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PHYTO TOXIC EFFECT OF COPPER AND CHROMIUM ON SEED GERMINATION PERCENTAGE OF *Vigna radiate* L.

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ABSTRACT

The present investigation deals with the effect of the copper on the germination of seedling on four groundnut cultivars (Co-6, VRM, Co-7, KM-2) of *Vigna radiata* were procured from Agricultural Office, Walajapet and Tamilnadu Agricultural University, Coimbatore for this study. The seeds of these four cultivars were treated with various concentrations of Copper and chromium solutions (0, 5,10,25,50 and 100).Three replicates were maintained for each concentration. The seeds were treated with distilled water as control separately. Both the treated and controlled seeds were grown in water soaked filter papers kept in petridishes under the room temperature. Seeds were treated regularly with various concentrations of copper sulphate and chromium solution respectively. The germination of seedlings were calculated on 7th day after sowing. The results obtained from this treatment shows that the copper and chromium decrease the germination of seedlings with increase in concentration. The germination of seedlings increase in 5% than control. While the concentrations increases other than 5% the germination gradually becomes decreases. In the 100% conentration very low germination or absent.The inhibition germination of these four cultivars of *Vigna radiata* were proportional to the higher concentrations of copper and chromium.

Key words:Germination

INTRODUCTION

Heavy metal toxicity is one of the major abiotic stresses leading to hazardous effects in plants. Most environmental problems caused by industrialization are the increment in the concentration of heavy metals in the air, land and water. Although heavy metals form an essential part of human and plant nutrition, but their higher levels of plants uptake cause carcinogenic and mutagenic effects (Goyer., et al.1977).Excessive level of heavy metals in the soil environment adversely affect the germination of seeds, plant growth, alter the level of biomolecules in the cells and interfere with the activities of many key enzymes related to normal metabolic and developmental processes (Zhang et al., 2009; Rahoui et al., 2010). It is involved in numerous physiological functions as a component of several enzymes, mainly those which participate in electron flow, catalyze redox reactions in mitochondria and chloroplasts (Hansch and Mendel, 2009).The presence of heavy metals in the environment causes deleterious effects to human beings, particularly at certain levels of exposure and absorption. Metals like copper are essential for life processes. Excessive quantities of copper becomes toxic as it interferes with photosynthetic and respiratory processes, protein synthesis and development of plant organelles (Agarwala *et al.*, 1995; Upadhyay and Panda,

2009).Chromium interferes with several metabolic processes, causing toxicity to plants as exhibited by reduced seed germination or early seedling development (Sharma et al., 1995).As the chromium concentration in plants increases, it adversely affects several biological parameters. Ultimately there is loss of vegetation, and land some times becomes barren (Dube *et al*., 2003).*Vigna radiata* and *Vigna mungo* are the most commonly used pulse crop plants with high economical value. In recent years much interest has been exhibited in the use of diluted effluents for irrigating crops. Ionic toxicity may be the cause of drastic effects of heavy metal salts on seed germination or it could be due to osmotic effect (Shaukat et al., 1999).Copper is also one of the essential micronutrients for plant growth (Lolkema., et al, 1986). The accumulation of chromium by germinating seedlings appears to be significantly affected by Cr concentration and occurred in a linear manner (Azmat *et al*., 2005).

MATERIALS AND METHODS

The present investigation phyto toxin of copper and chromium on seed germination percentage of *Vigna radiata*, L. was carried out .For this research Co-6, Co-7,KM-2 and VRM cultivars of *Vigna radiata* have been selected. All the experiments were conducted in the Laboratory of the PG and Research, Department of Plant Biology and Plant Biotechnology, Arignar Anna Govt. Arts College, villupuram, Tamilnadu, India.

Sample Collection: The present investigation deals with the effect of the copper on the germination of seedling on two cultivars (CO7 and KM2) were procured from Agricultural Office, Walajapet and the other two cultivars Co-6 and VRM were procured from Tamilnadu Agricultural University,Coimbatore. The experimental plant, green gram belongs to the family Fabaceae is one of the important pulses of India. Seeds with uniform size, colour and weight were selected and it stored in metal tins as suggested by Roa (1976).The chemicals Cupper sulphate and chromium salts were procured from standedised chemical laboratory. Germination studies were conducted with the V.radiata varieties Co-6, c0-7, KM-2 and VRM by using the various concentrations of these both chemicals simultaneously. The method of germination studies were carried out as recommended by International Seed Testing Association, (1979).The seeds were sterilized for two minutes in 0.2% mercuric chloride ($HgCl_2$) solution.the seeds were then thoroughly washed in distilled. The sterilized fifty seeds were arranged equi – especially in sterilized petridishes lined with filter paper. In each petridishes was irrigated uniformly by different concentration of copper and chromium solutions separately. In addition to this, petridishes containing seeds were irrigated with distilled water and maintained as control.The petridishes were kept under room temperature (28± 2° C).The emergence of radicle was taken as criteria for germination. Germination was confirmed by the initial appearance of the radicle by visual observations. The germination percentage was calculated by using the formula. The germinated seeds number was counted 7^{th} day after sowing and germination percentage were calculated.

$$\text{Germination percentage} = \frac{\text{Percentage of seeds germ}}{\text{Total number of seeds sown}}$$

RESULTS AND DISCUSSION

The phytotoxin effect of copper and chromium research carried out to examine the seed germination percentage of four varieties of *Vigna radiata*. Results obtained from present study were given in Table-1.The results showed that similar

phytotoxi effect of both copper and chromium on seed germination percentage of *V.radiata*. Both positive and negative effects were seen on seed germination of *V.radiata*. Copper is also one of the essential micronutrients for plant growth (Hansch., et al.,2009).In low concentration of copper and chromium solution treatment, receiver vegetable crop showed positive effects. From the results 5% concentration treatment shows alone to increased the germination percentage. Low concentration may be stimulatory to plant growth while higher concentrations are inhibitory and toxic to plant growth (Sharma *et al.,* 2000). Germinaition in the 7th day of 5% concentration in the varieties of Co-6, Co-7,KM2 and VRM seeds was increased values ± 4.7, ±4.8, ± 4.45 and ±4.55 respectively than the treatment given control ±4.8, ±4.75, ±4.5 and ±4.5 separately. The concentration of 5% copper treatment exhibit the positive inhibitory seed germination in *V.radiata*. These studies strongly support the previous findings. High concentrations of copper, the root and shoot elongation was poor with a concominant decrease in root and shoot length (Bouazizi *et al*., 2008, 2010; Ahsan *et al*., 2007).

While the concentration increases upto 5% treatment, the other concentrations 10, 25 and 50% seed germination exhibited gradually decreased values found similarly in four varieties of *V.radiata* seeds. In excessive quantities copper becomes toxic as it interferes with protein synthesis and development of plant organelles (Upadhyay and Panda, 2009). Very low negative germination was observed in 100% treated receiver seedlings. The values of Co-6,Co-7,KM-2 and VRM shows decreased ±3.45, ±3.6, ±2.90 and± 3.20 in seedlings of *V.radiata*. The increased values of germination observed in all concentrations of treatment of VRM variety than other three Co-6, Co-7 and KM-2 varieteties. Chromium is used on a large-scale in many different industries, including metallurgy, electroplating, production of paints and pigments, tanning, wood preservation, chemical production, and pulp and paper production (Zayed and Terry, 2003).Chromium toxicity produces chlorosis and necrosis in plants (Cervantes *et al*., 2001). The decreased whole germination percentage was recorded in the seeds germinate in chromium treatment when compared with seeds germinated in copper solution. The slightly decreased values ±4.5, ±4.6 and ±4.20 in 5% chromium treatment given to seeds of Co-6, Co-7 and KM-2 varieties of *V.radiata* conominantly.

The similar germination percentage of seeds obtained in control. The other 10, 25 and 50 percent concentration shows gradual decreased seed germination percentage of these three varieties. Although there are some investigations (Wierzbicka and Obidzinska, 1998; Seregin and Kozhevnikova, 2005) about comparative mechanisms effect of heavy metals as chromium on seed germination .The very high negative germination decreased perentage was recorded in the 7th day treatment of 100% concentration of chromium in all varieties of *V.radiata* for this study. The lower germination values ±2.75, ±2.95 and± 2.20 observed in 100% treatment. The reduced germination of seeds under Cr stress could be a depressive effect of Cr on the activity of amylases and on the subsequent transport of sugars to the embryo axes (Zeid, 2001). The higher negative effect was found in chromium than copper treatment. The increased positive values in 5%(±4.55) , negative values in 10%(±4.20),25%(±3.90),50%(±3.50) and 100%(±3.20) chromium treatment of VRM variety. This investigation showed that germination of seeds was significantly negative affected, when the concentration increased. Excess of copper and chromium applications inhibited germination properties in four varieties of *V.radiata*. There are several reports on the promotary and inhibitory effect of copper and chromium treatment on various plant species. Symptoms of Cr phytotoxicity include inhibition of seed germination or of early seedling development, reduction of root growth, leaf

chlorosis and depressed biomass (Sharma *et al*., 1995). Low concentrations shows growth promotary and higher concentrations shows germination inhibitory effect in four varieties of *V.radiata*. Some heavy metals are essential micronutrients for plants but their excess may result in metabolic disorders and growth inhibition in most of the plant species (Claire ., et al., 2000). Significant increase in the growth, possibly due to copper is required by plants in trace amount (Reichman, 2002).

CONCLUSION

Heavy metals are the intrinsic component of the environment with both essential and non essential types. It is usually accumulated due to unplanned municipal waste disposal, mining and use of extensive pesticides.The results from these study clearly revealed that the copper and chromium concentrations exhibited a promotary germination effect in 5% concentrations in Co-6,Co-7,KM-2 and VRM varieties of *Vigna radiata* seeds.The decreased germination percentage was observed in all other concentrations (10,25 and 50%) concentrations of both copper and chromium metal treatments over control .The intensity of higher inhibitory effects showed in the seed germination of all four varieties ,when seeds treated in 100% concentration of both copper and chromium treatment. The intensity of inhibition of seed germination increased as the concentration of copper and chromium solution increased. The intensity of decrease as concentration dependent. The intensity of inhibition was directly proportional of the concentration of solution employed. Among the different concentrations of copper and chromium salt solution and the 5% treatment alone showed a positive promontory effect while the other concentrations 10, 25 ,50 and 100% exhibited inhibitory negative effect on the germination of the varieties Co-6,Co-7,KM-2 and VRM of *Vigna radiata* crop seeds. The exposure of *Vigna radiata* variety to Copper and chromium results Shows decrease in germination at high concentrations and at lower concentration of heavy metals increase in germination was observed but very low germination was observed at higher concentrations.

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Table-1: Phyto toxic effect of copper and chromium on seed germination percentage of *vigna Radiata* L.

Metal		Copper				Chromium			
Variety		Co-6	Co-7	KM-2	VRM	Co-6	Co-7	KM-2	VRM
Conccentration	0	93 (±4.65)	95 (±4.75)	90 (±4.5)	90 (±4.5)	93 (±4.65)	95 (±4.75)	90 (±4.5)	90 (±4.5)
	5	94 (±4.7)	96 (±4.8)	89 (±4.45)	91 (±4.55)	90 (±4.5)	92 (±4.6)	84 (±4.20)	87 (±4.35)
	10	90 (±4.5)	92 (±4.6)	79 (±3.95)	84 (±4.20)	82 (±4.10)	87 (±4.35)	78 (±3.90)	79 (±3.95)
	25	85 (±4.25)	88 (±4.4)	72 (±3.60)	78 (±3.90)	72 (±3.60)	75 (±3.75)	65 (±3.25)	69 (±3.45)
	50	76 (±3.8)	80 (±4.0)	66 (±3.30)	70 (±3.50)	62 (±3.10)	66 (±3.30)	52 (±2.60)	58 (±2.90)
	100	69 (±3.45)	72 (±3.6)	58 (±2.90)	64 (±3.20)	55 (±2.75)	59 (±2.95)	44 (±2.20)	49 (±2.45)

Chart-1: Phyto toxic effect of copper on seed germination percentage of *Vigna Radiata* L.

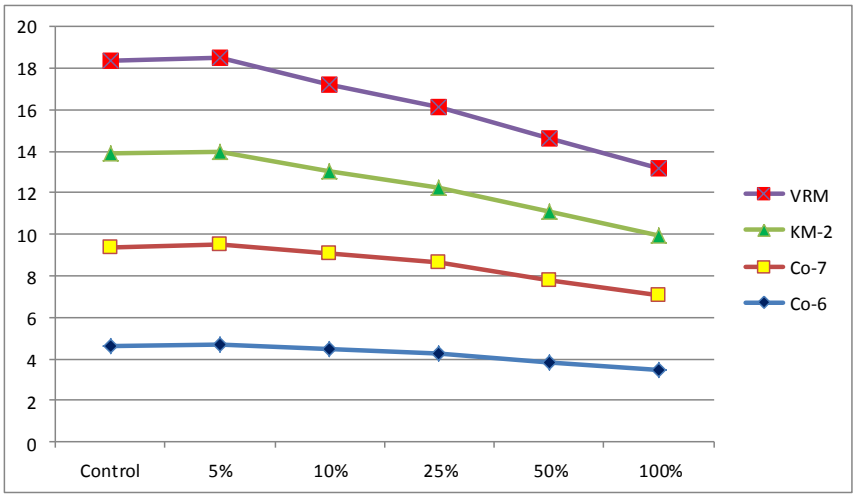

Chart-2: Phyto toxic effect of chromium on seed germination percentage of *Vigna Radiate* L.