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Juhi Sinha, Shobha Shrivastava
Govt. M.L.B. Girls P.G. (Autonomous) College near Polytechnique square Bhopal (M.P.) India

Devika Rawat
Govt. M.V.M. Jahangeerabad Bhopal (M.P.) India.

To study the effect of Pb in *Brassica juncea* L. by chlorophyll, Dry biomass and G.G.I. Estimation

Juhi Sinha*, Devika Rawat, Shobha Shrivastava

ABSTRACT

Phytoextraction methods can be applied to reach the target of fallow-lands reuse and earn more incomes for farmers. In many studies, Indian mustards (*Brassica juncea*) were planted in the metal-contaminated soils to study their suitability in phytoextraction. In this pot study, *B. juncea* plants were planted in artificially Pb-contaminated soils in different concentration of Pb (0, 5, 10, 15 and 20 mg/kg) and find the effect on chlorophyll content and dry biomass of plant. In the present study we find the significant inhibition between the shoots of the control plants and the plants treated with 15 and 20 mg/kg Pb for the dry biomass, G.G.I., and the day 30 chlorophyll evaluation parameters.

Keywords: Phytoremediation, *Brassica juncea,* Lead, Chlorophyll evaluation, G.G.I.

1. INTRODUCTION

Phytoremediation describes the treatment of environmental problems (bioremediation) through the use of plants which mitigate the environmental problem without the need to excavate the contaminant material and dispose of it elsewhere. Certain plant species are able to tolerate and extract high concentrations of Pb from soil [1-4]. *B. juncea* can remediate Lead and many other soil trace elements. This plant is used to remove heavy metals from the soil in hazardous waste sites because it has a higher tolerance for these substances and stores the heavy metals in its cells. The plant is then harvested and disposed of properly. This method is easier and less expensive than traditional methods for the removal of heavy metals. It also prevents erosion of soil from these sites preventing further contamination. The present study will provide information on *B. juncea's* tolerance and responses to Pb contaminated soil. This data will be helpful to further evaluate the potential of *B. juncea* for phytoremediation of Pb contaminated soil in Bhopal (M.P.).

2. MATERIALS AND METHODS

The pot culture experiment was performed to study the Pb remediation from contaminated soil. The soil was sampled in a depth of 0–15 cm from agricultural fields Mandideep area Bhopal, M.P., dried indoors until it could be crumbled to pass through a 4 mm-sieve for pots experiment and a 2 mm-sieve for analyses of physicochemical properties. Soil was transferred to polyethylene pots (20 cm diameter and 15 cm depth). Each pot containing 1000 g soil. Each soil sample was divided into control and Pb treated groups (0, 5, 10, 15 and 20 mg/kg Pb). The soil contamination was performed by adding a specific amount of heavy metals; they were dissolved in deionised water into each pot. Plants were grown in a growth chamber and were maintained in a 20/18°C (day/night) growth chamber with 14 h daylight, and a relative humidity 38/32% (day/night).

Correspondence:
Juhi Sinha
Govt. M.L.B. Girls P.G. (Autonomous) College near Polytechnique square Bhopal (M.P.) India
E-mail: *juhi_sinha30@rediffmail.com*

After plant sowing, each pot was fertilised with N, P, and K using urea (120 mg N/kg), calcium phosphate (100 mg P/kg), and potassium sulphate (50 mg K/kg) as a basal fertilising 5. The pots were weighed daily and irrigated with deionised water to replace water lost throughout evapotranspiration.

Three parameters were taken to determine the response of mustard plant to Pb:

The dry matter weight of plants, Grade of growth inhibition (G.G.I.) and the study of the phytotoxicity, chlorophyll pigment will be determined following the method of Arnon 6. Chlorophyll content was evaluated on days 15 and 30 of the experiment. For dry biomass and G.G.I. determination, plants were harvested on day 30 of the experiment. The plants were washed with distilled water, and dried at 75^0C for 96 hours in an incubator. The G.G.I. was evaluated by using the following formula: G.G.I. = [(C-T) / C] x 100 where C and T represent the dry weight of tissues of the control (C) and metal-treated plants (T)[7,8]. using the methods of Einhellig and Rasmussen 9. Leaves were randomly collected for the chlorophyll evaluation.

Statistical analyses

Statistical analysis was done in SPSS (Windows Version 10.0.1 Software Inc. New York) using a one-sided students t-test. All the values represent mean of triplicates and are expressed as Mean SD. $p<0.01$, $p<0.05$ was considered as significant.

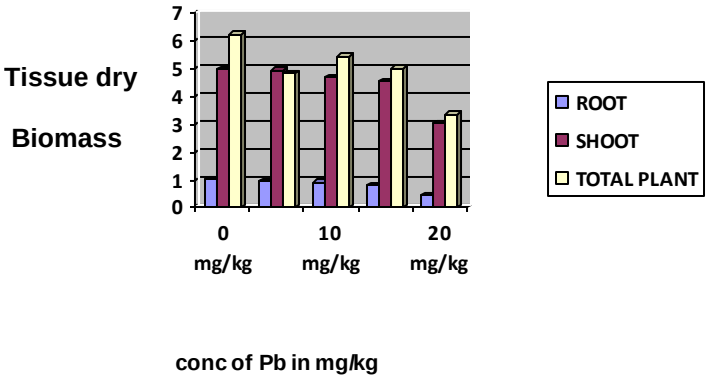


Figure 1. Tissue dry biomass of the control and lead treated plants

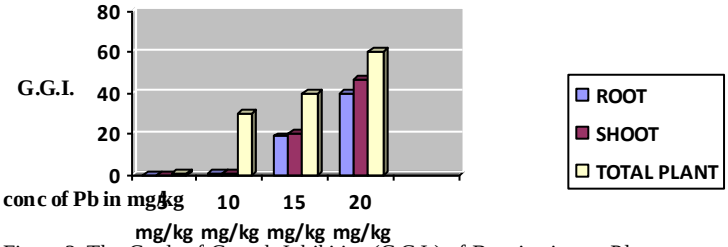


Figure 2. The Grade of Growth Inhibition (G.G.I.) of Brassica juncea Plants grown in soil containing varying concentrations Pb for 30 days.

G.G.I. = [Control mean–Treated mean/Control mean] x 100

(Control group GGI = 0%, representing 100% growth).

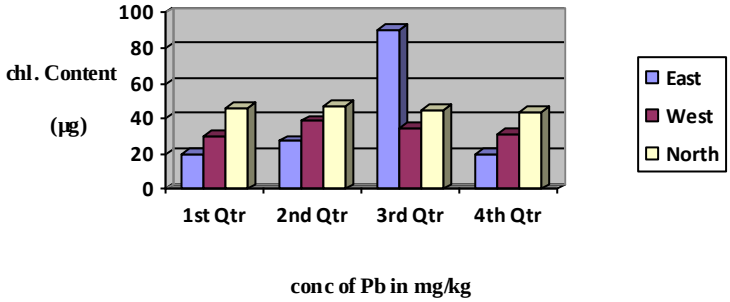
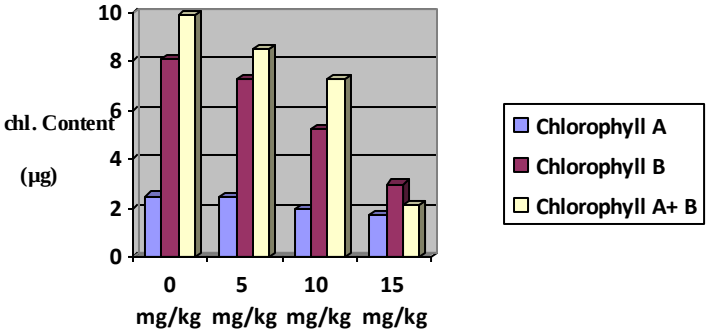


Figure 3. Chlorophyll content µg of total extractable chlorophyll of Brassica juncea plants grown in soil containing various Concentrations Pb for 15 days.



3. RESULT AND DISCUSSION

The dry biomass of mustard plant the significant inhibition observed in the shoot biomass of plants treated with 15 and 20 mg/kg Pb, while in root dry biomass the slight inhibition observed only in 10, 15 and 20 mg/kg Pb treated group (Graph-1) The G.G.I of shoot was found to be significant in plants treated with 20 mg/kg Pb while the G.G.I of root was found to be significant in plants treated with 10, 15 and 20 mg/kg Pb as compared to control. The total plant G.G.I. was observed in 15 and 20 mg/kg Pb treated plants. (Graph- 2)

The chlorophyll content a, b and a + b were found to significantly lower in the 15 mg/kg Pb treated plants as compared to the control plants, On day 15, (graph- 3) while by the day 30, chlorophyll content had increased in all plant groups as compared to day 15. The Pb contamination in soil caused reduction in chlorophyll content in all Pb treated groups on day 15 and 30.

4. CONCLUSION

The results of all parameters suggest that *B. juncea* is able to tolerate Pb concentrations up to 5 mg/kg without showing signs of metabolic inhibitions or phytotoxic effects. Moreover, no

significant differences were observed between the shoots of the control plants and the plants treated with 5 mg/kg and 10 mg/kg while the slight inhibition has been shown in 15 mg/kg and 20 mg/kg Pb for the dry biomass, G.G.I., and the day 30 chlorophyll evaluation parameters. This may suggest two possibilities: The process of translocation of Pb into the shoot is not occurring. Or, translocation is occurring without significant phytotoxic effects. Studies are being conducted in our laboratory to explore such questions.

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