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Rhizoremediation potential of spontaneously grown *Typha latifolia* on fly ash basins: Study from the field

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ABSTRACT

Lesson of the phytoremediation from the field research is a current need. In this regard, we took a field study on the phytoremediation of fly ash (FA) basins. Increasing disposal area of FA is an environmental concern and poses a threat to various ecosystems worldwide. Luxuriant and spontaneous growth of *Typha latifolia* on FA basin revealed its toxitolerant characteristics and colonizer nature. The metal accumulation of Zn, Mn, Cu, Pb, Cd, Cr and Ni ranged from 72 to 133, 80 to 183, 8 to 43, 3 to 16, 2 to 8, 4 to 37 and 10 to 36 $\mu g\, g^{-1}$ in root, rhizome and middle part of leaf in *T. latifolia* plant grown under flooded and non-flooded conditions of FA basin, respectively. The bioconcentration factor (BCF) calculated under both flooded and non-flooded conditions for Zn, Mn and Ni in all plant parts were found to be greater than one. The BCF value for Cr was greater than one in root and rhizome parts of the plant, whereas BCF value for Pb was higher than one only in root part. This clearly shows the metal accumulation potential of *T. latifolia*. The translocation factors (TF) for all the metals were lower than one except for Mn metal under both the conditions. These field results revealed that *T. latifolia* is a suitable candidate for the rhizoremediation of heavy metals in FA basin because of its lower TF values than one. Being cosmopolitan and perennial nature it may be used for the rhizoremediation of FA basins worldwide.

1. Introduction

Fly ash (FA) is one of the most extensively generated problematic solid wastes from coal-based thermal power plants worldwide, and its disposal poses a serious threat to various ecosystems. The total amount of ashes generated worldwide is estimated to exceed 750 million tons $year^{-1}$, but only less than 50% of FA is utilized (Izquierdo and Querol, 2012), whereas in India the FA production is expected to increase to 300 million tons $year^{-1}$ by 2016 and 2017 (Skousen et al., 2012). This huge amount of FA is being disposed to FA basins in the form of thin slurry. These dumping FA causes severe pollution through leaching or seepage in the surrounding ecosystems (Pandey et al., 2011). As a result of leaching many toxic metals and metalloids are added to the environment (Pandey et al., 2009a; Pandey and Singh, 2012). Thus, these pollutants pose a threat to receiving habitat. However, safe FA utilization in agriculture and forestry sector has been advised by several researchers worldwide due to the presence of plant's micro- and macro-nutrients (Ram et al., 2007; Pandey et al., 2009b; Pandey and Kumar, 2012; Singh et al., 2011; Singh and Pandey, 2013). A number of human health related problems have been recognized in nearby residents of coal-based thermal power plants (US EPA, 2007; Chakraborty and Mukherjee, 2009).

Therefore, the management of FA basins in order to prevent these pollutants in the environment is an urgent need. In this context, the phytomanagement of FA basins has been considered as a potential and effective tool (Pandey et al., 2009a; Pandey and Singh, 2012). Major limiting factors for vegetation growth on the FA basins include high pH, heavy metals toxicity, lack of nitrogen and organic matter (Pandey and Singh, 2010). These hostile conditions prevent the natural colonization of flora on the inert FA basins. However, some spontaneously grown plant species have been reported from various FA disposal sites of thermal power plants (Maiti and Jaiswal, 2008; Mitrović et al., 2012; Pandey and Singh, 2011; Pandey et al., 2012; Pandey, 2012b; Kumari et al., 2013). In this regard, Pandey (2013) suggested that "connecting science to decision-making related to eco-restoration of FA dump would immensely benefit from the insights that species which

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