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Study of microbial decomposers on Bacterial population during decomposition of crop residues

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ABSTRACT: *The experiment was carried out on "Study of microbial decomposers on Bacterial population during decomposition of crop residues" during the year 2011 - 2012 at college of Agriculture, Latur. the experiment was laid out in factorial randomized block design with three replications consisting of four levels of decomposer species (*T.viride, T.harzianum, pseudomonas, *commercial composting culture) and two levels of cereal crop residues (sugarcane trash and pigeon pea straw). The composting samples were collected at different stage and analysed for it physical, chemical and biological properties.*

The results indicated that the quality of compost was significantly influenced by decomposer species and crop residues .The chemical properties like Ec, N, P, K and micronutrients were found to be increased progressively throughout the composting of crop residues . However, C:N ratio, organic carbon and P^H of all the treatments were decreased significantly during an experiment. Among various biological properties Co_2evolution population density /CFU of the decomposers, mycelia dry weight ,growth rate and colony characteristics were increased vigorously with time .compost obtained from sugarcane trash was rich in macro and micro nutrients as compared to pigeon pea straw .The quality of compost obtained from decomposers species Tricoderma viride was superior to all other decomposers.

INTRODUCTION

Decomposers are vital components of the nutrient cycle, without decomposers, nutrients would not cycle back into our environment and waste would accumulate at an alarming rate. If decomposers did not exist, within a month the earth would be covered in a layer of dead flies almost twenty feet deep! Decomposers consume dead plant and animal matter, so the nutrients contained within them can be erased. If nutrients were not recycling in our environment, they would not be available to other organisms.

The term decomposer is used to describe a build of organism's viz., bacteria, fungi, insects, earthworms. That process organic constituent's (plant material) to release carbon and other nutrients such as nitrogen (N) and phosphorus (P). This process creates a key link in transfer of energy and cycling of nutrients between various tropic groups in an ecosystem. This transfer of energy from one tropic group to another occurs via the consumption, death and decay of organisms. The breakdown of organic matter and conversion of organically bound nutrients in to basic inorganic forms is called mineralization.

The decomposer community consists of four main categories of organisms: microbes, microfauna, mesofauna (litter transformers) and macrofauna (ecosystem engineers).

Decomposers or saprotrophs are organisms that break down dead or decaying organisms and carry out the natural processer of decomposition like herbivores and predators, decomposers are heterotrophic, meaning that they use organic substrates to get their energy, carbon and nutrients for growth and development.

Fungi are the primary and common decomposers of litter in many ecosystems unlike bacteria, which are unicellular organisms most saprotrophic fungi grow as a branching network of hyphae. While, bacteria are restricted to growing and feeding on the exposed surfaces of organic matter, fungi can use their hyphae to penetrate larger places of organic matter. Additionally, only fungi have evolved the enzymes necessary to decompose lignin, a chemically complex substance found in wood. These two factors make fungi the primary decomposers in forests, where litter has high concentrations of lignin and often occurs in

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large pieces. Fungi eat the dead matter by releasing acid found in their body to melt the decaying material then sucking in all the acid along with the melted material.

Trichoderma species are fungi that are present in nearly all soils and other diverse habitats in soil they frequently are the most prevalent culturable fungi. Trichoderma spp. including T.harzianum, T. viride, T. koningii and T.hamatum of other species. Trichoderma is a genus of fungi that is present in all soils, where they are the most prevalent culturable fungi.

Fungi and bacteria are the major organisms decomposing dead leaves and other organic matter. Decomposition is a complex process. Organic matter is broken down into carbon dioxide and the mineral forms of nutrients like nitrogen. It is also converted into fungi and bacteria through these organisms feeding on the organic material. Crop residues are the non-economic plant parts that are left in the field after harvest. The harvest refuses include Straws, Stubble, Stover and haulms of different crops. Crop remains are also from threshing sheds or that are discarded during crop processing. This includes process wastes like groundnut shell, oil cakes, rice husks and cobs of maize, sorghum and cumbu. The greatest potential as a biomass resource appears to be from the field residues of sorghum, maize, soybean, cotton, sugarcane etc. In Tamil Nadu 190 lakh tones of crop residues are available for use. These residues will contribute 1.0 lakh ton of nitrogen, 0.5 lakh ton of phosphorus and 2.0 lakh tonns of potassium. However crop residues need composting before being used as manure.

Sugarcane is one of the important cash crops in India and plays pivotal role in both agricultural and industrial economy of the country. Sugarcane produces about 10 to 12 tonnes of dry leaves per hectare per crop. The detrashing is done on 5th and 7th month during its growth period. This trash contains 28.6% organic carbon, 0.35 to 0.42% Nitrogen, 0.04 to 0.15% Phosphorus, 0.50 to 0.42% Potassium. The sugarcane trash incorporation in the soil influences physical, chemical and biological properties of the soil . India has a large potential of manurial resources such as animal waste, crop residues, green manures, marine and agro-industrial wastes. Among these sources crop residues has been receiving considerable importance. It is estimated that in India 388 million tonns of crop residue is available which can be add 7.3 million tonns of major N,P,K with considerable amount of micronutrients. Crop residues such as Sugarcane trash, Soybean, Jowar, Wheat, Pigeon pea, Sunflower, Gram, Groundnut, Mung, Rice, Ragi, Cowpea, etc. are available in ample quantities in all over the India. (Beri 1996). The conventional method of composting takes a long time of about 6-8 months to produce compost from organic wastes. Further compost prepared from these residues is poor in nutrient content and bulky in nature, therefore this waste can be effectively recycled in the form of good quality manure through composting. To reduce the composting period and to increase its nutrient value it was necessary to undertake studies which will enlighten the decomposition of crop residues through composting

MATERIAL AND METHODS

An experiment was conducted during the year 2011-2012 on "Influence of microbial decomposers on quality of compost using crop residues". The experiment on composting was conducted at departmental compost shade, Department of Soil Science and Agricultural chemistry, College of Agriculture, Latur during the months of July 2011 to October 2011 which is geographically located between 180 05 to 180 75 North latitude and 760 25 to 770 25 East latitude and has an altitude of 540-634 m from mean sea level and has subtropical climate. According to agro-climatic conditions, Latur falls in agro-ecological situation VII of Assured Rainfall Zone which is typically characterized by hot summer and general dryness throughout the year except during South West monsoon. The annual precipitation is 794 mm. In general, monsoon commences by the second fortnight of June and retreats by September end. The winter season starts from November and ends by middle of February. The coldest months are December and January, whereas April and May are the hottest. Crop residues of sugarcane (Sachharam officinaram), pigeon pea (Cajanus cajan) were used for experiment. Polythene bags of height 40 cm and top diameter 33cm were used for decomposition of crop residues.

It was collected from department of Animal Husbandry and Dairy Science, College of Agriculture, Latur. Different crop residues viz., sugarcane trash, pigeon pea straw were collected from college farm and other materials like plastic, dung etc were separated from crop residues. After that the crop residues were chopped into small pieces and dried them.

Polythene bags were punched with punching machine to remove excess water and proper aeration in polythene bags. During decomposition of crop

residues, polythene bags were kept under the shed to avoid direct effect of sunlight and rain.

At the time of polythene bags filling, cow dung slurry was prepared and treatment wise required quantity of inoculation culture was added in it. Polythene bags were filled with 1 Kg sugarcane trash / pigeon pea straw and it was inoculated layer wise with cow dung slurry containing decomposing culture. Moisture in the polythene bags was maintained at field capacity by adding required quantity of water. The crop residues in the polythene bags were mixed every week. Four species of decomposers namely Trichoderma viride, Trichoderma harzianum, Pseudomonas and commercial composting culture were brought from M.K.V, Parbhani and used for decomposition.

Observations on population density / CFU of the decomposers was recorded from 15 days after inoculation and was continued after every 15 days till final finished compost is ready. The representative samples were obtained at 15 days interval for three months from each treatment to determine the population of bacteria, fungi, and actionomycetes. The samples were collected from each treatment separately and air dried. 10 gms of air dried samples were serially diluted up to 105 dilution and different dilutions were used while for estimation of bacteria, fungi, actionomycetes as 105, 104 and 102 dilution, respectively. Nutrien tagar (Bacteria), Martins Rose Bengal agar (fungi), kusters agar (actionomycetes), medium were used for enumeration of these microorganisms and Potato Dextrose agar medium used for enumeration of fungal pathogens. The Petri plates were incubated at 300 C for a week, and population were counted and expressed per unit dry weight of substrate.

During composting period the samples were collected at an interval of 15 days i.e., 15th, 30th, 45th, 60th, 75th and 90th days with the help of soil tube agar, these samples were analysed for different properties. The experiment was laid out in factorial randomized block design with three replications and thirty-two treatment combinations. The experiment was initiated on 21 July and completed on 21 Oct. 2011. The data obtained regarding the study was subjected to statistical analysis by following the procedure pertaining to Factorial Randomized Block Design (FRBD) as given by Panse and Sukhatme (1967). The significance of difference was tested by F test. 5% level of significance was used to test the significance of result. The critical difference were calculated when difference among the treatments were found significant by F test.

RESULT AND DISSCUTION

The present investigation "Study of microbial decomposers on Bacterial population during decomposition of crop residues" were conducted at College of Agriculture, Latur and the results obtained are interpreted.

Effect on bacterial population

Table 1 represents the bacterial population (CFU x 105g-1) in different composts. It showed the influence of crop residues and decomposers applied at various rates. It was also affected at various intervals after inoculation. Generally, bacterial population was found increased up to 60 days after inoculation and decreased by 15 to 16 percent at 75 days and further increased drastically by 18 to 20 percent at 90 days after inoculation.

Both the crop residues showed significant difference at 45, 60 and 90 days after inoculation Both the crop residues recorded steady increase in bacterial population up to 60 days after inoculation. It was declined (about 15%) at 75 days and again increased drastically (about 18 to 20%) at 90 days after inoculation. Sugarcane trash recorded the bacterial population in the range of 24.72 to 90.08 CFU x 10-5 g-1 with the mean population of 61.77 CFU x 10-5 g-1. Pigeonpea straw also recorded bacterial population in the range of 24.25 to 91.08 CFU x 10-5 g-1.

All the test decomposers applied at various rates were found to affect the bacterial population. However, significantly highest bacterial population in the range of 27.66 to 93.50 CFU x 10-5 g-1 with the highest mean of 71.25 was recorded with the treatment T3 this was followed by the treatments T7 and T11 which recorded bacterial population in the range of 25.85 to 92.83 and 25.16 to 93.00 CFU x 10-5 g-1 with the mean of 62.92 and 62.55 CFUx10-5 g-1, respectively. Both of which were at par, the treatment T15 which recorded bacterial population in the range of 26.00 to 93.00 CFU x 10-5 g-1 with the mean of 62.83 CFU x10-5 g-1treatment T11 which recorded bacterial population in the range of 25.56 to 93.00 CFU x10-5g-1 with the mean of 62.55 CFU x 10-5 g-1 remaining treatments recorded mean bacterial population in the range of 61.03 to 58.50 CFU x 10-5 g-1 which were shown in table (19, 20 and 21).

Interaction effects

Interaction effects of the test crop residues and decomposers and their rate of application were found significant in 45, 60 and 90 days.

Table 1
Bacterial population CFU x 105/g. during decomposition of crop residues

Crop residues (M)	*Number of days*					
	15	*30*	*45*	*60*	*75*	*90*
Sugarcane Trash - M1	24.72	42.02	53.85	87.17	72.79	90.08
Pigeon pea straw - M2	24.25	36.68	54.48	87.65	73.83	91.08
SE ±	0.52	4.19	0.21	0.23	0.66	0.19
CD at 5 %	NS	NS	0.57	0.63	Ns	0.52
Decomposers with Quantity (T)						
T1 – *Trichoderma viride*@ 10g/kg	19.66	33.50	53.17	85.33	72.00	87.33
T2 – *T. viride*@15g/kg	23.33	39.16	54.33	86.33	73.66	88.67
T3 – *T. viride*@20g/kg	27.66	82.16	56.83	90.67	76.66	93.50
T4 – *T. viride*@25g/kg	24.00	37.33	54.00	86.00	72.83	88.67
T5 – *Trichoderma harzianum*@10g/kg	22.33	35.50	53.00	86.17	72.66	88.83
T6 – *T. harzianum*@ 15g/kg	24.33	37.83	54.17	86.00	73.50	89.33
T7 – *T. harzianum*@20g/kg	25.85	38.50	56.17	89.83	74.33	92.83
T8 – *T. harzianum*@25g/kg	25.00	36.66	54.17	87.33	73.50	89.83
T9 – *Psudomonas ssp.*@10g/kg	23.83	34.00	54.00	85.33	73.66	90.83
T10 – *Psudomonas ssp.* @15g/kg	23.83	35.00	53.83	86.83	72.33	91.67
T11 – *Psudomonas* ssp. @20g/kg	25.16	36.50	56.33	89.67	74.66	93.00
T12 – *Psudomonas ssp.*@25g/kg	24.83	34.50	52.33	87.83	72.16	91.17
T13 – Commercial composting culture @10g/kg	25.00	34.83	53.00	87.50	72.33	89.83
T14 – C. C. C. @15g/kg	25.83	37.50	53.33	87.50	71.66	90.33
T15 – C. C. C. @20g/kg	26.00	39.33	54.17	90.00	74.50	93.00
T16 – C. C. C.@ 25g/kg	25.16	37.33	53.83	86.17	72.50	90.50
SE ±	1.42	11.87	0.58	0.64	1.87	0.53
CD at 5 %	NS	NS	1.61	1.77	NS	1.46
Interactions (M x T)						
SE ±	2.01	16.78	0.82	0.91	2.64	0.75
CD at 5 %	NS	NS	2.27	2.51	NS	2.06
MEAN	11.35	81.64	5.06	4.78	2.24	3.33

Bacterial population content at 45 days

The data given in Table 2 showed a significant interaction with crop residues and decomposers to their rate of application with the bacterial population content.

The interaction of M1 × T recorded bacterial count in the range of 51.33 to 56.67 CFU × 105 g-1. However, significantly highest bacterial count content was recorded with the treatment combination M1T3 (56.67 CFU × 105 g-1), followed by M1T7 and M1T11 (each 56.33 CFU × 105 g-1).

The interaction of M2 × T recorded at 45 days bacterial content in the range of 51.33 to 57.00 CFU × 105 g-1. While, significantly highest bacterial population content was recorded with the treatment combinationM2T3 (57.00 CFU × 105 g-1) followed by M2T7 and M2T11 (each 56.33 and 56.00 CFU × 105 g-1).

Bacterial population content at 60 days

Result (Table 2) indicated that all the treatment interactions of crop residues and decomposers with their rate of application significantly influenced the bacterial count content as that of 45 days content.

The interaction of M1 × T recorded bacterial population content in the range of 83.33 to 91.00 CFU × 105 g-1. However, significantly highest bacterial count content was recorded with the treatment combination M1T3 (91.00 CFU × 105 g-1)followed by M1T7 and M1T15 (each 90.67 CFU × 105 g-1).

The interaction of M2 × T recorded bacterial content in the range of 85.00 to 98.00 CFU × 105 g-1. However, significantly highest bacterial population content was recorded with the treatment combination M2T3 and M2T7 (98.00 CFU × 105 g-1) and followed by M2T3 (each 90.33 CFU × 105 g-1) which were at par with each other.

Bacterial population content at 90 days

Result indicated that bacterial population content was significantly influenced with the interaction of crop residues × decomposers and their rate of application.

The interaction of M1 × T recorded bacterial population content in the range of 87.00 to 93.00 CFU × 105 g-1. While, significantly highest bacterial population count was recorded with the treatment combinationM1T3 (93.00 CFU × 105 g-1) over rest of the treatment combinations and followed by M1T7, M1T11 and M1T15 (each 92.67 CFU × 105 g-1) and all of which were at par.

The interaction of M2 × T recorded bacterial population content in the range of 87.67 to 94.00 CFU×105 g-1. However, significantly highest bacterial population was recorded with the treatment combination M2T3 (94.00 CFU×105 g-1). Rest of the treatments recorded bacterial population content in the range of 92.33 to 88.67 CFU × 105 g-1 and all of these were at par.

Similarly, Border and Wagner (1986) also reported a higher bacteria and actinomycetes population with soybean residues.

Table 2
Interaction effect of crop residues and decomposer with their rate of application on Bacterial population at 45 days, 60 days and 90 days

Decomposer Level (T)	*Crop residues level at 45 days*		*Crop residues level at 60 days*		*Crop residues level at 90 days*	
	M_1	M_2	M_1	M_2	M_1	M_2
T1 – *Trichoderma viride*@10g/kg	52.67	53.67	85.67	85.00	87.00	87.67
T2 – *T. viride*@15g/kg	54.33	54.33	86.67	86.00	87.00	90.33
T3 – *T. viride*@20g/kg	56.67	57.00	91.00	90.33	93.00	94.00
T4 – *T. viride*@25g/kg	54.33	53.67	85.67	86.33	88.67	88.67
T5 – *Trichoderma harzianum*@ 10g/kg	53.67	52.33	84.33	88.00	87.67	90.00
T6 – *T. harzianum*@15g/kg	55.00	53.33	85.00	87.00	88.00	90.67
T7 – *T. harzianum*@ 20g/kg	53.33	56.00	90.67	98.00	92.67	93.00
T8 – *T. harzianum*@25g/kg	54.67	53.67	87.67	87.00	89.33	90.33
T9 – *Psudomonas ssp.* @10g/kg	53.33	54.67	84.00	86.67	91.33	90.33
T10 – *Psudomonas ssp.* @15g/kg	52.00	55.67	85.67	88.00	92.33	91.00
T11 – Psudomonas ssp. @20g/kg	56.33	56.33	89.67	89.67	92.67	93.33
T12 – *Psudomonas ssp.* @25g/kg	53.33	51.33	88.00	87.67	91.67	90.67
T13 – Commercial composting culture @10g/kg	51.33	54.67	88.00	87.00	89.33	90.33
T14 – C. C. C. @15g/kg	51.67	55.00	87.67	87.33	89.33	91.33
T15 – C. C. C. @20g/kg	53.33	55.00	90.67	89.33	92.67	93.33
T16 – C. C. C. @25g/kg	52.67	55.00	83.33	88.00	88.67	92.33
SE±	0.82	0.91	0.75			
CD @ 5%	2.27	2.51	2.06			

SUMMARY AND CONCLUSION

The research experiment entitled Study of microbial decomposers on Bacterial population during decomposition of crop residues was conducted at College of Agriculture, Latur, during the year 2011 and 2012. This experiment was designed with different four microbial decomposers, Trichoderma viride, Trichoderma harzianum, Bacillus/ pseudomonas and commercial composting culture with various rates of inoculums, Quantity per kg crop residues were tested as 10, 15, 20 and 25 g on sugarcane trash and pigeon pea straw. The experiment with 32 treatment combinations in 96 polythene bags was carried out in triplicate as in Factorial Randomized Block Design. Decomposed samples were collected at different stages for 30 and 90 days. Population density/CFU of the decomposers was recorded from 15 days after inoculation at an interval of 15 days and continued till the final finished compost obtained mycellialdry weight, pH, electrical conductivity and growth rate of the composts were analyzed after 30 and 90 days of incubation. Whereas, organic carbon, CO_2 evolution, C:N ratio, NPK, micronutrients including Mn, Fe, Zn, Cu were determined from the composts after 90 days of incubation period.

Population density/CFU of the decomposer is evaluated in terms of their bacterial, fungal and actinomycetes population. A progressively increases in bacterial population observed in sugarcane trash as the days of incubation increases. It showed 24.72, 42.02, 53.85, 87.17, 72.79 and 90.08 CFU/ 105 g-1 for 15, 30, 45, 60, 75 and 90 days, respectively in sugarcane trash. However this increasing trend also noticed at higher rate in T3 (*T. viride* 20 g/kg), followed T7, T11 and T2. The treatment T5 noted lower bacterial population. In compareason between days of incubation, the bacterial population was found more increasing trend in the treatment of T3 for 45 to 90 days pigeon pea straw reported more content of bacterial population.

CONCLUSION

Among the different treatments of decomposers of crop residues, the pigeon pea straw decomposed with treatment T_3 (T. viride 20 g/kg) shown more significant effect on biological properties. Population density of bacteria found increased in this treatment with pigeon pea crop residues.

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