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Soil microbial population is the mirror of soil health

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Abstract
An investigation was carried out to study the "Soil microbial population is the mirror of soil health" under incubation in the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar-pradesh. The experiment were laid out in Completely Randomized Block Design with twelve treatments replicated three times. N, P, K were applied through urea, single super phosphate and muriate of potash, respectively. While the total amount of organics were applied 14 days before incubation study. Microbial population of the experiment under incubation as bacterial population g^{-1}soil x10^5, control (T_1) treatment was show lowest at different days of incubation. There was an increase in microbial population of other treatments due to addition of organic and inorganic sources of nutrients at each days of incubation. Addition of fertilizers and manures either in combination or in alone has significantly shown as increase in bacterial population over control (T_1). The highest and lowest bacterial population was recorded at 90 and 0- days of incubation; whereas the treatments receiving 100% N through FYM were showed maximum population of bacteria through-out experimentation periods. The at par values were observed in the treatments of T_3 to T_7 and T_8 to T_{12} except T_8 and T_{12} treatments at different days of incubation. All the treatments show superiority over initial value of bacterial population through-out incubation periods. The population of fungi was maximum and minimum observed at 60 and 0- days of incubation due to different treatments under different periods of incubation. Incorporation of nitrogen through alone organic treatments (T_8 to T_{12}) increased significant fungal population over control (T_1). Similar, to the population of bacteria; fungal pupation has also showed maximum and minimum population in the treatments of 100% N through FYM (T_8) and control (T_1) respectively, through out the experimentation periods under incubation study. Among the treated conditions alone nitrogen through organic sources given better response over other treatments under incubation at different days. Most of the values were at par with each other in the treatment of integrated approaches (T_3 to T_7) and organic alone treatments (T_8 to T_{12}) in respective days of incubation. Declined trend was started from 90 days of incubation in all the treatments in fungal population over 60 days of incubation. Application of N through organic manures / wastes alone treatment (T_8 to T_{12}) were recorded maximum population of actinomycetes over other treatment under incubation study at deferent days. Similar, to the population of bacteria and fungi the highest and lowest population of actinomycetes were recorded in the treatments receiving FYM alone (T_8) and control (T_1), respectively at different days of incubation. Among the different days of incubation the maximum and minimum values were observed at 60 and 0- days respectively. Most of the values were at par with each other in the treatment T_3 to T_7 and T_8 to T_{12}; except T_8 and T_{10}.

Keywords: Organic sources, inorganic sources, microbial population under incubation study

Introduction

The population and functions of microorganisms can not be over looked while considering the soil health because these are mainly the microorganisms which provide living environment to the soil and perform various functions like transformation of nutrients to usable forms, decomposition of organic residues, biochemical activities and enzymatic activities. The most accepted and valid indicator of the sum total of biological activity is its enzyme activity. Soil enzyme activities are 'sensors' of soil degradation since they integrate information about microbial status, and also from soil physico-chemical conditions (Aon and Colaneri, 2001 [1]; Baum *et al.*, 2003) [2]. They may correlate well with nutrient availability. Routine application of organic sources and inorganic fertilizers are an essential components of soil management in arable crop production systems. Organic matter inputs, such as farm yard manure, green manure or straw, either alone or in combination with mineral fertilizers held the potential to sustain or improve the soil ecological basis of crop production such as nutrient availability, water holding capacity and soil structure, etc. soil microorganisms are the major protagonists of organic matter decomposition and nutrient turn-over in arable soils. It has been frequently reported that soil microbial activity is an important aspect of soil quality.

Materials and Methods: Incubation study was conducted on the soils collected from the NC-1 plot Agricultural Research Farm, BHU, Varanasi during 2005-06 (from 02.09.2005 to 02.01.2006). 500 g processed soil was filled in suitable plastic containers. Prior to filling required quantity of organic manures and inorganic fertilizers were added in soil as per treatment. Low quantity of fertilizers were dissolved in water for a treatment and equal amount of solution was distributed in respective replications to make the replication homogenous. The treated soil was brought to

about 60 per cent of W.H.C. and then incubated at $30^0C \pm 1$ in Caltar Narang B.O.D. Periodic evaporation loss was recouped after every three day. Soil samples were collected and analyzed at 0, 30, 60, 90 and 120 days after incubation (DAI) with standard procedures.

Microbial population

For enumerating the microbial population of soil, composite, soil samples were made by pooling together the samples of soil from all the samples of soil from all the plastic cup of each treatments. Total bacteria, fungi and actinomycetes were estimated by following the serial dilution and plating technique as described by Schimidt and Caldwell (1967). The following media were used for plating.

1. Thornton's Media for total bacterial counts (Thornton, 1922) [8]
2. Mortins Rose-Bengal-Streptomycin-Agar medium (Mortin,1950) was used.
3. Actinomyectes were counted by using Kenknight and Munaier's medium (Subba Rao, 1990) [7]. The triplicate plates were incubated at 30^0C for a period of 14 days and characteristic colonies of actinomycetes were counted at the end of incubation.

Results and Discussion

Effect of organic and inorganic sources of nutrients on microbial population in the soil during incubation study:

Microbial population of the experiment under incubation as influenced by different organic and inorganic sources of nutrients have been presented in Table 01. The control treatment was showing lowest microbial population at zero days after incubation (DAI). There was an increase in microbial population of other treatments due to addition of organic and inorganic sources of nutrients not only at zero DAI but at each interval of incubation. Bacterial population at zero-DAI were varying from 11.00 x $10^5 g^{-1}$ soil in control (T_1) to maximum 30.63 x $10^5 g^{-1}$ soil in T_8 (100% N through FYM). Addition of fertilizer and different manures either in combination or in alone has significantly shown an increase in bacterial population over control. This population sharply increased at 30-DAI in all the treatments with minimum and maximum values of 30.00 and 49.00 x$10^5 g^{-1}$ soil,

Table 1: Effect of organic and inorganic sources of nutrients on microbial population in the soil during incubation study

Treatments	Bacteria (x $10^5 g^{-1}$soil)					Fungi (x 10^3 g^{-1} soil)					Actinomycetes (x 10^4 g^{-1} soil)				
	Days after incubation					Days after incubation					Days after incubation				
	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120
T_1	11.00	30.00	33.67	42.67	25.33	6.00	14.00	14.08	12.50	8.20	8.67	14.05	26.35	21.20	17.13
T_2	15.00	38.33	44.67	45.00	37.33	6.67	16.67	21.00	16.85	12.00	13.00	19.25	32.00	25.33	24.33
T_3	22.67	44.33	50.00	52.33	45.67	8.80	18.00	25.33	22.50	16.00	15.23	25.00	35.09	32.33	27.33
T_4	22.87	40.00	46.30	50.67	42.45	8.67	19.00	23.63	17.33	14.50	15.33	22.67	36.00	29.83	25.67
T_5	22.00	42.67	47.26	51.20	44.00	8.50	17.00	24.00	18.50	15.50	15.13	24.32	35.46	30.02	26.33
T_6	21.00	41.67	45.33	50.00	42.02	8.40	18.33	22.33	16.67	13.00	14.66	21.02	34.45	28.33	24.67
T_7	22.30	43.33	48.00	52.12	44.67	7.99	16.67	24.45	19.20	14.30	15.00	24.65	35.55	31.33	26.67
T_8	30.63	49.00	71.33	72.00	53.67	9.67	20.67	27.67	23.00	16.67	19.00	32.67	44.00	40.33	36.76
T_9	30.33	44.00	67.00	69.25	50.20	9.00	19.67	25.20	20.20	15.50	17.00	28.33	42.00	37.33	31.67
T_{10}	30.37	46.33	69.33	71.00	51.06	9.67	19.33	26.40	21.95	16.33	16.30	30.26	43.06	38.67	34.33
T_{11}	29.00	43.33	63.05	68.25	49.33	8.99	18.87	24.33	19.30	14.67	16.00	26.33	41.00	35.05	30.33
T_{12}	30.00	46.67	70.67	71.67	52.00	9.33	20.00	27.10	22.33	15.33	16.33	31.30	42.08	39.43	35.67
SEm ±	0.92	1.00	0.99	1.23	1.27	1.05	0.69	0.95	1.14	0.92	0.92	1.00	0.99	1.23	1.27
CD(P=0.05)	1.89	2.07	2.04	2.54	2.63	2.16	1.42	1.96	2.35	1.99	1.89	2.07	2.04	2.54	2.63

respectively due to T_1 and T_8. All the values were significant over control. There was further increase in bacterial population as the incubation period increased to 60 days. The rate of increase at this days of incubation was greater due to organic treatments compare to other treatments the rate of increase become slower at 90-DAI compare to previous days of incubation. The at par values were observed in the treatments of T_3 to T_7 and T8 to T_{12} except T_8 and T_{12} treatments at different days of incubations (Fig.1a and 1b).

The population of fungi were varied from 6.00 to9.67 x 10^3 g^{-1} soil at zero days of incubation. Significant increase were observed except T_2 (100% NPK through chemicals) and T_6 (100% NPK +10 kg N through D.S.) in all the treatments over control. Fungal population sharply increased and 30 and 60-DAI in all the treatments. At 30-DAI, the minimum and maximum values of 14.08 and 27.67 x $10^3 g^{-1}$ soil, respectively, were due to control (T_1) and 100% N through FYM (T_8). Also all the treatments were showing significant increase over control at this stage of incubation. However, organic treated pots were showing superiority over combined use of organic and inorganic treatments (T_3 to T_7). There was further increase in fungal population as the incubation period increases unto 60-DAI but rate of increase was comparatively slower than previous days of incubation. Declined trend was started from 90-DAI in most of the treatment but controlled (T_1) treatment has shown declined trend in fungal population even after 60- DAI. Most of the values were at par with each other among the treatments of T_3 to T_7 and T_8 to T_{12} in respective days of incubations (fig-2a and 2b).

Data regarding to the population of actinomycetes indicated significant variation in all treatments at 0, 30, 60, 90, and 120-day. The population values varied from 8.67 x 10^4 g^{-1} soil 19.00 x $10^4 g^{-1}$ soil at zero days after incubation due to control (0-DAI, T^1) and T_8 (100% N through FYM) respectively. The increasing or decreasing trends of actinemycetes population were similar to bacterial and fungal population. Each treatment has shown highest population of actinomycetes at 60 DAI where values were in the range of 26.35 x 10^4 g^{-1} soil in control to maximum 44.00 x 10^4 g^{-1} soil due to alone treatment of FYM (T_8). All the organic treatments have shown significant increase over control, inorganic as well as integrated treatments (fig. 3a and 3b).

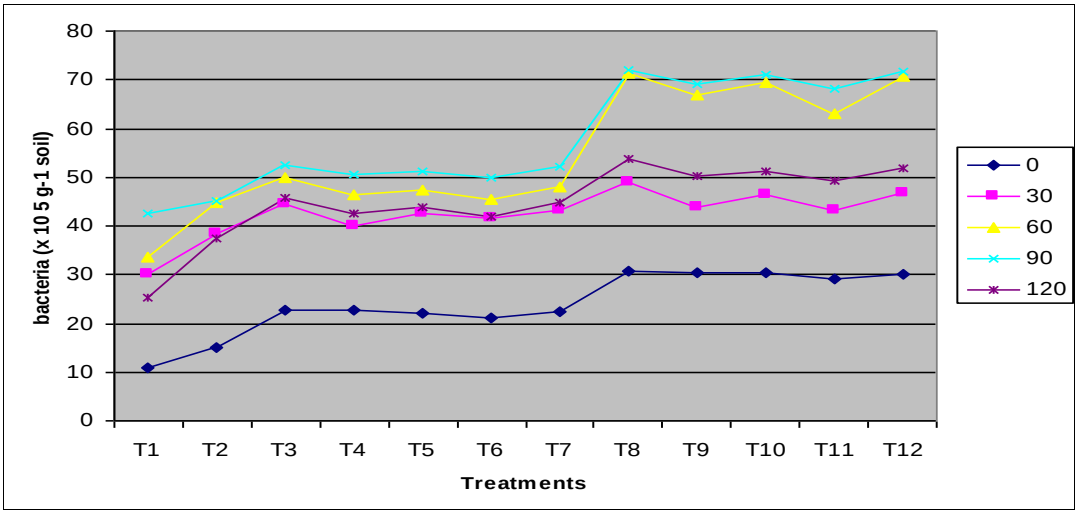

Fig 1a: Effect of organic and inorganic sources of nutrients on bacterial population in the soil during incubation study

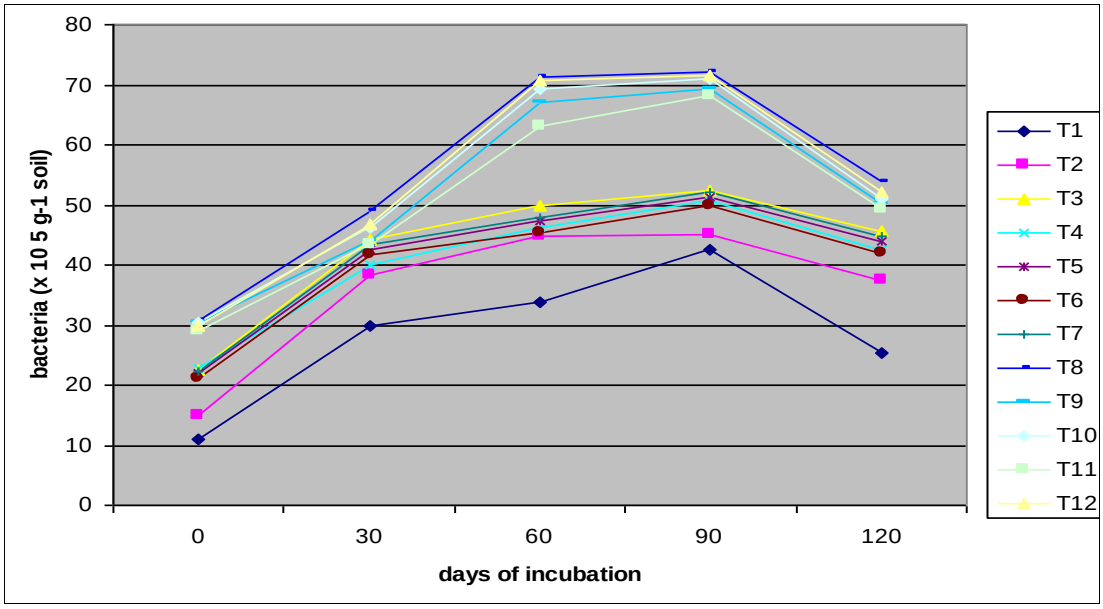

Fig 1b: Effect of organic and inorganic sources of nutrients on bacterial population in the soil during incubation study

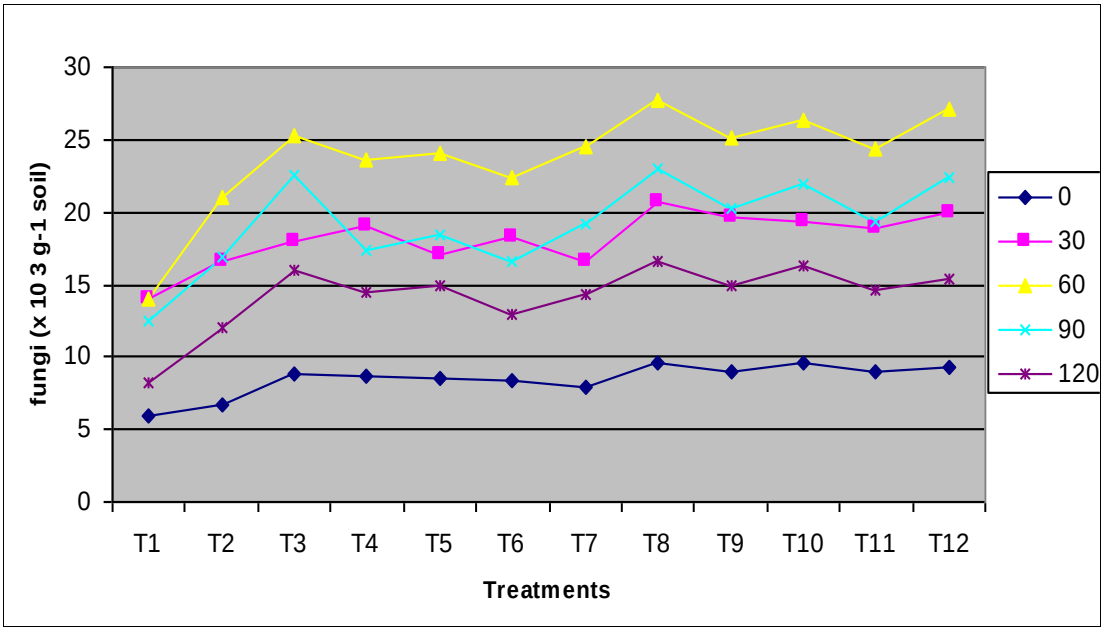

Fig 2a: Effect of organic and inorganic sources of nutrients on fungal population in the soil during incubation study

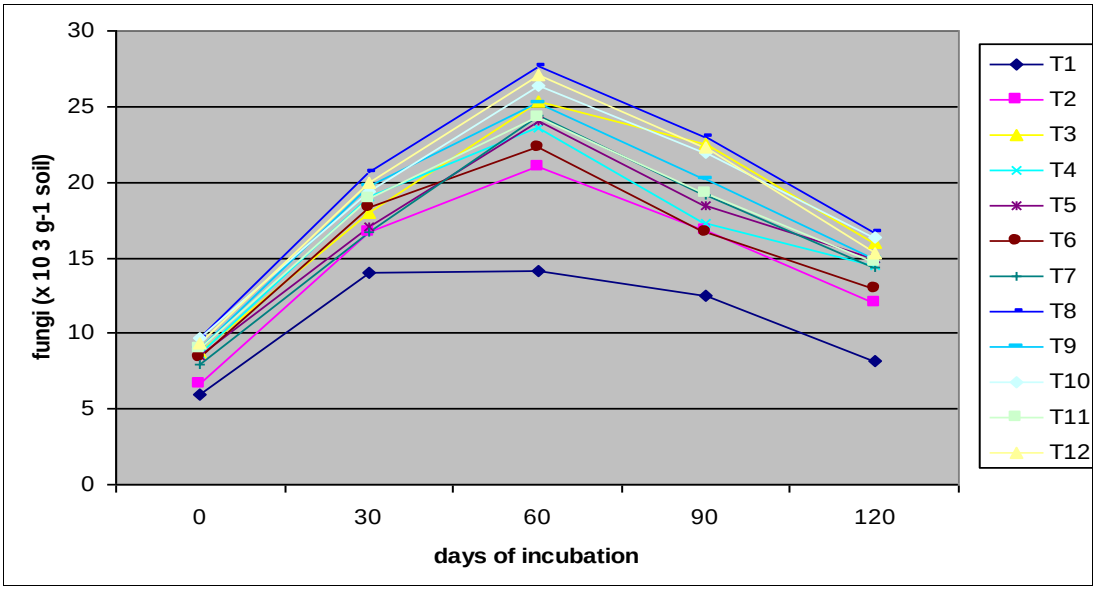

Fig 2b: Effect of organic and inorganic sources of nutrients on fungal population in the soil during incubation study

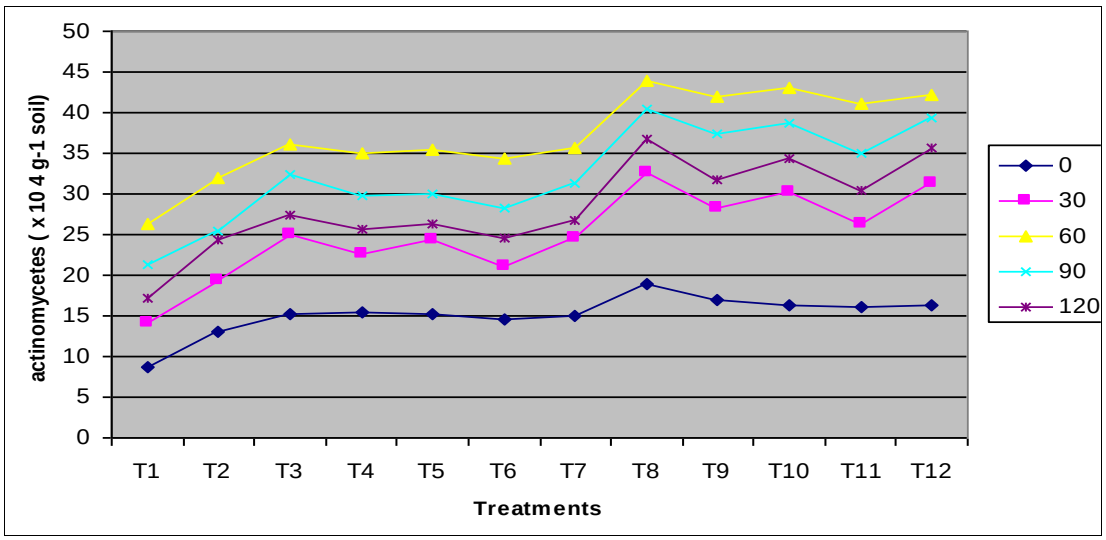

Fig 3a: Effect of organic and inorganic sources of nutrients on actinomycetes population in the soil during incubation study

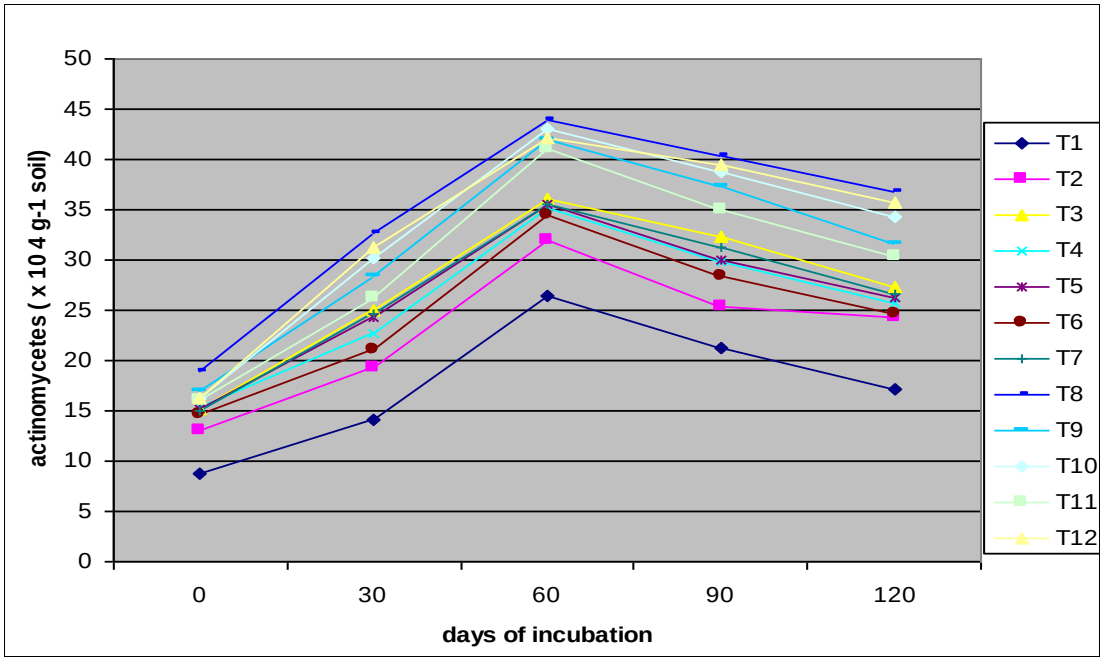

Fig 3b: Effect of organic and inorganic sources of nutrients on actinomycetes population in the soil during incubation study

Conclusions: Application of organic manures alone treatments was found to be favourable for microbial population under incubation study. Soil health improvement is recorded in case of organic treatments.

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