

# Vermicomposting Water Hyacinth: Turning Fisherman's Nightmare into Farmer's Fortune

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**Abstract:**-Water hyacinth (*Eichhornia crassipes*) in Lake Victoria has caused water loss through evapotranspiration, provided a breeding ground for mosquitoes and interfered with fishing and navigation. The weed contains macronutrients such as nitrogen (2.5%), phosphorus (1.0%) and potassium(5.3%) which can be made available to plants by using earthworms to convert the plants into compost. The worm cast and vermicompost obtained is a better source of organic manure than other aerobically or anaerobically degraded compost and has a lower environmental impact than chemical fertilizers. This study investigated the vermicomposting of water hyacinth by the fast-growing composting worm *Perionyx excavatus* and determined the concentrations of macronutrients. It was found that the vermicompost contained 47% more nitrogen, 60% more phosphorus and 40% more potassium than compost produced without worms. This suggests that vermiculture could be a means of reducing water hyacinth in Lake Victoria or other water bodies while producing a valuable agricultural product.

**Keywords:** Waterhyacinth, vermicompost, macronutrients, *Perionyx excavatus*, microorganisms, farmer

## I. INTRODUCTION

Water hyacinth, *Eichhornia crassipes* is one of the most widespread, persistent, troublesome and harmful aquatic weeds [1]. It causes enormous losses of water through evapotranspiration, provides a breeding ground for obnoxious insects like mosquitoes, and prevents light penetration into the water below. This inhibits photosynthesis of submerged aquatic plants and phytoplankton, which can contribute to deoxygenation. The weed, which invaded Lake Victoria in 1989 [2], spread to cover about 17,000 ha in Kenya by November 1998 but this declined to about 400 ha in 2001. The decline was attributed to biological control by weevils (*Neochetina* spp.) and mechanical control [3]-[5]. Beaches covered by hyacinth mats varied in size but when they were totally covered there was a significant impact on communities by reducing economic and recreational activities on the lake. These included swimming and washing, boating and navigation, and fishing, with fish catchability decreasing by as much as 45%. [6]- [7].

The weed has some beneficial uses, however, especially as a source of macronutrients such as nitrogen, phosphorus and potassium that are essential for plant nutrition [8]-[10] and it can be used to improve soil fertility and increase crop yields [11]-[12]. It is therefore a potentially valuable resource

in a region where continuous land cultivation has led to reduced soil fertility and crop productivity [13]. These macronutrients are only available in bound forms, and their conversion into forms available to plants is enhanced by the activity of earthworms [14]-[16].

Vermicomposting involves the biodegradation of organic wastes into an amorphous, dark brown, microbially active, humus-rich substance under conditions of optimum temperature, moisture and aeration. It is environmentally sound, requires little energy, capital or equipment, and does not involve intensive management [17].

The resultant material, vermicompost, provides a base for the establishment of beneficial microorganisms such as nitrogen-fixers, actinomycetes, fungi and free-living microbes whose activity is essential for the release of diverse nutrients to plants [18]. Such beneficial microbes include soil bacteria that produce vitamins, growth hormones, enzymes, antibiotics, and immobilized microflora that promote plant growth [15]-[16] and increase yields[15]-[19].

Growth hormones such as gibberellins, cytokinins and auxins are released by metabolic activity in vermiculture while it contains antibiotics and actinomycetes which contribute to the control of pests and diseases [15] while the application of vermicompost to fields improves the physico-chemical and biological properties of soil [18], [20].

Inorganic fertilizers are expensive and are not readily accessible to many small-scale farmers [21]. Furthermore, an increase in the use of inorganic fertilizers has been linked to increased health hazards in humans and livestock, and severe environmental problems like water and soil pollution, [18],[22],[23]. This highlights the importance of organic composts such as those produced by earthworms, and this paper discusses the role of vermiculture in utilising water hyacinth. In particular, it compares the concentrations of selected macronutrients (N, P and K) in the vermicompost with that of natural composting.

## II. METHODS

The earthworm *Perionyx excavatus* was used in this study. It matures rapidly (24) and starts producing cocoons at 8-12 weeks and has a wide range of temperature (8-35°C) and moisture tolerance. Being a non-burrower, it leaves its

excrement as loose mounds on the surface and it can be recovered to use as compost.

Twelve jute bags of water hyacinth were collected from ponds on the campus of Annamalai University, Chidambaram, India, and dried in the sunlight for 20 days. The water hyacinth was then chopped into small pieces and buried in a pit (1.8 x 1.5 x 1.2 m) and moistened by sprinkling it with water daily for two weeks to enable semi-decomposition to occur.

The experiment was carried out at a temperature of 25 ±2°C and at a 75% moisture content. Six cement cisterns measuring 50 x 30 x 20 cm were used as worm bins for this study, with three serving as experimental bins and the other three as the controls. Semi-decomposed water hyacinth was put in the cisterns and 200 adult worms were introduced in each of the experimental cisterns. Water was sprinkled daily in all the cisterns to ensure a moisture content of 70-80%, and the experiment lasted for 25 days.

The concentrations of nitrogen, phosphorus and potassium in the water hyacinth were determined in samples taken at the time of the worm introduction, and after 25 days, from both the experimental bins and controls. Nitrogen (N) was determined by the macrokjeldahl method (25), phosphorus (P) by the vanadomolybdate yellow colour method (26) and potassium (K) by flame photometry (25). The crude protein content was estimated by the formula  $N \times 6.25$  where N = nitrogen content (27).

Table I. Comparative Values of N, P, K and Crude Protein in Natural Compost (control) and Vermicompost (experimental), both made from Water hyacinth.

Treatment	Initial	Control	Experimental
Day	0	25	25
N (%)	1.27	1.58	2.32
P (%)	0.98	1.70	2.30
K (%)	2.02	2.08	2.90
Protein (%)	7.9	9.9	14.5

### III. RESULTS

The nitrogen concentration increased by 24% and by 82% in the experimental bins (Table I) and the difference between the control and experimental was highly significant (t-test,  $p < 0.01$ ). The phosphorus content increased by 73% and 134% in the control and experimental samples respectively, and the differences between treatments was also highly significant (t-test,  $p < 0.01$ ). Potassium increased by 3% in the controls but by 43% in the experimental treatments which is also a highly significant increase ( $p < 0.001$ ).

### IV. DISCUSSION

Earthworms, known to man from the time of Aristotle, who called them the "intestines of the earth" have been recognized

as the most important soil invertebrates for their contribution to the fertility and productivity of the soil. Earthworms have been used to compost different forms of organic waste, such as animal and plant waste, sewage sludge, sugar factory wastes, cow and horse dung, pig and cattle slurries and the droppings of poultry and rabbits (28). In all cases, the materials were turned into NPK-rich vermicompost. Earthworm vermicompost, with continuous application, releases the nutrients slowly and at a constant rate and protects plants (15). Increased concentrations of nitrogen, phosphorus, potassium and crude protein are well documented in vermicompost (15),(24). The present results, showing that nitrogen, phosphorus, potassium and crude protein were from 14-46% higher in vermiculture than in the wormless, natural compost clearly establishes the role of *P. excavatus* as a good composter. Thus, vermiculture offers a means of converting waste from water bodies into a rich manure.

Fishing is the major industry on the lake and water hyacinth mats may invade fishing grounds causing loss of fishing nets and blocking waterways, thus delaying access to markets. It was estimated that fish catches decreased by 5-45% (with the most severe effects being recorded in Kenya) during the period when the lake was most severely affected by water hyacinth [7],[29]. To the farmer however, this weed could be a fortune since it is very rich in plant nutrients, and with vermiculture, these nutrients can be released much faster than the natural decomposition process.

### V. CONCLUSION

Water hyacinth is thus not just an enemy but also a friend of the lakeshore communities.

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