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EFFECT OF SALT SOLUTIONS ON THE PERFORMANCE OF "JAVA CITRONELLA"

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ABSTRACT

Salt solutions viz., NaCl, $CaCl_2$, $MgCl_2$, $NaHCO_3$ and Na_2CO_3 affected tillers/plant and herb yield of 'Java citronella' *(Cymbopogon martini)*. More than 30% herb yield reduction was recorded with Na_2CO_3 in comparison to $CaCl_2$, $MgCl_2$, NaCl and Na_2SO_4. Various salts also affected the chemical composition significantly in second harvest. Ionic nature of salt solutions affected nutrient uptake significantly and $CaCl_2$ and $MgCl_2$ were found to have more favourable dominating effect whereas, Na_2CO_3 the least.

INTRODUCTION

Salt effects on plants mainly depend on the length of time for which the plants are exposed to the nature of ionic concentration. Some literature is available to explain the effect of ionic nature of solutions on field crops (Agarwal et al. 1964) but effect is unknown in case of "Java citronella" (*Cymbopogon martini*) which is an aromatic grass (perennial herb with fibrous roots). It thrives well in tropical and sub-tropical climates and oil extracted from it is used extensively in soap, perfumery, cosmetics and flavouring industries in the world. Keeping in view the importance of this herb, the present study was undertaken to see the effect of various salt ions on the performance of "Java citronella" and also the the effect on pH and ECe of the soil.

MATERIAL AND METHODS

The experiment was conducted in a sandy loam soil having pH 7.9, organic carbon 0.12%, ECe 1.65 dSm^{-1}, available N 76 kg ha^{-1}, available P_2O_5 17.6 kg ha^{-1}, available K_2O 460 kg ha^{-1}. The microplots (2x2 m) were prepared for the planting of slips of "Java citronella" were separated by polythene sheet upto 90 cm depth and were irrigated continuously for one day for the setting of exposed soil. Six types of salt solutions having 80 meL^{-1} concentration were prepared by dissolving, NaCl, $CaCl_2$, $MgCl_2$, Na_2SO_4, $NaHCO_3$ and Na_2CO_3. The N, P and K were applied @ 80, 40 and

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30 kg ha^{-1}, respectively. The slips were planted on 15th July 1987 in microplots. In each micro plot nine plants were maintained. Salt solutions were applied seven times during the study period (just after transplanting on 15th July, 16th August, 20th October, 12th November, 5th December 1987, 8th February and 20th April 1988). Ordinary water was also applied after 15 days of every saline water irrigation. The observations on height and number of tillers/plant were recorded at monthly interval. The herb samples (harvested in January 1988 and June 1988) were washed with water, dried (65° C) and their fresh and dry weight recorded. The oil content of herb was extracted by distillation process (Clavenger's glass apparatus). N, P, K, Ca, Mg and Na in herb samples were estimated by following the methods outlined by Piper (1966). Soil samples (0-15 and 15-30 cm depth) were taken at the time of first and second harvest to see the changes with respect to pH and ECe by adopting standard procedures.

RESULTS AND DISCUSSION

Effect on height and tillers

Significant effect of salt solutions on height was observed after six months of irrigation (Fig. 1). Maximum height and number of tillers were found with $CaCl_2$ treatment. Comparatively less plant height and tillers were recorded with HCO_3 and CO_3 in comparison to Cl and SO_4. Such depressing effects of CO_3 and HCO_3 on plant growth have also been reported by Gupta (1964).

Fresh and dry weight

Salt solution significantly affected the fresh and dry weights of "Java citronella" during both the harvests. Effect of $CaCl_2$ solution dominated followed by $MgCl_2$ (Fig. 2). Among Na salts Cl and SO_4 enhanced significantly the fresh weight of herb as compared to CO_3 and HCO_3 during January 1988. The fresh herb yield reduced to the extent of 77.5, 66.7, 54.7, and 43.1% in January 1988 and 86.1, 69.6, 33.3 and 45.0 % in June 1988 by Na_2CO_3 in comparison to $CaCl_2$, $MgCl_2$, NaCl and Na_2SO_4, respectively. This infers that Cl and SO_4 anions are less harmful than CO_3 and HCO_3 and secondly Ca and Mg cations have beneficial effect over Na. These results are in confirmity with Agarwal et al. (1964) and Bhambota and Kanwar (1970).

Oil yield

More oil yield was found with $MgCl_2$ and $CaCl_2$ in comparison to Na_2CO_3, $NaHCO_3$ and Na_2SO_4 (Fig.2). NaCl and Na_2SO_4 also enhanced significantly the oil production as compared to Na_2CO_3 and $NaHCO_3$ in first cut. The reduction in oil yield with Na_2CO_3 and $NaHCO_3$ can be ascribed to the low herb yields with these salt solutions in comparison to others.

Chemical composition and nutrient uptake

Results on chemical composition and nutient uptake are given in Table 1 & 2.

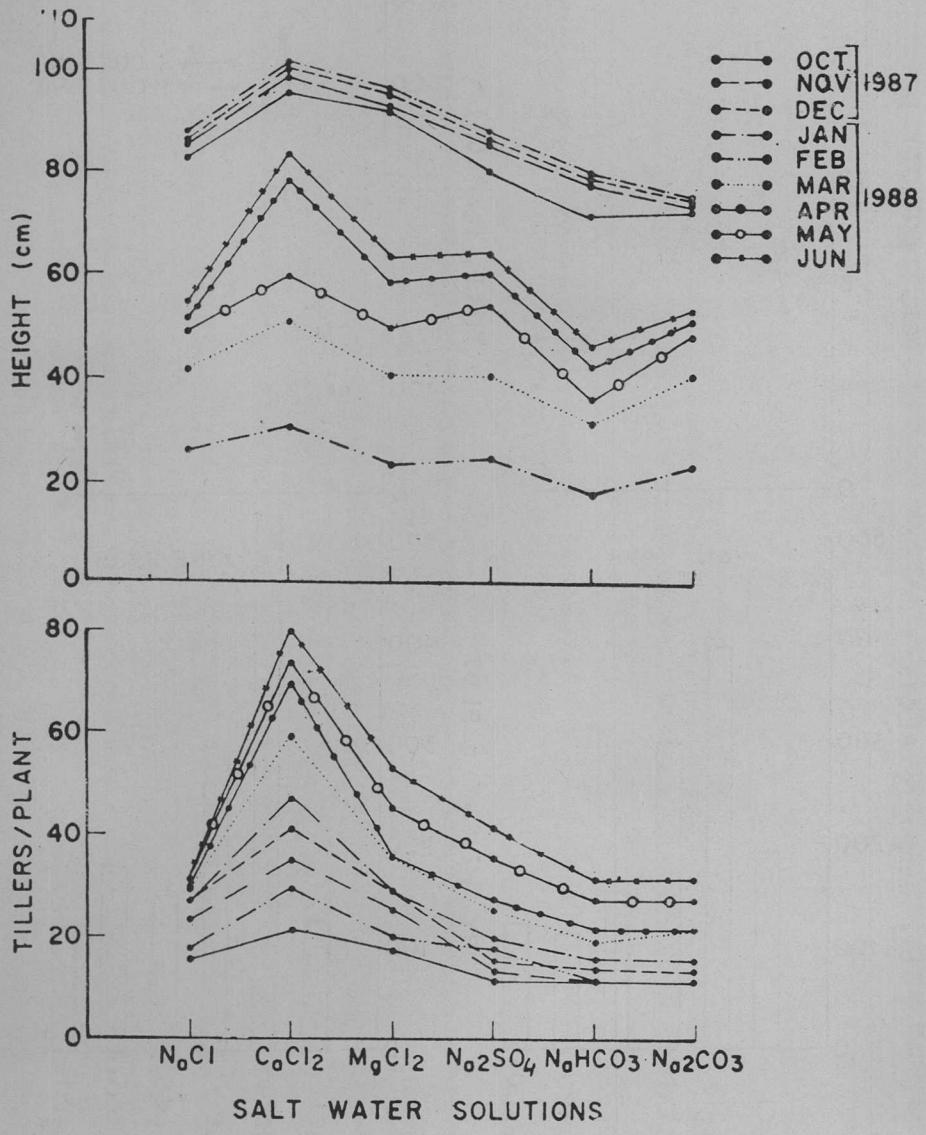

Fig. 1 Effect of Salt solutions on height and tillers/plant of Javacitronella

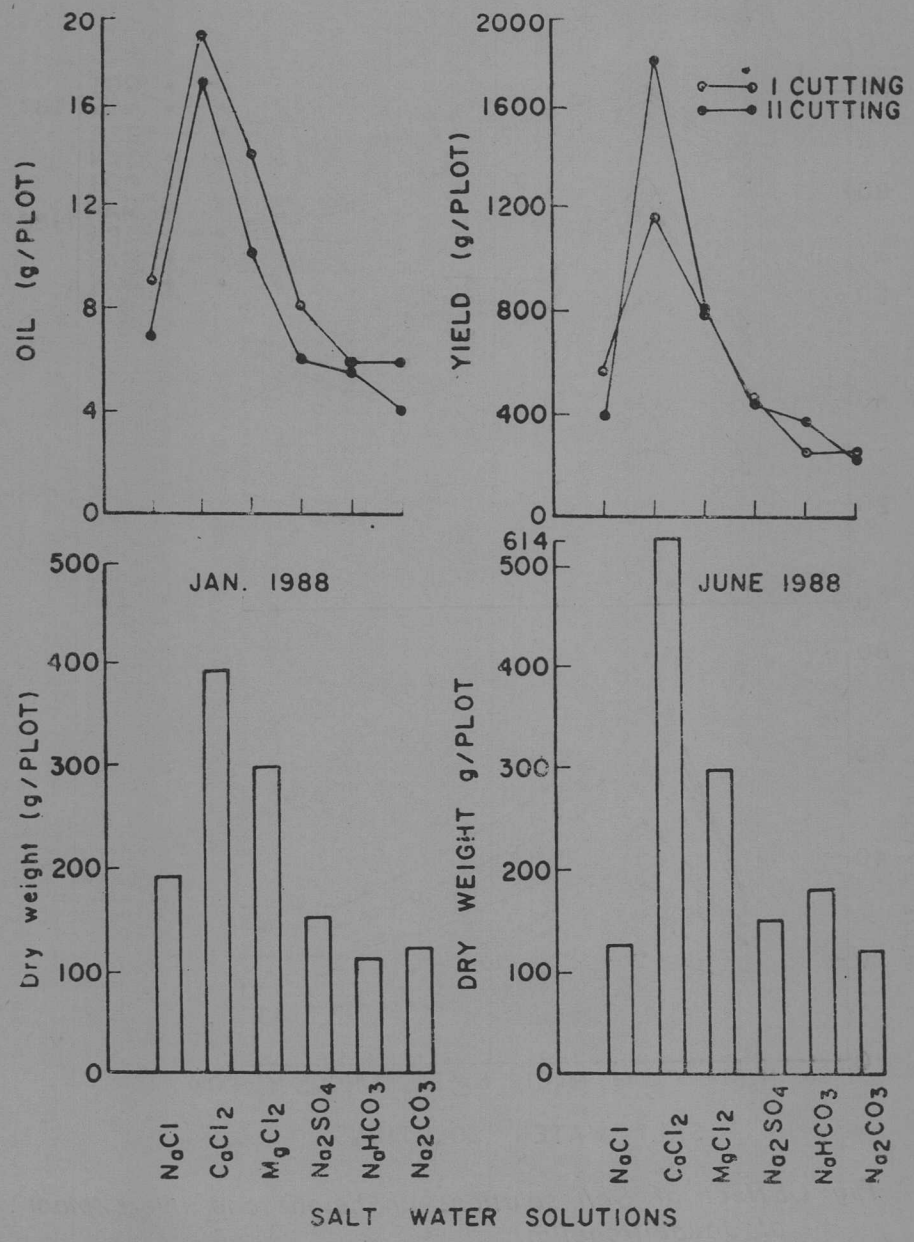

Fig. 2 Effect of Salt solutions on oil production (g/plot' herb yield and dry weight (g/plot) of Javacitronello

Table 1. Effect of salt solutions on mineral composition of "Java citronella" during January 1988 (1) and June 1988 (2)

Salt solution	Mineral composition (%)											
	N		P		K		Na		Ca		Mg	
	1	2	1	2	1	2	1	2	1	2	1	2
NaCl	2.75	1.0	0.56	0.56	0.86	1.38	0.33	0.40	0.66	1.20	0.27	0.46
$CaCl_2$	2.82	2.2	0.70	0.88	1.16	1.90	0.34	0.14	1.06	1 40	0.31	0.49
$MgCl_2$	1.85	1.6	0.91	0.98	1.34	1.16	0.33	0.12	0.93	1.50	0.35	0.58
Ng_2SO_4	2.62	1.6	0.61	0.62	1.17	0.60	0.32	0.20	0.70	0.30	0.19	0.43
$NaHCO_3$	3.12	2.9	0.57	0.76	0.89	0.96	0.37	0.32	0.60	1.00	0.26	0.55
Na_2CO_3	0.61	2.6	0.83	0.82	0.88	0.92	0.51	0.36	0.60	0.90	0.22	0.27
CD 5%	1.17	1.2	0.22	0.02	NS	0.12	0.03	0.08	0.13	0.30	NS	0.08

NS = Non significant.

Table 2. Effect of salt soultions on mineral uptake of "Java citronella" during January 1988 (1) and June 1988 (2)

Salt Solutions	Mineral uptake (g $plot^{-1}$)											
	N		P		K		Na		Ca		Mg	
	1	2	1	2	1	2	1	2	1	2	1	2
NaCl	5.09	1.26	1.10	0.72	1.69	1.77	0.65	0.56	1.42	1.56	0.53	0.59
$CaCl_2$	10.93	12.38	2.86	5.33	4.66	11.83	1.35	0.82	4.18	9.01	1.07	3.00
$MgCl_2$	5.59	4.99	2.70	2.88	3.95	3.38	0.99	0.35	2.75	4.16	1.05	1.70
Na_2SO_4	4.31	2.42	0.97	0.97	1.87	0.95	0.49	0.32	1.09	2.01	0.32	0.67
$NaHCO_3$	3.65	5.28	0.67	1.40	1.04	1.76	0.43	0.58	0.70	1.81	0.30	1.01
Na_2CO_3	0.74	3.22	0.48	1.03	1.08	1.18	0.62	0.46	0.73	1.06	0.28	0.34
CD 5%	3.68	4.18	1.02	1.26	1.27	2.59	0.11	0.25	0.90	2.76	0.34	0.65

Nitrogen

The N content of the herb was significantly affected with NaCl, $CaCl_2$, $MgCl_2$ and Na_2SO_4 as compared to Na_2CO_3. Maximum average uptake was noted with $CaCl_2$ followed by $MgCl_2$ and minimum with Na_2CO_3. This is due to favourable growth and high herb yield with $CaCl_2$. Favourable effect can be rated as $CaCl_2$ > $MgCl_2$ > Na_2SO_4 > NaCl > Na_2CO_3 (mean of two harvests).

Phosphorus

Maximam average P concentration was found with $MgCl_2$ followed by $CaCl_2$ whereas P uptake g $plot^{-1}$ was maximum in $CaCl_2$ followed by $MgCl_2$.

Potassium

Maximum average K-concentration and uptake g $plot^{-1}$ was observed in $CaCl_2$ treatment followed by $MgCl_2$. The K-content varied from 0.86 to 1.34% in January 1988 and 0.60 to 1.90% in June 1988. Reduction in K content with CO_3 and HCO_3 may be because of increase in ESP (Agarwal et al. 1964).

Sodium

Accumuation of Na content was significantly higher with CO_3, HCO_3 and Cl ions associated with Na. Maximum average Na content was found in Na_2CO_3 followed by NaCl application. Because of more dry matter production with $CaCl_2$ and $MgCl_2$ the Na uptake was also observed more in $CaCl_2$ followed by $MgCl_2$ treatments Higher Na content with sodium salt solutions have also been reported by Agarwal et al. (1964).

Calcium

Maximum average Ca content was found with $CaCl_2$ followed by $MgCl_2$ and minimum with Na_2CO_3. Almost, the same pattern was observed for Ca uptake. It was observed that Ca concentration increased with $CaCl_2$ and $MgCl_2$ applications at early stages of growth as compared to NaCl, Na_2SO_4 and $NaHCO_3$. Higher concentration of Na in solutions decreased the accumulation of Ca in tissues and this is in confirmity with the finding of Cerda et al. (1977).

Magnesium

Maximum average Mg concentration was observed in $MgCl_2$ treatment and minimum with Na_2CO_3. Mg content varied from 0.19 to 0.35% in January 1988 and from 0.27 to 0.58% in June 1988. The increase in Mg content was noticed in the later period of growth. The decreased Mg uptake with NaCl, Na_2CO_3 and Na_2SO_4 has also been earlier reported by Bhambota and Kanwar (1970).

Effect on ECe and pH of soil

Higher ECe and pH values were observed in surface samples than sub-surface (Table 3). Increased ECe values were observed in the soil at the second cut in comparison to the first cut however, pH values remained unchanged. It is also observed that Cl and SO_4 anions enhanced ECe values as compared to CO_3 and HCO_3 but this trend reversed for pH values. The average ECe values for surface soil were 1.6 and 2.0 times with chloride to that of $NaHCO_3$ and Na_2CO_3 after 52 weeks.

Table 3. Effect of ionic nature of salt solutions on ECe and pH of soil.

Salt solutions	Soil depth (cm)	First cut		Second cut	
		ECe (dSm^{-1})	pH	ECe (dSm^{-1})	pH
NaCl	0-15	10.8	8.7	13.8	8.7
	15-30	10.8	8.4	8.5	8.6
$CaCl_2$	0-15	11.2	8.6	14.2	8.7
	15-30	11.0	8.5	8.2	8.5
$MgCl_2$	0-15	11.0	8.7	14.0	8.9
	15-30	9.0	8.4	10.2	8.3
Na_2SO_4	0-15	10.5	8.6	14.5	8.7
	15-30	9.5	8.7	10.0	8.6
$NaHCO_3$	0-15	7.0	9.2	8.6	9.6
	15-30	6.5	9.3	5.6	9.1
Na_2CO_3	0-15	5.8	9.4	6.8	9.8
	15-30	4.3	9.2	4.4	9.4

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