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# Evaluation of compost, vermicompost and their teas produced from rice straw as affected by addition of different supplements

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**Abstract** Ten treatments were prepared to find out the optimal combinations of different materials to be added to rice straw to produce high quality compost and vermicompost. The effect of addition of N, P and K either in organic or inorganic form as well as addition of bio-accelerator i.e. *Trichoderma harzianum* NRRL 13019 and *Phanerorchaete chrysosporium* NRRL 6359 were studied. Another set of the same 10 treatments was prepared by adding earthworm namely *Eisenia fetida* to each of the plastic bin which containing the pre-composted materials when the temperature steadily reached 30 °C i.e. after finishing the thermophilic phase. The composting process was continued in both sets up to 16 weeks. Tea was prepared using compost and vermicompost which were produced from the four best treatments.

Results revealed that the finished products of compost and vermicompost are free from total and fecal coliforms as well as *Salmonella* sp. and *Shigella* sp. The values of tested parameters of compost and vermicompost that produced from rice straw supplemented with cattle dung, organic P and K and fungal accelerator (treatment No. 7) were within the recommended levels of high quality products.



## Introduction

Egypt is a highly successful producer of rice with average yield of more than 6.5 t ha$^{-1}$ in 2011/12. Harvesting index of Egyptian rice varieties left up to 60% straw (FAO Rice Market Monitor, 2013). The options for disposal of straw on-farm are limited and include burning as a means of quickly

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cleaning land for the following crops. The burning causes atmospheric pollution. In addition, incorporation of rice paddy straw stubble into wet soil makes a temporary immobilization of N and methane ($CH_4$) emission that contributes to greenhouse gases (Dobermann and Fairhurst, 2002). Therefore, the most common practices for recycling rice straw and most of organic wastes are composting and vermicomposting (vermiculture) processes (Ghosh, 2004). Since composting and vermicomposting are of the most promising low-cost technologies to convert agro-industrial contaminant solid wastes into value-added biofertilizer (Misra et al., 2003).

There are many factors influencing the quality of produced compost, which include the pre-processing, particle size and feedstock utilized, the C/N ratio, bio-accelerator, nutrients amendment, pH, aeration, moisture content, temperature, the maturation stage, etc. (Last, 2006).

Vermicomposting is a low cost technology system used for conversion of organic waste into organic fertilizers (Arancon et al., 2004), at which several interactions between earthworms and microorganisms occur in the worm gut (Edwards, 1998). Earthworms can consume practically all kinds of organic matter typically that placed in a compost pile, and they can eat wastes typically equal to their own body's weight per day. The castings are rich in nitrate, phosphorus, potassium, calcium and magnesium (Misra et al., 2003).

Compost and vermicompost teas are made in a variety of ways; all methods are similar in having water and mature compost or vermicompost, to get their extract. There are different factors affecting the quality of compost tea and vermicompost tea, e.g. compost stability, the quality of water used in producing compost tea, brew time and aeration, additives (Ingham, 2005).

The objective of this investigation is to study the effect of addition of different supplements to rice straw on the general properties of mature compost, vermicompost and their teas.

## Materials and methods

Rice straw was collected from Moshtohor, Qalubia Governorate, air dried and fragmented into small pieces (2–5 cm length). The chemical and physical properties of the collected rice straw are presented in Table 1. Analysis was performed by Microbiol. Dept., Soil, Water and Environmental, Res. Inst., A.R.C., Giza, Egypt.

### *Organic additives*

Fresh cattle dung was collected from a private farm in Moshtohor, Qalubia Governorate. It was used as organic nitrogen source to adjust the C/N ratio of the rice straw. The chemical and physical properties of cattle dung are presented in Table 1. Analysis was performed by Microbiol. Dept., Soil, Water and Environmental Res. Inst., A.R.C., Giza, Egypt.

Rock phosphate (18% $P_2O_5$) was provided by Al-Ahram Company, Giza Governorate. It was used as a source of phosphorus. Feldspar (12% $K_2O$) was provided by Al-Ahram Company, Giza Governorate and used as a source of potassium. The general characteristics of the rock phosphate and Feldspar are presented in Table 2. Analysis was performed by Microbiol. Dept., Soil, Water and Environmental, Res. Inst., A.R.C., Giza, Egypt.

**Table 1** Chemical and physical characteristics of rice straw and cattle dung.

| Characteristics | Rice straw | Cattle dung |
|---|---|---|
| pH (1:10) | 6.56 | 7.35 |
| EC (1:10) (dS/m) | 2.63 | 4.40 |
| Bulk density (kg/m$^3$) | 50.00 | 750.00 |
| Moisture content (%) | 10.00 | 60.00 |
| Dry matter (%) | 90.00 | 40.00 |
| Organic matter (OM %) | 99.50 | 43.10 |
| Organic carbon (OC %) | 57.71 | 25.00 |
| Total nitrogen (TN %) | 0.50 | 2.00 |
| $NH_4^+$-N (mg/kg) | 17.50 | 43.74 |
| $NO_3^-$-N (mg/kg) | 8.75 | 11.67 |
| C/N ratio | 115.4:1 | 21.5:1 |
| Ash (%) | 0.50 | 56.90 |
| Total phosphorus (%) | 0.36 | 0.65 |
| Total potassium (%) | 0.89 | 0.45 |

**Table 2** Chemical and physical characteristics of rock phosphate and feldspar.

| Characteristics | Rock phosphate | Feldspar |
|---|---|---|
| pH (1:2.5) | 7.49 | 8.50 |
| EC (1:5) (dS/m) | 2.61 | 0.53 |
| Moisture content (%) | 3.00 | 0.95 |
| Dry matter (%) | 97.00 | 99.05 |
| Total nitrogen (TN %) | 0.015 | 0.025 |
| Total phosphorus (%) | 11.20 | 0.01 |
| Total potassium (%) | 0.55 | 11.62 |

### *Inorganic additives*

Ammonium sulfate (20.6% N); Super phosphate (12% $P_2O_5$) and Potassium sulfate (48% $K_2O$) were kindly provided by Soil, Water and Environmental. Res. Inst., A.R.C., Giza, Egypt.

### *Biological accelerators*

Pure cultures of *Trichoderma harzianum* NRRL 13019 (as cellulose decomposer) and *Phanerochaete chrysosporium* NRRL 6359 (as lignin decomposer) were kindly provided by Microbiol. Dept., Soil, Water and Environmental Res. Inst., A.R.C., Giza, Egypt.

These cultures were used as compost activators in order to improve the quality of the compost. Each strain was grown individually in potato dextrose broth medium for 6–7 days in shaking incubator (150 rpm) at 28 °C.

*Eisenia fetida* used in this study was kindly provided by the Station of Using Earthworm Technology to Recycling of Organic Wastes Under Egyptian Conditions in the Central Laboratory for Agricultural Climate, Ministry of Agriculture and Land Reclamation, Agricultural Research Center, Egypt.