The correlations between grain-filling duration and other agronomic traits were calculated.

Differences in grain-filling duration among the 21 varieties tested were highly significant. Bg 90-2 had the longest, at 40 d; PP2462/ 11 had the shortest, at 16 d (see table). Bg 380 and Bg 90-2 were similar, and differed significantly from all others tested.

Because there was no appreciable difference in mean daily temperature, solar radiation, and daylength during grain filling, the variability found cannot be attributed to environmental factors.

Grain-filling duration showed a highly significant positive correlation with days to 50% heading ($r = 0.70$) and a negative correlation with rate of filling ($r = 0.81$). Correlation coefficients of grain filling and grain numbers per panicle and 100-grain weight were not significant.

We believe that Bg 90-2 and Bg 380 inherited their longer grain-filling duration from Taichung Native 1. □

Grain-filling rate and duration and some agronomic traits of 21 rice varieties. IRRI, 1987 dry season.

Variety	Days to 50% heading	Grains/ panicle (no.)	Grain filling[a] Rate (10 mg/panicle per d)	Grain filling[a] Duration (d)
SSD106	57	65	9.8 b	18 h
Bg 750	57	42	12.2 a	17 h
PP 2462/11	67	62	13.0 a	16 h
Bg 276-5	73	123	9.1 bc	19 gh
Bg 367-4	75	172	7.5 cd	23 fg
Bg 34-8	79	119	5.9 ef	27 cdef
lR50	83	108	6.5 de	24 fg
IR36	83	93	7.9 cd	23 fg
Seeraga Samba	87	219	3.4 hi	26 def
IR64	88	107	8.6 bc	24 efg
IR26	98	172	4.6 fgh	33 b
IR54	101	160	4.7 fgh	33 b
Bg 380	102	169	4.4 fghi	38 a
Bg 90-2	110	176	4.2 fghi	40 a
Bg 573	115	344	3.6 ghi	25 ef
H4	119	143	5.3 efg	32 b
Bg 11-11	125	264	2.8 i	31 bc
IR42	128	124	5.1 efgh	29 bcde
Bg 400-1	128	57	5.6 ef	30 bcd
Remadja	136	123	8.6 bc	24 fg
IR48	138	139	9.6 b	24 fg

[a] In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Grain quality and nutritional value

Grain properties of IR36-based starch mutants

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Properties of brown rice (1987 wet season crop) of 12 starch mutants with IR36 background were compared with those of IR36. All rices had lighter and less dense grain than IR36 (see table).

Sugary and shrunken mutants had the lowest starch content, but sugary had the highest content of total free sugars. About 50% of the measured starch content of the sugary mutant was actually phytoglycogen. Protein contents were high, and the amylose extender (ae) mutant showed the highest lysine content, followed by dull 2035.

In protein per seed, the sugary mutant had the lowest protein value, but dull EM47 was highest followed by dull

Brown rice properties of IR36 and its starch mutants. IRRI, 1987 wet season.

Entry	Mutant description	100-grain wt (g)	Density (g/cm^3)	Composition (% wet basis): Starch + free sugars	Composition: Total free sugars	Composition: Reducing sugars	Composition: Crude protein	Protein/ seed (mg)	Lysine (g/16.8 g N)	Lysine/ seed (µg)	Crude fat (% wet basis)	Apparent amylose[a] (% dry basis)	GT (°C)
IR36	(control)	1.8	1.54	73	2	0.3	11	2.0	3.9	78	1.5	22 (26)	73.5
82GF	Sugary	0.6	1.29	57[b]	9	1.5	16	1.0	4.1	41	5.5	0 (0)	>80[c]
EM20	Shrunken	1.1	1.22	61	2	0.3	16	1.6	4.2	66	4.8	15 (22)	73.5
2064	Amylose extender	1.8	1.38	68	2	0.4	10	1.8	4.7	85	1.9	34 (44)	77
EM36	Floury-2	1.5	1.36	68			12	1.8	4.1	74	2.2	10 (13)	72.5
ESD7-3(0)	Floury-1	1.8	1.28	71			10	1.8	4.1	74	1.7	19 (23)	74
2035	Dull	1.7	1.40	68			13	2.2	4.5	99	1.4	6 (8)	73
2057	Dull	1.3	1.40	71			12	1.6	3.9	62	1.4	5 (7)	73
2077	Dull	1.5	1.40	70			14	2.1	4.1	86	1.5	9 (11)	72
2120	Dull	1.4	1.38	69			12	1.7	3.8	65	1.6	6 (8)	74
EM-12	Dull	1.4	1.39	65			13	1.8	3.9	70	1.6	6 (8)	74.5
EM-47	Dull	1.7	1.39	70			14	2.4	3.6	86	1.5	5 (6)	66
EM-90	Dull	1.5	1.40	73			11	1.7	3.7	63	1.3	6 (7)	72.5

[a]Amylose content on starch basis in parentheses. [b]Includes phytoglycogen. [c]A few normal granules gelatinized between 57 and 62 °C.

2035, dull 2077, and IR36. Lysine per seed was highest in dull 2035, followed by dull 2077, dull EM47 and ae and IR36. Fat content was high in sugary and shrunken grains.

All mutants except ae had lower apparent amylose content in brown rice than IR36. Gelatinization temperature (GT) of the samples were intermediate except for dull EM47 and ae.

The extremely high GT value for the sugary mutant may be due to the effect of its high sucrose level on GT. Corresponding starch mutants based on Kinmaze showed similar trends in starch properties. A sample of the ae mutant of Kinmaze had 31 % apparent amylose in defatted brown rice. □

Quality characteristics of some new aromatic rices

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We compared milling and cooking performance of 13 aromatic rice lines and Basmati 370. All samples were grown under similar environmental conditions and tested 2 mo after hand harvesting.

Brown rice recovery varied widely (see table). All lines except NIRRI-PTB-11 and NIRRI-PTB-138 (PL) had higher brown rice yields than Basmati 370; NIRRI-PTB-22 had the highest yield. Head rice yield of NIRRI-PTB-22 was also highest. NIRRI-PTB-140 had more than 40% brokens. NIRRI-1-10643-1-65 had exceptionally long grains. Three lines had higher length:breadth ratios (L/B) than Basmati 370. Six lines had amylose as high as or higher than that of Basmati 370.

Cooked NIRRI-PTB-140-6 had the highest LB, followed by NIRRI-PTB-138 (PL). The elongation ratio of S41 was higher than that of Basmati 370. □

Milling and cooking characteristics of some aromatic rices. Ludhiana, India.

Variety or line	Milling recovery (% of rough rice)			Milled rice					
	Brown rice	Milled rice	Head rice	Protein (%)	Amylose (%)	Length of raw rice (mm)	Length:breadth		Elongation ratio[a]
							Raw rice	Cooked rice	
NIRRI-PTB-11	76.1	70.0	55.0	9.7	21.7	6.7	3.94	3.88	1.45
NIRRI-PTB-20	78.3	72.0	47.0	8.5	26.3	6.7	3.53	3.36	1.25
NIRRI-PTB-22	80.4	74.0	64.2	9.2	19.9	6.8	3.40	3.60	1.32
NIRRI-PTB-23	78.4	72.1	55.7	8.8	19.0	6.6	3.88	3.64	1.38
NIRRI-PTB-36	79.9	73.5	41.9	9.4	24.5	6.7	3.19	3.58	1.39
NIRRI-PTB-138 (PL)	77.5	71.3	47.7	9.8	18.1	7.7	4.05	4.42	1.38
NIRRI-PTB-138 (MS)	74.7	68.7	50.8	8.3	17.2	7.5	3.95	3.75	1.20
NIRRI-PTB-140	78.9	72.6	32.5	9.6	16.3	7.5	4.17	4.21	1.35
NIRRI-PTB-140-6	78.8	72.5	54.1	9.6	15.4	7.9	4.65	4.50	1.37
NIRRI-PTB-145	80.2	73.8	54.6	10.2	12.7	7.3	4.29	3.88	1.38
NIRRI-PTB-170	79.4	73.0	47.8	9.4	18.1	6.9	3.29	3.76	1.36
S41	79.9	73.5	43.5	9.0	19.0	7.0	3.89	4.07	1.57
NIRRI-1-106-4-3-1-65	79.5	73.1	48.7	8.4	18.1	8.3	4.61	4.03	1.46
Basmati 370	78.0	71.7	42.6	9.8	19.0	7.7	4.28	4.37	1.53
Mean	78.6	72.2	49.4	9.3	18.9	7.2	3.97	3.93	1.39

[a]Length of cooked milled rice ÷ length of raw rice.

Disease resistance

Sources of multiple resistance to rice blast (Bl) and bacterial blight (BB) in Nepal

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Rice Bl caused by *Pyricularia oryzae* and BB caused by *Xanthomonas campestris* pv. *oryzae* have been observed widely in the tropical and subtropical regions of Nepal, the country's major rice-producing areas. Breeding for varieties with multiple resistance to these diseases would be easier and quicker using sources with multiple resistance.

To identify such sources, varietal reactions to Bl and BB in Kankai,

Sources of multiple resistance to rice Bl and BB in Nepal, 1985-87.[a]

Variety	Reaction to Bl		Reaction to BB	
	Average	Range	Average	Range
Janaki	2.3	0.0-3.0	1.5	0.0-3.0
Laxmi	2.1	0.0-3.0	2.4	1.5-3.0
KAU1727	1.7	0.0-3.0	3.1	3.0-3.4

[a]Scoring according to *Standard evaluation system for rice* scale: 0-9. [b]Scored 21 d after inoculation.