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Effect of Various Organic and Inorganic Sources of Nitrogen on Growth and Yield of Maize (*Zea mays* L.)

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ABSTRACT: *In order to study the effect of FYM, sewage sludge and compost on growth and yield of Maize* (Zea mays *L.) an experiment was conducted during* rabi *season of 2009-10 in the field no 500-A, Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P. on sandy loam soil. The experiment was laid out in Randomized Block Design with 9 treatments and 3 replications. The different treatments were allocated randomly in each replication. FYM, sewage sludge and compost are used as organic source of nitrogen in sole and combination with sewage sludge while the Urea is used as inorganic source of nitrogen. The plants obtained maximum plant height, plant dry weight, Crop Growth Rate and Relative Growth Rate under the treatment of T_7- sewage sludge 1.67 t/ha + FYM 12 t/ha which was closely followed by sewage sludge T_6-3.34 t/ha + FYM 8 t/ha in plant dry weight, Crop Growth Rate and Relative Growth Rate; and T_8- RDF 120:60:60 kg NPK/ha in plant height. Number of cobs/plant, Number of grains row/cob, number of grains/row, seed index, grain and stover yield were recorded higher under the treatment T_7- sewage sludge 1.67 t/ha + FYM 12 t/ha which was closely followed by T_8- RDF 120:60:60 kg NPK/ha. Application of inorganic sources of nitrogen (RDF 120:60:60 kg NPK/ ha) gave the maximum net return and benefit cost ratio While the organic sources of nitrogen T_7- sewage sludge 1.67 t/ha + FYM 12 t/ha gave the maximum Gross return (Rs.41065 ha^{-1}), Net return (Rs.15986.23 ha^{-1}) and benefit : cost ratio (1.63) whereas the minimum Gross return (Rs.13461 ha^{-1}), Net return (Rs.566 ha^{-1}) and benefit : cost ratio (1.04) was obtained from T_9 (control).*

Keywords: *Maize, FYM, sewage sludge, compost, growth, yield, economics, Zea mays L.*

INTRODUCTION

The era of green revolution resulted in spectacular achievement in the food grain production due to the adoption of intensive agriculture. This involves increased use of synthetic inputs like inorganic fertilizers, pesticides, fungicides and greater exploitation of surface and groundwater resources in view of producing more and more from unit piece of land. Over exploitation of resources and indiscriminate usage create multivarious problems, which endanger the existences of all forms of life by disrupting the ecological balance. In India, there is a shortage of organic carbon in the soil because of poor use of organic manures, and also due to faster decomposition of organic matter. This has reduced the efficiency of soil to absorb fertilizers and give better yields (Muthuvel *et al*., 1990). Maize (*Zea mays* L.) is the third most important cereal next to rice and wheat, in the world as well as in India. It is a versatile crop and can be grown in diverse environmental condition and has multiple uses. It is uses as food, feed and fodder. Maize being a C_4 plant is an efficient converter of absorbed nutrient into food (Srikanth *et al*. 2009).

Among the essential nutrients, macro- elements such as nitrogen, Phosphorus and potassium play a crucial role in deciding the growth and yield. Maize having high yield potential responds greatly to application of nutrients. Therefore, proper management of nutrients is essential to realize maximum potential of the crop (Saker *et al*. 2009). Organic manures play a vital role in building up of organic carbon in the soil. These manures can create a favourable air and water regime around plant roots

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and act as carriers of some micronutrients besides its influence on the microbial and faunal activities in the soil (Murugesaboopati *et al.,* 2009). In recent years, emphasis on use of organic manures like FYM, Sewage sludge and rural compost in crop production has assumed increased importance due to pressure on organic agriculture. Available FYM and rural compost in India is not sufficient to meet the demand of the net cultivated area of 17 m ha. In India rapid urbanization is generating more than 6530 cubic metres (m^3) of sewage annually (Reddy *et al.*, 2007). Recycling of these organic manures in crop production helps in solving the problem of dumping organic wastes and pollution hazards to the environment. The present research was conducted to find the effect of FYM, sewage sludge and compost on growth and yield of Maize (*Zea mays* L.).

METHOD AND MATERIAL

A field experiment was conducted during *rabi* season 2009-10 at Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, U.P. situated at 25.67 °N latitude, 81.5 °E longitude and 98 m from sea level. This region has subtropical climate prevailing in the south-east parts of UP with both the extremes of temperature in summer and winter. In winter temperature sometimes fall very low upto 5 °C in December- January and very hot in summer with temperature reaching upto 47 °C in May and June hot desiccating winds are a regular feature during summer whereas there may be an occasional spell of frost during winter. The average rainfall in this area is above 90 cm during the winter months. Mechanical and chemical analysis of soil was done before experiment to know the initial status of the soil. The soil was sandy loam having 60% sand, 20% silt and 14.4% clay. The soil contained 0.39% organic carbon, 15 kg/ha available P and 325 kg/ha available K with pH 7.5 in the year of experiment. The treatment consisted of T_1- sewage sludge at 6.7 t/ha, T_2- compost at 24 t/ha, T_3- FYM at 16 t/ha, T_4- sewage sludge 3.34 t/ha + compost 12 t/ha, T_5- sewage sludge at 1.67 t/ha + compost at 18 t/ha, T_6- sewage sludge 3.34 t/ha + FYM 8 t/ha, T_7- sewage sludge 1.67 t/ha + FYM at 12 t/ha, T_8- RDF 120:60:60 kg NPK/ha and T_9- control. The field was prepared and laid out in Plots. Application of FYM was done one month before sowing; application of compost was done 20 days before sowing and application of sewage sludge was done 10 days before sowing. Maize composite variety 'Devaki' was sown on 29 October 2009 with 20 kg/ha seed rate. A uniform basal dose of 60 kg N, 60 kg P_2O_5 and 60 kg K_20 was applied at sowing time. Rest of the N was applied in two splits. One part was applied at knee high stage and the other part used at tasseling stage (only in T_8). The seed was sown at 5 cm depth in furrow keeping a spacing of (55 x 25 cm) with the help of Hoe and covered by light planking. Hand weeding was twice done at 25 and 45 DAS. Economics was calculated as per the treatment and different parameters *viz*. cost of cultivation, Gross return, net return and benefit cost ratio were estimated.

RESULT AND DISCUSSION

Growth, Yield Attributes and Yield

In the experimental field significantly taller plant (226.33 cm), maximum plant dry weight (132.88g), Crop Growth Rate (25.0475g/m^2/day), and Relative Growth Rate (0.0522 g/g/day) was observed with treatment T_7- sewage sludge 1.67 t/ha + FYM 12 t/ha. The lowest plant height (112.44 cm), Plant dry weight (60.33 g) Crop Growth Rate (11.4672 g/m^2/day), and Relative Growth Rate (0.0410 g/g/day) was recorded under T_9- Control. Similar result was also reported by Reddy *et al.* (2007). The plant height was at par with T_8- RDF 120:60:60 kg NPK/ha. This might be due to greater availability of nutrients resulting in increased in height. Dry weight of the plant was at par with T_6 (sewage sludge 3.34 t/ha + FYM 8 t/ha) and T_1 (sewage sludge 6.7 t/ha) at par with T_7. Significant increase in plant dry weight can be attributing to fact that sewage sludge application has increased biomass production.

Grain and Stover yield were recorded higher under the treatment T_7- sewage sludge 1.67 t/ha + FYM 12 t/ha. Highest grain yield of 27.76 q/ha with stover yield of 116.46 q/ha was closely followed by T_8- RDF 120:60:60 kg NPK/ha i.e. 25.43 q/ha grain yield and 109.13 q/ha stover yield. Treatment T_7 gave the high yield attributes and harvest index which were as number of cobs/plant (1.77), number of grains row/cob (15.46), number of grains/row (30.53), seed index (24.00) and harvest index (19.21%). T_3 (FYM 16 t/ha), T_6 (sewage sludge 3.34 t/ha + FYM 8 t/ha) and T_8- RDF 120:60:60 kg NPK/ha were at par with T_7 in number of cobs/plant and seed index while in all other attributes T_8 was at par with T_7. The higher growth and yield attributes under these treatments might be attributed to supply of nitrogen at critical stages of crop growth which resulted in higher growth and yield attributes.

Table 1
Effect of Different Treatments on Growth and Growth Parameters of Maize at Harvest

Treatments	*Plant height (cm)*	*Dry weight (g)*	*Crop Growth Rate (g/m2/day)*	*Relative Growth Rate (g/g/day)*
T_1- Sewage sludge 6.7 t/ha	197.99	129.11	24.3471	0.0506
T_2- Compost 24 t/ha	193.38	123.22	23.5305	0.0504
T_3- FYM 16 t/ha187.49	124.66	23.6565	0.0513	
T_4- Sewage sludge 3.34 t/ha + compost 12 t/ha	193.22	122.77	23.6105	0.0525
T_5- Sewage sludge 1.67 t/ha + compost 18 t/ha	182.55	123.10	24.2163	0.0490
T_6- Sewage sludge 3.34 t/ha + FYM 8 t/ha	212.83	132.22	24.4586	0.0499
T_7- Sewage sludge 1.67 t/ha + FYM 12 t/ha	226.33	132.88	25.0475	0.0522
T_8- RDF 120:60:60 kg NPK/ha	226.11	130.88	24.9699	0.0510
T_9- Control	112.44	60.33	11.4672	0.0410
Mean	192.48	119.90	22.8100	0.0044
F-test	S	S	S	S
SED ±	3.83	3.00	0.8154	0.0023
CD at 5%	8.11	6.36	1.7286	0.0048

Table 2
Effect of Different Treatments on Yield and Economics of Maize at Harvest

Treatments	*No of cobs/plant (no.)*	*No of grains row/cob (no.)*	*No of grains/ row (no.)*	*Seed index (100 seeds (g))*	*Grain yield (q/ha)*	*Stover yield (q/ha)*	*Harvest index (%)*	*Cost of cultiva-tion (Rs.)*	*Gross Return (Rs.)*	*Net Return (Rs.)*	*Benefit cost Ratio*
T_1- Sewage sludge 6.7 t/ha	1.10	10.93	25.66	21.00	19.83	89.46	18.21	19135.5	30274.5	11139.0	1.58
T_2- Compost 24 t/ha	1.22	11.73	25.80	22.16	22.86	98.80	18.78	28825.0	34251.0	54260.0	1.18
T_3- FYM 16 t/ha	1.44	12.26	25.86	22.83	22.56	100.16	18.38	27450.0	34200.0	6750.0	1.24
T_4- Sewage slndge 3.34 t/ ha + compost 12 t/ha	1.11	11.20	25.93	21.83	20.46	98.13	17.26	23397.0	32110.5	8713.5	1.37
T_5- Sewage sludge 1.67 t/ha + compost 18 t/ha	0.99	12.13	24.46	21.66	20.50	91.30	18.33	26111.0	31120.0	5009.0	1.19
T_6- Sewage sludge 3.34 t/ ha + FYM 8 t/ha	1.55	12.53	26.93	23.16	23.63	107.06	18.05	22752.5	36144.5	13392.0	1.59
T_7- Sewage sludge 1.67 t/ ha + FYM 12 t/ha	1.77	15.46	30.53	24.00	27.76	116.46	19.21	25079.7	41065.0	15986.0	1.63
T_8- RDF 120:60:60 kg NPK/ha	1.66	14.93	29.40	23.83	25.43	109.13	18.90	21098.0	37984.0	16860.0	1.80
T_9- Control	0.55	8.66	17.86	19.83	8.46	43.00	16.57	13075.0	13641.0	566.0	1.04
Mean	1.26	12.20	25.82	22.25	21.27	94.83	18.19	23051.4	32306.0	13630.6	1.40
F-test	S	S	S	S	S	S	NS	-	-	-	-
SED ±	0.21	0.39	0.83	0.62	0.81	3.56	0.88	-	-	-	-
CD at 5%	0.45	0.82	1.78	1.31	1.81	7.54	-	-	-	-	-

Economics of Different Treatments

Application of inorganic sources of nitrogen T_8--- RDF: 120:60:60 kg NPK/ha gave the maximum net return Rs. 16860 ha^{-1} and benefit cost ratio 1.80 because of the lower price of fertilizers and less quantity of fertilizers were used in comparison to manures. While the organic sources of nitrogen application of T_7 (sewage sludge 1.67 t/ha + FYM 12 t/ha) gave the maximum Gross return (Rs.41065 ha^{-1}), Net return (Rs.15986.23 ha^{-1}) and benefit: cost ratio (1.63) whereas the minimum Gross return (Rs.13461 ha^{-1}), Net return (Rs.566 ha^{-1}) and benefit: cost ratio (1.04) was obtained from T_9 (control).

REFERENCES

Murugesaboopati, P.; Sivamurugan, A.P. and Raja, D. (2009), Economic analysis of sorghum and maize based cropping system is irrigated upland. *Green farming,* 2(4): 218-220.

Muthuvel, P.; Santhi, R. and Mathan, K.K. (1990), Soil fertility under continuous rotational cropping of cotton – pearlmillet in a dry l; and vertisol. *Madras Agric. J.,* 77(1): 48-50.

Srikanth, M.; Amanullah, M.; Mohamed and Muthukrishnan, P. (2009), Yield and economics of hybrid maize as influenced by plant density and fertilizer levels. *Green Farming,* 2(4): 203-205.

Sekar, S.; Amanullah, M.; Mohamed; Manoharan, S. and Subramanian, K.S. (2009), Influence of fertilizer levels and growth substances on yield and quality of hybrid maize. *Green Farming*, 2(13 Spl.1): 889-892.

Reddy, S.R.; Reddy, V.C.; Parama, v.R.R. and Samanta Pampa (2007), Effect of FYM, sewage sludge and urban compost on growth and yield of sweet sorghum. *J. of Soils and Crops,* 17(2): 211-216.