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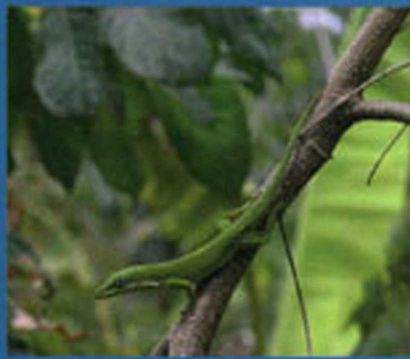

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EVALUATION OF QUALITY OF MUNICIPAL AND AGRICULTURAL WASTE UNDER AEROBIC AND ANAEROBIC COMPOSTING

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ABSTRACT

Studies were conducted at Regional Research Station, College of Agriculture, Wadura, SKUAST-K, to evaluate the quality of municipal and agricultural waste under aerobic and anaerobic composting. Composting methods with enrichment techniques were adopted with 2 methods (Aerobic & Anaerobic) and 7 treatments in each method. The samples of the aerobic were drawn after 30, 60, 90 and 120 days after composting and in anaerobic compost samples were drawn after 150 days of compost. Effect of bio-inoculum (pleurotus sajorcaju), chemical amendments (2% P_2O_5 & 1% N) and method of composting on OC, COD, CEC, C/N ratio, PH, EC and total nutrient status during composting was determined in Aerobic and Anaerobic composts. The OC, COD, C/N ratio decreased significantly during maturation of the compost irrespective of treatments and method of composting. High OC was recorded in 100 % USW compost in both the methods. It ranged from 20.15 % to 24.0 % in aerobic matured compost and from 21.5 to 23.25 in anaerobic matured compost. 100 % AW compost had lower C:N ratio(18.65 and 17.47 in aerobic and anaerobic composts, respectively) than 100 % USW compost (19.20 to 18.02 in aerobic and anaerobic compost, respectively). Whereas the Nitrogen content was increased from 0.78 % to 1.29 % in 100 % urban waste compost and 0.75 % to 1.23 % in 100 % agricultural compost. Rock phosphate treated composts in both methods enhanced the total P content with maximum of 0.89 % in both aerobic and anaerobic composts. There was gradual increase of total K content from initial status of 0.44 to 0.64 %.

INTRODUCTION

The disposal of ever increasing amounts of urban wastes and agricultural wastes is becoming a serious problem in India. Due to energy crisis, prohibitive cost of fertilizers and poor purchasing power of marginal and small farmers, it is imperative to develop strategy to use wastes to its maximum potential with proper technology to meet the shortage of fertilizers and for improving soil fertility. The paper aims to standardize the methods of composting for the production of organic manures of high quality.

MATERIALS AND METHODS

Studies were conducted at Regional Research Station, College of Agriculture, Wadura, SKUAST-K, to evaluate the quality of compost under aerobic and anaerobic composting. Composting methods with enrichment techniques were adopted with 2 methods (Aerobic & Anaerobic) and 7 treatments in each method. The chopped urban wastes and agricultural wastes (combination of cereals, legumes and oil seeds) were used for rapid composting technique by inoculating with pleurotus sajorcaju (1 kg t-1 of waste) and Rock phosphate (2%P2O5) and Urea (1% N) as mineral additives on material dry weight basis. Presampling of urban wastes and agricultural wastes was done for analysis of chemical properties. After 120 & 150 days of decomposition of aerobic and anaerobic composts (for every monthly turnings aerobic compost samples were collected intermittently) samples were collected, dried and ground to pass through 1 mm sieve and used for chemical analysis. Carbon content was determined as wet digestion method by Walkley and Black as described by Jackson 1973, CEC by Bower method Richards, 1954). Total N content in the compost samples was determined by Micro jehldal method. Total P & K content was extracted by digestion with diacid and estimated the total P colorimetrically as Vanado-

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molybdophosphophosphate yellow colour complex and K by using Flame photometer (Jackson, 1973). PH & EC was determined in 1:50 waste water extract after 30 minutes stirring by using digital pH and EC meters. The treatments involved during composting are:

T1 : 100 % Agricultural Waste + Microbe + Urea + Rock Phosphate + Cow dung
T2 : 100% Urban Solid Waste + Microbe + Urea + Rock Phosphate + Cow dung
T3 : 50 % Urban Solid Waste + 50 % Agricultural waste + Microbe + Urea + Rock Phosphate + Cow dung
T4 : 25 % Urban Solid Waste + 75 % Agricultural Wastes + Microbe + Urea +Rock Phosphate + Cow dung
T5 : 75 % Urban Solid Waste + 25 % Agricultural waste + Microbe + Urea + Rock Phosphate + Cow dung
T6 : 100 % Agricultural Waste + Microbe + Cow dung
T7 : 100 % Urban Solid Waste + Microbe + Cow dung

RESULTS AND DISCUSSION

Physico-Chemical Properties of Raw Materials used for Composting

The chemical characteristics of urban solid wastes and agricultural wastes used for the preparation of compost were determined to know the initial nutrient status of raw materials (Table 1) (Jackson, 1973). The two organic solid wastes were slightly alkaline to alkaline in reaction. The urban solid waste had the highest pH of 8.9 and agricultural wastes had 7.9 pH.
The electrical conductivity of 1:50 waste water extract was found to be highest in urban solid waste (0.49 dS m-1) than agricultural waste (0.46 dS m-1). The organic carbon in USW was 33.50% whereas it was 35.10 % in agricultural waste. Comparatively USW had less COD (360 mg kg-1) than AW (450 mg kg-1). The C: N ratio of Agricultural Waste was maximum (46.80) followed by Urban Solid Waste (42.94). The total N content of USW was 0.78 % whereas it was 0.75 % in AW. The total P was more in Agricultural Waste (0.44 %) than Urban Solid Waste (0.51 %). The total K content of USW was 0.42 % whereas AW contained 0.47 % of total K. Effect of bio-inoculum (*pleurotus sajorcaju*), chemical amendments (2% P_2O_5 & 1% N) and method of composting on OC, COD, CEC, C/N ratio, PH, EC and total nutrient status during composting was determined in Aerobic and Anaerobic composts..The OC, COD, C/N ratio decreased significantly during maturation of the compost irrespective of treatments and method of composting (Jeevan rao *et al*., 2007).

Table 1. Initial Characteristics of Urban Solid Wastes and Agricultural Wastes

Character	Urban Solid Waste	Agricultural waste
Chemical properties		
pH	8.9	7.9
EC (dS/m)	0.49	0.46
OC (%)	33.50	35.10
COD (mg/kg)	360	450
C:N ratio	42.94	46.80
CEC (mol/kg)	38	40
Total Nutrients (%)		
Total N	0.78	0.75
Total P	0.51	0.44
Total K	0.42	0.47

C:N ratio is one of the most important parameters that determines the extent of composting and degree of compost maturity. Irrespective of the materials used for composting, all the treatments attained drastic decrease of C:N ratio in final product compared to initial raw materials. C:N ratio of the composted materials narrowed down with the advancement of the period of decomposition. It was reported that the C:N ratio narrow down as nitrogen remain in the system, while some of the C is released as CO_2 (Sadasivam and Manickam, 1993). Further N fixing bacteria indirectly help in decreasing C:N ratio by making more N available from added Organic Matter (Rasal *et al* 1988., Shinde *et al*, 1992). In matured composts the reduction in C:N ratio was significant in all the treatments compared to initial sample. Comparatively 100 % AW compost had lower C:N ratio(18.65 and 17.47 in aerobic and anaerobic composts, respectively) than 100 % USW compost (19.20 to 18.02 in aerobic and anaerobic compost, respectively). High OC was recorded in 100 % USW compost in both the methods. It ranged from 20.15 % to 24.0 % in aerobic matured compost and from 21.5 to 23.25 in anaerobic matured compost.

Between the different types of composts (urban and agricultural wastes) USW compost showed significantly higher OC (24 & 23.25 % in aerobic and anaerobic composts) over agricultural waste composts (20.15 & 21.50 % in aerobic and anaerobic composts). The COD of the matured compost ranged from 142 to 156 mg kg-1 in aerobic method and 146 to 159 mg kg-1 in anaerobic compost in different treatments. Within the treatments there was no significant difference in total COD. Slight increase in COD status in USW compost than AW compost CEC was significantly increased with the passage of time in both the methods. CEC also increased at the end of the composting period. CEC was increased to maximum value of 69 c mol/kg from a initial value of 38 c mol/kg in 100 % AW compost. It is one of the indices for compost maturity (Jeevan rao *et al*., 2007). The initial pH values of agricultural wastes and urban wastes were ranged from 7.8 to 8.9, respectively, and they showed decrease with the advancement in period of composting from 30 days to 120 days in all the treatments of aerobic compost. Aerobic compost had pH value ranged from 7.4 (T1) to 8.1 (T2). In case of anaerobic method, matured compost (150 days) had the pH value of 7.5 (T1) to 8.2 (T2). Slightly more pH was observed in 100 % USW compost than 100 % agricultural waste compost The Electrical Conductivity in matured aerobic compost ranged from 0.32to0.45 dSm- 1, whereas in anaerobic compost it was varied from 0.36 to 0.46 dSm-1 Significantly high EC was recorded in treatments with chemical additives than non amended treatments. Electrical Conductivity of the decomposing material was maximum after 30 days and then decreased up to 120 days in aerobic compost. Due to high initial microbial activity and mineralization, soluble salt content will be high and hence high EC in initial stages. In later stages, as humification proceeds the humic fractions might have complexed with the soluble salts and then decreasing the amount of mobile free ions (Jeevan rao *et al*, 2007)

Nutrient Status

A significant difference in total nitrogen content was observed in composts with chemical additives (1.09 to 1.29 %) when

Table 2. Changes in Total Nitrogen (%) during Aerobic and Anaerobic Composting

Treatment	Aerobic Compost					Anaerobic Compost	
	0 days	30 days	60 days	90 days	120 days	0 days	150 days
T1	0.79	0.82	0.86	0.92	1.08	0.79	1.23
T2	0.82	0.87	0.95	1.05	1.25	0.82	1.29
T3	0.79	0.84	0.87	0.96	1.09	0.79	1.19
T4	0.78	0.85	0.87	0.94	1.13	0.78	1.24
T5	0.80	0.85	0.88	0.97	1.12	0.80	1.22
T6	0.75	0.79	0.81	0.86	0.85	0.75	0.89
T7	0.78	0.80	0.84	0.87	0.89	0.78	0.93
SE m±	0.029	0.032	0.032	0.041	0.037	0.029	0.039
CD (0.05%)	0.068	0.069	0.073	0.081	0.081	0.068	0.089

Table 3. Changes in Total Phosphorus (%) during Aerobic and Anaerobic Composting

Treatment	Aerobic Compost					Anaerobic Compost	
	0 days	30 days	60 days	90 days	120 days	0 days	150 days
T1	0.47	0.55	0.64	0.71	0.81	0.47	0.84
T2	0.55	0.59	0.68	0.75	0.89	0.55	0.89
T3	0.52	0.58	0.66	0.74	0.86	0.52	0.86
T4	0.54	0.58	0.67	0.75	0.84	0.54	0.87
T5	0.53	0.49	0.58	0.62	0.86	0.53	0.86
T6	0.44	0.47	0.49	0.50	0.51	0.44	0.52
T7	0.52	0.53	0.54	0.56	0.57	0.52	0.58
SE m±	0.016	0.018	0.023	0.028	0.037	0.016	0.034
CD (0.05%)	0.039	0.42	0.051	0.059	0.078	0.039	0.076

Table 4. Changes in Total Potassium (%) during Aerobic and Anaerobic Composting

Treatment	Aerobic Compost					Anaerobic Compost	
	0 days	30 days	60 days	90 days	120 days	0 days	150 days
T1	0.42	0.45	0.50	0.52	0.59	0.42	0.59
T2	0.47	0.47	0.48	0.50	0.60	0.47	0.64
T3	0.45	0.46	0.48	0.51	0.59	0.45	0.58
T4	0.45	0.45	0.47	0.51	0.58	0.45	0.61
T5	0.45	0.46	0.46	0.50	0.57	0.45	0.60
T6	0.42	0.46	0.48	0.52	0.55	0.42	0.58
T7	0.47	0.49	0.53	0.55	0.59	0.47	0.56
SE m±	0.019	0.022	0.029	0.031	0.029	0.019	0.023
CD (0.05%)	0.039	0.041	0.049	0.059	0.056	0.039	0.056

compare to composts without chemical additives (0.85 to 0.89 %). The total nitrogen content was significantly more in anaerobic compost (Table 2) than aerobic compost this may be due to minimum losses accounted in anaerobic compost. Maximum total nitrogen content of 1.29 % was found in 100 % USW compost treated with chemical additives and bio-inoculum while a minimum of 0.85 % was recorded in 100 % agricultural waste compost without addition of chemical amendments. The apparent increase in total nutrient content in compost is not only due to enrichment but also due to the reduction in weight because of decomposition (Jeevan rao *et al*., 2007). Results showed that Rock Phosphate charged compost in both the methods enhanced the content of total P in the final product when compared to untreated compost (Table. 3), this may be attributed due to greater mobilization of P from Rock Phosphate. A significant difference in total P content was observed in composts enriched with Rock Phosphate (0.81 to 0.89% and 0.84 to 0.89 % in aerobic and anaerobic methods, respectively) and composts without Rock Phosphate (0.51 to 0.57 % and 0.52 to 0.58 % in aerobic and anaerobic methods, respectively) (Jeevan rao *et al*., 2007). The total potassium content was ranged from 0.55 to 0.60 % in aerobic compost and it was varied from 0.56 to 0.64 % in anaerobic compost. Maximum total potassium content of 0.64 % was found in100 % AW anaerobic compost while a minimum of 0.55 % was recorded in T6 (aerobic compost). There was a gradual increase of Total K from initial waste to final matured compost (Table 4).

Conclusion

Method of composting also influenced the nutrient status of compost, bio-inoculum improved the decomposition for production of mature and quality compost. The OC, COD, C/N ratio decreased significantly during maturation of the compost irrespective of treatments and method of composting. Rock Phosphate charged compost in both the methods enhanced the content of total P in the final product when compared to untreated compost. Aerobic compost is preferred in a lesser time and to get rid of the bad odour of degrading organic wastes. With regard to the nutrient conservation, nutrient losses are minimum in anaerobic compost.

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