A Study on Phytoremediation Properties of Aquatic Plant Ceratophyllum demersum

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Abstract- *Water Contamination by heavy metals in some area is practically inevitable due to natural and anthropogenic activities. Environmental exposure to toxic heavy metals is one of the main important issues on environment. Aquatic plants are known to accumulate heavy metals. So, Phytoremediation process refers to the use of aquatic plants to clean up contaminated soil and ground water through the natural biological, chemical or physical activities and processes of the plants. Ceratophyllum demersum is one of the submerged aquatic plant which is used as in phytoremediation process. The present paper is an attempt to provide a detailed habitat, botanical description, natural phytoremediation properties of aquatic plant Ceratophyllum demersum.*

Keywords- Phytoremediation, Agricultural, Heavy metal, Environment

I. INTRODUCTION

Water Contamination by heavy metals in some area is practically inevitable due to natural process (Weathering of rocks) and anthropogenic activities (industrial, agricultural and domestic effluents) [1]. Environmental exposure to toxic heavy metals is one of the main important issues on environment and public health [2]. Therefore, their removal from wastewaters, particularly, has been examined extensively. A range of methods has been used for heavy metal removal and one of the most common methods is adsorption, with activated carbon being the most widely used adsorbent for this purpose. However, this can be expensive and there has been considerable interest in the use of other adsorbent materials, particularly biosorbents [3], [4].

Phytoremediation refers to the use of green plants to clean up contaminated soil and ground water. The plants used in phytoremediation technique must have a considerable capacity of metal absorption its accumulation and strength to decrease the treatment time [5]. It has long been known that aquatic plants, both living and dead, are heavy metal accumulators and, therefore, the use of aquatic plants for the removal of heavy metals from wastewater has gained high interest [6]. Some freshwater macrophytes including *Potamogeton lucens*, *Salvinia herzogoi*, *Eichhornia crassipes*, *Myriophyllum brasillensis*, *Myriophyllum spicatum*, *Cabomba sp*., *Ceratophyllum demersum* have been investigated for the removal of heavy metals [7], [8].

Ceratophyllum demersum is a submerged aquatic plant, belongs to the family Ceratophyllaceae *C. demersum* could be as a major role in the environmental conditions of stagnant and flowing waters. It is an indicator of water organic pollution, acidification and contamination with heavy metals [9]. It is used as in phytoremediation process. This plant could adsorb elements and decrease pollution of wastewater. The aquatic submerged plant *C. demersum* can be an effective biosorbent for zinc, lead copper removal under dilute metal conditions [10]. The capability of *C. demersum* for removal Pb, Cd and Ni were more than Fe, Mn and Zn [11]. In another study, *Ceratophyllum demersum* after proper acclimatization helps to reduce the organic load in sewage to a significant level as indicated by the removal efficiency of BOD and COD. An advantage in treating the sewage by *C. demersum* is the simultaneous removal of ammonia and phosphate from it. When the sewage treated with *C. demersum* is discharged into water bodies the dissolved oxygen level will not be depleted significantly to affect the aquatic life [12].

II. MATERIAL AND METHODS

The sample of selected plants were collected from different water bodies of Khetri of Jhunjhunu district of Rajasthan. During the survey, plants occurring in different water saturated areas were collected, photographed and identified. The field survey was dual in every month. They were preserved according to the conventional herbarium techniques. The species are identified with the help of relevant literatures. Aquatic plants are classified according to their habitat and morphological characteristics. Phytoremediation properties of this plant were carfully observed during study period.

III. STUDY SITE

The present study conducted on Pannasagar talab in khetri town of Jhunjhunu district. Khetri is a small town of Jhunjhunu district. It is situated in Western India and a part of

aravalli hills. Jhunjhunu district is located between $27^0$51'0"N Latitude and $75^0$16'12"E Longitude. The climate of Jhunjhunu district in Rajasthan is mainly dry [13]. The summer months are hot while the winter months are cool.

IV. HABITATS

Ceratophyllum demersum L. (hornweed or coontail) is a completely submerged plant and commonly seen in ponds, lakes, ditches and quiet, streams with moderate to high nutrient levels [14]. *Ceratophyllum demersum* grows fast in shallow, muddy, quiescent water bodies at low light intensities. It does not produce roots, instead it absorbs all the nutrients it requires from the surrounding water. If it is growing near the lake bottom, it will form modified leaves, which it uses to anchor to the sediment. However, it can float free in the water column and sometimes forms dense mats just below the surface.

V. BOTANICAL DESCRIPTION

C. demersum is a rootless submerged floating aquatic plant. It has fan shaped dichotomous leaves divided into many narrow segments. Each leaf has several small teeth on the midrib. These tiny teeth give the plant a rough feel. The size of plant is up to 1 meter long. Inter node of stem is 1-3 cm long and 4-9 leaves are arranged in a whorl. During winter the tips of branches may become much shortened, thickened and break off. These structures act as buds and grow in to a new plant [15].

Fig:1 *Ceratophyllum demersum* plant

VI. PHYTOREMEDIATION PROPERTIES

Many literature published on phytoremediation properties of *C. demersum.* Some are following:

Phytoremediation of Ni

Nickel is a necessary element in low concentrations for survival of the ecosystems, but in high concentrations is harmful and considered as a dangerous pollutant. This element pollutes water resources through different sources such as municipal and industrial wastewaters. Ni exceeding its critical level might bring about serious lung and kidney problems except from gastrointestinal distress, pulmonary fibrosis and skin dermatitis [16], [17] and it is known that Ni is human carcinogen [18].

C. demersum accumulated heavy metal (4.5 mg Ni from 1.8 L 6 mgL-1 Ni contaminated aquatic medium) and very good but in slow removal rate (50% Ni removal) and when plant grows more, with increasing of its biomass, it can accumulate more Ni (II) in its body. Great removal efficiency and high Ni accumulation capacity make *C. demersum* an excellent choice for these heavy metals phytoremediation [19]. Parneyan [20] also investigated the phytoremediation of Ni from a hydroponic system by *C. demersum. Ceratophyllum* plants were capable of removing up to 95% of lead from their solution. The plants accumulated heavy metals without the production of any toxicity or reduction in growth [21].

Phytoremediation of Pb

Lead is accounted significant pollutant due to solubility in water, which results in wide distribution in aquatic ecosystems lead is strongly toxic to organisms the excessive amount of lead in water cause many physiological and biochemical stress symptoms in plants, such as growth reduction, disturbed mineral nutrition, water imbalance and growth productivity and root elongation when they enter inside the cell wall like any other heavy metals they produce an oxidative stress in plant and lead to cell damage [22].

C. demersum is the best plant in phytoremediation of Pb from polluted water the plant ability to absorb Pb associated with the concentration in aqueous media.

Phytoremediation of Cd

Cadmium (Cd) is a non-essential and toxic element [23]. Cadmium can become a sanitary and ecological threat to drinking water resources, even at very low concentrations. *Ceratophyllum demersum* has proven to be suitable for phyto-remediation processes, its capacity to hyperaccumulate cadmium from the water body reaches values of the bio-concentration factor higher than 1000 [24].

VII. OBSERVATION

In the present study we observe that before month of September pond water was highly polluted due to many anthropogenic activity by local people. The colour of pond water was very dark and permeability of water was also very less. But after September to January colour of pond water change to less dark slowely. Permeability also increase in pond water. It was also observed that colour of *C. demersum* plant also change during this period. In September month *Ceratophyllum demersum* plant was less green colour. In September month *C. demersum* was in initial growing stage of life cycle. But in January month which is end stage of life cycle of *C. demersum*, plant was change into dark green colour. Many literature study also proved that *C. demersum* plant have a great phytoremediation properties. It is also proved in our study due to clean focus on the observation.

VIII. CONCLUSION

Heavy metals are highly toxic elements that can accumulate and concentrate in live tissues. Thus, clean alternatives must be developed in order to remove heavy metals from effluents. Submerged macrophyte has a high capacity for vegetative propagation and biomass production even under low nutritional conditions, which removes excess nutrients.

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