CONTEMPORARY RESEARCH IN INDIA
ISSN 2231 - 2137

PREPARATION AND CHARACTERIZATION OF COMPOST AND ENRICHED FYM FOR THEIR QUALITY

S. S. Kolape, A. S. Tathe and V. M. Amrutsagar

Division of Soil Science and Agricultural Chemistry, College of Agriculture, Karad, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra (India)

Received: 17/08/2018	Edited: 26/08/2018	Accepted: 31/08/2018

Abstract: *Three composts were prepared from wheat straw, sugarcane trash and bajra residue and three enriched FYM from Combination of two byre wastes (Jowar, bajra and maize) and cow dung at ratio of 1:1:3 by pit method . The C/N ratio was monitored at for each interval of 0, 30, 60, 90 and 120 days, when the C/N ratio reached below 20 it was considered as matured compost. The composts and enriched FYM samples (after 120 days period) were analyzed for physico-chemical properties, nutrient content, and quality parameters by using standard methods. The C/N ratio of all the composts and enriched FYM was decreased with advance decomposition from 30 days to 120 days irrespective of compost mixture. Wheat straw compost and sugarcane trash compost prepared by pit method showed good quality in respect of all twelve quality parameters under study and bajra straw compost showed poor quality for CEC, NH_4-N/NO_3-N ratio and WHC. The En-FYM-1 prepared from byre wastes of jowar and maize by pit method have good quality for all twelve quality parameters under study while, En-FYM-2 (jowar and bajra byre wastes) was poor for EC and NH_4-N/NO_3-N ratio and En-FYM-3 (bajra and maize byre wastes) poor for EC only. The nutrient content of N, P, K and S in compost and En-FYM prepared from cereals crops wastes were nearly equal.*

Key words: *Composts, enriched FYM preparation, quality parameters, nutrients status.*

In today's trend of farming, agronomic utilization of organic wastes such as agricultural, industrial and domestic wastes has been increased. However, application of these organic wastes to soil is not always beneficial to crop growth. Maturity of organic manures critically affects their successful utilization in agriculture (Kalaiselvi and Ramasamy, 1996). The preparation and use of different grades of composts has created a need for assessing the quality of the composts/FYM. A mature compost is hygienic and humified so that it improves soils and nourishes plant. The present investigation was carried out to analyze them for quality parameters and nutrients status at 120 days decomposition period.

Materials and Methods

Three composts were prepared from wheat straw, sugarcane trash and *bajra* residue and three enriched FYM from Combination of two byre wastes (*Jowar, bajra* and *maize*) and cow dung at ratio of 1:1:3 by pit method as per the method developed by M.P.K.V., Rahuri (Anonymous, 2003) having size 1.0 x 1.0 x 0.60 meter. The C/N ratio was monitored at for each interval of 0, 30, 60, 90 and 120 days, when the C/N ratio reached below 20 it was considered as matured compost. The pits of such composts were opened and the sample was taken from middle of pit at 30 cm depth. After air drying and oven drying at 70^0C, samples were powdered in wooden mortar and pestle and used for further investigation. The composts and enriched FYM samples (after 120 days period) were analyzed for physico-chemical properties, nutrients content, quality parameters viz., colour, odour, temperature, water holding capacity, pH, EC, cation exchange capacity, C/N ratio, water soluble organic carbon, and NH_4^+-N/NO_3^--N ratio by using standard methods and were compared with standard quality parameters proposed by different scientists (Table 1).

Results and Discussion

Changes in C:N ratio during decomposition of composts and enriched FYM

composts

The composts viz., wheat straw compost (WSC), sugarcane trash compost (STC) and *bajra* straw compost (BSC) showed the decrease in C/N ratio with advance of decomposition. The C/N ratio was steadily decreased from 30 days to 120 days irrespective of compost mixture. At 120 days decomposition period the lowest C/N ratio values for WSC, STC and BSC were 16.2, 20.0 and 19.9, respectively might be due to accelerated decomposition rate by use of decomposing culture and enrichment with N and P resulted into proliferation of microbial population. Among the composts the lowest C/N ratio was in the order of WSC< BSC< STC at the end of 120 days of decomposition period depending upon lignin like material left during the mineralization. In general, all composts showed good quality in respect of C/N ratio. Similar observations during decomposition of composts also reported by Shinde and Rote (1983), Bhanawase et al. (1994), Kalaiselvi and Ramasamy (1996) and Manna et al. (2000).

Enriched FYM

The C/N ratio was steadily decreased with advance decomposition and it was attended maturity at 120 days in all the En-FYM samples. At 120 days decomposition period the lowest C/N ratio values for En-FYM-1, En-FYM-2 and En-FYM-3 were 17.3, 19.5 and 19.1, respectively may be due to proliferated microbial population resulted from enrichment of material with N, P and decomposing culture. The lowest C/N ratio was in the order of En-FYM-1< En-FYM-3 < En-FYM-2 at 120 days decomposition period. The higher C/N ratio in En-FYM-2 and 3 might be due to content of lignin in *bajra* byre wastes. In general, all enriched FYM showed good quality in respect to C/N ratio.

Further it was noticed that there was not much difference in C/N ratio of compost and enriched FYM might be due to use of cereal crop residues for their preparation and enrichment with N, P and decomposing culture have equally influenced the same conditions during decomposition.

Quality Parameters

composts

The results revealed that compost viz., WSC, STC and BSC recorded temperature 32^0C, 37^0C and 41^0C respectively with mean value of 36.7^0C, indicated that the mesophilic phase of decomposition. The WSC exhibited earthy odour, while STC and BSC neither recorded earthy nor noxious odour. The colour of air-dry WSC and STC composts was dark brown (10 YR 3/3) while BSC was brown (10 YR 4/3). The water holding capacity of WSC, STC and BSC was 182.8, 171.6 and 200.7 per cent, respectively, while ash content was 17.9, 14.1 and 12.3 per cent respectively. The pH (1:10) of composts viz., WSC, STC and BSC was found to be 7.34, 7.65 and 6.92 respectively indicated WSC and STC were neutral to slightly alkaline in reaction but BSC showed slightly acidic pH might be due to development of anaerobic condition in the pit.

The EC of WSC, STC and BSC was 1.45, 1.31 and 1.40 dSm^{-1}, respectively, while the water soluble organic carbon (WSOC) content found to be 0.453, 0.399 and 0.446 per cent respectively. The low content of WSOC might be associated with microbial utilization of low molecular weight water soluble compounds like peptide, amino acids, fatty acids, phenols and aliphatic acid and converted into humus like product during decomposition (Chanyasak, et al. 1982). Cation exchange capacity of WSC, STC and BSC was 112.5, 77.5 and 68.3 C mol P^+ kg^{-1}respectively indicated that the accumulation of materials bearing a negative charge such as lignin derived products, carboxy or phenolic hydroxy groups (Harda and Inoko, 1980). The ammonical nitrogen (NH_4^+-N) content in WSC, STC and BSC was found to be 104, 91 and 131 $mgkg^{-1}$, respectively while nitrate nitrogen (NO_3^--N) content in respective compost was 680, 577 and 485 $mgkg^{-1}$.The higher concentration of NO_3^--N than NH_4^+-N in later stage of mesophilic phase was enhanced by rate of

nitrification. Similar results also reported by Nandi et al. (1996) and Manna et al. (2000). The NH_4^+-N/NO_3^-N ratio of the WSC, STC and BSC was found to be 0.153, 0.158 and 0.270, respectively at 120 days decomposition. At later stages, the rate of nitrification process was enhanced as result of mineralization of organic nitrogen, the NO_3^--N content was increased and resulted in narrow ratios NH_4^+-N/NO_3^-N (Bernal et al., 1998). The WSC and STC composts were found to be good quality in respect of chemical indices namely pH, EC, WSOC, C/N ratio, CEC, NH_4^+-N and NH_4^+-N/ NO_3^--N ratio, while BSC was poor in respect of CEC and NH_4^+-N/ NO_3^--N ratio.

Enriched FYM

At 120 days period of decomposition, the enriched FYM namely En-FYM-1, 2 and 3 recorded maximum temperatures 32^0C, 39^0C and 36^0C respectively, indicated mesophilic phase of decomposition. An En-FYM-1 and 3 were earthy in odour while En-FYM-2 experienced neither earthy nor noxious odour at later stage of decomposition. The colour of all enriched FYM found to be dark brown (10 VR 3/3) as result it indicated that all enriched FYM found to be mature by appearance. The water holding capacity of enriched FYM-1, 2 and 3 was 190.2, 178.6 and 189.6 per cent, respectively. The ash content in En-FYM-1, En-FYM-2 and En-FYM-3 was 19.8, 18.1 and 15.3 per cent, respectively. The ash content in an enriched FYM was higher than compost because of higher proportion of cattle dung used during preparation.

All enriched FYM were found to be good quality in respect of physical indices viz., temperature, odour, colour and water holding capacity as per the standards reported by Kalaiselvi and Ramasamy (1996) and Subramanian (2002).

The pH of En-FYM-1, 2 and 3 was 7.61, 7.27 and 7.89 respectively. The EC of En-FYM-1, 2 and 3 was 1.48, 1.81 and 1.57 dSm^{-1}. The electrical conductivity of En-FYM-2 and 3 was higher as compared to En-FYM-1 might be because of formation of more soluble solids during decomposition. Similarly, EC of enriched FYM was higher than compost might be because of application of higher proportion of cattle dung with higher ash content. The water soluble organic carbon (WSOC) content in En-FYM-1, 2 and 3 was 0.464, 0.672 and 0.510 per cent, respectively. The low values of WSOC in compost and enriched FYM might be due to application of decomposing culture and enrichment with N and P in early stage of decomposition, proliferated microbes utilized the low molecular weight water soluble compounds. The cation exchange capacity (CEC) of En-FYM-1, 2 and 3 was 102.5, 70.0 and 98.6 Cmol P^+ kg^{-1}, indicated that En-FYM-1 was found to be more stable and mature than other two. Ammonical N content in En-FYM-1, 2 and 3 was found to be 78, 126 and 71 $mgkg^{-1}$, respectively while nitrate-N content was to the tune of 492, 361 and 458 $mgkg^{-1}$ at 120 days decomposition period. The higher concentration of NO_3^-- N than NH_4^+- N in later stage of mesophilic phase of decomposition was due to enhanced rate of nitrification. Similar results also reported by Nandi et al. (1996) and Manna et al. (2000). The NH_4^+- N/ NO_3^-- N ratio of enriched FYM-1, 2 and 3 was 0.159, 0.349 and 0.155, respectively. The narrow ratio in En-FYM-1 and 3 might be due to higher content of NO_3^--N in these two enriched FYM. The En-FYM-1 was good quality in respect of chemical indices viz., pH, EC, WSOC, C/N ratio, CEC, NH_4^+-N and NH_4^+-N/ NO_3^-- N ratio, while En-FYM-2 was poor due to EC and NH_4^+-N/ NO_3^-- N ratio and En-FYM-3 in respect of EC only as compared to the values proposed by Kalaiselvi and Ramasamy (1996), Bernal et al. (1998) and Jothimani and Maheswari (2002).

Nutrient status

Composts

The total N content in WSC, STC and BSC was 1.51, 1.35 and 1.29 per cent respectively. The higher content of nitrogen was due to enrichment with urea and single super phosphate and decomposing culture. Enhanced microbial N-mineralization of cereal crop residues and released nitrogen at the end of decomposition period in all composts. Total P content in WSC, STC and BSC

was 0.46, 0.39 and 0.40 per cent respectively and total K content was 0.90, 0.85 and 1.00 per cent respectively. The higher K contained in BSC probably due to higher K content in *bajra* residue. Similarly more or less trend was observed in total S content as that of P content. The total S content in WSC, STC and BSC was to the tune of 0.48, 0.41 and 0.47 per cent respectively. These results are in conformity with results reported by Shinde and Rote (1983), Bhanawase et al. (1994) and Manna et al. (2000) for various cereal crop residues, enriched with N and P additives and use of decomposing culture. The data pertaining to micronutrient cations revealed that, the average Fe, Mn, Zn and Cu content in these compost were 7473, 583, 241 and 110 $mgkg^{-1}$, respectively. The WSC and STC recorded higher content of micronutrient cations than that of BSC. This might be attributed to higher degree of humification and chelation of metallic cations. Similar results also reported by Vasanthi and Kumaraswamy (1999), Srikanth et al. (2000) and Ganguly and Singh (2004).

Enriched FYM

The average content of total N, P, K and S in an enriched FYM was 1.38, 0.45, 0.87 and 0.48 per cent respectively. The increase in N and P content may be because of enrichment with urea, single super phosphate and use of decomposing culture accelerated rate of degradation through cellulose decomposers and synergetic effect of P for increment of N in end product. En-FYM-1 recorded higher content of total N (1.48 %) followed by En-FYM-3 (1.38 %) and lower in En-FYM-2 (1.27 %). The content of total K and S was associated with concentration in cereal crop byre waste used for preparation. Similar results also reported by Gaur (1994) and Patil (1994) for N, P, K and S. An average concentration of micronutrient cations viz., total Fe, Mn, Zn and Cu in enriched FYM were 6713, 668, 299 and 134 $\mu g\ g^{-1}$ respectively. In general, Fe content was highest while lowest in Cu content in all the En-FYM. The En-FYM-1 prepared from byre wastes of *jowar* and maize had higher content of Fe, Mn and Zn than that of En-FYM- 2 and 3 indicated that the accumulation of materials bearing a negative charge such as lignin derived products chelated the metallic cations. The higher concentration of these micronutrients in FYM also reported by Patil (1994) and Ganguly and Singh (2004).

Conclusions

Among the compost, WSC showed lowest C/N ratio (16.2) followed by BSC (19.9) and STC (20.0) at the end of 120 days composting period indicated all compost have good quality for C/N ratio. All composts found to be mature and good quality for different physical and chemical parameters except BSC, which showed poor quality for NH_4^+-N/NO_3^--N ratio and CEC. The WSC was highly matured recording highest CEC than STC and BSC.

Among the En-FYMs, En-FYM-1 prepared from jowar and maize byre waste showed lowest C/N ratio (17.3) followed by En-FYM-3 (19.1) and En-FYM-2 (19.5) prepared from bajra-maize wastes and jowar-bajra wastes, respectively at 120 days of composting period and have desired C/N ratio. Among En-FYMs, En-FYM-1 has good quality and maturity for all physical and chemical quality parameters.

All composts and enriched FYM have optimum level of N, P, K and S and micronutrient cations concentration at maturity.

References

Anonymous, 2003. *Krishi Darshani*, MPKV; Rahuri. pp.210.

Chanyasak V., Hirari, M. and Kubota, H. 1982. Changes in chemical components and nitrogen transformation in water extracts during compositing of garbage. J. Ferment. Technol. 58 : 533-539.

Bernal, M.P., Paredes, C., Sanchez, M.A. and Cagara, J. 1998. Maturity and stability parameters of composts prepared with wide range of organic wastes. Bioresource Tech, 63: 91-99.

Bhanawase, D.B., Rasal, P.H., Jadhav, B.R. and Patil, P.L. 1994. Mineralization of nutrients during production of phospho-compost. J. Indian Soc. Soil Sci., 42 (1): 145-147.

Ganguly, T.K. and Singh, A.B. 2004. Chemical amendments and bioinoculum in compost production and quality comparison of various composts. In Management of organic wastes for crop production. Vol. I. Maharana Pratap Univ. Agric. and Tech., Udaipur, Ed. Swami, B.N. pp. 24-30.

Gaur, A.C., Sadasivam, K.V., Vimal, O.P. and Mathur, R. 1971. A study on the decomposition of organic matter in an alluvial soil. CO_2 evaluation, microbiological and chemical transformation. Plant and Soil, 34: 17-38.

Harada, Y. and Inoko, A. 1980. The measurement of cation exchange capacity of composts for the estimation of degree of maturity. Soil Sci. Pl. Nutr. 26 (1): 127-134.

Jothimani, P. and Maheswari, M. 2002. Composting-An eco-friendly way of solid waste management. Summer school on Eco-friendly management of solid and liquid wastes for Agriculture. TNAU, Coimbatore. pp. 404-411.

Kalaiselvi, T. and Ramasamy, K. 1996. Compost maturity: can it be evaluated? Madras Agric. J. 83: 609-618.

Manna, M.C., Ganguly, T.K. and Ghosh, B.C. 2000. Evaluation of compost maturity and mineral environment quality through simple chemical parameters. J. Indian Soc. Soil Sci. 48 : 781-786.

Nandi, N., Hajra, J.N. and Sinha, N.B. 1996. Microbial synthesis of humus from rice straw following two-step compositing process. J. Indian Soc. Soil Sci. 44 (3) : 413-416.

Patil,G.D. 1994.Characterization of spent wash/spent slurry press mud composts and their effects on yield, nutrient uptake by maize (*Zea mays* L.) and soil properties. Ph. D. Thesis submitted to the M.P.K.V., Rahuri.

Shinde, B.N. and Rote, B.P. 1983. Use of rock phosphate and microbial cultures for composting of sugarcane trash by heap method. Indian J. Agric. Chem., 15 (3) : 147-154.

Srikanth, K., Sreenivasa M., Sudhir, C.A. and Siddaramappa, R. 1999. Effect of microbial inoculum and RP on decomposition and quality of farm city and industrial wastes. Mysore J. agrci. Sci., 33 : 243-247.

Subramanian, P. 2002. Composting techniques. Summer school on Eco-friendly management of solid and liquid wastes for agriculture. TNAU., Coimbatore, pp. 170-179.

Vasanthi, D. and Kumaraswamy, K. 1999. Efficacy of vermicompost to improve soil fertility and rice yield. J., Indian Soc. Soil Sci., 47 (2) : 268-272.

Table 1: Standard quality values for good quality organic manures.

Sr. No	properties	Standard Value	Reference
1	Temperature (^oC)	30-45	Kalaiselvi and Ramasamy (1996)
2	Colour	Black– brown	Jothimani and Maheswari (2002)
3	Odour	Earthy	Jothimani and Maheswari (2002)
4	WHC (%)	150-200	Subramanian (2002)
5	pH (1:10)	6.5-8.0	Kalaiselvi and Ramasamy (1996)
6	EC (dSm^{-1})	<1.5	Jothimani and Maheswari (2002)
7	WSOC (%)	<1.7	Bernal *et.al.* (1998)
8	C:N ratio	<20.0	Kalaiselvi and Ramasamy (1996)
9	CEC (Cmol $p+kg^{-1}$)	>70.0	Kalaiselvi and Ramasamy (1996)
10	NH_4^+-Ncontent (%)	<0.04	Bernal *et.al.* (1998)
11	NH_4^+-N/NO_3^--N ratio	<0.16	Bernal *et.al.* (1998)
12	HA/FA ratio	<1.0	Jothimani and Maheswari (2002)

Table 2: Periodical changes in C/N ratio during decomposition of compost and enriched FYM

C/N ratio of organic manures											
Compost							*Enriched FYM*				
Sr. No.	Compost	Initial C/N ratio of mixture	Days				En-FYM	Initial C/N ratio of mixture	Days			
			30	60	90	120			30	60	90	120
1	*WSC*	79.2 (100)	54.1 (68.3)	42.6 (53.9)	30.7 (38.8)	16.2 (20.5)	***En-FYM-1***	84.9 (100)	57.9 (68.2)	46.6 (54.9)	33.0 (38.9)	17.3 (20.4)
2	*STC*	98.1 (100)	63.3 (64.5)	51.9 (52.9)	36.8 (37.5)	20.0 (20.4)	***En-FYM-2***	89.2 (100)	58.6 (65.7)	49.3 (55.3)	35.8 (40.1)	19.5 (21.9)
3	*BSC*	89.2 (100)	62.3 (69.8)	46.7 (52.4)	35.7 (40.0)	19.9 (22.3)	***En-FYM-3***	87.0 (100)	60.8 (69.9)	47.1 (54.1)	34.5 (39.7)	19.1 (22.0)

() Figures in parenthesis indicated percent C/N ratio over initial value.

Table 3: Physical properties (Parameters) of compost and enriched FYM at 120 days of decomposition

Sr. No.	Type of manure	Temperature (^{0}C)	Odour	Colour	Water holding capacity (WHC)%	Ash content (%)
Compost						
1	WSC	32	Earthy	10YR3/3 Dark brown	182.8	17.9
2	STC	37	No noxious	10YR3/3 Dark brown	171.6	14.1
3	BSC	41	No noxious	10YR4/3 Brown	200.7	12.3
Enriched FYM						
1	En-FYM-1	32	Earthy	10YR3/3 Dark brown	190.2	19.8
2	En-FYM-2	39	No noxious	10YR3/3 Dark brown	178.6	18.1
3	En-FYM-3	36	Earthy	10YR3/3 Dark brown	189.6	15.3

Table 4: Chemical properties (Parameters) of compost and enriched FYM at 120 days of decomposition

Sr. No.	Type of manure	pH (1:10)	EC (dSm^{-1})	WSOC (%)	C/N ratio	CEC (Cmol P^+kg^{-1})	NH_4-N $mgkg^{-1}$	NO_3-N $mgkg^{-1}$	NH_4-N/ NO_3-N ratio
Compost									
1	WSC	7.34	1.45	0.453	16.2	112.5	104	680	0.153
2	STC	7.65	1.31	0.399	20.0	77.5	91	577	0.158
3	BSC	6.92	1.40	0.446	19.9	68.3	131	485	0.270
Enriched FYM									
1	En-FYM-1	7.61	1.48	0.464	17.3	102.5	78	492	0.159
2	En-FYM-2	7.27	1.81	0.672	19.5	70.0	126	361	0.349
3	En-FYM-3	7.89	1.57	0.510	19.1	98.6	71	458	0.155

Table 5: Nutrients status of composts and enriched FYMs at 120 days of decomposition

Sr. No.	Type of manure	Macronutrient (%)				Micronutrient (mg kg^{-1})			
		N	P	K	S	Fe	Mn	Zn	Cu
	Compost								
1	WSC	1.51	0.46	0.90	0.48	8940	631	271	110
2	STC	1.35	0.39	0.85	0.41	7820	654	259	115
3	BSC	1.29	0.40	1.00	0.47	5660	463	193	104
	Enriched FYM								
1	En-FYM-1	1.48	0.44	0.85	0.49	7338	727	328	121
2	En-FYM-2	1.27	0.43	0.95	0.51	5840	579	284	136
3	En-FYM-3	1.38	0.48	0.80	0.43	6960	697	287	146