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INTRODUCTION: High levels of trace elements are characteristic of Brazilian soils. However, the presence of these trace elements may increase with incorrect application of agricultural inputs, industrial waste, agricultural chemicals, and mining waste. Many trace elements have known biological functions. Neglecting the permissible limits of these trace elements in the soil can lead to plant ecological and nutritional imbalances. Chromium (Cr VI) causes oxidative and mutagenic changes to plant cells, therefore, can be a highly toxic threat to both plants and the animals feeding on these plants. The harmful effects of Cr VI are greater than other forms of this element due to its mobility, capacity to penetrate plant tissue, oxidative and mutagenic capacity, and ability to inhibit soil biochemical processes. Even at low concentrations Cr VI can be toxic and cause inhibition of germination, limit root and shoot growth, and cause foliar chlorosis. When absorbed by plants, the accumulation of Cr VI is concentrated predominantly in the roots, with proportional translocation to the shoots. Due to its detrimental behavior in soil and ability to be absorbed by plants in the form of chromate, the investigative study of Cr VI is imperative. The effects of Cr VI on plants can be observed and investigated in the common bean.

This study aims to evaluate the emergence and initial development of Phaseolus vulgaris cv. BRSMG Madrepérola grown on soil contaminated with Cr VI.

MATERIALS AND METHODS: An experiment was carried out in a greenhouse of the Department of Soil Science of the Federal University of Lavras, Lavras, Minas Gerais, Brazil. A randomized experimental design was used with four replicates of six treatments of Cr VI (0, 75, 150, 300, 450 and 600 mg kg⁻¹). The recommended fertilizer was applied to each test and corrections were performed following the analysis of results.

Each test was composed of a 500 cm³ pot filled with soil samples taken from the 0-20 cm topsoil horizon of a Red-Yellow Latosol (Oxisol). The contaminate used was potassium dichromate (K₂Cr₂O₇). Ten seeds were sown into each pot following contaminate application. Potassium dichromate was applied to all treatments equally. It was applied as potassium chloride to ensure no nutritional differences.

The test was concluded 21 days after the emergence of 50% of the control plants. The variables evaluated were: emergence, number of leaves, shoot length, shoot dry weight, stem diameter, root length and root dry weight. The normality and homogeneity of the data were tested. The significance in the differences of the endpoints was tested by a one-way ANOVA. In the case of significant differences (p≤0.05), a Dunnett’s test was performed to detect the difference between the treatments and the control (no observed effect concentration -NOEC). The EC₅₀ (concentrations that reduce endpoints by 50% when compared with the control) were estimated through non-linear models. All analyses were conducted using STATISTICA version 7.

RESULTS AND DISCUSSION: All variables evaluated were affected by Cr VI (Figure 1). The emergence of plants (EC₅₀: 421 ± 38.6 mg kg⁻¹) and stem diameter (EC₅₀: 498 ± 37.6 mg kg⁻¹) were the least sensitive variables. Effects on emergence and stem diameter were observed at doses greater than 150 mg kg⁻¹, for all other variables the effects were observed at doses greater than 75
mg kg$^{-1}$. The most sensitive variable was biomass dry weight in which a reduction of 50% was observed in comparison to the control treatment. The EC$_{50}$ ($114 \pm 16.5$ mg kg$^{-1}$) derived for shoot dry weight was about 3.7 times lower than the EC$_{50}$ for the emergence of plants. Effects on leaf number, root and shoot length were intermediate and had EC$_{50}$ ranging from 173 to 237 mg kg$^{-1}$. The presence of Cr VI damaged plant photosystems, nutrient uptake, chloroplasts and, therefore, affected plant photosynthesis and growth. There was inhibition of root formation from 150 mg Cr kg$^{-1}$, together with the other points discussed, this also contributed to the deleterious effect on plant growth. The results for LVAd cannot be applied to other soil classes as the toxicity of the treatment is related to availability of the element in soil solution. Thus, for the same treatment, soils with properties that provide greater available Cr VI tend to have more pronounced deleterious effects. Moreover, factors that affect Cr speciation also affect phytotoxicity. More studies are needed to verify the effect of Cr VI contamination on the development, production, and transfer to grains and to verify the location of this element in plants.

**Figure 1.** No observed effect concentrations (NOEC), and 50% (EC$_{50}$) effect concentration (with 95% confidence intervals in parentheses) for the toxicity of the chromium to *Phaseolus vulgaris* L. cv. BRSMG Madrepérola.

**CONCLUSIONS:** Harmful effects on the production of common bean biomass occur at lower levels than the observed effects for plant emergence. Among the evaluated variables, shoot dry weight was the most sensitive. Chromium levels greater than 75 mg kg$^{-1}$ are harmful to bean crops. Contents greater than 114 mg kg$^{-1}$ should be considered highly phytotoxic, because the biomass production is reduced by 50%.

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