepyaung, Dwarf Basmati, Mussatrene
Plant height (cm)	74.4 - 176.1	132.7	Guinata, Kinandang Pula, Kalimunchh Mutant, Kunsan-Woo-Shah-Gon, Balugyun, Macunting, Dwarf Basmati
Number of tillers/plant	3.2- 17.5	8.3	Basmati 370, Sitasail, Basmati 208, Basmati 372, Basmati 376, Basmati, Surkh 81-15, Mikhudeb, Ayepyaung, Sipala, New Sabarmati, Kasturi, Dwarf Basmati
Panicle length (cm)	20.6 - 39.4	30.1	Basmati 122, Basmati 372, Basmati 410, Basmati 6113, Pageleoh, N-12, Type 3
Number of filled grains/ panicle	20.0 - 265.0	105.2	Kinandang Pula, Basmati 123, Basmati 376, Lakchhmivilas, Badshahbhog
Spikelet fertility (%)	18.3 - 97.0	81.0	Kinandang Pula, Dinorado, Palawan, Yi-Lu-Hsiang
Panicle exsertion score (1-9 scale)	1.0-8.0	3.7	Basmati 370, Type 3, Sitasail, Basmati 123, Basmati 138, Basmati 372, Basmati 376, Basmati 613
1000-grain weight (g)	8.3-31.6	19.8	Kinandang patong, Milfor 6-2, Tarome, Cembocelak, New Sabarmati, Palawan, Ku 76-1
Grain yield/plant (g)	2.7-59.9	16.8	Bindli, Sitasail, Basmati 123, Basmati 376, Yi-Lu-Hsiang, New Sabarmati

of variability was very high in case of grain yield per plant as indicated by the range (2.7- 59.9 g). The highest yielding genotype Basmati 376 produced as many as 17.5 productive tillers per plant and longer (35.6 cm) panicles. Its spikelet fertility (84.1%) was better than the spikelet fertility of Basmati 370 (73.5%), T3 (79.7%) and Pusa Basmati 1 (80.7%) and 1000 grain weight *at par* with Basmati 370. The main defect of this genotype was tallness which made it prone to lodging.

The range of treatment means and the promising cultures for different quality traits are given in Table 2. Perusal of this table shows that hulling

Table 2. Range, mean and promising cultures for quality traits

Character	Range	Mean	Promising cultures
Hulling recovery (%)	65.4-81.8	76.0	Yi-Lu-Hsiang, Kinandang Pula, Samudrawati, Bong Cay, Multani
Milling recovery (%)	63.3-78.9	72.5	Bong Cay, Samudrawati, Kala Joha, New Sabarmati
Kernel length/breadth ratio	2.02-4.6	3.5	Multani, Basmati 370, Karnal Local, Basmati 5854, Basmati 6131, Basmati 5888, Basmati Naham 381
Chalkiness of endosperm (score 0-9 scale)	0.00-9.0	3.5	Kasturi, Pusa Basmati 1
Amylose content (%)	6.8-35.9	22.1	Kasturi, T3, Basmati 370, Basmati 107, Basmati 113, Basmati 122, Basmati 375A, Basmati 405
Alkali digestion value (score : 1-7 scale)	1.1-6.0	3.6	Basmati 5853, Bong Cay, Balugyun, Sipala, Basmati 122, Basmati 6311, Basmati 136
Water uptake number	110.0-442.5	255.6	Azucena, Kinandang Pula, Basmati 6316, Kunsan-Woo-Shah-Gon, Basmati 5854, Basmati 375
Volume expansion	2.2-6.4	4.0	Kinandang Pula, Basmati 370, Kunsan-Woo-Shah-Gon, Azucena, N12, Dwarf basmati
Gel consistency	26.5-100.0	56.5	Azucena, Basmati 334, Basmati C 622, Basmati 5853, Basmati 6311, Kasturi, Basmati Naham 381
Aroma (score: 0-3 scale)	0.0-3.0	1.5	Milfor 6-2, Basmati 93A, Basmati 123, Basmati 5853, Basmati Surkh 81-15, Xiang-Geng-Dao

and milling recovery showed a wide range of variation in the germplasm evaluated. Though, these traits are highly influenced by the weather conditions during grain formation, moisture content at the time of hulling, the method of drying and miller used (Govindaswami and Ghosh, 1968), there were many genotypes in the germplasm which gave significantly higher milling out-turn than Basmati 370 and T3. Kernel length/breadth (L/B) ratio is one of the important parameters deciding shape of the kernel, but majority of the lines contained less than 20% opaque areas. A few genotypes also possessed clear

endosperm free from opaque areas and could be used as donors. Majority of the cultures had intermediate amylose a desirable trait for basmati rices. The gelatinization temperature, water uptake number and volume expansion are important parameters of rice cooking quality. All the three traits showed wide range of variation and promising donors are listed in Table 2. High natural variation for volume expansion has also been reported by Sood and Siddiq (1980). The variation for gel consistency was quite high and varieties with hard (< 40 mm), medium (41-61 mm) and soft (> 61 m) gel were observed. The characteristics of cooked rices are frequently assessed with the presence of aroma. With few exceptions, majority of the germplasm evaluated was armoatic.

The evaluation of the germplasm indicated presence of high natural variability for different agronomic traits and quality components and some of the identified donors are already being exploited in the basmati breeding programme at Pantnagar.

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