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Water Hyacinth- A Substitute for Other Sources of Raw Materials for Vermicompost Production

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SUMMARY

Aquatic weeds, such as water hyacinth, are often viewed negatively due to their invasive nature and the problems they cause in water bodies. Uncontrolled proliferation of these macrophytes endangers these ecosystems, having both economic and ecological implications; therefore, they need to be managed. However, many are not aware of the significant potential and economic value of these profusely growing invasive weed plants. Increasing awareness about the benefits of aquatic weeds can help shift perceptions and promote sustainable practices. However, its lower nutrient content makes it less preferable among farmers and limits its applicability. In this article we have discussed vermicomposting of aquatic weed water hyacinth (Eichornia crassipes) using Eisenia fetida as a substitute for other sources of raw materials for vermicomposting. Several scientists have found that the nutrients of vermicompost analysed showed an enhanced nitrogen (2.56 %), phosphorus (1.90 %), potassium (1.35 %), calcium (1.85 %), magnesium (1.70 %), iron (0.70%) and organic carbon (33.0%). Therefore, we can conclude that water hyacinth vermicompost could be a used as a good biofertilizer in the field to increase the fertility of soil. Moreover, it is an ecofriendly method to solve the chronic problem of Eutrophication in aquatic water habitats.

INTRODUCTION

Water hyacinth (*Eichhornia crassipes*) is a fast-growing perennial aquatic plant commonly found in wetlands, lakes, rivers, and other water bodies. It thrives particularly well in nutrient-enriched water, making it a prolific and often problematic species due to its rapid growth and spread. (Wilson *et al.* 2005). The dense mats formed by water hyacinth can obstruct rivers, canals, and lakes, affecting water transportation and irrigation systems. (Opande *et al.* 2004). The thick canopy of leaves prevents sunlight from reaching submerged aquatic plants, which can lead to the death of these native plants that rely on sunlight for photosynthesis and it reduces nutrients for young fish in sheltered bays (Sindhu *et al.* 2017).Water hyacinth provides ideal breeding grounds for mosquitoes and for certain species of snails that are vectors for diseases. For example, the aquatic snail Biomphalaria is known to carry the parasitic flatworms responsible for schistosomiasis (bilharzia), a significant health problem in many tropical and subtropical regions. Water hyacinth clogs the supply intakes of hydroelectric plants, disrupting the flow of water necessary for power generation. It also obstructs the access to fishing areas and beaches, making it difficult for local communities to engage in subsistence fishing. Therefore, the control of this invasive weed requires a multifaceted approach that combines chemical, physical, and biological methods. However, control of the weed has met with little success (Abdelsabour, 2010), in turn a need for an alternative mean of its control arouse. Ongoing research, international collaboration, and community involvement are crucial for developing and implementing effective control strategies. Therefore, the control of this invasive weed receives attention and many efforts have been made to control these weeds through chemical, physical and biological methods.

Water hyacinth compost, as an organic source, significantly contributes to the enhancement of soil organic matter, which plays a vital role in enriching the soil's physical, chemical, and biological properties. Water hyacinth compost promotes the formation of stable soil aggregates, increases soil porosity, reduces soil bulk density and improves the soil's ability to retain moisture. Water hyacinth compost provides a slow-release source of essential nutrients like nitrogen, phosphorus, potassium, and trace elements. cation exchange capacity, pH, soil microorganism are the some other soil properties reported to improve with water hyacinth compost application (Begum *et al.*, 2022).

Table 1: Nutrient composition of water hyacinth plants

Sl. No.	Contents	Fresh Plant (%)	Zero-Moisture Basis	Composition of Ash
1.	Moisture	95.5	-	-
2.	Nitrogen (N)	0.04	1.5	-
3.	Ash	1.0	-	-
4.	Phosphorus(P_2O_5)	0.06	-	7.0
5.	Potassium (K_2O)	0.20	-	28.7%
6.	Chlorine (Cl):	-	-	21.0
7.	Calcium (CaO	-	-	12.8
8.	Sodium (Na_2O)	-	-	1.8
9.	Organic Matter	3.5	75.8	-

Source: (Jafari, 2010)

Effect of water hyacinth vermicompost on soil properties

Inorganic fertilizers, while effective, present several challenges for small-scale farmers and the environment (Chianu *et al.*, 2012). The high cost and limited accessibility make them a less viable option for many farmers. Additionally, the increased use of inorganic fertilizers has been associated with significant health risks for humans and livestock. These fertilizers can lead to severe environmental issues such as water and soil pollution. Water hyacinth, an invasive aquatic plant, can be effectively converted into vermicompost, providing a sustainable solution for its management while enriching the soil. This vermicompost has been found to be superior to town compost and farm yard manure in terms of nutrient content. Specifically, it contains higher levels of essential nutrients such as nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O). Additionally, the carbon to nitrogen ratio of water hyacinth compost is more favourable, indicating better nutrient availability and balance. In fact, it is reported to be four times richer in nutrients compared to farm yard manure, making it an excellent organic fertilizer option for enhancing soil fertility and crop productivity (Basak, 1948). Balasubramanian *et al.* (2013) reported that the soil organic matter ranged from 0.64-3.57% in soil mulched with water hyacinth throughout cropping period and influences soil physical properties inclusive of aggregate formation, porosity, bulk density, cation exchange capacity, water holding capacity.

Addition of water hyacinth vermicompost into the soil enhances aggregate formation which varies with application rate. Water hyacinth-based compost decreases bulk density in soil as we know that bulk density is inversely related to total porosity. Oroka, 2013 also reported similar results where he found that in sole cassava and cassava-groundnut intercrop with application of vermicompost prepared from mixture water hyacinth and farm manure, an increase in total porosity and corresponding decrease in bulk density than untreated plots. Agbede *et al.* 2008 also reported that the decline in soil bulk density with a related expansion in porosity under water hyacinth based manures might be because of more significant measure of organic matter deposition.

Water hyacinth vermicompost improves CEC which is beneficial for plant nutrition, as it ensures that essential nutrients are more readily available to plants. The soil's ability to retain and exchange cations, such as calcium, magnesium, potassium, and sodium has increased with the addition of this vermicompost. As aggregation and porosity increases either micro pores or macro pores, water holding capacity also increases with higher amount of micro pores. Khan and Sarwar, 2002 found that the water holding capacity of sandy loam soil increased from 8.21 to 10.16% with addition of 1000 g of water hyacinth compost.

Effects of water hyacinth vermicompost on growth and yield

Availability of essential mineral nutrients required for plant growth and development has been enhanced due to the application of water hyacinth vermicompost that influences several growth parameters such as germination percentage, number of leaves, leaf area index, plant height, length of shoot and root, root: shoot ratio,

biomass content, collar root diameter. Hawkesford *et al.* 2012 ported that Nitrogen and phosphorous are the primary elements needed by plants. Phosphorus is important in root growth and development and therefore nutrient uptake; while nitrogen is important in chlorophyll formation for photosynthesis and protein formation hence fast growth.

The nutrients are released through mineralization process of organic matter content which improves moisture retention capacity of soil and thereby released nutrients become readily available for plant uptake with improved dissolution of those nutrients. Olupot, 2004 reported that more number of microorganisms in the water hyacinth vermicompost improves soil aeration and enhance uptake of dissolved nutrients by the roots and better growth and development of crops. Several studies revealed that yield components such as panicles/pot, seed index increased significantly with application of water hyacinth vermicompost either alone or fortified with nutrient rich locally available sources. Khan and Sarwar, 2002 also reported similar increase in yield of rice from 19.7% to 22.3 with application of water hyacinth compost at a rate of 1000 g per pot.

CONCLUSION

Vermicomposting of water hyacinth, therefore stands out to be an economically viable, environmentally friendly, socially acceptable technique for managing this menace weed from the environment. It leverages the natural activity of earthworms to produce high-quality organic fertilizer that supports sustainable agriculture which in turn promotes community engagement and generates employment. Infact, vermicomposting is a onetime investment technology as earthworms reproduce at a faster rate under congenial environment with very little inputs. Vermicomposting water hyacinth will not only reduce the harmful impact of this invasive weed but also will reduce surface and ground water pollution besides producing organic matter for the soil to improve soil heath for agricultural sustainability.

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