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Water Hyacinth - Effective Remediation for Heavy Metal Pollution

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Abstract

Water hyacinth (*Eichhornia Crassipes*) is a fast-growing aquatic plant considered as a weed when growth is not controlled. Heavy metal pollution in water bodies is increasing at alarming rate, reducing the quality of water bodies. Water hyacinth is typical example for hyper accumulators of heavy metals. Research studies shows that *Eichhornia crassipes* was able to accumulate chromium in its shoots at 223 times and zinc at 134 times than the concentration in the water. The presence of potential metal sites mainly on stems and roots makes the hyacinth a good tool for heavy metal extraction. The microorganisms associated with roots helps to do the transition of heavy metals by producing enzymes. It is not advisable to use the water hyacinth for compost making if it's growing in contaminated water bodies.

Introduction

The water hyacinth (*Eichhornia Crassipes*) is a fast-growing aquatic plant native to the Amazon basin which reproduces by means of stolon and seeds. Water hyacinth can grow well in tropical desert to rainforest zones. The optimum temperature for the growth of hyacinth is below 34 °C and plant does not tolerate soil salinity. When the growth is not controlled, water hyacinth can cover the water bodies and affect the quality of water system and act as a weed.

A water body can be said polluted if it contains unwanted substances and where these substances interfere with the natural functioning of water bodies. These unwanted substances reduce the quality of water bodies are called pollutants and the one of the major sources of water pollution is industrial activities. Pollution of water bodies with heavy metals, oil spills and heavy load of organic substance is one most alarming topic nowadays and the main hurdle here is to find out proper method to remove pollutant from water bodies (Pravin, 2012).

Apart from the point of view as a weed, water hyacinth plays an important role in purifying water by absorbing and locks up the impurities from the water. As water hyacinth can accumulate large number of contaminants due to its proliferous growth, it is not edible for human consumption. Thus, water hyacinth, high biomass producing aquatic weeds considered as a phytoremediator mechanism for polluted and contaminated water. Normally aquatic plants are receptable for all kind of waste like industrial wastes, heavy metals, municipal wastes, sludges and sewages *etc.* But water hyacinth have been studied extensively for their ability to remove the heavy metal from water. In Phyto-filtration, plants function as biofilters; thereby effectively sequester metals from polluted or contaminated water (Metcalf *et al.*, 1916). So, the success of Phyto-filtration depends on the plant growth rate and the

ability to concentrate a high amount of metal in Phyto-mass without experiencing phytotoxicity.

Eichhornia crassipes as Hyperaccumulator

Research studies shows that *Eichhornia crassipes* was able to accumulate chromium in its shoots at 223 times and zinc at 134 times than the concentration in the water. So, *Eichhornia crassipes* can be considered as a heavy accumulator. Heavy accumulators defined based on bioconcentration factor or the ability to accumulate metals in plant tissues. Bioconcentration and translocation factors are the best way to measure the efficiency of plants for trace element accumulation and translocation from contaminant environment (Upadhyay *et al*., 2007).

Mechanism

Water hyacinth contains many potential metal binding sites for both cationic and anionic metal complexes. Potential metal binding sites includes carboxyl, amine, imidazole, phosphate, sulphate, sulfhydryl and hydroxyl. Scanning electron microscope image shows that maximum numbers of binding sites are located on roots and root hairs. Water hyacinth is not only capable to absorb and accumulate heavy metals but also it could tolerate the toxicity by converting it from chemically active toxic state to inactive, non-toxic state. Soil microorganisms, which live in close association with plants support to absorb heavy metal by producing hormones mainly siderophores. When plants are growing in soils contaminated with heavy metals, microorganisms support the plant to sustain by limiting the level of stress hormone, mainly ethylene.

Water hyacinth root is enriched with thick microbial growth which helps in degradation of heavy metals in water bodies. The oxygen need of microbes is mostly satisfied by the photosynthesis of water hyacinth. The diffusion of oxygen seems to be ineffective here because of proliferous vegetative growth. The oxygen generated by water hyacinth due to photosynthesis is useful for the facultative and aerobic bacteria to degrade organic matter. Cyanide degradation by water hyacinth was effective in controlling pollution. Water hyacinth can grow in oil refinery waste water after the water has undergone an initial treatment of oil separation. Water hyacinth is used as biological indicator to indicate heavy metal pollution in tropical areas.

In water bodies, heavy metals displayed high level during the summer seasons presumably due to high evaporation and accumulation of heavy metals mainly concentrate in roots of water hyacinth. Generally, rhizomes and roots of water hyacinth remove most of the heavy metals from the aquatic habitat or constructed wetland. Therefore, it is undesirable to involve contaminated rhizomes and roots in fodder or compost. But it was noted that there was good removal of heavy metal when the contamination level is low. Studies indicated that water hyacinth is a good accumulator for Cadmium (Cd) and Chromium (Cr) and poor accumulator for Arsenic (Ar) and Nickel (Ni). Upadhyay *et al.* (2007) stated that in several countries, water hyacinth is successfully used for biogas production in fermenters in the ratio of 25% cowdung and 75% of dry water hyacinth, yield best rates of methane production.

Conclusion

Pollution is considered as one of the major undesirable effect on society due to urbanization, industrialization, population growth *etc*. The proliferous growth and metal binding capacities of water hyacinth could be very useful to mitigate heavy metal pollution in water bodies and thus helps in improve the quality of water bodies. So, there is a need of proper research to explore the capacity of water hyacinth in mitigating the heavy metal pollution.

References

Metcalf, L., Eddy, H.P., 1916. American Sewerage Practice. *Disposal of Sewage,* McGraw-Hill Book Company Vol 3, p. 187.

Pravin, U., Ravindra, M., Manisha, P., Deepak, V., 2012. Aquatic pollution in Mithi River of Mumbai: assessment of physico-chemical parameters. *Interdisciplinary Environmental Review* 13(4), 245–268.

Upadhyay., Alka, R., Tripathi, B.D., 2007. Principle and Process of Biofiltration of Cd, Cr, Co, Ni & Pb from Tropical Opencast Coalmine Effluent. *Water, Air, & Soil Pollution*, Springer 180(1-4), 213–223.