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Original Article

Investigation of Plants Purification Capability of Cu on Two Cultivars of Mung Bean Plants in Contaminated Soils

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ABSTRACT

Objective: To study plants purification capability of Cu on two cultivars of vetch plant (Vigna Radiata) in contaminated soils and their effects on morphological characteristics. **Methods:** we conducted a completely randomized trial as factorial. Different concentrations of Cu (0, 150, 300, and 400 mg/ Kg of dried soil) were used. After four weeks growth on contaminated soil, parameters such as aerial parts height, roots, fresh and dry weight, as well as intake and aggregation levels of Cu in aerial parts and roots were measured in both cultivars of Sistan and Gohar. **Results:** Analysis results indicated that increased levels of Copper to decreased height of aerial parts and roots, and dry and fresh weight of both cultivars. Measuring of metal content showed that with increase in metals concentration in soils, their aggregation into aerial parts will be increased. Metal aggregation within aerial parts and roots was not different significantly, indicating metals transferring from roots to aerial parts. **Conclusions:** Results show that the vetch plant is able to purify soils and intake heavy metals such as Cu from it.

1.INTRODUCTION

The vetch plant is an annual, brushy, semi runner plant, with a height of range 15-90 and more, with upright roots, course nodes and many branches. Its small flowers are greenish -yellow or pale yellow. It is a valuable legume and plays a major role in the nutrition of people of little income in the developing countries, as it is a rich source of high quality protein. It plays a role in soil enrichment and fertility by biological fixation of nitrogen, in prevention of soil erosion as a covering plant, and is applied as foliage(Dodwad *at el*., 1998). Heavy metals are conventionally defined as elements with metallic properties and an atomic number >20. The most common heavy metal contaminants are Cd, Cr, Cu, Hg, Pb, and Zn. Metals are natural components in soil . Some of these metals are micronutrients necessary for plant growth, such as Zn, Cu, Mn, Ni, and Co, while others have unknown biological function, such as Cd, Pb, and Hg (Bieby *at el*., 2011). Copper is the third most used metal in the world (VCI, 2011). Copper is an essential micronutrient required in the growth of both plants and animals (Raymond *at el*.,2011). One of the consequences of heavy metals penetration into environment is their effect on the plants growth and function. Heavy metals

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decrease cell division and prevent of cells growth by lowering turgescence (Dodwad *at el*., 1998). Roots are the first organ of plant which are influenced by heavy metals present in soils. Decreased level of roots growth, associated with lower weight and inappropriate extension of roots, leads to decrease in absorbing surfaces of roots and, as a result, decreased content of absorbed nutrients. These influence on biological activities and lower plant growth (Manahan. 2003). Some of the plants have adaptive mechanisms to aggregate or tolerate high concentrations of pollutants in rizosphere. Using of these plants in order to purify contaminated water, air and/ or soils, is defined as plant purification, which a new tool for soil, water and air improvement. In this process, plants act as a solar pump and can extract and gather heavy metals out of environment . Plant purification is an important and cost- effective method for removing of pollution, by which we use of plants to purify soils, sediments, underground water and surface water. By combining, fixing and degradation of pollutant complexes present in rizosphere, selective absorbing of metals and aggregating them within their branches, or sublimating them into atmosphere, plants decrease level or toxicity of pollutants. In respect of the nutritional value of the vetch plant across developing countries, and expansion of environment contamination to these areas, this study tries to evaluate toxic effects of metal Cu on the growth and development of this plant and, also, its capability to aggregate these metal.

Phytoremediation, also called green remediation, botanoremediation, agroremediation, or vegetative remediation, can be defined as an in situ remediation strategy that uses vegetation and associated microbiota, soil amendments, and agronomic techniques to remove, contain, or render environmental contaminants harmless (Helmisaari at el., 2007).

2. MATERIALS AND METHODS

This research studies effects of Cu, as $CuSo4$ at four levels (0, 150, 300, and 400mg/ Kg of dry soil), on some of the morphological characteristics, absorbance and aggregation levels of Pb across aerial parts and roots of the vetch plant. completely randomized, factorial trial, with three replicates, was conducted. In this research we used of vetch plant (Vigna Radiata). Seeds were bought of the Center of Seed Breeding, Karaj, Alborz, Iran. $CuSo4$ with a prespecified concentration were added to soil and stored in sealed nylon packets for 10 days in order for metals to be absorbed by soil. Intact seeds were sterilized in %5 Bleach water for 1 minute, and, then, rinsed by distilled water for 5 minutes. After sterilization and rinsing, seeds were sowed into pots with a height of 20 Cm and diameter of 10 Cm. Pots irrigation was done in alternate days. When seedlings were 5 Cm in height, only 5 plantlets were maintained in each pot. During experiment, irrigation was done once each 3 days. Finally, after four weeks planting, and with appearance of toxicity symptoms, plants were harvested.

Morphological characteristics such as length of aerial parts and roots were measured by a ruler in centimeters. To measure fresh weight, sample was rinsed out and, after drying, was weighted (in grams) by a balance with a precision of 0.01(ANDFX-3000). Also, to measure dry weight, samples were transferred to an oven with a temperature of 60°C, for 24 Hours, and, then, weighted by a balance of precision 0.001(Sartorius TE 14S) in gram units. Absorbance and aggregation levels of Cu in the aerial parts and roots of the vetch plants (Cultivars Sistan & Gohar) were studied. In this assay, we used of an atomic absorbance system with a connected bulb (AAS-240), facilitated with a flame. Sample packets were placed on an oven (70°C) for 24 hours until drying. Then, samples were mortared and grinded to dissolve better in acid. After grinding, 0.5 of aerial parts sample and 0.2 g of roots sample were taken and 20cc of 4/0 M nitric acid was added to each sample. Samples were placed in bath for 2 hours in order for acid to impact on the plant components. After 2 hours, samples filtered by a filter paper No. 24. Extract volume were increased to 50cc. in this stage, extracts are prepared to feed into atomic absorbance system.

Statistical manipulations ranges, mean, and standard deviation were measured using Excel 2010 (Microsoft Office) and one-way ANOVA and correlation analysis using SAS statistical software.

3. Results

3.1. Morphological Characteristics

In this study, heavy metals stress decreased morphological characteristics significantly. Increased level of Cu in both cultivars leads to a lower length of aerial parts which is higher in Sistan cultivar compared to that of Gohar (Figs. 1).

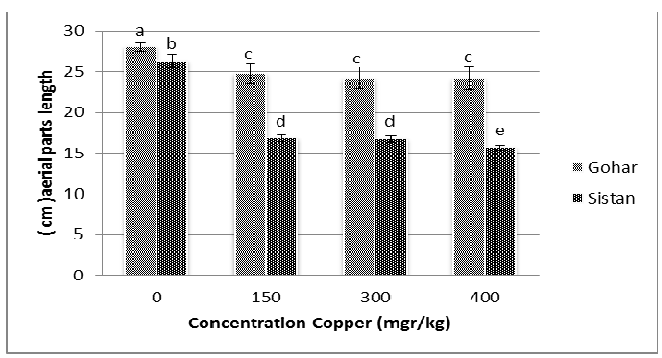

Figure 1. Effects of Cu and Cultivar on the aerial parts length

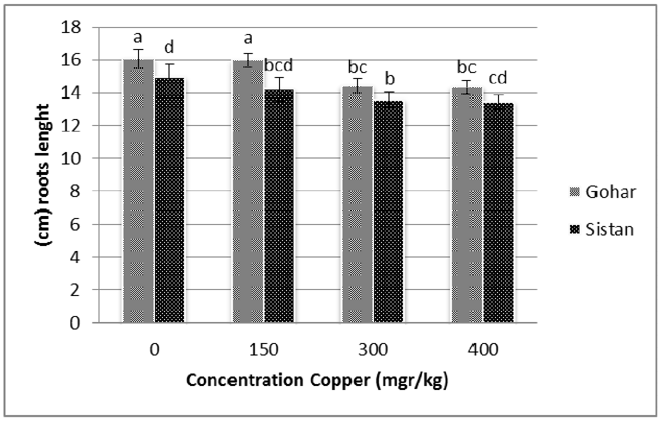

Figure 2. Effects of Cu and Cultivar on roots length

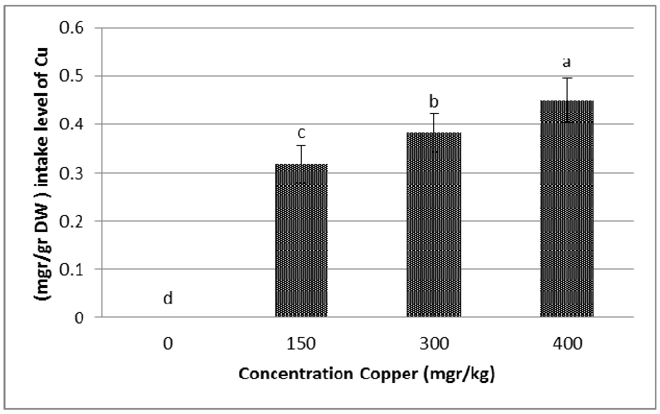

Figure 3. Effects of Cu on the intake level of Cu

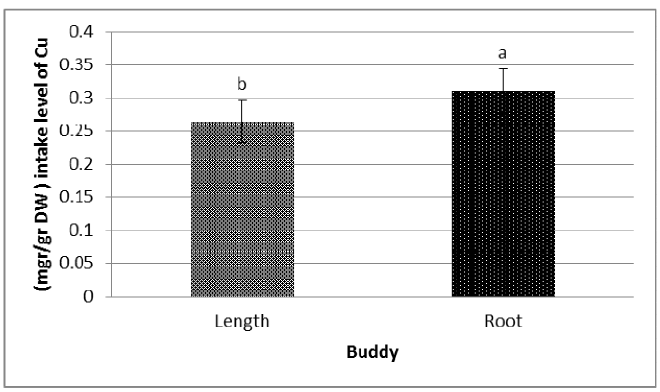

Figure 4. Effects of body on the intake level of Cu

3.2. Absorbance and aggregation levels of Cu

In this study, a higher level of Cu to significant increase in aggregation and absorbance level of these metals among aerial parts and roots of both cultivars. As to effects of organs on absorbance level, it is observed that roots intake more Cu than aerial parts (figure 3). As shown in figure 4, . As to effects of organs on absorbance level, it is observed that roots intake more Cu than aerial parts.

4. DISCUSSION

4.1. Morphological Characteristics

A number of studies have shown that when plants are exposed to high concentrations of heavy metals, their dry and fresh weight and their roots length will be decreased (Cheng & Huang, 2006). Heavy metals prevent of plants growth in numerous ways. They decrease cell division and inhibit cell growth by decreasing turgescence. proposed that heavy metal effects on shoots and roots length and on leaves surface are seems to be related to unusual cell division, and, also, to metals prevention from photosynthesis and respiration in shoots and protein synthesis in roots, or due to decreased level of cell division and its growth(Paivoke. 1983) Decreased growth may be due to a lower level of photosynthesis, as it is shown that plants exposure to high concentrations of heavy metals causes a decrease in plant photosynthesis. Photosynthesis damage is essentially due to a decrease in chlorophyll content and increase in lipids peroxidation.

4.2. Intake and aggregation levels of Cu

Different studies have shown that metal concentration of plant tissues is a function of heavy metals content present in growth media(Brunet *at el*., 2008). planting of G. max L. in a soil polluted with lead without thorough examination of such soil for Pb contamination could pose a great danger to population who harvest its seeds for consumption because this plant was found to accumulate substantial quantity of Pb in its seeds(Bieby *at el*., 2001).

The high concentration of Cu and the other trace heavy metals present in the underground parts of the plants may be due to the absorption ability of the plants to get the trace heavy metals from the polluted soils. WHO's permissible limit of copper in medicinal plants is 10 mg/kg, while its intake in food is 2-3 mg/day(Vitoria *at el*., 2005). Pb is a non essential heavy metal. Pb causes oxidative stress and contributes to the pathogenesis of lead poisoning by disrupting the delicate antioxidant balance of the mammalian cells.WHO's permissible limit of lead in plant is 10 mg/kg(Rehman *at el*., 2013). After absorption by roots, heavy metals are stored in vacuoles and their concentration or consumption is under control of cell energy in order to make no toxicity. This energy consumption leads to plants exposure to stress and their lower growth and function(Clemens. 2006).

CONCLUSION

Heavy metals uptake, by plants using phytoremediation technology, seems to be a prosperous way to remediate heavy-metals-contaminated environment. It has some advantages compared with other commonly used conventional technologies. Several factors must be considered in order to accomplish a high performance of remediation result. The most important factor is a suitable plant species which can be used to uptake the contaminant. In view of this study results, it may be said that the vetch plant has transferred a same level of Cu across its aerial parts and roots and it seems that there has been no limitation for internal transferring of metals of roots to aerial parts. This is very important for plant purification, as it shows that the vetch plant is able to intake and aggregates these metals within its aerial parts and roots. Also, it indicates advantages of such plants cultivation in contaminated industrial areas, as this method, as compared to other methods, is an environmental-friendly, cheap and simple way.

REFERENCES

Bieby, V. T., Siti, R. S. A., Hassan, B., Mushrifah, I., Nurina, A., Muhammad, M., (2011). A Review on Heavy Metals (As, Pb, and Hg) Uptake by Plants through Phytoremediation. *International Journal of Chemical Engineering*.

Brunet JA, Repellin G, Varrault N, Terrync Y, Zuily-fodil. 2008. Lead accumulation in the roots of grass pea (Lathyrus sativus), a novel plant for phytoremediation systems. C.R Biologies. 331: 859-864.

Clemens, S. (2006). Toxic metals accumulation. responses to exposure and mechanism of tolerance in plants. *Biochemistry*, 88: 1707-1719

Dodwad, I. S., Salimath, P. M., Patil, S.A., (1998). Evolution of green gram collection for dry matter accumulation and its partitioning. *Legume Research*. 21 (3/4): 209-212.

Helmisaari, H. S., Derome, J., Nojd, P., Kukkola, M. (2007). Fine root biomass in relation to site and stand characteristics in Norway spruce and Scots pine stands. *Tree Physiology*, 27. 1493-504.

Manahan, S. E. (2003). Toxicological Chemistry and Biochemistry. CRC Press. Limited Liability Company (LLC), 3rd edition.

Paivoke, H. (1983). The short term effect of zinc on the growth anatomy and acid phospatase activityof pea seedlings, *Ann Bot,* 20:307–309.

Raymond, A. W., Felix. (2011). Heavy Metals in Contaminated Soils: A Review of Sources, Chemistry, Risks and Best Available Strategies for Remediation, *ISRN Ecology*.

Rehman, A., Ullah, H., Khan, R. U., Ahmad, I. (2013). Population based study of heavy metals in medicinal plant Capparis decidua. *International Journal of Pharmacy and Pharmaceutical Sciences*. vol. 5, no. 1.: 108–113.

VCI, Copper history/Future, Van Commodities Inc. (2011). *http://trademetalfutures.com/copperhistory.html*

Vitoria, A. P., Cunha, M., DaAzevedo, R. A. (2005). Ultra structural changes of Radish leaf exposed to cadmium. Environ, Exp, Bot. 58: 47-52.