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Accumulation of Heavy Metals in Tomato Plant Treated with Carpet Effluent

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ABSTRACT

Carpet industries release a large amount of wastewater which is discharged on land and into adjacent water bodies. This wastewater causes soil and ground water pollution besides causing a number of adverse effects on flora and fauna. The objective of the present study is to analyze the accumulation of heavy metals in tomato plant treated with carpet effluent. Carpet industry effluent was obtained from district Bhadohi and used in this study. A pot experiment was conducted adopting Completely Randomized Design with five treatments and three replications in the natural open weather conditions for 60 days during the plant season. Five concentrations viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. Observations related to accumulation of heavy metals (Zn, Cu, Cr, Pb and Ni) 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 tomato fruit. Maximum amount was recorded with 100% effluent concentration as compared to control.

Keywords: Carpet industry effluent, Tomato, Heavy metals (Zn, Cu, Cr, Pb and Ni)

I. INTRODUCTION

The textile (carpet) industry effluent contains waste chemicals, high BOD, COD, hardness, dyes, oil and grease and toxic metal etc. Numerous studies have been carried out to study the effect of textile wastewater on crop plant (Dayama, 1987). *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 (Khan and Jain, 1995).

Untreated wastewater often contains a large range of chemical contaminants from waste sites, chemical wastes from industrial discharges, heavy metals, fertilizers, textile, leather, paper, sewage waste, food processing waste and pesticides. World Health Organization (WHO) has warned significant health implications due to the direct use of wastewater for irrigation purposes. These contaminants pose health risks to communities (farmers, agricultural workers, their families and the consumers of wastewater-irrigated crops) living in the proximity of wastewater sources and areas irrigated with untreated wastewater (Qadir *et al.*, 2010).

Heavy metals accumulate in top soil (at 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 (Mahmood *et al.*, 2014).

Most of the industrial effluents and wastes contain heavy metals in an amount sufficient enough to cause toxicity to crop plants. The trace elements including Cu, Zn, Mn, Fe and B are essential micro-nutrients required for plant growth. These elements are also considered as heavy metals as they may be toxic to plants at high concentrations (Parveen *et al.*, 2015).

Interveinal chlorosis and loss of leaf colour in plant suffering from Ni toxicity in several plant species was reported by Mishra and Kar (1974). Bhargava and Singh (1982) reported that heavy metal Zn, 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 (Muchuweti *et al.*, 2006).

It was found that industry effluents carry heavy metals which are harmful to vegetables crops and these heavy metals such as Ni, Cr, Zn, Cd, As and Pb reduced the all growth parameters of the crops.

Effect of heavy metals (Cd, Pb, Cu) on seed germination of *Arachis hypogaea* L. was recorded by Abraham *et al.*, (2013) 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 Lead 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.

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 analyze the accumulation of heavy metals in tomato plant treated with carpet effluent.

II. METHODS AND MATERIAL

For present study, carpet industries effluent containing municipal sewage were collected from Ghosia town of district Sant Ravidas Nagar, Bhadohi. Bhadohi district is situated in Latitudes 25˚23 'north and Longitudes 82˚34' East at the distance about thirty miles from west of Varanasi, twelve miles north-east of Gopiganj and about three miles south of the river Varuna.

To find out the accumulation of heavy metals in tomato plant treated with carpet 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 during the plant season. Pots were filled with normal soil without any effluent treatment. The seedling of tomato (*Solanum lycopersicum* L.) was obtained from Indian Institute of Vegetable Research (IIVR), Varanasi. Seedling was transplanted in the second week of September in the pots. Five concentrations of effluent viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. 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 was recorded after 45 and 60 days after transplanting.

Tomato fruits were collected at 45 and 60 days after transplanting. Fruits of every plants were separated, dried at room temperature, grinded and then stored in little paper bags until analyses.

The concentration of heavy metals (Zn, Cu, Cr, Pb and Ni) in the fruit samples was determined by Atomic Absorption Spectrophotometer (AAS Model GBC 932 place). 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 (Lisjak *et al.*, 2009) as follows: 1g of dry matter was placed in 100 ml flat bottom flask, and 10 ml HNO_3 and 4 ml H_2SO_4 were added. The flask was covered with a watch glass, allowed to stand for few hours at room temperature and then heated gently on a hot plate for thirty minutes. After cooling down to room temperature, the extract was filtered through quantitative filter paper into 50 ml flask and diluted with deionized water to the mark.

III. RESULTS AND DISCUSSION

In present study, the data related to heavy metal contents such as zinc, copper, chromium, lead and nickel of tomato fruits treated with different concentrations (0%, 25%, 50%, 75% and 100%) of carpet industry effluent recorded on 45 and 60 days after transplanting (DAT) have been presented in table 1 and figure 1 to 5 respectively. The data reveals that zinc, copper, chromium, lead and nickel content increased with increasing concentrations of carpet industry effluents.

From the data, it is found 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. Maximum amount was recorded with 100% effluent concentration as compared to control.

Results of present study are supported by the study of Hui and Singh *et al.*, (1974) has reported that heavy metals such as Cd, Co, Cr, Cu, Hg, Ni, Pb and Zn are of particular concern in industrial, agricultural and domestic wastes. When such wastes are allowed to enter various ecosystems, heavy metal concentrations may gradually increase to toxic levels of micro flora and fauna. The consumption of high amounts of cadmium causes osteoporosis in humans. The uptake of heavy metals by the rice crop irrigated with untreated effluent from a paper mill has been reported to cause serious health concerns. Irrigating rice paddies with highly contaminated water containing heavy metals leads to the outbreak of itai-itai disease in Japan.

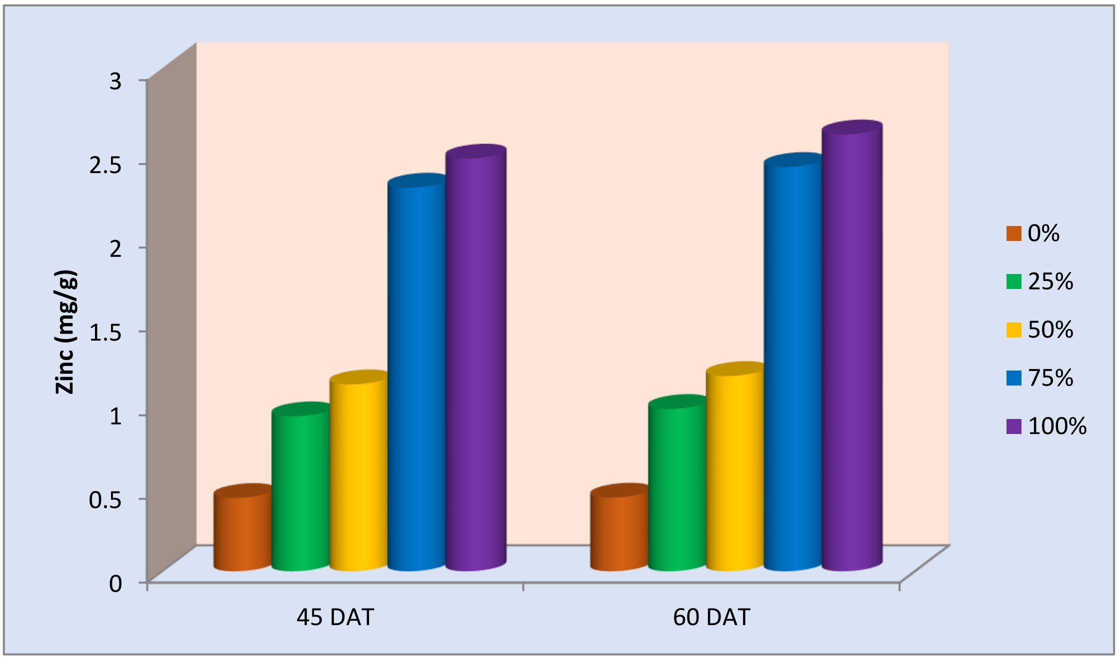
Table 1: Effect of carpet industry effluent on heavy metal content (mg/g dry weight) of tomato fruit

Effluent conc. (%)	45 DAT					60 DAT				
	Zn	Cu	Cr	Pb	Ni	Zn	Cu	Cr	Pb	Ni
0	0.438	0.109	0.113	0.137	0.193	0.440	0.111	0.114	0.150	0.203
25	0.926	0.256	0.442	0.662	0.841	0.970	0.260	0.449	0.666	0.843

50	1.117	0.375	0.562	0.837	0.937	1.167	0.379	0.567	0.840	0.940
75	2.290	0.464	1.103	1.147	1.337	2.413	0.467	1.143	1.173	1.360
100	2.463	0.632	1.373	2.027	2.227	2.607	0.637	1.417	2.043	2.243
SEm±	**0.0624**	**0.0049**	**0.039**	**0.0202**	**0.0201**	**0.0598**	**0.005**	**0.0388**	**0.0232**	**0.0215**
CD (5%)	**0.1922**	**0.015**	**0.1203**	**0.0623**	**0.0619**	**0.1844**	**0.0153**	**0.1194**	**0.0715**	**0.0663**

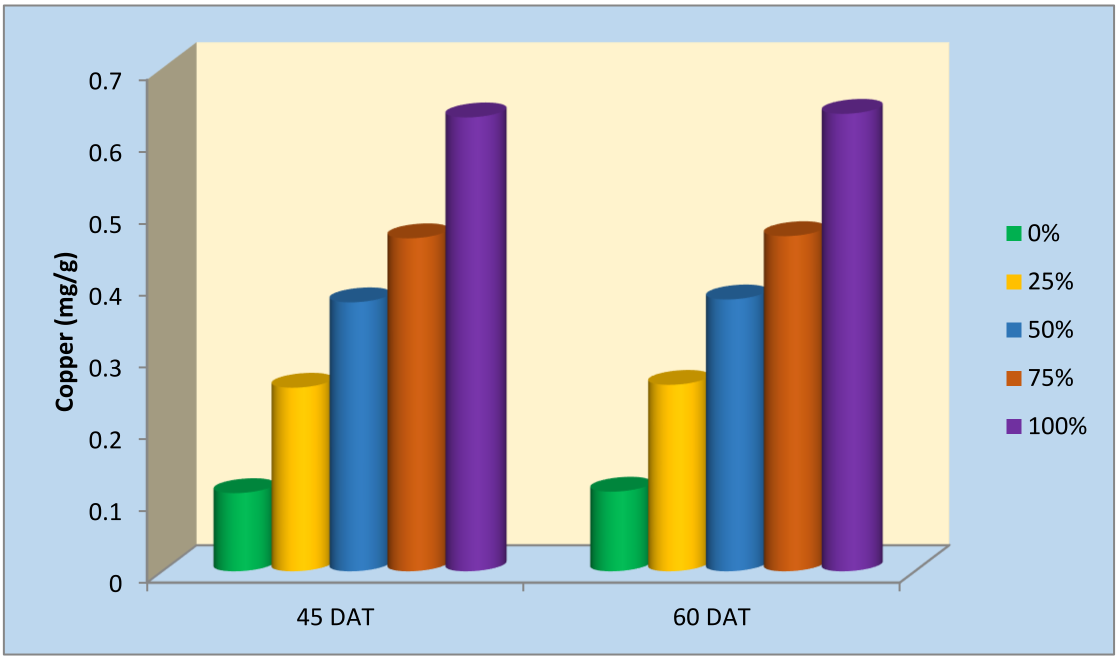
DAT = Days after transplanting

Figure 1: Effect of carpet industry effluent on zinc (Zn) content (mg/g dry weight) of tomato fruit



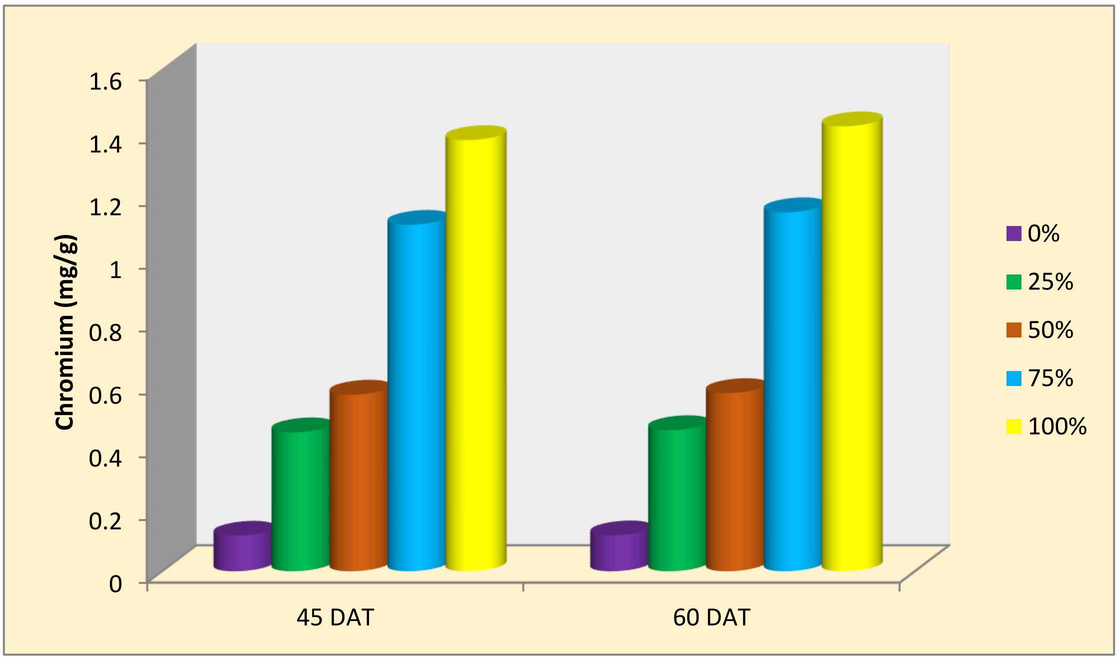
DAT = Days after transplanting

Figure 2: Effect of carpet industry effluent on copper (Cu) content (mg/g dry weight) of tomato fruit



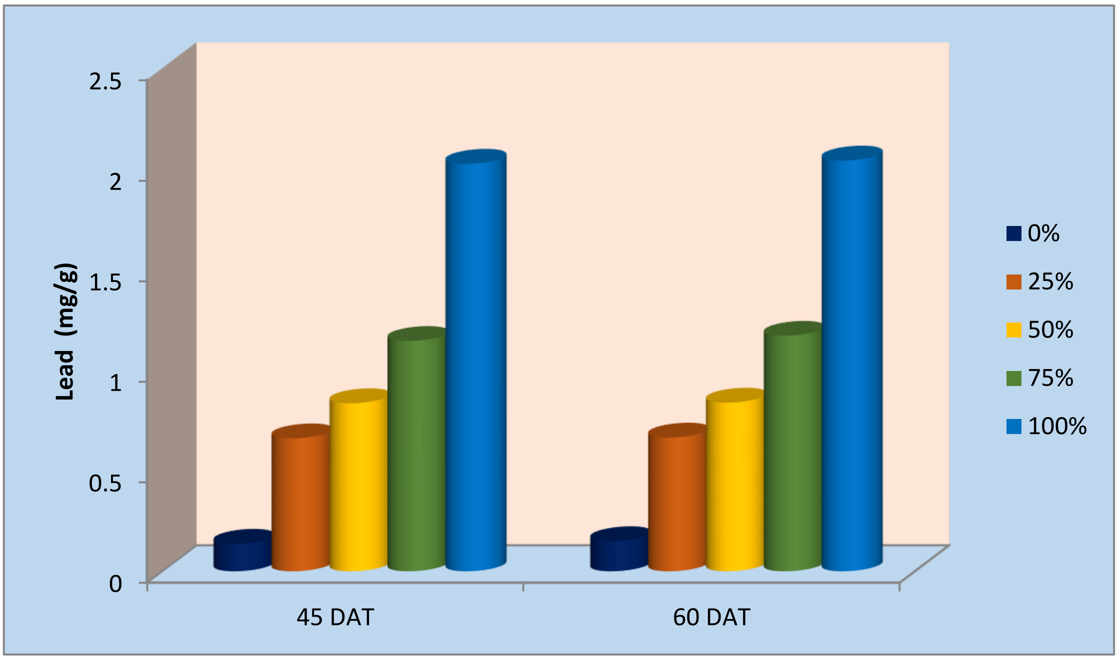
DAT = Days after transplanting

Figure 3: Effect of carpet industry effluent on Chromium (Cr) content (mg/g dry weight) of tomato fruit



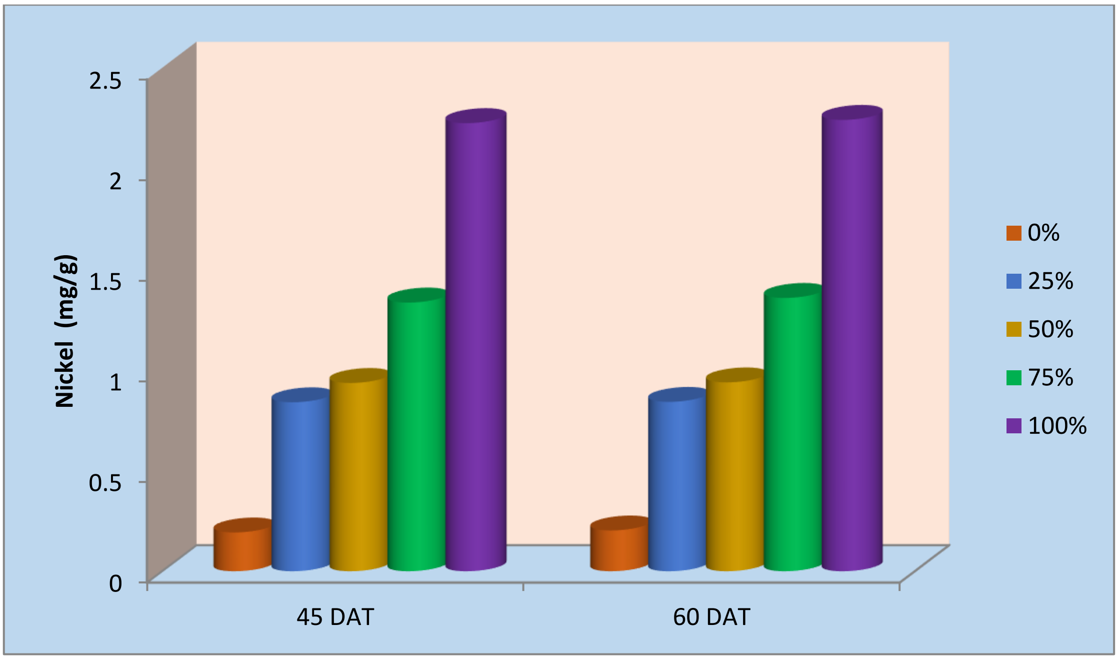
DAT = Days after transplanting

Figure 4: Effect of carpet industry effluent on Lead (Pb) content (mg/g dry weight) of tomato fruit



DAT = Days after transplanting

Figure 5: Effect of carpet industry effluent on nickel (Ni) content (mg/g dry weight) of tomato fruit



DAT = Days after transplanting

IV. CONCLUSION

This study concluded that effluent of carpet industry affects the tomato plant. It is found 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. Maximum amount was recorded with 100% effluent concentration as compared to control.

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