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Phytoremediation of sewage pollutants through some macrophytes near industrial area of Balrampur

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Abstract

The present study deals with the phytoremediation of aquatic pollutants through macrophytes including *Lemna, Eicchornia* and *Hydrilla*. The study was conducted from June 2009 to September 2009 on Suawn Nala and was observed that application of aquatic plants is the cheapest and ecofriendly method for the removal of pollutant from sewage.

Keywords: *Aquatic plants, Ecofriendly, Macrophytes, Phytoremediation, Sewage*

Introduction

Balrampur is a fast developing industrial city at Indo-Nepal border at eastern Uttar Pradesh and is a famous industrial city and well known for a major sugar industry *i.e.* Balrampur Chini Mill (BCM) Ltd. BCM is the largest sugar industry of India by its production point of view. In spite of this unit several other small scale industries like pulse mill, rice mill, dairy plants etc. are also functional in Balrampur. These units are discharging their wastes and garbage into Suawn Nala, Balrampur (Fig.1). This is the fact that these industries are the backbone of the rural economy of Balrampur. Need has arisen to review and recognize environmental problems associated with them. The enormous quantities of wastes (solid, liquid, and gas) generated by these rural industries has led to problems of air, water, and soil pollution. The problems of water quality and water pollution are solely severe in many industrial areas and are threatening the population residing in adjoining areas. In the recent past, several studies (Manas, 1976; Kundra and Purthy,1979; Handa, 1981; Krupanidhi, 1984) have reported that receiving water bodies are becoming increasingly contaminated due to discharge of domestic and industrial waste waters. The present study deals with the phytoremediation of aquatic pollutants of Suawn Nala by some aquatic macrophytes *viz. Lemna, Eichornia and Hydrilla*. These plants have great potential in treating industrial effluent and to prevent early pollution of water bodies.

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Materials and Method

Phytoremediation of polluted water of Suawn Nala, Balrampur was done by using macrophytes. A fresh plant of *Eichornia, Lemna* and *Hydrilla* having 100 g weight were grown in cemented turf of 60 cm diameter and 20 cm depth, containing polluted water of Suawn Nala for a period of 10 days. The treatment potential of the macrophytes and elimination of pollutants from polluted water of Suawn Nala were assessed on monthly basis by estimating quality of polluted water before and after treatment. The quality was determined by analyzing physico-chemical parameters following the standard methods of APHA (1998) and Khanna and Bhutiani (2008).

Results and Discussion

The result of physico-chemical analysis of polluted water of Suawn Nala, Balrampur City before and after 10 days of culture of *Eichornia*,

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Lemna and *Hydrila* are presented in Table 1. Reduction in the temperature was observed after 10 days of culture.The effect of temperature controls the chemical reactions, solubility of the substances, chemical and biological reaction of the organism in water and the growth of nuisance organisms are enhanced by warm water condition and could lead to the unpleasant taste and odour

Fig. 1: Suawn Nala- carrying industrial effluent

(Sacramento, 1963, Mechalas *et al*., 1972). In natural water, pH changes diurnally and seasonally due to variation in photosynthetic activity, which increases the pH value (Bouwer, 1978; Yadav *et al.*, 1987). The pH value was observed around 7.0 before the culture but it increased after culture. The treated sewage showed effective reduction in turbidity. The values were in the range of 22 NTU-37.8 NTU. Electrical conductivity was in the range of 736.2 – 907 µmhos/cm. According to Rao *et al.* (1979), solids in water samples vary with the alkaline nature. Total alkalinity observed before the treatment was in the range of 285 – 327 mg/l which reduced after the treatment and was observed in the range of 254 – 293 mg/l. Free CO_2 was observed highest in the month of August *i.e.* 108 mg/l and was lowest in the month of September i.e. 2.9 mg/l, before and after treatment.

Table 1: Physico-chemical characteristic of sewage water in Balrampur city before and after phytoremediation by *Eichornia, Lemna* and *Hydrila*

Parameters	Unit	June 2009		July 2009		August 2009		September 2009	
		BP	AP	BP	AP	BP	AP	BP	AP
Temperature	(^{0}C)	41.5	38.3	39.6	36.1	37.8	36.3	37.6	34.4
pH	-	6.93	7.10	7.32	7.40	7.23	7.39	7.10	7.46
Turbidity	NTU	47.6	37.8	44.2	35.4	32.0	27.0	29.9	22.0
EC	µmhos/cm	940.0	879.0	902.0	835.0	920.0	907.0	785.0	736.2
TDS	mg/l	609.4	585.2	608.0	560.0	576.0	520.0	382.0	346.0
Total alkalinity	mg/l	317.0	289.0	325.0	278.0	327.0	293.0	285.0	254.0
Free CO_2	mg/l	97.2	64.7	99.9	63.2	108.0	76.0	56.0	22.90
Chloride	mg/l	170.2	152.0	194	167.0	189.0	167.0	163.0	149.0
Dissolved oxygen	mg/l	1.6	5.0	2.6	5.4	2.40	5.20	4.70	6.50
COD	mg/l	293.4	244.8	220.0	179.0	212.0	187.0	133.0	121.0
Total hardness	mg/l	295	246.0	345.0	287.0	349.0	284.0	298.0	270.0
Calcium	mg/l	167.0	136.0	148.0	103.0	142.0	112.0	164.0	107.0
Ammonical-N	mg/l	8.04	5.50	10.8	6.54	24.70	20.90	9.08	7.86
Nitrate-N	mg/l	59.3	48.90	72.5	54.8	63.30	50.10	68.80	52.20
Phosphate	mg/l	0.485	0.378	0.448	0.386	0.452	0.387	0.502	0.298
Organic phosphate	mg/l	0.552	0.532	0.542	0.479	0.486	0.302	0.899	0.577

BP= Before Plantation, AP = After Plantation

Very small changes were reported in chloride content due to non-utilization by the plants. Dissolved oxygen (DO) values were increased in small quantity in sewage water after culture of *Eichornia*, *Lemna* and *Hydrilla which* helped in oxygen transfer in water system by their roots.Chemical oxygen demand (COD) was recorded maximum as 293.4 mg/l in the month of June and minimum was observed as 121.0 mg/l after treatment in the month of September. The reduction in COD after culture was due to more availability of oxygen in water for oxidation of organic matter. The peak value of total hardness (349 mg/l) was observed in the month of August.

Calcium value was always found above 100 mg/l in all the four months of experimentation. Calcium being a useful nutrient absorbed by plant *Eichornia*, *Lemna* and *Hydrila* for their growth and development which fluctuated from 103 to 167 mg/l before and after treatment in different months. Nitrogen content was estimated in the form of ammonical nitrogen. Nitrate nitrogen is the stable product of oxidation, the maximum value of nitrate nitrogen was observed 24.7 mg/l while minimum was observed as 5.50 mg/l before and after treatment. Phosphorus content was estimated as total phosphate. The peak value of phosphate was found as 0.502 mg/l and organic phosphates as 0.899 mg/l in the month of September

Table 2: Monthly variation in NPP (gm^{-2} day^{-1}) of *Eichornia* after 10 days of culture in sewage water during 2009 (initial biomass of *Eichornia* used for culture = 7.2 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P $g.m^{-2}$ day^{-1}
June	15^{th}-25^{th}	11.20	1.12	1.47
July	15^{th}-25^{th}	6.93	0.69	0.96
August	15^{th}-25^{th}	16.57	1.65	2.10
Sept.	15^{th}-25^{th}	10.44	1.04	1.38
Mean X	___	___	___	1.47

Table 3: Monthly variation in NPP (gm^{-2} day^{-1}) of *Lemna* after 10 days of culture in sewage water during 2009 (initial biomass of *Lemna* used for culture = 2.9 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P gm^{-2} day^{-1}
June	15^{th}-25^{th}	3.56	0.35	0.47
July	15^{th}-25^{th}	1.20	0.12	0.20
August	15^{th}-25^{th}	4.50	0.45	0.59
Sept.	15^{th}-25^{th}	0.80	0.08	0.15
Mean X	___	___	__	0.35

Table 4: Monthly variation in NPP (gm^{-2} day^{-1}) of *Hydrila* after 10 days of culture in sewage water 2009 (initial biomass of *Hydrila* used for culture = 10.4 g dry weight)

Months	Period	Production gm^{-2}	Productivity	N.P.P gm^{-2} day^{-1}
June	15^{th}-25^{th}	16.58	1.65	2.17
July	15^{th}-25^{th}	8.64	0.86	1.23
August	15^{th}-25^{th}	11.65	1.16	1.59
September	15^{th}-25^{th}	20.11	2.01	2.59
Mean X	___	___	____	1.90

The potential of *Eichornia, Lemna and Hydrila* species for phytoremediation of polluted water of Suawn Nala, Balrampur city was evidence from the result of net primary productivity (NPP), which registered a significant increase in value after 10 days of culture. The higher value of NPP of *Eichornia* was observed 2.10 gm^{-2} day^{-1} in month of August (Table 2) and the higher value of NPP of *Lemna* was observed 0.59 gm^{-2} day^{-1} in month of August (Table 3). Like *Eichornia* and *Lemna*, in *Hydrila* the value of NPP was found maximum as 2.59 gm^{-2} day^{-1} in the month of September (Table 4). The observed NPP value proved that rainy season is the best for phytoremediation of sewage water through *Eichornia, Lemna and Hydrila* species. The result of in vitro culture has proved the application of aquatic plant *Eichornia, Lemna and Hydrila* species for removal of pollutant from sewage water of Balrampur city (Dings, 1978). It is

concluded from the above findings that phyto remediation is the cheapest, ecofriendly and natural method for the removal of pollutant occur in sewage.

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