Rooting and Acclimatization of the Selected Cultures of *Musa paradisiaca* in Media Containing Copper Ions

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***Abstract*—**From the previous research in plant tissue cultures, the promising results was obtained, i.e. shoot cultures of *Musa paradisiaca* var. saba were able to grow on media containing copper ions with concentration up to 20 part per million (ppm) and could remove 1.631 ppm of the ions and accumulate them in their biomass. Then, this research is targeted to cultivate the resulting selected cultures on rooting media and then acclimate them on normal soil and soil containing various concentrations of copper with an intention to get plants that are able to reduce the contamination of copper ions in contaminated soil. From the results of this project it is clear that Murashige Skoog (MS) media without any addition of Naphthalene Acetic acid (NAA) has already been able to induce the formation of roots of the selected shoot cultures. Up to the end of this research period, the completely growing cultures are able to be acclimated on normal soil and soil containing copper ions up to 25 ppm and the acclimated cultures (regenerant plants) can accumulate promisingly as much as 2.122 ppm of them in their biomass from soil containing 25 ppm copper ions.

***Keywords*—**Shoot cultures of *Musa paradisiaca* var. saba, copper ions, rooting media, regenerant plants.

I. Introduction

PHYTOEXTRACTION (or phytoaccumulation) uses plants or algae to remove contaminants from soils, sediments or water into harvestable plant biomass. In general, this process has been tried more often for extracting heavy metals than for organics. At the time of disposal, contaminants are typically concentrated in the much smaller volume of the plant matter than in the initially contaminated soil or sediment. The plants absorb contaminants through the root system and store them in the root biomass and/or transport them up into the stems and/or leaves. A living plant may continue to absorb contaminants until it is harvested. After harvest, a lower level of the contaminant will remain in the soil, so the growth/harvest cycle must usually be repeated through several crops to achieve a significant cleanup. After the process, the cleaned soil can support other vegetation [1].

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Unique remediation features possessed by plants are: 1) immobilization, 2) removal, and 3) destruction. Partial immobilization of water soluble contaminants is brought about by plant transpiration (soil water taken up, transported, and evaporated from leaf surfaces) since the process removes soil water that would otherwise cause contaminant leaching and movement. Removal of toxic metals from contaminated soil occurs when inorganic ions are taken up by plant roots and translocated through the stem to aboveground plant parts. Since both root physiology and biosynthetic pathways vary considerably among plant species it is anticipated that rhizoremediation properties will also vary among plants. The most useful species for rhizoremediation may be previously unexplored species with no commercial importance prior to their use in rhizoremediation. Both the direct and indirect degradation of soil contaminants can potentially occur at the lowest depth of root penetration, a special feature of plant remediation. Thus, through the efforts of a relatively small group of scientists working around the world over the last 20 years, phytoremediation has become a well established, multifaceted technology capitalizing on three plant properties: transpiration, ion uptake, and metabolism with the later having both direct and indirect influences [2].

In 1999, Maria Greger and Tommy Landberg proved that willow (*Salic minimalis*) has a significant potential as a phytoextractor of Cadmium (Cd), Zinc (Zn), and Copper (Cu), as willow has some specific characteristics like high transport capacity of heavy metals from root to shoot and huge amount of biomass production [3].

The term "Green Liver Model" is used to describe phytotransformation, as plants behave analogously to the human liver when dealing with these xenobiotic compounds (foreign compound/pollutant) [4]. Hence, the plants reduce toxicity (with exceptions) and sequester the xenobiotics in phytotransformation. Trinitrotoluene phytotransformation has been extensively researched and a transformation pathway has been proposed [5].

High concentrations of copper (100 ppm, 200 ppm, or 500 ppm) in the diet of animals may favorably influence feed conversion efficiency, growth rates, and carcass dressing percentages. Chronic copper toxicity does not normally occur in humans because of transport systems that regulate absorption and excretion. Autosomal recessive mutations in