Production of Vermicompost from *Eichhornia crassipes* an Alien Invasive Species of Nepal

Suchita Shrestha[1*] and Ananda Shova Tamrakar[2]

[1]Central Department of Environmental Science, Tribhuvan University, Kirtipur
[2] Central Department of Zoology, Tribhuvan University, Kirtipur

Abstract

This study is an attempt to explore the production of vermicompost and compost from an invasive Alien Species of Nepal, *Eichhornia crassipes*. This species has invaded aquatic habitats and is creating different environmental and economical problems. For the purpose of sustainable solution to this aquatic weed vermicomposting was tested. The present work was carried out during the year 2007/08 in the Central Department of Environmental Science, Tribhuvan University. Vermicomposting was done in three replicate bins by using two earthworm species *Eissenia foetida* and *Lampitto mauriti* during the study period.Water hyacinth from Beeshazari taal was cut and fed to earthworms from which almost 2.1:1 waste to compost ratio was generated. The chemical analysis result of the vermicompost viz, percentage of Organic matter, Nitrogen, Phosphorous and potassium were found to be 62.84%, 0.413%, 0.087% and 0.0232% respectively which are less than in composition of other studied and analysed vermicompost from other sources like organic waste. The C: N ratio was increased in the vemicompost compared to initial plant sample indicating the need for further decomposition. Heavy metals was found to be much lower than that of Municipal Solid Waste (MSW) compost applied to agricultural land given by USEPA, 1994.

Key Words: Water hyacinth, Vermicompost, C: N ratio, heavy metals, Municipal Solid Waste.

Introduction

An alien species has been defined as a species that is non-native, non indigenous, exotic, and foreign and /or introduced to an ecosystem other than its natural home. They include both useful as well as harmful plants. Alien species that spread unmanageably, propagate relatively rapidly and outnumber all other native species in their own ecosystem are harmful for us. These species have been termed as Invasive Alien Species (IAS) (IUCN, 2005) *Eichhornia crassipes* also known as Water Hyacinth is one of the high risks posing IAS. Water hyacinth is highly prolific such that they can double in number every in as little as 12 days (IUCN, 2005) in warm nutrient enriched waters, forming huge solid floating mats. Dense mats blocks waterways, disrupt navigation and other recreational activities. In addition, it threatened livelihoods of communities by reducing fish populations, fouling hydroelectric power turbines, and providing habitats for malaria contaminating water due to decomposition and loss of water through high rate of evaporation. Though water hyacinth has lots of disadvantages it possesses some potential values like making compost, mulching, fodder, as a source of energy and for the waste water treatment process. So composting and vermicomposting of this invasive plant would be the solution of its proper management and a source of resource as well. According to Gajalakshmi *et al.*, 2002)

Correspondence: such.shrestha@gmail.com

water hyacinth can be composted in 20 days and the composted weed can be vermicomposted three times as rapidly as uncomposted water hyacinth. The successful vermicompost of water hyacinth were studied (Saini *et al.*, 2008, Ansari, 2009 , Sannigrahi, 2009, Chauhan *et al.*, 2010) with or without combining with other substrate while the application of vermicompost of water hyacinth were studied on various species of plants and fishes(Gajalakshmi and Abbassi, 2002; Rakshit *et al.*, 2008, Chakrabarty *et al.*, 2009).

Vermicomposting is a method of making compost with the use of earthworms, which generally live in soil, eat biomass and excrete it in digested form(Gupta, 2004) Vermicompost is a finely divided peat like material with excellent structure, porosity, aeration, drainage and moisture-holding capacity(Appelhof, 1982). The main objective of this short paper is to show the quality of the vermicompost of water hyacinth and the change occurred in nutrient level of water hyacinth before and after the vermicomposting.

The study was conducted in the Central Department of Environmental Science (CDES), Tribhuvan University, Kirtipur in the duration of 5 months and 14 days in three aluminium boxes with suitable conditions of bedding, moisture and partially decomposed chopped water hyacinth as feeding materials along with the cattle dung as an initial inoculum.

The overall objective of the study is to exploit the potential value of water hyacinth,the serious threat to wetland, through the process of vermicomposting.The specific objectives were to prepare vermicompost of water hyacinth, analyse the physical and chemical parameters of hyacinth plant and its vermicompost and compare them and also
to detect the heavy metals present in the prepared vermicompost.

Materials and Methods

1. **Selection of worm bin**: Three aluminium boxes of 1m length, 50 cm breadth and 35cm height were chosen for replication of experiment. Drainage holes were drilled in the bottom and sides of the bin for ensuring good water drainage and air circulation. Boxes were provided with a lid to conserve moisture, exclude light and scavengers and other unwanted pests.
2. **Preparation of Bed:** For the bedding materials a layers of thoroughly moistened two jute bags were placed then 200gm of some days old cow dung were spread followed by the clippings of roots of hyacinth because of their fluffy nature that holds moisture and allows air to circulate.
3. **Inoculation** 500 adult earthworms of two species *Eisenia foetida* and *Lampito mauritti* were introduced in each box.
4. **Feeding**: Shredded hyacinth were used as feeding material. 800gm of chopped hyacinth were spread at initial phase.

Later feeding material and water for maintaining moisture was added and sprayed time to time.After the vermicompost was ready, its quality was checked in terms of parameters like C:N ratio and N, P, K.

5. Methods of determination of physical and chemical parameters of plant materials and compost

Parameters	Methods
Moisture content	Hot air oven
pH	pH meter
Organic matter	Walkely and Black method
Total Nitrogen	Kjeldhal method
phosphorous	Spectrophotometer
potassium	Flame Photometer

Table 1: methods of determining physical and chemical parameters

Result and Discussion

The time required for the maturation of the vermicompost was 5 months and 14 days. The weight of raw materials fed to earthworms was 2368 gm in each boxes and the weight of moist vermicompost prepared was found to be 1123 gm. Thus, the ratio of raw materials to moist vermicompost was 2.1:1.

The differences in the physical and chemical parameters viz.,moisture content, pH, organic matter, Nitrogen Phosphorous and Potassium content and C:N ratio are shown in the table below.

Boxes (3 replicates)	Moisture content%	pH	Organic Matter%	C:N	N%	P%	K%
Before Vermicomposting	86.68	-	67.38	22.3	1.773	0.00125	0.001
After Vermicomposting	66.82	7.70	62.84	Very high	0.413	0.087	0.0232

Table2. Analysis of physical and chemical properties

Water hyacinth, being the aquatic plant, had the moisture content of 86.6 percent which is higher than the suitable condition for the earthworm 12% to 34% (Edward and Lofty, 1972 as cited in Dhimal, 2006). Since water in hyacinths are locked up within the plant so the overall compost system was as much moistened as was preferred but not that soaked. The mean pH value of final vermicompost was 7.7. The pH of finished compost is usually alkaline i.e. pH= 7.1-7.5 (Gupta, 2004). The organic matter content decreased from 67.38 to 62.84 percent which is comparatively less decrement indicating slow decomposition of the organic matter. For the compatible agricultural use, the total level of Nitrogen should not be less than 0.6 percent (Zucconi and Bertoldi, 1991). The nitrogen content of the prepared vermicompost of water hyacinth was 0.413 percent which suggests it is not still suitable to use as a fertilizer, however, the value is higher in comparison to 0.19 percent (Lohani, 2005). The decrease in nitrogen content may be due to its loss in the form of ammonia and nitrate. Due to decrease in Nitrogen content in final product the C: N ratio was very high which may be due to the loss of Nitrogen in the form of ammonia and nitrate during decomposition. A wide range of C: N ratio (40:1 or more) indicates incomplete

decomposition. Other nutrient contents like phosphorous and potassium were increased as compared to the initial feedstock but were less as compared to the normal range 0.5-0.9 percent for phosphorous and 0.2-0.8 percent for potassium(Zucconi and Bertoldi, 1991). The initial content of potassium and phosphorous in the plant sample were low and so were the value in the vermicompost although the rate of increament was high.

The heavy metal concentration in the final vermicompost of *Eichhornia crassipes*, as shown in the table below, was quite less than the limit on heavy metals of Municipal Solid Waste (MSW) compost applied to agricultural land given by USEPA, 1994.

Parameters	**Observed values(mg/L)**
Copper	0.023
Zinc	1.18
Lead	0.033
Cadmium	N.D.(<0.01)
Nickel	0.021
Chromium	N.D.(<0.01)
Arsenic	<0.005
Mercury	N.D.(<0.005)

Table 3. Analysis of Heavy Metals in vermicompost

Conclusion

The study revealed that the vermicompost from water hyacinth takes much longer time to be prepared indicated by the C: N ratio. The properties of vermicompost were quite satisfactory. The vermicompost technique may be one of the solutions for the management.

Acknowledgements

The first author expresses gratitude to the Central Department of Environmental Science, (Tribhuvan University) for the facility and support rendered. Thanks are also due to the then head of CDES, Prof. Dr. Umakant R. Yadav. I am also thankful to the Samudayik Digo Bikas Kendra, Bharatpur for the partial financial support. I would like to acknowledge my friends Ms. Anita Shrestha , Ms. Sangita Maharjan and finally to Mr. Raju Maharjan, staff of Environment Section, Lalitpur Municipality.

References

Ansari, A. A. 2009.Indigenous Approach in Organic Solid Waste Management in Guyana (South America), University of Guyana. *Global Journal of Environmental Research* 3 (1): 26-28.

Appelhof, M. 1982. Worms Eat My Garbage, Flower Press, Kalamazoo, Michigan, USA.

Chauhan. A and Joshi**.** ??? 2010. Composting of Some Dangerous and Toxic Weeds Using

Eisenia foetida. *Journal of American Science* 6(3):1-6.

Chakrabarty, D., Das, S. K. and Das, M. K. 2009. Relative efficiency of vermicompost as direct application manure in pisciculture. *Paddy Water Environ.*7:27–32

Dhimal, M . 2006 . Effectiveness of vermicomposting in management of organic waste at central zoo Jawalakhel and its relevancy to Hattisar management in Nepal. A dissertation submitted to Central Department of Enviromental Science, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Gajalakshmi??? and Abbassi????, 2002. Effect of the application of water hyacinth compost/vermicompost on the growth and flowering of *Crossandra undulaefolia*, and on several vegetables. Centre for Pollution Control & Energy Technology, Pondicherry University, Bioresource technology.85(2):197-199.

Gupta, P. K. 2004. Vermicomposting for Sustainable Agriculture. Agrobios (India).

IUCN. 2005. An Inventory and Assessment of Invasive Alien Plant Species of Nepal.

Lohani, S. 2005. Potentiality of Biogas generationfrom non-dung based plant resource in Nepal. A case study submitted to Central Department of Environmental Science, Tribhuvan University, Kirtipur,Kathmandu, Nepal.

Rakshit, A., N. C., Sarkar and D., Sen. 2008. Influence of Organic Manures on Organic Manures of Organic Manures on productivity of two varieties of rice. *Journal of Central European Agriculture*.9 (4): 629-634.

Saini, V.K., R. C., Sihag, R. C., Sharma, S. K., Gahlawat and R.K., Gupta.2008. Biodegradation of water hyacinth, sugarcane bagasse and rice husk through vermicomposting. *International Journal of Environment and Waste Management* .2(6): 601 – 609.

Sannigrahi, A. K. 2009. Management of some aquatic weeds through vermicomposting. *Indian Journal of Environmental Protection*, 29(9):809-811.

Trivedy, R.K. and P.K., Goel. 1986. Chemical and Biological Methods for Water Pollution Studies 1st edition, Environmental Publications, KARAD (India).

USEPA. 1994. Composting of Yard Trimmings and Municipal Solid Waste. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response (EPA530-R-94-003).

Zucconi,F and M.D., Bertoldi.1991. Specifications for Solid Waste Compost, the Art and Science of Composting. JG Press,Inc.Emmaus,Pennsylvania.

http://www.indiaenvironmentportal.org.in/content/management-some-aquatic-weeds-through-vermicomposting

http://www.agricultureinformation.com/forums/news-reports/16781-weeds-into-vermicompost.html

http://www.americanscience.org

http://inderscience.metapress.com/app/home/main.asp?referrer=default