



## Changes in Soil Microbial Population in Rainfed Groundnut with Long term Application of Manure and Fertilizers

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### ABSTRACT

The highest bacterial population was noticed in surface soil than the subsurface soil at different growth stages of rainfed groundnut. Highest soil microbial population was observed with the application of NPK + gypsum+ZnSO<sub>4</sub> followed by FYM treatment. The soil microbial population increased upto flowering stage, thereafter decreased except fung, whose population increased till the harvest of the crop. The lower values were observed in the treatments where N or P or K alone was applied.

**Key words :** Groundnut, Soil microbial population

Groundnut is an important oilseed crop of Andhra Pradesh, occupying about 80 percent in *kharif*. Like any other crop, the productivity of groundnut in light soils is very low which can be improved through integrated nutrient management, combining organic sources, liming material (an amendment) and chemical fertilizers. Indiscriminate use of chemical fertilizers may lead to nutritional imbalance in soil and thereby deteriorate soil health particularly in respect of population of micro organisms in the soil. Soil harbors a dynamic population of microorganisms, which play major role in decomposition of organic matter and transformation of plant nutrients. Application of FYM lead to maintenance of the physical and chemical condition of the soil. Application of FYM along with chemical fertilizers result in the highest population of fungi, bacteria and actinomycetes than application of FYM alone (Nambiar, 1994). Decomposition of organic matter in general, not only increases the microbial population but also enriches the soil by releasing available N to a greater extent. Some of the earlier reports stated that long term application of anhydrous ammonia and urea to soil increased fungal and bacterial population in oil seed crops (Biederbeck *et al.* 1996). Long-term field experiments can be used for precisely monitoring changes in microbial population. The present experiment was undertaken to study the long term effects of continuous application of manure and fertilizer either single or in combination with or without organic manures on microbial population building and nutrient use efficiency of groundnut – groundnut system on alfisols during *kharif* seasons of 2002 & 2003.

### MATERIAL AND METHODS

The present field trial was done at Regional Agricultural Research Station, Tirupati, A.P. during *kharif* 1981 but the observations are pertaining to 2002 and 2003 seasons under rainfed conditions. The soils were slightly acidic in reaction with pH ranging from 5.46 to 5.79, and EC ranging from 0.04 to 0.05 dSm<sup>-1</sup>. The mean organic carbon content of soil was 0.21 to 0.34 percent. The available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O contents were ranged from 132.4 to 176.2; 6.1 to 18.35 and 137.5 to 197.9 kg ha<sup>-1</sup> respectively. The experiment was designed with eleven treatments replicated four times in randomized block design as follows.

- T<sub>1</sub> : Control (no fertilizer or manures)
- T<sub>2</sub> : Farm yard manure @ 5 t ha<sup>-1</sup>  
(once in 3 years)
- T<sub>3</sub> : 20 kg Nitrogen (N) ha<sup>-1</sup>
- T<sub>4</sub> : 10 kg Phosphorus (P) ha<sup>-1</sup>
- T<sub>5</sub> : 25 kg Potassium (K) ha<sup>-1</sup>
- T<sub>6</sub> : 250 kg Gypsum ha<sup>-1</sup> as top dressing
- T<sub>7</sub> : 20 kg N + 10 kg P ha<sup>-1</sup>
- T<sub>8</sub> : 20 kg N + 10 kg P + 25 kg K ha<sup>-1</sup>
- T<sub>9</sub> : 20 kg N + 10 kg P + 25 kg K +  
250 kg Gypsum ha<sup>-1</sup> (gypsum as top  
dressing) at flower initiation
- T<sub>10</sub> : 20 kg N + 10 kg P + 25 kg K +  
100 kg lime ha<sup>-1</sup> (lime as top dressing at  
flower initiation)
- T<sub>11</sub> : 20 kg N + 10 kg P + 25 kg K + 25 kg  
zinc sulphate ha<sup>-1</sup> (as basal, once in 3  
years) + 250 kg Gypsum ha<sup>-1</sup> as top  
dressing

Groundnut crop was raised by adopting recommended package of practices. Soil samples were collected from 0 to 15 cm and 15 to 30 cm depth to quantify microbial population viz., fungi, bacteria, and actinomycetes at 5 Days after sowing (DAS) (initial), 30 DAS (flowering) and after harvest by adopting serial dilution pour plate technique with the use of potato dextrose agar medium outlined by Allen (1959). The soil microbial count was worked out as follows:

Total number of colony forming units (CFU/g dry soil)  
=Average No.of colonies / Dry weight of the soil

The data was subjected to statistical analysis as per the procedure described by Nigam and Gupta (1979).

## RESULTS AND DISCUSSION

### Bacterial population

Results indicated that bacterial population was influenced by the long term application of manure and fertilizer at different stages of crop growth in surface and subsurface soil (Table 1). The highest population of bacteria was noticed in the surface soil than the subsurface soil. In general maximum count of bacteria was observed at flowering stage and minimum at five days after sowing and after harvest of the crop. This could be attributed to high organic matter content in the soil at flowering stage irrespective of treatments. Higher bacterial count was recorded in  $T_{11}$  and it was on par with  $T_9$ ,  $T_{10}$  and  $T_8$  compared to the other treatments may be due to high accumulation of organic carbon and improved soil physical condition. The results are in close proximity with the findings of Nambiar (1994). Application of FYM ( $T_2$ ) @ 5 t ha<sup>-1</sup> once in three years also showed significant positive relationship with soil bacterial population than the other treatments where N or P or K alone had applied.

### Fungal population

The fungal population was significantly influenced by the treatment in both surface and subsurface soil (Table - 2) and was more in surface soil than the subsurface soil. This might be due to high organic matter and aerobic condition prevailed in surface soil. Population increased from initial stage to harvest (maturity) of the crop. Similar observations were made by Panda *et al* (1996). Among the treatments the higher population of fungi was found in  $T_{11}$  and it was on par with  $T_2$ . Higher

population in these treatments might be attributed to the higher organic matter present in the soil, because of higher amount of leaf fall and root-biomass added to the soil due to good crop growth. Vijay Kumar and Narasimhan (1995) reported that fungal population was positively correlated with the available moisture, available phosphorous and organic carbon contents of the groundnut cultivated soil.

### Actinomycetes population

The results indicated that actinomycetes population at different stages of the crop growth in surface and subsurface of the soil had significantly influenced by the treatments (Table-3). At the initial stage of the crop the actinomycetes population was less and increased during flowering stage and decreased at maturity stage (harvest of the crop). The actinomycetes population followed the same trend as that of bacterial population. The actinomycetes population was high in the treatments viz.,  $T_{11}$ ,  $T_9$ ,  $T_{10}$  and  $T_2$ . Lower values were observed in alone application of N or P or K and control due to low organic matter content (Balasubramanian and Palaniyappan, 1994).

Therefore it can be concluded that organic and inorganic fertilizers influenced the soil microbial population viz., fungi, bacteria and actinomycetes. Irrespective of the treatments, microbial population increased up to flowering stage there after decreased except fungi whose population increased till the harvest of the crop. Among the treatments under study combined application of nutrients along with soil amendment (lime / gypsum) treated plot had recorded significant higher soil microbial population followed by FYM applied plot

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Table 1. Effect of long term application of manure and fertilizers on soil bacterial population ( $1 \times 10^6 \text{ g}^{-1}$ ) at different growth stages of rainfed groundnut

Treatments	Kharif 2002						Kharif 2003					
	Initial (5 DAS)		Flowering (30 DAS)		After harvest		Initial (5 DAS)		Flowering (30 DAS)		After harvest	
	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)
T <sub>1</sub>	6.25	4.00	71.50	47.50	12.25	6.0	8.00	2.50	88.50	54.75	14.00	8.25
T <sub>2</sub>	14.00	9.50	188.00	96.25	41.75	26.50	14.25	9.50	235.25	123.25	36.75	16.00
T <sub>3</sub>	8.25	6.75	48.25	34.25	22.00	15.75	9.25	6.50	191.50	97.25	34.25	10.50
T <sub>4</sub>	6.50	6.00	156.75	48.75	31.00	18.75	6.75	5.00	139.25	88.00	33.25	11.00
T <sub>5</sub>	5.50	4.25	160.75	595.0	31.50	21.75	9.00	5.50	192.57	72.50	34.25	8.50
T <sub>6</sub>	6.75	5.00	150.50	68.75	32.25	22.25	8.75	5.25	128.75	88.25	28.75	9.25
T <sub>7</sub>	8.25	5.50	188.00	74.75	29.00	21.00	8.25	6.00	209.75	99.25	36.50	9.00
T <sub>8</sub>	8.50	3.50	232.00	109.25	29.50	20.50	9.50	5.57	373.25	101.50	37.00	9.00
T <sub>9</sub>	9.75	5.00	229.00	123.75	41.50	28.00	14.00	7.50	367.25	109.50	41.25	15.50
T <sub>10</sub>	11.00	6.75	225.50	115.25	37.00	26.25	16.00	11.75	386.25	128.50	39.50	20.00
T <sub>11</sub>	16.75	12.75	261.50	110.57	44.75	35.50	24.25	16.25	402.75	149.75	46.50	30.50
Mean	9.23	6.27	171.07	80.79	32.05	22.02	11.64	7.41	232.30	101.14	34.73	13.41
Sem±	0.92	0.57	14.31	6.78	2.88	2.71	1.54	0.99	27.55	6.53	3.66	2.07
CD at 5%	2.66	1.63	41.32	19.57	8.31	7.83	4.45	2.87	79.58	18.85	10.58	5.99

Table 2. Effect of long term application of manure and fertilizers on soil fungal population ( $1 \times 10^5 \text{ g}^{-1}$ ) at different growth stages of rainfed groundnut

Treatments	Kharif 2002						Kharif 2003					
	Initial (5 DAS)		Flowering (30 DAS)		After harvest		Initial (5 DAS)		Flowering (30 DAS)		After harvest	
	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)
T <sub>1</sub>	3.25	1.75	4.50	3.25	5.75	3.25	5.00	2.50	4.00	2.50	5.25	2.50
T <sub>2</sub>	9.00	2.75	11.75	4.50	12.75	9.50	9.25	6.00	15.75	9.75	17.50	9.50
T <sub>3</sub>	6.25	1.75	3.00	2.00	8.25	3.75	7.50	4.50	4.25	3.25	11.25	4.50
T <sub>4</sub>	3.25	2.75	6.00	6.25	5.50	3.75	4.25	2.75	5.25	3.00	7.75	6.50
T <sub>5</sub>	3.75	1.75	1.75	1.25	3.50	1.75	4.75	3.50	4.75	3.50	9.50	4.25
T <sub>6</sub>	4.25	3.00	3.25	2.50	4.50	3.25	5.50	3.50	7.00	5.25	13.00	8.25
T <sub>7</sub>	3.75	2.50	6.00	2.25	3.25	2.25	5.75	3.75	6.25	4.25	12.50	11.50
T <sub>8</sub>	4.00	3.00	7.50	5.25	4.25	3.50	4.50	2.75	14.00	5.75	14.50	7.75
T <sub>9</sub>	3.75	2.50	8.25	4.25	6.00	5.25	6.00	4.50	11.50	9.50	15.25	10.50
T <sub>10</sub>	4.50	2.50	7.25	6.50	10.25	8.25	6.00	5.00	14.25	8.50	14.75	11.25
T <sub>11</sub>	9.75	3.57	14.25	9.00	13.50	9.75	11.00	8.50	16.75	10.50	23.50	15.75
Mean	5.05	2.55	6.82	4.27	7.05	4.93	6.32	4.30	9.52	5.98	13.16	8.39
Sem±	0.51	0.34	0.91	0.62	1.11	0.77	0.89	0.50	0.70	0.72	2.28	0.97
CD at 5%	1.47	0.982	2.63	1.77	3.22	2.24	2.58	1.44	2.02	2.09	6.59	2.79

Table 3. Effect of long term application of manure and fertilizers on soil actinomycetes population ( $1 \times 10^4 \text{ g}^{-1}$ ) at different growth stages of rainfed groundnut

Treatments	Kharif 2002						Kharif 2003					
	Initial (5 DAS)		Flowering (30 DAS)		After harvest		Initial (5 DAS)		Flowering (30 DAS)		After harvest	
	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)	0-15 (cm)	15-30 (cm)
T <sub>1</sub>	0.5	-	1.5	0.75	2.50	1.50	1.00	0.50	2.25	1.25	1.25	1.25
T <sub>2</sub>	2.00	1.5	7.25	3.50	3.25	2.00	1.50	1.00	7.75	3.75	5.00	3.25
T <sub>3</sub>	1.00	0.75	1.25	1.25	1.25	0.75	1.00	1.00	1.25	0.75	1.00	0.50
T <sub>4</sub>	1.50	1.00	1.25	1.5	1.75	1.25	1.00	1.00	1.25	0.75	1.50	1.00
T <sub>5</sub>	1.25	1.00	1.50	1.00	1.25	0.75	1.25	0.75	2.00	1.00	1.50	1.25
T <sub>6</sub>	1.25	1.00	1.25	0.75	1.50	0.75	1.00	1.00	2.75	1.25	1.50	1.50
T <sub>7</sub>	1.50	1.00	1.57	1.00	1.25	1.25	1.00	1.00	2.00	1.75	1.25	1.25
T <sub>8</sub>	1.50	1.75	2.00	1.00	1.75	1.25	1.75	1.50	3.00	2.00	3.00	2.25
T <sub>9</sub>	2.25	1.5	8.00	2.00	1.57	1.75	2.00	1.50	7.75	2.25	5.00	2.00
T <sub>10</sub>	2.50	1.50	8.50	4.25	2.57	1.75	2.50	1.75	7.50	3.25	5.00	2.00
T <sub>11</sub>	4.00	2.75	10.00	6.00	3.75	2.50	3.75	2.50	9.00	4.50	6.00	3.50
Mean	1.75	1.23	3.93	2.07	2.07	1.41	1.61	1.23	4.22	2.05	2.55	1.80
Sem±	0.44	0.27	0.54	0.54	0.41	0.32	0.36	0.29	0.55	0.44	0.50	0.32
CD at 5%	1.27	0.77	1.55	1.56	1.18	0.91	1.04	0.83	1.60	1.26	1.44	0.92

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