EFFECT OF INORGANIC AND ORGANIC SOURCES OF NUTRIENTS ON YIELD AND YIELD ATTRIBUTES OF LEMON GRASS (*CYMBOPOGON FLEXUOSUS L.*) UNDER SALT AFFECTED SOILS IN BALIA DISTRICT OF U.P.

V. B. Shahi[1], P. N. Singh[1] and Pardeep Kumar[2]

[1]Department of Ag. Chemistry and Soil Science, S. M. M. Town P. G. College, Ballia -277 001 (UP)
[2]Department of Soil Science, College of Agriculture S.V.P.U.A.T., Meerut 250 110

Abstract : Field experiments were conducted at the Agricultural Research farm Nidharia of Sree Murali Manohar Town Post Graduate College district, Balliah, during 2005-2006 and 2006-2007 to evaluate the effect of different organic manures *viz*., FYM , green leaf manure, vermicompost and poultry manure. The treatments were applied at the time of field preparation as T_1 – 100% NPK as RDF (40:60:40 Kg ha^{-1}),T_2 – 50% NPK+ 5t FYM/ ha^{-1},T_3 – GLM (Green leaf manuring) 10t / ha^{-1}.+10t FYM,T_4 – 100% N through vermi compost ha^{-1} and T_5 – 100% N through poultry manure ha^{-1}. All the treatments increased the herbage yield, maximum herbage (lemon grass) yield under T_5. Content in plants and their uptake in lemon grass were highest under T_5 followed by T_4, T_1, T_2, and T_3 indicating thereby superiority of T_5 over all the treatments. Thus the effect of farmyard manure, green leaf manure, vermi compost, poultry manure and NPK alone or in combination with very useful in enhancing the status of N, P, K, Ca, Mg and S of crops.

Keywords : FYM , Green leaf manure, Vermicompost and Poultry manure

INTRODUCTION

The area of saline and sodic type of land is increasing due to continuous use of poor quality of irrigation waters, faulty method of irrigation and impeded drainage. These lands either hardly produce any crop or produce a very poor crop. Sodic soils are generally low in organic matter, nitrogen and available Zn content, low to medium in available P and medium to high in available potassium content.

Due to lower content of organic carbon and presence of excess salts result in poor soil physico chemical and biological properties. Various amelioration like gypsum, green manuring and other organic alone or as in combination have been used for amendments of saline, sodic soils. Organic matter is the key component in the build up or maintenance of a saline sodic soil. Many soil properties such as microbial activity, CEC and aggregation are directly affected by the presence of organic matter. Indirectly, soil organic matter influence the nutrient and water use efficiency, root growth and stress tolerance, and quality of water and air that interact with the soil. The production and emission of greenhouse gases are largely controlled by how soil organic matter is managed. The integrated use of organic materials and inorganic nitrogenous fertilizers has received considerable attention in the past with a hope of meeting the farmer's economic need as well as maintaining favorable ecological conditions on long-term basis. The application of organic materials to different cropping systems and their ability to incorporate nitrogen as well as organic matter, may offer opportunities to increase and sustain productivity of cropping system and fertility of soil. The integrated nutrient management helps to restore and sustain fertility and crop productivity. It may also help to check the emerging deficiency of nutrients other than N, P and K. The results of several long-term experiments in different cropping systems reveal that long-term sustainability of productivity in intensive cropping system could be achieved only through integration of inorganic and organic sources of nutrients (Singh, 1992). Non edible aromatic crops on the place of traditional edible crops should be tried. This practice will not hamper the income of farmers on the one hand and health of consumers. The present study aims to evaluate the effect of different organic manures along with inorganic fertilizers on soil properties and yield and its attributes of lemon grass in sodic soils.

MATERIAL AND METHOD

Field experiments were conducted at the Agricultural Research Farm Nidharia of Sree Murali Manohar Town Post Graduate College district Balliah, the eastern most part of the Uttar Pradesh. The experimental site is situated at 26°11" N and 84°39" E. The site is characterized by sub tropical climate. The average of annual rainfall was 983 mm. The soil of the experimental site was Sandy loam in texture, low in organic carbon (0.19%) medium in available Nitrogen (235 kg/ha), Olsen P (18.25 kg/ha) and Exchangeable K (227kg/ha) with soil pH of 8.7, soluble cation (me L^{-1}) Ca^{++}(6.55), Mg^{++}(6.55), Na^{+}(41.0) and K^{+}(2.28) and soluble anions(me L^{-1}) CO^{-3}(4.7), HCO^{-3}(8.76), Cl^{-}(38.71) and SO^{-4}(4.65). The treatments consisting different organic manures along with inorganic fertilizers were as follows T_1 – 100% NPK as RDF (40:60:40 Kg ha^{-1}),T_2 – 50% NPK+ 5t FYM/ ha^{-1},T_3 – GLM (Green leaf manuring) 10t / ha^{-1}.+10t FYM,T_4 – 100% N through vermi compost ha^{-1} and T_5 – 100% N through poultry manure ha^{-1}. Out of Recommended Doses Fertilizer 20 kg nitrogen was applied through urea, 60 kg phosphorous through single super phosphate (SSP) and 40 kg potassium through murate of potash per

hectare as basal dose at the time of plantation. Remaining nitrogen (20 kg) was applied as top dressing in 3 split doses during the each growing season. The crops were propagated by means of rooted slips. Tops of clumps were cut off within 25 cm of the root. The lower brown sheath was removed to expose young roots. Two slips were placed into each hole about 15 cm deep. Rooted slips of lemon grass were planted at a distance of 60 cm plant to plant and 60 cm row to row. The plantation was done on July 25, 2005. Field was irrigated immediately after planting At each location composite samples were collected from different horizons, viz. 0-15 cm, 15-30 cm, 30-45 cm, 45-60 cm and 60-90 cm.

Physicochemical analysis of soil like pH with the help of glass electrode digital pH meter Jackson (1973). , ECe with the help of Conductivity Bridge at 25 ^{0}C. Soil organic carbon content was determined by Rapid Titration Method (Walkley and Black, 1934). Cation exchange capacity was determined using sodium acetate solution (pH 8.2) with the help of centrifuge Jackson (1973). Available nitrogen was determined using alkaline potassium permanganate method (Subbiah and Asija, 1956). The Olsen s (0.5 M $NaHCO_3$ pH 8.5) method (Olsen et al.,1954) was used for determination of available-P in soil. Exch K was extracted with 1N neutral (pH 7.0) ammonium acetate solution. Air dried plant samples were ground in Wiley Mill having stainless steel blades and digested in diacid mixture of H_2SO_4 : $HClO_4$ (10:4) as per standard procedures (Jackson 1967) were followed for the estimation of phosphorous (colorimetric, yellowed vanadomolybdate), potassium (flam photometerically), Sulphur (Spectro photometer), Nitrogen was estimated by micro-Kjeldahl procedure.

RESULT AND DISCUSSION

Number of tillers

The number of tillers of lemon grass (Cymbopogon flexosus) were recorded during different growth stages of crop at 30, 60, 90, 120 and 150 days after transplanting (DAT). The number of tillers of lemon grass increased with advancement of crop age. The maximum number of tillers recorded with T_5 (100% N through poultry manure ha^{-1}) while the minimum tillers with T3 at all the growth stages. The T5 treatment was found statistically superior over the all other treatments T1,T2 &T3. While the T5 was numerically increased tiller number in comparison to T4 but it was statistically similar in the respect of all the growth stage of plant. (Table 1)

Plant height of lemon grass

The effect of treatments on plant height of lemon grass recorded at 30, 60, 90, 120 and 150 days after transplanting has been presented in table 2. The plant height of lemon grass increased with advancement of crop age. Highest plant height of lemon grass was recorded T_5 as compared to other treatments like T1, T_2 and T_3 at 30, 60, 90 120 and 150 days after transplanting. While T5 was statistically at par with T4.Allthough,T5 was numerically increased plant height

Herbage yield of lemon grass

The herbage yield of lemon grass with the presence of different treatments recorded at first, second, third, fourth and fifth harvesting stages of crop growth has been given in table 3. The herbage yield of lemon grass ranged from 137.0 to 162.2, 185. 2 to 198.1, 228.2 to 241.4, 360.3 to 374.6 and 478.4 to 487.4 q ha^{-1}, respectively. The herbage yield of lemon grass kg/ plat ranged from 78.8 to 92.1 and 478.4 to 487.4 q ha^{-1}, at 120 days after transplanting respectively. The effect of treatment was significant during all the stages of crop growth in relation to herbage yield of per plot of lemongrass. The maximum herbage yield was recorded at the treatment supplying 100% N through poultry manure followed by other treatment by T_4, T_1, T_2 and T_1 at every stages of harvesting of crops. The interaction effect of per treatments was found to be statistically significant at every stage harvesting of crop. Highest herbage yields were recorded in the treatment combination of 100% N through poultry manure and minimum was green leaf manuring at harvesting of crops. The results are in tune with the Singh *et al.* (2002).

Dry matter yield of lemon grass

The dry matter yield of lemon grass presented in table 4. The highest dry matter yield of lemon grass was found to be significantly superior over at all harvesting stage of crops. Dry matter yield was observed in the treatment T_5 followed by T_4, T_1.T_2 and T_3 in all stage of crop harvest. The dry matter yield of lemon grass ranged from 25.28 to 28.36, 34.31 to 40.49, 46.34 to 51.44, 65.39 to 73.47 and 87.41 to 92.49 q ha^{-1}, respectively at first, second, third, fourth and fifth harvesting stages. Performance of lemon grass was found to be significantly superior over at first, second, third, fourth and fifth harvesting stages of crops. The table 14 showed that over all interaction effect of treatment was found to be significant at all the harvesting stage of lemon grass. Maximum dry matter yield was recorded in the treatment combination of 100% N through poultry manure and minimum dry matter yield recorded as the treatment combination of green leaf manuring at all harvesting stage of crops.

Nutrient content of lemon grass

Data related to the nitrogen and phosphorous content has been presented in table 5. It is clear from the table that application of different organic and inorganic amendments on experimental soils has considerably increased the content of nitrogen over application combination of green manure and FYM (T_3). Maximum increase in content of nitrogen in

lemon grass was observed with treatment Poultry manure (T_5), irrespective of different harvesting stages as compare to other treatments. (Table-7)

Highest increase in respect to content of phosphorous in lemon grass was found with poultry manure (T_5) followed by vermicompost (T_4), while the minimum was recorded with GM and FYM application(T_1). The application of inorganic fertilizer performed similar as organic manure except T3. It was observed that the content of phosphorous was slightly increased at last harvesting stage as compare to other stages. Maximum increase in content of potassium in lemon grass was observed with T_5 followed by $T_4>T_1>T_2>T_1$Increase in concentration of K by lemon grass have been presented in table 6 may be due to the increase in soluble and exchangeable forms of K as a result of improved physico-chemical condition of the experimental soils treated by organic substances rich in K content FYM, green leaf manure, vermicompost and poultry manure are very rich sources of K. As a result, K content by lemon grass increased in experimental soils under study.

Data related to concentration of nutrient element of S, Ca and Mg by lemon grass have been presented in table 6 & 7. It is clear from the data that the application of different organic and in organic amendments use (per treatment) in experimental soil has considerably increased the content of Ca, Mg and S at all the harvesting stages. The maximum improvement in respect of content of Ca, Mg, and S in lemongrass was found with T_5 followed by $T_4>T_1>T_2>T_3$. It is also evident from the table that the content in plant progressively increased with the crop growth from first to fifth harvesting. The content of Ca, Mg and S were comparatively more at fifth harvesting stage. Lemon grass tissues contained increased amount of Ca, Mg and S. It may be due to high intake of these nutrients.. Organic amendments, such as FYM, green leaf manure, vermicompost and poultry manure contain large amounts macro and micro nutrients and after decomposition, supply them in the available form thereby enriching the soil and plants by these elements. These results are in conformity with the results of Sinha and Jha. (1981) who reported that availability of micronutrients in soil is largely controlled by amount of organic matter and pH. This may be due to addition of micronutrient element in soil with organic manures / amendments and its more availability to plant ultimately plant can take more amounts of these nutrients.

Table 1: Plant height of lemon grass (cm) at different growth stage

	Days after transplanting (DAT)				
Treatments	30	60	90	120	150
T_1 (100 % NPK)	38.0	78.0	117.7	141.0	162.7
T_2(50% NPK + FYM)	37.7	80.3	116.3	140.3	162.3
T_3 (GML +FYM)	35.7	76.0	114.0	137.7	159.7
T_4 (Vermicompost	40.0	83.0	119.0	141.3	163.0
T_5 (Poultry Manure)	42.3	85.7	122.0	145.3	166.7
SEm+	0.72	1.22	1.00	1.22	1.13
C.D.(P=0.05)	2.4	4.0	3.3	3.9	3.7

Table 2: Number of plant tillers of Lemon grass at different growth stage

	Days after transplanting (DAT)				
Treatments	30	60	90	120	150
T_1 (100 % NPK)	17.0	41.0	57.0	67.0	87.0
T_2(50% NPK + FYM)	16.7	40.3	55.0	66.0	86.0
T_3 (GML +FYM)	16.0	40.0	52.0	65.0	85.0
T_4 (Vermicompost)	18.0	43.0	58.0	68.0	88.0
T_5 (Poultry Manure)	20.0	45.0	60.0	70.0	90.0
SEm+	0.6	1.0	1.3	1.4	1.2
C.D.(P=0.05)	2.1	3.2	4.1	4.5	3.9

Table 3: Herbage yield (q ha^{-1}) of lemon grass at different harvesting stage

	Days after transplanting (DAT)				
Treatments	30	60	90	120	150
T_1 (100 % NPK)	150.7	193.9	236.0	367.8	482.0
T_2(50% NPK + FYM)	142.1	190.6	232.1	363.3	481.1
T_3 (GML +FYM)	137.0	185.2	228.2	360.3	478.4
T_4 (Vermicompost	157.8	196.0	238.5	372.0	482.5
T_5 (Poultry Manure)	162.2	198.1	241.4	374.6	487.7
SEm+	0.76	0.19	0.27	0.33	1.10
C.D.(P=0.05)	2.5	0.60	0.90	1.1	3.6

Table 4: Effect on treatments on dry matter yield of lemongrass

	Days after transplanting (DAT)				
Treatments	30	60	90	120	150
T_1 (100 % NPK)	27.33	36.37	49.41	69.44	89.46
T_2(50% NPK + FYM)	26.31	35.34	48.38	66.42	88.44
T_3 (GML +FYM)	25.28	34.31	46.34	65.39	87.41
T_4 (Vermicompost)	28.36	38.39	50.42	70.45	90.47
T_5 (Poultry Manure)	30.41	40.49	51.44	73.47	92.49
SEm+	0.016	0.062	0.015	0.20	0.019
C.D.(P=0.05)	0.039	1.43	0.035	.47	0.045

Table 5: Tissues composition (N and P) of lemongrass at different harvesting Stage

	N (%)					P (%)				
Treatments	I har.	II har.	III har.	IV har.	V har.	I har.	II har.	III har.	IV har.	V har.
T_1 (100 % NPK)	1.29	1.31	1.30	1.31	1.33	0.26	0.26	0.27	0.28	0.31
T_2(50%NPK+ FYM)	1.28	1.29	1.28	1.29	1.31	0.24	0.25	0.26	0.27	0.29
T_3 (GML +FYM)	1.24	1.25	1.26	1.27	1.28	0.22	0.23	0.24	0.25	0.27
T_4 (Vermicompost)	1.31	1.32	1.31	1.34	1.35	0.27	0.28	0.28	0.29	0.32
T_5 (Poultry Manure)	1.32	1.33	1.34	1.35	1.36	0.28	0.28	0.32	0.31	0.33
SEm+	0.01	0.02	0.02	0.02	0.016	0.015	0.018	0.014	0.013	0.019
C.D.(P=0.05)	0.04	0.04	0.05	0.035	0.038	0.034	0.042	0.033	0.031	0.043

Table 6: Tissues composition (K and S) of lemongrass at different harvesting Stage

	K (%)					S (%)				
Treatments	I har.	II har.	III har.	IV har.	V har.	I har.	II har.	III har.	IV har.	V har.
T_1 (100 % NPK)	1.35	1.36	1.34	1.35	1.37	0.17	0.21	0.22	0.25	0.32
T_2(50%NPK+ FYM)	1.32	1.33	1.32	1.34	1.35	0.16	0.18	0.21	0.24	0.31
T_3 (GML +FYM)	1.29	1.31	1.26	1.27	1.32	0.15	0.18	0.22	0.26	0.29
T_4 (Vermicompost)	1.37	1.38	1.37	1.39	1.41	0.18	0.22	0.24	0.28	0.34
T_5 (Poultry Manure)	1.39	1.40	1.39	1.38	1.42	0.21	0.25	0.31	0.32	0.36
SEm+	0.012	0.017	0.016	0.016	0.012	0.011	0.01	0.01	0.02	0.016
C.D.(P=0.05)	0.029	0.039	0.04	0.038	0.028	0.027	0.02	0.028	0.044	0.038

Table 7: Tissues composition (Ca and Mg) of lemongrass at different harvesting Stage

	Ca (%)					Mg (%)				
Treatments	I har.	II har.	III har.	IV har.	V har.	I har.	II har.	III har.	IV har.	V har.
T_1 (100 % NPK)	0.25	0.27	0.25	0.26	0.29	0.33	0.37	0.41	0.44	0.46
T_2(50%NPK+ FYM)	0.24	0.25	0.24	0.25	0.26	0.31	0.34	0.38	0.42	0.44
T_3 (GML +FYM)	0.21	0.22	0.24	0.24	0.25	0.28	0.31	0.34	0.39	0.41
T_4 (Vermicompost)	0.27	0.28	0.28	0.29	0.32	0.36	0.39	0.42	0.45	0.47
T_5 (Poultry Manure)	0.28	0.28	0.32	0.31	0.33	0.41	0.49	0.44	0.47	0.49
SEm+	0.014	0.018	0.015	0.016	0.012	0.01	0.02	0.018	0.01	0.02
C.D.(P=0.05)	0.033	0.041	0.035	0.038	0.027	0.02	0.05	0.034	0.03	0.05

REFERENCES

Jackson, M. L. (1973). Soil chemical analysis. Prentice Hall of India Private Limited, New Delhi, P.205

Olsen, S.R., Cole, R.V. Watanabe, F.S. and Lean, L.A. (1954.) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *United States Department of Agriculture Circular*, 19 ; 939.

Singh, B., Singh, Y., Sadananda, U. S. And Meelu, O. P. (1992). Effect of green manure, wheat straw and organic manures on DTPA extractable Fe, Mn, Zn and Cu in a calcareous sandy loam soil at field capacity and under water logged conditions. *J Indian Soc. Soil Sci*., 40:114-118.

Singh, R.P., Singh, R.S., Singh, R.K. and Singh, A. (2002). Effect of Palmarosa (*Cymbopogon martinii*) on Improvement of Salt Affected Soils. Comm.

International Sem. held at Bangkok. Symposium, 33 Paper No.2023.

Singh, R.S., Singh, M.P. and Singh, V.B. (1987). Physico-chemical characteristics of salt and alkali affected riverside soils of eastern U.P. *Proc. Nat. Acad. of Sci., Tiruchira Palli,* India, 57: 3

Sinha, M.K. and Jha, S.N. (1981). Proc. Mang. Salt-affected Calc. Soils, Push, Bihar. p 41.

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for determination of available nitrogen in soil. *Cur. Sci*., 25: 259-260.

Walkley, A. and Black, I.A. (1934). Rapid titration method of organic carbon of soils. *Soil Science,* 37 : 29-33.