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# Vermicompost Induced Phytoremediation of Heavy Metals Copper and Chromium Contaminated Soil by the Plant *Sesamum indicum L*

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**Abstract:- The effect of vermicompost in phytoremediation of heavy metals copper and chromium in a contaminated soil by the plant *Sesamum indicum L* was studied. The experiment has been carried for a short period to understand the process of heavy metal extraction or removal while plant growth for both metals Cu and Cr. The vermicompost-heavy metal (different doses) mixed with soil and taken as a media for plant cultivation. Among the different doses (0, 5, 10, 20, 40 ppm) the plants were shown a considerable growth till 10ppm in both metals. The length of root and shoot of plants indicates the effective growth due to the usage of vermicompost and lower heavy metal doses (0, 5, 10 ppm). But the growth rate decreases with the increased doses (20, 40 ppm) of both heavy metals Cu and Cr. Similar results were also obtained in dry weight of root and shoot of the sesame plant in high doses for both metals. Higher amount of metal accumulation in plants made an adverse effect in physiological, metabolic activities which result in shunt growth and decreased dry weight (biomass). The high concentration of metals (Cr and CO) accumulates in shoots than any other parts of the plant which clearly indicate the metals removed from the given contaminated soil medium by the plant *Sesamum indicum L.* According to the present study the plant *S.indicum L* efficiently remove the heavy metals chromium and copper from the contaminated soil and it also has the ability to accumulate the heavy in their parts while growing. The efficiency of accumulation enhanced by addition of vermicompost. Hence it is concluded that the plant *S.indicum* L can be used in phytoremation for heavy metal pollution.**

***Keywords:-*** *Phytoremediation, Vermicompost, Heavy metal, Copper and Chromium.*

## I. INTRODUCTION

Phytoremediation can be defined as the use of plants with soil amendments such as vermicompost and other composts to eliminate or reduce the contaminants from the polluted site (Salt *et al.* 1998). The human activity of our environment is being contaminated by various types of pollution. Among them heavy metal pollution is a severe threat now days. (Mantovi *et al*., 2003)

A suitable and sustainable removable mechanism need for heavy metal contaminated soil to reduce its impact on the environment. Clean-up of extensive metal polluted soil by usual physical and chemical methods are unsatisfactory and undesirable for agricultural fields because they have need of large venture and inventive resources (Oh *et al.*, 2013). To overcome, this problem plant-based method has been introduced as a remedy for the high level of various heavy metals toxicity in soil.

Copper and Chromium are one the plentiful transition heavy metals in the environment. Copper it is called as currency metal, occurring mono and divalent oxidation states, it has been largely used a range of activities, like, pesticides and fungicides, wood additives, colour pigments for glasses, dye and paints, moreover it is superconductor (Rebecca, 2006). Cu is a critical necessary micronutrient for animal need at lower concentration (Wintz *et al.*, 2002) also for biological functions of plants (Muhammad *et al.*, 2015) and also acts as cofactor and activator during enzyme chemical reaction (Mildvan, 1970). Copper is relatively more toxic to plant than other indispensable trace elements, like zinc and magnesium (Dresler *et al.*, 2014).

Similarly the Chromium resources found reach in India. It has been widely used in defense system, flight constriction, space research, paint industries, and other dye industries and chrome plating factories etc., many industries and mines paved the way to the liberate of toxic to environment. Chromium toxic is one of the main struggle in India (Zayed, and Terry, 2003; Shanker *et al.*, 2005a). In terms of abundance Cr, placed the seventh place and found in many oxidation states, hexavalent chromium one among which is highly poisonous, carcinogen induce many mutagenic, carcinogenic effect to human and animals (Andaleeb *et al.,2008*). To overcome the problem conventional physiochemical technology has been applied but, they are costly, complicated and not effective, damaging the soil fertility and quality. The vermicompost as a solid waste treatment technology that deals with the decomposition of organic matters in solid waste in an eco-friendly way, without any adverse effects it can be easily stored, handled, and applied to agricultural fields (Usman Ali.et al., 2015). Use of organic matter, like natural compost, vermicompost, other fertilizers and biodegradable wastes, is a general practice for immobilization of heavy metals and soil amelioration of polluted soils (Clemente *et*

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*al.,* 2005). The consequence of organic material amendments towards heavy metal based on the character of the organic material, microbes present in, degradability, salt level and impacts on soil pH and redox potential, soil types and metals of interest (Walker *et al.,* 2004). Sevinc Adiloglu et al. (2017) observed the effect of the various doses of vermicompost implementation on some heavy metal and bio-availability of trace elements (Cr, Co, Cd, Pb, Zn, and Ni of Cucumber (*Cucumis sativus L.*) and switch grass (*Panicum virgatum*), Shrestha et al. (2019). The results revealed that vermicompost can be used as a fertilization program to protect the plant's quality and to eliminate its heavy metal contents. On the other hand, the use of organic fertilizers such as vermicompost should be extended for the maintenance of soil productivity. Amin et al. (2018) have studied potential for phytoextraction of Cu by *Sesamum indicum L*. and *Cyamopsis tetragonoloba L in* contaminated soil. Most growth parameters were reduced under high Cu stress. There are several study as for phytoremediation with vemicompost mixed soil in Plants such as Indian mustard (*Brassica juncea*), Corn (*Zea mays L*.) and sunflower (*Helianthus annuus L* ), Mahardika et al. (2018)). However in this study is one more trial to stabilize the heavy metals remediation by the plant *Sesamum indicum L*. The effect of vermicompost - heavy metals enriched soil to analyse and determine accumulation of the heavy metals on root and shoot length, dry weight of the plant *Sesamum indicum L*.

## II. MATERIALS AND METHOD

Sesame seeds were obtained from private seed supplier at Thiruvarur, Tamil Nadu. Seeds were immersed in 3% (v/v) of formaldehyde for 5 minutes and washed with distilled water several times to avoid microbial contamination. The Merck brand Chromium ($CrNO_3$) and Copper (CuSO4) Purchased from scientific company. Soil was collected from a depth of about 0-15 cm in the field near Thiru. Vi. Ka. Govt College, Thiruvarur, Tamil Nadu. Characterisation was done as in APHA, (1998) . Vermicompost was purchased in organic fertilizer shop at Thiruvarur, Tamil Nadu and the physicochemical parameters were measured as described in soil analysis.

In this study, the experiments were carried out separately for the two selected metals Chromium as CrNO3 and Copper as CuSO4. Heavy metals mixed separately in soil with vermicompost is taken as media for treated group and the heavy metals mixed soil without vermicompost is taken as a media for control group. The media contain 3:1 ratio of alluvial soil and vermicompost. The concentrations of each heavy metal used in this study were 0, 5, 10, 20, and 40 ppm. After 60 days the plants were harvested to the analyse parameters.

The plants were uprooted carefully and washed with distilled water, shoot and root length were measured by scale and recorded. The plant samples were washed with distilled water, carefully separate root and shoot with knife, allowed to dry in an oven at 70ºC for 3 days. The dried samples to make a powdered and allow the analyses the bio-accumulation of heavy metals method as described by APHA, (1998). After experimentation, data is pooled in a systematic way and means, standard deviations was analyzed using statistical tools like XL.

## III. RESULTS AND DISCUSSION

The results noticeably indicate that, all the growth parameters in both control and treated plants were declined slowly with the increase in concentration of both heavy metals Chromium and Copper. Among the different doses the root length increased up to 11.41 and 12.1 cm till 10ppm concentration of heavy metal Cr in both control and treated plants respectively. Whereas the root length decreased as dose increased, highest decline in root length 5.81 and 6.2cm observed at 40 ppm concentration of Cr in both control and treated plants respectively. Similar trends were observed in plants treated with vermicompost – copper mixed soil. The root length increased 12.22 and 14.21 cm till 10 ppm dose of Cu in control and treated plants respectively. Whereas the highest decline in root length observed as 7.10 and 8.49 at 40 ppm dose of Cu in control and treated plants.

The doses of heavy metals Chromium and Copper used 5ppm and 10ppm supported the root growth of the plants. Plants treated at lower concentrations were not significantly affected by the metals. However, at 40 ppm it will decrease, this could be attributing that the increase in the heavy metal concentration in the soil-vermi-compost media caused root length decrease with stunt growth of roots. Similar to the present result, Jadia and Fulekar, (2008) observed reduced root growth in sunflower plant grown in heavy metal enriched soil- vermicompost media. The changes observed in root of treated plants grown in high dosages of heavy metals were pale yellow colour to brown, loss of root hair and growth. The observed results were in agreement with Jadia and Fulekar, (2008) in sunflower plants (Fig.1). The experiment carryout similar to the root length, the shoot length in both control and treated plants were declined gradually with the increase in concentration of heavy metals Cr and Cu. Among the different doses the shoot length increased up to 63.27 and 68.06 cm till 10 ppm concentration of heavy metal Cr in both control and treated plants respectively. Whereas the shoot length decreased as dose increased, highest decline in root length 52.60 and 52.79 cm observed at 40 ppm concentration of Cr in both control and treated plants respectively.

Similar trends were observed in plants treated with vermicompost - Copper mixed soil. The shoot length increased 64.18 and 69.12 cm till 10 ppm dose of Cu in control and treated plants respectively. Whereas the highest decline in shoot length 59.12 and 60.04 cm observed at 40 ppm Cu (Table 10). The plants grown in control a treated media shown increased shoot length due the lower concentration (till 10 ppm) of metals support the growth. However, at 40 ppm it will decrease, this could be attributing that the increase in the heavy metal concentration in the soil-vermin-compost media caused shoot length decrease with stunt growth of shoot (Fig. 2).

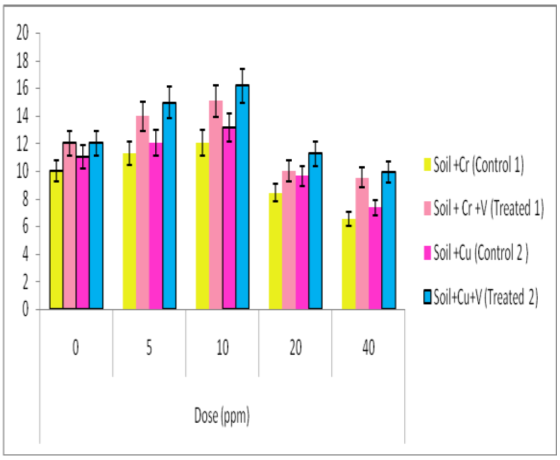


Fig. 1 Effect of heavy metals Copper and Chromium enriched soil - vermicompost on the Root length *Sesamum indicum L* 60 DAP

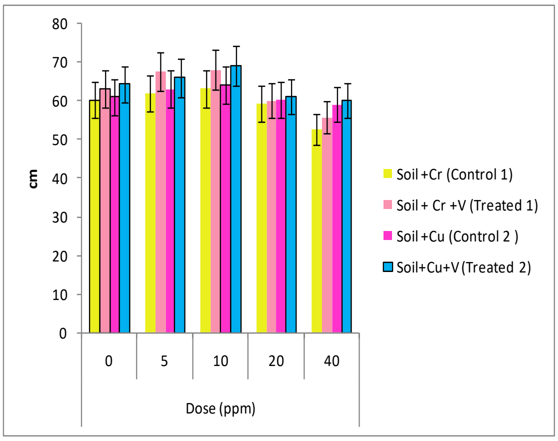


Fig. 2 Effect of heavy metals Copper and Chromium enriched soil - vermicompost on the Shoot length *Sesamum indicum L* 60 DAP

The dry weight of root and shoot of the plant found to decrease as heavy metal Cr and Cu concentration increased in both control and treated plants. Among the different doses, the root dry weight increased up to 1.75 and 2.01 g till 10 ppm concentration of heavy metal Cr in both control and treated plants respectively. Whereas the root dry weight reduced as dose increased, highest decline in root dry weight 0.68 and 1.05 g observed at 40 ppm concentration of Cr in both control and treated plants respectively. Similar trends were observed in plants treated with vermicompost and copper mixed soil. The root dry weight increased 2.78 and 3.22 g till 10 ppm dose of Cu in control and treated plants respectively. Whereas the highest decline in root dry weight 0.89 and 1.35 g observed at 40 ppm Cu (Fig. 3).

The dry weight of shoot in the plant found to decrease as heavy metal Cr and Cu concentration increased in both control and treated plants similarly. Among the different doses, the root dry weight increased up to 12.02 and 15.08 g till 10 ppm concentration of heavy metal Cr in both control and treated plants respectively. Whereas the Shoot dry weight reduced as dose increased, highest decline in shoot dry weight 6.55 and 9.50 g observed at 40 ppm concentration of Cr in both control and treated plants respectively. The plants treated with vermicompost with Cu mixed soil the same trends were observed. The shoot dry weight increased 13.12 and 16.18 g till 10 ppm dose of Cu in control and treated plants respectively. Whereas the highest decline in shoot dry weight 7.34 and 9.91 g observed at Cu 40 ppm (Fig.4).

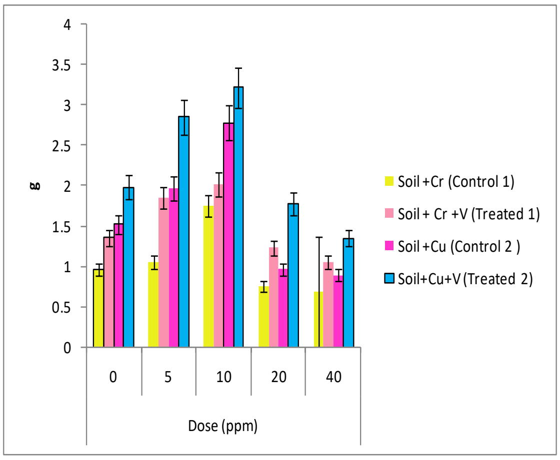


Fig. 3 Effect of heavy metals Copper and Chromium enriched soil - vermicompost on the Root dry weight *Sesamum indicum L* 60 DAP

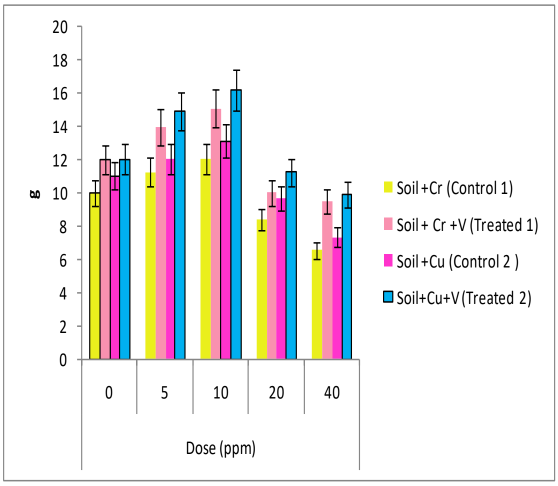


Fig. 4 Effect of heavy metals Copper and Chromium enriched soil - vermicompost on the Shoot dry weight *Sesamum indicum L* 60 DAP

Accumulation of heavy metals by plant *S. indicum* accumulates various heavy metals in various plant parts accordingly. The Cu accumulated more than Cr and the shoot contain more heavy metal concentration than root. The observed variation may be due to the nature of metal and concentration of metal in the soil, it also confirmed that the root can transfer the metal to shoot.

## IV. SUMMARY

The present study demonstrated that the effect of vermicompost in phytoremediation of heavy metals copper and chromium in a contaminated soil by the plant *Sesamum indicum L.* The experimental procedures have been carried for a short period to understand the process of heavy metal extraction or removal while plant growth for both metals Cu and Cr. In this experiment vermicompost-heavy metal (different doses) mixed with soil and taken as a media for plant cultivation. Among the different doses (0, 5, 10, 20, 40 ppm) the plants were shown a considerable growth till 10ppm in both metals. The length of root and shoot of plants indicates the effective growth due to the usage of vermicompost and lower heavy metal doses (0, 5, 10 ppm). But the growth rate decreases with the increased doses (20, 40 ppm) of both heavy metals Cu and Cr. Similar results were also obtained in dry weight of root and shoot of the sesame plant in high doses for both metals. Higher amount of metal accumulation in plants made an adverse effect in physiological, metabolic activities which result in shunt growth and decreased dry weight (biomass). The heavy metals Cu and Cr were up taken by the plants and effectively accumulate in all parts of the plant as the increased dose of heavy metals mixed in the soil medium. The high concentration of metals (Cr and CO) accumulates in shoots than any other parts of the plant which clearly indicate the metals removed from the given contaminated soil medium by the plant *Sesamum indicum L.*

## V. CONCLUSION

According to the present study the plant *S. indicum L* efficiently remove the heavy metals chromium and copper from the contaminated soil. And it also has the ability to accumulate the heavy in their parts while growing. The efficiency of accumulation enhanced by addition of vermicompost. Hence it is concluded that the plant *S.indicum L* can be used in phytoremdiation for heavy metal pollution. Effect of the accumulated heavy metals on human health yet be analyzed it will have fulfilled in my future study

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