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Original Contribution

EFFECT OF CADMIUM ON SEED GERMINATION AND EARLIER BASIL (*OCIMUM BASILICUM* L. AND *OCIMUM BASILICUM* VAR. *PURPURESCENS*) SEEDLING GROWTH

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ABSTRACT

As one of the consequences of heavy metal pollution in soil, water and air, plants are contaminated by heavy metals. Thus, this work aims to evaluate the response of two basil species (*Ocimum basilicum* L. and *Ocimum basilicum* var. *Purpurescens*) to treatment with cadmium (heavy metal) in the roots and leaves of young plants. This experiment was conducted on the basis of a completely randomized design (CRD) in greenhouse condition with four doses (0, 5, 10, 20 mg/lit) of cadmium heavy metal. The results indicated that germination of seeds was inhibited by cadmium as compared to control. In addition number of leaves, plant height, plant height above cotyledon leaves and root length were clearly shortened when the concentration of cadmium exceeded. Generally, it was shown that Cd is more toxic for *Ocimum basilicum* var. *Purpurescens* than *Ocimum basilicum* L.

Key words: Basil, Cadmium, Germination, Toxicity

INTRODUCTION

During the last decades the contamination of soil became very extensive and dangerous problem as a consequence of industrial activities (metallurgy, chemistry, energetics, etc.) (1). All these heavy metals: Cd, Cu, Hg, Ni, Pb and Zn are the most dangerous (2). There are two aspects on the interaction of plants with heavy metals: (i) heavy metals show negative effects on plants, and (ii) plants have their own resistance mechanisms against toxic effects and for detoxifying heavy metal pollution (3). Heavy metal accumulation in soils is of concern in agricultural production due to its adverse effects on food quality, crop growth, and environmental health (4). These metals are mostly absorbed by plants easily and prove toxic to plants that can be observed as growth retardation as a result of alterations in biochemical process like inhibition of enzyme activity, protein penetration and impaired nutrition etc. (5). Cadmium (Cd), being a highly toxic metal pollutant of soils, inhibits root and shoot growth and yield production, affects nutrient uptake and homeostasis, and is frequently accumulated by agriculturally important crops and then enters the food chain with a significant potential to impair animal and human health (6). Aydinalp and Marinoya (7) expressed the dose of 5 ppm of Cr^{+6}, Cu^{+2}, Ni^{+2}, and Zn^{+2} increased the shoot size by 13.0%, 59.0%, 35.0%, and 6.6%, respectively). Basil is used as a medicinal herb in medical treatments such as for headaches, coughs, diarrhea, worms, and kidney malfunctions. Basil essential oil has been utilized extensively in the food industry as a flavoring agent, and in perfumery and medical industries (8). The flowers and leaves of the plant constitute a rich source of essential oils (9). An infusion of the leaves is used as a disinfectant and as an insecticide (9). Present study is done to examine the toxicity of cadmium on germination and seedling growth of *Ocimum basilicum L.*, and *Ocimum basilicum* var. *Purpurescens* at varying concentrations.

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MATERIALS AND METHODS

Basil seeds *Ocimum basilicum* L. and *Ocimum basilicum* var. *Purpurescens* were immersed in 3% v/v formaldehyde/deionized water for five minutes to avoid fungal contamination. After that, the seeds were washed with deionized water and placed in pot which filled with soil pots irrigated with the heavy metals of Cd^{+2}, [$CdSO_4.8H_2O$] were used at the concentrations of 0, 5, 10, 15, 20 ppm. Each treatment was replicated three times for statistical purposes. Pots were maintained in greenhouse at 20-30 ºC and natural light. The seedlings were harvested after two weeks and the aboveground plant, number of leaves, plant height, plant height of cotyledon leaves and root length were recorded.

The data were analyzed by analysis of variance (ANOVA) to determine the effect of treatments, Treatment means were compared using LSD at the 5% level of probability.

RESULTS AND DISCUSSION

The effects of the different concentrations of Cd on aboveground plant of 2 cultivar of basil were presented in (**Figure 1**). There was a reduction in aboveground plant as metal concentrations in the growing media. The results of the present study revealed that Cd adversely influenced the seed germination. When the concentration of metals exceeded certain levels, an abnormal germination was resulted. Cd significantly decreased plant height of cotyledon leaves and plant height more than controls then the longest plant height and plant height of cotyledon leaves occurred in control plants (**Figures 2, 3**). Claire *et al.* (10) obtained similar results in a study using nickel and other heavy metals on cabbage, lettuce, millet, radish, turnip, and wheat.

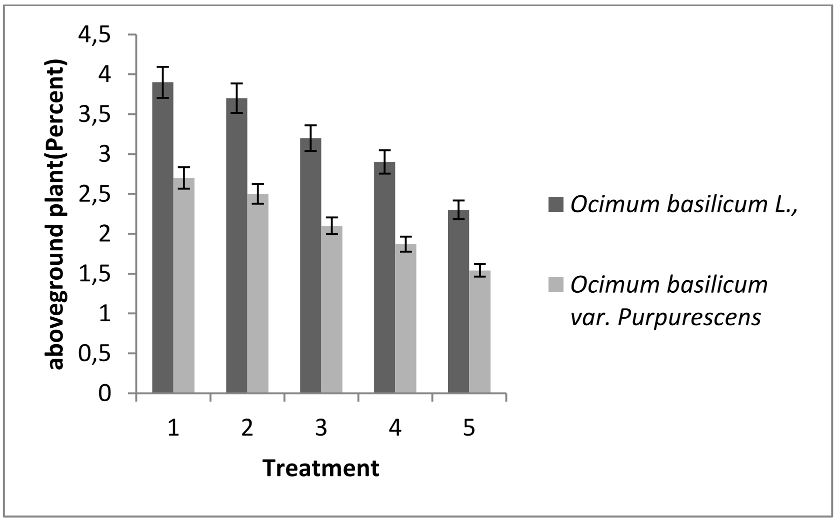

Figure 1. The effect of varying concentrations of cadmium on aboveground plant of *Ocimum basilicum L.,* and *Ocimum basilicum* var. *Purpurescens.*

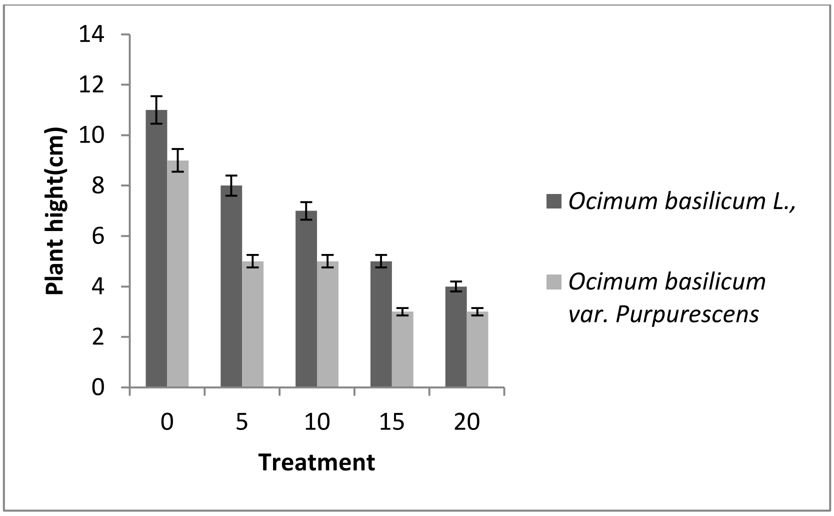

Figure 2. The effect of varying concentrations of cadmium on plant height of *Ocimum basilicum L.,* and *Ocimum basilicum* var. *Purpurescens.*

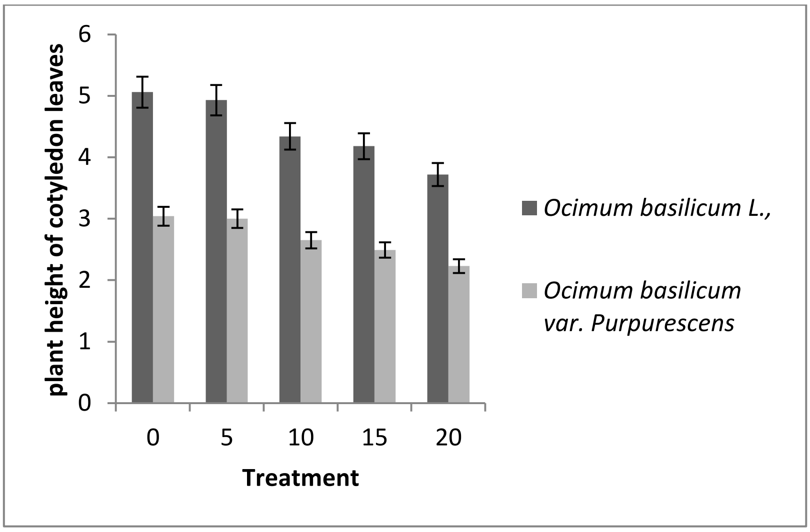

Figure 3. The effect of varying concentrations of cadmium on plant height of cotyledon leaves Of *Ocimum basilicum L.*, and *Ocimum basilicum* var. *Purpurescens.*

Chugh and Sawhney (11) reported that seed germination of pea (*Pisum sativum* L.) was affected by up to 0.5mM of Cd doses. The root growth was presented in **Figure 4.** Cd decreased the root growth by increasing the concentration respectively, as compared to the root growth of the control plants. No significant difference in roots length between control and Cd 5 ppm. The inhibition of root growth can be attributed in part to the inhibition of mitosis, the reduced synthesis of cell-wall components, damage to the golgi apparatus and changes in the polysaccharide metabolism, while browning is caused by suberin deposits (12). Presented data in **Figure 5** shows that different cobalt levels decreased number of leaves in two basil seedlings.

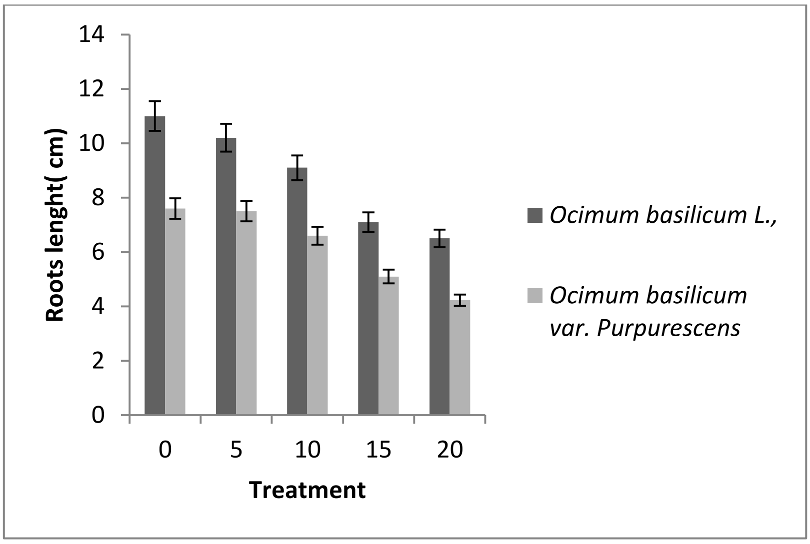

Figure 4. The effect of varying concentrations of cadmium on roots length of *Ocimum basilicum L.*, and *Ocimum basilicum* var. *Purpurescens.*

CONCLUSIONS

According to the results, the seed germination and earlier seedling growth of the basil plant is seriously affected by 20 ppm of Cd. This heavy metal is more toxic for *Ocimum basilicum var. Purpurescens* than *Ocimum basilicum* L. in aboveground plant, number of leaves, plant height, plant height of cotyledon leaves and roots length. Detailed studies need to be done in order to establish the maximum amount of Cd that the plants may tolerate, and the ability of the basil plants to germinate and grow in media containing mixtures of other heavy metals.

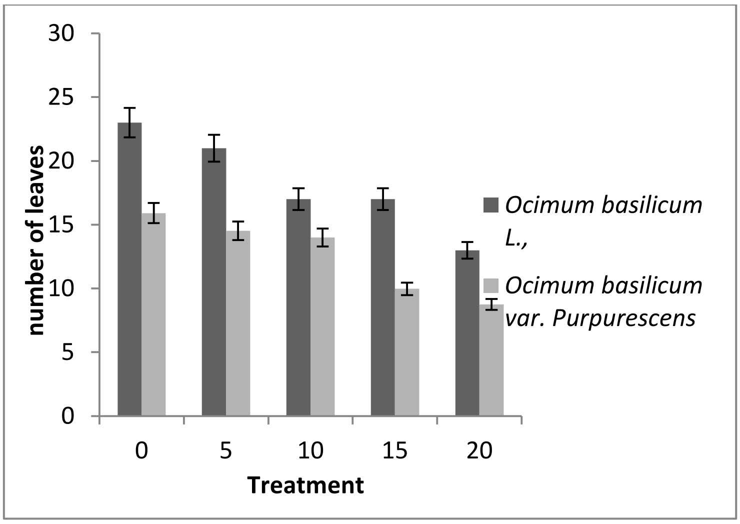

Figure 5. The effect of varying concentrations of cadmium on number of leaves of *Ocimum basilicum L.,* and *Ocimum basilicum* var. *Purpurescens.*

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