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EFFECT OF COPPER AND CADMIUM TOXICITY ON GROWTH INDICES OF WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

The effect of copper and cadmium on seed germination, seedling growth and fresh weight of wheat *Triticum aestivum* L., were studied in this experiment. Seeds were grown under laboratory conditions at 20, 40, 60, 80 and 100 ppm of metal ions of copper and cadmium. Both copper and aadmium treatments showed toxic effects on various growth indices of wheat. However, seed germination was drastically reduces to 95.28 percent and only 4.7 percent seeds were germinated and no root and shoot length was observed in case of 100 ppm cadmium. The results of the study suggests that inhibitory effects of cadmium treatments were more prominent than copper for germination and root growth of wheat.

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INTRODUCTION

Metallic elements are intrinsic components of the environment; there presence is considered unique in the sense that it is difficult to get rid of them completely. Metal pollution is continuously increasing and the root cause is the anthropogenic behaviour which interferes with the environmental activities and makes conditions toxic for living organisms. Although some metals are regarded essential nutrients, excess concentration of all metals lead to various toxic effects such as oxidative stress and inhibition of enzyme activities (Dietz *et al.,* 1999, Pohlmeier, 1999). Burhan *et al.* (2001) suggested that there are about 50 metals which are toxic to human health, plants and animals. The metals which are the most damaging one to crops are Cd, Cu, Mo, Ni, Pb and Zn (Lasat 2002 and Sharma *et al.* 2015). Copper is widely prevalent in our environment and was considered as essential elements for all living organisms including plants (Underwood, 1977; Goyer, 1991) Copper occurs in the environment as hydrated ionic species forming complex compounds with inorganic and organic legends. Mishra, 2015 also reported increase in the concentration of heavy metals in soil and crop due to their application in soil.

Cadmium is a common and transitional metal and available in the form of Cadmium Sulphate in the environment, geochemically it is quite mobile element in soil and thus freely taken up by plants. Cadmium is one of the highly dispersed metal by human activities (Kataba-Pendias and Dudka, 1990). Cadmium has many uses in industry and consumer products, like batteries, pigments, metal coatings and plastics. Many research workers have drawn their attention on the toxic effects of cadmium on plant growth (Breckle and Kahile, 1992; Iqbal and Mahmood, 1991; Mathur *et al.,* 1987). Thakur *et al.,* 2015 reported that elevation of soil cadmium levels and its potential cycling through food chain is of considerable concern.Significant reduction in Cd, Zn, and Pb heavy metals was reported in untreated industrial effluent inoculated with A. niger and A. flavus biomass with respect to industrial treated effluent. Keeping in view the importance of wheat as major staple food crop and the adverse effects of copper and cadmium on initial crop growth, the present experiment was carried out to investigate the effects of copper and cadmium on different growth indices of wheat (*Tritium aestivum* L.).

MATERIALS AND METHODS

Healthy seeds of wheat (*Triticicum aestivum* L.) were collected from Agricultural Research Farm Ujjain. The seeds were air dried and stored at room temperature with metal solutions. The 20, 40, 60, 80 and 100 ppm copper and cadmium solution were prepared in pure distilled water in laboratory by using copper sulphate (CuSO4.5H2O) and cadmium sulphate (CdSO4.5H2O). Pure distilled water was used as control. Ten seeds in five replicates were put in petridishes on circular filter papers (Whatman No. 42) and were treated separately with 5ml solution of 20, 40, 60, 80 and100 ppm solution. The petridishes were kept at temperature 32^{o} C. The fresh solution was applied every alternate day for the maintenance of concentration. The petri dishes were monitored daily for fungal and other type of infections. Experiment was concluded on 15th day and various parameters like germination plumule and radical length were measured (ISTA 1999). The Seedling fresh weight was taken with the help of digital balance.

RESULTS AND DISCUSSION

The results indicate that Seed germination, Seedling growth and fresh weight of *Tritium aestivum* L. were reduced in all treatments (20, 40, 60, 80 and 100 ppm) of copper and cadmium as compared to Control (Table I and II, Fig 1through 4). From the results it is evident that as the copper concentration increases the per cent germination decreases from 73 3 % to 40.0 %. The percent change as compared to control was -.9.15, -13.65, -27.29, -40.93, -45.43, respectively, under 20, 40, 60, 80 and 100 ppm concentration of Cu. While Cadmium treatment reduces the seed germination from 70.0 to 3.3 percent. The per cent germination decreased as compared to control as the Cd concentration increases from 0 to 100 ppm. From the data it is evident that at 80 and 100 ppm concentration the germination percent was only 3.3 percent.

The data on shoot and root length as affected by Cu and Cd levels are presented in Table 1 and 2 an Fig. 2 and 3. The shoot length of *Tritium aestivum* L. shows the same results for copper and cadmium. Copper reduces the shoot length from 11.88 (Control) to 10.18 , 8.48 , 7.76 , 7.58 , 6.76 cm, respectively for 20, 40, 60, 80 and 100 ppm; while in case of Cadmium Shoot length was reduced from 13.7 (Control) , 11.4 , 6.5 , 4.96 ,1.56 cm respectively in 20 , 40 r 60 and 80 ppm. However, in 100 ppm Cd solution the soot growths was completely hindered and shoot length was almost zero.

The root length was affected tremendously due to increased concentration of copper and cadmium. The reduction in root length was up to 91.30 percent due to 100 ppm copper concentration. cadmium was found more detrimental as the root length was reduced up to 99.38 percent at 80 ppm and no root development was found at 100 ppm cadmium.

The fresh weight of the seedlings was also affected by different concentrations of Cu and Cd. The Cd had more adverse effect on fresh weight as compared to Cu (Table 1 and 2). At 100 ppm level of Cd no fresh weight was recorded as there was no

Table 1: Effect of copper on seeding growth in wheat (*Tritucum aestivum L.,*)

Treatment	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
Seed Germination,%	73.30	66.60	63.30	53.30	43.30	40.00
	% change	-9.15	-13.65	-27.29	-40.93	-45.43
Shoot Length, cm	11.68	10.18	8.48	7.76	7.58	6.76
	% change	-12.85	-27.40	-33.57	-35.11	-42.13
Root Length,cm	8.33	3.16	2.12	1.66	0.92	0.92
	% change	-62.07	-74.55	-80.08	-88.96	-91.36
Fresh Weight,g	0.73	0.57	0.54	0.50	0.49	0.47
	% change	-21.90	-26.00	-31.50	-32.88	-35.62

Table 2: Effect of cadimium on seeding growth in wheat (*Tritucum aestivum L.,*)

Treatment	Control	20 ppm	40 ppm	60 ppm	80 ppm	100 ppm
Seed Germination,%	70.00	60.00	46.60	40.00	3.30	3.30
	% change	-14.29	-33.43	-42.86	-95.29	-95.29
Shoot Length,cm	13.70	11.40	6.50	4.96	1.56	Damaged
	% change	-16.79	-52.56	-63.80	88.62	
Root Length,cm	9.56	2.64	1.80	0.22	0.06	Damaged-
	% change	-72.39	-81.18	-97.79	-99.38	
Fresh Weight,g	0.71	0.54	0.48	0.42	0.36	Damaged
	% change	-23.90	32.40	-40.80	-49.30	

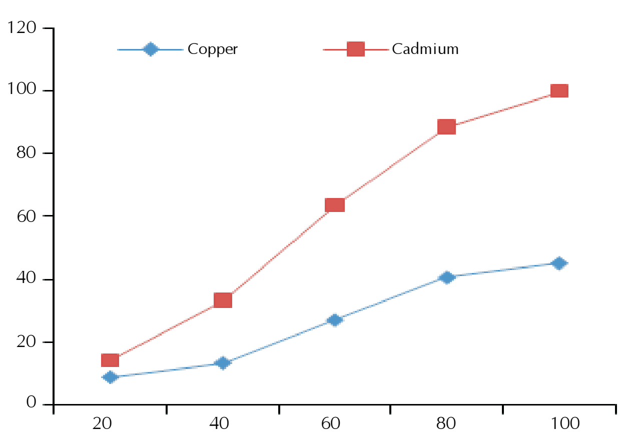

Figure 1: Seed germination % change

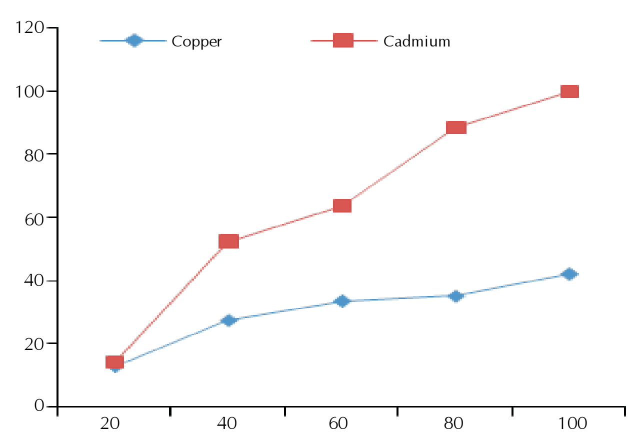

Figure 2: Shoot length % change

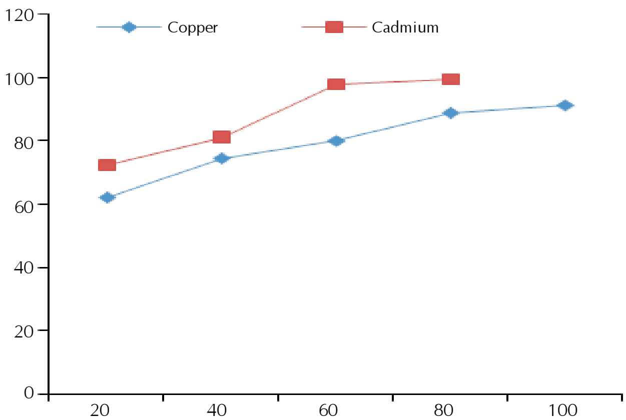

Figure 3: Root length % change

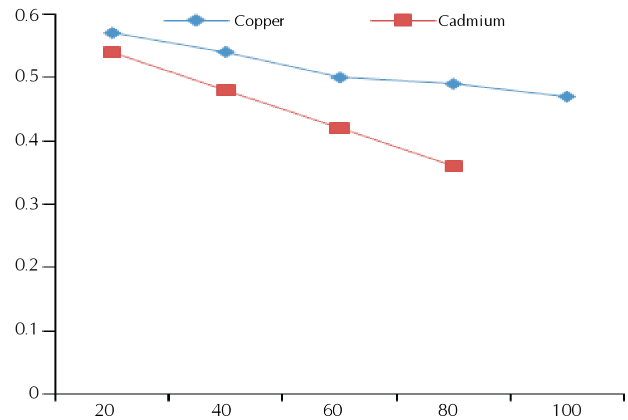

Figure 4: Variation in fresh weight

growth at this concentration of Cd.

Seed germination and seedling growth are vulnerable stages in the plant life cycle. In the present study we have investigated that how metal treatments affected germination and early growth performance of *Tritium aestivum* L. Similarly, Burhan *et al.* (2001) have found reduction in seed germination, root, shoot and seedling length of jute varieties, Corchorus olitorius CV. JRO524 and Capsuslar corchorus IRC 32 at different levels of lead The reduction in root length in *Tritium aestivum* L. was more prominent in different levels of copper and cadmium treatments as compared to shoot length . The reduced root length of Triticum aestivum in metal treatments could be due to reduction in mitotic cell division in meristematic zone of root as suggested by Lerda (1992) on Allium cepa. The reduction in root length occurred by accumulation of metals within the root, reducing the mitotic rate in meristematic zone especially blocking the metaphase in meristematic Cells, therefore root shows reduction in length (Goldbold and Kettner, 1991; Sharifa and Hishashi, 1992). The other reason for reducing root and shoot length of *Triticum aestivum* L. in metal treatments could be due to the reduction in meristematic cells present in this region and some enzymes contained in the cotyledon and endosperm cells become active and begin to digest and store food which is converted into soluble form and transported to the radical and plumule tips e.g; enzyme amylase convert starch into sugar and protease act on proteins, so when enzymatic activities were effected, the food did not reach to the radical and plumule and in this way root and shoot length were affected.

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