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FEASIBILITY OF COMPOST PREPARED FROM PADDY STRAW AND POULTRY MANURE USING MICROBIAL CONSORTIA

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Key words : *Paddy straw, Poultry manure, Co-composting, Microbial consortia, Ammoniacal nitrogen*

Abstract – A major portion of the paddy straw is subjected to open field burning leading to many environmental problems. Similarly, high rate application of poultry manure decreases the yield of crops which may be attributed to the toxic concentrations of nitrite, nitrate. So, the present investigation was planned to co-compost paddy straw and poultry manure using microbial consortia. Total organic carbon (%) declined to 30.70% and amount of total N (%) content increased up to 1.91 % in the treatment 4 after 90 days of co-composting. Ammonical nitrogen contents decreased from 8.20 to 5.12 and 49.02 to 10.09 (mg/Kg) in controls, and from 14.01 to 5.08 (mg/ Kg) in the treatment 4 prepared from 5:1 ratio of paddy straw and poultry manure along with microbial consortia and cattle dung. Nitrate nitrogen was maximum (510 mg/ Kg) in the treatment 4. Initially temperature was around 33°C and elevated to 56°C after 45 day of composting and then dropped down to 31 to 34°C in different treatments after 90 days of composting.

INTRODUCTION

Paddy straw is a vegetative part of rice plant which is a waste material after harvesting. India is the second largest producer of rice and more than 100 million tons of paddy straw is produced in India every year (Veena and Pandey, 2011). This agricultural waste may result in many problems to farmers as well as to the environment, if not handled properly. A major portion of this agricultural waste is subjected to open field burning leading to many environmental problems due to emission of carbon monoxide, carbon dioxide, un-burnt carbon and other air pollutants.

Poultry manure is organic waste material consisting of faecal waste and urinary excretion of poultry and is combined with litter or bedding materials such as woodchip, used as organic fertilizer, especially for soil low in nitrogen. The 2010 world flock is estimated to be over 18 billion birds with an estimated annual output of 22 million tons of manure (FAO, 2010). The poultry population in India is 489 million and the manure availability is estimated to be 12.1 million tons (Livestock census, 2003). Poultry waste begins to decompose immediately after excretion giving of ammonia which, in high concentration, can have adverse effects on the health and productivity of birds as well as the health of farm workers (Pierson *et al*., 2001; Zhang and Lau, 2007).

Management of poultry manure must be done in such a way that it minimizes the environmental pollution and problems associated with its land application. On the other hand, paddy straw consists of cellulose and hemicellulose encrusted with lignin, making its C:N ratio high. This organic waste can be converted to valuable fertilizer through composting.

Composting can be has tened by inoculation of beneficial microorganisms like bacteria, fungi and actinomycetes, playing an important role during different stages of degradation. Composting leads to valuable organic materials as end product and utilization benefits of these materials range from importance of soils fertility to a reliable means of waste disposal.Compost production and its agricultural use has become an attractive option of organic waste disposal. So, co-composting provides a reliable means of feasible and safe method to recycle agricultural waste along with poultry waste.

MATERIALS AND METHODS

Paddy straw was collected from farmer's fields of village Gangwa, Distt. Hisar (Haryana) India, and was mixed with poultry manure collected from Poultry Farm, Sirsa road, Hisar. The cattle dung and microbial consortia of three fungi *Aspergillus awamorii*, *Trichoderma viride*and *Paecilomyces fusisporus* used in the present study were collected from Animal Science Departmentand Department of Microbiology, CCSHAU, Hisar respectively.

Composting Experiment

Co-composting was carried out in the 1.5×1.5×1.5 ft size cemented pitswith 10 kg of organic waste materials (paddy straw and poultry manure). Moisture was adjusted to 60% of water holding capacity (WHC) and allowed to decompose. For proper aeration, turnings of compostable material were done after 15 and 30th day of experiment. The compostable samples were drawn 0, 15, 30, 45, 60, 75 and 90 day interval for analysis of different parameters.

S.No.	Treatments
T1	Paddy straw alone
T2	Poultry manure alone
T3	Paddy straw and poultry manure (5:1) + Cattle dung (10%)
T4	Paddy straw and poultry manure (5:1) + Microbial consortia + Cattle dung (10%)
T5	Paddy straw and poultry manure (10:1) + Cattle dung (10%)
T6	Paddy straw and poultry manure (10:1) + Microbial consortia + Cattle dung (10%)
T7	Paddy straw and poultry manure (15:1) + Cattle dung (10%)
T8	Paddy straw and poultry manure (15:1) + Microbial consortia + Cattle dung (10%)

Chemical analysis of compost samples

Organic carbon, available and totalnitrogenwere determined by dry Combustion (Nelson and Sommers, 1982), Keeney and Bremner (1965) and Kjeldahl's method (Bremner and Mulvaney, 1982) respectively.

RESULTS AND DISCUSSION

Initial analysis of compostable materials

Initial analysis of paddy straw and poultry manure has been shown in Table 1.

Table 1. Initial analysis of paddy straw and poultry manure

Components	Paddy straw	Poultry manure
Organic carbon (%)	47.33	32.04
Total Nitrogen (%)	0.53	1.61
C:N ratio	87.41	19.80
Ammoniacal nitrogen (mg /Kg)	8.09	48.64
Nitrate nitrogen (mg /Kg)	162	196
Total phosphorous (mg/Kg)	203	218
Total potassium (%)	0.89	0.98
pH	6.6	8.1

Changes in total organic carbon

Treatment 4 had lower content of organic carbon (30.70 %) as compared to all the other treatments after 90 days of composting (Fig. 1). All the treatments inoculated with microbial consortia were showing significant decline in % organic carbon as compared to the treatment without microbial consortia. Composting results in loss of organic carbon in the form of gases such as carbon dioxide and other gases. Daur (2016) also reported that organic carbon degradation was faster in the treatments with effective microorganisms as compared to the treatments without effective microorganisms.

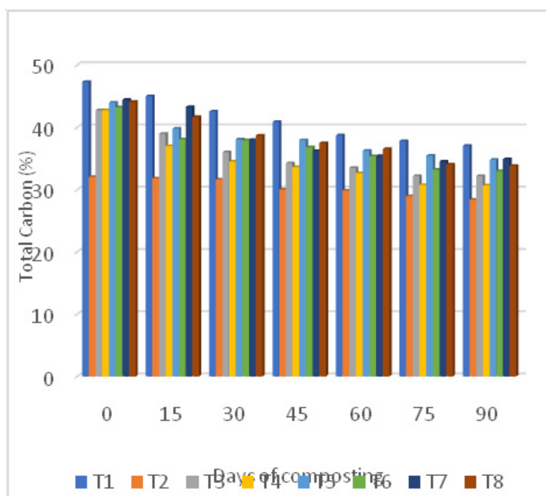

Fig. 1

Total nitrogen

Maximum amount of total nitrogen (1.91 %) was recorded in the treatment 4 (Fig. 2). However, in the treatment 2 having poultry manure alone, total nitrogen contents decreased with time. Thomas *et al*. (2013) reported that total N content increased with composting time in all the composting materials prepared from coir pith and poultry manure with or without lime and rockphosphate. Increase in total nitrogen content was due to the net loss of dry mass in the form of carbon dioxide as well as ammonia volatilization.

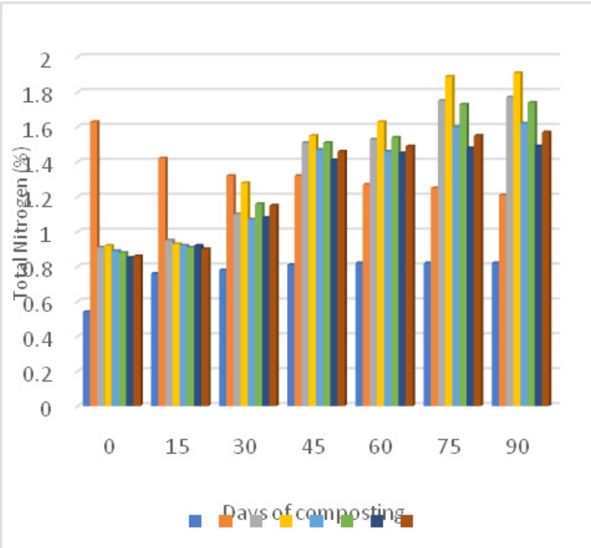

Fig. 2

Available Nitrogen

Figure 3 shows the changes in ammoniacal nitrogen during decomposition of paddy straw and poultry manure. The amount of ammoniacal nitrogen significantly decreased with time in all the treatments. It varied from 5.02 to 49.02 mg/Kg after 90 days of co-composting.

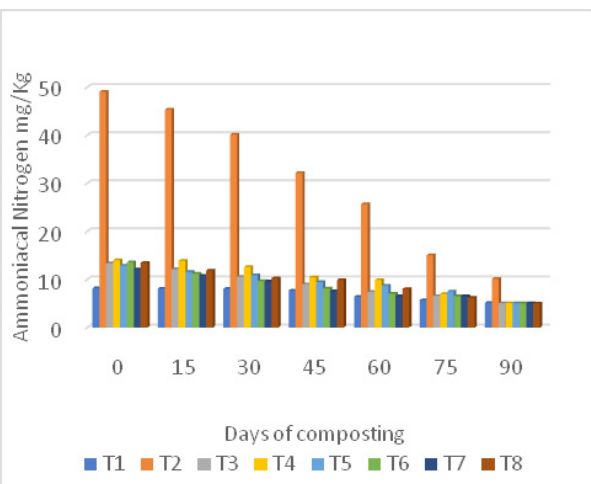

Fig. 3

Nitrate nitrogen varied from 163 to 510 mg/Kg during co-composting (Fig. 4). Amount of nitrate nitrogen was maximum in the treatment 4 (510 mg/Kg), which was having paddy straw and poultry manure in a ratio of 5:1 with cattle dung (10%) and microbial consortia. It was found that treatments with microbial consortia had significant more amount of nitrate nitrogen as compared to the treatment without consortia.

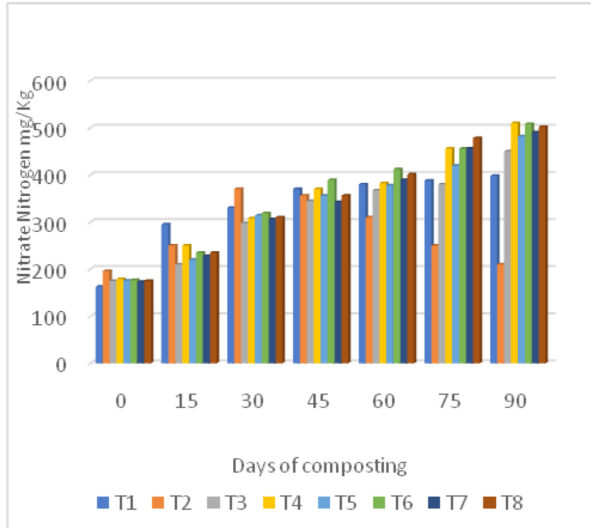

Fig. 4

C:N ratio

Data for the changes in C:N ratio has been shown in Fig. 5. The C:N ratio of all compostable material decreased with time. In the treatment 1 having paddy straw alone, the C:N ratio declined from 80.15 to 45.18 after 90 days of co-composting. There was a significant decline in C:N ratio (16.04) in the treatment 4 having paddy straw and poultry

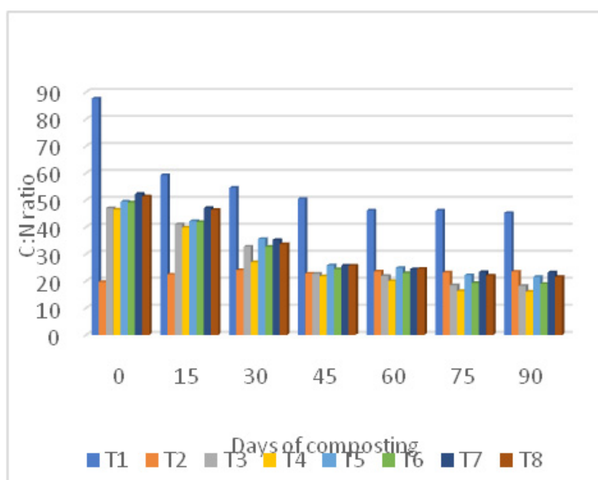

Fig. 5

manure in a ratio of 5:1 with cattle dung (10%) and microbial consortia as compared to the treatment 3. However, decline in C:N ratio from 75th to 90th days of composting was negligible. Treatments inoculated with microbial consortia showed more decline in the C:N ratio as compared to the treatments without microbial consortia. During decomposition, microorganisms decompose complex organic matter that results in oxidation of organic carbon to CO_2, certain other gases such as CH_4, CO and accumulation of nitrogen in their cells, lowered the C:N ratio of compost in the range of 15-20. Silva and Bras (2016) studied the effect of different organic amendments on the quality of poultry manure compost. He found that when poultry manure was composted with carcasse meal, ashes and grape pomace, its C:N ratio fell down to 7.0 from 22 and when composted with cellulosic sludge, C:N ratio came down to 11.2 from 22 after 67 days of composting.

Changes in temperature

The temperature of composting material was around 33ºC initially, but as the decomposition progressed, it increased with time and reached up to 56 °C after 45th day of co-composting (Fig. 6). After 50 days of composting, a gradual fall in the temperature was recorded in all the treatments. During composting, temperature increased up to 57 ºC and this was due to heat released from respiration and decomposition of organic matter of composting materials by microorganisms. Qian *et al*. (2014) reported that temperature of all composting materials was greater than 55 °C which lasted for 2 weeks. They also observed that swine manure and rice straw containing pile reached the thermophilic phase quickly than pile having dairy manure along with rice straw.

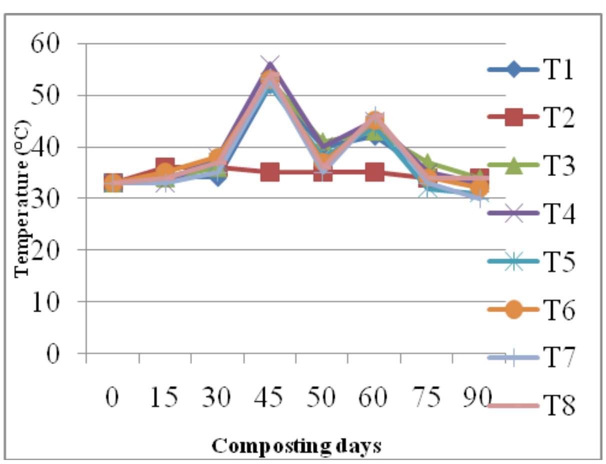

Fig. 6

CONCLUSION

Co-composting of paddy straw and poultry manure in 5:1 ratio along with microbial consortia and cattle dung 10% resulted into a brown colored quality compost with C:N ratio 16.04. This compost could be effective in agriculture as an alternative to chemical fertilizer.

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