unfavourable atmosphere created in the host to the invading pathogen.

22 September 1986; Revised 13 February 1987

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SALT RESPONSES OF ENZYMES FROM RICE CULTIVARS DIFFERING IN SALT TOLERANCE

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THE effect of NaCl on the *in vitro* activity of certain enzymes from salt-sensitive and salt-tolerant rice cultivars was studied. Seeds of seven rice cultivars viz AU 1, Co 43, CSC 1 (salt-resistant), CSC 2, IR 20, TKM 4 and TKM 9 (salt-sensitive) were sown in earthern pots filled with 7 kg of soil under net-house conditions during wet season. Salinization was imposed on three-week-old seedlings by adding 750 ml of sodium chloride solution of EC 10 m mhos/cm once in a week. The pots were irrigated with normal water on other days as and when required. Controls received only water. Shoot system was harvested six weeks after initial salinization and analyzed for sodium and chloride contents and enzymes activity. The electrical conductivity (EC) of soil was measured at the same time.

The EC of the soil at the end of six weeks of salt treatment was 7.95 m mhos/cm. Salt-sensitive cultivars Co 36, CSC 2 and IR 20 accumulated a high level of Na^+ and Cl^- in the shoot when compared to the control (table 1). Amylase activity was less stimulated in salt-tolerant cultivars AU 1, Co 43 and CSC 1 while it was highly stimulated in other salt-sensitive cultivars in response to salinity (table 2). Thus, it is evident that amylase activity is strongly associated with the salt tolerance of rice cultivars. The increase in amylase activity was positively correlated with salt tolerance of cultivars in sugarbeets and cotton subjected to Na_2SO_4 and NaCl salinity and soyabean and cotton exposed to NaCl salinity[1–4]. There was 1.7 to 4-fold promotion of membrane-bound ATPase activity in salt-tolerant cultivars CSC 1, Co 43 and AU 1 and it was less

Table 1 *Effect of NaCl on the sodium and chloride content of shoot system in rice cultivars at six weeks after initial salinization*

Cultivars	Sodium	Chloride
	mmol/g dry weight	
	S	S
AU 1 SR	1.33 (137)	1.10 (270)
Co 36 SS	2.22 (505)	1.76 (420)
Co 43 SR	1.25 (205)	1.37 (265)
CSC 1 SR	2.14 (278)	1.27 (255)
CSC 2 SS	2.62 (430)	1.65 (376)
IR 20 SS	2.06 (254)	1.54 (441)
TKM 4 SS	2.40 (238)	1.10 (201)
TKM 9 SS	1.29 (168)	1.10 (201)
Mean	1.91 (255)	1.43 (302)

S: salinized; SR:Salt resistance; SS: Salt sensitive; Figures in parentheses indicate control value expressed as per cent of control.

Table 2 *Effect of NaCl on the activity of different enzymes from the third leaf of rice cultivars at six weeks after initial salinization*

Cultivars	Amylase		ATPase		Nitrate reductase	
	C	S	C	S	C	S
AU 1	23	43	428	2238	271	543
Co 36	92	214	210	481	452	362
Co 43	54	74	710	2221	181	588
CSC 1	56	76	527	1440	181	679
CSC 2	58	114	241	626	452	271
IR 20	87	198	256	719	362	181
TKM 4	23	64	811	1606	679	362
TKM 9	44	92	527	969	769	362
Mean	55	109	464	1288	418	419

C: Control; Amylase: μmol of maltose released/10 minutes/mg protein; S: salinized; ATPase: μmol of phosphate released/30 min/mg protein; Nitrate reductase: μmol of NO_2 released/hour/g fr.wt.

promoted in salt-sensitive cultivars in response to NaCl treatment (table 2). NaCl-stimulated membrane-bound ATPase activity was reported in the leaves of *Avicennia nitida*[5] and in the cotyledons of *Phaseolus vulgare*[6]. The present results and also those reported earlier[7] indicate that NaCl-stimulated ATPase can be correlated with salt tolerance of species. Invariably the nitrate reductase activity was promoted in salt-tolerant cultivars, AU 1, Co 43 and CSC 1 but it was inhibited in salt-sensitive cultivars by NaCl treatment (table 2). These results agree with the earlier observation in wheat[8].

It is suggested that the variation in the responses of amylase, ATPase and nitrate reductase activities in the leaves of AU 1, Co 43 and CSC 1 to salinity could be one of the several possible indicators for salt tolerance of rice cultivars under saline conditions.

The authors acknowledge financial assistance from UGC and CSIR, New Delhi, and ISRO, Bangalore.

22 September 1986; Revised 28 January 1987.

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EFFECT OF BENLATE ON THE GERMINATION OF *AZOLLA MEXICANA* MEGASPOROCARPS

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THE aquatic fern *Azolla* has gained importance in recent years as a biofertilizer for lowland rice cultivation[1] due to the endosymbiont *Anabaena azollae* in the leaf cavities fixing nitrogen[2]. Though the fern produces mega and microsporocarps occasionally, germination and fertilization of spores are difficult.

Nitrogen-free growth medium i.e. $IRRI^{(-)}$ NO_3 was prepared with 2% agar sterilized and dispensed into 65 × 15 mm disposable petri dishes. Benlate, a systemic fungicide (methyl-1-butyl carbamoyl-2-benzimidazole carbamate) was used for treating the spores. Freshly harvested megasporocarp and microsporangia were pre-treated for 24 hr with 5, 10 and 20 ppm of Benlate. After treatment, 100 megasporocarps mixed with micro-sporangia at 1:2 ratio were transferred to the centre of each petri dish containing the solidified medium. $IRRI^{(-)}$ NO_3 liquid medium (0.2 ml) was added over the spores and mixed well. The petri dishes were sealed with 'parafilm' and incubated in the growth room at $26 \pm 1°C$ with light intensity of 100 μ E m^{-2} sec^{-1} for 5 weeks. The germinated spores were counted.

In another experiment Benlate (0.2 ml) at 100 ppm was added over the dry spores in the petri dish containing solidified agar medium. Addition of Benlate solution at 0.2 ml was followed at weekly intervals. The germination percentage was recorded.

Incorporation of Benlate at 5 ppm into the $IRRI^{(-)}$ NO_3 medium encouraged the germination of pre-treated wet spores (table 1). However, the fresh spores recorded a lower per cent of germination than the dry spores. It is of interest to note that addition of 100 ppm Benlate solution at weekly intervals registered more than 80% germination. These results suggest that the systemic fungicide breaks the dormancy and increases megasporocarp germination. This might be due to the elimination of the fungal contaminants around the spores. Fungal contaminants are known to reduce the seed germination in higher plants[3]. The occurrence of *Rhizoctonia solani* in the megasporocarp of *A. mexicana* is reported recently[4]. The systemic fungicide Benlate is effective in controlling *Rhizoctonia solani*[3]. Singh *et al*[5] found that the megasporocarp has a thick wall and germination depends on several factors. It is interesting that Benlate treatment significantly encouraged megasporocarp germination. This has application in the maintenance of germplasm as dried sporocarps and in introducing *Azolla* to new areas.

The author is thankful to Mr. Robert Toia Jr., Dr Barry Marsh and Dr G. A. Peters, C. F. Kettering Research Laboratory, Yellowsprings, Ohio, USA for assistance. Financial assistance by FAO/UNDP/ICAR is gratefully acknowledged. Laboratory facilities offered by Dr Jack Halliday,