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Phyto Remediation of Zn, or Ni, Using Barley (Hardeum Vulgare)

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Abstract

Heavy metal contamination of soil may pose risked and hazards to humans and animals and the ecosystem through direct ingestion or contact with contaminated soil. Soil contamination by toxic metals is one of the serious ecological problems all over the world. Basic sources of this contamination are the metal smelting industry, residues from metalliferous mining, combustion of fossil fuel and waste incineration, as well as some pesticides and fertilizers used in agriculture. This in addition to soils that are naturally rich in heavy metals. The main metals Cd, Pb, Ni, Zn, Cu, and the metalloid As. When plants accumulate metals, these metals can be ingested by animals, thus creating the potential for toxic effect at higher tropical levels. These widespread and persistent environmental pollutions have a high toxicity potential for reproductive and developing tissue and can induce teratogenicity in mammals. For remediation of Zn and Ni with the help of Hardeum Vulgare. Barley was grown in artificially contaminated soil. Soil is treated with different amendment in different percentage. Some metals also treated in soil (mg/kg) in the form of hydrate, after harvesting crop, plant were cut and dry at room temperature. Dry plant samples convert in to fine powdered from and react with di-acid and make a 100 ml distal water sample. The observe concentration of Zn and Ni are (3.34mg-5.85mg) and (3.72mg-6.47mg) respectively in species of Barley.

Keywords: Phyto, remediation, barley, Zn, Ni.

Introduction

Heavy metal contamination refers to the excessive deposition of toxic heavy metals in the soil caused by human activities. Heavy metals in the soil include some significant metals of biological toxicity, such as mercury (Hg), cadmium (Cd), lead (Pb), chromium (Cr) and arsenic (As), etc. They also include other heavy metals of certain biological toxicity, such as zinc (Zn), copper (Cu), nickel (Ni) and so on. In recent years, with the development of the global economy, both type and content of heavy metals in the soil caused by human activities have gradually increased, resulting in the deterioration of the environment[1-7]. Heavy metals are highly hazardous to the environment and organisms. It can be enriched through the food chain. Once the soil suffers from heavy metal contamination, it is difficult to be remediated.

In the past, soil contamination was not considered as important as air and water pollution, because soil contamination was often with wide range and was more difficult to be controlled and governed than air and water pollution. However, in recent years the soil contamination in developed countries becomes to be serious.

It is thus paid more and more attention and became a hot topic of environmental protection worldwide. Soil contamination with heavy metals is one of the major environmental problems in the world[8-11]. Heavy metals do not degrade and the danger they pose is made more serious by their almost indefinite persistence in the environment[12-14]. Their mobility and bioavailability are strongly dependent on their forms in soil, and it is the available form, not the total content, that determines the phyto-availability of heavy metals[15]. Sequential extractions give an indication of the pools or sinks of heavy metals that are potentially available under changing environmental conditions, and have been widely used in contaminated soils, sediments and sewage smudges[16,17]. The discharge of untreated domestic sewage, pig manure and industrial wastewater also contaminates irrigation water in many parts of Taiwan. This indirectly causes the accumulation of nitrate salts, and heavy metals such as copper (Cu) and zinc (Zn) in agricultural soils.

Sources of Soil Contamination: Rural and urban soils in both industrial parks and near small factories outside the parks are affected by a wide variety of contaminants. The most serious sources of soil contamination are[18]. Heavy metals in hazardous waste, including materials from chemical production, dyeing, electroplating and heat treatment, the production of batteries, metal treatment, mining and extractive industries, scrap yards, service stations and tanning; Hazardous organic waste materials, including those from medical centers, oil production and storage, and paint and pesticide production; and Corrosive metal waste materials, including those from acid/alkali plants and chemical engineering works.

Trace Elements in the Soil: A survey of heavy metal contamination in rural soils has been carried out since 1982[19]. According to this survey, 787 ha of rural soils were regarded as highly contaminated[19]. The bio available concentrations of heavy metals extracted by 0.1 M HC1 in these soils were higher than the critical levels proposed by the government, which were (per kg dry soil) 100 mg/kg for copper, 10 mg/kg for cadmium, 16 mg/kg for chromium, 100 kg/mg for nickel, 120 kg/mg for lead, and 80 mg/kg for zinc. The major trace elements found in these contaminated soils were cadmium, copper, chromium, nickel, lead and zinc.

Material and Methods

For soil sampling current year seeds are collected, FYM 36gm/pot, SSP 1.12 gm/pot, $CaCO_3$ also added with urea (for N) and KCl (for K) add per pots each combination were use for one sample pot in which 4kg soil were used.

Soil Selected: Sandy loam was selected for performing the pot experiments. Important physical properties of the soil used in the study are presented in table-1. Preliminary visual inspection showed that the soil was dark brown in color indicating a low amount of humus. Sandy soil is known to have a poor retention capacity for both water and metals. Soil pH play a major role control the solubility and hydrolysis of metal hydroxides, carbonates and phosphates.

Table-1
Important Properties of Soil Used for the Experiments

S.N.	Properties	Naturally Contaminated Soil
1.	pH	6.05
2.	Electrical Conductivity dsm^{-1} at $25^{\circ}C$	1.89
3.	Organic carbon (mg kg^{-1})	5.4
4.	Available N (Kg ha^{-1})	894
5.	Available P (Kg ha^{-1})	56
6.	Available K (Kg ha^{-1})	1093
7.	Available S (Kg ha^{-1})	590.4
8.	CEC (Kg^{-1})	9.64
9.	Mechanical Composition	
	Sand (%)	64
	Silt (%)	14
	Clay (%)	12
10.	Texture	Sandy loam
11.	Total Heavy Metals (ppm)	

Selected Plant Species: The plant species for the study were selected based on biomass and capability of survival based on some previous results[20]. The plants selected were barlay. Numbers of seeds sown in each pot were ten.

Pot morphological parameters: Such as length of shoot, number leaves, or total leaf area, dry weight of shoot par plant were determined for every sample.

Soil samples: About 5kg soils samples from 20 sub samples were taken in plastic bags of 6-7kg capacity of pots, the soil samples is spread to be air dried and extraneous material such as leaves twinges, rocks etc were removed and fill in 6-7 capacity pot.

Samples collection: Plant sample harvest than samples were collected in paper bags each samples was given a particular identification number, The collected plants samples were washed with distilled water, wiped and dried in oven at 60ºC and ground in a micro grinding mill and stored.

The heavy metal analysis is done to detect heavy metals in barley species samples with the detected AAS.

Results and Discussion

In different compassion FYM, SSP, $CaCO_{3,}$ $CaCO_3$+FYM and Ni, Cu, and Zn according to table-2. Heavy metal in plant the observe concentration of Zn and Ni are (3.34mg-5.85mg) and (3.72mg-6.47mg) respectively in species of Barley with compassion reference range (safe limit in India) for Ni($1x10^3$mg), and Zn($8x10^3$-10^{-1}mg).

Conclusion

Heavy metals contamination of soil showed several problems including toxic effect of element like Zn and Ni. Another serious problem is posed by the uptake of potentially toxic us elements through food or for age plant species and their being transferred to the food chain and finally to humans[21].

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Table-2
Physicochemical properties of experimental soil (on air dry basis) -

S.N.	Treatment Mg pot^{-1}	Replication Ist Zn Mg pot^{-1}	Refrance Range Zn(Mg)	Replication IInd Ni Mg pot^{-1}	Refrance Range Ni(Mg)
1.	Control	4.92	8.10^3-10^{-1}	5.67	$1x10^3$
2.	FYM	4.09	8.10^3-10^{-1}	5.48	$1x10^3$
3.	SSP	5.76	8.10^3-10^{-1}	4.28	$1x10^3$
4.	$CaCO_3$	4.21	8.10^3-10^{-1}	5.31	$1x10^3$
5.	$CaCO_3$+ FYM	5.24	8.10^3-10^{-1}	3.72	$1x10^3$
6.	Zn	4.85	8.10^3-10^{-1}	4.85	$1x10^3$
7.	Zn+ FYM	6.14	8.10^3-10^{-1}	6.47	$1x10^3$
8.	Zn+ SSP	3.72	8.10^3-10^{-1}	4.02	$1x10^3$
9.	Zn+ $CaCO_3$	5.31	8.10^3-10^{-1}	5.76	$1x10^3$
10.	Zn+$CaCO_3$+FYM	5.07	8.10^3-10^{-1}	4.37	$1x10^3$
11.	Ni	3.34	8.10^3-10^{-1}	3.81	$1x10^3$
12.	Ni+ FYM	3.81	8.10^3-10^{-1}	4.24	$1x10^3$
13.	Ni+ SSP	4.21	8.10^3-10^{-1}	5.47	$1x10^3$
14.	Ni+ $CaCO_3$	3.83	8.10^3-10^{-1}	4.37	$1x10^3$
15.	Ni+$CaCO_3$+FYM	5.42	8.10^3-10^{-1}	5.20	$1x10^3$
16.	Cu	4.17	8.10^3-10^{-1}	4.86	$1x10^3$
17.	Cu+ FYM	5.47	8.10^3-10^{-1}	3.72	$1x10^3$
18.	Cu+ SSP	4.13	8.10^3-10^{-1}	5.31	$1x10^3$
19.	Cu+ $CaCO_3$	5.47	8.10^3-10^{-1}	5.33	$1x10^3$
20.	Cu+$CaCO_3$+FYM	5.85	8.10^3-10^{-1}	5.85	$1x10^3$

Plant sample soil were mixed with different manner, in plant samples pots metals were mixed at the range of 0 and 20Zn+10Cu+2.5Ni (mg/kg) soil.

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