Chapter 9
Phytoremediation of Heavy Metals in Vicinity of Industrially Polluted Sites Through Ferns: An Overview

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ABSTRACT

This chapter deals with screening of native Pteridophytes (ferns) in the vicinity of fly ash (FA) contaminated areas of National Thermal Power Corporation (NTPC) in Kanti and Kahalgaon, Bihar, India. These ferns were used for phytoremediation of heavy metals in the aforementioned areas. The metal tolerance ability and diversity of the native ferns were examined on several diversity indices (population density, concentration of dominance, heterogeneity, equitability) and the results were compared with reference site (nearby forests). The present data revealed that 11 species of ferns (10 terrestrial and 1 climbing fern) had rich frequency distribution and better performance on FA sites. The results also revealed that all ferns had accumulated significant metal content in their tissues. However, metal content was varied in different fern species. Effect of FA on photosynthetic pigments were also analyzed and compared with the reference site. The results of the above study suggest the suitability and usefulness of these ferns for reclamation of FA contaminated wastelands.

DOI: 10.4018/978-1-5225-4162-2.ch009

INTRODUCTION

Coal is the chief source of energy and majority of power generating plants are coal based in India (Khan and Khan, 1996). As a result huge quantity of fly ash is generated as a by-product and besides, many toxic gases are emitted in the environment. In India, FA generation is expected to hike between 150 – 170 million tons per year by the end of 2012 (Pandey et al., 2011). It requires money and space for dumping. In addition, it has also been demonstrated to contain significant amount of noxious elements like Cr, Cd, Pb, Hg, As, Si, Ni, etc. has many deleterious effects are posing threat to the receiving environment. FA causes a number of human health related problems nearby inhabitants of coal-fired thermal power plants (Pandey et al., 2011). Besides, FA landfill decants into the nearby aquatic body and river through leaching increases turbidity, decreases primary productivity and adversely affect fishes and other aquatic biota (Pandey et al. 2011). Since, FA has been considered as the main source of pollution in nearby areas; therefore, its management is very important for the environmental perspective. Although FA is being used in various construction activities including land filling and query restoration (Pandey and Singh, 2010) as well as its safe utilization for agriculture (Pandey et al., 2009, 2010; Singh et al., 2011) and cultivation of non-agricultural crops would be helpful in its utilization but even then a huge quantity of FA remains for eco-friendly and cost-effective management. Therefore, cost-effective and green technology suggested for the management of FA is revegetation of the landfills by FA-tolerant plants, which serves the purpose of stabilization and provides a pleasant landscape (Rai et al., 2004; Pandey et al., 2009; Pandey and Singh, 2012). In this context, several plant species belonging to the family leguminosae has been found successful to revegetate fly ash landfills, (Gupta *et. al*. 2006; and Rai et. al., 2004) and various inorganic and organic blending of fly ash and inoculation of N_2 – fixing microbes (Blue Green Algae) has been found useful in enhancing growth of the plants. Besides, fern species *Pteris vittata* has been reported as hyper-accumulator of multimetals growing on fly ash dykes (Kumari et. al. 2011) including Arsenic hyper accumulator (Ma. *et. al,* 2001a, 2001b, Mehrag, 2002). Further, role of ferns in bioamelioration of fly ash has been done by (Kumari, 2007). Due to presence of high pH, negligible quantity of Nitrogen, Phosphorus and Potassium and high concentration of toxic metals in fly ash, crop plants show toxicity symptoms; whereas some common fern species like *Adiantum capillus-veneris* L., *Ampelopteris prolifera* (Retz.) Copel., *Diplazium esculentum* (Retz.) Sw., *Cyclosorus dentatus* (Forssk.) Ching and *Pteris vittata* L. do not show any visible toxicity symptoms during field surveys of both NTPC sites and it was also observed that these are luxuriantly growing in the vicinity of FA having high density cover. In this context, the feasibility of growing these ferns on FA dykes and their metabolic adaptation has been studied during present study by elucidating

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