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Rani Bathula
Department of Soil Science and Agriculture Chemistry, P.J.T.S.A.U, Hyderabad, Telangana, India

Rajeshwar Malawath
Programme Coordinator, KVK, Bellampalli, P.J.T.S.A.U, Hyderabad, Telangana, India

T Anjaiah
AICRP on Micronutrients, P.J.T.S.A.U, Hyderabad, Telangana, India

M Govardhan
ADR, Palem, P.J.T.S.A.U, Hyderabad, Telangana, India

S Triveni
Department of Agricultural microbiology and Bioenergy, P.J.T.S.A.U, Hyderabad, Telangana, India

Corresponding Author:
Rani Bathula
Department of Soil Science and Agriculture Chemistry, P.J.T.S.A.U, Hyderabad, Telangana, India

Dynamics of soil microbial population under rain fed conditions with and without soybean leaf fall addition

Rani Bathula, Rajeshwar Malawath, T Anjaiah, M Govardhan and S Triveni

Abstract
Soil microbes are indicators of soil health, to reduce the quantity of external fertilizer application and improve the soil health these soil microbes are important to degrade the available crop residues. Soybean is one of the most important legume in soil health management, considering the fact of this we conducted a field experiment at research farm of Agricultural Research Institute (ARI), Rajendranagar, Hyderabad, Telangana. The experiment consisted treatments were *viz*.,75% RDF, 100% RDF, 75% RDF + FYM @ 5 t ha^{-1}, 100% RDF + FYM @ 5 t ha^{-1} & absolute control was maintained under with and without leaf fall addition. Each plot measuring 6.1 m x 4.2 m and three replications. ADB-22 (Bhasar) a high yielding variety of soybean was used as the test crop in this experiment. The soil was black clay in texture and moderately alkaline (pH 8.4) in reaction, non-saline in nature (EC 0.16 dS m^{-1}) and high in organic carbon content (0.67%). Highest number of bacterial population was recorded under at 60 DAS, the treatments receiving RDF + FYM @ 5 t ha^{-1} as compared to the all other treatments. T_5 (184× 10^5 CFU g^{-1} of soil) and T_4 (178× 10^5 CFU g^{-1} of soil) on par with each other. Maximum fungal population was observed with the treatment T_5 (46 ×10^4 CFU g^{-1} of soil) at 60 DAS and maximum rhizobial population was found with T_5 (55 ×10^5 CFU g^{-1} of soil) under leaf fall addition plots.

Keywords: Leaf fall, bacteria, fungi and rhizobial population

1. Introduction
Soybean is one of the most important oil seed crop in the world. Oil and protein rich soybean has now been recognized all over the world as a potential supplementary source of edible oil and nutrition (Kaul and Das, 1986). The oil of soybean contains 85% unsaturated fatty acid and is cholesterol free. Soybean seeds contain 43.2% protein, 19.5% fat, 20.9% carbohydrate and a good amount of other nutrients like calcium, phosphorus, iron and vitamins (Guptha *et al.*, 2003). It is cultivated in an area of 2.72 lakh ha and in the state of Telangana. It is getting established as one of the leading crops of the state of Telangana. The continuous and imbalanced use of commercial fertilizers leads to the resurgence of secondary soil problems declining the soil productivity and causing soil pollution in long run. To overcome this problem of declining soil productivity one of the alternatives is cultivation of legume crops and also as a source of green manures or green leaf manures. Soybean, being an indeterminate crop produces a large number of leaves also these leaves get accumulated in the soil. These fallen leaves contribute a significant amount of organic matter to the soil. A considerable quantity of chemical fertilizers can be saved by returning crop residue back to the soil. Green manuring and green leaf manuring is a good source of ecosystem stability and the organic materials present in these sources are dynamic in nature and helps in improving physical, chemical and biological properties of the soil.

In Indian soils, the N is commonly the most limiting plant nutrient and has very low content because of low organic matter accumulation due to higher temperatures. Nutrient availability especially N in the soil depend on organic matter decomposition and mineralization processes. Soil mineralization is influenced by biomass inputs, microbial activities, and different abiotic factors such as micro climatic variations and agricultural practices. Recycling of organic matter from the plants residues is an important source of nitrogen. It is maintained through mineralization and immobilization processes in agro ecosystems. Microbial life only occupies a minor volume of soil near the root zone of the crop called as “rhizosphere soil” where microflora has continuous access to flow of low and high molecular weight organic substrates derived from roots. Bacteria and fungi have positive and negative effect on growth and development of plants.

Both biotic and abiotic factors affect the quantitative and qualitative compositions of the microbial population. Plants secrete various organic compounds and plant residues added to the soil which supplies energy sources like organic acids, amino acids, sugar and phenols to the soil microbial population which helps in proliferation of soil biota Bibhuti *et al.*, (2012) [6]. Continuous and highly imbalanced use of fertilizers cause deleterious effect on fertility status of soil, yield sustainability and soil microbial activities. There is scope to enhance the soil and crop productivity along with encourage the microbial population with the judicious use of organic, inorganic and integrated approaches under Soybean based cropping system (Swati, 2011) [16].

2. Materials & Methods

The present study was conducted during *kharif* 2016-17 at Agricultural Research Institute (ARI) Farm, Hyderabad, Telangana. Soil samples were analysed for pH, EC, organic carbon, N, P and K by standard procedures (Jackson, 1967). The soil was clay in texture and slightly alkaline (pH 8.4) in reaction, non saline in nature (EC 0.16 dS m^{-1}) and high in organic carbon content (0.67%) The available Nitrogen 278 Kg ha^{-1}, Phosphorus 23 Kg ha^{-1} and Potassium 319 Kg ha^{-1}. The experiment was laid out in factorial combination of with and without leaf fall incorporation along with inorganic fertilizers and FYM following randomized complete block design, each plot measuring 6.1 m x 4.1 m and three replications. The experimental Treatments were viz. 75% RDF, 100 RDF, 75% RDF + FYM and100% RDF + FYM and with and without incorporation of leaf fall and absolute control was maintained. In selected treatment plots FYM was applied one week before sowing mixed thoroughly with soil. The fertilizers treatments urea (46%-N), SSP (16%-P2O5), MOP (60%-K2O) were used as source of NPK and recommended dose of fertilizers was 80-60-40 kg ha^{-1} N-P-K. Leaf fall was collected from without leaf fall treatments at every 20 days interval till the harvest of the crop and oven dried at 60^{o}c for leaf fall dry matter production data. Soil samples were collected from the root zone of the soil to count the viable population of Bacteria, Fungi and Rhizobium, those were analysed at 20, 40, 60, 80,100 DAS, at harvest and at 20, 40 days after harvest by the standard serial dilution plate count method (Vlassak *et al.*, 1992) [17] using media *viz*., Nutrient Agar for Bacteria (Allen. 1959) [1], Potato Dextrose Agar for Fungi and Yeast Extract Mannitol Agar with Congo red for rhizobium and plates were incubated at 28 ± 2^{0}C in an incubator in triplicates. The microbial colonies appearing after the stipulated time period of incubation were counted as colony forming units (CFU g^{-1}) fresh weight of the soil sample. The microbial populations were expressed as number of colony forming per gram of soil.

3. Results

3.1 Bacterial Population

The results related to bacterial population was recorded at different growth periods of Soybean as influenced by various treatments with leaf fall were furnished in table 3.1 and 3.2. The bacterial population gradually increased up to 60 DAS (157 × 105 CFU g^{-1} of soil). Thereafter bacterial population declined in the subsequent intervals *i.e*., 80 DAS, 100 DAS, at harvest, 20 DAH and 40 DAH. However up to 40 DAS leaf fall did not significantly influence the bacterial population. This may be due to fact that there might have been more amount of degradation of organic matter in soil which resulted in increased microbial populations while at 80 DAS, it was decreased in all the treatments. The decrease in population may be due to non availability of root exudates at maturity stage. At 20 DAS, among the treatment T5 (100% RDF + FYM @ 5 t ha^{-1}) (145 × 105 CFU g^{-1} of soil) recorded higher bacterial population and was on par with T4 (75% RDF + FYM @ 5 t ha^{-1}) (139 × 105 CFU g^{-1} of soil) followed by T3 (83 × 105 CFU g^{-1} of soil), T2 (72× 105 CFU g^{-1} of soil) were recorded higher bacterial population over control (T1) (57 × 105 CFU g -1 of soil). Similar trend was observed at 40 DAS. Significantly the highest bacterial population was recoded at 60 DAS, the treatments receiving RDF + FYM @ 5 t ha^{-1} as compared to the all other treatments. T5 (184 × 105 CFU g^{-1} of soil) and T4 (178 × 105 CFU g^{-1} of soil) on par with each other. While T3 (137× 105 CFU g -1 of soil), T2 (126 × 105 CFU g^{-1} of soil) recorded higher bacterial population over control. However lowest bacterial population recorded in control (T1) (70 × 105 CFU g^{-1} of soil). Thereafter bacterial population slightly declined at 80, 100 DAS and at harvest and constantly decreased in subsequent intervals i.e., 20 DAH, 40 DAH.

At 60 DAS maximum bacterial population was found to be recorded with addition of leaf fall as compared to the without leaf fall. The treatment receiving 100% RDF+ FYM @ 5 t ha^{-1} (T_5) (193 ×105 CFU g^{-1} of soil) and was on par with T4 (175 ×105 CFU g^{-1} of soil) as compared to the all other treatments. While lowest bacterial population was recorded in treatments receiving inorganic fertilizers (T3, T2) alone. From 80 DAS onwards the bacterial population was maintained low up to 40 DAH it might be due to non-availability of crop. From the above results it could be observed that at 60 DAS, higher bacterial population could be seen in T5 and T4 treatments it might be due to the added leaf fall quite evident to known that organic matter introduced to soil stimulate the soil microbial population than application of inorganic fertilizers (T3, T2) alone. Rudragouda *et al.* (2014) [12] observed that combined application of compost + vermicompost equalent to RDF + Gliricidia with surface application of jeevamrutha recorded significantly higher bacterial population. Combined application of leaf fall and treatments provided sufficient amount of nutrients to the crop simultaneously bacterial population varied with the stage of the crop it might be due to the higher metabolic activities thereby secreting higher amount of root exudates which act as substrate to bacterial population. These results are in conformity with results of Mairan and Dhawan (2016) [10]. Khaddar and Yadav (2006) [8] reported that higher bacterial population was recorded at 50 DAS among all the treatments over 25 and 75 DAS and further observed that treatments receiving chemical fertilizers + FYM along with biofertilizer recorded significantly higher bacterial population than the treatment involving chemical fertilizers alone. At 20 DAH significantly higher bacterial population was observed where the treatments receiving abscised leaf fall it might be due to the decomposing root tissues and root nodules also provide carbon and energy to the soil bacterial population resulting in multiplication of microbial population. These results are in line with the findings of Nagar *et al.* (2016) [11]. Arbad and Ismail (2011) [2] reported that after harvest of Soybean the bacterial population was found significantly highest with treatment involving FYM @ 10 Mg ha-1 and was on par with treatment involving 100% NPK + FYM in Soybean-safflower cropping system.

Suresh *et al.* (1995) [15] observed that the application of green manure (*Glyricidia specieosa*) resulted in the highest total bacterial population 42 × 106 CFU g-1 soil than with the chemical fertilizer treatments in Rice.

Table 3.1: Effect of treatments on bacterial population (×10^5 CFU g^{-1} of soil) at various growth periods (20, 40, 60 and 80 DAS) of Soybean during *kharif* season.

Treatments	Bacterial population (× 10^5 CFU g^{-1} of soil)											
	20 DAS			40 DAS			60 DAS			80 DAS		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	54	59	57	62	64	63	56	83	70	57	96	77
T_2	69	74	72	92	94	93	96	156	126	78	105	92
T_3	81	84	83	81	83	82	112	162	137	103	115	109
T_4	136	142	139	119	122	121	165	191	178	131	142	137
T_5	147	142	145	126	127	127	175	193	184	138	144	141
MEAN	97	100		96	98		121	157		101	120	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	1.30	NS		1.01	NS		1.28	3.81		0.96	2.86	
Fertilizer Treatments	2.07	6.23		2.04	6.42		2.02	6.03		1.52	4.53	
Interaction	2.92	NS		3.21	NS		2.86	8.53		2.15	6.40	
CV%	5.13			3.90			3.56			3.31		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

Table 3.2: Effect of treatments on bacterial population (× 10^5 CFU g^{-1} of soil) at various growth periods (100 DAS, at harvest) and after harvest (20 and 40 DAH) of Soybean during *kharif* season.

Treatments	Bacterial population (× 10^5 CFU g^{-1} of soil)											
	100 DAS			At harvest			20 DAH			40 DAH		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	48	75	62	55	73	64	40	44	42	25	34	29
T_2	75	101	88	61	95	78	55	53	54	33	48	41
T_3	92	124	108	93	108	100	70	82	76	37	54	46
T_4	126	136	131	118	129	123	86	89	88	59	62	60
T_5	131	139	135	124	133	128	88	93	91	59	64	62
MEAN	94	115		90	107		68	72		43	52	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	1.06	3.16		1.28	3.81		0.74	2.20		0.59	1.77	
Fertilizer treatments	1.68	5.00		2.02	6.02		1.17	3.48		0.94	2.81	
Interaction	2.37	7.08		2.85	8.51		1.65	NS		1.33	NS	
CV%	3.92			5.00			4.09			4.85		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

3.2 Fungal Population

The perusal data on fungal population was recorded at different growth periods of Soybean as influenced by treatments and addition of leaf fall are presented in table 3.3 and 3.4. The maximum (37 ×104 CFU g^{-1} of soil) fungal population was recorded at 60 DAS. Thereafter fungal population declined in the subsequent intervals i.e., 80 DAS, 100 DAS, at harvest, 20 DAH and 40 DAH. However, up to 40 DAS leaf fall did not significantly influenced fungal population.

At 20 DAS, among the treatments T5 (100% RDF + FYM @ 5t ha^{-1}) (25 ×104 CFU g^{-1} of soil) recorded higher fungal population and was on par with T4 (75% RDF + FYM @ 5t ha^{-1}) (23 ×104 CFU g^{-1} of soil) followed by T3 (20 ×104 CFU g^{-1} of soil), T2 (16×104 CFU g^{-1} of soil) recorded higher fungal population over control (T1) (13 ×104 CFU g^{-1} of soil). Similar trend was observed at 40 DAS. Maximum fungal population was recoded at 60 DAS in T5 (100% RDF + FYM @ 5 t ha^{-1}) and T4 (75% RDF+ FYM @ 5t ha^{-1}) as compared to the all other treatments. T5 (45 ×104 CFU g^{-1} of soil) and T4 (44 ×104 CFU g^{-1} of soil) on par with each other. While T3 (34 ×104 CFU g^{-1} of soil), T2 (29 ×104 CFU g^{-1} of soil) recorded higher fungal population over control. However lowest fungal population recorded in control (T1) (26 ×104 CFU g^{-1} of soil). Thereafter fungal population slightly decreased at 80 DAS, 100 DAS and at harvest and constantly declined subsequent intervals i.e., 20 DAH, 40 DAH. At 60 DAS, maximum fungal population was found to be recorded with addition of leaf fall as compared to the without leaf fall. The treatment T5 (46 ×104 CFU g^{-1} of soil), T4 (44 ×104 CFU g^{-1} of soil) were on par with each other. While lowest fungal population was recorded in T1. Similar trend was observed up to harvest. Leaf fall did not influenced subsequent intervals i.e., 20, 40 DAH. This is clearly showed that the abscised leaf fall provides carbon and nutrients to the fungal population. Thereby higher fungal population recorded at 60 DAS. Similar results were observed by Khaddar and Yadav (2006) [8] and revealed that integrated application of biofertilizers along with poultry manure and FYM recorded higher fungal population at 50 DAS over 25 and 75 DAS in Soybean-Wheat cropping system and further observed that application of N levels with FYM promoted the fungal population prolifiration which might be due the added FYM act as source of energy to microbial population (Bhdoria *et al.*, 2011). Mairan and Dhawan (2016) [10] reported that application of FYM @ 5t ha-1 stimulate the microbial population than application of chemical fertilizers alone. Rudragouda *et al.* (2014) [12] revealed that combined application of compost + vermicompost equalent to RDF + gliricidia with surface application of jeevamrutha recorded significantly higher population of fungi. Addition of leaf fall coupled with NPK Fertilizer exerted a stimulating influence on the preponderance of fungal population in soil. The higher levels of NPK + FYM produced favorable influence on soil fungal population (Selvi, 2004 and Sharma *et al.*, 1983). At 20, 40 DAH higher fungal population recorded with leaf fall added treatments as compared to the without leaf fall added treatments it might be due the residual effect of FYM and root exudates provide good amount of substrate and enhance the microbial activity. These results are line with the findings of Swati (2011) [16]. Badole (2000) observed that application of FYM helped in higher fungal population as compared to inorganic sources which is mainly attributed to dead food material available from FYM.

Table 3.3: Effect of treatments on fungal population (×10^4 CFU g^{-1} of soil) at various growth periods (20, 40, 60 and 80 DAS) of Soybean during *kharif* season.

Treatments	Fungal population (× 10^4 CFU g^{-1} of soil)											
	20 DAS			40 DAS			60 DAS			80 DAS		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	13	13	13	14	16	15	24	27	26	11	13	12
T_2	16	16	16	19	21	20	27	31	29	15	16	16
T_3	19	21	20	22	24	23	32	36	34	21	23	22
T_4	22	24	23	28	29	29	43	45	44	32	35	34
T_5	25	24	25	30	32	31	44	46	45	34	36	35
MEAN	19	20		23	24		34	37		23	25	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	0.36	NS		0.48	NS		0.37	1.09		0.35	1.04	
Fertilizer treatments	0.69	2.06		0.67	2.00		0.58	1.73		0.55	1.64	
Interaction	0.87	NS		1.00	NS		0.82	2.44		0.78	2.32	
CV%	4.54			4.99			6.16			5.68		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

Table 3.4: Effect of treatments on fungal population (× 10^4 CFU g^{-1} of soil) at various growth periods (100 DAS, at harvest) and after harvest (20 and 40 DAH) of Soybean during *kharif* season.

Treatments	Fungal population (× 10^4 CFU g^{-1} of soil)											
	100 DAS			At harvest			20 DAH			40 DAH		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	13	17	15	13	14	14	9	10	10	6	8	7
T_2	19	20	19	17	19	18	10	17	14	8	10	9
T_3	23	24	23	24	23	24	15	18	16	11	12	12
T_4	29	32	31	33	36	35	19	20	20	14	14	14
T_5	31	33	32	34	38	36	20	21	21	14	15	15
MEAN	23	25		24	26		15	17		10	12	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	0.28	0.83		0.30	0.91		0.19	0.57		0.23	0.69	
Fertilizer treatments	0.44	1.31		0.48	1.43		0.30	0.90		0.37	1.09	
Interaction	0.72	2.16		0.68	2.03		0.43	NS		0.52	NS	
CV%	4.50			4.67			4.63			4.92		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

3.3 Rhizobial population

Data pertaining to the rhizobial population recorded at various stages of Soybean are presented in table 3.5 and 3.6. A close scrutiny of the data revealed that treatments significantly influenced the rhizobial population. At 20, 40 DAS, leaf fall did not influence the rhizobial population. However from 20 DAS the rhizobial population was constantly increased up to 60 DAS and recorded (41 ×105 CFU g^{-1} of soil) maximum population of rhizobium. Thereafter the population decreased in subsequent intervals i.e., from 80 DAS to 40 DAH. With regard effect of treatments, at 20 DAS the treatments receiving 100% RDF + FYM @ 5t ha^{-1} (T5) (53 ×105 CFU g^{-1} of soil) recorded higher rhizobial population as compared to the all other treatments and was on par with T4 (75% RDF + 5t ha^{-1} FYM) (52×105 CFU g^{-1} of soil). While the treatments receiving chemical fertilizers alone (T3) (35×105 CFU g^{-1} of soil), (T2) (32×105 CFU g^{-1} of soil) recorded higher population of rhizobium over control. Lower rhizobial population was found in control (T1) (27×105 CFU g^{-1} of soil). Similar results were recorded in all the stages though maximum rhizobial population was recorded at 60 DAS. Thereafter declined rhizobial population was observed in all the stages. The interaction effect of treatments and leaf fall significantly influenced the rhizobial population.

At 60 DAS, maximum rhizobium population was recorded with leaf fall added treatments as compared to the without leaf fall treatments. The treatment T5 (55 ×105 CFU g^{-1} of soil), T4 (52 ×105 CFU g^{-1} of soil) were on par with each other. While, lowest rhizobium population was recorded in T1. Similar trend was observed up to 100 DAS. Leaf fall did not influenced subsequent interval i.e., at harvest and 20, 40 DAH. At 60 DAS, the treatment receiving FYM @ 5 t ha^{-1} +

RDF recorded significantly higher rhizobial population as compared to chemical fertilizers alone. It might be due to that degraded products of FYM stimulatory effect towards the growth and proliferation of rhizobium population. The results are in conformity with Bhadoria *et al.* (2011) [5]. Limtong and Piriyaprin (2006) [9] observed the treatment receiving compost + chemical fertilizers shows positive influence on N fixing bacteria over chemical fertilizers alone. Rudragouda *et al.* (2014) [12] reported that combined application of compost + vermicompost equalent to RDF + Gliricidia with surface application of jeevamrutha recorded significantly higher N fixers population. Another reason for increased rhizobium population in the soil might be due to decomposed organics might have release organic acids thereby decrease the soil pH. Decreasing soil pH towards neutral promotes the rhizobial population Basu *et al.* (2011) [4, 5]. Fettel *et al.* (1998) [7] observed that increase the Bradirhizobial population with addition of lime.

Table 3.5: Effect of treatments on rhizobial population ($\times 10^5$ CFU g^{-1} of soil) at various growth periods (20, 40, 60 and 80 DAS) of Soybean during *kharif* season.

Treatments	Rhizobial population ($\times 10^5$ CFU g^{-1} of soil)											
	20 DAS			40 DAS			60 DAS			80 DAS		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	14	12	13	17	19	18	25	27	26	20	23	22
T_2	17	16	17	20	19	19	31	33	32	21	24	23
T_3	20	19	20	21	21	21	33	37	35	23	27	25
T_4	24	23	23	37	38	38	51	52	52	44	46	45
T_5	24	24	24	38	39	39	52	55	53	46	48	47
MEAN	20	19		27	27		38	41		31	34	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	0.40	NS		0.33	NS		0.39	1.15		0.38	1.13	
Fertilizer treatments	0.57	1.71		0.51	1.53		0.61	1.82		0.68	2.04	
Interaction	0.76	NS		0.73	NS		0.87	2.58		0.85	2.52	
CV%	5.95			4.71			3.81			4.57		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

Table 3.6: Effect of treatments on rhizobial population ($\times 10^5$ CFU g^{-1} of soil) at various growth periods (100 DAS, at harvest) and after harvest (20 and 40 DAH) of Soybean during *kharif* season.

Treatments	Rhizobial population ($\times 10^5$ CFU g^{-1} of soil)											
	100 DAS			At harvest			20 DAH			40 DAH		
	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean	F0	F1	Mean
T_1	18	17	18	14	15	15	3	4	4	3	3	3
T_2	23	26	25	22	24	23	4	5	5	3	3	3
T_3	31	34	33	30	33	32	6	6	6	4	4	4
T_4	42	44	43	41	41	41	8	8	8	5	5	5
T_5	43	45	44	42	42	42	9	9	9	5	5	5
MEAN	31	33		30	31		6	6		4	4	
	SE±(m)	CD		SE±(m)	CD		SE±(m)	CD		SE±(m)	CD	
Leaf fall	0.32	0.96		0.28	0.84		0.35	NS		0.23	NS	
Fertilizer treatments	0.51	1.53		0.45	1.32		0.55	NS		0.36	NS	
Interaction	0.73	2.16		0.63	NS		0.78	NS		0.51	NS	
CV%	3.93			3.57			5.23			5.20		

F_0= without leaf fall, F_1= with leaf fall, Treatments (T) = T_1= Control, T_2= 75% RDF, T_3= 100% RDF, T_4= 75% RDF+FYM 5t ha^{-1}, T_5= 100% RDF+FYM 5t ha^{-1}

Conclusions

1. From the above results it is concluded that application of organic and inorganic fertilizers (100 % RDF + FYM @ 5 t ha^{-1}) coupled with soybean leaf fall significantly proliferate the bacterial, fungal and Rhizobial population.
2. Maximum activity of bacteria, fungi and rhizobium were observed up to 60 DAS of soybean, thereafter activity of soil microbes were declined due to less availability of source of food.

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