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J. Environ. Biol.
33, 207-214 (2012)
ISSN: 0254-8704
CODEN: JEBIDP

Growth, biomass production and remediation of copper contamination by *Jatropha curcas* plant in industrial wasteland soil

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Publication Data

Paper received:
28 August 2010

Revised received:
18 January 2011

Accepted:
05 February 2011

Abstract

The survival, biomass production and copper (Cu) remediation efficiency of *Jatropha curcas* L. was evaluated in Cu rich industrial wasteland soil (IWLS), collected from a local town, Sandila (Hardoi), Uttar Pradesh, India. The IWLS had high bulk density, water holding capacity (WHC), pH, electrical conductivity (EC), organic carbon and NPK. The Cu and Mn contents in IWLS were about 3 and 2 fold higher than that in the normal field soil (control). Stem cuttings of the *J. curcas* clones (BTP-A, BTP-N and BTP-K) were planted in IWLS as well as the same amended with cowdung or sand. The percent survival, net elongations and biomass accumulation of *J. curcas* were decreased slightly in IWLS, as compared to the control soil. The translocation of Cu from soil to the plants was higher in IWLS grown plants, which was more pronounced in IWLS amended with cowdung. *J. curcas* clones BTP-N, showed better survival and Cu removal efficiency from IWLS.

Key words

Bioaccumulation, Copper toxicity, Industrial wasteland, *Jatropha curcas*

Introduction

Sandila town in district Hardoi (Uttar Pradesh), India, represents the ill planned proliferation of small industries resulting in the formation of wasteland in their surroundings due to ad hoc disposal of the effluents. The industrial effluents have converted large agricultural areas into dry wasteland, which remains as such even after closing of industrial units in the area (Ghavri and Singh, 2010). The industrial effluents often contain large quantity of toxic heavy metals. These metals are non bio-degradable and persistent and can be differentially toxic to microbes (Giller *et al.,* 2009), plants (Singh *et al.,* 2003,2007; Leon *et al.*, 2006; Kumar *et al.*, 2009; Ghavri *et al.,* 2010; Sharma *et al.,* 2010), animals (Rainbow, 2007) and human being (Butkus and Baltrenaite, 2007; Eren 2008; Lim and Schoenung, 2010) .

Though a limit of 2 ml l^{-1} of Cu in drinking water has been proposed the World Health Organization (WHO) as the provisional guideline value, entry of large doses of Cu in ecosystem can be toxic to microbes, plants and human being (Eren, 2008). Intake of excessive Cu in human being leads to severe mucosal irritation and corrosion, widespread capillary damage, hepatic and renal damage and central nervous system irritation followed by depression. Severs gastrointestinal irritation and possible necrotic changes in liver and kidney could occur (Nogue *et al.,* 2000; Eren, 2008). Copper is needed by plants in trace amount but their availability in the excess may cause plant toxicity (Ghasemi *et al.,* 2005; Sharma and Mukhopadhay, 2006). Phytotoxic concentration of the heavy metals referred in the literature does not always specify the levels (Wua *et al.,* 2010), upon reaching which, a tree become apparently vulnerable. The properties of soil/sludge transfer of heavy metal from the soil to the plants or ground water and phytoremediation potential of the various plants may also affect the toxicity of metals to the plants. The plants, which are less sensitive to the soil contamination, may be grown in such waste lands to remove the excessive toxic metals and to make the area green and cultivable. High Cu accumulations have been reported in *Betula pendula* roots (Maurice and LayerKvist, 2000), black alder (*Alrus glutinosa* L.) and pine (*Pinus sylvestris* L.) grown on sewage sludge (Butkus and Baltrenaite, 2007), however, these plants may not survive in semi tropical conditions of the Gangetic plains of Uttar Pradesh.