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EFFECTS OF HEAVY METALS ON MORPHOLOGICALAND PHYSICOCHEMICAL PROPERTIES OF MUSTARD- A INVITRO STUDY

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***ABSTRACT*:** Environmental Pollution due to heavy metal (HM) is a global issue. Both terrestrial and aquatic ecosystems are severely affected with HM due to various anthropogenic activities such as mining, improper waste disposal practices, extensive use of potentially hazardous agrochemicals etc. Heavy metals are reported to affect growth, morphology and metabolism of plants in several ways. To reveal the relationship be-tween metal toxicity, plant stress and detoxification responses, the effects of four different heavy metals i.e. Cadmium (Cd), Copper (Cu), Zinc (Zn) and Mercury (Hg) on *Brassica juncea* were studied. These heavy metals persist indefinitely in soil thereby posing an ever increasing threat to the entire ecosystem. These heavy metals persist indefinitely in soil due to various sources thereby posing an ever increasing threat to the entire ecosystem and cause toxic effects to biotic component of an ecosystem including plants thereby reducing the yield and productivity. Plant responses to HM stress has been studied and reviewed extensively. Mustard is considered to be one of the most important oil yielding crop of North India and it is majorly used as edible oil. The present study demonstrates the effect of different HM i.e. Cd ($cdcl_2$), Cu ($cucl_2$), Zn ($Zncl_2$) and Hg ($hgcl_2$) on two commercial varieties of Mustard (*Brassica juncea*) i.e. RH-30 and Laxmi. The toxic effects on seed germination, plant length, plant growth, seedling vigour and Total Phenolic content (TPC) of mustard (*Brassica juncea*) were studied in *In-vitro* conditions using different concentrations of heavy metal dissolved in Double distilled water (DDW) (10, 25, 50, 100 and 200 *mg/L)* along with the control which have no heavy metals

***Key Words*:** Agrochemicals, Cadmium, Copper, Zinc, Mercury, Heavy metal, *Brassica juncea* Total Phenolic content.

INTRODUCTION

Environmental Pollution due to heavy metal (HM) is a global issue (Bhat *et al* 2014). Both terrestrial and aquatic ecosystems are severely affected with HM due to various anthropogenic activities such as mining, improper waste disposal practices, extensive use of potentially hazardous agrochemicals etc. Heavy metals are reported to affect growth, morphology and metabolism of plants in several ways **(**Rastgoo, 2011). To reveal the relationship be-tween metal toxicity, plant stress and detoxification responses, the effects of four different heavy metals i.e. Cadmium (Cd), Copper (Cu), Zinc (Zn) and Mercury (Hg) on *Brassica juncea* were studied. These heavy metals persist indefinitely in soil thereby posing an ever increasing threat to the entire ecosystem. These heavy metals persist indefinitely in soil due to various sources thereby posing an ever increasing threat to the entire ecosystem and cause toxic effects to biotic component of an ecosystem including plants thereby reducing the yield and productivity (Kumar, 2012). Plant responses to HM stress has been studied and reviewed extensively (Gill and Tuteja, (2010), Bhat *et al* (2014)). Mustard is considered to be one of the most important oil yielding crop of North India and it is majorly used as edible oil (Meena *et al*, 2011, Gautam *et a*l (2012, Bhat *et al* (2014)). The present study demonstrates the effect of different HM i.e. Cd ($cdcl_2$), Cu ($cucl_2$), Zn ($Zncl_2$) and Hg ($hgcl_2$) (The sources of heavy metals are of AR quality, Qualigens) on two commercial varieties of Mustard (*Brassica juncea*) i.e. RH-30 and Laxmi. The toxic effects on seed germination, plant length, plant growth, seedling vigor and Total Phenolic content (TPC) of mustard (*Brassica juncea*) were studied in *In-vitro* conditions using different concentrations of heavy metal dissolved in Double distilled water (DDW) (10,

25, 50, 100 and 200 *mg/L)* along with the control which have no heavy metals.

MATERIAL AND METHOD

An *In vitro* plant study was conducted in the laboratory of Department of Energy and Environment Sciences, Chaudhary Devilal University, Sirsa. Two mustard (*Brassica juncea*) varieties Laxmi and RH-30 were procured from Krishi Vigayan Kendra Sirsa, C. C. S. Haryana Agriculture University, Hisar. Disposable plastic plates of diameter 8.5 (cm) diameter were arranged in complete randomized design and each plates has been clotted with a layer of cotton by both the sides of plates. The methodology of Aery (2010), Acharya, (2014) and Kalai, (2014) were adopted for surface sterilization of the test seeds of both the varieties with 1% sodium hypochlorite for 2 minutes and vigorously rinsed with DDW to remove sodium hypochlorite. 10 Seeds were sowed in each plates of each variety to observe different growth parameters i.e. Seed germination, Plant length and Seedling vigour and Total Phenolic content after 96hrs. of all the concentrations finally concentration of (10ppm, 25ppm and 50ppm*)* of all the HM along with the control applied on Mustard varieties RH-30 and Laxmi. *In-vitro* treatment method has been performed by following the methodologies of Aery 2010, Acharya, 2014 and Kalai, 2014.

The experiment was carried out in triplicate. Seed germination percentage was determined after 24 hours of incubation at room temperature (25 + 2 ^{o}C), the germinated seeds were counted and the percentage germination was calculated as (Gang *et* a*l*, 2013):

% Germination =Number of seeds germinated/Total number of seeds× 100

Root length, shoot length, fresh weight and total length (root +shoot) was calculated after 96 hours of seedling growth. The following formula was used for calculating the Seedling vigour (Arey, 2010).

Seedling vigour = Fresh weight × Total lenght

RESULTS AND DISSCUSION

Results clearly indicate that the abiotic stress caused by different doses of test heavy metals adversely affected the initial growth of plants there by reducing seed germination, plant length and seedling vigour in comparison of the control plants earlier Gill and Tuteja (2010), Gautam *et a*l 2012 and Bhat *et al* (2014) discussed the effect of different abiotic stress on different plant metabolic systems. Hg resulted as the most toxic metal followed by Cu and Cd. Hg completely inhibited seed germination and seeding growth in both the varieties at all the concentrations, similar results were earlier reported by Cheng (2003). However, variety specific differences were observed in all the studied parameters in case of Cu, Cd and Zn. It was observed that in Cu and Cd treated plants of both the varieties decrease in growth parameters with the increase in HM concentration similar observations were discussed by Bhat *et al* (2014). Whereas Zn resulted in higher seed germination, plant length and seedling vigour in both varieties as compared with other tested HM. Out of two varieties, Variety Laxmi was found to be comparatively more tolerant than RH-30 to HM stress. However an increase in total Phenolic content with the increase in concentration is observed in all the treatments having HM in comparison of control (Similar results were earlier reported by Singh, 2011, Rastgoo, 2014). The increase in TPC indicates the activation of defense mechanism in test plants which is due to the presence of HM causing oxidative stress (Hamid, 2010, Singh, 2011). Intervarietal deferens is observed as TPC in RH-30 is found to be higher in comparison of Laxmi.

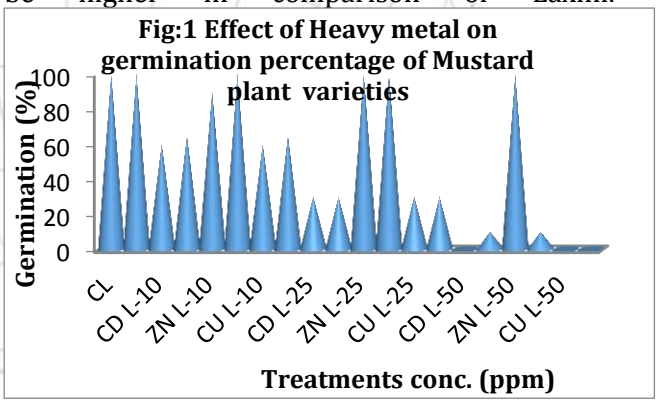


Fig:1 Effect of Heavy metal on germination percentage of Mustard plant varieties

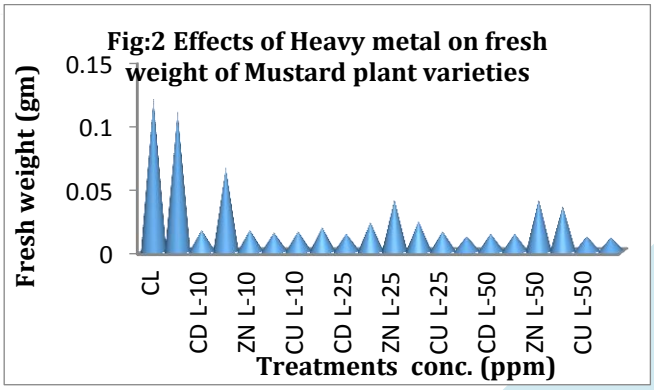
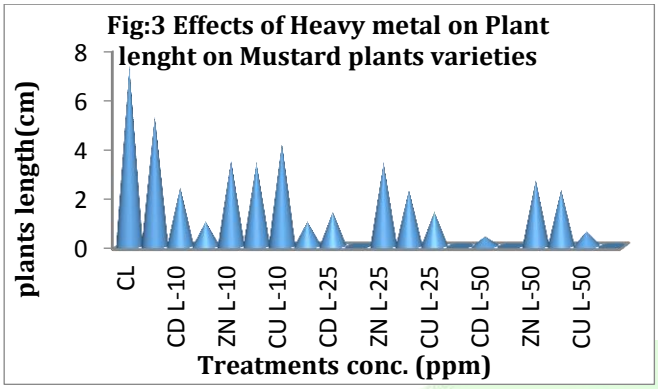
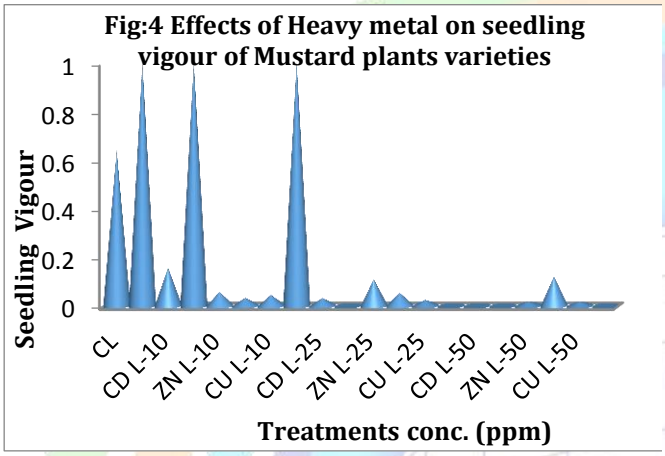
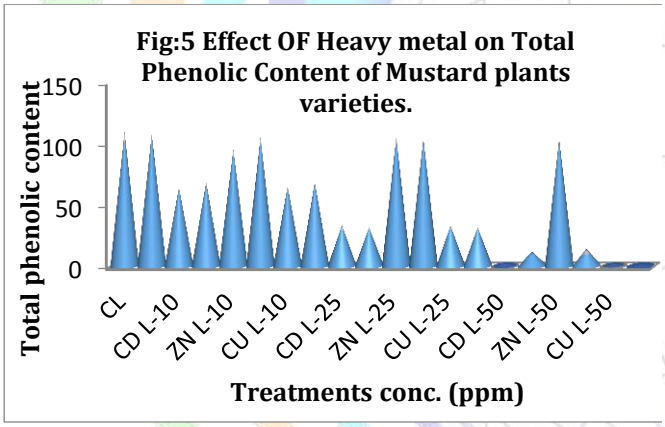


Fig:2 Effects of Heavy metal on fresh weight of Mustard plant varieties







CONCLUSION

I. In this *In-vitro* study both the test variety RH-30 and Laxmi responded differently in case of different test heavy metals at different time interval.

II. Each of the heavy metal i.e, Hg, Cu, Cd produced their own inhibitory effect on both the test varieties i.e. RH-30 and Laxmi

III. After conducting the preliminary study Variety Laxmi may be recommended for the areas having different heavy metal emission sources as it resulted to be a comparatively heavy metal tolerant variety then RH-30

IV. Intensive Pot trial and field study is recommended to ultimately know the Phytoremediation potential of Variety Laxmi.

V. It is concluded that with the increase in concentration of test heavy metal both test va-rieties RH-30 and Laxmi are facing oxidative stress which may be correlated to the enhancement of Total Phenolic content.

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