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Response of lemon grass (*Cymbopogon flexuosus*) to nitrogen under saline condition

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ABSTRACT

A greenhouse experiment was conducted at R.B.S. College Bichpuri, Agra (U.P.) to study the effect of varying salinity levels on lemon grass (Cymbopogon flexuosus) in relation to N fertilization. The treatments comprising four salinity (control, 4, 8 and 12dSm^{-1}) and four nitrogen (0, 20, 40 and 60 mgKg^{-1}) levels were evaluated in factorial randomized block design with three replications. As compared to normal condition, the magnitude of decrease in herb and dry matter yield of lemen grass was higher at higher salinity levels. A significant increase in herb and dry matter yield was recorded with EC 4 dSm^{-1} over control but minimum herb and dry matter yield was recorded at 12dSm^{-1}. Application of nitrogen in soil resulted significant improvement in herb and dry matter yield as compared to control and maximum values were recorded with 60 mg N kg^{-1}over control. The interaction between soil salinity and nitrogen had a significant effect on herb and dry matter yield. The minimum and maximum values of yields were recorded under 12 dSm^{-1} + no N and 4 dSm^{-1} + 60 mg N Kg^{-1} treatments, respectively. The content of N, P and K in lemen grass tended to decrease with salinity levels and increased with N application. Sodium content increased with salinity and nitrogen levels. Nitrogen uptake by lemon grass was recorded maximum at 4dSm^{-1} salinity level, but higher levels of salinity decreased N uptake. Sodium uptake increased significantly at higher salinity levels over control. But P and K uptake by lemon grass decreased significantly with salinity levels as compared to control. Nitrogen application under all salinity levels had a positive effect on uptake of nutrients by lemon grass.

Key word: Nitrogen, salinity, lemon grass, nutrient uptake, content and yield

INTRODUCTION

In arid and semi arid region, soil salinity adversely affects the crop productivity. Application of fertilizer (N) to the growth medium may minimize the harmful effects of salinity on the growth and yield of crops. Lemen grass (*Cymbopogon flexuosus*) is an important aromatic crop and has gained considerable economic importance as its essential oil is being used in the formulation of different blends of perfumes, cosmetics, beverages pharmacenticals etc. Lemon grass may tolerate mild acidity to mild salinity of soil under pH 5.5 to 8. Saline soils are characterized by presence of excessive quantity of natural soluble salts in the root zone to interfere with plant growth and productivity. The maintenance of optimum level of soil fertility is essential for successful crop production in saline soil as problem is more nutritional nature. This can be said more for nitrogen and for phosphorus to some extent. Nitrogen has specific vital role in growth, development, quality and quantity of crop. This nutrient plays an important role in biosynthesis of amino acids, nucleic acid and proteins. Applications of fertilizers at moderate level of salinity with in tolerance limit of the crop in question are reported to improve crop growth. Significant response to application of nitrogen has been reported by several workers (Kumar, 2019). Therefore, the present study was undertaken to evaluate the optimum dose of nitrogen and its interaction with soil salinity for lemon grass crop.

METERIALS AND METHODS

A greenhouse experiment was conducted at R.B.S. College Bichpuri, Agra (U.P.) using lemon grass as test crop. The soil used in green house experiment had pH 8.0, EC 0.23 dSm^{-1}, organic carbon 3.1g kg^{-1}, available N 65 mg kg^{-1}, P 4.4 mg kg^{-1} and K 75 mg kg^{-1}. The four levels each of salinity (Control, 4, 8 and 12dSm^{-1}) and nitrogen (0, 20, 40 and 60 mgKg^{-1}) were evaluated in factorial randomized block design with three replications. The salinity levels were created artificially by adding the calculated amounts of $CaCl_2$, $MgSO_4$, $MgCl_2$ and NaCl into the soil. After mixing the soil lots of different EC thoroughly, 10 kg soil was filled in pots. The

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required earthen pots of similar size and shape for experiment were selected, cleaned and lined with polythene sheet. At approximate moisture level, three slips of lemon grass were planted in each pot. The recommended dose of P_2O_5 and K_2O were applied through single superphosphate and muriate of potash, respectively. The crop was irrigated with deionized water as and when needed. The crop was harvested in first weak of December and herb and dry matter yields were recorded. These samples were wet digested with nitric and perchloric acid. Phosphorus, K, Na were determined in the acid extract by molybdatevanadate yellow color method and flame photometer respectively (Jackson, 1973). Nitrogen content in plants was determined by Kjeldahl method. The uptake of various nutrients by plants was worked out by multiplying their content values with corresponding yield data.

RESULTS AND DISCUSSIONS

Yield studies

It is observed from the data (Table 1) that as the salinity levels increased, the herb and dry matter production decreased but this reduction was more pronounced in higher salinity level (EC 8 dSm^{-1}) or more. The reduction in yields due to salinity may be ascribed to accumulation of excess salts in root zone which inhibits plant growth by decreasing osmotic potential of the soil solution. Prasad *et al.* (1997) and Kumar (2019) also reported decreased yields with increasing soil salinity levels. Application of N through fertilizer may alleviate to some extent the adverse effect of salinity. Higher herb and dry matter production was obtained at same level of salinity when N level was increased. Prasad *et al.* (1997) and Kumar (2019) also observed that the suppressing effects of higher salinity were alleviated to some extent with N fertilization. The maximum average yields of herb and dry matter were recorded under 60 mg N kg^{-1} (Singh, 2019). The interaction between soil salinity and nitrogen had a significant effect on the herb production (Table 2).The salinity levels reduced the herb yield significantly over control irrespective of nitrogen application. On the other hand, application of N at all salinities increased the herb and dry matter yields of lemon grass. In this experiment, at the salinity level of 4 dSm^{-1} and above, a marked decrease in yields was obtained with the plants fertilized with the highest level of N (60 mg kg^{-1}). The maximum yields of herb and dry matter were noted under no salinity and 60 mg N kg^{-1}.

Table 1: Effect of nitrogen and salinity levels on yield, oil and citral content in oil of lemon grass

Treatment	Yield (g/pot)		Oil Content (%)	Citral content (%)
	Herb	Dry matter		
Salinity levels (dSm^{-1})				
Control	129.22	48.86	0.70	90.2
4	122.15	45.60	0.69	90.1
8	113.87	43.04	0.68	90.4
12	107.87	41.60	0.64	90.0
SEm±	2.02	0.57	0.013	1.70
C.D. (P=0.05)	5.87	1.66	0.038	NS
Nitrogen (mg Kg^{-1})				
0	100.54	37.31	0.61	90.0
20	112.71	42.57	0.63	90.2
40	114.21	47.36	0.72	90.1
60	123.40	50.82	0.76	90.5
SEm±	2.02	0.57	0.013	1.70
C.D. (P=0.05)	5.87	1.66	0.038	NS

Oil content

The oil per cent in lemon grass decreased significantly with each successive increase in soil salinity level up to 12 dSm^{-1} (Table 1) and minimum value was recorded under 12 dSm^{-1} salinity level. Similar results were reported by. The oil content in lemon grass was significantly higher with the application of 60 mg N kg^{-1} soil over control. Both levels of N (40 and 60 mg N kg^{-1}) had significant beneficial effect on oil content as compared to control and

lower levels of N. and Prasad *et al.* (1997) also reported an increase in oil content at higher nitrogen levels.

Total citral content:

Total citral content in lemon grass oil was not affected significantly with salinity level. However, a gradual reduction in total citral content was recorded with increasing salinity levels. The minimum value of total citral content was recorded at 12 dSm^{-1} salinity levels. Similar results were reported by Prasad *et al.* (2010). Nitrogen application did not affect the total citral content in lemon grass oil. However, a slight increase in total citral content in lemon grass oil was recorded with increasing levels of nitrogen. The maximum values of total citral content were recorded with 60 mg N kg^{-1} soil treatment. Singh *et al.* (2012) also reported similar results. The interaction effect of nitrogen and salinity levels on total citral content was non-significant.

Table 2: Interactive effect of N and salinity on yield of lemon grass

Salinity (dSm^{-1})	Herb yield (g/pot)				Dry matter (g/pot)			
	Nitrogen (mg kg^{-1})				Nitrogen (mg kg^{-1})			
	0	20	40	60	0	20	40	60
Control	111.52	123.14	136.74	145.49	42.13	46.49	54.97	48.86
4	102.69	116.83	129.28	138.81	36.97	44.16	52.46	45.60
8	95.69	108.91	121.22	130.29	36.01	41.13	49.22	43.04
12	91.93	101.96	114.20	121.41	34.13	38.53	46.63.	41.60
C.D. (P=0.05)	11.73				3.31			

Content and uptake of nutrients

Nitrogen: A perusal of data (Table 3) reveals that the levels of salinity decreased the content and uptake of nitrogen in plants in comparison to control. The minimum average value of nitrogen content and uptake was recorded at the salinity level of 12 dSm^{-1}. The reduction in the nitrogen uptake by lemon grass due to EC level of 12 dSm^{-1} over control was 21.3 and 33.1%, respectively. The reduction in N content and uptake at higher salinity level may be ascribed to lower dry matter production. These findings are in agreement with those of Prasad *et al.* (1997). The content and uptake of lemon grass increased significantly with every increase in nitrogen supply over control. A consistent increase in N content and uptake was recorded upto 60 mg N kg^{-1}. Higher values of N content and uptake with increasing levels of nitrogen application are apparently the result of favourable effect of this treatment on N absorption and utilization by plants coupled with greater dry matter production. Prasad *et al.* (1997) also reported higher N uptake with nitrogen application.

Phosphorus: A study of Table 3 reveals that the salinity levels significantly reduced the content and uptake of P by lemon grass in comparison to control. Higher levels of salinity proved significantly detrimental over control in respect of P content and uptake by lemon grass. A drastic reduction in P uptake was noted at EC level of 12 dSm^{-1}. These findings are in accordance with those of Prasad *et al.* (1997). The results indicate that the application of nitrogen tended to increase the phosphorus content and uptake by lemon grass plants.. The maximum content and uptake of phosphorus by lemon grass plants was recorded with 60 mg N kg^{-1}. These results are in agreement with the findings of Singh. (2019).

Potassium: The increasing levels of soil salinity decreased significantly the content and uptake of K by lemon grass over control. Higher levels of salinity had a significant detrimental effect on the absorption and uptake of potassium by lemon grass over control. These findings are in accordance with those of Prasad *et al.* (1997). The nitrogen application brought about a significant increase in the content and uptake of potassium by lemon grass plants over control. This increase in K content and uptake with N addition may be ascribed to higher dry matter production and improvement in K content. These findings are in accordance with those of Prasad *et al.* (1997) and Singh (2019).

Table 3: Effect of nitrogen and salinity Levels on content (%) and uptake of nutrients (mg/pot) in lemon grass

Treatments	Nitrogen		Phosphorus		Potassium		Sodium	
	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake
Soil Salinity (dSm^{-1})								
Control	0.68	338.3	0.10	51.7	0.97	479.2	0.37	183.8
4	0.67	311.8	0.09	44.8	0.96	446.1	0.44	200.2
8	0.65	287.6	0.08	32.8	0.94	410.1	0.46	199.5
12	0.64	266.1	0.03	32.8	0.91	375.6	0.48	194.7
SEm±	0.007	3.92	0.019	2.52	0.014	1.58	0.007	3.51
C.D. (P=0.05)	0.020	11.39	NS	7.32	0.041	4.59	0.020	10.19
Nitrogen (mg Kg^{-1})								
0	0.54	204.9	0.08	30.9	0.85	318.6	0.45	169.4
20	0.62	264.1	0.08	36.4	0.93	399.6	0.44	186.9
40	0.70	383.2	0.09	46.4	0.95	452.9	0.43	205.9
60	0.79	401.7	0.10	53.6	1.05	536.8	0.42	216.1
SEm±	0.007	3.52	0.019	2.52	0.014	1.58	0.007	3.51
C.D. (P=0.05)	0.020	11.39	NS	7.32	0.041	4.59	0.020	10.19s

Sodium: A critical examination of the data (Table 3) indicated that the increasing levels of soil salinity increased significantly the content and uptake of N by lemon grass plants as compared to control. The sodium uptake by lemon grass plants increased from 183.8 to 200.2 mg/pot with EC level of 4 dSm^{-1}. These findings are in accordance with those of Prasad *et al.* (1997). The nitrogen application brought about a significant increase in the content and uptake of sodium by lemon grass plants over control. All the levels of nitrogen were found to be significantly superior over control in respect of sodium uptake by the plants. Similar results were reported by Prasad *et al.* (1997).

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