

## Influence of microbial decomposers on quality of compost using crop residues on major nutrient content

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**ABSTRACT:** The experiment was carried out on "Influence of microbial decomposers on quality of compost using 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 its 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<sub>2</sub> evolution 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 organisms 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 trophic groups in an ecosystem. This transfer of energy from one trophic 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 process 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.

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, “Influence of microbial decomposer on quality of compost using crop residues” were conducted at College of Agriculture, Latur and the results obtained are interpreted.

**Effect on nitrogen, phosphorus and potassium contents**

Table highlights N, P and K content of the test crop residues. It shown, significantly affected due to inoculation with different decomposers. In both the crop residues tested nitrogen percentage was found comparatively high than the P and K. The maximum N, P and K content were recorded with pigeon pea residues (M<sub>2</sub>) with values 1.37, 0.94 and 0.83 percent, respectively as compared to sugarcane trash i.e., 1.26, 0.82 and 0.82 per cent, respectively.

Among the composers, significant effect on N, P and K content of crop residues were recorded. The

decomposers recorded high N, P and K content in the range of 1.29 to 1.37, 0.84 to 0.96 and 0.76 to 0.91 per cent, respectively. However, maximum N (1.37), P (0.96) and K (0.91) contents were recorded with treatment T3 (*T.viride*@20g/kg) than the other treatments. It was found at par with the treatments T7, T11, and T15. While, minimum N, P and K content was recorded with treatment T10.

**Table 1**  
Changes in per cent nitrogen, phosphorous and potassium content in decomposed material as influenced by decomposer species and crop residues

Crop residues (M)	90 days		
	N (%)	P (%)	K (%)
Sugarcane Trash - M1	1.26	0.82	0.82
Pigeon pea straw - M2	1.37	0.94	0.83
SE ±	0.003	0.003	0.004
CD at 5 %	0.01	0.01	0.01
Decomposers with Quantity (T)			
T <sub>1</sub> - <i>Trichoderma viride</i> @ 10g/kg	1.30	0.86	0.80
T <sub>2</sub> - <i>T. viride</i> @15g/kg	1.30	0.87	0.81
T <sub>3</sub> - <i>T. viride</i> @20g/kg	1.37	0.96	0.91
T <sub>4</sub> - <i>T. viride</i> @25g/kg	1.31	0.87	0.80
T <sub>5</sub> - <i>Trichoderma harzianum</i> @10g/kg	1.31	0.86	0.78
T <sub>6</sub> - <i>T. harzianum</i> @ 15g/kg	1.31	0.87	0.79
T <sub>7</sub> - <i>T. harzianum</i> @20g/kg	1.36	0.95	0.90
T <sub>8</sub> - <i>T. harzianum</i> @25g/kg	1.30	0.86	0.80
T <sub>9</sub> - <i>Pseudomonas ssp.</i> @10g/kg	1.31	0.85	0.81
T <sub>10</sub> - <i>Pseudomonas ssp.</i> @15g/kg	1.29	0.84	0.76
T <sub>11</sub> - <i>Pseudomonas ssp.</i> @20g/kg	1.36	0.95	0.90
T <sub>12</sub> - <i>Pseudomonas ssp.</i> @25g/kg	1.29	0.85	0.79
T <sub>13</sub> - Commercial composting culture @10g/kg	1.31	0.85	0.82
T <sub>14</sub> - C. C. C. @15g/kg	1.30	0.86	0.80
T <sub>15</sub> - C. C. C. @20g/kg	1.36	0.95	0.90
T <sub>16</sub> - C. C. C.@ 25g/kg	1.31	0.85	0.82
SE ±	0.01	0.01	0.01
CD at 5%	0.02	0.02	0.03
Interactions (M x T)			
SE ±	0.01	0.01	0.02
CD at 5%	0.03	0.03	0.04

**Interaction effects of the test crop residues × decomposers and their rate of application were found significant in respect of N, P and K content.**

**Nitrogen content**

The data revealed that the interaction effect between crop residues and decomposers with their rate of application influenced significantly the nitrogen content. The interaction of M1 × T recorded nitrogen in the range of 1.25 to 1.29 percent. However, significantly highest nitrogen content was recorded

with the treatment combination  $M_1 T_3$  (1.29%) followed by  $M_1 T_{17}$ ,  $M_1 T_{11}$  and  $M_1 T_{15}$  (each 1.28%). The nitrogen content increased with mean value 1.26 per cent.

The interaction of  $M_2 \times T$  recorded nitrogen content in the range of 1.33 to 1.44 percent. However, significantly highest nitrogen content was recorded with the treatment combination  $M_2 T_3$  (1.44%) followed by  $M_2 T_{17}$ ,  $M_2 T_{11}$  and  $M_2 T_{15}$  (each 1.43 %). P content increased with mean value 1.37 per cent.

### Phosphorus content

The data indicated that all the treatment interactions of crop residues and decomposers with their rate of application significantly influenced the phosphorus content as that of nitrogen content. The interaction of  $M_1 \times T$  recorded phosphorus content in the range of 0.76 to 0.95 percent. However, significantly highest phosphorus content was recorded with the treatment combination  $M_1 T_3$  (0.95%) and at par with treatment combinations  $M_1 T_{17}$ ,  $M_1 T_{11}$  and  $M_1 T_{15}$  (each 0.94). The P content recorded with mean value 0.82.

The interaction of  $M_2 \times T$  recorded phosphorus content in the range of 0.93 to 0.97 percent. While, significantly highest phosphorus content was recorded with the treatment combination  $M_2 T_3$  (0.97%) followed by  $M_2 T_{17}$ ,  $M_2 T_{11}$  and  $M_2 T_{15}$  (each

0.96%). The lower P content was recorded with treatment combination  $M_2 T_9$ .

### Potassium content

The interaction  $M_1 \times T$  recorded potassium content in the range of 0.77 to 0.90 percent. However, significantly highest potassium content was recorded with the treatment combination  $M_1 T_3$  (0.90%) followed by  $M_1 T_{17}$ ,  $M_1 T_{11}$  and  $M_1 T_{15}$  (each 0.89%) and all of which were at par. The lowest K content was obtained with treatment combination  $M_1 T_9$ .

The interaction of  $M_2 \times T$  recorded potassium content in the range of 0.74 to 0.91 percent. However, significantly highest potassium was recorded with the treatment combination  $M_2 T_3$  (0.91%) followed by  $M_2 T_{17}$ ,  $M_2 T_{11}$  and  $M_2 T_{15}$  (each 0.90%) over rest of the treatment combinations.

Shaikh (2004) studied the effect of different of composting methods from agricultural wastes and its effects on nitrogen,  $P_2O_5$  and  $K_2O$  for 60 days. The result indicated that NADEP method of decomposing found more superior over other methods in relation to N, P and K contents. The data obtained from noticed that potassium content was significantly influenced with the interactions of crop residues  $\times$  decomposers and their rate of application.

**Table 2**  
Interaction effect of crop residues and decomposer with their rate of application on Nitrogen content, Phosphorus content and Potassium content

Decomposer Level (T)	Nitrogen content		Phosphorus content		Potassium content	
	$M_1$	$M_2$	$M_1$	$M_2$	$M_1$	$M_2$
T1 - <i>Trichoderma viride</i> @10g/kg	1.25	1.34	0.80	0.93	0.80	0.80
T2 - <i>T. viride</i> @15g/kg	1.26	1.34	0.80	0.93	0.80	0.81
T3 - <i>T. viride</i> @20g/kg	1.29	1.44	0.95	0.97	0.90	0.91
T4 - <i>T. viride</i> @25g/kg	1.25	1.38	0.80	0.93	0.81	0.79
T5 - <i>Trichoderma harzianum</i> @ 10g/kg	1.25	1.37	0.80	0.93	0.78	0.77
T6 - <i>T. harzianum</i> @15g/kg	1.26	1.36	0.80	0.93	0.79	0.78
T7 - <i>T. harzianum</i> @ 20g/kg	1.28	1.43	0.94	0.96	0.89	0.90
T8 - <i>T. harzianum</i> @25g/kg	1.25	1.33	0.78	0.93	0.80	0.80
T9 - <i>Pseudomonas ssp.</i> @10g/kg	1.26	1.36	0.75	0.92	0.77	0.85
T10 - <i>Pseudomonas ssp.</i> @15g/kg	1.25	1.34	0.76	0.93	0.78	0.74
T11 - <i>Pseudomonas ssp.</i> @20g/kg	1.28	1.43	0.94	0.96	0.89	0.90
T12 - <i>Pseudomonas ssp.</i> @25g/kg	1.25	1.33	0.77	0.93	0.80	0.77
T13 - Commercial composting culture @10g/kg	1.25	1.36	0.77	0.93	0.79	0.85
T14 - C. C. C. @15g/kg	1.25	1.35	0.78	0.93	0.78	0.83
T15 - C. C. C. @20g/kg	1.28	1.43	0.94	0.96	0.89	0.90
T16 - C. C. C. @25g/kg	1.25	1.36	0.77	0.93	0.83	0.80
SE±	0.01	0.01	0.02			
CD @ 5%	0.03	0.03	0.04			

## SUMMARY AND CONCLUSION

The research experiment entitled Influence of Microbial Decomposers on Quality of Compost Using 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<sub>2</sub> evolution, C:N ratio, NPK, micronutrients including Mn, Fe, Zn, Cu were determined from the composts after 90 days of incubation period.

Pigeon pea straw crop residues shown a more percent of nitrogen (1.37%), phosphorous (0.94%) and potassium (0.83%) than the sugarcane trash i.e. 1.26, 0.82 and 0.82 percent of N, P and K, respectively. Incomparision between different decomposers, treatment with *T. viride* 25g/kg recorded the highest score of N (1.37%), P (0.96%) and K (0.91%). Whereas, treatments T<sub>1</sub>, T<sub>8</sub>, T<sub>10</sub> and T<sub>12</sub> reported lower nitrogen content i.e. 1.29%. Phosphorous content was noticed minimum in T9 and T10 decomposers i.e. 0.84%. Whereas, Potassium was found as lowest as 0.76 percent in T<sub>11</sub> (*Pseudomonas spp* 20g/kg) decomposer. When the data was compared between the crop residues with decomposers the rate of nitrogen, phosphorous and potassium percent were found more in pigeon pea straw in T<sub>3</sub> decomposers.

## CONCLUSION

In a nutshell the following conclusion are drawn

1. There was no significant difference noticed between sugarcane trash and pigeon pea

straw decomposed in terms of their pH, electrical conductivity, organic carbon, CO<sub>2</sub> evolution, C:N ratio, NPK and micronutrient contents like Mn, Zn, Fe and Cu.

2. Among the different treatments of decomposers of crop residues, the pigeon pea straw decomposed with treatment T<sub>3</sub> (*T. viride* 20 g/kg) shown more significant effect on biological properties. Population density of bacteria, fungi and actinomycetes were found increased in this treatment with pigeon pea crop residues. Mycellial dry weight (mg) was higher in this treatment. Whereas T<sub>3</sub> treatment also found positive effect on increased growth rate in both the crop residues decomposers.

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