Phytoremediation Potential of *Hydrilla verticillata* for the Degradation of Contaminants from Textile Effluent

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Abstract **-** This research paper is focused to assess the phytoremediation potential of Hydrilla verticillata for treatment of effluent discharged from textile industries. The phytoremediation experiments were carried with the help of 10%, 25%, 50%, 75% and 100 % textile effluent. Hydrilla verticillata showed a significant reduction in various physico-chemical parameters such as pH, electrical conductivity, TDS, BOD and COD etc. of different concentrations of textile effluent within 7 days of treatment except 100% textile effluent. It has been observed that Hydrilla verticillata is used as efficient plant for degradation of dyes from water resources through phytoextraction mechanism. Hence, Hydrilla can be used as a phytoremediator plant for secondary or tertiary level treatment of textile effluent.

Keywords **-** *Phytoremediation, Decoloroization, Textile effluent*

Abbrevations:
Textile Effluent –TE
Total Dissolved Solids- TDS
Electrical Conductivity-EC
Dissolved Oxygen – DO
Biological Oxygen Demand- BOD
Chemical Oxygen Demand- COD

I. INTRODUCTION

The textile industry is major originator of effluent due to the large quantity of water are produced in the various processes. These textile effluents containing a variety of dyes along with other chemicals such as different acids and bases, various salts, detergents, oxidants etc. Approximately, for the preparation of each 1Kg of fabric more than 7000 different compounds and additives are used [1]. In India, there are approx. 10,000 textile industries and 2100 bleaching and dyeing industries in India and the majority of industries are situated in the states of Tamil Nadu, Punjab and Gujarat (2). Due to usage of dyes and chemicals, textile effluents increasing the turbidity of the receiving water body. Most of dyes are non-biodegradable in nature and moreover have carcinogenic properties or causing other skin problems like allergies, dermatitis and skin irritation. High potential health risk is caused by adsorption of azo dyes and their breakdown products (toxic amines) through the gastrointestinal tract, skin, lungs, and also formation of hemoglobin adducts and disturbance of blood formation[3]. Also, dyes may affect the aquatic life as the result of reduced light penetration due to dark color of effluent. Hence it becomes very necessary to treat the textile effluent before their release into the environment. Several physical and chemical methods have been widely used for the treatment of textile effluent but not effective due to their high cost and secondary pollution [4-10]. So that the use of biological methods are preferred to treat waste water containing dyes. Bioremediation strategies using bacteria, fungi and plants are potential treatment methods widely in practice for detoxification of hazardous chemicals. Among the various biological methods, phytoremediation appears as one of the very innovative technology which can be used for the removal of textile dyes [11]. This technology introduces a number of ways with which plants will able to extract, decrease, volatize, degrade, or immobilize environmental pollutants from soil and water, thus restoring contaminated sites to a relatively clean and nontoxic environment. Phytoremediation of textile dyes have been reported using some wetland as well as terrestrial plants [12-17]. The Bioremediation technologies, which focus on living organisms as cleanup agents, are seen as an alternative with great potential for the affordable remediation of polluted sites [18-21]. However, scientist have discovered that plants have properties that can make them remediation agents and a new innovative eco friendly field called phytoremediation is receiving more attention from all over world.

II. MATERIAL AND METHODS

Materials

A. Textile Effluent

Textile effluent samples were collected in plastic air tight container from a local textile mill of Ludhiana district of Punjab (India). Ludhiana is hub of Textile industries so that why Ludhiana is also called Manchester of Punjab. But now-a-days, Ludhiana is listed among most polluted cities of India. Also, according to a report published in The Tribune of India (Jan-2013) which clearly states that Ludhiana is among the worst performing district in the state when it comes to checking water-pollution where most of industries dump their toxic waste directly in the Buddha-nullah canal[22]. The waste

effluent transported to the laboratory for analysis and treatment through phytoremediation process.

B. Plant Material

For present study the plant samples were collected from a pond near Jhansla village of Rajpura (Dist. Patiala) and further grown in an artificial pond in nursery of Chitkara University, Punjab. Before exposed to textile effluent, plants were washed and cleaned thoroughly for 8 hours under running tap water to remove any type of contaminants and then with distilled water.

Fig 1: Aquatic Plant Hydrilla verticillata

Table 1: Phytoremediation Experiment Set

Experimental setup (5L)	Textile effluent (TE) concentration
Set A	10%TE
Set B	25%TE
Set C	50%TE
Set D	75% TE
Set E	100% TE
Set F	Control (Tap water)

III. RESULTS AND DISCUSSION

Phytoremediation is an innovative green technology that uses plants species to remediate water, soil as well as air pollution. Phytotechnologies has gained importance due to remediation of contaminants such as pesticides, heavy metals, solvents, crude oil etc in various projects worldwide. The present work utilizes the response of a submerged aquatic weed (Hydrilla verticillata) to evaluate the remediation of textile effluents. Hydrilla verticillata is a submerged aquatic weed belongs to family Hydrocharitaceae. Hydrilla grow very fast under surface water and form dense mass in water bodies. The expansion of resistant this weed poses a significant characteristics to it which shows ability to clean the environment [24]. Earlier, plant was reported as hyperaccumulator of Pb, Hg, Cr and Cd [25,26]. On basis of this ability, phytoremediation potential of Hydrilla verticillata was explored for remediation of effluent of textile industry. The various physio-chemical parameters (table 2) of collected effluent levels indicate the noxious level of pollutants and the presence of biologically resistant compounds in textile effluent.

Table 2: Various Physio- Chemical Charactertics of Textile Effluent

Effluent Parameter	Values
pH	11.8
Temperature	40°C
Odor	Pungent
Color	Dark Black
TDS	4210 ppm
EC	3.87mho/cm
DO	0.62 ppm
BOD	395.45 ppm
COD	1975.45 ppm

Methods

To access the potential of Hydrilla verticillata to remediate textile effluent, experiment were performed in different sets with different concentration of textile effluent. All phytoremediation experiments were performed in three sets and average values were determined. Approximately 40 liters of raw effluent was brought to the laboratory and diluted to different textile effluent concentrations in plastic tubs up to volume of 5 liters for different experiments set up (as shown in table 1). For each experiment set up, approximately 500g of Hydrilla verticillata was transfer to each tub. Different physico-chemical analysis like pH (Glass electrode method: Jackson 1967), Electrical Conductivity (Conductivity Meter: Jackson 1967), Total Dissolved Solids (Filtration, Evaporation (103C) method: Standard Method APHA 2002), Dissolved Oxygen (Modified Winkler's Method: Standard Method APHA 2002), Biological Oxygen Demand (Modified Winkler's Method : Standard Method APHA 2002),Chemical Oxygen Demand (Open Reflux Method: S.M. APHA 2002) of textile effluent were observed before and after 7 days of experiment [23]

In preliminary experiments, the growth of aquatic plant Hydrilla was found to be decreased within 3days in 100% effluent. Hence, effluent was treated in different concentrations for Phytoremediation study. The results indicate that, Hydrilla reduced all the physio-chemical parameters except dissolved oxygen to a significant level up to 50% diluted textile effluent as shown in Figures 2- 6. The dissolved oxygen is an important parameter for check the level of water pollution. In results of treatment of textile effluent with Hydrilla showed increased the DO content in all sets of experiment as shown in table 3. The TDS reduction by Hydrilla is maximum 62% decrease in 10% textile effluent (Figure 2). TDS and EC were closely related hence, follows the almost same trend of treatment performance during phytoremediation experiment. In each experimental set, TDS and EC value was found to be decreasing after phytoremediation with Hydrilla (Figure 2 & 3). Reduction in the values is due to absorption of dissolved so by *Hydrilla verticillata* which indicate toward its nutrient absorbing capacity. The BOD and COD removal by Hydrilla verticillata in different experimental sets shows that its treatment performance is negligible almost 3-5% well in 100% textile effluent and follows same trend in almost all concentrations as shown in fig 4 & 5. It indicates dilution induces the reduction in BOD and COD performance of *Hydrilla verticillata.* Gamage and Yapa also reported a reduction in BOD and COD values of textile effluent by Phytoremediation with water hyacinth [20]. This indicates dilution influences the performance of plants in waste water. The most important parameter was pH which is reduced in each concentrations except 100% effluent where it reduced to only 0.1 as shown in fig 6.Reduction in pH value supports thegrowth of aquatic plant and also indicates the bacterial action to degrade BOD and COD of effluent[27].These results were also supported by results of *Eichhornia crassipes* treatment with dye waste water [28]. In 100% textile effluent, plant was unable to grow well. Because textile effluent contains highly toxic compounds which affected the growth of plant. In control sets Hydrilla growth is well in tap water. In different textile effluent concentrations, growth shows variation in decreasing trend in order 75%, 50%, 25% and 10% textile effluent.

Table 3: Variation in dissolved Oxygen content

Textile Effluent Concentration	**DO Content (Before Experiment)**	**DO Content (After Experiment)**
10%TE	6.0	6.83
25%TE	3.91	6.06
50%TE	2.34	5.16
75% TE	0.96	3.43
100% TE	0.65	0.90
Control (Tap water)	8.20	7.90

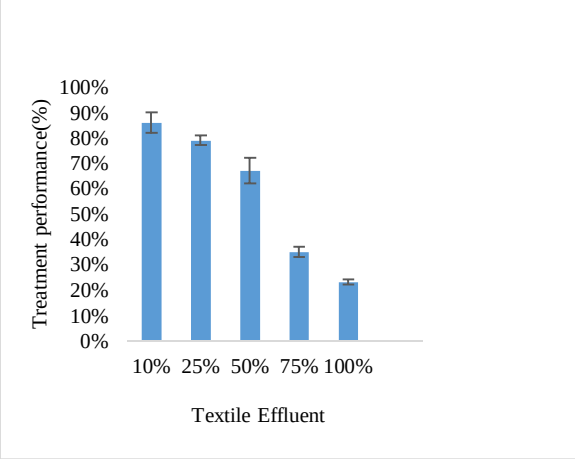

Fig. 2: Treatment performance of TDS

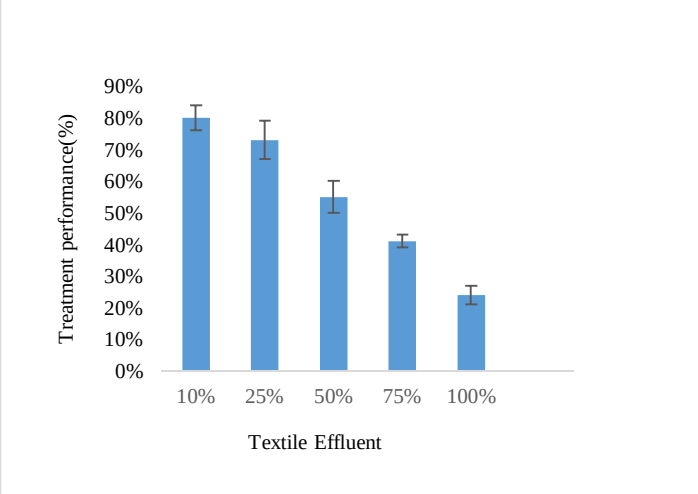

Fig. 3: Treatment performance of Electrical conductivity

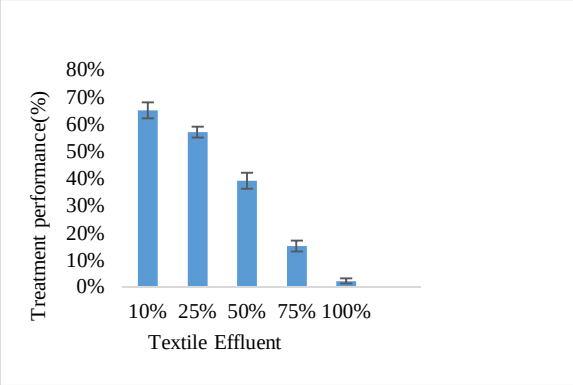

Fig. 4 **:** Treatment performance of BOD

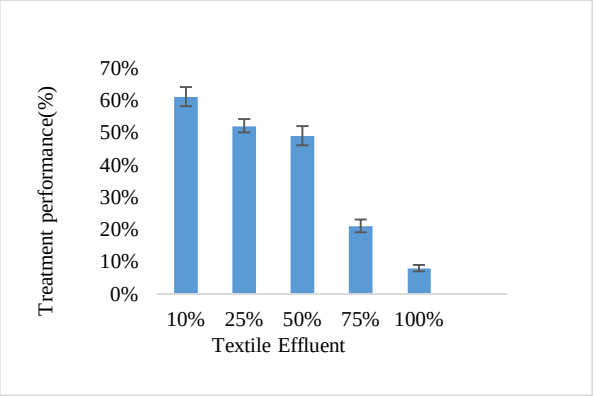

Fig 5**:** Treatment performance of COD

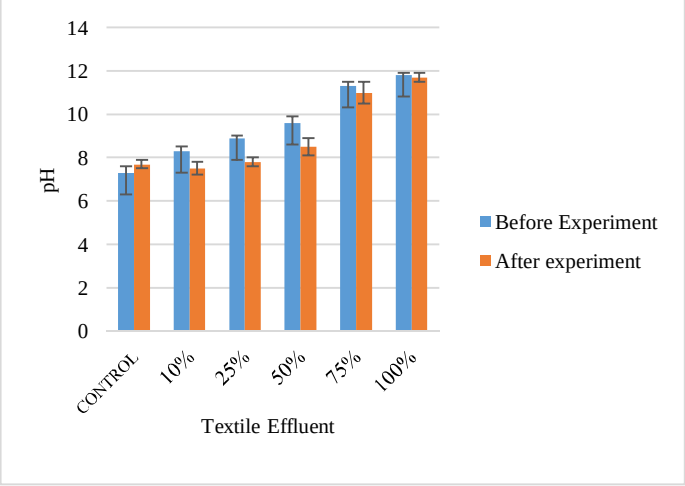

Fig. 6: Treatment performance of pH

IV. CONCLUSION

Results obtained indicate that Hydrilla verticillata was an effective tool for phytoremediation process. The Hydrilla verticillata was found to be efficient in decreasing values of pH, EC, TDS, BOD and COD etc., within 7 days of treatment of different concentrations of textile effluent. The reduction in pH can be used for treating highly alkaline effluent. There is significant reduction in these parameters in almost all concentration except 100% textile effluent support the use of Hydrilla as a phytoremediation plant for secondary and tertiary treatment of industrial effluent. Hence, promising attributes of Hydrilla verticillata for its tolerance to different diluted textile effluent concentration without retarding growth of plant, proven the suitability of Hydrilla verticillata in dyeing industry effluent treatment pools after primary treatment.

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