20. Leaf Proline Content (LPC) and Chlorophyll Stability Index (CSI) – a tool for selection of salt tolerant genotypes in rice

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Salinity is a major problem in arid and semiarid tropics. In India about 8.6 mha (Pathak 2000) of land area is affected by soil salinity. Rice is affected differentially by salinity in almost all growth stages (Akbar 1986). Thus there is a need to develop high yielding rice varieties or hybrids having salt tolerant traits / mechanisms. The leaf proline content (LPC) and chlorophyll stability index (CSI) are the two important physiological traits which are directly related to salt stress.

The high accumulations of proline and chlorophyll in plants indicate that the plant did not have much problem to survive in salt stress environment. The high LPC and CSI showed that the plant has the ability to convert the glutamate into proline and this proline seems to have diverse roles under different abiotic stresses (Verma 1999). The high CSI value indicates the better availability of chlorophyll in the plant and helps the plant to withstand stress. This leads to increased photosynthetic rate, more dry matter production and higher productivity. The LPC and CSI served as potent characters in identifying tolerant genotypes to salt stress situation.

The experiment was conducted in two different locations *viz*., experimental farm, AC & RI, Madurai (normal soil – soil pH 7.4, water pH 7.2, EC of soil and water 0.4 and 0.24 dSm^{-1} respectively) and experimental farm, ADAC & RI, Trichy (salt affected soil - soil pH 9.2, water pH 7.6, EC of soil and water 7.25 and 1.84 dSm^{-1} respectively) to know the response of genotypes in two different conditions in relation to LPC and CSI. Plants were raised in a randomized block design with two replications. Randomly selected five plants in each replication were subject to LPC and CSI analysis. For LPC, fully expanded leaves from 65 days old plants were collected and one gram of the sample was macerated and subjected to LPC as per the method suggested by Bates et al. (1973). The CSI in the leaf was estimated using a spectrophotometer following the method of Koleyoreas (1958). It was calculated as the difference in light transmission percentage between treated (kept at 65℃ for an hour) and untreated leaf samples (kept at ambient temperature for one hour).

The experimental results were given in the Table 1. Most of the genotypes accumulated more proline under salt stress environment in the present case indicating proline accumulation as an important osmotic adjustment during stress situation (Kavikishore et al. 2005). Under normal condition, six parents and eleven hybrids registered highly significant LPC and seven parents and 20 hybrids excelled the mean for CSI. In the salt environment five parents and 17 hybrids for LPC and five parents and 15 hybrids for CSI had highly significant values. Among parents TS 29 registered highly significant values for both LPC and CSI value under salt environment. For LPC alone COMS 9A, TRY 1, CO 43, jaya and BTS 24 recorded high *per se* under stress situation compare to normal soil condition. For CSI, TS 29, IR 58025 A, Pokkali, Vytilla 1 and BTS 24 registered high value under stress situation than normal condition.

The following hybrids *viz.,* TS 6/CSR 27, TS 6/Pokkali, TS 6/Vytilla 1, TS 6/ Co 43, TS 6/Jaya, TS 6/ BTS 24, TS 6/Vytilla 2; TS 29/jaya, TS 29/BTS 24, TS 29/ Vytilla 2; IR 58025 A/CSR 13, IR 58025 A/Vytilla 1, IR 58025 A/TRY 1, IR 58025 A /Co 43, IR 58025 A/jaya, IR 58025 A/ BTS 24 and IR 58025 A/Vytilla 2 recorded significantly high leaf proline content under salt stress situation when compared toothier general mean value. Whereas, the hybrids TS 6 / BTS 24; TS 29 crossed with CSR 27, Pokkali, Vytilla 1, jaya, BTS 24, Vytilla 2; COMS 9A / BTS 24; IR 58025 A/Pokkali, IR 58025 A/Vytilla 1, IR 58025 A/TRY 1, IR 58025 A/CO 43, IR 58025 A/jaya, IR 58025 A/BTS 24 and IR 58025 A/Vytilla 2 recorded highly significant CSI value as compared to its normal growing condition and adjudged as salt tolerant hybrids.

In general the hybrids TS 6 crossed with CSR 27, Pokkali, Vytilla 1, Vytilla 2 and IR 58025 A/CSR 13, IR 58025 A/Vytilla and IR 58025 A/jaya and the parents TS 29, IR 58025 A and BTS 24 were generally found to be more tolerant as they had high LPC and CSI values. Hence, the above said hybrids are highly suitable for salt affected soils and the parents identified can be used in the future breeding programme for transfer of salt tolerant traits to the susceptible genotypes.

Table 1. Effect of salt stress on Leaf Proline Content (LPC) and Chlorophyll Stability Index (CSI)

Genotypes	LPC		CSI		Genotypes	LPC		CSI	
	Normal	Stress	Normal	Stress		Normal	Stress	Normal	Stress
TS 6	0.57	0.57	45.20*	39.8	TS 29 / Pokkali	0.73	0.79	62.91	72.9*
TS 29	0.77*	0.77*	46.59*	48.4*	TS 29 / Vytilla 1	0.72	0.79	62.39	74.9*
COMS 9A	0.70*	0.73*	35.16	28.2	TS 29 / TRY 1	0.70	0.78	63.75*	69.6
IR 58025 A	0.52	0.52	48.52*	50.4*	TS 29 / CO 43	0.72	0.79	64.12*	63.8
GM	**0.64**	**0.65**	**43.87**	**41.69**	TS 29 / Jaya	0.82*	0.84*	63.59*	70.5*
CD (0.05)	**0.05**	**0.04**	**0.47**	**2.31**	TS 29 / BTS 24	0.79	1.15*	59.59	81.3*
CSR 13	0.65	0.83	58.12	41.7	TS 29 / Vytilla 2	0.77	0.81*	63.60*	69.9*
CSR 27	0.65	0.84	59.56*	42.3	COMS 9A / CSR 13	0.53	0.66	58.46	45.0
Pokkali	0.69*	0.84	68.26*	70.5*	COMS 9A / CSR 27	0.56	0.69	60.66	49.2
Vytilla 1	0.71*	0.84	59.68*	62.7*	COMS 9A / Pokkali	0.56	0.69	62.74	54.6
TRY 1	0.65	0.79	52.64	47.2	COMS 9A / Vytilla 1	0.62	0.73	58.85	45.8
CO 43	0.72*	0.88*	55.49	46.9	COMS 9A / TRY 1	0.62	0.73	60.64	49.1
Jaya	0.69*	0.88*	52.36	49.7	COMS 9A / CO 43	0.63	0.74	58.41	45.0
BTS 24	0.56	0.94*	60.59*	64.2*	COMS 9A / Jaya	0.57	0.69	62.32	53.4
Vytilla 2	0.65	0.80	55.69	53.2	COMS 9A / BTS 24	0.65	0.75	64.04*	67.2*
GM	**0.66**	**0.84**	**58.04**	**53.15**	COMS 9A / Vytilla 2	0.68	0.77	59.63	47.1
CD (0.05)	**0.03**	**0.04**	**1.45**	**2.18**	IR 58025 A / CSR 13	0.83*	0.88*	64.10*	61.7
TS 6 / CSR 13	0.70	0.78	63.33*	56.8	IR 58025 A / CSR 27	0.70	0.78	64.09*	63.9
TS 6 / CSR 27	0.83*	0.97*	64.08*	61.8	IR 58025 A / Pokkali	0.77	0.68	64.05*	67.0*
TS 6 / Pokkali	0.83*	1.00*	64.18*	63.8	IR 58025 A / Vytilla 1	0.83*	0.87*	62.87*	73.2*
TS 6 / Vytilla 1	0.83*	0.88*	63.87*	60.2	IR 58025 A / TRY 1	0.76	0.81*	62.73	73.8*
TS 6 / TRY 1	0.71	0.78	64.08*	62.1	IR 58025 A / CO 43	0.78	0.81*	63.96*	66.7*
TS 6 / CO 43	0.79	0.82*	62.04	52.4	IR 58025 A / Jaya	0.82*	0.82*	63.65*	67.5*
TS 6 / Jaya	0.75	0.80*	60.76	49.4	IR 58025 A / BTS 24	0.83*	0.86*	58.71	82.8*
TS 6 / BTS 24	0.84*	0.93*	64.03*	66.7*	IR 58025 A / Vytilla 2	0.83*	0.91*	63.40*	71.4*
TS 6 / Vytilla 2	0.82*	0.83*	62.59	54.0	**GM**	**0.78**	**0.76**	**62.50**	**62.46**
TS 29 / CSR 13	0.73	0.79	64.13*	63.0	**CD (0.05)**	**0.04**	**0.04**	**0.83**	**2.08**
TS 29 / CSR 27	0.65	0.75	63.43*	70.8*					

*** Significant at 5% leve**

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