Adverse soils

Performance of promising salt-tolerant varieties in Karnataka, India

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Rice is the main cereal crop in the lowlands of Vani Vilas Sagar tract, Karnataka. A large proportion of this area is black soils; most are affected by salt. The varieties presently grown are SR26B and S317, known locally as Banku and Halubbalu, respectively. Both have fair tolerance for adverse soils, but they lodge even at preflowering stage. They are also susceptible to blast disease. Some breeding to improve SR26B was initiated at the Agricultural College, Dhanwar, in 1968. But the improvement was only in earliness and photoperiod insensitivity. The development prompted the testing of new salt-tolerant lines — from crosses involving SR26B, S317, and other rices from various rice research institutes within and outside of the state — for adaptability to the Vani Vilas tract.

During both the 1977 dry and wet seasons 17 MR lines from crosses involving Kare Kagga and SR26B, 3 IRRI varieties, and 1 culture from AICRIP, Hyderabad, were evaluated along with popular local varieties at Alur village. The experiments were in a randomized block design, replicated three times. Rice was sown on 25 January and 22 July in the 1977 dry and wet seasons, respectively. Three or four 26-day-old seedlings were transplanted at a 20- × 15-cm spacing to accommodate a plot size of 3.6 m^2.

In the dry season, the cultivars MR353, MR359, MR363, and SR26B-M (a photoperiod-insensitive mutant from SR26B) yielded better than Mangala, the high yielding tolerant check (see table). The three MR rices matured 5 days later than Mangala but 20 days earlier than SR26B-M. In the wet season, the yields of MR353, MR359, and the new entries MR340 and Dasal were comparable with those of SR26B. All varieties matured from 9 to 22 days earlier than SR26B. The mean yields over 2 seasons of MR353, MR359, MR362, and SR26B-M were more than 4 t/ha. The MR cultures clearly owe their tolerance to their female parent Kare Kagga, a popular cultivar on the west coast of Karnataka, India, known for its high tolerance for soil adversities.

Because of their plant stature, earliness, and photoperiod insensitivity, MR340, MR353, MR369, and MR363 have been advanced for multilocational performance testing in Vani Vilas Sagar, Tungabhadra, and Krishnarja Sagar project areas, where soil problems similar to those of Hiriyur prevail in vast areas.

Performance of rice varieties and lines in the salt-affected soils at Alur, Karnataka, India, in the 1977 dry and wet seasons.

Designation	Parentage	Days to maturity	Yield[a] (t/ha)		
			1977 DS	1977 WS	Mean
MR 338	K. Kagga/IR8	120	4.2	1.0	2.6
MR 343	SR 26B/Waner 1	145	4.0	2.5	3.2
MR 346	K. Kagga/IR8	120	3.1	3.1	3.1
MR 353	K. Kagga/IR8	120	6.1	3.3	4.7
MR 359	K. Kagga/IR8	120	6.4	3.3	4.9
MR 362	K. Kagga/IR8	130	5.4	2.8	4.1
MR 377	K. Kagga/IR8	130	5.6	1.1	3.3
C7		145	4.9	1.2	3.0
SR 26B mutant	SR 26B	140	6.1	2.8	4.4
Madhu	TN1/TKM 6	125	4.2	1.2	2.7
MR 348	K. Kagga/IR8	130	4.7		
MR 358	K. Kagga/IR8	130	5.0		
MR 363	K. Kagga/IR8	120	6.8		
MR 375	K. Kagga/IR8	130	3.8		
MR 376	K. Kagga/IR8	135	5.4		
IR20	Peta[3]/TN1//TKM 6	135	3.5		
Mangala	Jaya/S 317	115	5.4		
MR 261	IRS/Waner 1	130		3.1	
MR 292 F	Jaya/S 317	133		3.1	
MR 340	K. Kagga/IR8	133		3.1	
MR 341	K. Kagga/IR8	132		3.1	
MR 342	K. Kagga/IR8	128		3.1	
IR3541-6-PN-58-5-3-1	IR442-2-58/IR1514A-E666//BRJI-13-B-55/IR480-5-9-3	130		2.6	
IR40	IR20*2/ *O. nivara*//CR94-13	130		2.6	
Dasal		126		3.8	
Getu		128		2.7	
SR 26B		142		3.5	

[a] DS = dry season; WS = wet season.

Phosphorus-efficient varieties

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The possibility that Texas rice varieties are efficient utilizers of phosphorus (P) would explain the lack of yield increase when P fertilizer is applied to rice grown on seemingly P-deficient soil. Beaumont

Response of rice varieties to P deficiency in culture solution and in the field at Beaumont, Texas, USA.

Variety	Yield response (t/ha)		Change (%)[a]	RTR (%)[b]	IRRI P deficiency rating[c]
	0 kg P/ha	20 kg P/ha			
Labelle	4.4	4.7	+6	0[d]	–
Lebonnet	4.3	4.5	+4	0	–
Brazos	5.9	5.8	–3	500	–
IR20	2.0	2.2	–	0	R
IR28	5.3	5.4	+2	88	R
Starbonnet	4.3	4.4	+2	0	–
Caloro	2.0	2.2	–	100	–
Nato	4.1	4.3	+5	0	–
Bonnet 73				0	–
Vista				0	–
MI48				0	S
IR2061-464-2				175	R
IR442-2-58				68	S
Dawn				0	–
Mars				0	–
Nova 76				0	–
Calrose 76				0	–

[a] Yields of IR20 and Caloro were so low that no evaluation was made.
[b] Relative tillering ratio = no. of tillers in 1 ppm P nutrient solution divided by no. of those in 10 ppm P and multiplied by 100. The tiller count is made after 4 weeks of growth.
[c] R = resistant; S = susceptible to P deficiency; – = information not available.
[d] 0 means plants failed to tiller in either 1 or 10 ppm P solution. There is no clear explanation why IR20 or some other varieties had no tillers.

clay, an important Texas rice soil, generally contains less than 1 ppm P (extractable with ammonium acetate of pH 4.2). Yet rice yields on this soil are substantial and are seldom increased by application of P fertilizer. To test the hypothesis that certain Texas varieties are efficient utilizers of P (i.e. resistant to P deficiency), their yield responses to P fertilizer were compared with those of IR20 and IR28, which the 1974 IRRI Annual Report had reported as resistant to P deficiency. The first eight varieties in the table were planted on a Beaumont clay containing 1 ppm extractable P. Each variety was fertilized with adequate nitrogen and 0 or 20 kg P/ha.

The poor yields of the late-maturing varieties IR20 and Caloro made evaluation of their P efficiency impossible. The six other varieties' yield response to P fertilizer suggests two possibilities: 1) the soil was not so deficient in P as to cause a P stress or, 2) Nato, Starbonnet, Labelle, Lebonnet, and Brazos are as resistant as IR28 to P deficiency, which means that they are unrecognized sources of resistance to P stress.

A technique described in the 1975 IRRI Annual Report was used to further evaluate the P efficiency of selected varieties. It provides a measure of P efficiency by determining the relative tillering ratio (RTR) (see footnote in table for RTR formula). The pH of the nutrient solution was adjusted to 5.0 and the RTR of the resistant rices IR20 and IR28 and of the susceptible MI-48 were compared with that of selected US varieties in the greenhouse where temperatures averaged about 20°C (see col. 4 of table). The data indicate that Brazos and Caloro are possible new sources of tolerance for P stress and suggest that 10 ppm P may be toxic to Brazos.

The relatively high RTR values for IR2061-464-2 and IR28 agreed with their resistance rating to P deficiency based on field tests at IRRI. But the values for IR20 and IR442-2-58 did not agree with the resistant and susceptible RTR ratings, respectively, given in the 1974 IRRI Annual Report. Similarly, the RTR values in this study do not agree with field results. For instance, the RTR values of Labelle, Lebonnet, Starbonnet, and Nato in nutrient solution were very low, but their yields without P fertilizer in the field were as good as those with P fertilizer. Further evidence that RTR may not reflect P efficiency in the field is in the 1975 IRRI Annual Report. Nevertheless, according to data collected in this study (not reported here) the RTR technique appears to indicate P efficiency better than measurements of shoot weight, root weight, and/or root: shoot ratio — but it is not as reliable as field evaluation.

Although both the field and the RTR technique identified IR28 and Brazos as tolerant of P stress, additional studies are planned to characterize the P efficiency of selected US varieties more precisely.

Corrections

The authorship of the article *Genetic potential and utilization of rice in northeastern India,* IRRN 2:6 (December 1977) should read:

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The authorship of the article *A study of vein-swellings of rice plants infected with ragged stunt,* IRRN 3:2 (May 1978) should read:

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