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Optimization of Plants Biomass due to Cadmium Application in Soil

Pushpendra

Deptt. of Environmental Science GBU, GB Nagar (U P)

ABSTRACT

Unlike organic contaminants, metals cannot be degraded so it requires removal. Heavy metals form the main group of inorganic contaminants. Plant potential for Cd extracting generally depends on shoot Cd concentration and shoot biomass yield. In the present experiments, this technology has been tested by six plant species in pot experiments. During this study, different Cd concentrations were given to different pots. In this study, the response of different plant species, in the sandy loam soil has been observed. Industrial waste materials Disposal have been contaminating hectares of productive agricultural land throughout the world. Increase in metal concentrations in the soil is mainly due to this. Cd Phytoextraction is a promising and environment friendly approach for soil decontamination.

Keywords: *Cadmium, Phytoextraction, Contaminated Soils, Heavy Metals, Chlorosis*

I INTRODUCTION

Generally, the background cadmium (Cd) concentration in agricultural soils remains less than 1 mg per kg (Chaney *et al*., 1997). The main objectives of the present study were to study the seed and dry matter yield of the Raya (*Brassica juncea*), Toria *(B. campastris)*, Oat *(Avena sativa)*, Barley *(Hordeum vulgare)*, Bathua *(Chenopodiun murale*) and Rijhka *(Medicago sativa)* in to two different soils. Organic compounds can be degraded while metals remediation requires physically removal or immobilization. Disposal of Industrial waste materials have been estimated to contaminate hectares of productive agricultural land throughout the world. It causes an increase in metal concentrations in the soil (Ebbs et *al.*, 2002). Cadmium being toxic to plant, its increased concentration in soil reduces growth and impairs metabolism (Foy 1978; Singh *et al.*, 2012). The beneficial effect of sewage waste water irrigation and adverse effect of Cd on different crops have also been reported by several workers (Pushpendra *et al.*, 2014).

This study provides a promising start for biomass based phytoextraction as it includes high biomass producing species and growing these species is practically easier than producing hyper accumulators. Remediation of metal compounds presents a different set of problems when compared to organics (Foy *et al* 1978). Phytoremediation is often referred to botanical bioremediation or green remediation (Pathak et *al.*, 2013; and Sharma *et al.*, 2012). The apparent complexing and slow release of Cd to root system alleviates its toxicity *(*Yanai *et al., 2006).* This is probably a result of dilution of the absorbed Cd in a larger biomass of plant tissues.

II MATERIALS AND METHODS

The pot experiments were conducted in Cd spiked soils to examine the effect of different Cd concentration on the plant growth. The present investigation was done to fulfill the objectives of the present study. The experiments were conducted using 5 kg capacity earthen pots.

2.1 Physico-Chemical Properties of Soils

Before starting the experiment, the soils were characterized. The soils were characterized for background concentration of Cd and different chemical parameters and they are shown in Table 1. The yield of different plant parts of all the six species is show in figures respectively.

2.2 Treatments and Cd levels:

The pot experiments were given five treatments (0, 20, 40, 60 and 80 mg Cd Kg^{-1} soil) to examine the effect of different Cd concentration on the plant growth. The experiments were conducted in earthen pots.

2.3 Plant Species

Raya (*Brassica juncea*), Toria *(B. campastris)*, Oat *(Avena sativa)*, Barley *(Hordeum vulgare)*, Bathua *(Chenopodiun murale*) and Rijhka *(Medicago sativa)* were chosen for this work. To observe the seed and dry matter yields these six plant species were grown in to two different soils. All the plants were grown with three replicates.

III RESULTS AND DISCUSSION

After recording other observations, the harvested plants were put in paper bags and kept at 65±2°C for 48 hours till constant weight was obtained and recorded as g $plant^{-1}$ after taking average. The results of the present study are shown in the Fig 1 to 2. It was necessary to observe the amount of cadmium initially in the soil. Before starting the experiment, the soils were characterized. The soils were characterized for background concentration of Cd and different chemical parameters.

3.1 Dry Matter Yield

In the controlled (Cd_0) treatment, there were no distinct Cd toxicity symptoms throughout the growing period of crops. At 40 mg Cd kg^{-1}, some light chlorotic symptoms, resembling to Fe-chlorosis, appeared after about 2 weeks of germination. The chlorotic symptoms became more conspicuous with the increasing levels of Cd, and Chlorosis was most conspicuous in Oat followed by Barley, Toria, Bathua, Rijhka and Raya. At 60 and 80 mg Cd kg^{-1} soil treatments, the leaves were considerably narrow and small as compared to Cd control in all the species tested. Dry matter yield varied widely with all the plant species.

3.2 Leaf and Seed Biomass

The highest dry matter yield was found in Raya while it was lowest in Rijhka. The reduction in the yield with Cd application was mainly due to its toxic effects on the plant growth. It was observed that the application of

Cd decreased the dry matter yield in all the species. Leaf dry matter yield was also affected by application of different treatments of Cd. There was a 3, 11, 17 and 25 percent decrease in dry matter yield in the 20, 40, 60 and 80 mg Cd kg^{-1} soil, respectively as compared to control. There was a little seed yield decrease in all the plant species up to 20 mg Cd kg^{-1} soil, whereas the seed yield decreased much at the 40, 60 and 80 mg Cd kg^{-1} soil, than control.

IV CONCLUSION

The highest leaf dry matter yield of Raya was also recorded. Similar trend was observed in Toriya, Oat, Bathua, Rijhka and Barley. In this study, the response of different plant species. Cd_0 to Cd_{80} treatment the mean seed yield decreased from 3 to 37 percent and leaf 3 to 25 percent respectively. The maximum decrease in the mean dry matter yield was at Cd_{80} treatment. Experiments, in which soils used rather than solution, approximately are more closely to the natural conditions, where the effect of soil buffering capacity influences nutrient availability to plants. The goal was to assess to develop the heavy metal removal technique in natural conditions of the soil with and without chelators. It was observed that Cd affects all the growth parameters. However, it could be used to remediate the Cd contaminated soil without the application of any chemical.

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Table 1: Physico-Chemical Characteristic of the Soil

Characteristics	**Contents**
*pH	7.67
*EC (dSm^{-1})	0.39
Mechanical Composition (%)	
i) Sand	76.3
ii) Silt	12.3
iii) Clay	1.4
Organic carbon (%)	0.36
Olsen's P ($mg\ kg^{-1}$)	12.0
CEC (m.e/100 g)	7.2
Metal contents ($mg\ kg^{-1}$)	
i) Lead	2.78
ii) Cadmium	0.80
iii) Nickel	0.25
iv) Zinc	3.1
v) Iron	14.4
vi) Manganese	5.1
vii) Copper	3.4

***1:2** Soil: Water suspension

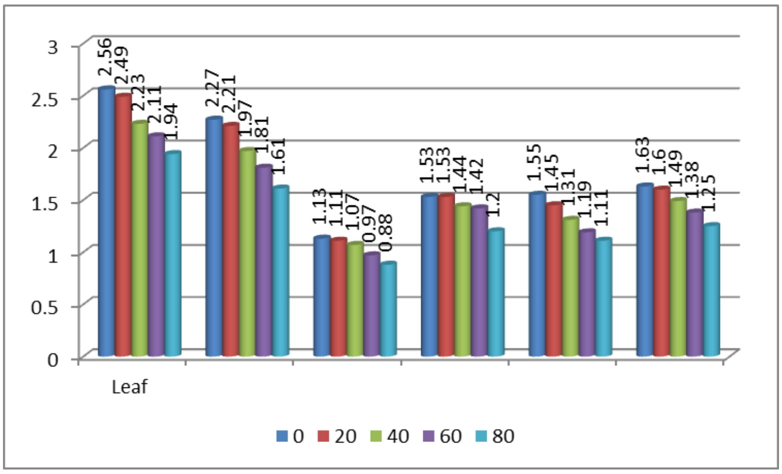

Fig 1: Yield of (g $Plant^{-1}$) Species due to Cd Application in Soil

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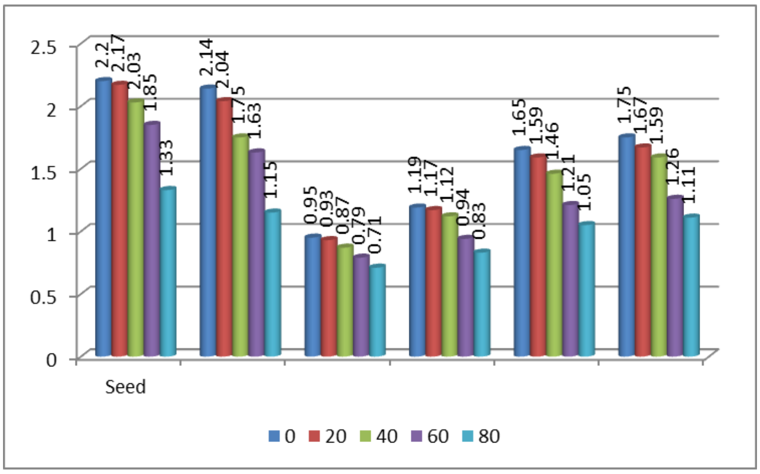

Fig 2: Yield of Species (g Plant^{-1}) due to Cd Application in Soil