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# Determination of heavy metals in soil treated with textile industry effluent

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## ABSTRACT

Textile industry effluents are discharged on land and into adjacent water bodies. These effluents cause soil and ground water pollution. Textile effluents carry heavy metals which are harmful to vegetables crops. The objective of the present study is to determine the heavy metals in soil treated with textile industry effluent. Textile industry effluent was obtained from district Sant Ravidas Nagar, Bhadohi and used in this study. A pot experiment including tomato was conducted adopting Completely Randomized Design with five treatments and three replications in the natural open weather conditions for 60 days. Five concentrations of effluents viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. Observations related to concentration of heavy metals (Zn, Cu, Cr, Pb and Ni) in soil were recorded at 45 and 60 days after transplanting. Results reveal that minimum amount was recorded in 0% concentration of effluent (control). As the concentration of effluent increased there is continuous increase in zinc, copper, chromium, lead and nickel content in soil. Maximum amount was recorded with 100% effluent concentration.

**Keywords:** Heavy metals (Zn, Cu, Cr, Pb and Ni), Soil, Textile industry effluent

## INTRODUCTION

Textile effluent contains heavy load of pollutants, exhibiting high total dissolved solids, total suspended solids and many other organic and inorganic compounds including heavy metals. Presence of these toxic substances, limit its application for irrigation purposes [1]. However, availability of some vital micronutrients like copper, zinc, iron and manganese in textile effluent may offer a possibility to use it for irrigational purpose after proper treatment [2]. These elements are also considered as heavy metals as they may be toxic to plants at high concentrations [3].

Untreated effluent often contains a large range of chemical contaminants like heavy metals from industrial discharges. World Health Organization (WHO) has warned significant health implications due to the direct use of textile effluent for irrigation purposes. These contaminants pose health risks to communities (farmers, agricultural workers, their families, cattles and the consumers of effluent-irrigated crops) living in the proximity of textile industrial area and areas irrigated these effluents [4]. Most of the textile industrial effluents contain heavy metals in an amount sufficient enough to cause toxicity.

Impact of heavy metals (Cd, Pb, Cu) on seed germination of *Arachis hypogaea* L. was recorded by Abraham [5] and found that Cd, Pb and Cu significantly decreased seed germination of *Arachis hypogaea* L. as compared to control. Increased concentration of Cd at 75 and 100 mg/l affected the groundnut seed germination extremely. While Pb treatment at 75 and 100 mg/l significantly reduced seed germination of groundnut as compared with control. Copper treatment at 100 mg/l also condensed seed germination of *Arachis hypogaea* L. as compared with control.

Numerous studies have also been carried out to study the effect of textile effluent on crop plant [6]. *Triticum aestivum* seeds were exposed with textile industry effluent resulted reduction in root and shoot length of seedlings including their dry weight, chlorophyll, protein and carbohydrate content [7].

After assessment of the beneficial and harmful effect of the different concentration of effluents on crops, suitable dilution can be used as liquid fertilizer. In this present study, attempt has been made to determine the heavy metals concentration in soil treated with textile industry effluent.

## MATERIALS AND METHODS

For present study, textile industry effluent was collected from Ghosia town of famous carpet - textile industry district Sant Ravidas Nagar, Bhadohi. This district is situated in Latitudes 25˚23 'north and Longitudes 82˚34' East at the distance about thirty miles from west of Varanasi, and about three miles south of the river Varuna.

To find out the determination of heavy metals in soil treated with textile industry effluent, a pot experiment was conducted adopting Completely Randomized Design with five treatments and three replications in the natural open weather conditions for 60 days. Pots were filled with normal soil without any effluent treatment. Five concentrations of effluent viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. Tomato (*Solanum lycopersicum* ) was used as test crop. All the pots were uniformly watered with distilled water whenever required. In treated pots, effluent of various concentrations was given at the interval of 15 days. The data pertaining to accumulation of heavy metals in soil was recorded after 45 and 60 days after transplanting.

At 45 and 60 days after transplanting of tomato plant, surface (0-15cm) soil samples were collected in polythene bags for heavy metal analysis. Heavy metals (Zn, Cu, Cr, Pb and Ni) in the soil sample were estimated following standard procedure using Atomic Absorption Spectrophotometer (AAS Model GBC 932). Measurements were made in triplicate for plant sample to check the precision of the results. Previous extraction of heavy metals from the plant material was performed using $HNO_3$-$H_2SO_4$ solution [8].

## RESULTS AND DISCUSSIONS

In present study, the data related to heavy metal concentration such as zinc, copper, chromium, lead and nickel in soil treated with different concentrations (0%, 25%, 50%, 75% and 100%) of textile industry effluent recorded on 45 and 60 days after transplanting (DAT) have been presented in table 1 and figure 2 to 6. The data reveals that zinc, copper, chromium, lead and nickel content increased with increasing concentrations of textile industry effluents.

The data related to 45 DAT shows that zinc, copper, chromium, lead and nickel in soil ranged from 0.680 to 4.950, 0.140 to 0.760, 0.160 to 4.560, 0.125 to 1.430, 0.198 to 2.670 mg/kg and increased with increasing concentrations of effluent. The data presented at 60 DAT indicates that zinc, copper, chromium, lead and nickel concentration varied from 0.820 to 5.50, 0.199 to 1.533, 0.205 to 5.40, 0.139 to 2.89, 0.340 to 2.880 mg/kg at this stage.

From the data, it was found that minimum amount was recorded with 0% concentration of effluent (control). As the concentration of effluent increased there was continuous increase in heavy metals content. Maximum amount was recorded with 100% effluent concentration as compared to control.

Results of present study are supported by the study of Bhargava and Singh [9] the reported that heavy metal inhibits the growth of seedling. Vegetables take-in heavy metals and quantities high enough to cause clinical problems both to animals and human beings that consume those [10].

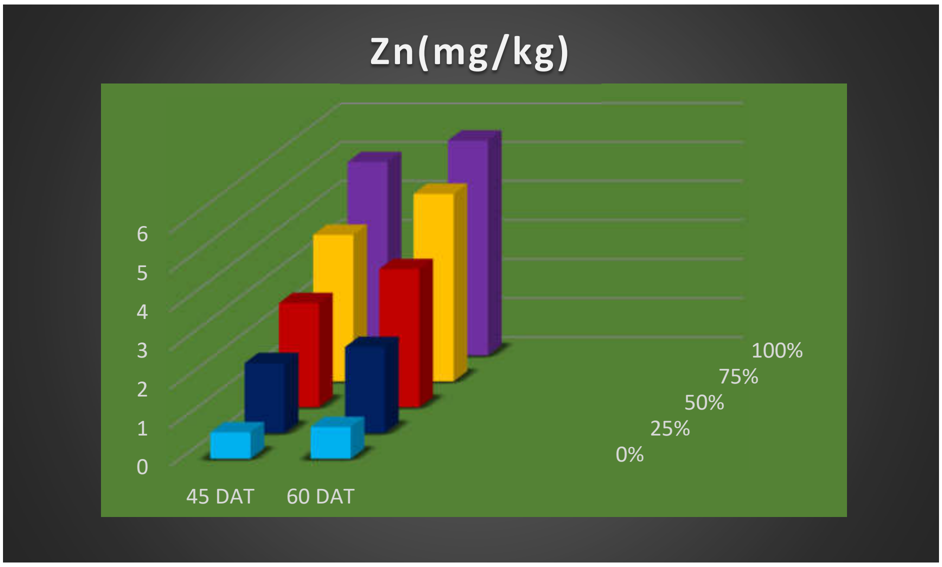
Heavy metals accumulate in top soil (at a depth of 20 cm) and sourcing through plant roots; they enter the human and animal body through leafy vegetables consumption and inhalation of contaminated soils [11].

**Table 1 : Heavy metal content (mg/kg dry weight) of soil treated by effluent S1**

| Efflu. Conc. (%) | 45 DAT | | | | | 60 DAT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Zn | Cu | Cr | Pb | Ni | Zn | Cu | Cr | Pb | Ni |
| 0 | 0.680 | 0.140 | 0.160 | 0.125 | 0.198 | 0.820 | 0.199 | 0.205 | 0.139 | 0.340 |
| 25 | 1.800 | 0.450 | 1.700 | 0.560 | 0.856 | 2.211 | 0.522 | 2.330 | 0.876 | 0.895 |
| 50 | 2.670 | 0.540 | 2.450 | 0.770 | 0.943 | 3.540 | 0.723 | 3.640 | 0.978 | 1.200 |
| 75 | 3.750 | 0.670 | 3.810 | 0.940 | 1.567 | 4.800 | 1.340 | 4.710 | 1.460 | 1.622 |
| 100 | 4.950 | 0.760 | 4.560 | 1.430 | 2.670 | 5.500 | 1.533 | 5.400 | 2.890 | 2.880 |

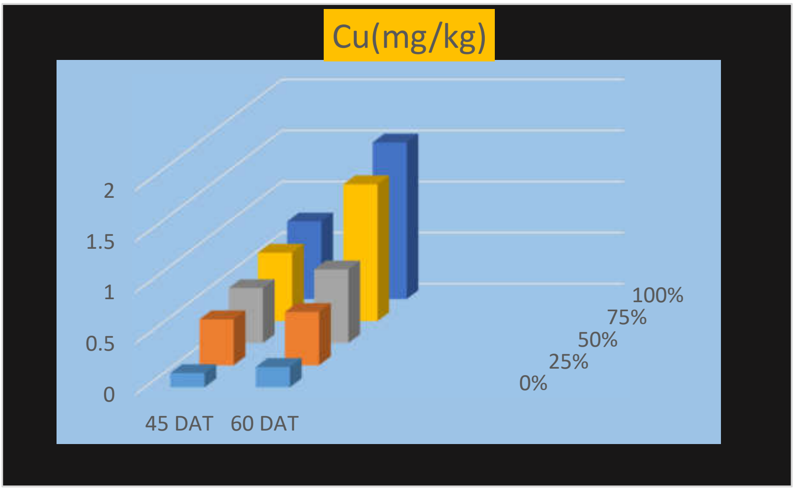
**DAT = Days After Transplanting**

**Figure 2: Zn concentration mg/kg (dry weight) in soil treated with textile effluent**



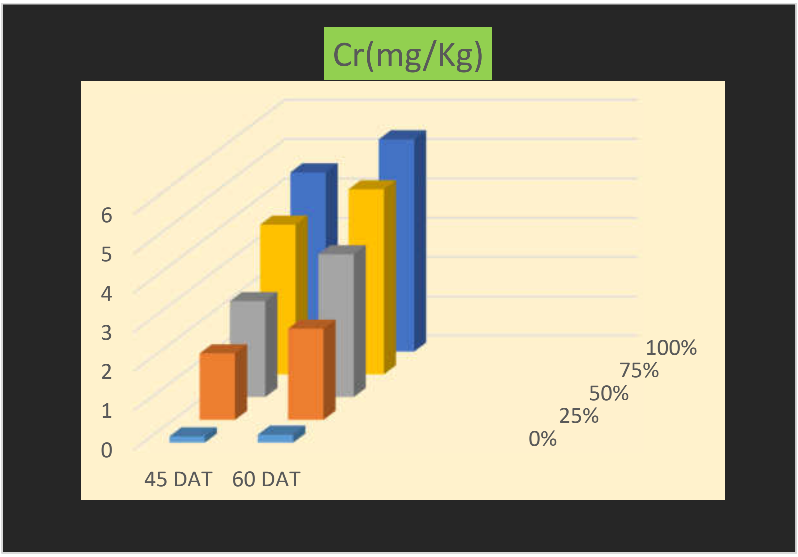

**DAT = Days After Transplanting**

**Figure 3: Cu concentration mg/kg (dry weight) in soil treated with textile effluent**



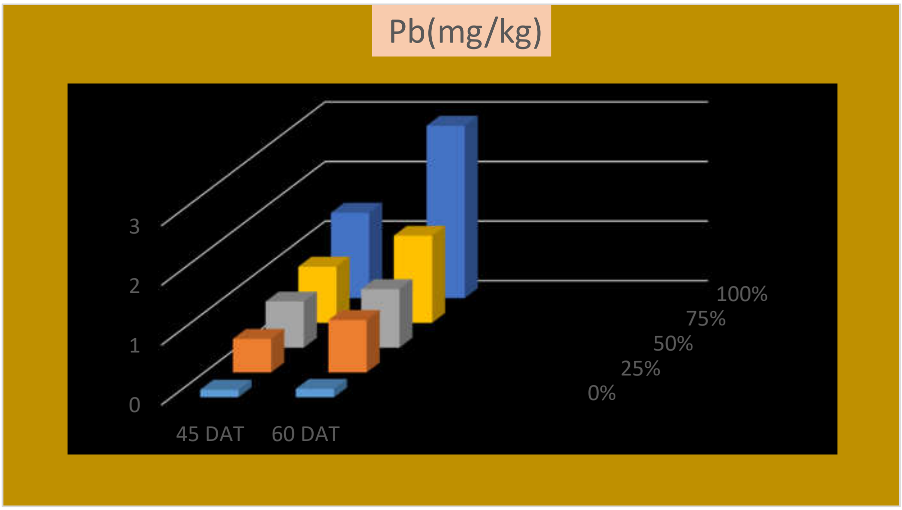

**DAT = Days After Transplanting**

**Figure 4: Cr concentration mg/kg (dry weight) in soil treated with textile effluent**



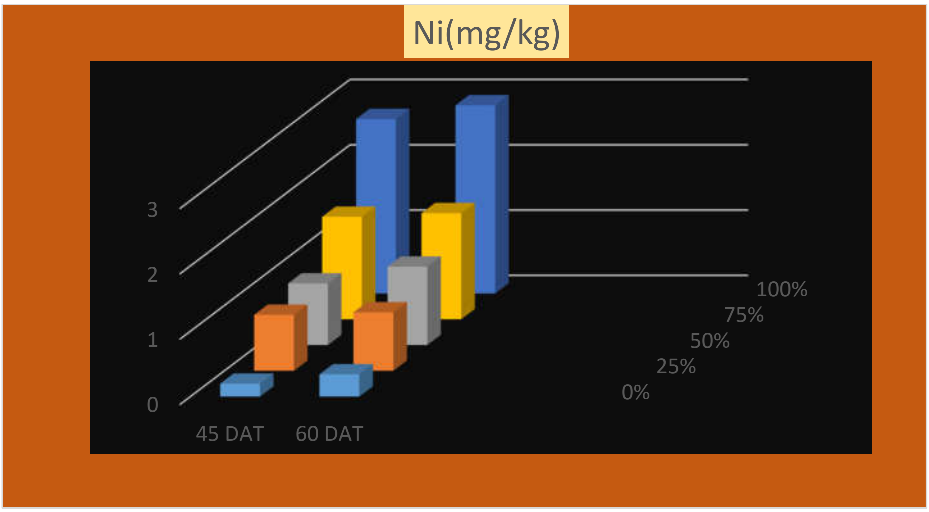

**DAT = Days After Transplanting**

**Figure 5: Pb concentration mg/kg (dry weight) in soil treated with textile effluent**




**DAT = Days After Transplanting**

**Figure 6: Ni concentration mg/kg (dry weight) in soil treated with textile effluent**




**DAT = Days After Transplanting**

## CONCLUSION

This study concluded that effluent of textile industry affects the soil. It was found that minimum amount recorded in 0% concentration of effluent (control). As the concentration of effluent increased there was continuous increase in zinc, copper, chromium, lead and nickel content. Maximum amount was recorded with 100% effluent concentration.

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