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Studies on the Effect of *Typha angustata* (Reed) on the Removal of Sewage Water Pollutants

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Summary

Rhizoremediation is the process in which exudates derived from the plant root stimulate the survival and activity of the soil bacteria and fungi, resulting in a more efficient degradation of water soluble pollutants in rhizosphere. The present study was carried out in the zone of naturally growing reed plants (reed zone) and zone not occupied by *Typha angustata* along the banks of a domestic sewage pool in one of the residential areas of Puducherry. The lower levels of biochemical oxygen demand(BOD) and total dissolved solids (TDS) and lower concentration of heavy metals such as lead, manganese, zinc and copper and higher level of dissolved oxygen (DO) were noticed in the Reed (*Typha angustata)* root zone compared to non reed root zone. Though all the six bacterial species under five types of bacterial populations and eight types of fungal populations were found in both the zones, the numbers of colonies were found to be more in reed zone than non reed root zone. This suggests that the rhizosphere of *Typha angustata* has a direct influence on the composition and density of soil microbial community. Exudates of Reed plant caused an increase in the metabolic activity of microbes of the rhizosphere and transformed the organic and inorganic pollutants into harmless compounds. It is concluded that *Typha* root zone with its myriad of microbes served as a bio-bed which has the potential to reduce the BOD and TDS levels of sewage water, decrease the concentration of heavy metals and increase dissolved oxygen in the water body.

Key Words: *Typha angustata*, Reed root zone, Bacteria, Fungi, Rhizoremediation

Introduction

The root zone treatment process is a natural way of treating industrial and domestic waste water. This treatment does the settling of particulate matter, filtration and chemical precipitation through contact of the water with the substrate. Exudates secreted by the roots which give organic acids, enzymes and proteins and stimulate the metabolic activity of rhizosphere resulting in decreasing wide range of effluents including those from factories, chemical plants, and run off from mining spoil, dairies and municipal sewage water into harmless compounds [1].

Plant roots provide such suitable habitats for the growth of microorganisms resulting in high number of many microbial populations around the roots. Both aerobic and anaerobic microbes are active in the rhizosphere due to development of aerobic and anaerobic zones in reed bed.

Fungi, bacteria and algae are major organisms in the root zones that tolerate heavy metals. Bacterial species absorb lead with other heavy metals [2]. Certain fungi species reduce high concentration of heavy metals such as nickel and lead [3].

Though a lot of works were carried for cleaning up of the polluted sites by using various physical, chemical and biological methods, only a very little work on the cleaning of water pollutants has been carried out using rhizosphere microorganisms. The present work was undertaken to enumerate the microbial flora of reed root zone and their effect in reducing the pollution caused by domestic sewage water in one of the residential areas of Puducherry, India.

Materials and Methods

Typha angustata (200 cm tall) plants growing along the bank of sewage pool were uprooted gently and the black soil attached to the roots was removed. After the removal of sediments accumulating heavily around rhizome by washing it in the habitat water itself, the rhizome was first shaken in the distilled water of a beaker, followed by gentle brushing of the sediments.

The beaker with the turbid water was transferred to ice box and brought to the laboratory for analysis. The turbid water was filtered through filter paper. Filterate and the residue were transferred aseptically to the two containers.

Microbes (fungi and bacteria) were isolated from the soil samples of the study area employing dilute plate methods [4]. Fungi and Bacteria were identified with the help of standard manuals [5].

The physico-chemical parameters of reed root zone soil and non reed root zone were analyzed by using standard procedure.

Results and Discussion

The physico-chemical parameters of reed zone soil and non reed root zone soil were analyzed (Tables 1). The temperature of reed zone soil was 26.7°C and non reed zone soil was 27.8°C.

The pH of reed zone soil was 7. 34 and that of non reed zone soil were 7.25 (Table 1). The levels of Biochemical Oxygen Demand (BOD) of reed root zone and non reed root zone were found to be 5.6 mg/l and 7.6 mg/l respectively. The total dissolved solids (TDS) of reed root zone and non reed zone were found to be 574 mg/l and 708 mg/l respectively, wherein the Dissolved Oxygen (DO) content of reed root zone (7.6 mg/l)was higher than the non reed root zone whose DO was 5.7 mg/l.

Table 1. Physico – chemical parameters of the Soil

Sl. No.	Parameters	Reed zone	Non-reed zone
1	Temperature	26.7ºC	27.8 ºC
2	PH	7.34	7.25
3	BOD	5.6mg/l	7.2mg/l
4	TDS	574mg/l	708mg/l
5	DO	7.6	5.7

The analysis of heavy metal concentration in both zones revealed that in the reed root zone soil, concentration of Lead, Manganese, Zinc and Copper were 0.107 ppm, 0.196 ppm, 0.177 ppm and 0.075 ppm (Table 2) respectively while non reed zone soil showed higher concentrations i. e., 0. 121 ppm. Lead, 0.210 ppm manganese, 0.177 ppm. zinc and 0.075 ppm. copper. Thus the reed root zone soil showed lower concentrations of all the four heavy metals than the non reed root zone soil (Fig. 1)

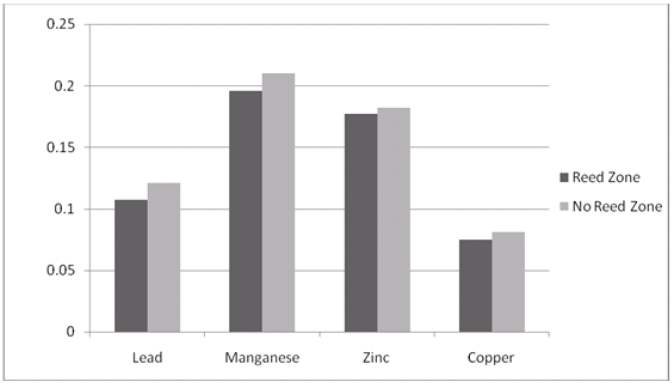

Fig 1. Heavy metal concentration (ppm) of the reed zone and non reed zone soil

Table 2. Heavy metal concentration (ppm) of the reed zone and non reed zone soil

Sl. No	Heavy metals	Reed zone	Non – Reed zone
1	Lead	0.107	0.121
2	Manganese	0.196	0.210
3	Zinc	0.177	0.182
4	Copper	0.075	0.081

Table 3. Fungal populations of Reed and Non – reed zone.

Sl. No	Type of Microorganisms	No of colonies		
		Reed Zone Sediment	Water	Non Reed Zone Water
1	*Mucor* sp.	Numerous	Numerous	5
2.	*Trichoderma* sp.	13	6	2
3	*Aspergillus niger*	2	10	1
4	*Microsporum audouinii*	2	10	-
5	*Trichophyton terrestre*	15	7	4
6	*Sepedonium* sp.	2	5	2
7	*Chaetomium* sp.	6	12	13
8	*Cephelosorium* sp. -	-	1	-

Microbiological studies on reed root zone soil and non reed root soil revealed more number of bacteria and fungi in reed root zone than the non reed root zone.

The observations are in conformity with that of [6] who reported that the microorganism oxidizes the organic material aerobically and Phosphate, Sulphate, Carbon compounds and Nitrogenous materials are reduced to their elemental forms.

In the present study, it was observed that the reed rhizosphere of *Typha angustata* supported six bacterial species ascertained from their colony morphology and colour. [7] reported that the bacteria are able to proliferate by using the pollutant substrate as a natural source and may become dominant. Similar trend was witnessed in the present study that the reed plant growing along the banks of a domestic sewage pool supported higher number of bacterial and fungal species compared to that of non reed root zone.

Typha angustata has been reported to possess arenchyma tissue in their stem and root that allows air to move quickly from the leaf surface to the root. Oxygen released from the reed root zone oxidizes the rhizosphere and allows processes requiring oxygen such as organic compound breakdown, decomposition, and dinitrification to occur. The present study supports the findings of [8] that the most successful wetland species exhibit modified root morphology and anatomy to facilitate internal oxygen movement from the shoot to growing root that creates an aerobic micro-environment where aerobic microbes could flourish using the nutrients from the effluents and ultimately increase dissolved oxygen level causing reduction In BOD of the root soil.

The findings on fungal population in the rhizosphere of reed roots are in close conformity with reports of [3]. It was observed that the reeds rhizosphere has supported eight different fungal populations viz. *Mucor, Trichoderma, Aspergillus niger, Microporum audouinii, Trichophyton terrestre, Sepedonium, Chaetomium and Cephalosporium:* however, the non reed zone also supported same type of fungal population but their number is lesser than that of root zone. Concentration of all the four heavy metals viz. copper, manganese, zinc and lead was found to be slightly lesser than that of non reed root zone (Table 3).

It is concluded that *Typha* root zone with its myriad of microbes served as a bio-bed with microbes which reduces the BOD and TDS levels of sewage water, decreases the concentration of heavy metals and increases dissolved oxygen in the water body.

Thus *Typha angustata* can be considered to be a solar driven biological pump and treatment system carrying out degradation of water soluble pollutants in the sewage [9].

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