



## Effect of organic and inorganic sources of plant nutrients on changes of microbial population in the soil under incubation in different days of intervals

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### Abstract

An investigation was carried out to study the “Effect of organic and inorganic sources of plant nutrients on changes of microbial population in the soil under incubation in different days of intervals” under incubation in the Department of Soil Science and Agricultural Chemistry, KNIPSS, Sultanpur, Uttar-pradesh. The experiment was 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 was applied 15 days before incubation study. The effect of recommended doses of fertilizers in addition to organic manures of different sources equivalent N ha<sup>-1</sup> and with their sole treatments on microbial population under incubation have shown significant variations over control (T<sub>1</sub>). Microbial population of the experiment under incubation as bacterial population g<sup>-1</sup>soil x10<sup>5</sup>, control (T<sub>1</sub>) 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<sub>1</sub>). The highest and lowest bacterial population was recorded at 45 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<sub>3</sub> to T<sub>7</sub> and T<sub>8</sub> to T<sub>12</sub> except T<sub>8</sub> and T<sub>12</sub> 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 25 and 0- days of incubation due to different treatments under different periods of incubation. Incorporation of nitrogen through alone organic treatments (T<sub>8</sub> to T<sub>12</sub>) increased significant fungal population over control (T<sub>1</sub>). Similar, to the population of bacteria; fungal population has also showed maximum and minimum population in the treatments of 100% N through FYM (T<sub>8</sub>) and control (T<sub>1</sub>) 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<sub>3</sub> to T<sub>7</sub>) and organic alone treatments (T<sub>8</sub> to T<sub>12</sub>) in respective days of incubation. Declined trend was started from 45 days of incubation in all the treatments in fungal population over 25 days of incubation. Application of N through organic manures / wastes alone treatment (T<sub>8</sub> to T<sub>12</sub>) were recorded maximum population of actinomycetes over other treatment under incubation study at different 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<sub>8</sub>) and control (T<sub>1</sub>), respectively at different days of incubation. Among the different days of incubation, the maximum and minimum values were observed at 25 and 0- days respectively. Most of the values were at par with each other in the treatment T<sub>3</sub> to T<sub>7</sub> and T<sub>8</sub> to T<sub>12</sub>; except T<sub>8</sub> and T<sub>10</sub>.

**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; Baum *et al.*, 2003) [2, 4]. 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

This chapter elaborates the materials used, experimental procedures followed and techniques adopted during the present investigations.

The present investigation entitled “Effect of organic and inorganic sources of plant nutrients on changes of microbial population in the soil under incubation in different days of intervals, involving laboratory experiments, which was carried out in the soils of Agricultural Research Farm Department of Soil Science & Agricultural Chemistry, Kamla Nehru Institute of Physical and Social Sciences, Sultanpur, Uttar Pradesh, India, (KNIPSS) during *rabi* seasons of 2023-24 and 2024-25. The details of materials

used and methods employed during the course of experimentation are presented in this chapter.

**Incubation study:** Incubation study was conducted on the soils collected from the A-1 plot Agricultural Research Farm. 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  $32^{\circ}\text{C} \pm 1$  in B.O.D. Periodic evaporation loss was recouped after every three day. Soil samples were collected and analyzed at 0, 15, 25, 45 and 65 days after incubation (DAI).

**Details of Treatment:** Given below in table no. 1.

**Table 1:**

T <sub>1</sub>	:	Control
T <sub>2</sub>	:	Full dose of NPK (N: P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O) 125: 70: 65
T <sub>3</sub>	:	Full dose of NPK + 3 tonne ha <sup>-1</sup> FYM (equivalent to 15 kg N)
T <sub>4</sub>	:	Full dose of NPK + 85 kg CW ha <sup>-1</sup> (equivalent to 10 kg N)
T <sub>5</sub>	:	Full dose of NPK + 1.5 tonne PM ha <sup>-1</sup> (equivalent to 15 kg N)
T <sub>6</sub>	:	Full dose of NPK + 1.5 tonne DS ha <sup>-1</sup> (equivalent to 15 kg N)
T <sub>7</sub>	:	Full dose of NPK + 0.4 tonne PyM ha <sup>-1</sup> (equivalent to 10 kg N)
T <sub>8</sub>	:	125 kg N as FYM + PK
T <sub>9</sub>	:	125 kg N as CW + PK
T <sub>10</sub>	:	125 kg N as PM + PK
T <sub>11</sub>	:	125 kg N as DS + PK
T <sub>12</sub>	:	125 kg N as PyM + PK

### 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 Schmidt and Caldwell (1967). The following media were used for plating.

#### 1. Thornton's Media for total bacterial counts (Thornton, 1922) <sup>[20]</sup>

The population of this organism was enumerated using asparagine mannitol agar medium. The triplicate plates were incubated at 30°C for a period of 7 days. The characteristic colonies of bacteria were counted.

K <sub>2</sub> HPO <sub>4</sub>	-1.0 g	MgSO <sub>4</sub> .7H <sub>2</sub> O	- 0.2g
CaCl <sub>2</sub>	- 0.1 g	NaCl	- 0.1 g
FeCl <sub>3</sub>	-Trace	KNO <sub>3</sub>	- 0.5g
Asparagine	-1.0g	Mannitol	-1.0g
Agar-agar	-15.0g	Distilled water	-1000 ml

After the agar and salts have been dissolved, add the mannitol and adjust the pH 7.4.

#### 2. Total fungi

The plates replicated three times were incubated at 30°C and counting was made after 3 days of incubation. For counting fungi, Mortins Rose-Bengal-Streptomycin-Agar medium (Mortin,1950) was used.

Glucose -10.0g Peptone -5.0g  
 KH<sub>2</sub>PO<sub>4</sub> -1.0g MgSO<sub>4</sub>.7H<sub>2</sub>O -0.5g  
 Rose Bengal -0.035g Agar-agar -15.0g Distilled water -1000 ml  
 Streptomycin @ 30 mg L<sup>-1</sup> was added to melted medium and was cooled to 50°C.

#### 3. Actinomycetes

Actinomycetes were counted by using Kenknight and Munaier's medium (Subba Rao, 1990) <sup>[18]</sup>. The triplicate plates were incubated at 30°C for a period of 14 days and characteristic colonies of actinomycetes were counted at the end of incubation.

Dextrose	-1.0 g	K <sub>2</sub> HPO <sub>4</sub>	-0.10 g
NaNO <sub>3</sub>	-0.1g	KCl	-0.1g
KCl	-0.1g	MgSO <sub>4</sub> .7H <sub>2</sub> O	-0.1g
Agar-agar	-15.0g	Distilled water	-1000 ml.

#### Procedure

##### 1. Serial dilution

10 g (air dried) soil sample was taken in 250 ml conical flask containing 90 ml of sterile water and plugged with cotton. Shaking of conical flask was done on mechanical shaker to mix soil and water. With the help of 1 ml sterile pipette 1 ml suspension from conical flask was transferred to culture tube containing 9 ml of sterile water and plugged with cotton. Test tube was then shaken on mechanical shaker and was labelled 10<sup>-2</sup>. Desired serial dilution was obtained adopting the similar procedure as above and

labelled. Serial dilution of  $10^{-3}$ ,  $10^{-4}$  and  $10^{-5}$  were made for fungi, actinomycetes and bacteria, respectively.

## 2. Plating

1 ml of suspension was transferred to sterilized petriplates. About 20 ml of respective media was poured into petriplate and uniformly spread. After solidifying the media petriplates were inverted and kept in BOD at  $30^{\circ}\text{C} \pm 1$ .

Microbial counts were recorded when colonies were developed.

Microbial population  $\text{g}^{-1}$  soil = Number of colonies  $\text{plate}^{-1}$  x dilution factor.

## Methods used for physio-chemical properties of soil analysis

The methods used along with references for soil and plant analysis have been presented in table no. 2.

**Table 2:**

Parameter	Method used	References
Soil texture	Hydrometer method	Bouyoucos (1927) [3]
W.H.C. (%)	Keen box	Black <i>et al.</i> (1966)
B.D. ( $\text{Mg m}^{-3}$ )	Pycnometer	Black <i>et al.</i> (1966)
P.D. ( $\text{Mg m}^{-3}$ )	Pycnometer	Black <i>et al.</i> (1966)
C.E.C. [c. mole ( $\text{p}^+$ ) $\text{kg}^{-1}$ soil]	Centrifuge method	Jackson (1973) [10]
pH (1:2.5 soil water suspension)	Glass electrode pH meter	Jackson (1973) [10]
EC (1:2.5 soil water suspension)	Conductivity bridge	Jackson (1973) [10]
Organic carbon ( $\text{g kg}^{-1}$ )	Chromic acid digestion	Walkley and Black's (1934) [21]
Available – N ( $\text{mg kg}^{-1}$ )	Alkaline permanganate method	Subbiah and Asija (1956)
Available – P ( $\text{mg kg}^{-1}$ )	Olsen's method	Wattanabe and Olsen (1965)
Available – K ( $\text{mg kg}^{-1}$ )	Flame photometer (Ammonium acetate extract)	Jackson (1973) [10]

**Methods used for manure analysis:** Presented in table 3.

**Table 3:**

Parameter	Method used	References
Organic carbon	Wet chromic acid digestion	Walkley and Black's (1934) [21]
Total N	Distillation in 'Kelplus' N-estimation system	Jackson (1973) [10]
Total P	Vanado-molybdo phosphoric acid yellow colour method	Jackson (1967) [9]
Total K	Flame photometer	Jackson (1973) [10]
Micronutrients	Atomic absorption spectrophotometer	Anonymous (2003) [1]
W.H.C. (%)	Keen box	Black <i>et al.</i> (1966)
pH (1:2.5 manure water suspension)	Glass electrode pH meter	Jackson (1973) [10]

## Statistical Analysis

All the experimental data of soil, plant and soil microorganism were statistically analysed to drawn conclusion of significance by using the method as prescribed by Panse and Sukhatme (1967) [13]. The test of significance was carried out at 5% level of significance by referring to 'F' table value. Critical differences were worked out for the effects which were significant.

## Results and Discussion

### Physico-chemical characteristics of Soils

The physico-chemical characteristics of the initial soil samples collected from KNIPSS, Sultanpur block of Agricultural Research Farm for incubation study have been reported in table 4. The soils of this area belong to the soil order Inceptisol.

**Table 4:** Physico-chemical properties of Initial soil.

Soil Properties	Values
Texture of the soil	Sandy loam
Bulk density ( $\text{Mg m}^{-3}$ )	1.10
Particle density ( $\text{Mg m}^{-3}$ )	1.85
Water holding capacity (%)	42.50
pH	7.10
E.C. ( $\text{dSm}^{-1}$ )	0.035
O.C. ( $\text{g kg}^{-1}$ )	5.5
C.E.C. [ $\text{cmol}(\text{p}^+) \text{kg}^{-1}$ soil]	10.50
Available N ( $\text{mg kg}^{-1}$ )	79.24
Available Olsen's P ( $\text{mg kg}^{-1}$ )	3.91
Available K ( $\text{mg kg}^{-1}$ )	65.31
<b>Micronutrients (<math>\text{mg kg}^{-1}</math>)</b>	
Available Zn	0.38
Available Fe	6.0
Available Cu	0.50
Available Mn	7.0
C: N Ratio	11.36

**Table 5:** Microbiological and biochemical properties of the initial soil.

Soil Properties	Values
<b>A. Microbial counts</b>	
Total fungi ( $\times 10^3$ g <sup>-1</sup> soil)	4.00
Total bacteria ( $\times 10^5$ g <sup>-1</sup> soil)	9.00
Total actinomycetes ( $\times 10^4$ g <sup>-1</sup> soil)	7.67

### Physico-chemical properties of organic sources used during experimentations

The locally available organic wastes such as digested sludge (DS), farm yard manure (FYM), carpet waste (CW), sulphinated pressmud (PM) and poultry manure (PyM) were analyzed for the evaluation of the manurial value i.e., for the plant nutrients present in them. The data regarding chemical composition of organic wastes are given in table 6. As indicated by chemical composition of organic wastes, the water holding capacity, organic carbon and nitrogen content were highest in woolen carpet waste and while phosphorus and potassium contents were highest in poultry manure. As far as Zn, Cu, Fe, and Mn are concerned; these were more in PM and DS than CW, PyM and FYM.

The nutrient status of the different organic wastes employed in this experiment was in the following order

#### Nutrient contents in organics:

N	=	CW > PyM > PM = DS > FYM
P	=	PyM > PM > DS > FYM > CW
K	=	PyM > FYM > DS > PM > CW
Zn	=	DS > PM > PyM = CW > FYM
Cu	=	PM > DS > PyM > CW > FYM
Fe	=	PM > DS > FYM > PyM > CW
Mn	=	PM > DS > PyM > FYM > CW

**Table 6:** Physico-chemical properties and nutrient contents in various organic sources.

Parameters	Organic Sources				
	FYM	CW	PM	DS	PyM
WHC (%)	121.22	334.80	211.80	89.50	121.22
pH	6.7	7.3	7.2	7.4	6.9
Organic carbon (%)	18.50	56.55	15.08	8.70	13.25
N (%)	0.5	12.0	1.0	1.0	2.5
P (%)	0.38	0.05	0.94	0.40	1.9
K (%)	0.90	0.05	0.28	0.33	1.6
Micronutrients (mg kg <sup>-1</sup> )					
Zn	40	90	440	760	90
Cu	2.8	20	260	130	71
Fe	1665	20	5040	4740	1400
Mn	40	20	460	250	90
C: N ratio	37.0	4.52	14.36	5.03	5.26

### Incubation Study

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

**Effect on microbial population:** Microbial population of the experiment under incubation as influenced by different organic and inorganic sources of nutrients have been presented in table 7 and figure-1(fungi). 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 control (T<sub>1</sub>) to maximum in T<sub>8</sub> (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 15-DAI in all the treatments with minimum and maximum values of soil, respectively. All the values were significant over control. There was further increase in bacterial population as the incubation period increased to 25 days. The rate of increase at this day of incubation was greater due to organic treatments compare to other treatments the rate of increase become slower at 45-DAI compare to previous days of incubation.

The population of fungi (table 8, fig. 2) were varied in soil at zero days of incubation. Significant increase was observed except T<sub>2</sub> (100% NPK through chemicals) and T<sub>6</sub> (100% NPK +15 kg N through D.S.) in all the treatments over control. Fungal population sharply increased at 15 and 25-DAI in all the treatments. At 15-DAI, the minimum and maximum values of the soil respectively, were due to control (T<sub>1</sub>) and 100% N through FYM (T<sub>8</sub>). 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<sub>3</sub> to T<sub>7</sub>). There was further increase in fungal population as the incubation period increases unto 25-DAI but rate of increase was comparatively slower than previous days of incubation. Declined trend was started from 45-DAI in most of the treatment but controlled (T<sub>1</sub>) treatment has shown declined trend in fungal population even after 25 - DAI.

Data regarding to the population of actinomycetes indicated significant variation in all treatments at different intervals. The population values varied from treatment to treatments in soil at zero days after incubation due to control (0-DAI, T<sup>1</sup>) and T<sub>8</sub> (100% N through FYM) respectively. The increasing or decreasing trends of actinomycetes (table 9, fig. 3) population were similar to bacterial and fungal population. Each treatment has shown highest population of actinomycetes at 25 DAI.

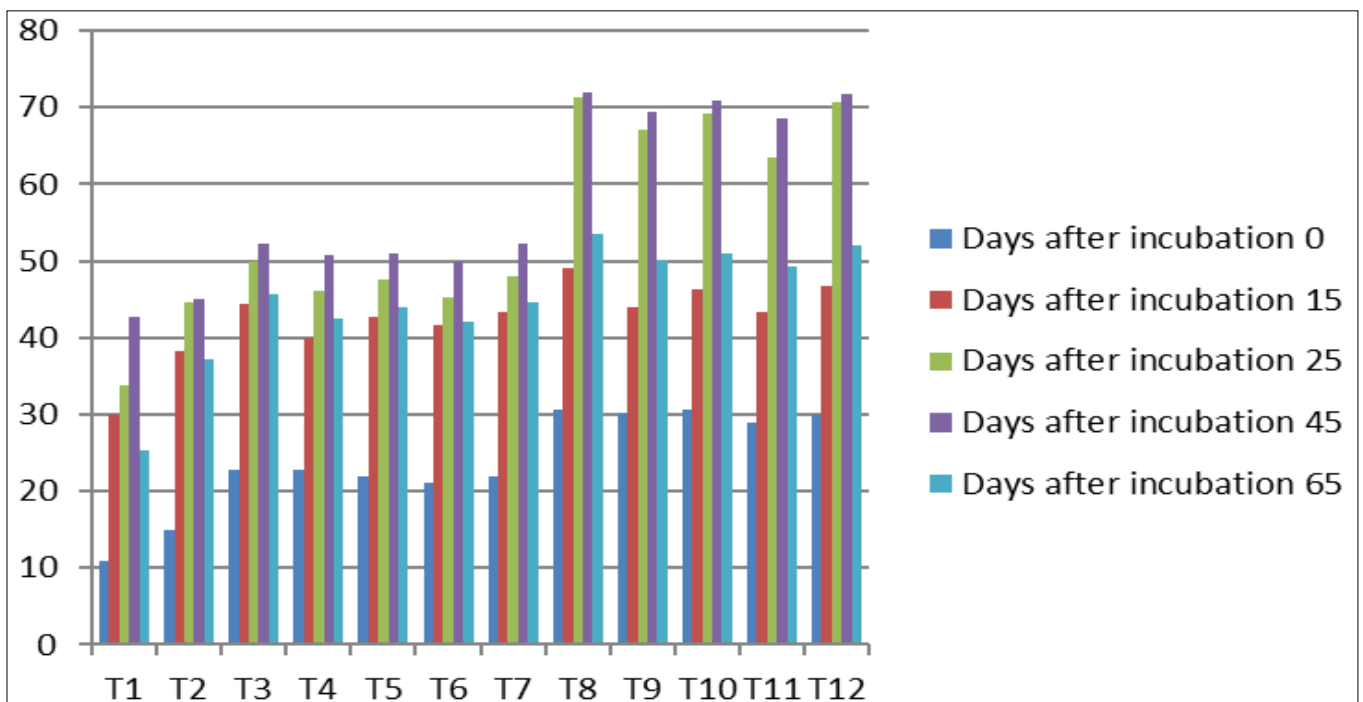
There was general trend of sharp increase in bacterial, fungal and actinomycetes population upto 25- DAI while, activity of urease and dehydrogenase enzyme sharply increased only up to 15 DAI by the all treatments. After respective period of above incubations both microbial population and enzyme activities were rapidly declined. This kind of trend of activation in microbial population was due to addition of organic sources acting as sole source of carbon and energy for the heterotroph as also reported by Selvi *et.al.* (2004) [17] and Qureshi *et.al.* (2005) [14]. Increased microbial population was responsible for sharp increase in urease and dehydrogenase activity of soil enzymes, Chhonkar and Tarafdar (1981) [6] have found that the activity of enzyme was significantly and positively correlated with organic carbon, fungal bacterial and actinomycetes population in the soil. The applied organic sources were able to mineralized rapidly in early days of incubation, hence, there was more mineralization than immobilization which consequently provided sufficient

nutrition for the proliferation of microbes and their activities in terms of soil enzymes. Since, the mineralized nutrients were highly available upto 25 days, there for rapid increase in microbial activity was observed to this period of incubation as it has also been confirmed by the findings of Rai, *et.al.* 2023 <sup>[15]</sup> and Nannipieri *et.al.*, 1983 <sup>[12]</sup>. To the fact, enzymic activity in the soil is very much governed by the nature of subtrat present in the soil. Complex organic components are mineralized after 30 to 60 days and onwards by the specific group of microbes responsible for urease and dehydrogenase might be decreased while, population of another group of microbes responsible for mineralization of complex compound were proliferating. Therefore, activity of those enzymes decreased without decreasing counts of microbes at 25- DAI. After that the both microbial and enzymes activity were in decreasing trend might be due to

decreasing rate of mineralization of organic sources added in the soil. Application of organic sources as in treatments of T8 to T12 were showing lesser urease and higher DHA activities compare to integrated treatment of RDF and organic sources equivalent to 10-15 kg N ha<sup>-1</sup> (T<sub>3</sub> to T<sub>7</sub>) in different DAI. Also, the organic treatments were having higher bacterial, fugal and actinomycetes population compare to other treatments. Higher urease activity was might be due to addition of amide form of nitrogen applied through urea in integrated treatment. Reverse to that organic treatments having no application of urea were showing high rate DHA activity. Among the various treatments the variability in values of microbial activities very much governed by the content of N and C/N ratio of the different sources taken in study.

**Table7:** Periodical changes in soil bacterial population due to organic and inorganic sources of nutrients during incubation study

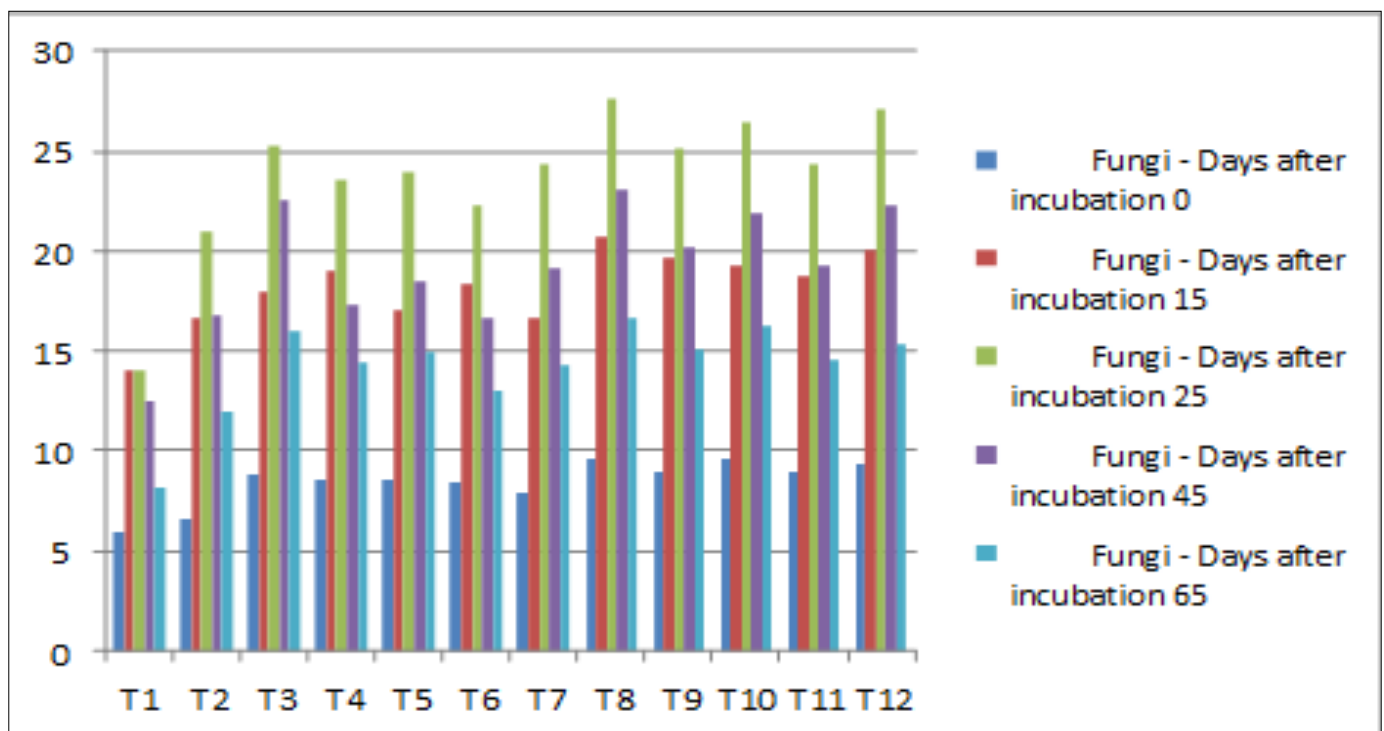
Treatments	Bacteria (x10 <sup>5</sup> g <sup>-1</sup> soil)				
	Days after incubation				
	0	15	25	45	65
T <sub>1</sub>	11.0	30.0	33.7	42.7	25.3
T <sub>2</sub>	15.0	38.3	44.7	45.0	37.3
T <sub>3</sub>	22.7	44.3	50.0	52.3	45.6
T <sub>4</sub>	22.7	40.0	46.0	50.7	42.4
T <sub>5</sub>	22.0	42.7	47.6	51.0	44.0
T <sub>6</sub>	21.0	41.7	45.3	50.0	42.0
T <sub>7</sub>	22.0	43.3	48.0	52.2	44.6
T <sub>8</sub>	30.63	49.0	71.3	72.0	53.6
T <sub>9</sub>	30.3	44.0	67.0	69.5	50.2
T <sub>10</sub>	30.7	46.3	69.3	71.0	51.0
T <sub>11</sub>	29.0	43.3	63.5	68.5	49.3
T <sub>12</sub>	30.0	46.7	70.7	71.7	52.0
SEM±	0.92	1.00	0.99	1.23	1.27
CD(P=0.05)	1.89	2.07	2.04	2.54	2.63



**Fig-1:** Effect of organic and inorganic sources of nutrients on bacterial counts in the soil during incubation study

**Table 8:** Periodical changes in soil fungal population due to organic and inorganic sources of nutrients during incubation study

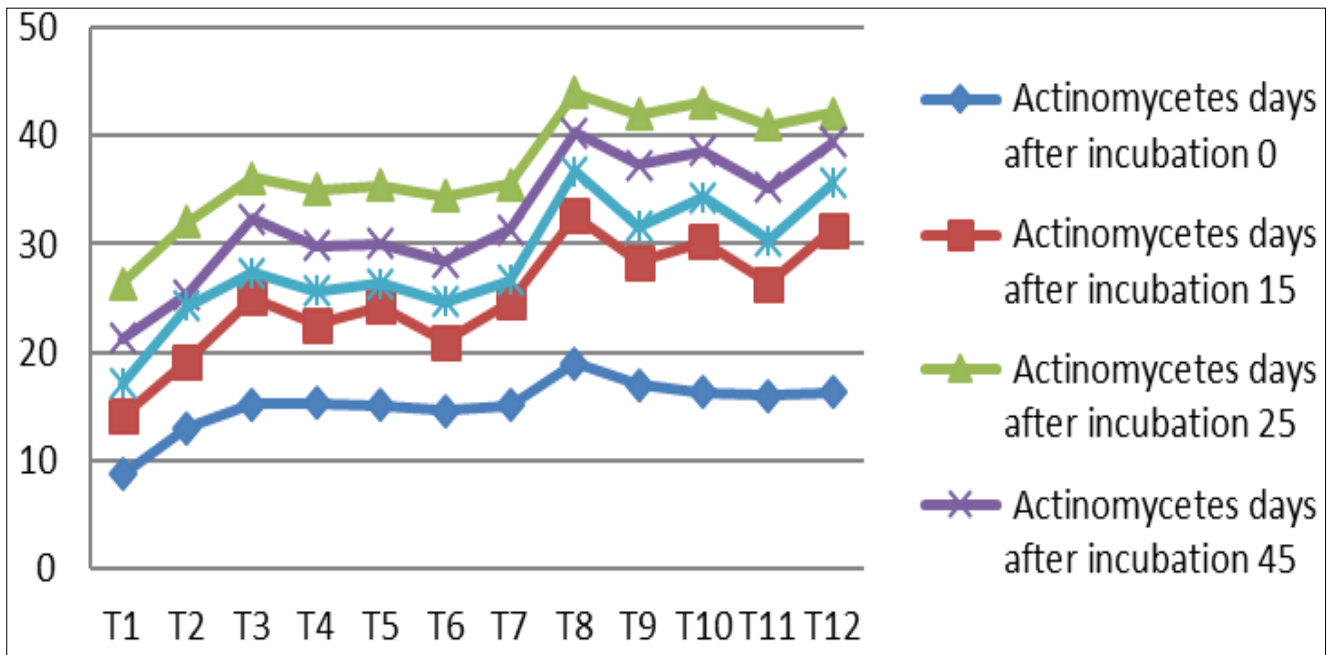
Treatments	Fungi ( $\times 10^5 \text{g}^{-1} \text{soil}$ )				
	Days after incubation				
	0	15	25	45	65
T <sub>1</sub>	6.0	14.0	14.0	12.5	8.2
T <sub>2</sub>	6.6	16.6	21.0	16.8	12.0
T <sub>3</sub>	8.8	18.0	25.3	22.5	16.0
T <sub>4</sub>	8.6	19.0	23.6	17.3	14.5
T <sub>5</sub>	8.5	17.0	24.0	18.5	15.01
T <sub>6</sub>	8.4	18.3	22.3	16.6	13.02
T <sub>7</sub>	7.9	16.6	24.4	19.2	14.33
T <sub>8</sub>	9.67	20.67	27.67	23.0	16.67
T <sub>9</sub>	9.0	19.6	25.2	20.2	15.03
T <sub>10</sub>	9.6	19.3	26.4	21.9	16.3
T <sub>11</sub>	8.9	18.8	24.3	19.3	14.6
T <sub>12</sub>	9.3	20.0	27.1	22.3	15.3
SEm $\pm$	1.05	0.69	0.95	1.14	0.92
CD(P=0.05)	2.16	1.42	1.96	2.35	1.99



**Fig-2:** Effect of organic and inorganic sources of nutrients on fungal counts in the soil during incubation study

**Table 9:** Periodical changes in soil actinomycetes population due to organic and inorganic sources of nutrients during incubation study

Treatments	Actinomycetes ( $\times 10^5 \text{g}^{-1} \text{soil}$ )				
	Days after incubation				
	0	15	25	45	65
T <sub>1</sub>	8.67	14.06	26.3	21.22	17.1
T <sub>2</sub>	13.01	19.2	32.05	25.3	24.3
T <sub>3</sub>	15.2	25.0	36.07	32.3	27.3
T <sub>4</sub>	15.3	22.6	35.0	29.8	25.6
T <sub>5</sub>	15.1	24.3	35.4	30.0	26.3
T <sub>6</sub>	14.6	21.0	34.4	28.3	24.6
T <sub>7</sub>	15.04	24.6	35.5	31.3	26.6
T <sub>8</sub>	19.00	32.67	44.00	40.33	36.76
T <sub>9</sub>	17.0	28.3	42.0	37.3	31.6
T <sub>10</sub>	16.3	30.2	43.05	38.6	34.3
T <sub>11</sub>	16.0	26.3	41.03	35.2	30.3
T <sub>12</sub>	16.3	31.3	42.06	39.4	35.6
SEm $\pm$	0.92	1.00	0.99	1.23	1.27
CD(P=0.05)	1.89	2.07	2.04	2.54	2.63



**Fig-3:** Effect of organic and inorganic sources of nutrients on actinomycetes counts in the soil during incubation study

### Summary and Conclusion

**Summary:** Microbial population of the experiment under incubation as bacterial population  $\text{g}^{-1}\text{soil} \times 10^5$ , 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 45 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 25 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 population 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 45 days of incubation in all the treatments in fungal population over 25 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 different 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 25 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  $T_{10}$ .

### Conclusion

Application of organic manures / wastes alone treatments was found to be favourable for microbial population and enzymatic activity under incubation study in different days of incubation. The application of recommended doses of N through farm yard manure, poultry manure, press mud and carpet waste were also found suitable for nutrient acquisition as organic sources. However, soil health improved in case of organic treatments.

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