Genetic Variability for Yield Components in Aromatic and Quality Rice Germplasm

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India is a home for rich diversity of aromatic and other quality rice. Collection and characterization of this germplasm is not only important for utilizing the appropriate attribute based donors in breeding programmes but is also essential in the present era for protecting the unique rice, which are particularly endemic to our country, under the UN Convention on Biological Diversity (CBD). At the Directorate of Rice Research under the two ICAR network programmes on quality rice, a collection of long and short grain aromatic and other quality types were evaluated and characterized to identify donors for utilization and also get information on character associations which would contribute towards planning sound breeding methods. Earlier attempts to characterize the vast rice genetic resources both within the country (CRRI, 1971, DRR, 2000) and abroad (IRRI, 1970) were made but this is an effort devoted only to quality rice and its variability.

Four hundred and eighty one scented/quality germplasm accessions predominantly indigenous (366) with a few exotic (115) were grown in an augmented design (Federer, 1956) with 6 checks (Kasturi, Pusa Basmati 1, Basmati 370, Karnal Local, Jaya, IR 64). The plot size was 2.61 m^2 for each entry and standard management practices were followed. Eleven yield and yield components were recorded from 5 randomly selected plants from the middle row excluding border plants from each accession as per Standard Evaluation System for Rice, (INGER), IRRI (1996). Estimates of variability parameters (mean, minimum, maximum, range, standard deviation, skewness, kurtosis) and correlation analysis of the data for quantitative traits were done (Panse and Sukhatme 1989).

The germplasm accessions showed a wide range of variability for all the agronomic and yield components. The plant height ranged from 62 cm to 177 cm with maximum number (100 accessions) being tall (150 cm) (Table 1; Fig 1). The number of productive tillers $plant^{-1}$ ranged from 3 to 24 with 250 accessions possessing tillering capacity of 15 productive tillers/plant. Longest flowering duration recorded was 140 days (Khao Jao Hawn), while the shortest was 84 days (RR 501) with nearly 200 entries flowering in 110 days. Flowering duration was the least variable character (cv: 29%) while the sterile grains/panicle and sterility percentage were the most variable characters (cv: 96% and 92%) The panicle length varied from 5 cm to 35 cm with a good number of cultivars (250) recording 30 cm panicle length. 150 entries showed a maximum of 150 total spikelets/ panicle, while maximum number of entries as high as 400 showed at least 50 sterile spikelets/panicle indicating that sterility could be one of the major limiting factors for yield in this group of rice. Chauhan and Tandon (1984) in hill rice; Mani *et al.* (1977) in aromatic genotypes also reported wide range of variability for yield components. Some of the promising entries for yield components include: Maniki Madhuri was tallest (177 cm); Badshabhog (23) followed by HBC 85 (22)

Table 1. Variability parameters in aromatic and quality rice germplasm with respect to agronomic and yield components

	PHT	TNO	FD	MAT	PL	TSNO	FSNO	SSNO	STP	GY	TW
MEAN	130.3	12.1	105.2	135.1	26.2	145.1	121.6	23.6	17.2	3.3	19.8
MIN	62.0	3.0	84.0	114.0	5.0	28.0	4.0	0.0	0.0	0.5	7.4
MAX	177.0	24.0	140.0	167.0	35.0	405.0	321.0	200.0	94.6	10.0	34.7
SD	24.4	3.6	8.8	8.6	4.1	59.0	53.1	21.6	14.7	1.5	4.2
CV%	43.30	54.60	28.93	25.22	39.66	63.74	66.12	95.74	92.30	68.30	46.16
Skewness	-0.42	0.36	0.75	0.66	-1.02	0.96	0.60	2.57	2.10	1.25	0.02
Kurtosis	-0.77	0.26	0.77	0.48	2.35	2.08	0.74	11.67	5.73	2.23	0.67

Please see abbreviations of column heads below Table 2

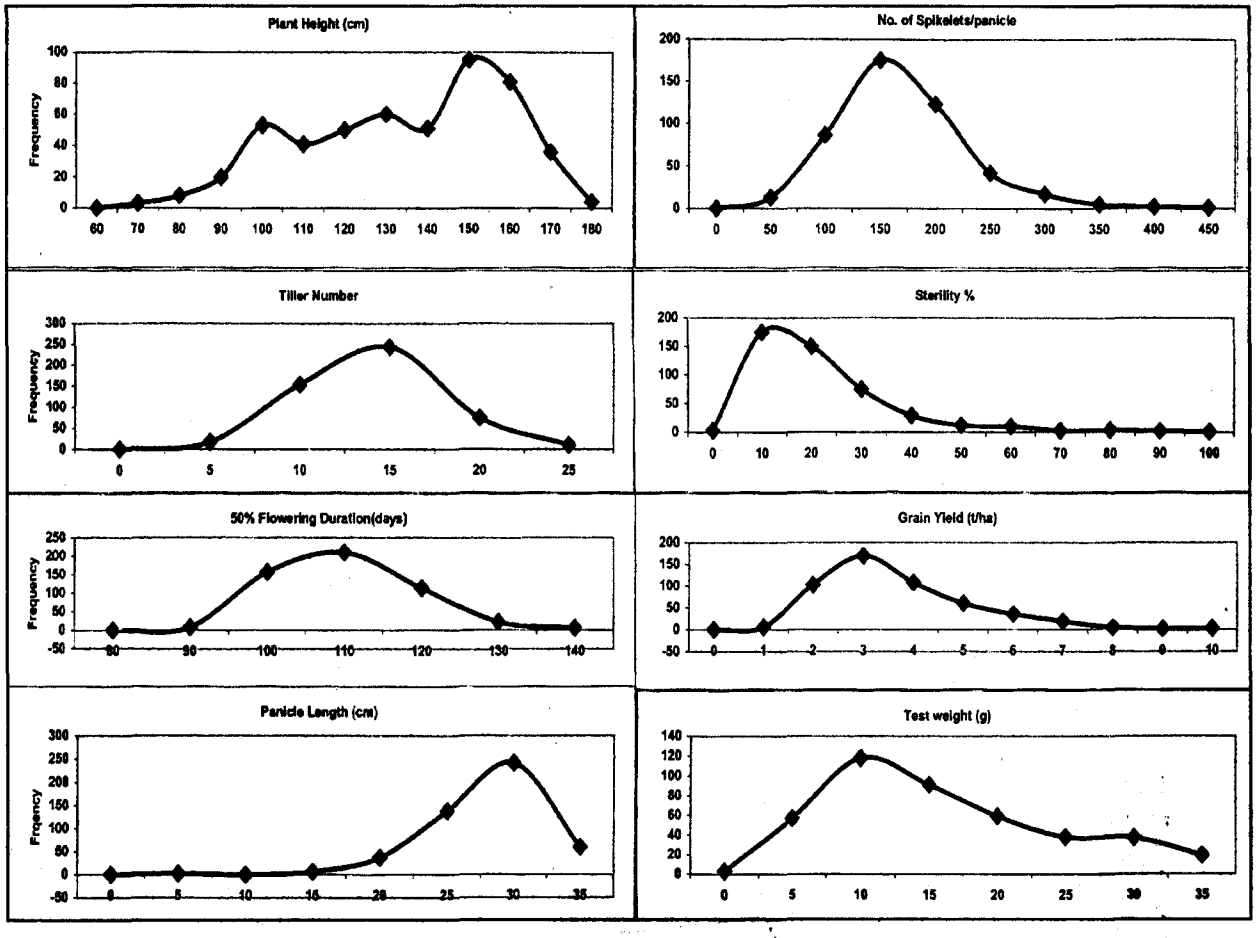

Fig. 1. Frequency distribution of aromatic and quality rice germplasm accessions with respect to agronomic and yield components

for highest productive tiller/plant; Basmati 1 and Badshahbhog for maximum panicle length of 34 cm. Bongcay exhibited no sterility while among the basmati types, Basmati 370B recorded least sterility (1.8%). MTU 22 recorded highest total spikelets/panicle (405) while maximum test weight was recorded in Naipon No. 1 (34.7 g) followed by RP 3120-15 (31.7 g) and highest yield in ARC 7229 and C-4-63-G (9.99t/ha) (Table 2).

Highly significant correlations among some of the important agronomic and yield components were observed (Table 3) especially in case of plant height and flowering duration which have influence on grain yield and its components. Plant height had high significant correlation with panicle length (0.496**) followed by total grains/ panicle with grain yield (0.391**). While increase in flowering duration entailed in increase of total spikelet number/panicle, followed by fertile spikelets/panicle and grain yield; increase in total spikelets/panicle was positively associated with fertile spikelets/panicle which had an impact in enhancing the grain yield. Studying varietal variation and association among panicle traits in rice Sharma and Dubey (1997) also found that grain yield/ panicle had significant positive association with total spikelets/panicle. Similar correlations were also reported by Talukdar and Talukdar (1997), Prasad *et al.* (1988) and Gupta *et al.* (1999). Highly significant correlations were also obtained between panicle length and flowering duration and height of the tiller by earlier workers (Palaniswamy and Kumaran 1990; Raja Gopalan 1967; Richharia *et al.* 1963). The investigation has thus identified many useful donors for yield contributing traits in both dwarf and tall plant stature and the character association established would help in planning effective breeding methods.

Table 2. Top aromatic and quality rice germplasm accessions based on agronomic and yield components

PHT				TNO		FD	
Short		Tall				Early	
BPT 5204	65	Randhuni pagal	170	RP 3238-33	21	RR 501	84
TD 52	65	Basmati Mehtrah	173	Gopal Bhog	21	UPR 1071-21	85
Calrose 76	72	Basmati Bahar	174	ARC 14760	21	Hinohikari	87
Koshihikari	76	BR-9	174	Du thom thai binh hai phong	22	BK 865-1	87
IR 841-85-1-1-2	78	Maniki Madhuri	177	IR 62873-417-4-3	22	Hassany	87
				HBC 85	22		
				Badshahbhog	23		
FD		PL		TSNO		STP	
Long							
Pusa Basmati 1	131	Hansraj	34	Katarni	344	Bong Cay	0.0
Basmati 5875	131	Basmati 43 A	34	Kon Joha 2	347	HKR 120	1.2
Bong Cay	137	ARC 14372	34	MTU 4407 (Vijaya Mahsuri)	383	Hung-mi-hsiang-ma-tsan	1.4
Bong Cay	137	Basmati 1	35	IR 62873-405-1-1	391	Ayepyaung	1.8
Bong Cay	137	Badshahbhog	35	MTU-22 (Kusuma)	405	Basmati 370 B	1.8
Khao Jao Hawm	140						
GY		TW		TW			
		Low		High			
AKP 1	7.99	Badshahbhog	7.4	SPRLR 841-84-9-5-2-1-3	30.8		
MTU-23 (Akkullu)	8.33	Kon Joha 2	9.1	Basmati T 370	31.2		
Basmati 376	9.99	Randhuni pagal	9.1	RP 3120-15	31.7		
ARC 7229	9.99	Jeraga Samba	9.9	Pusa 743	31.7		
C-463-G	9.99	Govind Bhog	10.1	Naipon No 1	34.7		

PHT – Plant height (cm); TNO – Tiller No.; FD – 50% flowering duration (days);
PL – Panicle length (cm); TSNO – Total spikelets no/panicle;
STP – Sterility%; GY – Grain yield (t/ha); TW – Test weight (g)

Table 3. Correlations among agronomic and yield components in aromatic and quality rice germplasm

	PHT	TNO	FD	MAT	PL	TSNO	FSNO	SSNO	STP	GY	TW
PHT	–	0.055	0.138**	0.142**	0.496**	0.019	0.031	-0.022	-0.069	-0.155**	-0.153**
TNO		–	-0.088	-0.098	0.272**	0.002	0.042	-0.100*	-0.143**	0.117*	-0.038
FD			–	0.980**	-0.021	0.0193**	0.195**	0.044	0.024	0.110*	-0.169**
MAT				–	-0.034	0.191**	0.187**	0.055	0.033	0.114*	-0.192**
PL					–	0.127*	0.221**	-0.189**	-0.348	0.028	-0.089
TSNO						–	0.926**	0.434**	-0.114*	0.351**	-0.107*
FSNO							–	0.065	-0.432**	0.391**	-0.079
SSNO								–	0.742**	-0.002	-0.101*
STP									–	-0.218**	-0.126*
GY										–	0.083
TW											–

PHT – Plant height (cm); TNO – Tiller No.; FD – 50% flowering duration (days); MAT – days to maturity;
PL – Panicle length (cm); TSNO – Total spikelets no/panicle; FSNO – Fertile spikelets no/panicle;
SSNO – Sterile spikelets no/panicle; STP – Sterility%; GY – Grain yield (t/ha); TW – Test weight (g)
* Significant at 5% level; ** Significant at 1% level

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Evaluation of Sub-tropical Pear Germplasm

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Key Words: Pear, Evaluation, Flowering characters, Morphological variation

Pear is one of the most important temperate fruits of the world next to apple. Most of the cultivars belonging to *Pyrus communis* are suitable for cultivation in temperate climate. However, the Oriental pear [*Pyrus pyrifolia* (Burm.) Nakai] cultivars are well adapted to sub-tropical climate of North-Western states of India. The Patharnakh is the leading cultivar in the region although some scattered plantations of soft pear cultivars such as LeConte and Baggugosha also exist. To broaden genetic base of pear, a survey of Punjab and adjoining states was made to harness the genetic variability both in sand and soft pears. As a result 19 superior strains of soft pear were collected. In addition, Asian pear cultivars and their hybrids were also introduced from France and USA. This paper deals with studies wherein evaluation of sub-tropical pear germplasm has been done with respect to morphological and flowering characteristics.

Thirty different strains/cultivars of Asian and European pears and their hybrids were collected from indigenous and exotic sources during 1989-1992 and planted in the test block of New Orchard of the Department of Horticulture, Punjab Agricultural University, Ludhiana, for evaluation of their performance under Punjab conditions. The observations on morphological and flowering characteristics were recorded. The tree height and mean tree spread from North-South and East-West and plant girth were measured when the plants were dormant. The volume of the tree was calculated and expressed in m^3. The data was also recorded on the date of leaf fall, leaf emergence, full-bloom and duration of flowering. The percentage of fruit set was recorded by bagging the unopened flowers on the spurs to assess the self-compatibility in different genotypes.

The data given in Table 1 indicate that the AR-89-2 was the most vigorous which recorded maximum tree height (7.27 m), spread (3.560 m) and volume (49.51 m^3). This was followed by AR-89-1 and ARP-90-17. The least vigorous strain was found to be ARNBD-92-28 which had minimum height (4.08 m) and tree volume (4.63 m^3). However, the stem girth was maximum (63.50 cm) in AR-89-8 followed by AR-89-2 (61.12 cm) and it was minimum (34.37 cm) in ARG-90-18. In earlier studies, Gupta and Chauhan (1976) reported that average tree height of Patharnakh was 5.8 m, whereas that of LeConte and Smith cultivars was 4.4 m. The coefficient of variance of volume was recorded to be 58.52 which indicates that the great variability in terms of tree volume does exist in the