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A Review on Water Hyacinth (*Eichhornia crassipes*) and Usage in Agriculture

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Water hyacinth is an invasive weed that grows all freshwater conditions or the environment. One of the most effective invaders of the aquatic plant kingdom is Water hyacinth (*Eichhornia crassipes*). It grows quickly and has been known to double in number in only two weeks. Its quick spread across a wide area of water results in numerous issues, including impassable barriers in lakes, navigational obstructions, drainage blockages in lower channels that result in floods in upper channels, and obstructions to the flow of water in irrigation pipes (Charudattan 1982). Millions of rupees are being spent by governments worldwide to control this plant (Praveena and Naseema 2004). Because of its beauty, it has spread to many areas of the world as an ornamental garden pond plant after emerging from the Amazon basin. It was first introduced in Egypt in 1879 and also in the United States in 1884 as an ornamental plant, which the native place belongs South America. It is also thought that water hyacinth was originally brought from Brazil to India in 1896 as an ornamental plant (Rao, 1988). It's the most common, enduring, and problematic aquatic weed in India.

Water hyacinth is a freshwater perennial free-floating hydrophyte with long dark roots, belonging to the family *Pontederiace.* The plant varies in size from a few inches to over 3 feet. The leaves occur in blue-green color look like a purple or lavender flower and have thick stalks. It grows particularly in tropical and sub-tropical climatic areas and has a high nutritional content in water. The temperature range that water hyacinth tolerates is between 21.1 to 27.2 °C, and its estimated pH tolerance range is between 5.0 to 7.5 (Vidya, S., & Girish, L. (2014).

It has been stated that under ideal circumstances, wet water hyacinths may grow up to 17.5 metric tons per hectare each day. In India, the average water hyacinth output is said to be 150 MT fodder/ha/year.

Impact of Water Hyacinth Compost on Plant Development

The use of water hyacinth-based compost affects a number of growth characteristics. Growth parameters include germination %, number of leaves, leaf area index, plant height, shoot and root lengths, root: shoot ratio, biomass content, and collar root diameter. In general, the trials revealed that compost application enhances the mean values of the aforementioned qualities considerably or non-significantly compared to control. It is due to the availability of key mineral nutrients necessary for plant growth and development. Water hyacinths can be utilized to produce compost or biogas. The biogas sludge includes nearly all of the substrate's nutrients and may be utilized as fertilizer. The usage of water hyacinth compost on various crops has increased yields. Plants primarily need nitrogen and phosphorus. Phosphorus is crucial in root growth and development, and hence nutrient intake, but nitrogen is important in chlorophyll creation for photosynthesis and protein formation, resulting in rapid growth (Hawkesford et al., 2012). These nutrients are released through the mineralization process of

organic matter content, which also enhances soil moisture retention capacity, and as a result of better solubility, those released nutrients are easily available for plant uptake. Water hyacinth compost may also be used to improve the qualities of alluvial soil and promote the development of red ginger. Mashavira et al. (2015) that water hyacinth compost applied at a rate of 74.1 t ha-1 slows the maturation of tomato fruits because increased nitrogen availability boosts plant growth and encourages vegetative growth at the expense of fruiting and maturing. Compost generated from water hyacinth alone has been demonstrated to produce superior quality compost than compost made from a mix of water hyacinth and manure, implying that composted water hyacinth might be utilized as a replacement to peat in nursery substrates (Fan, R., Luo, J et all., (2015). Mixtures of water hyacinth produced into agricultural fertilizers from various types of animal wastes, plant wastes, household and domestic wastes, etc. are applied to promote water retention in soils in landlocked locations. In India, compost developed from water hyacinth, cow dung, and sawdust in a 6 : 3 : 1 ratio increased all nutrients (N, P, Na, K, and Ca) and enhanced compost stability (Singh, J., & Kalamdhad, A. S. 2015). This demonstrates that water hyacinth is an effective raw material for compost manufacture.

Challenges in Utilization of Water Hyacinth

In less developed nations, water hyacinth harvesting is done manually, which involves removing aquatic plants from the water surface with the use of hands. As a result, hand reaping is labor-intensive, requires a lot of energy, has poor proficiency, and is inefficient in large lakes or bodies of water. It takes more time (Cerveira Junior and Carvalho et al., 2019) and may result in harm to humans and aquatic wildlife. These disadvantages can be mitigated with mechanical harvesting, which uses mechanical mowers, destroyer boats, mechanized dredgers, weed harvester tractors, and crusher boats to extract weeds from bodies of water. This method of harvesting has a somewhat high initial capital cost. Water hyacinth, as a plant biomass, is principally represented of three constituents: lignin, cellulose, and hemicellulose, which are seldom accessible to microbes during organic manure decomposition. Lignocellulose is the primary organic molecule that limits the rate of composting of agricultural and forestry waste, with lignin serving as a key source of speed-limiting compounds (Patel et al., 1993). To produce high-quality water hyacinth compost in a shorter amount of time, lignin, cellulose, and hemicelluloses must be degraded faster throughout the composting process. Water hyacinth can be inoculated with an external lignin degrader or composted using a rotating drum. Rotary drum composting produces high-rate composting due to proper mixing of composting materials and a greater thermophilic temperature (Singh and Kalamdhad et al. 2014). Water hyacinth is a well-known pollutant-removal agent, particularly for heavy metals. As a result, it remains questionable whether absorbed heavy metals can accumulate in plant tissues when water hyacinth is used to make compost. In general, water hyacinth roots absorb more heavy metals than shoots, and these roots and rhizomes can be eliminated from compost production as a first-line method of reducing heavy metal buildup. On the other hand, powdered water hyacinth may be turned into a slurry and fermented for three months to lower heavy metal content (So et al., 2003; Sanni and Adesina, 2012). Leaching causes the loss of nutrients, particularly nitrogen and potassium. Another issue connected with composting is the loss of nutrients, particularly nitrogen and potassium, through leaching (Guo et al., 2012; Goyal et al., 2005, Masaka and Ndhlovu, 2007) and denitrification (Prasad et al., 2013). The loss of nutrients slows composting maturity (Osoro et al., 2014; Lata and Veenapani, 2011; Seoudi, 2013) and lowers compost quality.

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