Vol 6 Issue 3 April 2016

ISSN No : 2230-7850

International Multidisciplinary
Research Journal

Indian Streams Research Journal

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RNI MAHMUL/2011/38595 ISSN No.2230-7850

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ISSN: 2230-7850 Impact Factor : 4.1625(UIF) Volume - 6 | Issue - 3 | April - 2016

Indian Streams Research Journal

INVESTIGATION ON POTENTIAL OF *EICHHORNIA CRASSIPES* AS ANTI-POLLUTANT AND MANURE: A PRELIMINARY STUDY.

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ABSTRACT

The textile industry produces huge volumes of wastewater through various steps and discharges the effluent in the environment. The textile waste water is one of the most polluting among all in the industrial sectors. For the protection of our environment now a days we can use different aquatic macrophytes treatment system for removal of different pollutants and this kind of treatment is called as phytoremediation. Water hyacinth (*Eichhornia crassipes*) is a worst invasive aquatic weed which has adverse effects on aquatic body and its ecosystem. The present study was conducted to investigate the phytoremediation capacity of Water hyacinth (Eichhornia crassipes) when subjected to textile effluent. The water hyacinth has effective absorption capacity which will reduce toxicants present in the textile effluent discharged by local dye industries. The waste plant materials of hyacinth after treatment with textile effluent were subjected vermicomposting and subsequent analysis for the various parameters of the compost was carried out. It is found that the compost has good nitrogen and phosphorous content so it can used as manure.

KEYWORDS :Water hyacinth, *Eichhornia crassipes*, textile effluent, absorption, vermicomposting etc.

INTRODUCTION

The textile industry uses huge quantities of water and produces large volumes of wastewater through various steps in dyeing and finishing processes and discharges the effluent in the surrounding environment. The textile waste water is the most polluting among all in the industrial sectors [1, 2]. The textile effluent is a mixture of polluting substances like inorganic, organic, elemental and other substances [3]. It is considered as most polluting among all industrial sectors. It adversely affects water resources, fertility of soil, aquatic organisms and ecosystem integrity. Untreated disposal of these effluents containing various dyes into the receiving water body causes damage to aquatic ecosystem by blocking the sunlight or to human beings by mutagenic and carcinogenic effects [4].

Phytoremediation is one of the new concepts that involve the use of plants to clean contaminated environments. It is a cheap and environment friendly cleanup process which uses hydrophytes to degrade, assimilate and metabolize or detoxify contaminants [5, 6, and 7]. The economic success of phytoremediation largely depends on photosynthetic activity and growth rate of plants [8]. Aquatic macrophytes treatment system (AMATS) is a well established environment protective technique as a phytoremediation for removing pollutants. Some freshwater macrophytes such as *Salvinia hergozi, Eichhornia crassipes, Cabomba sp*., and *Cratophyllum demersum* have been investigated for their potential removal of heavy-metal and colour [9]. Among these above mentioned aquatic plants *E. crassipes* (Water hyacinth) that came under *Pontederiaceae* family stands as a challenging, most productive invasive aquatic plant shows extreme risk to the ecosystem. It shows high biomass production rate, its effective tolerance to pollution, and its heavy metal and nutrient absorption ability made it possible to use in wastewater treatment ponds. [10,11,12,13,14]. Considering the applications and utilization of the water hyacinth its chief role in textile effluent treatment is recently undergoing higher attentiveness to find an substitute for the currently available textile effluent treatment techniques. The aim of present work was to use water hyacinth, for dye removal and to subject the plant further for composting by using earthworm species.

MATERIALS AND METHODS:

2.1. Collection of effluent:

The colored textile effluent containing Red RB was collected from MIDC area, Solapur, Maharashtra. This effluent was directly used as a dye solution and diluted effluent was also used for study. The absorption maxima of effluent were determined by spectrophotometer.

2.2. Plant used for the study:

Water hyacinth (*Eichhornia crassipes*) plant was collected from Dharmveer Sambhaji Lake, Solapur, Maharashtra. This plant was then washed with distilled water. The fresh plant was then grown in laboratory by maintaining proper optimum condition. Finally that plant was used as experimental plant for textile dye removal from the effluent. The plants were grown in nutrient solution which was renewed once a week. The nutrient solution contained NH_4NO_3 38 mg/l; KH_2PO_4 3.5 mg/l; KCl 30 mg/l; $CaCl_2{\bullet}2H_2O$ 9 mg/l; $MgSO_4{\bullet}7H_2O$ $_7$ mg/l; trace elements such as Fe, Mn, B, Zn, Mo, Cu and Co at concentration of 3.0, 0.45, 0.12, 0.16, 0.05, 0.005 and 0.005 mg/l respectively [15].

2.3. Experimental set up:

The removal of dye was studied by following experiment in two different set such as Set 1 - containing 100% effluent + water hyacinth, Set 2 – containing effluent: water (50:50) + water hyacinth, Control – containing effluent only. In both set 1 and set 2, twelve pieces of water hyacinth were grown under laboratory condition. The color reduction was determined by spectrophotometric analysis after particular time interval i.e. 24, 48, 72, 96, 120 and 144 hrs. The absorption was taken at 519 nm [8].

2.4. Preparation of compost:

Grown water hyacinth after the experiment was collected and subjected to composting. Cow dung and garden waste was used for preparation of compost as supplements. The mixture for composting was prepared in following proportion. Cow dung (1 kg) + garden waste (1 kg) + remaining water hyacinth plant residue (2 kg) + used filter papers. All these materials were mixed together in pit for about 30 days of incubation for preparation of the precompost [8]. The precompost was then subjected to vermicomposting by means of the earthworm species [16]. Pits made for vermicomposting were 1 m deep and 1.5 m wide. Covered the bottom of the cement ring with a layer of tiles or coconut husk or polythene sheet. Spreaded 15–20 cm layer of organic waste material (precompost prepared in previous step) on the polythene sheet. Sprinkled rock phosphate powder if accessible (it helps in improving nutritional value of compost) on the precompost and then sprinkled cow dung slurry on the top of the soil. Allowed the material to decompose for 15 to 20 days. When the heat evolved during the decomposition of the materials had subsided (15–20 days after heaping), released the earthworms through the cracks developed. Covered the ring with wire mesh or gunny bag to prevent birds from picking the earthworms. Sprinkled water each three days to keep sufficient moisture and body temperature of the earthworms.

2.5. Analysis of compost:

After 45 days the compost was taken from pit area and subjected to compost analysis. The colour, pH by pH meter, total nitrogen content by Kjeldahl method and total phosphorous content by Dickman and Bray's [17] adopted method were determined.

RESULT AND DISCUSSION:

3.1. Absorption Maxima of Effluent

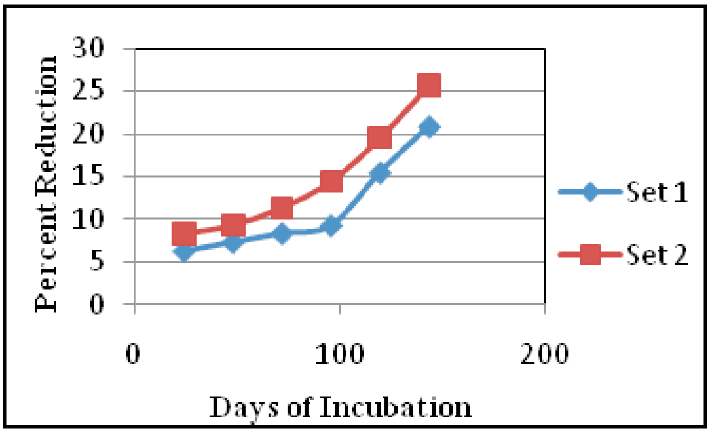
The colored textile effluent containing Red RB was subjected to find out absorption maxima of effluent by spectrophotometer in the range between 400 – 800 nm. We have observed the maximum absorption for effluent at 519 nm. Thus 519 nm was future used for determination of percent decolonization of effluent.

3.2. Colour Reduction

The removal of dye was studied by following experiment in two different set such as Set 1 and Set 2. The color reduction was determined by spectrophotometric analysis after particular time interval i.e. 24, 48, 72, 96, 120 and 144 hrs. The absorption was taken at 519 nm. The percent reduction of dye was recorded in Table 1 and Graph 1. The maximum color decrease was observed at 144 hours after the introduction of the floating and submerged plants into the 50% diluted effluent. It accounts for 25.77% removal of colour at 144 hours respectively. In the original concentrated effluent the colour removal was at the rate of 20.89%.

Set	percentage of color reduction (dye removal)					
	24 hrs	48 hrs	72 hrs	96 hrs	120 hrs	144 hrs
Set 1	6.18	7.24	8.27	9.21	15.45	20.89
Set 2	8.24	9.27	11.34	14.43	19.58	25.77

Table 1: Percentage of color reduction (dye removal) by water hyacinth when treated with textile effluent.



Graph 1: Percentage of color reduction (dye removal) by water hyacinth when treated with textile effluent.

The removal of the aqueous dyes might be due to Biosorption i.e., the sorption of dye molecules onto the root, shoot and the leaves of the plant. Similar result has been put forth by Vengata Mohan *et al*., [18]. Interestingly, the insight into the speciation and localization of dyes in plant tissues also provides a due rate and extent of uptake by particular plant parts. It was often observed that roots accumulate much higher concentration of pollutants [19]. It has been found that *Eichhornia crassipes* showed maximum performance in diluted effluent. The composition of diluted dye effluent for the plant uptake become easy than in highly concentrated dye effluent.

3.3. COMPOST ANALYSIS

The treated plants were then subjected to composting along with used filter papers, cow dung and garden waste. The various components such as pH, total nitrogen content and total phosphorous content were analyzed. The Table 2 showed the values of N (5.3%), P (2.6%), pH (7.10) and color of the vermicompost.

Sr. No.	Parameter	Value
1	Total nitrogen (N)	5.3%
2	Total Phosphorus (P)	2.6%
3	pH	7.10
4	Colour	Blackish brown

Table 2: Compost Analysis for total nitrogen, total phosphorus, pH and colour of soil.

The pH was 7.2, which was well suited for plant growth. Li *et al*., have recorded the similar results in the Vermicomposting process [20]. The results could be achieved either by the respiratory activity of earthworms and microorganisms or by amplify in nitrogen by microbial mineralization of organic matter in combination with the addition of the worm's nitrogenous waste through their excretion [21]. It appears that the process of vermicomposting tends to result in higher levels of plant-availability of most nutrients than does the conservative composting process.

CONCLUSION:

Bioabsorption is one of the new cleanup concepts to clean contaminated environments. An interdisciplinary technology can advantage from many different approaches that used aquatic plants are suitable for wastewater treatment because they have tremendous capacity of absorbing nutrients and remove heavy metals from wastewater and hence bring the pollution load down.

Water hyacinth is one of the great number of aquatic plant species successfully used for wastewater treatment in decades, was of particular importance.

The present work utilizes the answer of a free floating aquatic weed (*Eichhornia crassipes*) to evaluate the textile effluent dye in two different concentrations. The macrophyte water hyacinth was submerged for 144 hrs in the dye water solutions (for all the four dyes). The study reads a better results (25.77%) in 50% diluted effluent. The dilution increases potential of *Eichhornia crassipes* to remove pollutants from dye water. The results also showed that the waste plant residues on vermicomposting with cow dung and garden waste showed a presence of nitrogen and phosphate. The value of pH was slightly alkaline.

The results of the study conclude that the macrophyte free floating water hyacinth was a safer application to reduce the bioavailability of toxic waste waters in the environment.

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