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Studies on the Comparative Tolerance of Minor Millets to Saline Irrigation

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ABSTRACT

Pot culture studies were undertaken to study the relative tolerance of minor millets to salinity. The results revealed that among the four crops tried Kudiravali was found highly tolerant and the yields were relatively unaffected. Panivaragu and Thenai were next in order to salinity tolerance. Samai was found highly susceptible to salinity. The varieties PC. 49 (Kudiravali) CO. 3 (Thenai) and Cul. 196 (Panivaragu) were tolerant upto 3000 ppm of salt concentration and yielded normally.

INTRODUCTION

Irrigation water with the presence of excessive concentration of salts in soil severely inhibits or entirely prevents plant growth. In India, Agarwal and Gupta (1963) reported that different crops and their varieties exhibited differential tolerance to salinity. Crops are also known to differ in tolerence to salinity at germination (Bhumbla *et al.*, 1968). Morachan *et al.* (1971) reported that grain yield decreased with increase in salinity. Kaliappan *et al.* (1967) found varietal difference to salinity and increased duration from sowings to panicle emergence with increased salt concentration. Grain setting was progressively decreased with increased salt concentration (Kaliappan and Rajagopal, 1968). Number of panicle was reduced due to increased soil salinity (Balasubramaniam, 1965 and Desai and Rao, 1957). Hence a study on the influence of saline water on different crops and varieties will give useful information on their response to saline conditions facilitating the selection of tolerant crops and varieties.

MATERIALS AND METHODS

The study was made on the black soil with pH 8 0 and E. C. 1.6 mmhos/ cm. The treatments included original soil and three levels of salinity viz. 600, 3000 and 6000 ppm. of which 600ppm was the wetland water and 3000 and 6000 were obtained by mixing $CaCl_2$, Na_2CO_3, NaCl and $MgSO_4$ in

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proportionate quantities in 100 litre of water Based on the treatment, the required volume of salt solution was added to 50 kg of soil taken in pot of size 1 5 × 1.5 ft Four minor millet crops with two varieties in each viz. Thenai (Var. CO 3 and CO 4), Samai (CO 2 and 307), Panivaragu (Var. CO 1 and 196) and Kudiraivali (K1 and PC 49) were sown on 20 -6—73. After germination, two clumps in each variety were maintained During the crop growth period 15 irrigations with saline water were given as per schedule. Necessary plant protection measures and removal of weeds were done. The crops were harvested and yields recorded. Biometric observations like plant height, number of tillers, number of panicles, grain and chaff weights were recorded.

RESULTS AND DISCUSSION

Thenai: (*Setaria italica*).

Among the two varieties, CO 3 performed better than CO 4. In CO 3, height, number of tillers, panicle and grain weights were significantly superior to the traits of Co 4 variety (Table 1). Among different concentrations of saltwater upto 3000 ppm, yield reduction was not much. However, high concentration of 6000 ppm recorded the lowest readings in height, tiller number panicle number and grain weight upto 3000 ppm. This is in close agreement with the findings of Kaliappan and Rajagopal (1968) that increased salt concentration decreased the yield of ragi

Thenai variety Co 3 can be cultivated with 16 per cent and Co 4 with 17.3 per cent reduction in yield than the control. Under 6000 ppm yield reduction was 67.7 per cent in Co. 3 and 75 per cent in Co 4. Morachan *et al.* (1971) in their work on three varieties of ragi clearly brought out the varietal difference to salinity

Samai (*Panicum milliare*)

The variety Co 2 and Cul. 307 did not differ significantly in yield (Table I). As the concentrations of the salts in irrigation water increased, the yield decreased significantly. The yield reduction is attributed to the decrease in number of tillers and panicles. The height of the plants was also reduced much due to high concentrations. This is in close agreement with the findings of Morachan *et al.* (1971) that higher salt concentration depressed the plant height. There was a spectacular increase in the chaff weight as the concentration of the salts increased and the chaff weight was equal to the grain weight. The varieties and concentration interaction was also significant. The varieties and concentration interaction was also significant Both the variety CO 3 and Cul. 307 recorded maximum grain weight in the lowest concentration of salt water (600 ppm). As concentration increased to 3000 and 6000 ppm the chaff weight was more pronounced. Reduction in grain setting in rice due to increased salinity levels reported by Balasubramanian (1965) supports the present findings of increased chaffyness due to increased salinity. In the variety CO 3, the grain weight and

TABLE 1. Yield and yield attributes of crops under different salt concentration

	Plant height (cm)	No. of Tillers	Number of panicle	Grain Weight (g)	Chaff weight (g)
	1	2	3	4	5
Thenai					
Co 3	94.30	10.80	15.06	4.25	0.843
Co 4	78.25	9.70	9.20	2.52	0.510
S. E.	0.26	0.11	0.14	0.09	0.012
C. D.	0.78	0.33	0.41	0.27	0.035
F Test	Sig	Sig	Sig	Sig	Sig
Concentration (ppm)					
600	96.9	12.3	13.99	4.77	0.680
3000	88.4	11.0	12.90	3.98	0.790
6000	73.6	7.5	9.50	1.40	0.560
S. E.	0.32	0.13	0.17	0.11	0.014
C. D.	0.95	0.40	0.50	0.33	0.043
F Test	Sig	Sig	Sig	Sig	Sig
Interaction					
600×Co 3	103.4	12.4	16.9	5.89	0.930
3000	100.6	12.0	16.8	4.95	0.960
6000	78.9	8.0	11.4	1.90	0.640
600×Co 4	90.3	12.1	11.0	3.64	0.430
3000	76.2	10.0	9.0	3.00	0.620
6000	68.2	7.0	7.6	0.910	0.480
S. E.	0.45	0.19	0.24	0 15	0.02
C. D.	1.35	0.56	0.71	0.46	0.06
F Test	Sig	Sig	Sig	Sig	Sig

Table 1 [continued]

	1	2	3	4	5
Samai					
Co 2	99.47	10.23	17.73	1 47	0.83
Cul 307	89.30	12.27	16.33	1.39	0.72
S. E.	0.37	0.187	0.22	0.06	0.02
C. D	1.11	0.5b	0.66	...	...
F Test	Sig	Sig	Sig	N. S.	N. S.
Concentration [ppm]					
600	101.15	13.50	24.60	1.85	0.465
3000	110.25	9.25	14.10	1 39	0.795
6000	71.75	10.90	12.40	1.04	0.934
S. E.	0.45	0.23	0.27	0.07	0.025
C. D.	1.36	0.69	0.81	0.213	0.074
F Test	Sig	Sig	Sig	Sig	Sig
Interaction					
600 × Co 2	100.1	13.00	25.2	2.09	0.410
3000	115.4	8.50	13.0	1.28	0.820
6000	82.9	9.20	15.0	1.05	1.030
600 × Cul 307	102.2	14.0	24.0	2.08	0.520
3000	105.1	10.2	15.2	1.62	0.770
6000	60.1	12.6	9.8	1.50	0.865
S. E.	0.64	0.32	0.38	0.10	0.35
C. D.	1.93	0.98	1.15	0.30	0.106
F test	Sig	Sig	Sig	Sig	Sig

Table 1 [continued]

	1	2	3	4	5
Panivaragu					
Co 1	41.33	15.33	23.0	2.90	0.950
Cul 196	32.00	21.42	26.67	4.00	0.766
S. E.	0.22	0.19	0.24	9.09	0.062
C. D.	0.65	0 57	0.73	0.27	0.051
F Test	Sig	Sig	Sig	Sig	Sig
Concentration [ppm]					
600	45.0	28.0	34.5	5.25	0.715
3000	38.5	17.5	28.0	3.40	0.992
6000	26.5	9.63	12.0	1.70	0.914
S. E.	0 27	0.23	0.29	0.11	0.021
C. D.	0.80	0.71	0.89	0.34	0.065
F test	Sig	Sig	Sig	Sig	Sig
Interaction					
600 × Co 1	148.0	23.0	32 00	4.80	0.999
3000	41.0	14.0	26.00	2.60	1.002
6000	35.0	9.0	11.00	1.30	0.940
600 × Cul 196	42.0	33.0	37.0	5.70	0.431
3000	36.0	21.0	30.0	4.20	0.981
6000	18.0	10.25	13.0	2.10	0.869
S. E.	0.38	0.33	0.42	0.03	
C. D.	1.13	1.00	1.26		0.088
F test	Sig	Sig	Sig		Sig

Table 1 [continued]

	1	2	3	4	5
Kudiravali					
K1	104.33	5.83	6.07	9.37	1.971
Cul 49	112 00	6.50	6 53	11.63	1.858
S. E.	1.06	0.06	0.09	0.08	0.032
C. D.	3.21	0.19	0.28	0.26	0.96
F test	Sig	Sig	Sig	Sig	Sig
Concentration [ppm]					
600	122.0	7.95	7.40	13.45	1.963
3000	111.5	5.85	7.00	10.50	1.959
6000	91.0	4.70	4.50	7.55	1.823
S. E.	1.30	0.08	0.11	0.10	0.040
C. D.	3.93	0.23	0.34	0.32	0.120
F Test	Sig	Sig	Sig	Sig	Sig
Interaction					
600 × K1	120.0	7.8	7.20	13.10	1.980
3000	104.0	5.3	6.00	9.70	2.042
6000	89 0	4.4	5.00	5.30	1.872
600 × P C 49	124.0	8.1	7.60	13.80	1.945
3000	119.0	6.4	8.00	11.30	1.876
6000	93.0	5.0	4.00	9.80	1.754
S. E.	1.84	0.11	0.16	0.15	
C. D.	5.56	0.32	0.49	0.45	
F Test	Sig	Sig	Sig	Sig	

chaff weights were in equal proportion i e. 1:1.

Panivaragu. *(Panicum milliaceum)*

The two varieties of Panivaragu (Co 1 and Cul. 196) differed significantly in their tolerence to saline irrigation (Table 1). Cul. 196 recorded maximum grain weight which was influenced by the increased number of panicles and tillers. The concentration of salt water also had pronounced effect in lowering the yield. At 3000 ppm there was 35.3 per cent reduction in yield and in 6000 ppm the yield reduction was 67.7 per cent. At 600 ppm maximum grain weight was recorded in Cul. 196. At 3000 ppm Cul. 196 faired better than Co 1. This revealed the suitability of the variety at medium salt concentration. At 6000 ppm more than 50 per cent reduction in yield was noticed in both the varieties. The chaffness increased with the increase in salinity level.

Kudiravali *(Echinoloa colona)*

P C 49 was significantly superior over K_1 in yield and its attributes (Table 1). Here also, as concentration increased, yield reduction was marked. There was an yield reduction of 22.1 and 44 per cent respectively for 3000 and 6000 ppm. The reduction in height, tillers and panicle number were significant as salinity levels increased. Among the two varieties PC 49 performed better in all the three concentrations than K1. The varietal difference to salinity was already reported by Kaliappan and Rajagopal (1967) and Morachan *et al.* (1971) that ECW 840 was more influenced by salinity when compared to Co 7 and Co 8. The yield reductions at 3000 and 6000 ppm in varieties P C 49 and K1 were 18.2 and 29 per cent respectively proving their suitability at higher concentrations. The chaff weight did not differ significantly.

The decrease in yield due to higher salt concentration in irrigation water was due to the cumulative effect of decrease in plant height, reduction in the number of tillers and panicles. This has been reported by Kaliappan and Rajagopal (1967) and Morachan *et al.* (1971). These trends were noticed in all the crops tried in this experiment at 6000 ppm. The varietal difference among the crop varieties may be due to their genetic make up of the plant.

Improved varieties of Kudiravali P C 49, Thenai Co 3 and Panivaragu Cul. 196 showed tolerance upto 3000 ppm salinity and yielded normally.

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