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A NEW ENVIRONMENTAL FRIENDLY TECHNIUE TO REMOVE THE POLLUTANTS FROM CONTAMINATED SOIL.

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ABSTRACT

Heavy metals are among the most important sorts of contaminant in the environment. Several methods already used to clean up the environment from these kinds of contaminants, but most of them are costly and difficult to get optimum results. Currently, Phytoremediation is the bio-chemical application of plants to detoxify pollutants, and is an ideal and modern technique for environmental clean-up. Regarding the vast industrial wastewaters from a lot factories and different chemical backgrounds have caused contamination of soils in Mysuru, phytoremediation is an effective and affordable technological solution used to extract or remove inactive metals from industrial contaminated soils. This remediate process is environmental friendly and potentially cost effective. This paper reports about the mobility, bio-availability and Phytoremediational response of plant in heavy metals in Industrial contaminated soil of Mysuru, City, India. Additionally, Translocation factor (TF) and Biological Concentration Factor (BCF) also carried to know the capability of the selected plant species.

Key words: Heavy Metal, Soil, Mobility, Bio-Availability, Translocation factor (TF), Biological Concentration Factor (BCF)

I. INTRODUCTION

Heavy metals are among the contaminants in the environment. Beside the natural activities, almost all human activities also have potential contribution to produce heavy metals as side effects. Migration of these contaminants into non-contaminated areas as dust or leachates

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through the soil and spreading of heavy metals containing sewage sludge are a few examples of events contributing towards contamination of the ecosystems [1].

Several methods are already being used to clean up the environment from these kinds of contaminants, but most of them are costly and far away from their optimum performance. The chemical technologies generate large volumetric sludge and increase the costs [2]; chemical and thermal methods are both technically difficult and expensive that all of these methods can also degrade the valuable component of soils [3]. Conventionally, remediation of heavy-metal-contaminated soils involves either onsite management or excavation and subsequent disposal to a landfill site. This method of disposal solely shifts the contamination problem elsewhere along with the hazards associated with transportation of contaminated soil and migration of contaminants from landfill into an adjacent environment. Soil washing for removing contaminated soil is an alternative way to excavation and disposal to landfill. This method is very costy and produces a residue rich in heavy metals, which will require further treatment. Moreover, these physio-chemical technologies used for soil remediation render the land usage as a medium for plant growth, as they remove all biological activities [1].

The use of plants for remediation of soils and waters polluted with heavy metals, has gained acceptance in the past two decades as a cost effective and noninvasive method [4]. This approach is emerging as an innovative tool with great potential that is most useful when pollutants are within the root zone of the plants (top three to six feet). Furthermore, phytoremediation is energy efficient, cost-effective, aesthetically pleasing technique of remediation sites with low to moderate levels of contamination. The method of phytoremediation exploits the use of either naturally occurring metal hyper accumulator plants or genetically engineered plants [5]. A variety of polluted waters can be phytoremediated, counting sewage and municipal wastewater, agricultural runoff/drainage water, industrial wastewater, coal pile runoff, landfill leachate, mine drainage, and groundwater plumes [6]. A rising method for polluted area remediation is phytoextraction [7] . Phytoextraction is the uptake of pollutants by plant roots and translocation within the plants. Pollutants are generally removed by harvesting the plants, and it has been recognized as an appropriated approach to remove pollutants from soil, sediment and sludge [8]. Plants may play a vital role in metal removal through absorption, cation exchange, filtration, and chemical changes through the root.

A major environmental concern due to dispersal of industrial and urban wastes generated by human activities is the contamination of soil. Controlled and uncontrolled

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disposal of waste, accidental and process spillage, mining and smelting of metalliferous ores, sewage sludge application to agricultural soils are responsible for the migration of contaminants into non-contaminated sites as dust or leachate and contribute towards contamination of our ecosystem. A wide range of inorganic and organic compounds cause contamination, these include heavy metals, combustible substances, hazardous wastes, explosives and petroleum products. Major component of inorganic contaminates are heavy metals they present a different problem than organic contaminants. Soil microorganisms can degrade organic contaminants, while metals need immobilization or physical removal. Although many metals are essential, all metals are toxic at higher concentrations, because they cause oxidative stress by formation of free radicals.

II. MATERIALS AND METHODS

The plants were transplanted into pots containing 10 liters of urban wastewater and water and aeration was done. Central composite design and response surface methodology were used in order to clarify the nature of the response surface in the experimental design and explain the optimal conditions. of the independent variables. Control soil analysis was done to determine the basic property. The grown plants were collected and differentiated into root, stem and leaf. Each part were dried separately and crushed and made powder form. The powdered plant parts were digested with acidic mixture and analyzed with ICP-MS

III. RESULT AND DISCUSSION

Uptake of heavy Metals by Plant Soluble metals can enter into the root symplast by crossing the plasma membrane of the root endodermal cells, or they can enter the root apoplast through the space between cells. While it is possible for solutes to travel up through the plant by apoplastic flow, the more efficient method of moving up the plant is through the vasculature of the plant, called the xylem. To enter the xylem, solutes must cross the Casparian strip, a waxy coating, which is impermeable to solutes, unless they pass through the cells of the endodermis. Therefore, to enter the xylem, metals must cross a membrane, probably through the action of a membrane pump or channel. Once loaded into the xylem, the flow of the xylem sap will transport the metal to the leaves, where it must be loaded into the cells of the leaf, again crossing a membrane. The cell types where the metals are deposited vary between hyper-accumulator species [9].

The lower concentration of pH of the polluted soil samples shows the indication of

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mobility of the metal ion. Even in the crushed part of the plant were also analyzed to determine the concentration of accumulated metal from the polluted soil environment. The whole plant body was having low pH, it’s a plant inner mod minerals and nutrients for the photosynthesis process. All the metal ion in the soil would not be uptake by the plant, but most of the essential ion will be moved to the plant. Even this phenomenon also very useful to transform the metal and remove the metal from polluted soil. These results shows the analyzed plants are good accumulator of heavymetals. By using these plant species up to certain extent toxic heavy metals could be removed from the polluted soil.

Lead and Cadmium are the two toxic heavy metal even at the low concentration for the living systems. Zinc, Chromium and Copper are the essential micro nutrients for the proper growth of the plant species. But these micro nutrients should not reach higher concentration, coz it may lead to death of the plants. Hence for the removal or transformation of these toxic heavy metal , phytoremediation technique can be used.

The metal concentration, transfer and accumulation of metals from soil to roots, stem and leaf was evaluated through Biological Concentration Factor (BCF). BCF is an index of the ability of the plant to accumulate a particular heavy metal with respect to its concentration in the soil. Translocation Factor (TF) was described as ratio of heavy metals in plant shoot to that in the plant root. The TF value will be higher for those plants which retain the metal in roots without translocation to aerial parts of the plant body.

Samples	pH	Zinc (Zn)	Lead (Pb)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)
Control Soil (Agricultural soil)	7.4	78	12	BDL	36	28
Polluted Soil/ Industrial area soil	6.6	126	58	16	86	77
Plant Species: Canna Indica, L.						
Root	6.6	38	18	04	23	26
Stem		62	16	06	36	28
Leaf		36	08	02	15	12
Total		136	42	12	74	66

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TF		**2.5**	**1.3**	**2**	**2.2**	**1.1**
BCF		**1.0**	**0.72**	**0.75**	**0.8**	**0.85**
Plant Species: Abutilon Indicum						
Root	**6.3**	**48**	**18**	**06**	**27**	**26**
Stem		**59**	**22**	**12**	**32**	**30**
Leaf		**19**	**16**	**08**	**14**	**12**
Total		**126**	**56**	**26**	**73**	**68**
TF		**1.6**	**2.1**	**3.3**	**1.7**	**1.6**
BCF		**1.0**	**0.96**	**1.6**	**0.84**	**0.88**
Plant Species: Echinochloa Colona						
Root	**6.4**	**46**	**14**	**07**	**21**	**23**
Stem		**58**	**28**	**09**	**43**	**38**
Leaf		**21**	**12**	**04**	**18**	**18**
Total		**125**	**54**	**20**	**82**	**81**
TF		**1.7**	**2.8**	**1.8**	**2.9**	**2.4**
BCF		**0.99**	**0.93**	**1.25**	**0.95**	**1.05**
Plant Species: Cleome Viscosa						
Root	**6.3**	**36**	**19**	**04**	**18**	**32**
Stem		**49**	**28**	**12**	**37**	**29**
Leaf		**27**	**16**	**06**	**22**	**17**
Total		**112**	**63**	**22**	**77**	**78**
TF		**2.1**	**2.3**	**4.5**	**3.2**	**1.4**
BCF		**0.88**	**1.08**	**1.3**	**0.89**	**1.01**

IV. CONCLUSION

Unlike organic compounds, metals cannot be degraded, and cleanup usually requires their removal. Most of the conventional remedial technologies are expensive and inhibit the soil fertility; this subsequently causes negative impacts on the ecosystem. Phytoremediation is a fast developing field, since last ten years lot of field application were initiated all over the world, it includes Phytoremediation of organic, inorganic and radionuclide‟s. This sustainable and inexpensive process is fast emerging as a viable alternative to conventional remediation methods, and will be most suitable for a developing country like India. Most of the studies have been done in developed countries and knowledge of suitable plants is particularly limited in India. In this regard, heavy metals may be removed from polluted soil either by increasing the metal-accumulating ability of plants or by increasing the amount of plant biomass. In heavily contaminated soil where the metal content exceeds the limit of plant tolerance, it may be possible to treat plants with plant growth-promoting rhizobacteria, increasing plant biomass and thereby stabilizing, re-vegetating, and remediating metal-polluted soils.

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