Original Research Article

Evaluation of physio chemical properties in different water hyacinth composts

Arti Mathur[1*], Sanjeev Kumar Mathur[2], Rakesh Mehta[3], A. B. Singh[4], A. Subba Rao[5]

[4]Principal Scientist, [5]Ex. Director, Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal, Madhya Pradesh-462038, INDIA.
Email: artimathur101@gmail.com, asrao110@gmail.com

Abstract

The water hyacinth (*Eichhornia crassipes*) is an aquatic weed. It is free floating and originated in the wetland area of India, where it was kept under control by natural predators and it act as an extremely important alternative for meeting some of the most urgent needs of agriculture community. The experiment was conducted at the Research Farm of Indian Institute of Soil Science, Bhopal (Geographical location 23^0 18" N latitude, 77^0 24" E longitudes, altitude 485 m msl). Water hyacinth, a source of organic waste material, was collected from Kaliasot River passing by Danish Kunj, Bhopal. Cow dung as a raw material (a source of microorganisms) was collected from Lamba Kheda village near IISS, Bhopal. The composting experiment was conducted at the Research Farm with rock phosphate, lime, urea, microbial enriched culture and earthworms arranged from the Soil Biology Division, IISS, Bhopal. Among these water hyacinth composts, the highest percentage of N was evaluated in phospho nitro compost and in phospho compost with lime; their values are 1.32 and 1.27 respectively. Where the control compost gave the lowest value of N that is 1.14. The highest percentage of P and K were found in phospho sulpho nitro compost that are P 0.78, K 1.04 and the lowest percentage of P and K in control compost (P 0.35 and K 1.02).

Key Words: Water hyacinth, compost, Phospho compost, nitrogen, phosphorus, potassium.

[*]**Address for Correspondence:**
Dr. Arti Mathur, Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal, Madhya Pradesh-462038, INDIA.
Email: artimathur101@gmail.com

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INTRODUCTION

Compost is naturally not a fertilizer, while when used at normal rates compost can reduce the amount of essential fertilizer. Compost can increase the water holding capacity of sandy textured soils, and can improve structure and water movement through heavier textured soils that are high in silt and clay content. By increasing the organic content of the soil, biological activity can be enhanced. Water and nutrient holding capacity can be improved in some soils. Some compost has the ability to suppress fungal diseases; research in this area is ongoing. Composts prepared from different organic wastes differ in their quality and stability. This mainly depends upon the composition of the raw material used for the composting process (Gour and Singh, 1995, Ranalli *et al.*, 2001). Water hyacinth belongs to family Pontederiaceae. It well known species grows in all types of fresh water. Water hyacinth differs in size from a few inches to over three feet tall. Water hyacinth has flashy purple flowers and its leaves are rounded and fibrous, attached to elastic and sometime puffed up stalks. Water hyacinth is one of the most productive plants on earth and considered as one of the worst invasive aquatic weed (Gopal, 1984; Malik, 2006). Due to its fast growth and the robustness of its seeds, the water hyacinth has since then caused major problems in the whole area. At an average annual productivity of 50 dry (ash-free) tons per hectare per year, water hyacinth is one of the most productive plants in the world attributing the weed to cover water surfaces faster than most other plants (Abbasi *et al.*, 1986). The project will be beneficial for those cities where the problems of aquatic weeds are much that can be over come through removal of such weeds. The compost preparation by exploitation of water hyacinth will help to treat this aquatic weed in a way which will further enhance the productivity of soil thereby keeping various ponds and lakes of the city in healthy state. This compost will provide an alternate method in contrary to conventional

composts with an added advantage over chemical fertilizers. Therefore, water hyacinth biomass (harvested from water hyacinth in fasted natural water bodies), can be used as an effective source for bio-compost production through different types of composting.

MATERIALS AND METHODS

This experiment was conducted at the form of ICAR-Indian Institute of Soil Science Bhopal (geographical location 23^0 18" N latitude, 77^0 24" E longitudes, altitude 485 m amsl). Water hyacinth as a source of waste material collected from Kaliasot River, Bhopal and Cow dung nearby dairy farm. Rock phosphate, lime, urea, microbial enriched compost and epigeic earth worms were arranged from Soil Biology Division. ICAR-IISS Bhopal.

The details of experiment set up are given below:

Experimental setup: There were seven pits for composting, dimension of each compost pits were length 6' ×3'×2.5' (L×B×D). Approximate 500 kgs fresh water hyacinth was chopped in small pieces and filled in each of those pits along with cow dung in the ratio of 2:1.

- The bottom most layer of farm yard manure was about 1 inch thick containing about 10 kilograms.
- The second layer above the manure compost's layer was of chopped fresh water hyacinth which was about 5 inch thick needed containing about 15.7% of total water hyacinth.
- The third layer above second layer was of fresh cow dung which was about 2 inch thick containing approx 13.33% of cow dung.
- The fourth layer above the cow dung layer was of chopped fresh water hyacinth (~15.7 % of total water hyacinth) of 5 inch thickness.
- The fifth layer above fourth layer was of fresh cow dung (~13.33 %) of 2 inch thickness.
- The sixth layer above the fifth layer was of chopped fresh water hyacinth (~15.7 %) of 5 inch thickness.
- The seventh layer above sixth layer was of fresh cow dung (~13.33 %) of 2 inch thick each pit remained empty by about 8 inch for turning and watering operation.

In each pit, different materials were used for composting fresh water hyacinth with cow dung. It was observed that after 21 days material in each pit was partially decomposed, and then in each pit various treatments were imposed as mentioned in table 1 Earthworms and microbial culture were inoculated after 32 days.

Table 1: Composition of different materials used for composting from water hyacinth

Sr. No.	Material	Quantity in Kg	Material %
1	Water hyacinth + Cow dung	77+40	15.7+13.3
2	Rock phosphate	2.925	2.5
3	Lime	2.34	2
4	Urea	0.06	0.5
5	Gypsum	11.7	10
6	Earth warm	2	-
7	Microbial culture	0.0585	-

As per the shown table above mentioned materials were applied in each pit. Prepration of microbial culture and their sub cultures of fungai (*A. awamori, A hetromorphous and R. pusillus*) were prepared by using potato dextrose agar media. Seven different types of composts were developed by incorporating the materials.

Table 2: Different types of compost

S. No.	Constituents/ Treatments	Compost type	Pit
1	Water hyacinth and cow dung (T1)	Control	1
2	Water hyacinth, cow dung and rock phosphate (T2)	Phospho compost	2
3	Water hyacinth, cow dung and rock phosphate, lime (T3)	PhosphoSulpho compost	3
4	Water hyacinth, cow dung and rock phosphate, lime, urea (T4)	Phospho Nitro compost	4
5	Water hyacinth, cow dung and rock phosphate, gypsum, urea (T5)	PhosphoSulpho Nitro compost	5
6	Water hyacinth and cow dung, epigic earthworm (T6)	Vermi Compost	6
7	Water hyacinth and cow dung, microbial culture (T7)	Microbial enriched compost	7

Analytical Techniques: Different parameters were analyzed for the characterization of both substrates (water hyacinth and cow dung) and products (water hyacinth compost) by dry ashing and wet oxidation method (Issac and Johson, 1975). TOC (kjeldahl, 1883) was determined by titration method. Total Nitrogen (N) in substrates and composts were determined by (Kjeldahl, 1883).Total phosphorus (P) in substrates and composts (Jackson, 1967). Total Potassium (K) in substrates and composts (Jackson, 1967), the most common method for K determination is through flame photometer.

RESULTS AND DISCUSSION

Composting of water hyacinth biomass was completed in 7 -8 weeks. The mature composts were black in colour, granular and fibrous with pleasant earthy smell compared with control mixture which was light brown in colour, course in appearance with a foul smell. The macronutrients substrates and composts (T1, T2, T3, T4, T5, T6 and T7) were determined. Initial studies performed with S1 and S2 showed significantly higher

levels of nitrogen and Potassium in S1 in comparison to S2.

Table 3: Evaluation of physiochemical parameters of water hyacinth and cow dung

S. No.	Parameter	Water Hyacinth (S1)	Cow dung (S2)
1	TOC (%)	40	25
2	TN (%)	2.06	1.08
3	TP_2O_5 (%)	0.48	0.41
4	TK (%)	1.85	0.41

The contents of other properties and macronutrients shown in table3 such as TOC, TN, TP and, TK were 40%, 2.06%, 0.48, 1.86% respectively. The water hyacinth is rich in N and K among macronutrients then results obtained for physico-chemical of substrates and amended water hyacinth composts are further discussed.

Table 4: Analysis of physico-chemical parameters of seven different types of water hyacinth composts

S. No.	Parameters (Water Hyacinth)	Control	Phospho compost	Phospho compost (Lime)	Phospho Nitro compost	Phospho Sulpho Nitro compost	Vermi Compost	Microbial enriched compost
		T1	T2	T3	T4	T5	T6	T7
1	TOC (%)	23.3	21	31.6	35.5	23.8	27.2	24.4
2	TN (%)	1.14	1.20	1.27	1.32	1.16	1.16	1.23
3	TP (%)	0.56	0.86	0.87	0.88	0.89	0.59	0.58
4	TK (%)	1.02	1.03	1.03	1.036	1.04	1.03	1.03

Table 4 provides the data on analysis of water hyacinth compost made with incorporation of different organic, mineral and microbial cultures. The general properties of composts and the nutrient compositions of composts varied depending on the amendments applied to the organic mature. With the addition of P through rock phosphate the phosphorous concentration increased in the compost.

Total Organic Carbon: Reduction in organic matter and total C-content has direct correlation with rate of decomposition (Ros *et al*., 2006) so, total organic content of composts were measured. Total organic C-content was observed 40% for water hyacinth which was decreased with composting. Highest percent reduction was observed 21% with T2 followed by T1 and T7 (23.3% and 24.4%) composts (Table 4).

Total Nitrogen: Total N content of compost depends on the initial N content present in the feed material and the degree of decomposition (Crawford, 1983). Decrease in pH, mineralization of protein us organic material and conversion of ammonium nitrogen into nitrate may be responsible for addition of N in compost (Yadav and Garg, 2011). Total nitrogen (TN) content in the prepared composts was approximately equal to initial substrate (S2). The initial TN content of the substrates was 2.06 and 1.08 g kg-1 for S1 and S2, respectively. Whereas, TN content of treated composts was in the range of 1.16 to 1.23 g kg-1 after composting. **Total Phosphorous:** Phosphorous is also an essential element for plant growth which also increased on composting. This may be due to transformation of unavailable forms of phosphorus to easily available forms by microbial enzymes like alkaline and acid phosphates etc. On composting, phosphorous content were enhanced in all composts. Maximal increase was found in compost (T5) approx 58.90% followed by T4 (57.1%) and T3 (55.4%) composts. Acid phosphatases and alkaline phosphatases may be responsible for this Transformation (Ghosh *et al*., 1999). After vermicomposting phosphorus content was highest in T4 and T5, and minimum in T1, CD + WH mixture (Table4).

Total Potassium: The potassium (K) content was greater in all the composts than initial waste (S2) (Table 3). The increase in potassium content was 1–2% in the composts as compared with K content in control. The differences in the results can be attributed to the differences in the chemical nature of the initial raw materials. (Suthar 2008) has reported 104 - 160% increase in potassium content during vermicomposting.

CONCLUSION

The result of the studies have shown that the water hyacinth composts prepared by combining different amendments such as rock phosphate, lime, urea, gypsum microbial cultures and earthworm, the highest percentage of N was evaluated in phospho nitro compost and in phospho compost with lime; their values are (1.32 and 1.27) respectively. Where the control compost gave the lowest value of N that is 1.14. The highest percentage of P and K were found in phospho sulpho nitro compost that are P 0.89, K 1.04 and the lowest percentage of P and K in control compost (P 0.56 and K 1.02).

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