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Phytoremediation of Heavy metal Contaminated Soil Using '*Helianthus annuus*'

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ABSTRACT

The goal of this study was to see if Common Sunflower plants (Helianthus annuus) could accumulate large amounts of Lead (Pb), Zinc (Zn), and Cadmium (Cd) in order to extract heavy metal (Cd> Pb> Zn) to help with soil phytoremediation. Pot studies carried out on the two different samples. The contaminated soil from the study location was tested for selected heavy metals (Zn, Cd, and Pb). The results showed that when the Hyperaccumulator plant, Helianthus annuus, was used, the content of heavy metals in the soil was found to be reduced.

Key words: *Phytoremediation, Sunflower, Heavy metals Zinc, Cadmium,Lead*

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INTRODUCTION

Phytoremediation (Phyto, which means "plant," and remedium, which means "restoring balanced") is a green method that uses plants and their associated rhizosphere microorganism to remove or accumulate heavy metals from contaminated soil.Phytoremediation is a broad term that relates to all of the techniques by which plants remove, convert, or stabilise contaminants in soil, water, or the environment. After it establishes soil remove the low cost of growing a crop and is minimal compared to those remove the heavy metal into the soil, plant-based remediation technology can work well with minimum costs. Metal pollution has become one of the most severe environmental problems today in the world. Most common heavy metals present in the environment are Zinc (Zn), Cadmium (Cd), Chromium (Cr), Lead (Pb), Mercury (Hg), and Nickel (Ni). Phytoremediation has emerged as an alternative technique for removing metal-polluted soils. We suggest that phytoextraction can assist sunflower plants remediate Cd, Pb, and Zn polluted soils. The use of plants to remove inorganic (primarily) and organic pollutants from polluted soil, water, sludge, or sediments is known as phytoextraction. The contaminants are taken up by the plant roots and transported to the above-ground parts in procedure. The contamination is transferred from the root to the shoot, improving tissue harvesting easier and decreasing overexposure.

MATERIAL AND METHODS

Soil Sample Collection and source of plant sampling

The experiment was carried out in a pot at the Makarpua GIDC and Nandesari GIDC in Vadodara, Gujarat. The sample was taken in December of 2021, during the winter season. The sampling locations were 22 15'0.3" N and 73.1851" E, along with 22 41452" N and 73 05'43.7" E. For this study, a soil sample was taken from a depth of 0-15 cm, as well as two separate industrial locations. A spade and a core sampler were used to collect the samples. The samples were collected and put into sampling bags. The soil was dried in an oven at temperatures ranging from 55 to 105 ° C. for 24 hours. The soil was screened using a 2mm stainless steel sieve. The physicochemical parameter was assessed using the Indian Standard method, while heavy metals were tested using the aqua-regia method. As a result, this study was carried out to test if heavy metals may degrade or extract into polluted soil, permitting hyperaccumulators plants to be used.

Experimental protocol

The experimental design was totally randomly selected, with three metal varieties replicated to make a total of two Helianthus annuus experiment pots. The two-experiment was filled with 10 kg of soil that was already sieved with a 2 mm sieve. The Helianthus annuus samples were then planted in each pot.This study utilized Helianthus annuus (common sunflower) plants. For the phytoremediation of polluted soils, the sample plants were grown in the soil. The plants were grown for one month and then matured for another two to three months. The observation was carried out over a period of 1-2 months. Although the plants appeared to be rapidly growing, they looked pale and unhealthy.

Laboratory Analysis

The heavy metal concentration in soil was determined using the aqua regia method, as modified by Kayode et al (2010). 1.0-2.0 g of organic slurry, 30% H2O2, DDW, conc. HCl, and DDW were added to a 250ml beaker. The sample was heated to 95 degrees Celsius and allowed to reflux for 10 to 15 minutes without boiling. Allow the solution to evaporate to 5 mL without boiling, keeping a minimum of 2 to 3 mL of solution over the beaker's bottom at all times. Excessively severe effervescence must be eliminated if losses are to be eliminated.Inductively coupled plasma optic emission spectrometry (ICP-OES) was used to analyse the Zn and Pb concentration of soil filtrates.

RESULT AND DISCUSSION

Table 1 shows the result in contaminated soil for heavy metal concentrations on 2nd week in Pb, Zn, and Cd were 338.8, 854.1, and 3.9 mg/kg in Nandesari and Makarpura soil concentration of heavy metal in soil were 966.6, 172.6, and 109.0 mg/kg respectively sample before the pot experiment. The result for Zn and Pb showed significant values of heavy metal at Nandesari and Makarpura soil samples.

After the pot experiment with Helianthus annuus, the results showed a significant increase in Pb and Zn accumulation in Makarpura soil. And the value of heavy metal concentration in the Nandesari soil sample was higher than the initial values before the pot experiment. Heavy metal through the use of the Helianthus annuus plants into the soil sample resulted in the largest concentration of Pb, Cd, and Zn. The heavy metal trend found was in the order Pb>Cd>Zn, showing a considerable decrease in soil accumulation in plants (Table 3.2). Contamination of soil planted with H. annuus as a result of Pb, Cd, and Zn. As a result, the final Zn concentration of 130.6 mg/kg in the Makarpura soil sample was within the normal range.

Table *1* The value of heavy metal before pot experiment

Sr. No.	Sample name	Test Parameters	Result (mg/kg)	Permissible value in soil (mg/kg)	Permissible value in plants (mg/kg)
1	Nandesari G.I.D.C	Zinc	854.1	300-600	0.60
		Cadmium	3.9	3-6	0.02
		Lead	338.8	250-500	2
2	Makarpura G.I.D.C	Zinc	172.76	300-600	0.60
		Cadmium	109.0	3-6	0.02
		Lead	966.6	250-500	2

Source: Indian standard (Awasthi,1988), (WHO,1996)

Table *2* The value of heavy metal after pot experiment

Sr. No.	Sample Name	Test parameters	Result (mg/kg)	Permissible value in soil (mg/kg)	Permissible value in plants (mg/kg)
1	Nandesari G.I.D.C	Zinc	939.2	300-600	0.60
		Cadmium	5.9	3-6	0.02
		Lead	388.3	250-500	2
2	Makarpura G.I.D.C	Zinc	130.6	300-600	0.60
		Cadmium	8.1	3-6	0.02
		Lead	693.7	250-500	2

CONCLUSION

According to this study, Helianthus annuus has the highest accumulative potential for Pb, Cd, and Zn. These plants had the highest concentrations of Pb, Cd, and Zn from contaminated soil, which they accumulated through plant roots, according to the experiment. It may be assumed from the results that the use of Helianthus annuus reduced the value of heavy metal. This suggests that the phytoremediation procedure could be carried out with Helianthus annuus. According to the result of this research, Helianthus annuus acts as a hyperaccumulator plant for phytoremediation of soil polluted with heavy metals such as zinc, cadmium, and lead. The results indicate that the Helianthus annus hyperaccumulators plants were good at accumulating Cadmium, Zinc, and Lead.

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