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RESEARCH ARTICLE

FUNGAL DIVERSITY OF HIGH ENERGY BATTERY EFFLUENTS SOIL SAMPLES OF AVOOR THIRUCHIRAPPALI

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ABSTRACT

Industrial wastewater and soil sample is one of the most essential source of contamination in the surface environment. Fungi provide much valuable service to the mankind and in the soil ecosystem and also the causes of different types of disease. In addition, to produce chemical with different odours and tastes in water. The continuous irrigation of wastewater results dramatic change in the soil nutritional status may favor certain fungal groups while hampering the growth and diversity of spores. In the present study that the isolation of fungi from 10^{-3} dilution factors were in the highly population diversity from the high energy battery effluents waste water percolated soil sample of Avoor, Tiruchirappalli. The result obtained showed that the most widely distributed fungi of *Alternaria alternata, Aspergillus flavus, Aspergillus fumigatus, A.vercicolur, Cladosporium sp, Cruvalria lunata, Fusarium sp, F.oxysporum, F.solani, Rhizopus* sp, *R.oryzae, Trichoderma viride* and *Verticillium sp*. grew well in soil containing heavy metal. The experimental results indicated that, most of the physiochemical properties such as pH, electrical conductivity, organic carbon, organic matter, available N_2, Phosphorus, potassium, iron, manganese, calcium, magnesium and sodium were analyzed. This heavy metals also investigated such as As, Cd, Ni, Pb, Zn, Cr and Cu from battery effluents contaminated soil. Furthermore, the results indicated that fungi of metal contaminated soil have high level of metal tolerance and bio sorption properties from the fungi were analyzed.

INTRODUCTION

Fungi are an important of the soil microbiota typically constituting more of the soil biomass than bacteria, depending on soil depth and nutrient conditions (Aminsworth and Bishy, 1995). The role of fungi in the soil is an extremely complex and it is fundamental to the soil ecosystem. The beneficial effects of soil microorganisms are maximum fold and range from nitrogen fixation, organic matter decomposition and breakdown of metabolic by products and agrochemical enhancing the bioavailability to nitrates, sulphates, phosphates and essential metals (Bridge and spooner, 2001). Soil health is correlated with the soil biota as they provided essential nutrients to the soil and microbes by different processes (Kibble white, *et al*., 2001).

Various toxic elements including heavy metals are present in wastewater and soil toxic elements at elevated concentration are known to affect soil microbial population and their associated activities. The objective of the study is isolation and identification of fungi and physicochemical analysis along with heavy metal determination from battery effluent irrigated soil samples of Avoor, Tiruchirappalli.

The presence of heavy metals and residues from road and town houses and industrial wastes has been found to be the causes of pollution in soil. Wastewater possesses different biological, physical and chemical effects on the environment. Some physicochemical analysis of soil affected by industrial pollution (Oyinlola *et al*., 2005).

Microorganisms and human being received pollutants which is toxic when any kind of pollution comes in and accumulating into the soil (Dilip 2006). Nearly 90% of Cd, Ni, and Pb accumulated in the 10–15 cm soil depth when this soil irrigated with wastewater. Although many of elements including heavy metals are required by living organisms for their normal function, these elements considered one of the most harmful industrial pollutants in the environment also at high concentrations; they become toxic in the environment condition. In every step of tanning process a considerable

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amount of waste water is released contain huge amount of chemicals. Most of the industries have effluent treatment plants but there is no complete removal of chemicals and they were found in the treated samples (Mohan *et al.*, 2015).

MATERIALS AND METHODS

Sample site

Soil (High energy battery effluent) samples were collected from Avoor Trichy district. The collected soil samples (Western and Eastern) were brought to the laboratory in sterile polythene bags and bottle stored at 4^0C until further work.

Isolation of fungi from industrial (HEB) effluent soil (Warcup 1955)

Isolation of fungi from the battery effluents of soil samples were carried out by soil dilution plate method by using Potato dextrose agar media. The fungi were identified with the help of standard manual (Barneutt 1998, Ellis 1993, Gilman, 2001, Raper and Fennel 1965 and Subramanian 1971).

Identification of fungi (Zafar et al., 2006)

The culture were identified at genus level on the basis of macroscopic (colonial morphology, color, texture, shape and appearance of morphology) and microscopic characteristics (septation in mycelium, presence of specific reproductive structures, shape and structure of conidia.

Soil physicochemical properties

Collected samples were brought to the laboratory by a sterile polyethene bag and sieved through 2mm sieve at field moist conditions and determination of soil moisture content and pH was analyzed. Air dried ground and sieved (0.25mm) samples were used for the estimation of organic C, total N, available P and K content. Moisture content was determined by weight loss after drying 10g of soil at 105°C for 24 hours and expressed as percentage dry weight. Soil pH was measured in a 1:5 water suspension using a portable digital pH meter, colorimetric method (Anderson and Ingram, 1993), Micro kjeldhal distillation and titration method (Jackson 1967) were applied to estimate organic carbon, total nitrogen, available phosphorus and exchangeable potassium.

Heavy metal determination (Nazir, et al., 2015)

Soils were subjected to atomic absorption spectrometer (Perkin Elmer) for being analyzed for metals like Cd, Cr, Zn, Ni, Fe, Cu and Pb. The instrument setting and operational conditions were done in accordance with the manufacturer and specifications.

RESULT AND DISCUSSION

In present study, totally 92 colonies of fungi were isolated by three dilution factors from the collected battery effluents soil samples. Colonies were distributed in the 15 different species belonging to 8 genera were identified. The following genera *Alternaria, Aspergillus, Cladosporium, Curvularia, Fusarium, Rhizopus, Trichoderma* and *Verticillium* were identified. Maximum number of species present in *Aspergillus sp* belong to 3 species were represented from eastern area soil when compare to western area soil. The eastern area soil were isolated fungi such as *Alternaria alternate, Aspergillus flavus, A.fumigatus, A.niger, A.versicolor,Curvularia lunata, Fusarium* sp, *F.oxysporum, F.solani, Rhizopus oryzae, Trichoderma harzianum, T.viride,* and *Veticillium* sp. were recorded. Whereas, western area soil were recorded fungi such as *Aspergillus flavus, A.niger, Cladosporium* sp, *Fusarium oxysporoum, Rhizopus* sp and *Trichoderma harizanum* (Table-1).

Table-1 Isolation of fungi from Battery effluents soil of Avoor Trichy district

S.No	Name of the parameter	Battery effluents soil	
		Eastern	Western
1.	pH	6.2	6.5
2.	Electrical conductivity (dsm^{-1})	0.40	0.46
3.	Organic Carbon (%)	0.13	0.1
4.	Organic Matter (%)	0.24	0.18
5.	Available Nitrogen (Kg/ac)	105.2	101.9
6.	Available Phosphorus (Kg/ac)	4.75	5.83
7.	Available Potassium(Kg/ac)	122	129
8	Available Iron (ppm)	4.89	4.9
9	Available Manganese (ppm)	2.16	2.01
10	Cat ion Exchange Capacity (C. Mole Proton$^+$/kg)	23.6	23.9
	Ex changeable Bases (C. Mole Proton$^+$/kg)		
11	Calcium	10.6	9.8
12	Magnesium	6.8	7.3
13	Sodium	1.26	0.91
14	Potassium	0.24	0.31

Physiochemical parameter like pH, electrical conductivity, organic carbon, nitrogen, organic matter, phosphrous, potassium, sodium, calcium, magnesium, sulphur, and iron content were analyzed. Eastern soil samples were high content of phosphorous when compared to western soil samples (Table-2).

Table-2 Physico chemical properties of battery effluents soils

S.No	Name of the fungi	Battery effluent soil	
		Eastern area soil	Western area soil
1	*Alternaria alternaria*	+	-
2	*Aspergillus flavus*	+	+
3	*A.fumigatus*	+	+
4	*A. niger*	+	-
5	*A.versicolor*	-	-
6	*Cladosporium* sp	-	+
7	*Curvularia lunata*	+	-
8	*Fusarium* sp	+	-
9	*F.oxysporum*	+	+
10	*F. solani*	+	+
11	*Rhizopus* sp	-	+
12	*R.oryzae*	+	-
13	*Trichoderma harzarnum*	+	+
14	*T.viride*	+	-
15	*Verticillium* sp	+	-

The microbial population was determined the number of environmental factors like pH moisture content and soil organic matter (Kennedy *et al.*, 2005) higher fungal population during rainy and autumn seasons to supported the findings of other workers (Arunachalam *et al.*, 1997), which perhaps was due to prevailing favorable moisture and temperature setting during the period of leaf litter and other plant residues are decomposed faster during rainy season and sufficient soil organic matter and humus accumulates that may have enhanced the colonization of the soil microbes in subsequent period Domsh *et al*., (1993). Hackl *et al*., (2000) the indicated the plant species growing on the soil also equally influence the population and composition of species of the soil fungi. Dominance of the genus *Aspergillus* sp greater rate of spore production and dispersal and partly due to their resistance over extreme environmental conditions (Schimel, 1995).

Pb was high due to wide use of lead products in storage batteries and its anthropogenic sources being the combustion of leaded gasoline17. The higher Fe, Pb and Cr concentrations showed that there is heavy metals pollution at the sampling site where anthropogenic activities such as battery charging, welding are heavier while the lower concentration of Zn and Cd showed that anthropogenic activities are lower and could be as a result of variety of iron salt (Abubakar and Ayodele, 2002; Jankiewicz, 2002; Yusuf, *et al*., 2015). The concentrations of Fe, Pb and Cr have exceeded the permissible limit prescribed by World Health Organization (WHO, 1971) and Federal Environmental Protection Agency (FEPA, 1998). This means that the inhabitants of this area are vulnerable to heavy metal toxicity (Zaharaddeen, *et al*., 2014 and Ifeoma, *et al*., 2014).

The present study revealed that As, Cr, Cu, Pb and Ni present in the soil sample are in higher concentrations than Zn and Cd, that are in trace amount and were in the following order of abundance As > Cr > Cu > Pb > Ni > Zn > Cd. In the present investigation that heavy metal analysis from the eastern soil was 127, 0.1, 7.9, 8.4, 0.96, 40.6 and 8.5 mg/kg with As, Cd, Ni, Pb, Zn, Cr and Cu recorded from the soil whereas western soil samples also lesser represented such as 124, 0.15, 8.1, 7.9, 0.2, 40.1 and 8.1 with As, Cd, Ni, Pb, Zn, Cr and Cu recorded. Thus, the results may be due to the toxicity effect may vary on the soil samples. The observation revealed that the isolates were able to utilize the content of heavy metal hence the ability to grow well at the minimum concentration. However, the fungi can be recommended for use in the biodegradation of heavy metals from the soil (Table-3).

Table-3 Studies on heavy metal analysis from battery effluent soil

S.No	Properties	Battery Effluent contaminated soil (Mg/kg^{-1})	
		Eastern	Western
1	Total As	127	124
2	Cd	0.1	0.15
3	Ni	7.9	8.1
4	Pb	8.4	7.9
5	Zn	0.96	0.2
6	Cr	40.6	40.1
7	Cu	8.5	8.1

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