NUTRIENT VARIATIONS IN VERMICOMPOST PREPARED FROM DIFFERENT TYPES OF STRAW WASTES

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SUMMARY

The field experiment was carried out to study the chemical changes in different organic wastes during vermicomposting with time interval in rainy season in CCS Haryana agriculture university, Hisar during 2011-12. The agricultural wastes like wheat straw, millet straw, pulse brawn and mustard straw were used as substrates for vermicomposting. The earthworm *Eisenia fetida* was found most useful for conversion of vermicompost so *Eisenia fetida* was used in preparation of vermicompost. In vermicompost process, several physical, chemical and the biological reactions took place resulting in changes in the organic matter in a certain period of time. Vermicomposting allowed obtaining organic sources of nutrients which were physically, nutritionally and biochemically improved over composts. In the present studies increased the nutrient content in vermicompost so as changes in nitrogen, potassium, phosphorus (NPK) were studied in different agricultural wastes with time.

Key words : Agricultural wastes, *Eisenia fetida*, straw, vermicompost

Environmental degradation is a major threat to the world, and use of chemical fertilizers contributes largely to deterioration of the environment through depletion of fossil fuels, generation of carbon dioxide and contamination of water resources. It leads to loss of soil fertility due to imbalanced use of fertilizers. Now there is a growing realization that the adoption of ecological and sustainable farming practices can only reverse the declining trend in the global productivity and environmental protection (Kassam and Friedrich, 2012). On one hand, tropical soils are deficient in all necessary plant nutrients and on the other hand large quantities of such nutrients contained in domestic wastes and agricultural byproducts are wasted. It is estimated that in cities and rural areas of India nearly 700 million tonnes organic wastes are generated annually which is either burned or land filled. Such large quantities of organic wastes generated also pose a problem for safe disposal. Most of these organic residues are burned currently or used as land fillings. Microorganisms and earthworms are important biological organisms helping nature to maintain nutrient flows from one system to another and also minimize environmental degradation. The earthworm population is about 8-10 times higher in uncultivated area. This clearly indicates that earthworm population decreases with soil degradation and thus can be used as a sensitive indicator of soil degradation. Furthermore, losses in organic carbon, decreases in PH mineralization of the organic matter containing proteins (Garg and Gupta, 2011) and conversation of ammonium nitrogen into nitrate may be responsible for nitrogen addition in vermicompost. Vermicomposting liquids contain valuable nutrients that promote plant growth by spraying (Shlrene and Mahamad, 2013). In view of this, the possibility of producing valuable compost by vermicomposting from different types of straw wastes was explored.

MATERIALS AND METHODS

The present field experiment was carried out in the field of Zoology department in CCS Haryana Agriculture University Hisar in rainy season during 2011-12. The agricultural wastes like wheat straw, millet straw, pulse brawn and mustard straw were used as substrates for vermicomposting. The earthworm *Eisenia*

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fetida was used in preparation of vermicompost. The dry weight of all the five wastes was calculated by keeping 1 kg of waste in the oven at 60^{0}C overnight. The wastes were then mixed up separately with the fresh cow dung in a ratio of 1 : 5 (substrate : cow dung). Eighty kg dry weight of the mixtures was filled in the pits measuring 2 in x 0.5 m x 0.6 in (Length, breadth and depth) made in open field under a temporary shed of straws. Each mixture was having six pits. The pits having the organic waste mixtures were covered with gunny bags and were watered 1 - 5 litres per pit daily.

The earthworms were released in the pits after 15 days (after surpassing the thermogenic stage of microbial decomposition). One hundred healthy adult earthworms, having almost same weight were randomly selected, and released in each pit. The earthworms were released in three pits only and the remaining three were kept as control for comparison of changes in chemical composition with the vermicompost prepared by the earthworms

The experiment was conducted for 90 days (after the release of earthworms). The samples for chemical analysis were collected on 0, 30, 60 and 90 days of the release of earthworms. These were analyzed for carbon by Nelson and Sommers, 1982, nitrogen by Kjeldhal method, (Brenner and Mulvancey, 1982) phosphorus by John method, 1970 and potassium by flame photometer method (Jackson, 1973).

RESULTS AND DISCUSSION

Changes in Nitrogen Content

In vermicompost process, several physical, chemical and the biological reactions took place, there by resulting in changes in the organic matter in a certain period of time. In the present studies changes in nitrogen, potassium and phosphorus were studied in different agricultural wastes with time. In this experiment, the change in nitrogen% in different agricultural wastes was observed. The nitrogen% in wheat straw: cow dung in the ratio (1 : 5) was found maximum 1.74 per cent after 90 days. In mustard straw, changes in nitrogen % was observed maximum 1.80 per cent after 90 days. In pulse brawn, it was 1.91 after 90 days. In millet straw, it was 1.86 per cent after 90 days. In cow dung as control, nitrogen % was found 1.30 % after 90 days time interval (Table 1, Fig. 1). Earthworms also have a great impact on nitrogen transformation in manure, by enhancing nitrogen mineralization, so that mineral nitrogen was retained in the nitrate form (Bertrand *et al*., 2015). Excretory products mucus, body fluid, enzyme and even decaying tissue of the death earthworms are associated with the higher level of N in vermicompost (Deka *et al*., 2011; Vasanthi *et al*., 2013). Similarly, Jain (2016) found that nitrogen contents increase and lower the C/N ration during waste management of temple floral by vermicomposting. Furthermore, losses in organic carbon, decreases in PH and mineralization of the organic matter containing proteins (Garg and Gupta 2011) and conversation of ammonium nitrogen into nitrate may be responsible for nitrogen addition in vermicompost. Senthilkumari *et al*., (2013) and Chellachamy and Dinakaran (2015) similarly found nitrogen contents increase during vermicomposting of epicarp of fruits.

TABLE 1
The changes in nitrogen % in different agricultural wastes during vermicomposting

Waste mixture in ratio (1 : 5)	Time days			
	0	30	60	90
	N (%)			
Wheat straw : Cow dung	0.84b	1.04a	1.34	1.74a
Mustard straw : Cow dung	0.81a, b	1.15b	1.45a	1.80a
Pulse brawn : Cow dung	0.85b	1.21b	1.53b	1.91a
Millet straw : Cow dung	0.82a, b	1.19b	1.49a, b	1.84a
Cow dung	0.73a	0.98a	1.18	1.30
C. D. (P=0.05)	0.08	0.08	0.05	0.36

Values denoted by similar letter in each column do not differ significantly.

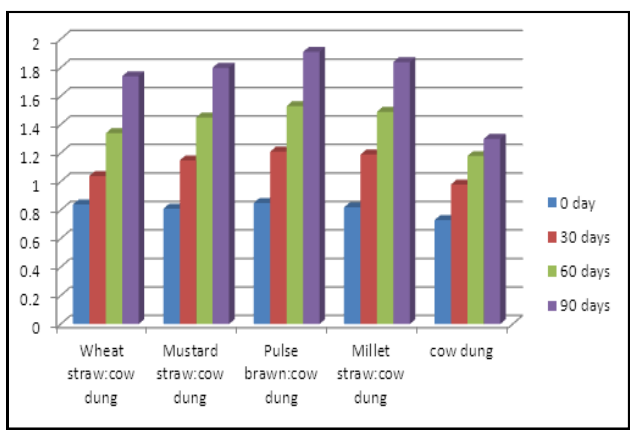

Fig. 1. The changes in nitrogen % in different type of straw wastes during vermicomposting.

Changes in Potassium Content

The changes in potassium % in different types of straw wastes (Table 2, Fig. 2) were found maximum 1.72 per cent in wheat straw after 90 days. In mustard, it was 2.05 per cent. In pulse brawn, potassium % was 1.53 per cent. In millet straw, it was observed 1.63 per cent. In cow dung as control, potassium % was 1.07 per cent. The maximum increase in percent of potassium was found in mustard straw and minimum increase in percentage of potassium was found in cow dung during vermicomposting at different time interval. The present finding is in agreement with the earlier work of Deka *et al.*, (2011). They have reported four folds increase in K content in the vermicompost. This increase in K content in earthworm processed material may be due to higher mineralization rate as a result of enhanced microbial and enzyme activities in the gut of earthworm. The remainder of nutrients followed more or less similar trend i.e., P content increased at a fluctuating level while K and Ca decreased and the Mg level remained almost static during composting with and without earthworm (Ghosh *et al.*, 1999).

Change in Phosphorus Content

The change in phosphorus % in different agriculture waste was found maximum in wheat straw waste mixture with time during vermicomposting. It was found maximum 2.09 per cent as compared to other wastes and minimum in cow dung i.e. 1.15 per cent after 90 days (Table 3, Fig. 3). Normally, P is found in the unavailable forms like calcium phosphate or potassium phosphate. The present study revealed that the worms have the ability to convert insoluble P into soluble forms. Vermicomposting proved an efficient

TABLE 2
The Changes in Potassium % in different agricultural waste during vermicomposting

Waste mixture in ratio (1 : 5)	Time days			
	0	30	60	90
	------------------N (%)----------------			
Wheat straw : Cow dung	0.84b	1.10	1.36a	1.72
Mustard straw : Cow dung	0.94	1.26	1.63	2.05
Pulse brawn : Cow dung	0.73a	0.91	1.21	1.53
Millet straw : Cow dung	0.79a, b	1.08	1.33a	1.63
Cow dung	0.62	0.81	0.95	1.07
C. D. (P=0.05)	0.06	0.05	0.05	0.07

Values denoted by similar letter in each column do not differ significantly.

TABLE 3
The Changes in Phosphorus % in different agricultural waste during vermicomposting

Waste mixture in ratio (1 : 5)	Time days			
	0	30	60	90
	------------------N (%)----------------			
Wheat straw : Cow dung	1.27	1.54	1.83	2.09
Mustard straw : Cow dung	1.18a	1.34	1.55	1.64
Pulse brawn : Cow dung	1.05	1.24	1.44a	1.57
Millet straw : Cow dung	1.14a	1.33	1.45a	1.54
Cow dung	0.83	0.94	1.07	1.17
C. D. (P=0.05)	0.04	0.07	0.05	0.08

Values denoted by similar letter in each column do not differ significantly.

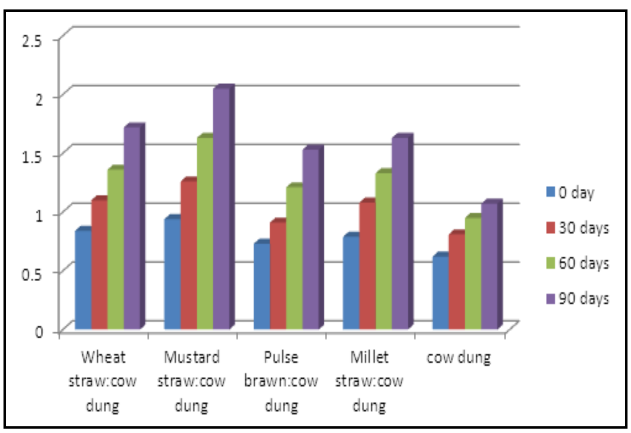

Fig. 2. The changes in potassium % in different type of straw wastes during vermicomposting.

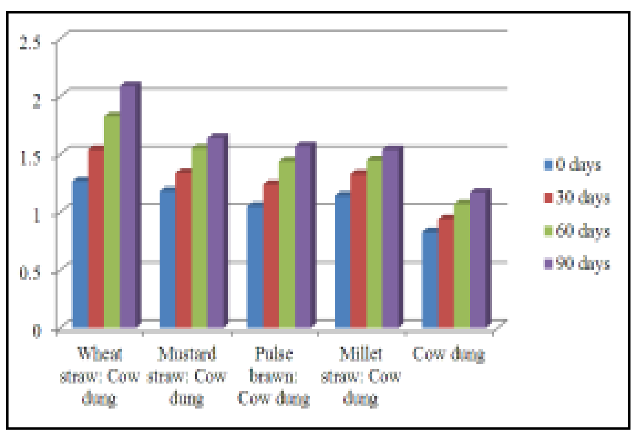

Fig. 3. The changes in phosphorus % in different type of straw wastes during vermicomposting.

technology for providing better P nutrition from the organic waste. The enhanced phosphorous level in vermicompost suggests phosphorous mineralization during vermicomposting process and suggests that the passage of organic matter through the gut of earthworm's results in phosphorus is converted to forms, which are more available to plants. Some previous studies also indicate enhanced potassium content in vermicompst by the end of the experiment (Suthar, 2007). The increase in total phosphorus during vermicomposting is probably due to mineralization and mobilization of phosphorus due to the bacterial and faecal phosphatase activity of earthworms. The nutrient content of the vermicompost varies with the type of wastes used as substrate (Amaravathi and Reddy, 2014; Saikrithika *et al*., 2015).

CONCLUSION

This research is concluded that in vermicompost lot of changes occur due to which mictonutrients changes take place. The reduction was greater in vermicomposting as compared to the ordinary composting and this may be due to the fact that earthworms have higher assimilating capacity. The increase in the Nitrogen value is as result of carbon loss and probably because of mineralization of organic matter. Therefore the changes in macronutrient content and some enzymatic activities of vermicompost due to lime addition to organic wastes which in turn leads to the enrichment of nutrients could be an interesting study. The reduction in carbon and lowering of C/N ratio in the vermicomposting could be achieved either by the respiratory activity of earthworms and microorganisms or by an increase in nitrogen by microbial mineralization of organic matter in combination with the addition of the worm's nitrogenous wastes through their excretion.

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