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Effect of Saline Water and Fertility levels on Calcium, Magnesium and Zinc Contents and their uptake by Lemongrass

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Abstract

A field experiment was conducted to study the effect of irrigation water salinity and fertility levels on the calcium, magnesium and zinc contents and their uptake values in lemon grass at various harvests. The irrigation water salinity EC 10dSm^{-1} decreased significantly the contents and uptake values of Ca, Mg and Zn as compared with low levels of salinity. The fertility level N_{120} + P40 + K40 + Zn25 enhanced significantly the Ca, Mg and Zn contents and their uptake values in all four harvests of lemongrass.

Key words

Saline Water, Fertility levels, nutrient content and uptake, lemon grass.

Introduction

Optimum status of available nutrients irrespective of source is essential in soil for proper plant growth and production in normal as well as under salt stressed environment. Besides high osmotic pressure of soil solution in root zone, there is often an imbalance and low availability of nutrients in saline environment[7], which is responsible for poor growth and imbalance nutrient composition of crop plants and supplemental fertilizer application has proved to overcome such effects [1]. This paper will contribute information on effect of saline water and fertility levels on the concentration of Ca, Mg and Zn and their uptake in case of lemon grass.

Material and Methods

A microplot experiment was conducted for two years on a sandy loam soil having organic carbon 1.4 g kg^{-1}, available N 168.0, available P 12.5 available K 212.0 kg ha^{-1} and available zinc 0.52 mg kg^{-1}. The three levels of EC (canal water (S_1), 5 (S_2) and 10 dSm^{-1} (S_3) and nine levels of fertility control (F_1), 60 kg N ha^{-1} (F_2), 60 kg N + 40 kg P_2O_5 ha^{-1} (F_3), 60 kg N +40 kg P_2O_5 + 40 kg K_2O ha^{-1} (F_4), 60 kg N + 40 kg P_2O_5 + 40 kg K_2O + 25 kg $ZnSO_4$ ha^{-1} (F5), 120 kg N ha^{-1} (F_6), 120 kg N + 40 kg P_2O_5 ha^{-1} (F_7) 120 kg N + 40 kg P_2O_5 + 40 kg K_2O ha^{-1} (F_8) and 120 kg N + 40 kg P_2O_5 + 40 kg K_2O + 25 kg $ZnSO_4$ ha^{-1} (F_9) were evaluated in split plot design with three replications. The saline waters were prepared by dissolving bicarbonate, sulphate and chloride salts of calcium and magnesium in canal water (EC 0.46 dSm^{-1}). The fertility levels were developed using urea, single super phosphate and muriate of potash and zinc sulphate. The slips of lemon grass were planted on 14th July 1998 at a distance of 45 ´ 45 cm in 2.5 ´ 2.5 m microplots after application of calculated amount of fertilizers. The crop was irrigated with canal water just after planting and thereafter irrigations with treatment water were given. The plant samples of each harvest (first harvest November, 1998, second harvest June, 1999, third harvest November 1999 and fourth harvest June, 2000) were dried and processed for the estimation of Ca, Mg and Zn contents by adopting standard methods. For the calculation of uptake values, the dry matter data were used.

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Results and Discussion

Calcium Content and its uptake :

It is evident from Table 1 that calcium content decreased with each higher level of salinity[6]. On the other hand it is observed that calcium content in lemon grass increased significantly with fertilization during all the four cuttings. The F_2 fertility level increased significantly the calcium content as compared to F_1 level. The F_8 fertility level enhanced significantly the calcium content in lemon grass as compared to other fertility level except F_9 fertility level. This increase in calcium content with fertilization may be due to favourable effect of fertilization on the absorption of calcium by plants. Acrilical examination of data shows that each higher level of salinity caused significant reduction in calcium uptake by lemongrass due to reduction in calcium content and dry matter production with the use of saline water. The maximum calcium uptake by crop was recorded with F_9 fertility level which was significantly higher than other fertility levels due to favourable effect of this fertility level on the calcium content and dry matter production[2].

Magnesium Content and its uptake

It is seen from data given in Table 2 that each higher level of salinity decreased significantly the magnesium content in lemon grass as compared to any preceding lower level of salinity. It might be due to more sodium concentration in solution, which reduced the absorption of magnesium [6]. On the other hand the fertility, level F_6 enhances significantly the magnesium content as compared with any other fertility treatment. The maximum magnesium content in lemon grass was recorded at F_9 fertility level, which was significantly higher than other fertility treatments during all four harvests. Each higher level of salinity reduced significantly the magnesium uptake values as compared to lower levels of salinity. It might have been due to reduction in dry matter production and magnesium content of lemon grass because of adverse effect of salinity. Similar to calcium uptake, the fertility level F_9 enhanced significantly the magnesium uptake values as compared to other fertility treatments[2].

Zinc Content and its Uptake. It is clear from Table 3 that each higher level of salinity decreased significantly the zinc content[5] and its uptake values as compared to lower levels of salinity, which might be due to nutrient imbalance in soil solution. The fertility level F_5 increased significantly the zinc content as compared to fertility treatment F_3, F_4, F_5, F_6, F_7, and F_8 [3]. But treatment F_5 enhanced significantly the zinc uptake values only in comparison to fertility levels F_2, F_3 and F_4. Effect of fertility level F_9 was found beneficial regarding zinc content and its uptake values as compared to generally other fertility treatments. The low values of zinc content at fertility treatments F_2, F_3 and F_4 may be due to nitrogen, phosphorus and potassium rich fertilizer application[4].

Table 1. Effect of salinity levels of irrigation water and fertility levels on the Calcium content and calcium uptake of lemon grass at various harvest stages

Treatments / **Salinity levels**	**Calcium content (%)**				**Calcium uptake (kg/ha^{-1})**			
	Ist	IInd	IIIrd	IVth	Ist	IInd	IIIrd	IVth
S_1	0.32	0.47	0.43	0.49	5.390	25.169	23.195	27.007
S_2	0.21	0.41	0.31	0.42	3.385	20.720	16.215	22.314
S_3	0.19	0.31	0.24	0.32	2.723	12.747	11.141	14.631
SEm ±	0.001	0.001	0.001	0.001	0.031	0.198	0.071	0.080
CD at 5%	0.005	0.005	0.005	0.005	0.120	0.780	0.280	0.310

F_1	0.20	0.35	0.27	0.35	2.133	12.407	9.919	12.444
F_2	0.22	0.38	0.31	0.39	2.557	14.958	13.001	16.253
F_3	0.24	0.38	0.32	0.40	3.271	15.867	14.051	17.916
F_4	0.25	0.40	0.33	0.41	3.962	19.256	17.029	20.952
F_5	0.24	0.39	0.31	0.40	3.708	18.043	15.064	19.253
F_6	0.23	0.39	0.39	0.40	3.631	18.007	15.060	19.325
F_7	0.24	0.41	0.41	0.43	4.460	23.936	21.413	26.745
F_8	0.26	0.43	0.43	0.44	5.236	25.840	22.179	28.266
F_9	0.27	0.45	0.45	0.47	5.533	27.596	23.934	30.702
SEm ±	0.002	0.002	0.002	0.002	0.053	0.343	0.124	0.139
CD at 5%	0.006	0.006	0.006	0.006	0.150	0.950	0.340	0.380

Table 2. Effect of salinity levels of irrigation water and fertility levels on the Magnesium content and Magnesium uptake of lemon grass at various harvest stages

Treatments / **Salinity levels**	**Calcium content (%)**				**Calcium uptake (kg/ha^{-1})**			
	Ist	IInd	IIIrd	IVth	Ist	IInd	IIIrd	IVth
S_1	0.26	0.30	0.37	0.50	4.435	16.143	20.333	27.883
S_2	0.18	0.26	0.26	0.45	2.974	13.361	14.178	24.408
S_3	0.17	0.20	0.20	0.32	2.596	8.064	9.382	14.702
SEm ±	0.001	0.001	0.001	0.002	0.032	0.139	0.092	0.115
CD at 5%	0.005	0.006	0.006	0.007	0.120	0.540	0.360	0.450
F_1	0.17	0.21	0.23	0.34	1.853	7.556	8.368	12.140
F_2	0.18	0.22	0.24	0.36	2.011	8.906	9.966	15.205
F_3	0.18	0.23	0.24	0.38	2.496	9.321	10.705	17.092
F_4	0.21	0.25	0.28	0.43	3.348	12.175	14.169	21.817
F_5	0.21	0.23	0.27	0.40	3.263	10.823	12.907	19.274
F_6	0.20	0.24	0.28	0.41	3.137	11.226	13.226	19.708
F_7	0.21	0.27	0.30	0.45	3.899	15.622	18.858	28.573
F_8	0.24	0.30	0.33	0.51	4.898	18.028	21.158	32.457
F_9	0.25	0.31	0.34	0.53	5.110	19.042	22.323	34.712
SEm ±	0.002	0.002	0.002	0.003	0.055	0.240	0.160	0.200
CD at 5%	0.006	0.007	0.007	0.008	0.150	0.670	0.440	0.550

Table 3. Effect of salinity levels of irrigation water and fertility levels on the Zinc content and Zinc uptake of lemon grass at various harvest stages

Treatments / Salinity levels	Calcium content (%)				Calcium uptake (kg/ha^{-1})			
	Ist	IInd	IIIrd	IVth	Ist	IInd	IIIrd	IVth
S_1	48.75	48.11	46.75	45.26	79.4586	250.8118	249.2445	244.5791
S_2	42.10	40.72	38.92	32.27	67.7605	203.0700	202.9439	194.5584
S_3	36.89	36.33	34.14	33.57	53.2787	146.0850	155.3977	149.9970
SEm ±	0.027	0.043	0.020	0.015	0.418	1.706	0.461	0.401
CD at 5%	0.108	0.170	0.077	0.061	1.641	6.699	1.811	1.575
Fertility levels								
F_1	45.56	44.22	42.49	41.21	49.6164	156.7150	153.7315	144.3808
F_2	44.90	44.21	41.46	40.80	51.4593	174.7000	173.6393	171.2746
F_3	41.79	41.68	40.09	38.85	57.7668	171.1298	176.6206	173.7169
F_4	40.82	40.22	38.36	37.36	65.8079	191.6584	194.2273	189.1112
F_5	45.11	43.90	42.19	40.74	70.0758	201.9406	202.8334	196.7576
F_6	40.72	39.79	38.07	36.72	62.7660	180.7834	170.9357	175.0338
F_7	40.62	39.68	37.85	36.70	73.6634	230.4639	238.1436	229.6674
F_8	40.58	39.68	38.35	36.81	82.6580	235.9026	242.4617	233.4926
F_9	43.16	42.10	40.56	39.10	87.6799	256.6064	261.1652	253.9687
SEm ±	0.048	0.075	0.034	0.027	0.724	2.956	0.799	0.695
CD at 5%	0.132	0.208	0.094	0.075	2.007	8.193	2.215	1.926

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