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Title of thesis: "Effect of Cadmium and Mercury on the growth and development of *Glycine max* (L.)"

ABSTRECT:

Heavy metals are significant environmental pollutants, and their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons. In most terrestrial ecosystems, there are two main sources of heavy metals: natural sources and anthropogenic sources. Natural sources are underlying parent material, volcanoes and continental dusts etc. Due to an increase of anthropogenic activities environmental pollution by heavy metal becomes an important global health problem for human beings as well as for plants.

AIM OF THE STUDY:

Analyzing the results obtained from different plots of *Glycine max* (L.) were individually treated with following doses: 0.05 mM, 0.10 mM, 0.50 mM, 1.00 mM and 2.00 mM for $CdCl_2$, $HgCl_2$ and their combinations i.e. ($CdCl_2$+$HgCl_2$) are based on experimental analyses carried out at three developmental stages.

RESULTS:

Estimation of morphological parameters such as root lengths, shoot lengths, shoot fresh weight, root fresh weight, and shoot dry weights, root dry weight, leaves per plant, number of leaf and yield attributing characters like number of pods per plant and numbers of pods per plot were analyzed from both control and treated plants.

The biochemical aspects of *Glycine max* L. like photosynthetic pigment (chlorophyll a, chlorophyll b and total chlorophyll) was decreased with increasing concentration of $CdCl_2$, $HgCl_{2,}$ and combination of $CdCl_2$+$HgCl_2$. However, the carotenoid content was increased with increasing concentration of $CdCl_{2,}$ $HgCl_2$ and in combination of CdCl2+$HgCl_2$.

The decline of chlorophyll a, chlorophyll b and total chlorophyll may be due to interference with the synthesis of proteins: the structural component of chloroplast. Protein, sugar, nitrate content, nitrate reductase activity and amino acid content showed a slight increase with (0.05 mM) $CdCl_{2,}$ $HgCl_{2,}$ combination of CdCl2+$HgCl_2$ treatment following a decline with increasing concentrations. A decrease in protein content may be a consequence of decrease in NR activity, as the enzyme is believed to be the rate limiting in the overall assimilation of nitrate.

Proline increased with the increasing concentration of metals as it enhanced the stress tolerance of plants by the mechanism of osmoregulation, protection of enzymes against denaturation and stabilization of protein synthesis as it scavenges the hydroxyl radicals.

Enzyme kinetics showed a significant enhancement with increasing heavy metal doses except the catalase where there was a slight decrease with increasing concentrations of heavy metalThe activities of enzymatic antioxidants, superoxide dismutase, ascorbate peroxidase and glutathione reductase enhanced significantly whereas that of catalase decreased with increasing concentration of $CdCl_2$, $HgCl_2$, and combination of $CdCl_2$ + $HgCl_2$. In Elemental analysis Nitrogen and Sulphur content decreased under heavy metal treatment at all stages of growth However, Nitrogen and Sulphur content showed a gradual decrease with increasing concentrations of heavy metals.

An exposure of increasing concentration of heavy metals significantly reduces the oil content (%) when applied separately, while the interactive effect of heavy metal (combinational treatments) showed less decrease in oil content and showed antagonistic impact of heavy metal on oil content. In this study we have also examines the impact of HMs on daidzein (Isoflavonoid) content of soybean seeds. HMs treatment increased daidzein (bioactive) production, the concentration of daidzein were found to be increased with the increasing concentration of HMs up to 1.0 mM treatments and after that it sharply decresed at 2.0 mM treatments.

Conclusion:

It is clear that growth parameters such root lengths, shoot lengths, shoot fresh weight, root fresh weight, and shoot dry weights, root dry weight, leaves per plant, number of leaf and yield attributing characters like numbers of pods per plant, number of pods per plot decreased with increasing concentration heavy metal supplementation, except at 0.05 mM $CdCl_2$ dose where, there was a slight increase with respect to control. In response to $CdCl_2$, $HgCl_2$ and $CdCl_2$+$HgCl_2$ combined doses, chlorophyll *a*, chlorophyll *b* and total chlorophyll declined and showed a dose-dependent response except with 0.05 mM $CdCl_{2,}$ which showed an enhancement with respect to control. While carotenoids with all the treatments showed a significant linear increase with increasing concentrations, the decline of chlorophyll *a*, chlorophyll *b* and total chlorophyll may be due to interference with the synthesis of proteins-the structural component of chloroplast.

Physiochemical parameters like Protein, sugar, nitrate content, nitrate reductase activity and amino acid content showed a slight increase with 0.05 mM $CdCl_2$ treatment following a decline with increasing concentrations of Hg and their combination. A decrease in protein content may be a consequence of decrease in NR activity as the enzyme is believed to be the rate-limiting in the overall assimilation of nitrate.

Different treatments affects nitrogen, and sulphur metabolism resulting in significant differences in seed composition, suggesting carbon metabolism alteration. In Elemental analysis Nitrogen and Sulphur content decreased under heavy metal treatment at harvest stages in different parts of the plant.

Thus, it is evident that, because of the demand for healthier, more functional soybean oils, greater emphasis is being placed on modifying the fatty acid profile in soybean seed oil due to heavy metal contaminated soil.

In this study we have examines the impact of HMs on daidzein content and we found that HMs treatment increased daidzein (bioactive) production at different doses of treatment. The concentration of daidzein were found to be increased with the increasing concentration of HMs up to 1.0 mM treatments and after that it was going to be decreased at 2.0 mM treatments..