Composting of Some Dangerous and Toxic Weeds Using *Eisenia foetida*

Avnish Chauhan* and Joshi PC

Department of Zoology and Environment Science, Gurkula Kangri University, Hardwar, Uttaranchal 249404, India.
*Corresponding author: avnishchauhan_in@yahoo.com

Abstract: The experiments were conducted to obtain compost from some toxic weeds by using vermicomposting and conventional methods. The weeds used in the experiment were congress grass (*Parthenium hysterophorus* Linn.), water hyacinth (*Eichhornia crassipes*) and bhang (*Cannabis sativa* Linn.). Total six sets of experiments were setup by using above materials. Three of them were test experiments and rests were control experiments. In all the test experiment 50 worms were introduced. The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment having *Eisenia foetida*. The otherwise toxic weeds used in this experiment are thus converted into compost with higher concentration of nutrients. [Journal of American Science 2010;6(3):1-6]. (ISSN: 1545-1003).

Keywords: *Parthenium hysterophorus* L., *Eichhornia crassipes, Cannabis sativa* L., *Eisenia foetida,* cow dung.

1. Introduction

The practice of Vermiculture is at least a century old but it is now being received worldwide with diverse ecological objectives such as waste management, soil detoxification, regeneration and sustainable agriculture. The growth of industries and ever increasing human population has led to an increased accumulation of waste materials (Joshi and Chauhan, 2006). The use of earthworms as a waste treatment technique is gaining popularity. This method is commonly known as vermicomposting. Vermicompost, a very potential organic input for sustainable agriculture, contains beneficial microorganisms, both major (N, P, K) and micronutrients, enzymes and hormones (Probodhini, 1994). Adding of vermicompost to soil improves the chemical and biological properties of soil and hence improves its fertility (Purakeyastha and Bhatnagar, 1997). Earthworms constitute more than 80% of soil invertebrate population in many ecosystems, especially in the tropical ecosystems (Sinha et al., 2002). In India so far, 509 species, referable to 67 genera and 10 families have been reported (Kale, 1991). Earthworms act in the soil as aerator, grinders, crushers, chemical degraders and biological stimulators. Plants like *Parthenium hysterophorus* Linn. Water hyacinth (*Eichhornia crassipes*) and Bhang (*Cannabis sativa* Linn.) grow as weeds in and around different fields, road sides and forest.

Parthenium hysterophorus L. known as congress grass is a dangerous imported weeds and is poisonous, pernicious, allergic and aggressive and posses a serious threat to human being and livestock. At present it is one of the most troublesome and obnoxious weed of wasteland, forest, pasture, agricultural land and cause nuisance to mankind (Bakthavathsalam and Geetha, 2004). Water hyacinth tops the list of most dreaded aquatic weeds and now spread to all around the globe. It has successfully resisted all attempts of eradicating it by chemical, biological, mechanical, or hybrid means (Abbasi and Ramasamy, 1999). The origin place of water hyacinth is South America, Venezuela in particular. It has now spread to over 50 countries around the earth. *Cannabis sativa* L. is commonly known as bhang in India. It occurs wild in central Asia and throughout India. It is native of central and western Asia, now naturalized in the sub- Himalayan tract and abundant in wasteland from Punjab State Eastward to Bengal and Bihar state extending southwards. Commonly occurs in waste places along roadside and becomes gregarious along irrigation channels. The fresh plant is not poisonous but becomes poisonous when damaged on drying, heating, smoking and aging of it or its extract and plants parts (Dhiman, 1997). In the present study earthworm species, *Eisenia foetida* is used to decompose these plants.

2. Materials and Methods

2.1 Composting materials

The *Parthenium hysterophorus* and *Cannabis sativa* L. were collected from playing ground of B.H.E.L. Hardwar, Uttaranchal, India and water hyacinth was collected from nearby ponds.

2.2 Cow dung

One week old cow dung was used in experiments because fresh cow dung can be dangerous for earthworms due to decomposition process, when generation of heat take place that can kill to earthworms.

2.3 *Eisenia foetida*

Eisenia foetida is one of the best known species for its feeding behavior and were randomly picked from a stock culture maintained in a kitchen garden near residential area.

2.4 Design of Experiment

The present study was carried out during Jun 2005 to Nov 2005. After collecting weeds from different places it was cut into very small pieces and then these small pieces were placed separately in the earthen pits with size 2m×1m×2m. The pits were covered with soil up to 10 cm height. After a period of 20 days all these partially decomposed weeds were collected in separate polythene bags.

The partially decomposed weed material free from soil was collected separately and sun dried for 2 days. The above weed plants material were manually powdered using stone mortar and stored in separate polythene bags. These powdered material shredded to 2-mm sizes before use (Kaushik and Garg, 2004). Reduced particle size of the culture medium tend to be favorable for raising growing worms and also provides more surface area per volume of culture medium, which facilitates microbial activities as well as moisture availability (Bakthavathsalam and Geetha, 2004*)*.By using above weed plants and cow dung, six sets of experiments were set up in plastic containers (50 cm in diameter, depth 16 cm). Three of them were test experiments and rests three were control experiments. In all test experiment 50 young earthworms were introduced. The moisture content was 40-70% throughout the study period and maintained by sprinkling of adequate quantities of water. In first set (1a) of experiment the bedding was prepared by mixing of partially decomposed cow dung with partially decomposed *Parthenium hysterophorus* used in equal amounts (w/w).The control set (1b) of this bedding was without *Eisenia foetida*. In the second set (2a) the bedding was prepared by taking equal amounts of partially decomposed cow dung and partially decomposed water hyacinth. The control set (2b) of this experiment did not have worms. In the third set (3a) of experiment the bedding was same as that of the second set (3b) of experiment but the partially decomposed water hyacinth was replaced by partially decomposed Bhang. The control set of this experiment did not have worms.

2.5 Analytical Procedure

The followings chemical parameters of each bedding materials were analyzed: Organic carbon was determined by the Walkley-Black method (1934). Total Kjeldhal nitrogen (TKN) was determined according to Bremner & Mulvaney (1982) procedure. Available phosphorus was analyzed by employing Olsen's (1954) method and Potassium was determined by ammonium acetate extractable method (Simard, 1993). All the above nutrients and C/N, C/P ratios were analyzed after every 15 days. In each test experiment offspring's and cocoons were observed after completion of experiment by direct count method.

3. Results & Discussion

The data on Organic carbon, Nitrogen , Phosphorus , Potassium, C/N ratio and C/P ratio of all three test and control experiments are presented in Fig. 1,2,3,4,5 and 6, respectively. However the data on number of earthworms and earthworm's cocoons in the test experiment are given in Fig. 7 and 8, respectively.

The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment set up using earthworms. There was a 20.7%, 26.2% and 23.3% decrease in organic carbon in the first, second and third sets of test experiment respectively. In control, it was 25.6%., 21.5% and 26.4% respectively. The reduction in organic carbon during the first 3-4 months of vermicomposting could be due to the respiratory activity of earthworms and microorganisms (Curry et al., 1995; Edwards and Bohlen, 1996). The increase in organic carbon after 3-4 months was probably due to the addition of earthworms cast, which are rich in organic carbon. There was a 133%, 133% and 149% increase in nitrogen in the first, second and third sets of test experiment respectively. In control, it was 11.8%, 13.3 % and 42% respectively. Bansal & Kapoor (2000) vermicomposting with *Eisenia foetida* of crop residues and cattle dung resulted in significant reduction in C: N ratio and increase in N. There was a 109.2%, 60% and 53% increase in phosphorus in the first, second and third set of test experiment respectively. In control, it was 28.1%, 22.5% and 14.9% respectively. *Eisenia foetida* helps to increase the microbial activity and release the nitrogen, potassium and calcium as suggested by (Edwards, 1995). Anonymous (1992) found higher amount of phosphorus in test experiment than control experiment using earthworm species. There was a 131.2%, 110% and 137.9% increase in potassium of first, second and third sets of test experiment respectively. Decrease in C/N ratio in the first, second and third set of test experiment was 66.3%, 68.3% and 69.2% respectively. Talashilkar et al., (1999) studied changes in chemical properties during composting of organic residues as influenced by earthworm activity. According to them there was a decrease in C: N ratio. The organic carbon is lost as

CO_2 and N contents of compost is decomposed on the initial N present in the waste and extent of decomposition (Crawford, 1983; Gaur & Singh, 1995). Similarly, C/P ratio of test sets decreased by 62.2%, 53.9% and 50.1% in first, second and third sets respectively, while in control the decrease was 42.2%, 36% and 35.9% respectively. Some workers have reported higher content of NPK and micronutrients in vermicompost (Jambhelkar, 1992; Delgado et al., 1995). The studies clearly indicate that use of worms is highly useful in composting of otherwise toxic plant material. The number of earthworms in each test experiment has increased with time and at 150 days these were 84, 88 and 104 respectively while the numbers of cocoon observed after 150 days was 266, 280 and 289 in test sets 1a, 2a and 3a, respectively.

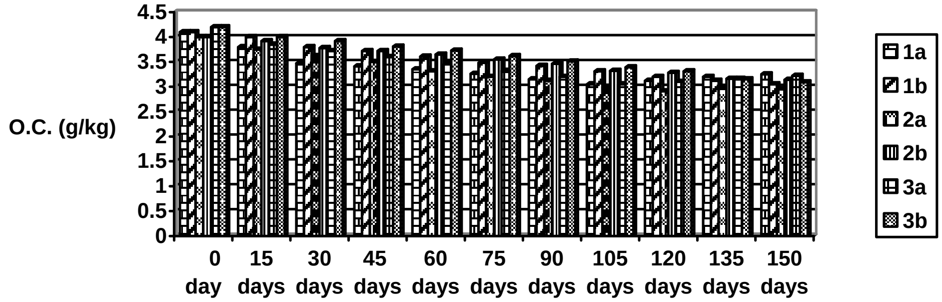

Figure 1. Effects of *Eisenia foetida* inoculation on organic carbon (g/kg) during composting

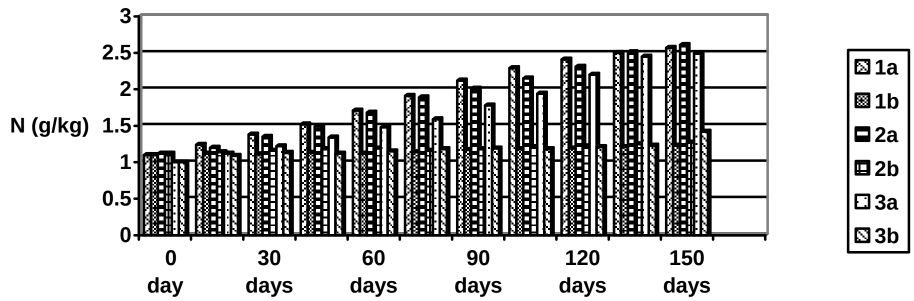

Figure 2. Effects of *Eisenia foetida* inoculation on nitrogen values (g/kg) during composting

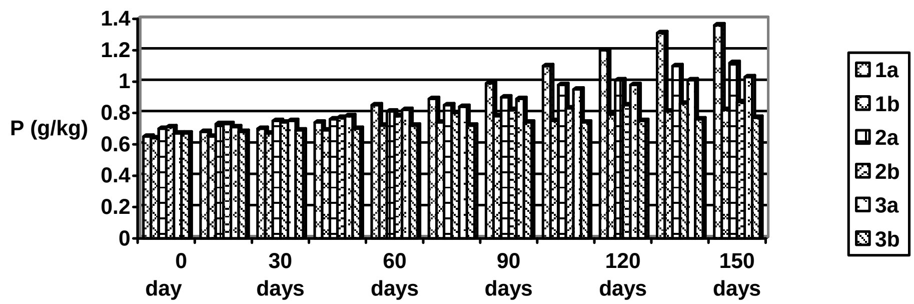

Figure 3. Effects of *Eisenia foetida* inoculation on phosphorus values (g/kg) during composting

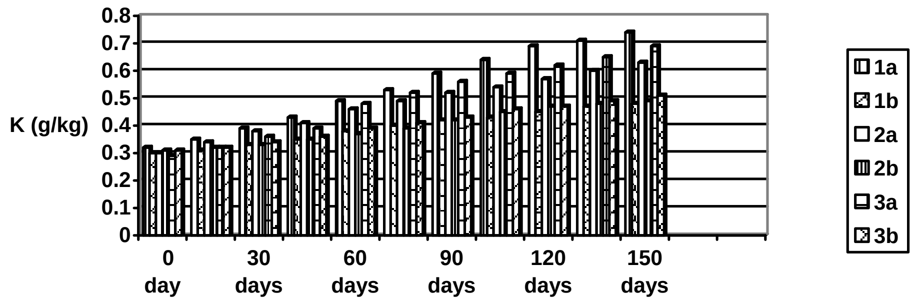

Figure 4. Effects of *Eisenia foetida* inoculation on potassium values (g/kg) during composting

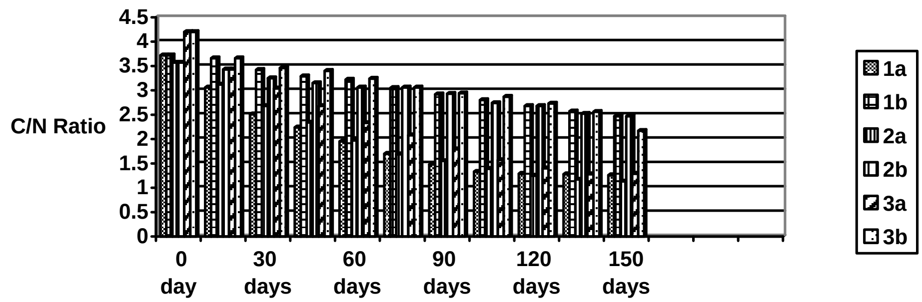

Figure 5. Effects of *Eisenia foetida* inoculation on C/N ratio (g/kg) during composting

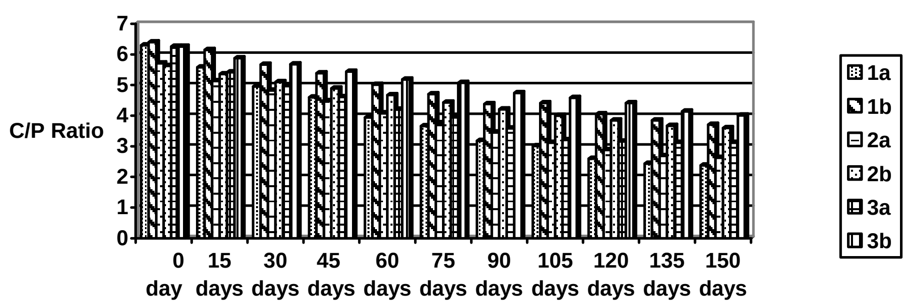

Figure 6. Effects of *Eisenia foetida* inoculation on C/P ratio (g/kg) during composting

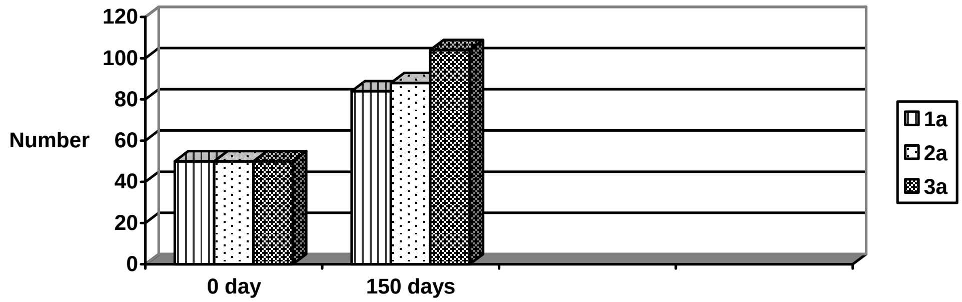

Figure 7. Number of earthworms in the experiments (2), (3) and (4).

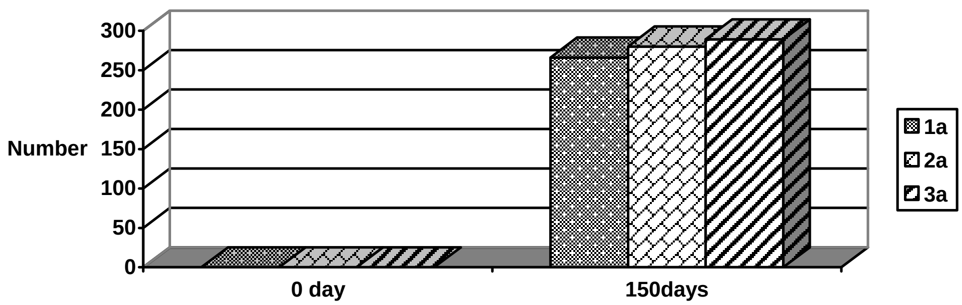

Figure 8. Number of Earthworms Cocoons in The Experiments (2), (3) and (4).

Acknowledgements

The authors are thankful to the Department of Zoology and Environmental Sciences Gurukul Kangri University, Hardwar for providing necessary facilities.

References

[1] Abbasi, S.A. and Ramasamy E.V. 1999. *Biotechnological methods of pollution control*. Orient Longman (University Press India LTD). Hyderabad., 168 pp.

[2] Anonymous, 1992. Recycling of crop residue in the soil and its effect on the performance of rabi sorgum. 29th Meeting of Research Review Committee. Report Agri. Chem. & Soil. Sci., M.P.K.V., Rahuri, India.

[3] Bansal, S., Kapoor, K.K. 2000. Vermicomposting of crop residues and cattle dung with *Eisenia foetida*. Biores. Technol. 73, 95-98.

[4] Bakthavathsalam, R. and Geetha, T., 2004. Reproductive influence of the earthworm, *Lampito mauritii* cultured in different media of paddy chaff and weed plants materials. Environment & Ecology 22(3), 574-578.

[5] Bremner, J. M., Mulvaney, R.G., 1982. Nitrogen total. In: Page, A. L., Miller, R. H., Keeney, D.R. (Eds.), Method of Soil Analysis. American Society of Agronomy, Madison, pp.575-624.

[6] Crawford, J.H., 1983. Review of composting. Process Biochem. 18, 14-15.

[7] Curry, J.P., Byrne, D., Boyle, K.E., 1995.The earthworm of winter cereal field and its effects on soil and nitrogen turnover. Biol. Fertil. Soil 19, 166-172.

[8] Delgado, M., Bigeriego, M., Walter, I., Calbo, R., 1995. Use of California redworm in sewage sludge transformation. Turrialba. 45, 33-41.

[9] Dhiman, A.K., 1997. A survey of medicinal plants of Hardwar and adjoining area VIS-A VIS the raw plants drug being sold in local market. PhD Thesis. G.K. University, Hardwar.

[10] Edwards, C.A., 1995. Historical overview of vermicomposting. Biocycle (June 1995), 56-58.

[11] Edwards, C.A., Bohlen, P.J., 1996. Biology and Ecology of Earthworms, third ed. Chapman and Hall, London, England.

[12] Gaur, A.C., Singh, G., 1995. Recycling of rural and urban wastes through conventional and vermicomposting. In: Tandon, H.L.S. (Ed.), Recycling of crop, Animal, Human and Industrial Wastes in Agriculture. Fertilizer Development and Consultation Organization, New Delhi, pp. 31-49.

[13] Jambhekar, H.A., 1992. Use of Earthworms as a potential source to decompose organic wastes. In: Proceeding of the National Seminar on Organic Farming, Mahatama Phule Krishi Vidyapeeth, Pune. pp. 52-53.

[14] Joshi, P.C. and Chauhan, A., 2006. Composting of some organic materials using *Eisenia foetida* and Conventional microbial methods: A comparative study. Uttar Pardesh J. Zool. 26(1): 123-125.

[15] Kale, R., 1991.Vermiculture: Scope for New Biotechnology. Calcutta: Zoological Survey of India.

[16] Kaushik, P. and Garg, V.K., 2004. Dynamics of biological and chemical parameters during vermicomposting of solid textile mill sludge mixed with cow dung and agricultural residues. Biores. Technol. 94, 203-209.

[17] Olsen, S.R., Cole, C.V., Watanabe, F.S., Dean, L.A., 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circ. US Dep. Agric., p. 939.

[18] Probodhini, J., 1994. Recycle kitchen waste into vermicompost. India Fmg., 43(12), 34.

[19] Purakeyastha, T.J. and Bhatnagar, R.K., 1997. Vermicompost: a promising source of plants nutrients. India Fmg., 46(2), 35-37.

[20] Simard, R.R., 1993. Ammonium acetate expectable elements. In: Martin, R., Carter, S. (Eds.), Soil Sampling and Method of Analysis. Lewis Publisher, Florida, USA, pp. 39-43.

[21] Sinha, R.K., Herat, S., Agarwal S., Asadi, R. and Carretero E., 2002. Vermiculture and waste management: Study of action of earthworms *Elsenia foetida, Eudrilus euginae* and *Perionyx excavatus* on biodegradation of some community wastes in India and Australia. The Environmentalist 22, 261-268.

[22] Talashilkar, S.C., Bhangarath, P.P., Mehta, V.B., 1999. Changes in chemical properties during composting of organic residues as influenced by earthworm activity. J. Indian Soc. Soil Sci. 47, 50-53.

[23] Walkley, A., Black, I.A., 1934. An examination of the Degtjareff method for determining soil organic matter and prepared modifications of the chromic acid titration method. Soil Sci. 34, 29-38.

4/11/2009