Table 2. Reaction of TM 2011 to pests and diseases. RRS, Tirur, Tamil Nadu, India, 1986-88.

Pest or disease	Resistance rating[a]	
	TM2011	IR50
Bacterial blight		
Coimbatore	3	5
Blast		
Aduthurai	0	4
Coimbatore	5	7
Brown spot		
Coimbatore	5	5
Sheath rot		
Aduthurai	5	3
Tungro		
Aduthurai	5	3
Coimbatore	7	5
Brown planthopper		
Ambasamudram	3	5

[a] *Standard evaluation system for rice* scale.

(IET10883) performed well in six of eight locations, with 10.6% higher yield than national check Akashi recording a mean grain yield of 3.5 t/ha. □

Integrated germplasm improvement—rainfed lowland

TM6012, a short-duration rainfed rice

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TM6012 is a short-duration, drought-resistant rice selection derived from C22/BJ1. It has a 115-d duration and is suitable for a season with 890-940 mm rainfall.

TM6012 was compared with PMK1 in the 1985-88 wet seasons. It averaged 2.3 t/ha; PMK1 yielded 1.8 t/ha (see table).

TM6012 has fine grain and is resistant to blast. It has field tolerance for leaffolder, gall midge, and sheath rot. □

Performance of TM6012.

Character	PMK1 (check)	TM6012
Parentage	CO 25/ADT31	C22/BJ1
Duration (d)	110-115	115-120
Plant height (cm)	71.00	90.00
Productive tillers (no./plant)	4.50	6.80
Panicle length (cm)	15.70	18.50
Filled grains (no./panicle)	63.60	72.50
Empty spikelets (no./panicle)	15.40	12.00
1000-grain weight (g)	24.00	19.50
Grain yield (t/ha)	1.8	2.3
Kernel color	White	White
Grain shape	Short bold	Long slender

Integrated germplasm improvement—upland

TM8602, a new upland rice

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Several breeding lines were evaluated for yield potential coupled with drought tolerance. TM8602, a derivative of CO 31/C22, was found to be promising.

TM8602 is medium-duration (140 d) and is well adapted to local environmental conditions. In yield trials in 1985-88 wet seasons (Aug seeding), TM8602 averaged 2.2 t/ha, 22.2% higher than local check CO 31 (see table).

TM8602 is intermediate in height with moderate tillering and short bold grain. It performed well under drought conditions, and has been recommended for the upland areas of Tamil Nadu. □

Performance of TM8602 under drought stress. Tamil Nadu, India.

Season	TM8602				CO 31			
	Duration (d)	Yield (t/ha)	Drought score[a]		Duration (d)	Yield (t/ha)	Drought score[a]	
			DRT	DRR			DRT	DRR
Wet 1985	135	1.7	1	1	145	1.5	3	3
Wet 1987	145	2.2	1	1	145	2.1	3	3
Wet 1988	130	2.8	1	1	135	1.8	3	3
Mean	137	2.2	1	1	142	1.8	3	3

[a] By the *Standard evaluation system for rice*, June 1988. DRT = drought tolerance, DRR = drought recovery.

Seed technology

Effect of wet and dry heat treatment on rice seed germination and seedling vigor

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Hot water and dry heat treatments commonly are used to control a number of seedborne pathogens (fungi, nematodes, and bacteria) and to break seed dormancy in rice. But these treatments could adversely affect seed vigor and viability.

In international programs involving seed exchange, such as the International Network for Genetic Enhancement of Rice (INGER), a gap of 2-3 mo can occur between treatment and sowing, due to transit and postentry handling operations in recipient countries.

We studied the effects of hot water treatment (55, 60, and 65 °C for 15, 30, and 45 min) and dry heat treatment (55, 60, and 65 °C for 3, 5, and 7 d) on germination and seed and seedling vigor (total dehydrogenase activity as measured by optical density [OD] of seeds stained with tetrazolium chloride and seedling dry weight after 7 d germination) in IR36, IR64, and Intan Gawri. Tests were made immediately after treatment and after storing treated seeds for 3 mo under ambient conditions (22-25 °C, 65-70% relative humidity).

For the hot water treatment, half the seeds were presoaked for 3 h at 22 °C, half were treated dry. Fungal infection was measured using the blotter method in four replications of 25 seeds each.

Hot water treatment of both dry and presoaked seeds at 55 °C for up to 45 min had no adverse effect on seed germination and vigor before or after storage. In fact, there was a slight improvement in seed vigor (see table). Treated seeds showed considerably lower fungal incidence than control, the difference was more pronounced with presoaked seeds.

At 60 °C, hot water treatment for 15 min had no adverse effect on dry seeds but it was highly deleterious to presoaked seeds. Treatment for 30 or 45 min resulted in marked reduction in germination and vigor, even in dry seeds. The adverse effects were more pronounced after storage.

The most drastic reduction in germination and vigor was in seeds treated with hot water at 65 °C. While dry seeds could partially withstand treatment up to 15 min, in all other cases seeds became nonviable.

Dry heat treatment resulted in considerably lower fungal incidence and did not have any adverse effect on germination and vigor of seeds before or after storage.

Hot water treatment of dry or presoaked seeds for 15-45 min at 55 °C and dry heat treatment at 55-65 °C for up to 7 d can be practiced without adverse effects on seed vigor. □

Effect of hot water and dry heat treatment on germination, seedling vigor, and fungal infection of rice seed.[a] IRRI, 1989.

Treatment	After treatment				After storage[b]	
	Germination (%)	Dehydrogenase activity (OD)	Seedling dry wt (mg)	Fungal infection (%)	Germination (%)	Seedling dry wt (mg)
Hot water						
No presoaking						
55 °C 15 min	97.5 ± 1.58	0.31 ± 0.03	9.98 ± 0.76	38.3 ± 6.7	100.0 ± 0	9.66 ± 1.33
30 min	94.2 ± 3.37	0.34 ± 0.02	9.30 ± 0.97	58.3 ± 2.35	98.3 ± 1.67	9.60 ± 1.53
45 min	97.6 ± 1.20	0.25 ± 0.003	10.10 ± 1.66	53.3 ± 4.41	98.3 ± 1.67	8.80 ± 1.25
60 °C 15 min	96.6 ± 1.66	0.25 ± 0.043	9.45 ± 1.18	55.0 ± 7.64	91.7 ± 2.88	8.16 ± 0.92
30 min	79.6 ± 2.60	0.19 ± 0.01	9.01 ± 1.82	38.3 ± 6.64	80.6 ± 4.26	8.00 ± 1.27
45 min	31.0 ± 13.88	0.19 ± 0.01	8.40 ± 2.2	25.0 ± 5.78	41.0 ± 14.87	5.76 ± 0.63
65 °C[c] 15 min	54.0 ± 15.63	0.19 ± 0.07	8.99 ± 1.07	21.6 ± 11.5	58.3 ± 13.41	8.40 ± 0.87
Presoaked[d]						
55 °C 15 min	91.7 ± 6.66	0.22 ± 0.03	10.23 ± 1.39	51.7 ± 9.24	93.3 ± 1.65	8.87 ± 1.48
30 min	98.7 ± 1.33	0.27 ± 0.03	9.60 ± 1.26	51.6 ± 4.41	90.0 ± 4.71	9.30 ± 1.25
45 min	88.0 ± 17.43	0.23 ± 0.05	9.74 ± 1.27	41.7 ± 3.33	93.7 ± 5.17	8.73 ± 1.27
60 °C 15 min	43.7 ± 11.03	0.27 ± 0.017	7.74 ± 1.84	26.7 ± 7.27	21.7 ± 4.28	4.03 ± 0.16
30 min	19.5 ± 6.36	0.26 ± 0.02	5.60 ± 0.24	20.0 ± 7.07	0	-
45 min	13.0 ± 1.36	0.20 ± 0.02	8.99 ± 1.07	17.5 ± 2.04	0	-
Dry heat						
55 °C 3 d	98.3 ± 1.67	0.32 ± 0.03	9.65 ± 0.98	36.7 ± 4.90	93.3 ± 2.72	9.23 ± 0.97
5 d	99.0 ± 1.0	0.29 ± 0.04	9.92 ± 0.29	32.0 ± 3.6	98.3 ± 1.67	9.83 ± 1.57
7 d	98.0 ± 0.9	0.34 ± 0.02	9.55 ± 1.04	40.0 ± 2.36	98.3 ± 1.67	9.66 ± 1.34
60 °C 3 d	99.0 ± 1.0	0.33 ± 0.28	9.23 ± 1.36	48.3 ± 3.33	98.3 ± 1.67	9.70 ± 1.31
5 d	99.0 ± 1.0	0.34 ± 0.02	9.19 ± 1.08	51.7 ± 4.41	98.0 ± 1.63	9.37 ± 1.05
7 d	100.0 ± 0.0	0.34 ± 0.02	9.95 ± 1.30	40.0 ± 4.71	91.0 ± 5.44	8.47 ± 0.95
65 °C 3 d	97.3 ± 1.45	0.32 ± 0.10	3.42 ± 1.81	46.6 ± 6.79	94.7 ± 2.59	10.4 ± 1.94
5 d	99.0 ± 1.0	0.36 ± 0.03	9.36 ± 1.25	46.6 ± 6.79	100.0 ± 0.0	9.07 ± 0.96
7 d	100.0 ± 0.0	0.37 ± 0.02	9.33 ± 1.34	38.3 ± 8.93	98.8 ± 0.97	9.46 ± 1.13
Control	93.6 ± 1.85	0.28 ± 0.05	9.02 ± 1.19	73.3 ± 5.44	99.0 ± 0.82	8.9 ± 1.02

[a]Mean of three cultivars (each with two replications) ± SEM. [b]Three months under ambient conditions. [c]At 65 °C, germination after treatment was zero with hot water at 30 and 45 min. [d]At 65 °C, germination after treatment and after storage for 15, 30, and 45 min was zero.

CROP AND RESOURCE MANAGEMENT

Soils

Contribution of different soil Zn fractions to Zn uptake by rice

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Zn in soil occurs in a number of distinct chemical fractions that differ in their solubility, and thus in the availability of the Zn to plants. We studied the contribution of these fractions to Zn uptake by rice in 15 soils of Bangladesh. Two 25-d-old rice seedlings (cv. BR3) were grown for 55 d in each earthen pot containing 2.5 kg air-dried soil and 2 cm standing water.

Zn fractionation data were obtained using the scheme of Murthy, as modi-