2012 International Conference on Environment, Energy and Biotechnology
IPCBEE vol.33 (2012) © (2012) IACSIT Press, Singapore

Oil Content and Growth Characters of Lemongrass With Respect to Iron Pyrite and RSC Rich Irrigation Water

V. P. S. Bhadauria[+1,3], Varsha Gupta[2], Rahul Raj [3] and F.M. Prasad[1]

[1] Department of Chemistry, St. John's College, Agra-282002 , India

[2] Krishi Anushandhan Bhawan-I, ICAR, Pusa, New Delhi

[3] Department of Chemistry, Milton Public School, Agra, India

Abstract. An experiment was conducted at, School of Chemical Sciences Department of Chemistry, St. John's College Agra, in factorial randomized block design by using different concentrations of RSC rich irrigation water (viz, 0, 5, 10 and 15 meq/l) with an aim to know the "oil content and growth characters of lemongrass with respect to iron Pyrite and RSC rich irrigation water". The chemical ameliorant pyrite in lemongrass was applied through basal application @ 0, 5 and 10 t/ha at the time of the transplanting. The results showed that the oil content and growth characters of lemongrass decreased significantly with increasing levels of RSC on the other hand enhancing levels of pyrite significantly increased all the above characters but Pyrite did not show appreciable performance in case of plant height. The P_2 (10 t/ha) level of pyrite proved more beneficial with regards to herbage yield of lemongrass.

Keywords: RSC, Pyrite, lemongrass

1. Introduction

The continuous use of rich RSC water for irrigation develops the higher concentration of exchangeable sodium ion on the exchange complex of the soil rendering it unsuitable for cultivation (Kanwar and Kanwar 1971). For neutralizing the adverse effect of various ions of salts in soil, a number of amendments such as Gypsum and Pyrite (Chauhan et.al 1989, Somani 1984) have suggested. The main objectives of chemical amendment application are to furnish soluble calcium to replace adsorbed sodium form soil colloidal complex. Because of the enhancement in the cost of inputs, the cultivation of traditional crops is becoming uneconomic with the use of rich RSC water. With the point of view of profitable trend in comparison to traditional agriculture, introduction of some new plant type having sodocity tolerances and high benefit cost ratio (B/C ratio) may attract the farmers to continue farming. Therefore, cultivation of high value aromatic plants may be a very good alternative for such problems for increasing the return to the growers as well as foreign exchange to the country. Lemongrass (*Cymbopogon flexuosus*) also is an important aromatic perennial grass and may be grown on warm and humid climate. In India lemongrass oil is primarily used for the isolation of citral for manufacturing vitamin A. Citral is also starting material for the preparation of ionones and it is also used flavor, cosmetic and perfumery industries. A small amount of oil is use as such in soaps, detergent and other preparation. In some countries, the grass is cultivated for flavoring food, such as chicken.

2. Materials and Methods

A green house experiment was conducted at St. John's College Agra in earthen pots of 30 cm. diameters filled with 10 kg soil, in factorial randomized block design. All twelve treatments were replicated thrice. The soil of the experimental site having sandy loam in texture with pH 7.90, ECe 1.75 dsm^{-1}, Organic carbon

+ Corresponding author. Tel.: + 91 7599258255;
E-mail address: vpsb19@yahoo.com

0.12 %, available N 78.0 Kg ha^{-1}, P 16.60 Kg ha^{-1}, K 455.0 Kg ha^{-1}, silt 17.0 and clay 15.4 %. Optimum moisture level was maintained with water with at four levels of RSC viz. 0, 5, 10, & 15 meq/l .The RSC were adjusted by dissolving required amount of sodium bicarbonate ($NaHCO_3$), in distilled water. Distilled water was used to avoid any contaminations of impurities. The 45 days old seedlings of lemongrass were transplanted in pots by using the irrigation and 40 Kg N ha^{-1}, 50 kg P_2O_5 ha^{-1}, 20 kg K_2O ha^{-1} through urea, single super phosphate & muriate of potash in lemongrass respectively. The oil content in fresh herb of lemongrass was estimated by steam distillation process using Clevenger's glass apparatus. The growth observations and herb yield data were recorded at first & second cuttings.

3. Result and Discussion

The data obtained on different growth characters are discussed under the following appropriate head

3.1. Plant Height and Number of Tillers Plant^{-1}:

There was gradual reduction in all the growth parameters studied with the increase in RSC rich water concentration levels at both harvests. However the sodicity in terms of CO_3^{--} and HCO_3^- concentration was found more depressive. It was further recorded that the R_2 and R_3 levels of RSC @ 10 and 15 mel^{-1} of water alkalinity caused reduction in plant height and No. of tillers $plant^{-1}$ followed by R_0 and R_1 levels at both the cuttings of lemongrass. The levels R_0, R_1, R_2 and R_3 showed significant difference with each other at both harvests of lemongrass respectively. This reduction may be ascribed due to development of unfavorable atmosphere around root zone of plants with the use of RSC rich water (Chauhan et. al 1989, Singh and Abrol 1986). The table further showed that the plant height and no. of tillers $plant^{-1}$ increased significantly at both the harvests of lemongrass with pyrite, as compared to control. The P_1 and P_2 levels of lemongrass were found to be superior over other levels at both the cuttings (Chauhan 1987, Prasad et al. 1982, Verma and Gupta 1984). This enhancement may be ascribed due to the physical condition of soil improved, therefore, nutrients supply to the plants increased.

3.2. Herb Yield

The herb yield of lemongrass was highest at R_0 level and the minimum yields recorded at R_3 sodocity level (Agarwal et. al 1964). Declined yield could be explained on the basis of deleterious effect of salinity on plant height and no. of tillers. Reduced plant height depressed the crop yield by reducing photosynthesis surface leading to poor synthesis of carbohydrates on one hand and its poor translocation and utilization on the others. An accumulation of alkali salts in soil by one way or the other leads to reduced water absorption from soil through increasing osmotic pressure of soil solution beyond the critical limits and results in to suppression of plant growth and vigor. When osmotic pressure increased, adjustment of plants related to sodic environment are performed rapidly, the physiological motivation leading to ion selectivity may temporarily be replaced by physiological once in order to restore osmotic balance, which is achieved to a considerable extent by restricted uptake of electrolytes under high sodic condition. Osmotic equilibrium between plant and environment is the result of interplay of checks and balances among which limitations to ion uptake plays an important role. The process of nitrification was inhibited in soil at 10% sodium carbonate resulting in narrowing in crop yield (Laura 1973). The specific effect of CO_3^{--} and HCO_3^- ions seemed to inhibit the metabolic process in plants and appeared responsible for reduction in yield (Paliwal et. al 1975). On the other hand increase in herb yield of the crop at both harvests was significant for each level of iron pyrite as compared to control. The highest herb yield of crop recorded in P_2 (15 $t.ha^{-1}$) was incorporated in the soil.

3.3. Dry Matter Production

Data with respect to dry matter production at two cuttings as affected by different treatments of sodic water and chemical amendments are equipped in table. It is clear from the results that the dry matter production significantly decreased at two harvests of lemongrass. The R_1 level of sodic water had significant difference over R_2 and R_3 levels at both harvests of lemongrass. All levels of RSC water showed highly significant difference with each other. Irrespective of treatment the dry matter production of lemongrass at both harvests may be arranged as $R_0 > R_1 > R_2 > R_3$ respectively pertaining to harmful effect. The reduction in dry matter production due to loss per hectare production of fresh weight, growth phonological characters like no. of tillers and plant height. Therefore low dry matter accumulation under increased level of RSC is quite justified (Chhabra et. al 1980). A further study of table reveals that the dry matter production increased significantly with application of Pyrite at both the harvests of lemongrass respectively. The enhancement in dry matter production is quite obvious as explained with an increment in fresh weight production due to increased availability of nutrients and improvement in physical condition of soil (Bajwa and Jasan 1989, Brar 1987, Singh et.al.1986).

3.4. Oil Content

The data with respect to oil content (kg ha^{-1}) in table clearly stated that the oil content reduced significantly with the rising concentration of RSC levels at both the harvests of lemongrass. The reduction in oil content was due to the effect of decreased herb yield production of lemongrass crop with the use of RSC rich irrigation water. The level R_3 has resulted marked reduction in oil content in comparison to other RSC levels. The table further indicates that the pyrite application did not reflect its significant effect on the oil content at both harvests of lemongrass. In general the pyrite levels increased the oil content at both two harvests of lemongrass.

4. References

[1] Kanwar, B.S. and J.S. Kanwar. Effect of residual carbonate in irrigation water on plant and soil. *Ind. J. Agric. Sci.* 1971, **14**: 54-56.

[2] Somani, L.L. Use of low grade pyrites as an amendment for alkali soils and to improve soil fertility – *A review. Ferti., News.* 1984, **29** (7) : 13-27.

[3] Chauhan, R.P.S., C.P.S. Chauhan and V.P. Singh. Use of pyrite in minimizing the adverse effect of saline water. *Ind. J. Agric. Sci.* 1989, **56**: 717-721.

[4] Singh, S.B. and Abrol, I.P. Effect of soil sodocity on growth yield and chemical composition of soyabean, *J. Indian Soc. Soil Sci.* 1986, **34**: 568-571.

[5] Chauhan, R.P.S., Chauhan, C.P.S. and Dixit, H.C. Efect of residual sodium carbonate in irrigation water on yield and chemical composition of Berseem. *J. Indian Soc. Sci*. 1989, **37**: 431-432.

[6] Chauhan, R.P.S. Sedimentary pyrites in improving nitrogen fertilization use efficiency in rice wheat system; *J. Maharastra Agric. Univ.* 1987, **12**(3): 274-277.

[7] Verma, S.K., and Gupta, R.K. Relative effectiveness of pyrites and Gypsum in reclaiming a sodic clay soil. *J. Indian Soc. soil sci.* 1984, **33** (2) : 465-468.

[8] Prasad, K., Singh, R.B. and Singh B.P. Pyrites and phsophates application on some soil characteristics. Grain yield and mineral compostion of gram cutivar (C-235) under calcarious saline alkali soil. *Proc. Indian Natn. Sci. Acad.* 1982, **48b**, 440-446.

[9] Agarwal, S.C., Mehrotra, N.K. and Singh, B.K. Influence of exchangeable sodium on growth and mineral composition of plants. I paddy and barley. *J. Indian, Soc. Soil.* 1964, **12** : 7-24.

[10] Laura, R.D. Effect of sodium carbonate on carbon and nitrogen minerlization of organic matter added to soil, *Geoderma*. 1973, **9**: 15-26.

[11] Paliwal, K.V., Maliwal, G.L. and Nanawati, G.C. Effect of bicarbonate rich irrigation wetes on the growth, nutrient uptake and synthesis of protein and carbohydrates in plants. *Pl. soil*. 1975, **43** : 523-536.

[12] Chhabra R, Abrol IP and Singh M, *Int. symp*. Salt affected soils, Karnal, 1980, 418.

[13] Brar, B. S. Sodium hazard of bicarbonate irrigation waters as affected by leaching fraction and amendment application *thesis abstracts.* 1987, **13** (12): 171-172.

[14] Bajwa, M.S. and Josan, A.S. Effect of Gypsum and sodic irrigation water on soil and crop yield in a rice-wheat rotation. *Agric. Water Manage*. 1989, **16** (1): 53-61.

Table : Oil content and Growth characters of lemongrass with respect to RSC and Pyrite levels

RSC levels in irrigation Water (meq. L^{-1})	**Plant height (cm) Mean**	**Number of Tillers $Plant^{-1}$ Mean**	**Herb yield (q/ha) Mean**	**Dry weight (q/ha) Mean**	**Oil content ($Kg.h^{-1}$) Mean**
R_0 (Control)	94.23	28.27	78.36	27.56	58.84
R_1 (5 meq. L^{-1})	88.54	23.62	68.74	24.42	48.14
R_2 (10 meq. L^{-1})	82.56	19.15	59.21	23.53	44.44
R_3 (15 meq. L^{-1})	72.43	15.54	51.11	21.51	39.39
S.Em ±	0.796	0.587	0.834	0.424	0.753
C.D. at 5 %	2.428	1.685	2.284	1.647	3.254
Pyrite Doses ($T.h^{-1}$)					
P_0 (Control)	83.13	23.43	61.51	23.58	42.16
P_1 (5 $T.h^{-1}$)	85.05	21.42	65.55	24.43	46.75
P_2 (10 $T.h^{-1}$)	87.87	21.12	67.53	26.54	54.20
S.Em ±	0.715	0.507	0.684	0.364	1.121
C.D. at 5 %	2.114	1.453	2.121	1.546	3.102