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Effect of Humanure, Pit Toilet Sludge and Sewage Sludge on Yield and Soil Properties of Tomato (L*ycopersican esculentum*)

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Abstract

A field experiment was conducted in the farmer's field at Nayanahalli village, Chintamani taluk, Chickaballapur district during 2014 to study the effect of humanure, pit toilet sludge and sewage sludge application on yield and soil properties of tomato crop. The results revealed that the average ten fruit weight (1311.12 g), average number of fruits per plant (40.99) fruit yield (53.12 t ha^{-1}) and haulm yield (9.64 t ha^{-1}) were significantly higher in the treatment of 150 per cent P through pit toilet sludge + balance N and K through fertilizers to supply 150 per cent N and K. The increase in yield was to the tune of 4.34 per cent, 6.41 and 19.13 per cent over RDF (100 % NPK + FYM), RDF alone and FYM alone treatments, respectively. The average ten fruit weight (919.10 grams), no of fruits per plant (33.56) and fruit yield (38.06 t ha^{-1}) were lower in absolute control. Soil pH, EC, organic carbon content and available major nutrients content of soil recorded higher in the treatments T_6, T_3 and T_9, respectively.

The generation of anthropogenic waste is increasing due to rapid urbanization. The municipalities all over the world are concerned with safe and feasible methods of their disposal. The current methods for disposal include land filling, incineration, dumping in sea and field application for agricultural use (Llorens, *et al.*, 2012). Incineration and land filling are not popular because of the high cost and environmental hazards. Therefore, the only viable option left for anthropogenic waste management is its utilization in agriculture as a source of organic matter and plant nutrients, which is perhaps the most convenient and feasible practice for their disposal. The motivation for recycling of fecal material (humanure and pit toilet sludge) and sewage sludge to agricultural soil is a low cost disposal method, and effective soil organic matter preservation and improving soil fertility. Fecal sludge (humanure and pit toilet sludge) and Sewage sludge (biosolids), which are enich in nitrogen, phosphorus, organic matter and other trace elements, represents a good source of nutrients for plant growth and a good soil conditioner to improve soil physical properties (Ozyazici, 2013). In this context, experiments were conducted to study the effect of humanure, pit toilet sludge and sewage sludge on yield and soil properties of tomato.

A field experiment was conducted during kharif-2014 with Tomato (private hybrid-440) as test crop in the farmer's field at Chintamani. Three sources of manure samples were analysed for pH, EC, organic carbon, major, secondary and micro nutrients, and heavy metals (Pb, Cd, Ni and Cr) content by adopting standard procedures.The soil of the experimental site was red loamy with slightly alkaline pH (7.88), Electric conductivity (1.01 dSm^{-1}) was within the permissible limits and high in organic carbon (0.96 %) content. The available nitrogen (373.39 kg ha^{-1}), phosphorus (150.24 kg ha^{-1}) and potassium (321.22 kg ha^{-1}) were medium, high and medium in range, respectively. The experiment was laid out in a Randomized Complete Block Design with thirteen treatments replicated thrice with a spacing of 120 cm × 45 cm. Treatment details are given in Table 2. Calculated quantity of manures based on K and P were applied and incorporated one week before transplanting of tomato seedlings. The full dose of phosphorous and potash fertilizers were applied at the time of transplanting where as nitrogen was applied in two split doses, first split dose at the time of transplanting and second split dose one month after transplanting. Irrigation was given through drip system. The growth and yield observations were recorded during the crop growth period and at the time of harvest and were statistically analysed. Post harvest soil samples were analysed for available nutrient content. The data were statistically analysed using two way ANOVA.

TABLE I

Characterization of Humanure, Pit toilet sludge and Sewage sludge

Parameters	Humanure	Pit toilet sludge	Sewage sludge
pH (1:5)	8.47	6.01	5.95
EC (1:5) (dS/m)	4.47	1.62	1.12
Total carbon (%)	15.66	14.62	7.13
N (%)	0.03	0.45	0.44
P (%)	0.58	0.77	1.06
K (%)	2.27	0.13	0.21
Ca (%)	3.08	0.13	3.63
Mg (%)	5.65	2.54	8.34
S (%)	1.61	1.21	1.52
Fe (ppm)	9243.61	6717.00	9921.50
Mn (ppm)	432.43	308.86	469.51
Zn (ppm)	476.62	400.72	457.19
Cu (ppm)	114.60	98.85	107.44
B (ppm)	309.5	263	218
Cd (ppm)	13.27	11.95	8.75
Cr (ppm)	39.15	35.24	33.91
Pb (ppm)	43.46	39.12	35.06
Ni (ppm)	48.47	43.62	31.32

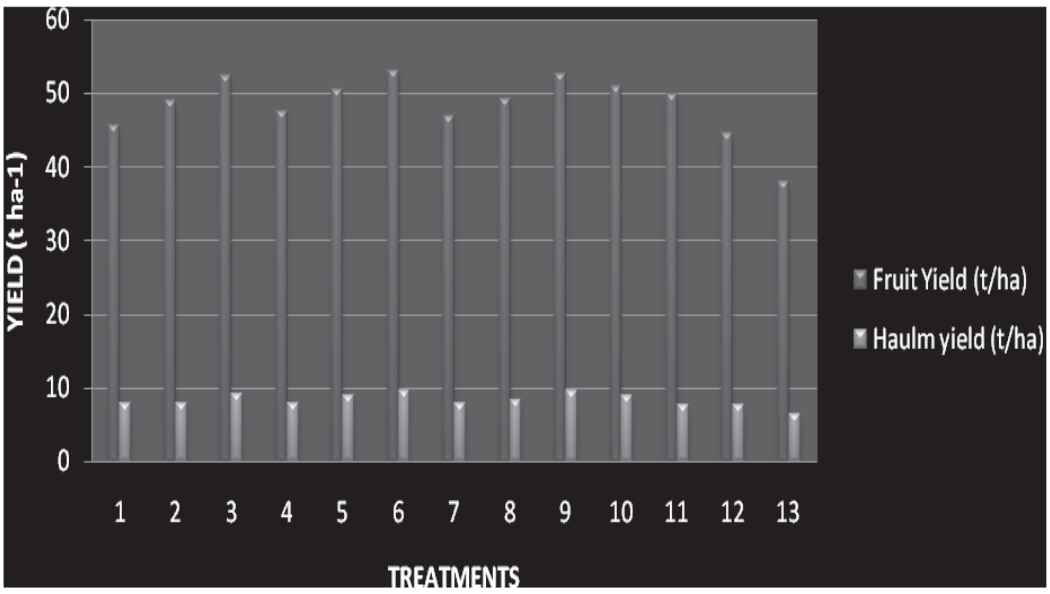

Fig. 1 : Effect of Humanure, Pit toilet sludge and Sewage sludge application of yield of Tomato

TABLE II

Effect of Humanure, Pit toilet sludge and Sewage sludge on pH, EC Organic carbon content and available NPK content of soil after harvest of tomato

Parameters	pH (1:2.5)	EC ($d.S.m^{-1}$)	OC (%)	Avail. N. ($kg\ ha^{-1}$)	Avail. P_2O_5 ($kg\ ha^{-1}$)	Avail. k_2O ($kg\ ha^{-1}$)
T_1 : 75 % K through Humanure + balance N and P through fertilizers to supply 75 % N & P	7.90	1.37	1.03	329.91	146.41	256.12
T_2 : 100 % K through Humanure + balance N and P through fertilizers to supply 100 % N & P	7.92	1.38	1.09	341.20	153.46	274.18
T_3 : 150 % K through Humanure + balance N and P through fertilizers to supply 150 % N & P	7.98	1.41	1.19	352.49	188.43	332.77
T_4 : 75 % P through pit toilet sludge + balance N and K through fertilizers to supply 75 % N & K	7.62	1.19	1.05	333.67	135.92	258.14
T_5 : 100 % P through pit toilet sludge + balance N and K through fertilizers to supply 100 % N & K	7.51	1.20	1.11	342.45	145.85	276.55
T_6 : 150 % P through pit toilet sludge + balance N and K through fertilizers to supply 150 % N & K	7.35	1.25	1.21	353.74	180.60	385.95
T_7 : 75 % P through Sewage sludge + balance N a nd K through fertilizers to supply 75 % N & K	7.58	1.15	1.02	327.40	133.54	250.16
T_8 : 100 % P through Sewage sludge + balance N and K through fertilizers to supply 100 % N & K	7.39	1.18	1.09	339.94	140.89	269.43
T_9 : 150 % P through Sewage sludge + balance N and K through fertilizers to supply 150 % N & K	7.27	1.20	1.18	343.71	176.59	303.83
T_{10} : Recommended dose of NPK + FYM	7.72	1.15	1.14	342.45	161.79	291.07
T_{11} : Recommended dose of fertilizer alone	7.79	1.12	0.91	327.40	148.56	245.64
T_{12} : Recommended dose of FYM alone	7.72	1.10	1.08	317.36	131.84	241.88
T_{13} : Control	7.83	1.06	0.89	316.11	122.73	219.12
S. Em±	0.12	0.06	0.06	5.96	1.90	20.49
C. D. at 5 %	0.36	0.19	0.18	17.88	5.70	61.42

The phosphorus content in pit toilet sludge and sewage sludge and potassium content in humanure sample were appreciably high. The secondary and micro nutrients were in sufficient range. The heavy metal content was within the permissible limits (Table I). The data of field experiments indicated positive impact of manures on growth and yield parameters of tomato. Significantly higher plant height (133.85 cm) and more number of branches per plant (10.95) were recorded in treatment combination of 150 % P through pit toilet sludge + balance N and K through fertilizers to supply 150 per cent N and K at 90 days after transplanting and were on par with T_9 and T_3. The application of 100 per cent pit toilet sludge, sewage sludge and humanure along with balanced fertilizer application (T_5, T_8 and T_2) recorded higher plant height (112.69, 118.98, 118.86 cm, respectively) compared to recommended doses of fertilizer (118.75 cm). The lowest (103.99 cm) growth parameters were recorded in control. Same trend was observed at 60 and 30 days after transplanting.

Significantly higher number of fruits per plant (40.99), average weight of 10 fruits (1311.12 g), fruit

yield (53.12 t ha^{-1}) and haulm yield (9.64 t ha^{-1}) recorded in treatment that received 150 per cent P through pit toilet sludge + balance N and K through fertilizers to supply 150 per cent N and K compared to treatment received recommended dose of fertilizers (32.05, 1131.71 g 50.91 t ha^{-1} and 8.88 t ha^{-1}) (Fig. 1). The lowest fruit and haulm yield (38.06 and 6.32 t ha^{-1}) was recorded in control. Increase in tomato yield in pit toilet sludge, humanure and sewage sludge treated plots may be due to higher plant height and more number of branches. Llorens *et al*., (2012) reported that growth of tomato plants was higher when synthetic fertilization had been substituted with composted sludge when compared with plants grown with traditional fertilization.

Changes observed in soil chemical properties due to humanure, pit toilet sludge and sewage sludge application are presented in the Table II. Significant difference of soil pH was observed after the harvest of the crop. Higher pH (7.98) was recorded with higher application of humanure (T_3) compared to other treatments. Slight increase in soil pH was observed which may be due to alkaline nature of humanure. The lower pH was recorded in control plot (T_{13}). Significantly higher EC (1.41 ds m^{-1}) was recorded in plots receiving 150 per cent K through Humanure + balance N and P through fertilizers to supply 150 per cent N & P (T_3) and it was on par with T_2 (1.38 ds m^{-1}) and T_1 (1.37 ds m^{-1}), respectively. The lower EC was recorded in treatment where no manure and fertilizer were applied (T_{13}).The decrease in soil EC value in pit toilet sludge and sewage sludge applied treatments may be due to their acidic nature and low EC values compared to humanure.

The higher organic carbon content was recorded in the soils of plots which were applied higher amount of manures compared to the plots which received recommended dose of fertilizers. The treatment T_6 recorded higher organic carbon content (1.21 %) and it is on par with T_3 and T_9 respectively. The lower organic carbon content was recorded in control (0.89 %) followed by only fertilizer applied treatment T_{11} (1.07 %). This is because, manures which are organic in nature contain higher amount of total organic carbon than the FYM (Mondala, *et al*., 2015). Considerable improvement in organic matter was observed particularly when higher amount of sludge was applied.

The NPK content of soil showed significant differences among the treatments. The available nitrogen (353.74 kg ha^{-1}) and potassium (385.95 kg ha^{-1}) content of soil recorded higher in the treatments which received higher amount of pit toilet sludge (T_6) followed by T_3 and T_9, respectively. The higher available phosphorus (188.43 kg ha^{-1}) content of soil recorded in T_3 and was on par with T_6 and T_9. The lower Available N (316.11 kg ha^{-1}), P_2O_5 (122.73 kg ha^{-1}) and K_2O (219.12 kg ha^{-1}) content of soil was observed in control.

From the present investigation, it can be inferred that three different sources of anthropogenic wastes like humanure, pit toilet sludge and sewage sludge can be used as nutrient sources in enhancing crop yield. Application of manures improves physical condition of soil inturn enhancing soil fertility.

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