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Performance Evaluation and Remediation of Waste Water by *Typha* Plant

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ABSTRACT :-Typha and aquatic plant was grown for phytoremediation treatment for waste water. The concentration of waste water were in range 0 (control), 20, 40, 60, 80 and 100%. Maximum value were observed in the range 40 to 60% waste water for fresh matter yield, dry matter yield, chlorophyll and ascorbic acid content, and catalase activity of Typha plant. Overall it is concluded that waste water can be used for irrigation or crop plant after phytoremediation treatment with aquatic plant.

Key word: Typha, Phytoremediation, waste water

Introduction

Phytoremediation is the use of vegetation for in place treatment of contaminated soils, sediments, and water. It's best applied at sites with shallow contamination of organic, nutrient, or metal pollutants that are amenable to 1 of 5 applications: Phytotransformation, Rhizosphere Bioremediation, Phytostabilization, Phytoextraction, and Rhizofiltration.

The use of plants for purifying contaminated soils and water has been evolved lot extra currently. In the 1970s, reclamation projects of mining websites developed technologies for protecting soil with flowers for stabilization functions and discount of visual effect (Williamson and Johnson, 1981). It became now not till the 1990s that the idea of phytoremediation emerged as a new technology that uses plant life for cleansing or lowering the toxicity of soils, floor and waste waters infected with the aid of metals, natural xenobiotics, explosives or radionuclides (Baker et al., 1994; Chaney, 1983; Chaney et al., 1997; Cunningham et al., 1995; Ernst, 1995; Lasat et al., 1998; Macek et al., 2000; McGrath, 1990; Raskin et al., 1997; Salt et al., 1995).

Material and Method

The wastewater samples were collected from waste water channel of Ganga Barrage, Kanpur in wide mouth large plastic bottles between 6-7 AM and bottle cork immediately and all the samples were brought to settle in an open plastic tubes for one week to allow microorganism to break down solid organic waste. The wastewater then filtered through multifolded cloths and brought the laboratory and stored in a refrigerator till before treatment analysis was completed. Sample for estimation of dissolved oxygen was collected in 250 ml bottle and fixed immediately of each treatment were analyzed. For the proposed study the test plants (*Typha*) were cultured from nearby area of Ganga Barrage. For culture of *Typha* aquatic plant 20L capacity plastic container were used. The concentrations of waste water were 0, 20, 40, 60, 80 and 100%. For the control (0%) pond water was used. Fresh matter yield, dry matter yield, chlorophyll and ascorbic acid content and catalase activity are recorded.

Physico-chemical analysis of water sample has been done as per standard procedures as per "Standard methods for examination of water and waste water" published by American Public Health Association (2017). Entire data have been statistically analyzed and tested for significance at 5% and 1% probability levels. The detail procedure of each these component were same as describe in I.B.P. hand book No. 8 (Gotterman et al., 1978); U.S.D.A. Hand Book No. 16 (Richards, 1954). All the data were subjected to the analysis of variance according to Steel and Torrie (1960).

Fresh matter yield was determined by weight first washing with running tap water, rinsing with distilled water and absorbing surface with clean white blotting paper.

Dry matter yield was determined by drying and finely chopped and mixed plants samples by first washing with running tap water, rinsing with distilled water and absorbing surface water with clean white blotting sheets, in a forced draught oven at 65 ^{0}C for 24 hours to constant weight. The samples were taken out from the oven and placed in a desiccators, cooled for about an hours and weighed for the determination of yield.

Chlorophyll was determined by the method of Petering (Petering et al., 1984). Finely chopped and weighed 200 mg of fresh matter was ground in a pestle and mortar with a little acid washed while silica sand in about 10 ml of 85% acetone. The acetone extract was filtered through Whattman No. 42 filter paper, the residue on the filter paper was thoroughly leached with 85% acetone to remain the last traces of chlorophyll and leachates were mixed. The extract was made to 25/ml and stored in dark in refrigerator till the measurement of colour intensity. The chlorophyll content was measured by estimating the absorption of the acetone extract in. Elico-CL- 20A-Photo-electric-calorimeter used red filter and referring the reading to the standard calibration curve prepared by the method of Comer and Zscheile (Comer and Zscheile, 1942).

Ascorbic acid content was estimated titrimetrically by the method of Harris and Roy (1933). For ascorbic acid determinations fresh matter was extracted with 5% metaphosphoric acid and titrated with 0.025% standardised 2-6, dichlorophenol indophenol dye. The tissue concentration of ascorbic acid has been expressed in mg/g FM.

Catalase was assayed in crude tissue extracts. The fresh plant material was used for the assay of catalase. The fresh material was finely chopped and ground with little acid washed while silica sand in a chilled pestle and morter in 0.005 M phosphate buffer pH 7, in the proportion of 1 g plant material to 10 ml of the buffer. Grinding was carried out in an ice-bath. The crude extract assayed in the crude tissue extracts within 3 hours of the preparation of the extracts. During this period the extracts were stored in a refrigerator. Where they were not found to undergo appreciable loss in activity of the enzyme assayed.

Catalase was assayed by the permanganate titration method of the Euler and Josephson (1927). 25 ml of 0.01 N hydrogen peroxide was taken in a flask and stabilized at 25^{o}C in a water bath. To this was added 5 ml of properly diluted enzyme extract. The content was thoroughly mixed and 0.05 ml alequate was immediately drawn in test tube containing 5 ml of 2N- sulphuric acid. Further aliquats from the reaction mixture were drawn at 3, 6, 9 and 12 minutes. The aliquats were titrated against 0.05 N $KMnO_4$ to determine the hydrogen peroxide decomposed. Monomolecular reaction constant was calculated as:

$$K = \frac{1}{t} \text{Log}_{10} \frac{A}{A - X}$$

where 't' is time in minutes. 'A' is ml $KMnO_4$ used at 0 minutes and 'A-X' is ml $KMnO_4$ used at 3, 6, 9 and 12 minutes. 'K' value for zero time was obtained by extrapolating the 3, 6, 9 and 12 minutes reading. The results have been expressed as unit catalase/g FM. The amounts at crude tissue extract taken for enzyme assay was such that by extrapolation of readings of 3, 6, 9 and 12 minutes the reading obtained for zero time was higher than that at 3 minutes. Care was taken to ensure that the activity of the enzyme in the crude extract was in the range in which the activity was found to be proportional to the enzyme concentration in the extract.

Aquatic plants (*Typha*) was raised in control as well as different concentrations of Waste water. The different Concentrations of waste water taken for culture of plants were: control (garden pond water), 20%, 40%. 60%, 80% and 100%.

For Study, samples were drawn and estimations were made for Fresh matter yield, Dry matter yield, Chlorophyll and Ascorbic Acid Content, and Catalase activity at 15,30 and 60 days in *Typha.*

RESULTS AND DISCUSSION

Fresh Matter Yield

Increase in fresh matter yield of 15, 30 and 60 days growth of *Typha* plant was observed with the increase in waste water level up to 60 % level of waste water. Further increase in waste water level decrease the fresh matter yield of 15, 30 and 60 days growth of *Typha* plant. As compared to control, all the level of waste water tested showed highly significant (P=0.01) increase in fresh matter yield of 15, 30 and 60 days growth of *Typha* Plant. Maximum fresh matter yield of 15, 30 and 60 days growth of *Typha* plants was observed at 60% waste water level. The results are in agreement with the results that Pavani *et al.* (2008) with Pistia in canteen waste water, Patel *et al.* (2008) with *Hydrilla verticillata* in municipal waste water (Table No. 1).

Dry Matter Yield

Increase in waste water level up to 60 % showed increase in dry matter yield of 15, 30 and 60 days growth of *Typha* plant. Further increase in waste water level showed decrease in dry matter yield 15, 30 and 60 days growth of *Typha* plant. As compared to control, all the level of waste water tested showed highly significant (P=0.01) increase in dry matter yield of 15, 30 and 60 days growth of *Typha* Plant. 60 % level of waste water showed maximum dry matter yield of 15, 30 and 60 days growth of *Typha* plant. The results are in agreement with the results that Abou El-Kheir *et al.* (2007) with *Lemna gibba* in sewage water, Shakya *et al.* (2007) with *Hydrilla* in waste water. (Table No. 1).

Chlorophyll Content

With the increase in waste water level up to 60 % level, chlorophyll content of *Typha* plant at 15, 30 and 60 days growth increased. Further increase in waste water level, decrease in chlorophyll content at 15, 30 and 60 days growth of *Typha* plant was observed. As compared to control, all the levels upto 60% waste water showed highly significant (P=0.01) increase in chlorophyll content in 15, 30 and 60 days growth of *Typha* plant. However, 80% waste water over control showed highly significant (P=0.01) increase in chlorophyll Content of 15 and 30 days growth of *Typha* Plant. 100% waste water in 15 and 30 days growth and 80 and 100% waste water in 60 days growth showed toxic effect for chlorophyll content. 60% waste water level showed maximum chlorophyll content of 15, 30 and 60 days growth of *Typha* plant. Results are in agreement with the results of Khuantrairong and Traichaiyaporn (2012) with *Cladophora* in canteen waste water. (Table No. 1).

Ascorbic Acid Content

Ascorbic acid of *Typha* increased with the increase in waste water level up to 60 % at 15 days growth, up to 40 % at 30 days growth and up to 20 % level at 60 days growth. Beyond these respective levels further increase in waste water level decrease the ascorbic acid content of *Typha* plant. As compared to control increase in ascorbic acid content of *Typha* plant was found to be highly significant (P=0.01) at 40, 60 and 80% waste water in 15 days, 40% and 60% in 30 days and 20% in 60 days growth, and significant (P=0.05) at 20% in 15 and 30 days growth of *Typha* plant was observed. 80 and 100% waste water showed toxic effect for ascorbic acid content of 60 days growth of *Typha* plant over control.

Maximum ascorbic acid content of 15 days growth at 60%, 30 days growth at 40% and 60 days growth of *Typha* plant at 20% level was observed. The results are similar with the findings of Raja *et al.* (2013, 2012) with *Azolla microphylla* in different concentrations of endosulfan insecticide reported significant increase in ascorbic acid content. (Table No. 1).

Table 1: Effect of waste water on Fresh matter yield, Dry matter yield, Chlorophyll content, Ascorbic acid content and Catalase activity of *Typha*

Days	Percent Waste water						LSD	
	C	20	40	60	80	100	P=0.05	P=0.01
	gm. fresh matter yield / treatment							
15	10.82	10.98	11.36	11.52	11.32	11.10	0.02	0.03
30	10.98	11.31	11.61	11.72	11.53	11.27	0.02	0.03
60	11.17	11.41	11.72	11.98	11.71	11.47	0.02	0.03
	gm. dry matter yield / treatment							
15	1.437	1.498	1.527	1.541	1.524	1.490	0.002	0.003
30	1.448	1.519	1.543	1.565	1.539	1.505	0.002	0.003
60	1.466	1.557	1.579	1.609	1.574	1.549	0.002	0.003
	mg chlorophyll / g FM							
15	0.76	0.84	0.87	0.92	0.84	0.78	0.02	0.03
30	0.79	0.85	0.91	0.94	0.82	0.71	0.02	0.03
60	0.81	0.89	0.94	0.99	0.76	0.66	0.02	0.03
	mg ascorbic acid / g FM							
15	0.027	0.029	0.032	0.034	0.031	0.028	0.002	0.003
30	0.028	0.030	0.033	0.032	0.029	0.026	0.002	0.003
60	0.029	0.032	0.030	0.028	0.025	0.023	0.002	0.003
	Unit catalase / g FM							
15	1.8	1.9	2.1	2.2	2.0	1.9	0.3	0.4
30	1.9	2.0	2.2	2.1	1.9	1.8	0.2	0.3
60	2.0	2.1	2.3	2.2	1.8	1.6	0.2	0.3

Catalase Activity

Up to 60% level increase in waste water level showed increase in catalase activity of 15 days growth and up to 40 % level increase in catalase activity of 30 and 60 days growth of *Typha* plant. Beyond these respective level further increase in waste water decrease the catalase activity of *Typha* plant. As compared to control increase catalase activity of *Typha* plant was found to be insignificant 15, 30 and 60 days growth, significant (P=0.05) at 40% in 15 days and at 60% in 30 and 60 days and highly significant (P=0.01) at 60% waste water in 15 days and 40% waste water in 30 and 60 days growth. 100% waste water was found to be toxic for catalase activity in 60 days growth. Maximum catalase activity of 15 days growth at 60% level and at 30 and 60 days growth of *Typha* plant at 40 % level was observed. Results are also on parallel lines with those of Prasad *et al.* (2005), Raja *et al.* (2013) also reported that the catalase increases upto certain concentration, then it decreases.

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