Global Journal of Science Frontier Research
Chemistry
Volume 13 Issue 6 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

# Removal of Ni, Cu and Zn from a Contaminated Soil using Different Brassica Species

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*Abstract* - The remediation of heavy metal (Ni, Cu and Zn) in contaminated soil by different Barley and *Brassica nigra* (IC - 247)]. Species of Barley and Brassica were grown in contaminated soil and after washing with tap water [seed was collected from Krishi Anusandhan Bhavan Pusa Delhi].

The soil were mixed different amendment [FYM, ssp, $CaCO_3$ and FYM+$CaCO_3$]. and metal was applied at the rate of 0 and 20 Zn +10 Cu + 2.5 Ni (mg/kg soil) in the form of hydrated salts of concerned metal viz $ZnSO_4.7H_2O$, $NiSO_4.6H_2O$, and $CuSO_4$. $5H_2O$. After harvesting the plant were treated with di acid and prepare sample with double distal water.

The observed concentration of Cu [2.78mg to 4.78mg], Ni [3.52mg to 6.43mg] and Zn [3.39mg to 5.5mg] respectively, in species of Rai (*B.nigra*) and observed concentration of Cu [3.95 mg to 5.49 mg], Ni [3.72 mg to 5.68 mg], Zn [4.09 mg to 5.76 mg] respectively in species of Barley.

*GJSFR-B Classification : FOR Code: 050304*

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*Strictly as per the compliance and regulations of :*

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## I. Introduction

Heavy metal contamination of soil is one of the most important environmental problems throughhout the world (Doumett et al, 2008: Nouri et al. 2006). The ability of heavy metals to accumulate and cause toxicity in biological system – humans, animals. Micro-organism and plants has been reported (Nouri 1980: D,amre et al. 2005). As chemical hazards heavy metals are non-biodegradable and can remain almost indefinitely in the soil environment. However, their availability to biota can change considerably depending on their chemical speciation in the soil. The adequate protraction and restoration of the soil eco-systems. Therefore, require the characterization and remediation of soil that are contaminated with heavy metals (Nouri et al. 2008: Nwachuk W. U. et al. 2010).

(Rattan et al. 2001) have reported a considerable accumulation of heavy metals like Zn, Cu, Ni and Fe in surface soil as well as vegetable and field crops grown is some villages. In effluent irrigation system, similar problems are also widely reported from other metropolises of our country (Adhikari et al. 1993).

In spite of the ever-growing number of toxic metal contaminated sites, the most commonly used method of cleaning heavy metal polluted site is excavation and burial. But its ecological sustain inability and economic feasibility is still under interrogation. There are many chemical approaches for the decontamination of such soils. Which offers way to render the contaminates immobile. But, it will not facilitate the physical removal of the contaminates from the soil system. Meanwhile the green – cure technology of phyto – remediation offers an economically viable, socially acceptable and environmentally sound solution in contrast to those mention above.

*Brissica jancea* (Kumar et al. 1995: Ebbs et al. 1997) have been widely cited to be hyper accumulators for several heavy metals (Zn, Pb, Cd, Se, Ni and Cu etc.). These have also been commercial used for the purpose of phyto – remediation / removal in developed countries mainly under temperate climate (Watanabe, 1997). Different members of *Brissica* family with special reference to Indian mustard have been reported to accumulate several heavy metals in its above ground biomass.

## II. Materials and Method

FYM (Farm Yard Manure) 36gm / pots sample, SSP (Single Super Phosphate) 1.12gm sample, $CaCO_3$ (calcium carbonate) 200gm / pots sample. Each sample pots were added urea and KCl 320gm / 10ml for N, for the potash KCl will be add in the form of KCl 10ml / (75gm / pots) sample pots were used to prepare a samples.

### a) *Apparatus*

Normal laboratory, glass ware(borosilicate) a $p^H$ a multipurpose flask, AAS(atomic absorption spectrophotometer), mental heater, sample collection boatel, whatman filter paper, conical flask.

### b) *Processing of the soil*

After collection of soil (0-15cm) from an agricultural land. The soil samples were air-dried ground and sieved to give <2mm particle size.

### c) *Addition of nutrients and pot filling*

4kg soil was taken mixed with fertilizer solution and poured into the pot N,P,K are applied as per the set schedule for the *Brassica* crop respectively in the case of artificially contaminated soil, the dose of heavy metal added were decided based on the information collect a from literature as shown in table (1):

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| Metals | Dose (mgkg$^{-1}$ soil) | Source of metal in use |
|---|---|---|
| Ni | 10 mg | $NiSO_4$ |
| Cu | 40 mg | $CuSO_4.5H_2O$ |
| Zn | 80 mg | $ZnSO_4.7H_2O$ |

*d) Collection and processing of plant and soil samples*

*Plant sample*

The harvest of the different species of *Brassica* was done according to the physiological stages. The collected biomass and it was first dried in shade followed by drying in the oven at 70 ℃ for loss of moisture. Dry weight of both biomass and make a powder from and digestion for the determination of heavy metal content. The digestion of mixture of plant were done using a Di-acid mixture (Wear and Evans 1968) and was made up to specific volume Zn, Cu, Ni were analyzed using AAS (GBC 904 AA).

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

| S. N. | Properties | Naturally contaminated soil |
|---|---|---|
| 1 | $P^H$ | 6.05 |
| 2 | Electrical conductivity dSm$^{-1}$ at 25 ℃ | 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 | C E C (Kg$^{-1}$) | 9.64 |
| 9 | Mechanical composition | |
| | Sand (%) | 64 |
| | Silt (%) | 14 |
| | Clay (%) | 12 |
| 10 | Texture | Sandy loam |
| 11 | Total heavy metals (ppm) | |

## III. Result and Discussion

*a) Physicochemical properties of soil*

Some physic chemical properties of parent and metal spiked soil were shown in table (2).Preliminary visual inspection showed that the soil was dark brown in color indicating a low amount of humus. Textural analysis showed the preponderance sand fraction (64%) followed by silt (14%) than clay (22%) thus classifying the parent soil (soil survey the soft 1998).Sandy soil are known to have a poor retention capacity for both water and metals. The slightly acidic $P^H$ 6.05 recorded for the parent soil is with in the rang of agricultural soil. Soil $P^H$ plays a major function control the solubility and hydrolysis of metal hydroxides, carbonates and phosphates.

*b) Heavy metal removal from soil by different mixture of ammendments*

FYM, SSP, $CaCo_3$, and $CaCo_3$ +FYM achieve heavy metal in plant the concentration were shows in table (3). For the sample of Control ,the concentration of Cu (2.78 Mg), Ni (3.52Mg) and Zn (4.40Mg),for the sample of FYM the concentration of Cu (4.58 Mg),Ni (4.46Mg) and Zn (3.39 Mg),for the sample of SSP the concentration of Cu (3.98 Mg), Ni (4.46Mg) and Zn (5.48 Mg),for the sample of $CaCo_3$ the concentration of Cu (4.78 Mg), Ni (6.43Mg) and Zn (4.25Mg),for the sample of $CaCo_3$+FYM the concentration of Cu (3.95 Mg), Ni (3.72 Mg)and Zn (5.5 Mg) were respectively in species of *Brassica nigra* (Rai).

For the sample of control ,the concentration of Cu(5.20Mg), Ni(), and Zn(), for the sample of FYM the concentration of Cu (), Ni (),and Zn(),for the sample of SSP the concentration of Cu(), Ni() and Zn(),for the sample of $CaCo_3$ the concentration of Cu (), Ni() and Zn (), for the sample of $CaCo_3$+FYM the concentration of Cu(), Ni() and Zn () in species of *Brassica compestris* (Sarso).

*Table 3 :* Concentrations of heavy metals in plants

| Type of sample | Species | Con. of Cu(gm) | Reference range(mg) | Con. of Ni(gm) | Reference range(mg) | Con. of Zn(gm) | Reference range(mg) |
|---|---|---|---|---|---|---|---|
| Control | Rai(*B.Nigra)* | 2.78 | $415\times10^{-5}$ | 3.52 | $1\times10^{-3}$ | 4.40 | $8\times10^{-3}$-$10^{-1}$ |
| FYM | Rai(*B.Nigra)* | 4.58 | $415\times10^{-5}$ | 4.46 | $1\times10^{-3}$ | 3.39 | $8\times10^{-3}$-$10^{-1}$ |
| SSP | Rai(*B.Nigra)* | 3.98 | $415\times10^{-5}$ | 4.46 | $1\times10^{-3}$ | 5.48 | $8\times10^{-3}$-$10^{-1}$ |
| $CaCo_3$ | Rai(*B.Nigra)* | 4.78 | $415\times10^{-5}$ | 6.43 | $1\times10^{-3}$ | 4.29 | $8\times10^{-3}$-$10^{-1}$ |
| $CaCo_3$+FYM | Rai(*B.Nigra)* | 3.95 | $415\times10^{-5}$ | 3.72 | $1\times10^{-3}$ | 5.5 | $8\times10^{-3}$-$10^{-1}$ |
| Control | Sarso(*B.Compestris)* | 5.20 | $415\times10^{-5}$ | 5.20 | $1\times10^{-3}$ | 5.86 | $8\times10^{-3}$-$10^{-1}$ |
| FYM | Sarso(*B.Compestris)* | 4.54 | $415\times10^{-5}$ | 4.54 | $1\times10^{-3}$ | 4.06 | $8\times10^{-3}$-$10^{-1}$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SSP | Sarso(*B.Compestris)* | 6.51 | $415\times10^{-5}$ | 6.52 | $1\times10^{-3}$ | 4.60 | $8\times10^{-3}$-$10^{-1}$ |
| $CaCo_3$ | Sarso(*B.Compestris)* | 6.11 | $415\times10^{-5}$ | 6.16 | $1\times10^{-3}$ | 5.47 | $8\times10^{-3}$-$10^{-1}$ |
| $CaCo_3$+FYM | Sarso(*B.Compestris)* | 3.68 | $415\times10^{-5}$ | 6.48 | $1\times10^{-3}$ | 5.86 | $8\times10^{-3}$-$10^{-1}$ |

## III. Conclusion

The soil that was contaminated with Cu, Ni and Zn in was treated with FYM, SSP, $CaCo_3$, and $CaCo_3$ +FYM, KCl and urea in Brassica species. The observed concentrations of Cu, Ni and Zn were 4.014 gm, 4.518 gm and 4.612 gm in *Brassica nigra* (rai) and observed concentrations of Cu, Ni and Zn were 5.208 gm, 5.78 gm and 5.17 gm in *Brassica compestris*_(sarso), respectively. By the use of this technology, we can remove heavy metals (Cu, Ni and Zn) from the contaminated soil. The green – cure technology of phyt-remediation offers an economically viable, socially acceptable and environmentally sound solution.

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