

Yield potential

Effect of seedling age on Basmati growth and yield

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Transplanting depends on a farmer's resources, particularly the availability of irrigation water, labor, and other farm inputs. However, nurseries are invariably seeded from the last week of May to the first week of Jun. Optimum

Yield and yield attributes of overage seedlings of 2 Basmati varieties. Islamabad, Pakistan.

Seedling age (d)	Basmati 370				Basmati 385			
	Productive tillers/hill (no.)	Spikelets/panicle (no.)	Yield (t/ha)	Yield decrease (%)	Productive tillers/hill (no.)	Spikelets/panicle (no.)	Yield (t/ha)	Yield decrease (%)
30	12.4	152.4	2.8	—	9.7	196.2	4.6	—
45	10.4	151.6	2.4	15.1	9.7	186.5	4.2	9.8
60	8.4	138.1	1.3	31.0	8.5	177.3	3.1	33.6

age for transplanting Basmati seedlings is considered to be 25-35 d.

We assessed the effect of transplanting overage seedlings on yield of Basmati 370 and Basmati 385. Yield

and yield attributes declined significantly with seedling age (see table). The yield decline was partly attributable to fewer productive tillers/hill and fewer spikelets/panicle. □

Relationship of transplanting time and grain yield of Basmati 385

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Basmati varieties cover about 85% of the total acreage in Kaalar. Usually transplanting is at the start of the monsoon, within a very short optimum period. But time of transplanting depends on a farmer's resources.

With the release of Basmati 385, we conducted an experiment to determine its optimum transplanting time. The trial was in a randomized complete

Yield and yield-contributing characters of Basmati 385 as affected by transplanting date. Islamabad Pakistan.

Transplanting date	Productive tillers/hill (no.)	Spikelets/panicle (no.)	Yield (t/ha)	Yield index ^b
15 Jun	11.5 a	194.2 a	4.9 a	93
1 Jul	10.3 a	210.2 a	5.3 a	100
16 Jul	10.5 a	189.6 a	4.4 b	84
31 Jul	9.8 b	178.8 b	3.8 c	72
15 Aug	8.7 b	161.1 c	2.1 d	51

^a Means in a column followed by the same letter are not significant at the 5% level by DMRT. ^b Index taking the yield for 1 Jul plot as 100.

block design with three replications. The crop was kept flooded.

Delayed transplanting significantly reduced grain yield (see table). Highest yield was from plots transplanted 1 Jul, with progressive declines as transplanting was delayed. Yield

decreased 49% from 1 Jul to 15 Aug, at a rate of 58 kg/d per ha. Yield attributes also showed progressive decline with delay in transplanting. The decrease in yield was partly the result of decrease in productive tillers/hill and in spikelets/panicle. □

Variability in rice grain-filling duration

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Duration of grain filling, defined as the time from flowering to maturity, ranges from about 30 d in the tropics to about 65 d in temperate zones. The variation is considered to be due to temperature difference, not to a varietal character. Modern indica varieties developed for the tropics produce extremely high

yields under temperate conditions. A primary reason for increased yield is a 2-3 wk extension of grain-filling duration.

We examined Bg 90-2 and Bg 380 with longer ripening duration and 19 other varieties with varied agronomic characters for grain-filling duration in dry season 1987 at IRRI. Seeds were sown on wetbed and 4-wk-old seedlings transplanted at 1 plant/hill in 7.2- × 0.9-m plots with 30- × 20-cm row spacing. The experiment was in a randomized complete block design with three replications.

Fertilizer was applied basal at 60-40-40 kg NPK/ha. Plots were fully protected against weeds, pests, and diseases.

Panicles were tagged at flowering, when about 5% of spikelets had dehiscent anthers. Ten tagged panicles taken at random from each test plot every 4 d from 0 to 46 d after tagging were oven-dried at 48°C for 3 d. Filled and unfilled grains were removed by hand, counted, and weighed.

Increase in grain weight was calculated, adopting Richard's function.

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)	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
IR50	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 efg	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 phytylglycogen. 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)				Protein/seed (mg)	Lysine (g/16.8 g N)	Lysine/seed (μg)	Crude fat (% wet basis)	Apparent amylose ^a (% dry basis)	GT (°C)
				Starch + free sugars	Total free sugars	Reducing sugars	Crude protein						
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

^aAmylose content on starch basis in parentheses. ^bIncludes phytylglycogen. ^cA few normal granules gelatinized between 57 and 62 °C.