Hydrilla verticillata: Effective Management Approaches

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ABSTRACT

Hydrilla verticillata is a submerged, invasive aquatic weed found in freshwater. It is a resilient plant and can withstand a variety of physical and chemical conditions such as pH, temperature and nutritional level of water body. While its notorious nature and detrimental effect on aquatic ecosystem, adaptability and nutritional properties offer opportunities for innovative solutions. Utilizing *Hydrilla* for value added products is a promising avenue. Biogas production from plant biomass could provide renewable energy while mitigating its spread. Composting could not only reduce its volume but also create nutrient rich soil amendments. Moreover, its capacity for phytoremediation particularly in accumulating heavy metals holds potential for cleaning polluted water bodies.

INTRODUCTION

Hydrilla verticillata commonly known as *Hydrilla* or water thyme is a submerged, perennial and vascular aquatic plant native to warmer regions of Asia including parts of China, Indonesia and Malaysia. It is found in freshwater environments and is a member of the Hydrocharitaceae family. In addition to growing more quickly than other submerged plants after artificial transplantation. *H. verticillata* is also more suited to absorb nutritional salts like phosphorus and nitrogen, which can be utilized to restore water (Wei *et al*., 2019). *H. verticillata* is an invasive and

extremely resilient plant that can store carbohydrates in large quantities through its vast root system. *Hydrilla* plant biomass is primarily composed of shoots and leaves as opposed to roots and length of a stem can exceed 35 feet. *Hydrilla* plants produce a dense mat on the water surface with about 80% of their biomass remaining in the top two feet of water (Shrivastava and Srivastava, 2021). *H. verticillata* is distributed across various states in India including West Bengal, Kerala, Tamil Nadu, Uttar Pradesh and Jharkhand. The distributions of *Hydrilla* in these states highlight its widespread presence and adaptability to diverse freshwater environment in India (Jain and Kalambhad, 2018). *H. verticillata* contains both C_3 and C_4 photosynthetic enzymes in one cell. Transitioning from C_3 to C_4 photosynthesis is an intriguing adaptation strategy observed in *Hydrilla* plant under extreme environmental condition such as high temperature, prolonged light exposure as well as fluctuation in CO_2 level (Von Caemmemer *et al*., 2014). *Hydrilla* plants can withstand both low-nutrient (oligotrophic) and high-nutrient (eutrophic) environments, broad pH ranges, salinity up to 7% or higher, temperatures upto 30°C (ideally 20–27°C) and light levels as low as 1% for photosynthetic activity (figure 1). Additionally, rocky, sandy and organic substrates all support the growth of *Hydrilla* plants.

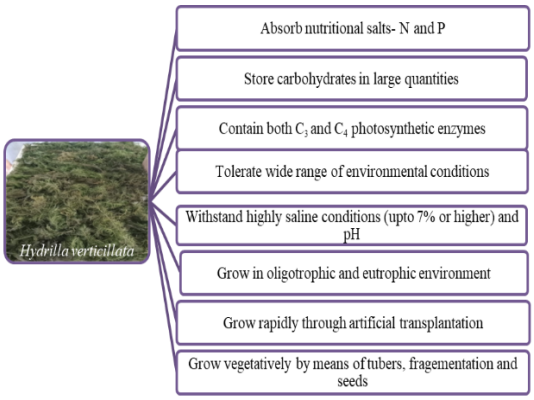

Fig. 1: Characteristics of *H. verticillata*

Chemical composition of *Hydrilla verticillata*

Protein and crude fiber content in *H. verticillata* has been reported to be 17.1% and 13.3%. Magnesium, calcium and potassium are the other important macronutrients discovered in *H. verticillata*, with respective concentrations of 0.9, 4.5 and 2.9% and when there is a shortage of phosphorus; *H. verticillata* can store phosphorus for a longer period of time. It can be applied as organic fertilizer; this availability of nutrients promotes better plant development and cultivation.

Negative impacts of *H. verticillata*

The dense growth of *Hydrilla* can impede water flow, affecting oxygen level and can also lead to the displacement of native aquatic vegetation. Ecologically significant submerged species like coontail (*Ceratophyllum demersum*), tape grass (*Vallisneria Americana*) and *potamogeton* spp. are negatively impacted when *H. verticillata* is introduced into water bodies. The presence of *Hydrilla* can have significant economic impact in recreational areas as the dense mats of *Hydrilla* can hamper swimming and fishing activities. Its growth can create stagnant water conditions providing breeding ground for mosquitoes and other vector of disease.

Management of *H. verticillata*

Controlling *Hydrilla* can indeed be challenging due to its resilience and potential environmental consequences of chemical and biological treatments. Finding sustainable and cost-effective methods to manage *Hydrilla* while minimizing harm to the environment is crucial. Mechanical removal, biological controls and targeted herbicide application can help strike a balance between controlling *Hydrilla* and preserving ecosystem. Biological control agents such as herbivorous fish-like grass carp or insects like *Hydrilla* weevils, which feed on *Hydrilla*, can help in controlling

its growth. However, this method requires careful consideration to avoid unintended consequences on native species.

Innovative approaches for management of *H. verticillata*

Biogas production

Rapid growth rate and high biomass poduction of this plant makes it a potentially valuable source of renewable energy. *H.verticillata* can be used a feedstock for biogas production because it has high moisture content, carbohydrates and has low C/N ratio (Wang *et al*., 2012). Co-digestion of *H. verticillata* (low C/N ratio) and rice straw (high C/N ratio) has been found to enhance methane content by 40% (Kainthola *et al*., 2019).

Composting

The process of biologically breaking down and stabilizing organic substrates is known as composting. Moisture content and C/N ratios are important factors responsible for composting of substrate as these affect the microbial activity, nutritional value and quality of end product. Over 60% moisture is required for the composting process and *H. verticillata* contains a good amount of moisture, thus it can be composted to produce organic fertilizer for agricultural use.

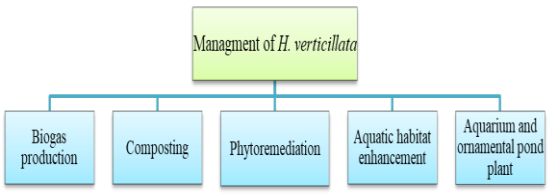

Fig. 2: Benefits of *H. verticillata*

Phytoremediation

H. verticillata holds promise for phytoremediation due to its ability to absorb nutrients and pollutants from water. Phytoremediation is a green technology that utilizes plant to remove, degrade or immobilize contaminants from soil, water and air. Some studies have demonstrated *Hydrilla*'s ability to accumulate heavy metals such as cadmium, lead and mercury from water bodies. By absorbing these metals into its tissue, *Hydrilla* can help in reducing their concentration in water, mitigating the toxicity to aquatic organisms (Lafabrie *et al*., 2013).

Aquatic Habitat Enhancement

Hydrilla can provide habitat and food for aquatic organisms. When managed appropriately, it can contribute to the biodiversity of aquatic ecosystems, supporting the ecological balance.

Aquarium and Ornamental Pond Plant

Attractive appearance, ease of maintance, long trailing stems and vibrant green foliage make *Hydrilla* an appealing addition to fresh water aquarium and ornamental ponds, providing visual interest and natural habitat for aquatic species.

CONCLUSION

By employing these economical methods for managing *Hydrilla*, not only the negative impacts on ecosystems, water quality and recreational activities can be mitigated but valuable resources such as biogas, compost etc. can also be extracted from this invasive species.

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