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ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 07, Issue, 11, pp.3800-3801, November, 2016

RESEARCH ARTICLE

GROWTH, HERB YIELD, OIL CONTENT CHLOROPHYLL AND NUTRIENTS UPTAKE IN LEMONGRASS (CYMBOPOGON FLEXEOSUS) AS AFFECTED BY GYPSUM AND SODIC WATER

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ARTICLE INFO

Article History:
Received 18th August, 2016
Received in revised form
27th September, 2016
Accepted 19th October, 2016
Published online 30th November, 2016

Key words:

Gypsum, RSC lemongrass,
Chlorophyll, Cymbopogon flexeosus.

ABSTRACT

The results showed that the height number of tillers at various intervals oil content fresh and dry weight of herb yield chlorophyll content N;P;K; Ca and Fe declined at higher concentration of RSC i.e. 15meL^{-1} levels except Na which tremendously reduced.the treatment R3 G0 having 15 meL^{-1} sodic water without chemical amendment resulted marked reduction in oil production,chlophyll content and N,P,K, Ca and Fe uptake in comparison to other levels of RSC wather in association with concentration. Presence of higher amount of CO_3^{--} and HCO_3^- ions in irrigation or soil solution increased the sodium adsorption on soil and thereby precipitates Ca^{++} and Mg^{++} as their carbonates.therefore solution- having bicarbonates in excess of Ca^{++} and Mg^{++} ion will have residue of $NaHCO_3$ upon evaporation and thereby increased the ESP and pH of the soil.

INTRODUCTION

The traditional agricultural crops grown with poor quality waters generally give poor returns to growers in Allahabad region. Cultivation of higher essential bearing plants such areas may be an appropriate solution of this problem to raise growers margin of profit. Lemongras is an aromatic grass and may be grown on marginal and sub marginal land on different categories of wasteland including saline and alkali soil and high hill slope. Singh and Anwar (1985). Because of the enhancement in the cost of inputs the cultivation of traditional crops is becoming uneconomical with the use of RSC rich water. Hence, introduction of some new aromatic plants having sodicity tolerance and high benefit cost ratio may attract the farmers to continus with the point of view of profitable trend in comparison to traditional agricultural. For neutralizing the adverse effect of various ions in soil, a number of amendments such as gypsum have been suggested in the literature chauhan and tripathi (Chauhan and Tripathi, 1983). The main objectives of chemical amendments application are to furnish soluble Ca to replace adsorbed Na from soil colloidal complex. It is therefore, essential to list such under trails before recommending the same to the cultivars.

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MATERIALS AND METHODS

A field experiment was laid out in micro plots consisting three levels of gypsum and four levels of RSC rich irrigation water @G0G5G10 t ha^{-1} and R0R5R10 and R15 meL^{-1} respectively at the research plot of chemistry department, Allahabad agricultural institute, deemed university, Allahabad to study the response of gypsum and RSC rich water on various growth parameters, oil content, chlorophyll and nutrients uptake in lemon grass. All twelve treatments were replicated thrice. The experimental soil was sandy loam having pH 7.40, ECE 1.10dSm^{-1}, organic carbon 0.215%, avalible N 155.5 Kg ha^{-1}, phosphorous 20.0 kg ha^{-1}, K 215 Kg ha^{-1} and CEC 15.15 cmol(p+)kg^{-1}. The RES rich waters were prepared by dissolving the $NaHCO_3$ and Na_2CO_3 salts in distilled water. The 45 days old slips of lemon gress were planted in the research plots at the distance of 45 X 45 cm in micro plots 2.5 X2.5 m in the month of july. The N,P and K fertilizers were added@ 40,50 and 20 Kg ha^{-1} through urea, SSP and muriate of potash respectively. The plants were irrigated with treatment (sodic) water whenever needed. The growth observations pertaining to herb yield were recorded at different intervals. The oil content and chlorophyll in fresh herb was also estimated and dried plant samples were analyzed for nutrients uptake. The chlorophyll content (a+b) and total

chlorophyll in plant were estimated in 80% acetone by spectrophotometric method (Arnon, 1949). The plant samples from experimental plots were analyzed for N by Piper (1950), P by Olsen *et al*. (1954). K, Ca and Na by Jackson (1967) in 1N NH_4OAC solution and iron by Chapman and Pratt (1965) method.

levels at all the stages of observation. However, the sodicity in terms of CO_3^{--} and HCO_3^- concentration was found more depressive. The treatment R3G2 followed by R_3G_1 and R_3G_0 showed more detrimental effect on plant height, number of tillers, fresh weight and dry weight of herb and oil contents (Table-1) particularly at later stages of growth because of more

Table 1. Effect of RSC level and gypsum on height, number of tiller, oil content and herb yield in lemongrass

Treatment	Height of plant		Number of tiller per plant		Oil content ml 100g-1	Fresh weight of herb yield kgplot-1	Dry weight of herb yield kg plot-1
	45 DAT	90 DAT	45DAT	90DAT			
R0G0	3.42	3.61	186	201	2.4	6.84	4.74
R0G1	3.52	3.84	156	168	2.4	7.08	4.83
R0G2	3.54	3.97	165	165	2.7	8.40	5.19
R1G0	3.57	3.99	126	156	3.0	9.42	5.28
R1G1	3.72	4.05	159	144	2.7	10.08	7.53
R1G2	3.84	4.34	194	208	3.3	11.19	8.40
R2G0	3.69	4.12	147	165	3.0	7.50	7.08
R2G1	3.51	3.91	159	159	2.7	6.84	5.19
R2G2	3.51	3.84	174	180	2.7	6.78	3.90
R3G0	3.42	3.53	134	144	2.4	4.43	3.30
R3G1	3.33	3.64	136	146	2.7	4.53	3.30
R3G2	3.20	3.56	138	147	2.5	4.48	3.41
C.D. for RSC	0.05	0.143	4.2	3.14	0.081	0.0618	0.041
C.D. for gypsum	0.062	0.124	5.15	3.85	0.07	0.0535	0.0359
C.D. for 5%'	0.087	0.251	7.28	5.44	0.141	0.107	0.0718

Table 2. Effect of sodic water and gypsum on chlorophyll content P, K, Ca, Na, and Fe uptake in lemongrass

Treatment	Chlorophyll content		Total chlorophyll mg-1	Nutrients uptake ($Kgha^{-1}$)					
	a	b		N	P	K	Ca	Na	Fe
R0G0	45.06	109.32	169.32	126.21	5.19	182.74	8.11	33.4	71.62
R0G1	39.66	120.75	180.63	114.25	5.64	221.07	8.51	29.78	84.22
R0G2	45.06	129.45	240.36	145.31	5.16	209.69	14.43	27.68	93.88
R1G0	54.72	165.36	217.56	159.52	5.79	244.78	8.09	43.99	45.83
R1G1	61.02	186.15	261.72	168.11	9.53	306.18	10.04	37.55	107.88
R1G2	72.12	248.64	3338.64	229.34	9.67	374.32	12.97	36.65	146.96
R2G0	58.80	156.96	252.42	181.80	7.07	326.16	9.4	48.34	128.28
R2G1	45.15	136.26	269.45	141.91	4.66	217.91	8.97	46.21	90.11
R2G2	39.45	126.18	276.75	117.1	3.89	175.70	5.97	45.0	48.9
R3G0	36.35	114.78	211.05	93.39	3.65	138.42	4.57	75.3	39.86
R3G1	42.15	118.84	217.14	103.8	3.79	148.79	5.5	73.64	69.34
R3G2	36.60	125.15	225.75	97.78	3.64	158.80	7.43	68.16	45.66
C.D. for RSC	1.113	1.872	2.469	6.916	9.892	9.892	0.593	3.73	14.1
C.D. for gypsum	0.964	1.62	2.138	8.471	8.565	8.565	0.514	3.23	12.21
C.D. for 5%'	1.923	3.24	4.277	11.98	1.028	17.14	1.028	6.49	24.43

Table 3. Statistical Analysis of different parameters

S.No.	Correlation coefficient between	'r'	Remark
1	Height of plants at 45DAT Vs. fresh weight	0.656	S
2	Height of plants at 45DAT Vs. dry weight	0.61	S
3	Number of tiller at 45 DAT Vs. Fresh weight	0.141	S
4	Oil content Vs. Nitrogen uptake	0.901	H.S.
5	Oil content Vs. P uptake	0.552	S
6	Oil content Vs. Fe uptake	0.607	S
7	Na uptake Vs. Ca uptake	-0.5	N.S.
8	Na uptake Vs. oil content	-0.246	N.S.
	S= significant		
	N.S. = Non significant		
	H.S.= Highly significant		

RESULTS AND DISCUSSION

The data obtained on different growth, herb yield, oil content, biochemical constituents and nutrients uptake are discussed under the following appropriate heads:

(a) Effect of sodicity and chemical ameliorants on growth

Threr was a gradual reduction in all the growth parameters studied with the increase in (RSC) sodic water concentration

accumulation of ions by that time singh8 reported that reduction in growth of wheat were almost linear with increasing sodic water concentration levels. Reduction in growth and dry matter production under salt stress conditions have also been reported by Tripathi and Kumar (1999), Singh *et al*. (1994) and Chauhan *et al*. (1989) who also reported that the plant growth declined to greater extent due to $NaCO_3$ and $NaHCO_3$ treatments. This reduction in number of tillers and herb yield appeared due to development of less water absorption, nutrient imbalance and unfavorable atmosphere

around root zone of the plants with the use of sodic water. Salam Abdul and Elkadi (1965) also observed the similar findings pertaining to yield. The inhibitory effect of salts on plant growth may probably be due to the osmotic effects on plant roots and thus causing low water availability and low nutrient absorption. But $5mel^{-1}$ sodic water and 10 t ha^{-1} gypsum brought significant improvement in growth parameters. This enhancement may be ascribed due to physical condition of soil improved and the gypsum reduced the ill effect of sodic water.

(b)Effect on nutrient uptake

It is revealed from the table (Table-2) that there was marked reduction in chlorophyll (a&b) and total chorophyll content with the increasing levels of sodic water. These results are in agreement with the findings of several workers (Yadav and Mehta, 1964; Maliwal and Paliwal, 1982). The lower concentration of sodic water and 10 the-1 gypsum showed appreciable impact in the rise of chlorophyll contents. It is abvious from the results that the higher concentration of RSC water depressed the uptake of N in lemongrass.the magnitude of reduction was greater at R3 sodicity level in comparison of other levels Chauhan *et al*. (1988) who reported that rhere was a marked reduction in N uptake in crops like pulses, barley, paddy and berseem. The decrease in tissue content N perhaps due to reduced rate of urea mineralization in presence of excess amount of soluble carbonate and bicarbonate ions in soil at higher RSC levels lavra16. Specific effect of CO_3^{--} and HCO_3^{-} seems to inhibit the metabolism process in plants and appear responsible reduction of crop growth, absorption of nutrients and the synthesis of protein and carbohydrates. Likewise the N content in lemongrass at G_2 level increased to the greater extent this may be ascribed to the increased root system and higher absorbing capacity. Poonia and Bhumbla(1973) observed an increase in N content while using gypsum levels. Similarly P uptake in lemongrass was highly affected by soil pH. The sodic water irrigation enhanced the pH of the soil thereby it becomes less available in soil solution caused low absorption by the plants from soil Lal *et al*. (1978). The higher concentration of carbonate and bicarbonate water reduced K uptake by rice plants Chauhan (1987). The K uptake reduced which may be due to domination of Na+ cation and consequently neutralized the potash. Application of moderate saline sodic water also significantly reduced the uptake of N,P and K. similar results in brinjal crop was observed by Kadam *et al*. (2007). The calcium uptake increased significantly to the greater extent at lower concentration of RSC water while it tremendously reduced with the rise in CO_3^{--} and HCO_3^{-} levels in irrigation water this may be due to the antagonistic effect of Na in roots medium. Similar observations recorded by Bains and Fireman (1964) and Chauhan *et al*. (1986). It is also obvious that the 10 t ha^{-1} gypsum got higher impact in the soil as well as it mitigated the adverse effect of sodic water to a greater extent, which in turn increased the Ca uptake in plants. These findings are further led to in consonance with those of Vakil and Ray (1971), Raikhy *et al*. (1985) have also reported that the uptake of Ca increased with increasing levels of chemical amendments under sodic environment. This was mostly due to the increasing levels mobility and concentration of $Ca^{++}$and Mg^{++} in soil solution. Gypsum in general tended to decrease the Na content in plant of lemongrass with the rise in its level. The RSC water @ $15meL^{-1}$ found more detrimental which significantly increased Na uptake in lemongrass Kanwar and Kanwar (1971). The iron uptake in lemongrass adversely affected with the rise in RSC levels in water. Paliwal and Maliwal (1971) showed that absorption of Fe decreased with increased ESP of soil. The higher application of gypsum with RSC water did not bring any appreciable change in enhancing the uptake of Fe but gypsum alone registered higher uptake of Fe. The above results are in conformity with findings of Kadam and Patel (2000), Uma and Agrawal (2005), Singh and Singh (1997). The scrutiny of the correlation coefficient between certain characters reveal that significant correlations were observed between height at 45 and 90DAT Vs fresh weight ('r'=0.656,)('r'=0.610), number of tillers at 45 DAT Vs. fresh weight ('r'=0.1411), oil content Vs. N,P and Fe uptake ('r'=0.910,'r'=0.552,'r'=0.607) respectively .the negative correlation coefficients were also observed between Na uptake Vs. Ca and oil content ('r'=0.500, 'r'=0.246) respectively. In general these studies indicate that the oil production in lemongrass may be increased by improving the characters viz. height of plant, fresh weight and number of tillers in lemongrass as well as by improving the ill effect of poor quality water by using adequate amendments also to neutralize the sodicity effect in soil in general.

REFERENCES

Arnon DL. 1949. Copper enzyme in isolated chloroplast poly phenol oxidase on beta vulgaris. *Plant Physiol*., 24:1-15.

Bains SS. and Fireman M. 1964. Effect of exchangeable sodium percentage on the growth and absorption of essential nutrients and sodium by five crop plants. *Argon J*., 56:432-435.

Chapman HD. 1965. Cation exchanges capacity. In methods of soil analysis, part -2 I (C.A. black Ed) USA, madison. wisc, pp891-901.

Chauhan RPS, Bhudayal, Chauhan, CPS. 1988. Effect of residual sodium carbonate in irrigation water on soil and bread wheat (triticum aestivum). *Indian J. Agric. Sci*., 58:454-458.

Chauhan RPS, chauhan CPS, Dixit HC. 1989. Effect of residual sodium carbonate in irrigation water on yield and chemical compositions of breseem. *J. Indian Soc. Soil sci*., 37:431-432.

Chauhan RPS, Chauhan CPS, Singh VP. 1986. Use of pyrite in minimizing the adverse effect of sodic water. *Indian Agric. Sci*., 56:717-721.

Chauhan RPS, Tripathi BR. 1983. Reclamation studies on highly saline sodic soils of semi arid tract in Uttar Pradesh. *J. Indian Soc. Soil Sci*., 31:587.

Chauhan RPS. 1987. Sedimentary pyrite sin improving nitrogen fertilizations use efficiency in rice wheat system. Maharashtra agric. Univ. 12: 274-277.

Jackson ML. 1967. Soil chemical analysis prentice hall of india Ltd. N. dehli p 10.

Kadam JR, Bhingardeve SD, Wattamwar MJ. 2007. Effect of saline water and fertigation on the availability of nutrients in soil, uptake of nutrient and yield of brinjal. *J. Maharashtra Agric. Univ*., 32(1):001-004.

Kadam JR, Patel KB. 2000. Effect of saline water through drip irrigation on the inceptisols under tomato. *J. Maharashtra Agric. Univ*., 25(3):231-232.

Kanwar BS. Kanwar JS. 1971. Effect of residual sodium carbonate in irrigation waters on plant and soil. *Indian J. Agric.Sci.*, 14:54-56.

Lal P, Mali GC, Singh KS. 1978. Effect of residual sodium carbonate in irrigation water on properties of loamy sandy soil and on yield and nutrient uptake by wheat and barley. Proc. Int. symp. Arid zone res. Dev jodhpur.

Lauar RD. 1973. Effect of sodium carbonate on carbon and nitrogen mineralization of organic matter added to soil. *Geoderma*, 9:15-26.

Maliwal GL, Paliwal KV. 1982. Effect of different levels of bicarbonates alone and in combination with carbonate in irrigation waters on the growth, mineral nutrition and quality of barley grown in sand culture. *Indian J.Agric. Sci*., 52: 593-599

Olsen SR. Cole CV watanabe ES, Dean LA. 1954. Estimation pf available foshfprus in soil by extraction with NaHCO3 Cri; U.S Deptt.Agric. 937.

Paliwal KV. Maliwal GL. 1971. Effect of fertilizers and manual on the growth and chemical compositions of maize irrigated with different quality water. *Indian J. Agron*, 16:316-321.

Piper CS. 1950. Soil and plant analysis Asia publishing house bombay.

Poonia SR. Bhaumbla DR. 1973. Effect of gypsum and calcium carbonate in plant yield and chemical composition and calcium availability in a non-saline sodic soil plant soil, 38:71-80.

Raikhy NP, Agrawal RK. Raina P. 1985. Performance of pyrite and gypsum as sulphur source in an arid sandy soil. *J. Indian Soc. Soil Sci*., 33:447-449.

Salam A. elkal MA. 1965. Effect of minereal content of barley as related to irrigartion with bicarbonate waters. *Plant soil*, 23:277-384.

Singh D, Singh B. 1997. Influence of residual sodium carbonate in sodic water o n yield, oil contained and oil production of lemon grass. *Journal of the Indian Society of Soil Science*, 45: 354-357.

Singh DV, Anwar M. 1985. Effect of soil salinity on herb and oil yield and quality of some cymbopogan sps. *J. of Indian Society of Soil Science*, 33:362-365.

Singh omvir. 1998. Effect of salinities and nitrogen on yield and nutrients uptake in okra. *Indian J. of Agronomy*, 43:333-337.

Singh RP. Singh B, Singh V. 1994. Effect of sodium to calcium activity ratio and residual sodium carbonate in irrigation water on physic- chemical properties of the haplustalfus and performance of wheat (Triticum aestivium L). annals arid zone, 33 (1): 23-27.

Tripathi KP. and Kumar P. 1999. Influence of saline water on growth and nutrients composition of moong bean. *J. Indian Soc. Soil Sci*., 47:383-385.

Uma, Agrawal RL. 2005. Effect of saline water and fertility levels on lemon grass growth and yield. *Ann.Pl Soil Res*., 7(1):68-71.

Vakil P Ray. 1971. Effect of chemical amendment on reclamation of saline alkali soil of barawaha tehsil . proc. All india syrup soil salinity Kanpur. 161-166.

Yadav CN. 1964. Mehta BV. Residual effect of sodium salts on the growth and chemical composition of sun hemp (*Crotoleria juncea* L). Growth on goradu soil. *Indian J. agric. Sci*., 58:244-250.

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