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Impact of some organic 'N' sources on soil physical properties and yield of tomato

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Abstract : A field experiment was conducted in red sandy loam soil with tomato (*Lycopersicon exculentum* Mill) var. CO 3 as test crop to evaluate the influence of organic N sources on soil physical properties and yield of tomato. The organic N sources tried were pig manure, fish meal, pressmud, poultry manure and FYM. Urea was taken for comparison. Application of organic N sources increased the saturated hydraulic conductivity, aggregate stability, total porosity and non-capillary porosity significantly than control. The N and P contents of the tomato crop were non-significant. Application of 150 kg N ha^{-1} in the form of fish meal increased the dry matter production, N and P uptake. Application of poultry manure increased the K content and uptake; fruit and seed yield. Seed recovery was increased due to application of 150 kg N ha^{-1} through pig manure and 75 kg N ha^{-1} through pressmud.

Keywords: Organic N sources, Soil properties, Nutrient uptake, Tomato yield and Seed recovery.

Introduction

The concentrated organic manure being rich in plant nutrients could replace the inorganic fertilizer on equivalent nutrient basis. Application of organic manure improves the soil physical, chemical and biological properties with direct impact on moisture retention, root growth, nutrient conservation *etc*. Organic matter neutralizes the repaid fall due to continuous use of fertilizers. Heavy metals react with inorganic nutrients, clay exchange site, carbonates and oxide surfaces and precipitate as hydroxides, carbonates, sulphides and phosphates in soil (Lee and Kitric, 1984). Hence organic produces are residue free and fetch a higher prize in the market than any other chemical farm produces. In India, organic manures as N sources *viz.*, poultry manure, fish meal, pig manure, farm yard manure and pressmud are produced by 150 million poultry, 8.6 million pigs, 182 millions cattle (FAO, 1984) and 700 sugar mills which would have been doubled by 2010 AD. The scientific community has an immediate task of exploring the organic agriculture, before it gets too late. Application of organic waste has been reported to improve the physical properties of soil besides increasing the crop yield (Mail, 1997). Tomato is a vegetable, grown universally in home gardens, greenhouse and market garden for shipment and canning. In India it is grown at an area of 8,21,000 ha with an annual production of about 80,20,000 t (Anonymous, 1985). Information on nutrient management under organic farming practices is scanty and hence the present study was taken up.

Table 1. Effect of different organic N sources and urea on physical properties of soil at harvest stage and yield of tomato.

Treatments	K (sat) (cm h^{-1})	TP (%)	NCP (%)	AS (%)	Yield kg $plant^{-1}$	t ha^{-1}
T_1	4.0	28	12.5	19.5	0.56	16.3
T_2	3.5	25	10.0	14.5	0.92	26.3
T_3	6.5	48	19.3	37.6	1.11	32.6
T_4	4.5	45	17.2	31.6	0.85	20.9
T_5	4.3	39	17.0	43.7	1.61	47.5
T_6	6.5	35	16.0	35.8	1.04	30.6
T_7	6.0	41	18.0	37.6	1.37	40.3
T_8	7.0	37	18.0	33.7	0.97	28.5
T_9	9.5	53	20.0	36.5	0.99	29.9
T_{10}	8.5	48	18.4	34.7	0.70	20.5
T_{11}	7.4	43	17.4	38.7	1.21	35.6
T_{12}	6.4	39	15.4	35.7	0.80	23.8
SEd	0.2	1.1	1.2	2.2	0.14	4.1
CD	0.4	2.2	2.4	4.4	0.285	8.2

TP = Total porosity NCP = Non capillary porosity
AS = Aggregate stability K (sat) = Saturated hydraulic conductivity.

Materials and Methods

A field experiment was laid out with different organic N sources during Dec. 1999 - Mar. 2000 in red sandy loam soil at Agricultural College and Research Institute, Killikulam in randomized block design with three replications. The treatments were T_1-control; T_2-recommended N though urea (326 kg ha^{-1}) T_3-recommended N through FYM (7,500 kg ha^{-1}); T_4-50% recommended N through FYM (3,750 kg ha^{-1}) T_5- recommended N through poultry manure (3,750 kg ha^{-1}); T_6-50% recommended N through poultry manure (1,530 kg ha^{-1}); T - recommended N though fish meal (1,705 kg ha^{-1}); T -50% recommended N though fish meal (856 kgha^{-1}); T -recommended N through pressmud (10,714 kg ha^{-1}); T_{10}-50% recommended N through pressmud T_{11}-recommended N through pig manure (2,102 kg ha^{-1}); T_{12}-50% recommended N through pig manure (1,051 kg ha^{-1}). Recommended N for tomato is 150 kg ha^{-1} (Anonymous, 1999).

Well-decomposed organic N sources were brought from near by sources, dried under shade, powdered well and analyzed for nutrient content following standard analytical procedure. The C, N, P, K, Ca and Mg content of poultry manure was 20, 4.9, 3.5, 2.2, 1.7

Table 2. Effect of different organic N sources on dry matter production, nutrient content, uptake at harvest, seed yield and seed recovery of tomato.

Treat-ments	Nutrients content at harvest (%)			Dry matter at harvest (kg ha^{-1})	Nutrients uptake at harvest stage (kg ha^{-1})			Seed recovery (%)	Seed yield (kg ha^{-1})
	N	P	K		N	P	K		
T_1	3.25	0.25	3.55	2280	74.1	5.6	81.0	1.20	194.4
T_2	3.39	0.20	1.79	5212	176.9	10.4	93.2	1.00	269.0
T_3	3.34	0.24	3.45	5156	172.0	12.2	178.1	1.24	403.0
T_4	3.04	0.25	2.61	3658	111.2	9.1	95.4	1.16	241.2
T_5	3.37	0.29	6.03	5350	180.4	15.7	322.4	1.18	559.3
T_6	3.14	0.24	4.37	4003	125.6	9.6	174.8	1.20	366.0
T_7	3.35	0.30	1.80	5503	184.3	16.3	98.9	1.14	458.5
T_8	2.87	0.26	2.04	4100	117.6	10.8	83.7	1.19	338.0
T_9	3.90	0.28	4.52	4115	160.3	11.7	186.0	1.16	329.4
T_{10}	3.57	0.27	4.89	3146	112.3	8.6	153.8	1.26	257.0
T_{11}	3.35	0.29	3.79	4958	166.0	14.4	187.7	1.26	447.3
T_{12}	2.71	0.24	3.25	3300	89.3	7.8	107.1	1.14	270.2
SEd	1.37	0.10	0.20	205	2.80	0.82	6.55	0.05	20.1
CD	NS	NS	0.41	409	5.80	1.71	13.54	0.01	40.0

and 1.1; FYM - 30.2, 2.0, 1.0, 0.4, 0.8, 2.1; fish meal - 19.3, 8.8, 6.8, 0.8, 2.5, 0.5; pig manure- 25.2, 3.7, 1.0, 0.9, 0.5; pressmud - 43.2, 1.4, 2.4, 1.9, trace, trace per cent, respectively. Based on N content of organic N sources, quantities required for recommended and 50% recommended level were worked out and applied. Half of the organic N source was applied before transplanting followed by weeding and hoeing. No fertilizer was added along with organic treatments.

The experimental area was red sandy loam soil with neutral pH (7.12) and medium in organic carbon (0.65 %). Soil contained available N, P_2O_5 and K_2O of 175, 21 and 330 kg ha^{-1}, respectively. Cultivation practices of tomato were done by following practices recommended by TNAU (Anonymous, 1999)

Soil samples were collected through core sampler. Post harvest soil cores (75 mm diameter and 0.75 mm height) were collected and analyzed for saturated hydraulic conductivity Soil in the cylinder is saturated through capillarity. At equilibrium, the quantity of water that flows out of the sample of length and cross sectional area for a given hydraulic head drop is measured for a given time (The hydraulic conductivity was calculated using Darcy's equation), total porosity (the ratio of volumes of pores to the soil bulk volume) and non-capillary porosity (Total porosity minus volume of water at 100 cm suction),

Fig.1 Effect of different organic N sources on yield of tomato

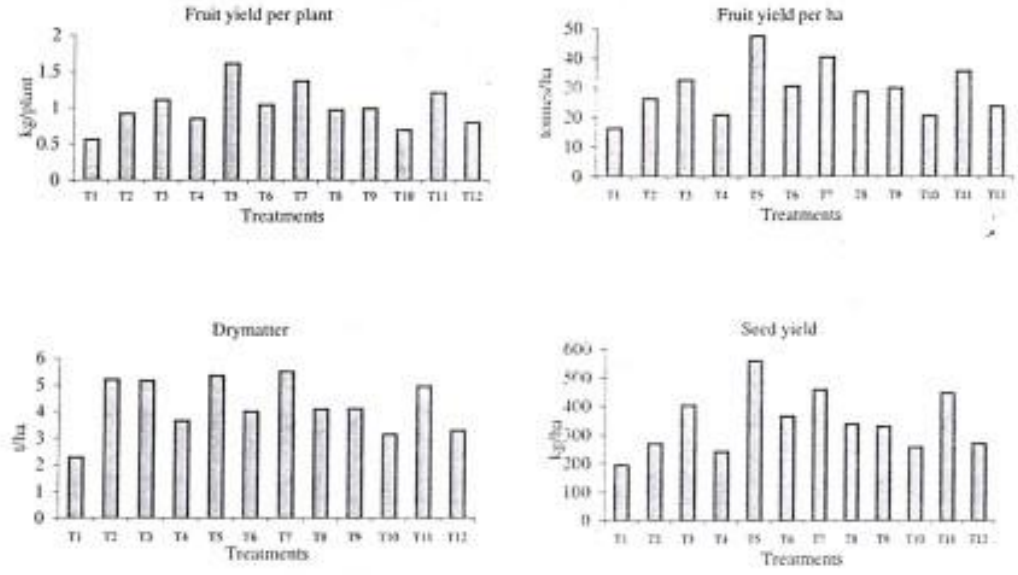
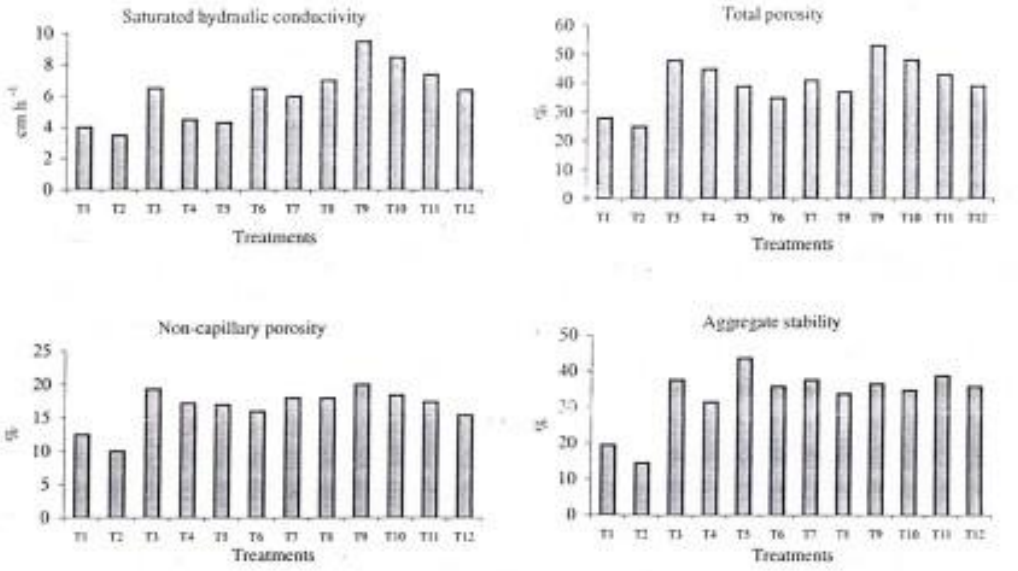


Fig.2 Effect of different organic N sources on soil physical properties



T_1-Control; T_2-100% N throg' urea; T_3-100% N thro' FYM; T_4-50% N thro' FYM;
T_5- 100% N thro' poultry manure; T_6-50% N thro' poultry manure;
T_7-100% N throg' Fishmeal; T_8-50 % N thro' Fishmeal; T_9-100%N thro' pressmud;
T_{10}- 50% N thro' press mud; T_{11}-100% N thro' pig mamnure; T_{12}-50 %N thro' pig manure

aggregate stability index (wet sieving) by the method suggested by Gupta and Dakshinamoorthy (1981). Plant samples collected for dry matter production were air dried initially and then dried in a hot air even at 60°C, powdered in a Willy Mill and utilized for further analysis. Total N, P and K contents of plant samples were estimated by standard procedure. Seed recovery per cent was obtained by the ratio of total weight of dried seeds obtained to the total weight of fruits taken. The data were statistically analyzed and results are discussed.

Results and Discussion

Incorporation of organic N sources had significantly led to higher saturated hydraulic conductivity (K sat.) Application of pressmud at recommended level of N recorded a higher K sat. of 9.5 cm h^{-1} while application of urea has a lower saturated hydraulic conductivity of 3.5 cm h^{-1} (Table 1-2 and Fig. 1-2). Non-capillary porosities of the post harvest soil sample was significantly higher (20.01%) in the plots applied with pressmud. Recommended dose of N in the form of urea recorded lower non-capillary pores (10.0%). Aggregate stability was significantly increased (44.3%) in the plots applied with recommended N in the form of poultry manure. Application of recommended N in the form of urea recorded lesser aggregate stability (15.0%) than control plot (20.01%). Total porosity of the soil was significantly increased due to application of orgartic N sources. Among the organic N sources, application of recommended dose of N in the form of pressmud recorded increased total porosity (53%) than other treatments in both the trials. Application of organic N sources increased the total porosity, non-capillary porosity, aggregate stability and saturated hydraulic conductivity compared to control plot (T_1) and the plot applied with recommended N in the form of urea (T_2). This may be due to better soil aggregation, which resulted in improved soil physical properties.

Application of organic N sources resulted in non-significant differences in N and P content but significant K content was recorded at harvest stages of tomato. Application of poultry manure recorded high K content (6.03%). There was significant increase in nutrient uptake and dry matter production at harvest, fruit yield, seed recovery and seed yield due to application of organic N sources than control. Among the organic N sources, application of 150 kg N in the form of fish meal recorded the highest dry matter production (55.3 kg ha^{-1}) was on par with 150 kg N in the form of poultry manure, urea and FYM and the lowest in control (2,280 kg ha^{-1}).

Application of 150 kg N ha^{-1} in the form of fish meal increased the N (184.3 kg ha^{-1}) and P (16.3 kg ha^{-1}) uptake which was on par with poultry manure. Application of recommended dose of N in the form of poultry manure recorded the highest K uptake (322.4 kg ha^{-1}).

Increased uptake of N, P and K due to application of organic N sources increased the availability of nutrients from soulblization action of organic acid produced during degradation, resulting in more release of native N, P and K. (Bandari *et al.,* 1992). Increased N and P uptake by fish meal and K by poultry manures may be due to higher nutrient content which increased dry matter production. Improvement in soil physical, chemical and biological properties, steady and adequate supply of N might had increased nutrient uptake due to application of organic N sources

especially by poultry manure. Similar observations were recorded by Hsieh and Hsu (1993) and Warnake and Siregar (1994) in different crops. Among the organic N sources, application of poultry manure recorded high yield (47.5 t ha^{-1}). Yield increase was 191 per cent over control and 80.6 per cent over urea. Yield increase due to organic N sources may be due to incorporation of organic carbon which improved the physical, chemical, biological properties and better solubilization of nutrients; root growth and nutrient uptake finally increased the yield of tomato. Poultry manure contains all the essential plant nutrients (Dosani *et al.,* 1999) increased the release of macro as well as micro nutrients in the soil resulting better extraction of nutrients increased dry matter production, nutrient uptake (Remesh, 1997), delayed senescence, increased fruit maturity period and uniformity in flowering (Roy *et al.,* 1987) which in turn increased the yield. Since solid and liquid portions of the poultry wastes are excreted together, poultry manure is a concentrated source of N, P and K. It is well documented as an excellent source of fertilizer (Simpson, 1990). Smith (1950) observed in poultry manure that 60 per cent of N was in the form of uric acid which changes rapidly to ammoniacal form for easy utilization by the plants. Reddy *et al.* (1982) reported that 50 per cent of N in poultry manure is in NH_4^+ N form. Forty to sixty per cent of organic N in poultry manure was mineralized within 70 days (Bitzer and Sim, 1985). The lowest yield (42.4 t ha^{-1}) was recorded in control in which no manure was applied.

Increased seed recovery (1.26%) was recorded due to the addition of 150 kg N in the form of pig manure and 150 kg N in the form of pressmud. Poor seed recovery (1.00%) was noticed due to application 150 kg N in the form of urea.

Application of 150 kg N in the form of poultry manure recorded higher seed yield of 559.3 kg ha^{-1}. This might be due to increased yield due to application of poultry manure as evidenced in the present investigation. Poor seed yield was recorded in control (194.4 kg ha^{-1}).

In the experiment, it was observed that recommended N for tomato may be applied through poultry manure (3,061 kg ha^{-1}) and higher fruit and seed yield may be obtained than application of recommended N through FYM, fishmeal, pig manure, pressmud and urea.

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