phosphorus and available potassium respectively was judged by the simple correlation coefficients with yield. $KMnO_4$ - N method recorded a correlation r = 0.578**, while Olsen - P reflected r = O.643** and NH_4OAc - K registered r = O.862** with yield.

Uptake :
UN = 58.6387 + 0.1388 (r = 0.164 NS)
UP = -0.3781 + 0.4694 (r = 0.779**)
UK = -0.2782 + 0.1709 (r = O.863**)
(where UN, UP and UK represent uptake of nitrogen, uptake of phosphorus and uptake of potassium)

Similar relationship with uptake as dependent variable was worked out for available nitrogen, available phosphorus and available potassium. The Olsen - P established significant correlation with r = 0.779**, while the influence of $KMnO_4$ - N on uptake of nitrogen was non-significant.

It was concluded that the methods - $KMnO_4$-N Olsen - P and NH_4OAc - K were good indices in predicting the soil available N, P and K as judged by the correlation/regression with pod yield and uptake of N, P and K using test crop of groundnut.

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EFFECT OF SALINITY AND SODICITY OF WATERS USED FOR SUPPLEMENTAL IRRIGATION ON SOIL PROPERTIES AND GROWTH OF PEARL MILLET (*Pennisetum americanum* L. (Leeke)

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ABSTRACT

A pot experiment was conducted during the *kharif* season of 1988-89 to find out the effect of levels of EC (3, 6 and 9 dSm^{-1}) and Adj. SAR of supplemental irrigation waters (15, 30, 45 and 60) on soil properties (ECE, SAR, ESP and pH), plant height, number of tillers per plant, test weight, grain and stover yield of three varieties (HLBH-10, MH-169 and MBH-130) of pearl millet. The increasing levels of EC and Adj.SAR of irrigation waters increased the ECe, SAR and ESP of soil. The pH of soil increased with increasing Adj. SAR while it decreased with increasing level of EC of irrigation water. The increasing levels of EC and Adj. SAR of irrigation water decreased the plant height, number of tillers per plant, test weight and grain and stover yield. The maximum plant height, tillers, test weight and grain and stover yield were observed in HLBH-10, followed by MH-169 and MBH-130.

It is well established that salinity and sodicity of irrigation water or soil limit the growth and development of plants and even cause premature termination of life cycle while altering their morphological, physiological and biochemical attributes. On the other hand, there are certain plants which grow vigorously and produce more dry matter under such conditions than the other plants. Even the different varieties of particular species may exhibit differential behaviour in this regard (Joshi and Singh, 1975). Thus, selection and growing of salinity and sodicity tolerant varieties is one of the most important practices for salt affected soils or under irrigation with poor quality waters.

Table 1. Composition of irrigtion waters

EC	SAR	pHC	Adjusted SAR	Cations (me/l)				Anions (me/l)			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	SO_4^{--}	HCO_3^{-}	CO_3^{--}
3	5.18	6.50	15.01	7.70	7.78	14.44	0.2	15	5	8	2
3	11.65	6.82	30.05	3.75	3.75	22.50	0.2	15	5	8	2
3	20.06	7.15	45.13	1.75	1.76	26.48	0.2	15	5	8	2
3	30.76	7.44	60.28	0.85	0.85	28.30	0.2	15	5	8	2
6	4.70	6.20	15.04	19.60	19.60	20.80	0.2	40	10	8	2
6	10.00	6.40	30.00	12.40	12.40	35.20	0.2	40	10	8	2
6	16.20	6.60	45.08	7.70	7.70	44.60	0.2	40	10	8	2
6	23.73	6.85	60.50	4.60	4.60	50.80	0.2	40	10	8	2
9	4.42	6.00	15.02	32.40	32.40	25.20	0.2	65	15	8	2
9	9.10	6.10	30.03	23.10	23.10	43.00	0.2	65	15	8	2
9	14.56	6.30	45.13	15.95	15.95	58.10	0.2	65	15	8	2
9	20.66	6.50	59.91	10.90	10.90	68.20	0.2	65	15	8	2

As new varieties of different crops are being released year after year, the screening of varieties for salinity and sodicity tolerance has to be a continuous process. Keeping this in view, the study was undertaken to know the tolerance behaviour of different varieties of pearl millet at different levels of salinity and sodicity.

MATERIALS AND METHODS

Twelve irrigation waters consisting of three levels of EC_{IW} (3.0, 6.0 and 9.0 dSm^{-1}) and four levels of Adj. SAR_{IW} (15, 30, 45 and 60) were prepared by adding varying quantities of different salts like $CaCl_2$, $MgCl_2$, NaCl, $MgSO_4$, Na_2CO_3, KCl and $NaHCO_3$ (Table 1). Calculated amounts of these salts were added in the original water to get the required EC_{IW} and Adj.SAR_{IW}. Eight kg of soil was filled in each galvanised cylindrical pot. The soil used for the experiment was loamy sand in texture with a pH of 7.8, organic carbon content of 0.25 per cent, available amount of N, P_2O_5 and K_2O were, respectively 67.5, 7.5 and 72.40 mg kg^{-1}, EC_e of 2.10 dSm^{-1} at 25° C, SAR of 10.80 and ESP of 10.70. Before sowing, a total quantity of P at the rate of 4 g P_2O_5 m^{-2} and K at the rate of 2 g K_2O m^{-2} were applied through single superphosphate and muriate of potash, respectively. The nitrogen at the rate of 8 g m^{-2} was applied through urea in split doses, *viz.*, 1/3 at the time of sowing, 1/3 at tillering stage and 1/3 at the time of ear formation stage.

The seeds of three varieties of pearl millet, *viz.*, HLBH-10, MH-169 and MBH-130 were sown on July 18, 1988 at the rate of 10 seeds per pot. After germination, only three plants were maintained up to maturity. The measured amount of each water having desired level of EC and Adj. SAR was used to irrigate the crop. Five irrigations as per treatments were given to crop during drought period. The total depth of water applied during the experimental period was 15 cms.

The crop was harvested on 21.10.1988. The data on plant height, number of tillers and test weight and grain and stover yields were recorded. After harvesting the crop, total soil in the pot was mixed and representative samples were collected from each pot separately and analysed for determining ECe, SAR, ESP and pH by following the standard laboratory methods.

RESULTS AND DISCUSSION

Soil properties

The ECe, SAR and ESP of soil increased significantly with increasing EC and Adj. SAR of irrigation water (Table 2). The ECe of soil at the end of the experiment was less than the EC of corresponding irrigation water. The pH of saturated paste of soil increased significantly with increasing Adj. SAR of irrigation water while it decreased significantly with increasing levels of EC of irrigation water.

As explained above the ECe of soil was increased with increasing EC of irrigation water. However, the ECe of soil was equal to or less than that of corresponding irrigation water. This is due to the high hydraulic conductivity and low field capacity (11.5%) of soil. The results are in

Table 2. Effect of EC_{IW}, Adj. SAR_{IW} and varieties on ECe, SAR, ESP and pH of soil

Treatments	ECe (dsm^{-1})	SAR	ESP	pH
EC of irrigation water				
EC_{IW} (dsm^{-1})				
3	1.36	22.29	24.50	8.81
6	5.26	26.35	27.71	8.69
9	8.06	30.00	28.62	8.59
SEm ±	0.109	0.166	0.166	0.056
CD at 5%	0.308	0.469	0.469	0.158
Adjusted SAR				
(Adj. SAR_{IW})				
15	5.03	12.02	12.14	8.34
30	5.16	20.07	19.97	8.52
45	5.27	30.07	33.31	8.16
60	5.43	42.59	42.36	9.16
SEm ±	0.126	0.192	0.192	0.065
CD at 5%	0.355	0.543	0.549	0.183
Varieties				
HLBH-10	5.35	26.20	26.93	8.67
MH-169	5.23	26.22	26.95	8.70
MBH-130	5.09	26.23	26.96	8.72
SEm ±	0.109	0.166	0.66	0.056
CD at 5%	NS	NS	NS	NS

NS : Not significant

agreement with those of Chandra Deo and Lal (1982) who reported an increase in ECe of loamy sand soil with an increase in EC of irrigation water. The ECe of soil at Adj. SAR 60 was significantly more than the ECe at Adj.SAR 15. The increase may be due to decrease in hydraulic conductivity with high Adj. SAR of irrigation water (Kanwar and Kanwar, 1968).

The SAR of saturation extract of soil increased with increase in EC of irrigation water. This may be due to the fact that during accumulation of salts due to irrigation and evaporation, the ratio of sodium to calcium is changed resulting into higher SAR value of saturation extract of soil. The observed increase in SAR of saturation extract of soil with increase in Adj. SAR of irrigation water may be due to the loss of calcium from the soil either by precepitation or absorption by the plants. The waters used in the experiment were rich in sodium which increased the proportion of sodium and ultimately increased the SAR of saturation extract of soil.

The ESP of soil increased with an increase in EC and Adj.SAR of irrigation water. This may be due to the fact that water of high Adj. SAR increase the proportion of sodium over calcium and magnesium. The adsorption of sodium on the colloidal complex is greatly affected by its concentration in the soil solution and its proportion to other cations. So an increase in ESP of soil with water of higher Adj. SAR is due to the replacement of calcium and magnesium from the colloidal complex by the sodium of irrigation water.

As explained earlier, the pH of soil increased with increase in Adj.SAR and decreased with EC of irrigation water. This may be due to the increase in Adj. SAR of irrigation water which increased the SAR of saturation extract of soil and ESP of soil and thus increased the pH of soil. The observed decrease in pH with increasing EC_{IW} may be due to the repression of thickness of the diffused double layer at higher concentration of soluble salts in the soil. The results are in agreement with the findings of Kanwar and Kanwar (1968) who reported that the increase in EC of irrigation water lowered the pH of saturation paste of soil.

Yield and yield attributes In general, plant height, number of tillers, test weight, grain and stover yield decreased with increasing levels of EC and Adj. SAR of irrigation water (Table 2). The maximum plant height, test weight and grain and stover yield were observed in case of HLBH-10 followed by MH-169 and MBH-130.

The reduction in yield and yield attributes at higher levels of salinity is due to increased osmotic pressure of soil solution which in turns restricted moisture availability to the plants (Maliwal and Paliwal, 1971). The plant height, tillers, test weight and grain and stover yield decreased with increase in Adj.SAR of irrigation waters due to poor physical condition and nutritional imbalance. Further, the excessive uptake of sodium may lead to denaturation of protein in the cell which is detrimental for growth and development of plants.

The difference in varietal response regarding above parameters under saline and sodic conditions is due to their inherent characteristics to tolerate salinity and sodicity. The maximum plant height, tillers, test weight and grain and stover yield were observed with the variety HLBH-10 as compared to MH-169 and MBH-130 because of its genetic characteristics of tolerating salinity and sodicity.

Table 3. Effect of EC_{iw}, Adj. SAR_{iw} and varieties on plant height, tillers, test weight and grain and stover yield of pearl millet

Treatments	Plant height (cm)	Tillers (per plant)	Test weight (1000-grains)	Grain yield (g pot^{-1})	Stover yield (g pot^{-1})
EC of irrigation water					
EC_{iw} (dsm^{-1})					
3	136.33	2.61	7.07	27.16	95.23
6	125.57	1.94	6.30	24.79	83.53
9	112.14	1.42	5.38	21.51	64.86
SEm ±	0.163	0.102	0.045	0.079	0.054
CD at 5%	0.459	0.287	0.126	0.223	0.153
Adjusted SAR					
(Adj. SAR_{iw})					
15	130.42	1.77	6.85	26.22	90.02
30	125.94	1.61	6.37	24.74	82.32
45	122.97	1.36	6.08	23.98	78.31
60	119.38	1.22	5.69	23.00	74.17
SEm ±	0.188	0.188	0.052	0.092	0.063
CD at 5%	0.526	0.332	0.146	0.258	0.177
Varieties					
HLBH-10	127.45	2.22	6.66	26.03	90.17
MH-169	125.02	1.97	6.62	24.87	77.81
MBH-130	121.65	1.77	5.86	22.56	75.64
SEm ±	0.163	0.102	0.045	0.079	0.054
CD at 5%	0.459	0.287	0.126	0.022	0.153

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SEED YIELD OF *Amaranthus* VAR. KANNARA LOCAL UNDER PARTIAL SHADE

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ABSTRACT

Studies on the influence of shade on growth and seed yield of *Amaranthus tricolor* var. *kannara local* indicated that an increase in shade significantly decreased the plant height, spike length and seed yield per plant. Growth and seed yield were highest in plants grown in open condition.

In seed production programme, seed yield per plant is very important. Among several factors affecting the yield, strong dependance on solar radiation was noticed by several workers (Venkateswaralu, 1977 ; Janardhan and Murthy, 1980). However, information on the performance of amaranth under varying degrees of shade is rather meagre. Therefore, an experiment was carried out at the Banana Research Station, Kerala Agricultural University, Kannara, to study the scope of amaranth culture and its yield potential in seed under shade.