EFFECTS OF LEAD ON THE PLANT GROWTH AND PHOTOSYNTHETIC ACTIVITY

EFECTUL PLUMBULUI ASUPRA CREŞTERII ŞI ACTIVITĂȚII FOTOSINTETICE A PLANTELOR

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Abstract. *Heavy metals disrupt the metabolic processes of living organisms. The presence of Pb^{2+} and other heavy metals in the environment has become a major threat to plant, animal and human life due to their bioaccumulation tendency and toxicity. Treatment of plants with lead nitrate showed inhibition in growth parameters. In order to understand the effects of Pb on the plant growth, we decided to perform experiments on Capsicum anuum plant which were irrigated with a solution containing lead nitrate. Our measurements showed that lead nitrate increases the content of photosynthetic pigments; no modifications were observations on height of plants and their biomass.*

Key words: lead nitrate, pepper plant, photosynthetic pigments

INTRODUCTION

Lead is a toxic element, which is conservative and has cumulative characteristics [4] .The majority of lead discharged into the environment comes from atmospheric and particulate sources. In addition, there are a range of industries which generate waste waters containing significant concentrations of lead. Soils are a major sink for lead, which might be absorbed and bioaccumulated by plants and animals eventually becoming available for human consumption. According to the literature, there is a positive correlation between lead in soil and blood lead concentration1. Excessive amounts of lead in the human body can cause hypertension and brain damage. Naturally occurring lead in soils is usually found atless than 50 mg/ kg. Nevertheless, contaminated surface soils may contain more than11, 000 mg /kg.

The presence of Pb^{2+} and other heavy metals in the environment has become a major threat to plant, animal and human life due to their bioaccumulation tendency and toxicity. It is therefore necessary that there are technologies for controlling the concentrations of these metals in aqueous discharges/effluents. To study the effects of heavy metals on plants and mechanisms of resistance, one must select crop cultivars and/or plants for removing heavy metals from soil and water. More highly resistant plants can be selected especially for a remediation of the pollution site. Understanding the bioavailability of heavy metals is advantageous for plant cultivation and phytoremediation. Decrease in the bioavailability to farmlands would reduce the accumulation of heavy metals in food. Alternatively, one could increase the bioavailability of plants to extract more heavy metals [2]. Current techniques for removing contaminants from soils are generally expensive and labor intensive. In addition, these techniques are frequently appropriate for small areas and may affect biological activity, soil structure and fertility as well.

Heavy metals have direct physiological toxic effects were reported by many authors [5], [6], [7].

In [3] authors studied the plants growth cultivated in mine wastes and in waste-amended soils that contain lead, cadmium, arsenic, and zinc. Lettuce had 100% survival in the 100% mine waste treatments compared to 0% for tomatoes. Metal concentrations were determined in plant tissues to determine uptake and distribution of metals in the edible plant parts. Tomato and bean plants contained the four metals mainly in the roots, and little was translocated to the fruits. Radish roots accumulated less metals compared to the leaves, whereas lettuce roots and leaves accumulated similar concentrations of the four metals. Lettuce leaves and radish roots accumulated significantly more metals than bean and tomato fruits. This accumulation pattern suggests that consumption of lettuce leaves or radish roots from plants grown in mine wastes would pose greater risks to humans and wildlife than would consumption of beans or tomatoes grown in the same area.

Heavy metals disrupt the metabolic processes of living organisms; they induce anatomical changes in primary leaves. N.Y.Chaudhry and Qurat-ul-Ain [1] indicated that applied lead nitrate showed inhibition in growth parameters. Pb binds the essential enzymes and cellular components and inactivates them. The number of stomata/mm registered increase with the application of growth hormones individually and in mixed doses, while a decrease in the number of epidermal cells/mm was observed at Pb treatments. Although hormones and having metal Pb nitrate showed their clear effects with individual applications, no generalized pattern was observed with the combination of hormones and heavy metal.

In order to better understand the effects of Pb on the plant growth, we decided to perform experiments on *Capsicum anuum* plant which were irrigated with a solution containing lead nitrate. At the end of the experimental period, the growth of the plants and the concentration of total chlorophyll, chlorophyll a (chla), chlorophyll b (chlb) and carotenoids in the leaves of the developing plants were monitored.

MATERIAL AND METHOD

Pepper seeds were planted in the University of Agronomy and Veterinary Medicine Iasi greenhouse and they were grown in pots. The seeds planted in the greenhouse were grown in optimal conditions.

After 10 weeks the pepper plants were treated with a solution of lead nitrate.

In order to accomplish the goal of this experiment 20ml solution were poured into the soil at the root of each plant. The procedure was performed for three times in a row.

A week after the end of the treatment the analysis of the growth and the photosynthetic activity was performed.

For pigment analysis were measured 1 g of fresh leaf tissue and were cut the leaves into small pieces (about 1 mm wide). The pigments were extracted by grinding in a mortar and pestle for 5 minutes. Afterwards the extract was filtrated and transferred to 100 ml acetone.

The pigment analysis was performed with a spectrophotometer SPECORD 200 from Analytik Jena, immediately after the solutions were prepared. The content of the photosynthetic pigments was calculated with the formula:

Chl a = (9.784 * E662 - 0.99 * E644) * V* 100 / m

Chl b = (21.462 * E644 - 4.65 * E662) * V*100/ m

Car = (4.695 * E440 - 0.268 * (5.134 *E662 + 20.436 * E644) * V *100 /m

where:

-E662, E644, E440 is the absorbance,

-V is the volume of the solvent,

- m is the mass tissue.

RESULTS AND DISCUSSIONS

The spectrum of the acetonic extract from photosynthetic pigments is presented in Fig.1

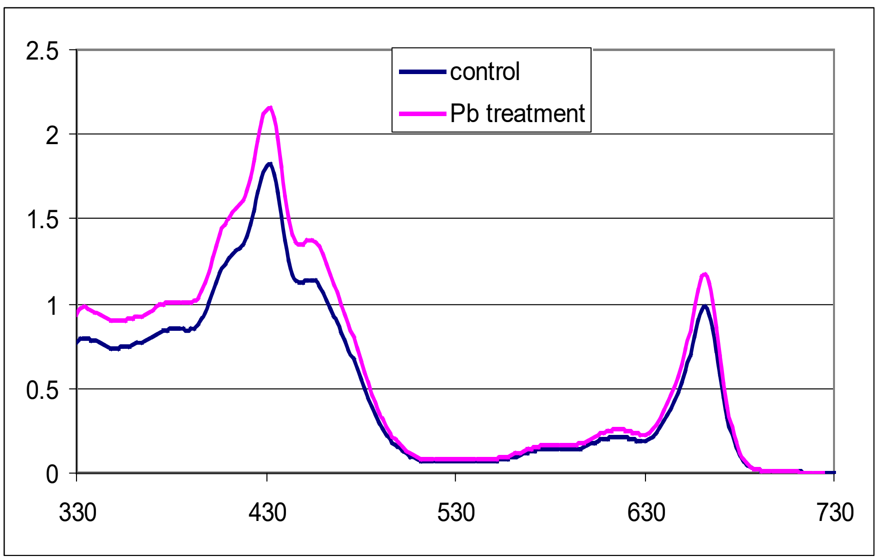

Figure 1. **Spectrum of pigments from control and treated with Pb pepper plants**

The content of photosynthetic pigments from the control plants and the treated ones with lead nitrate are presented in the Fig.2

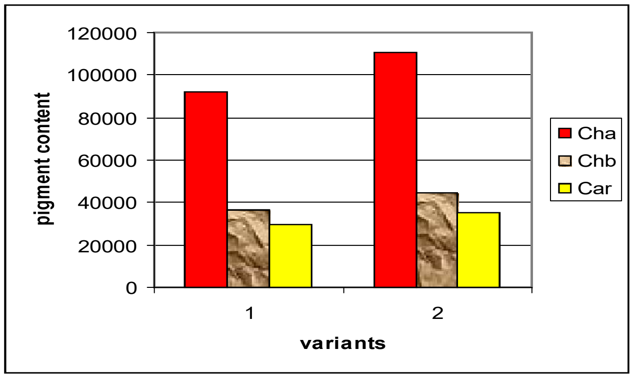

Figure 2. **Content of pigments from control and treated with Pb pepper plants**

CONCLUSIONS

The effects of lead nitrate on plants resulted in change of biochemical activities as well as of the function of plants. We can see from figures 1 and 2 that lead nitrate increases the content of photosynthetic pigments but no modifications were observations on height of plants and their biomass (figures not shown). Despite the fact that the heavy metals are toxic to people, in this phase of the research there have been no measurements taken about the transmission of this heavy metal to the leaves and the fruits of the plants

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