

# Effect of Pb contaminated soil on germination and development of *Sinapis alba* sps.

ANDA GABRIELA TENEA<sup>1,2</sup>, GABRIELA GEANINA VASILE<sup>1</sup>, CRISTINA DINU<sup>1</sup>, MIHAELA MURESEANU<sup>2</sup>

<sup>1</sup>National Research and Development Institute for Industrial Ecology ECOIND, 71 Drumul Podu Dambovitei, zip code 060652, Bucharest, Romania

<sup>2</sup>Craiova University, Science Faculty, Chemistry Department, 107i Bucharest Road, Craiova, Romania

## INTRODUCTION

The mineral component of the soil fixes the lead especially on clay minerals, and the organic component of the soil fixes the lead on humic acids. Consequently, over 80% of the lead from soil is bound, and only a small part remains bioavailable to the plants. This explains why in lead-polluted soils the toxicity on plants is not proportional to the total lead content [1]. This poster presents a laboratory experimental study aiming to evaluate the accumulating and transfer behavior of Pb in the roots, stems and leaves of white mustard plants grown in the presence of essential elements (Ca, Mg, Fe, Zn, Mn, Cu, Ni). The study makes a comparison between white mustard cultivated in unpolluted soil and in two Pb polluted soils at normal value (of 40 mg/kg Pb- test Pb I), and above the alert threshold value (80 mg/kg Pb – test Pb II) for soils with sensitive use according to in force legislation in Romania [2].

## MATERIALS AND METHODS

Mustard seeds *Sinapis alba* (SIA, MicroBiotests Belgium) and universal substrate composed of peat soil and humus for garden plants were used. The substrate had the following characteristics: pH 6.35, organic C 12%, N<sub>total</sub> 1.34%, P<sub>total</sub> 0.28%, K<sub>total</sub> 0.9%, conductivity: 555 μS/cm and humidity 40%. Each experiment (control and polluted) contained 1kg of dried soil and 30 mustard seeds. The watering regime was initially with tap water until the seeds germinate, and then two solutions of 40 mg/L of Pb (test Pb I), respectively 80 mg/L (test Pb II) were prepared, and the plants were watered twice with the Pb solutions, every 2 days. All experiments were conducted at an ambient temperature in the range of 20 °C - 25 °C, from April to July, with natural light for about 12 hours / day. The collection of soil and plant samples (root, stem and leaves) were performed after each month of experiment (30 days and 60 days).

## RESULTS AND DISCUSSION

Germination in the Pb I test was 10% lower than in the control test, respectively 30% lower in the case of the Pb II experiment compared to the control test, where 85% of seed were germinated. Lead inhibits metabolic processes such as nitrogen uptake, photosynthesis, respiration and water absorption. The values of chlorophyll concentrations are lower in test experiments than in the control sample.

Both experiments show that mustard plants do not bioaccumulate lead at this level of concentration, recording values of transfer and bioaccumulation indices lower than 1 or zero. Thus, lead is mainly found in the root, the plants do not accumulate lead either in the stem or in the leaves. Iron does not bioaccumulate in mustard plants, nor in control, nor in contaminated samples, the values of TC, respectively TF being sub unitary.

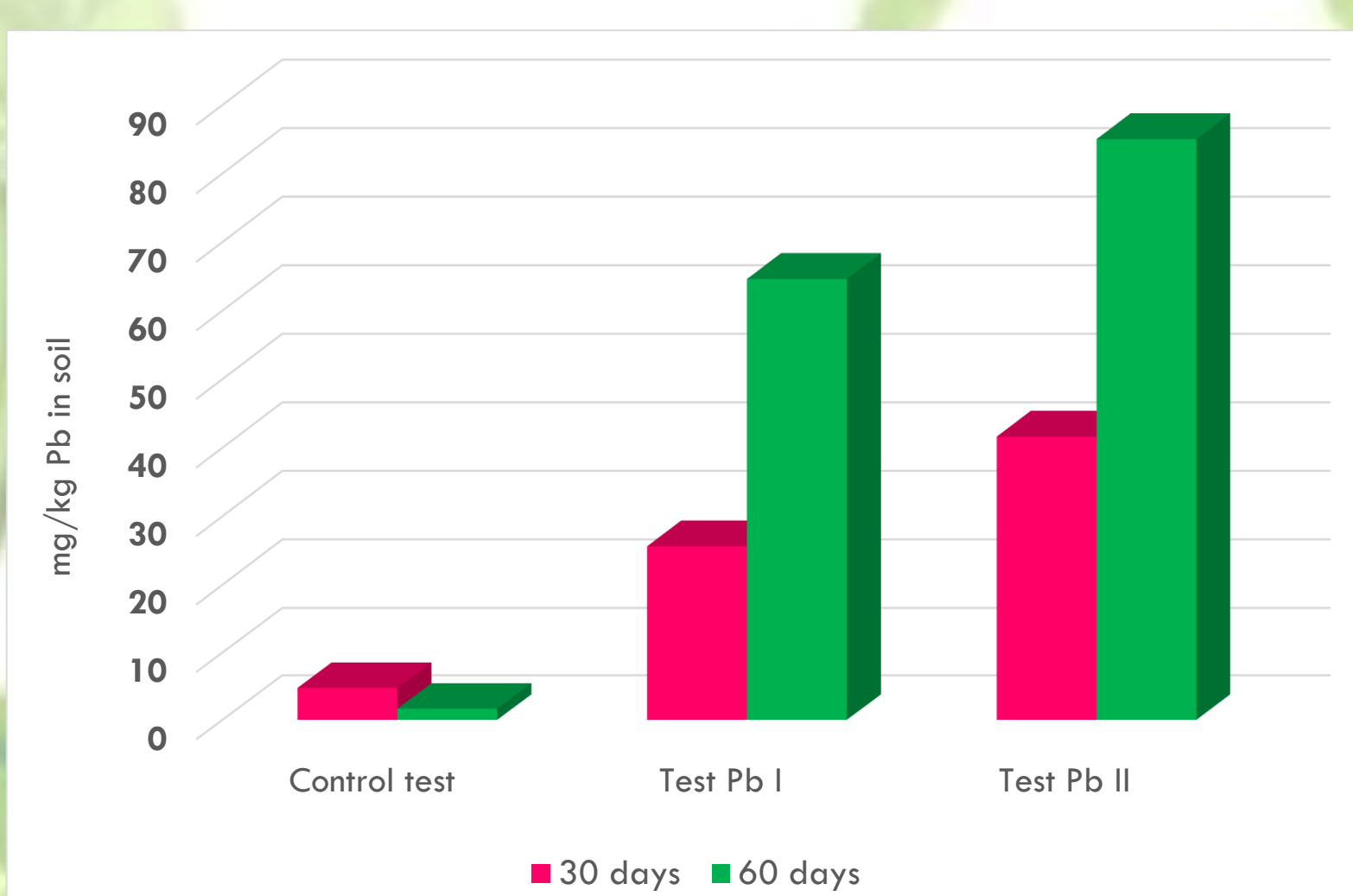


Figure 1. Pb content in soil

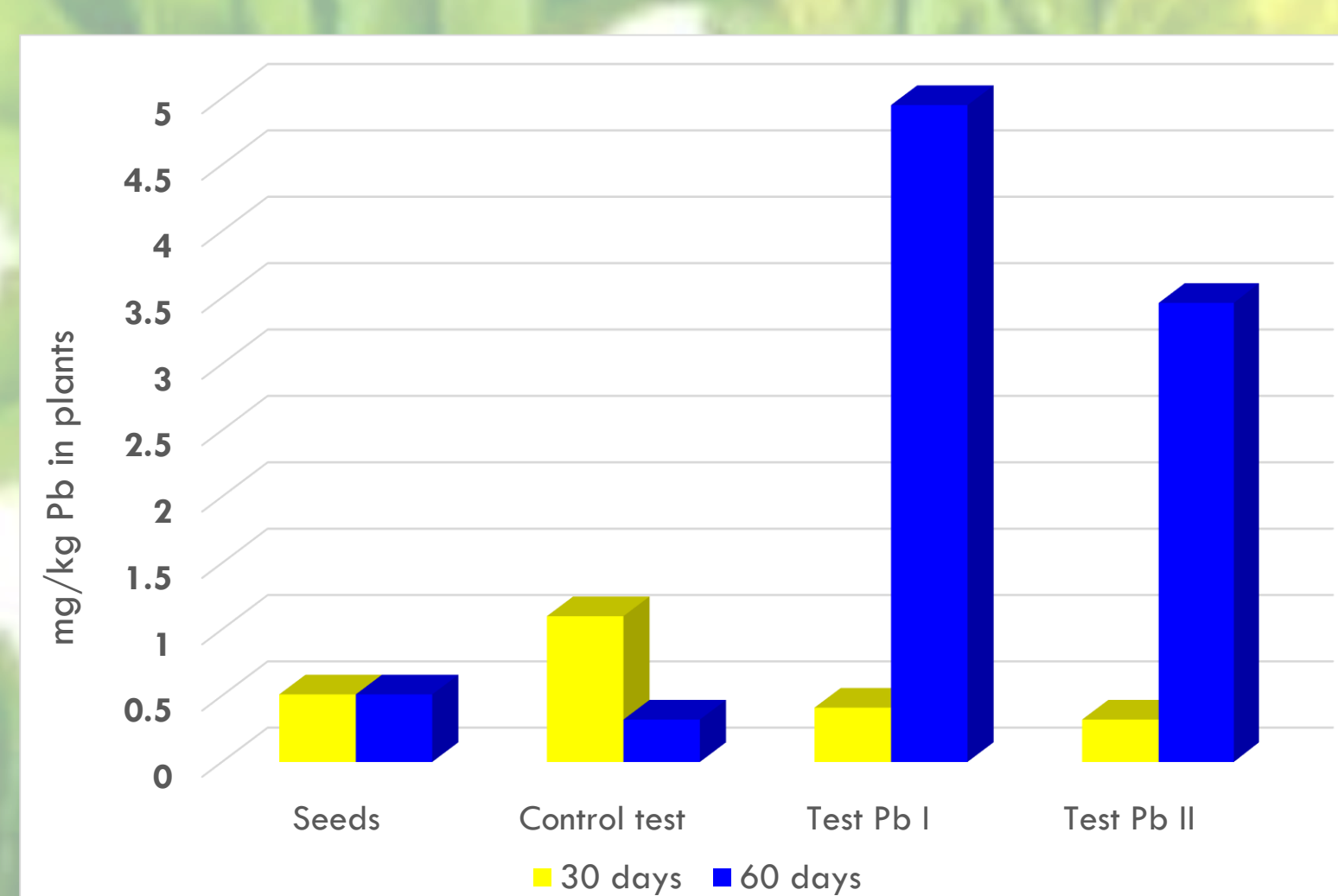


Figure 2. Pb content in plant

Calcium does not accumulate in the root being used by the plant in its growth and development. The translocation coefficients are higher in the experiment performed at the Pb concentration higher than the normal value (Pb I), compared to the Pb II test. And the concentrations extracted from the plant are 210% higher in the case of the Pb I test, respectively 230% higher in the case of the Pb II test compared to the control sample (118,129 mg / kg), figure 3. Manganese bioaccumulates mainly in the leaves and less in the stem, the concentrations remaining in the roots being very low. The bioaccumulation model is identical to that of the control sample, but the concentrations extracted in the contaminated plants are 7 times lower in the Test Pb I, respectively 17 times lower in the Test Pb II, figure 4.

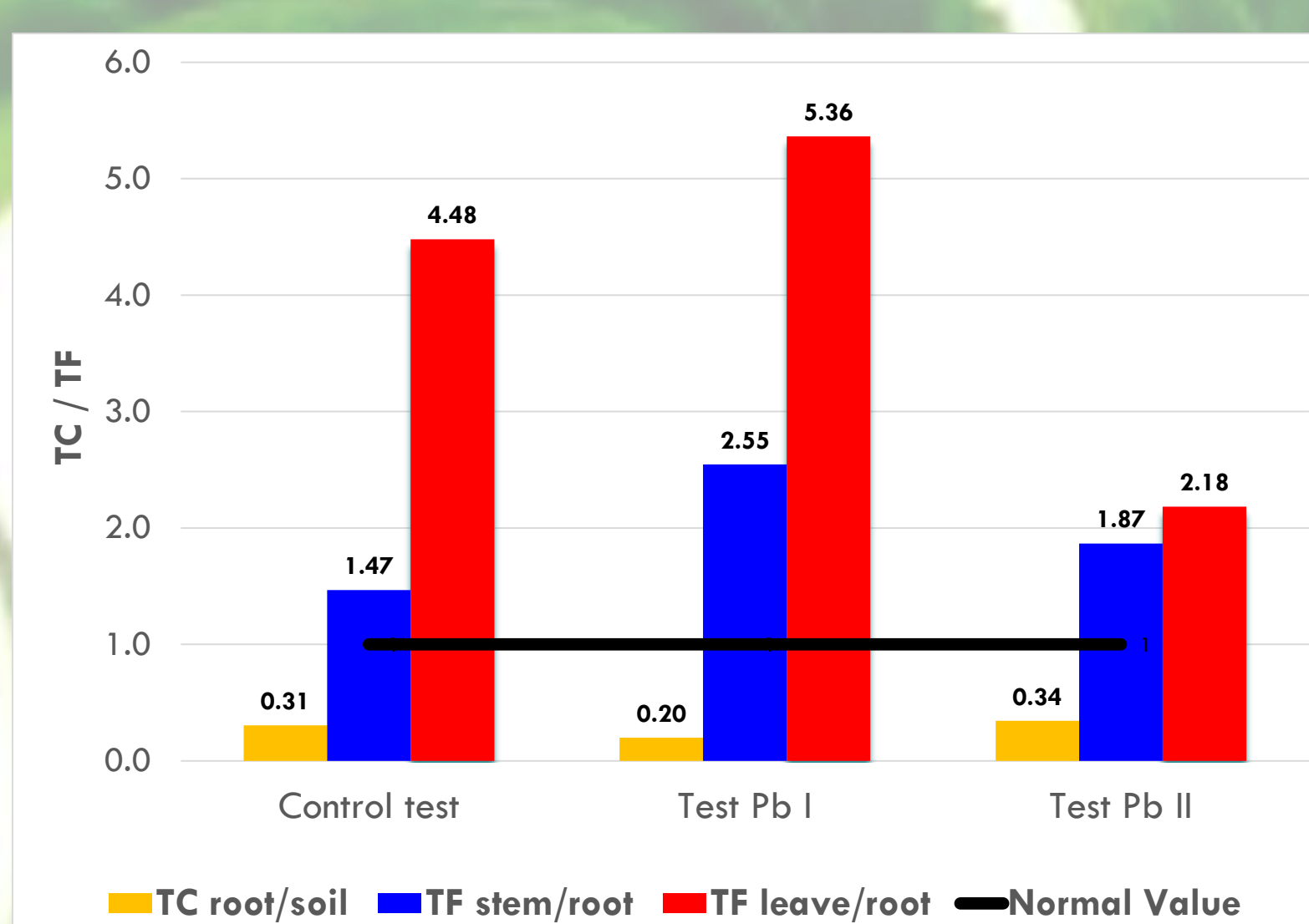


Figure 3. TC/TF for Ca

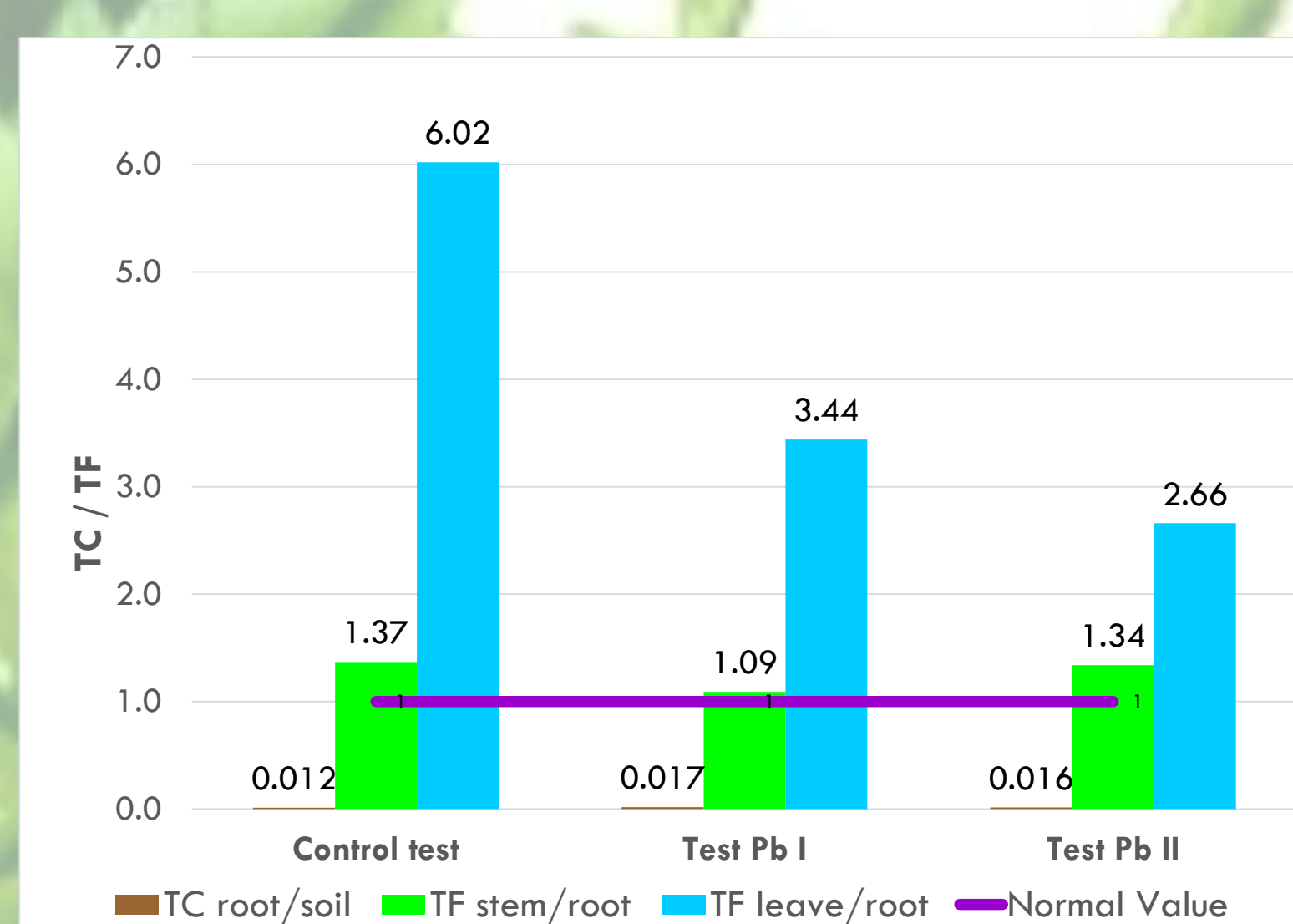


Figure 4. TC/TF for Mn

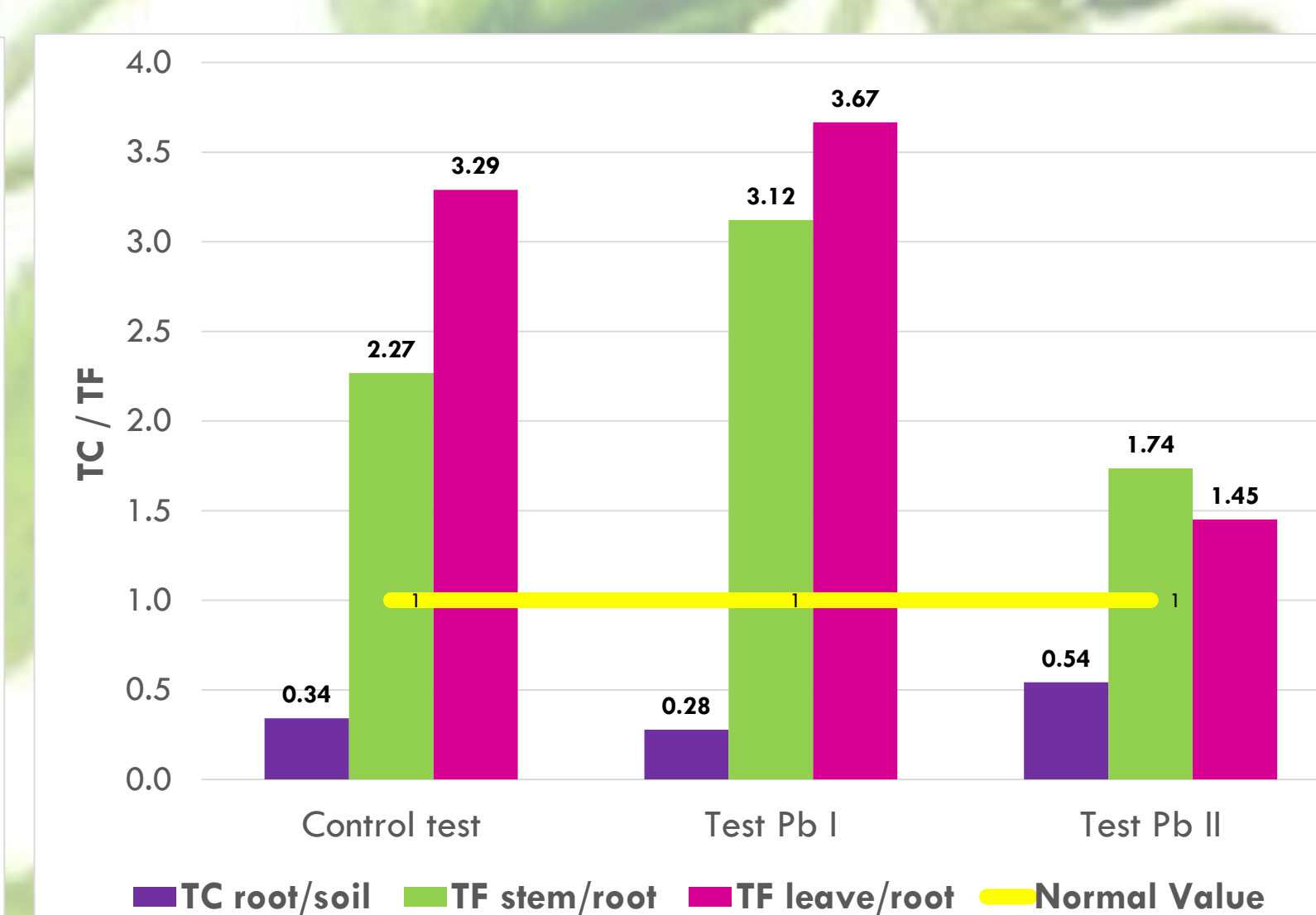


Figure 5. TC/TF for Mg

The mustard leaves extracted more Mg in polluted tests than in the control sample, Mg concentrations being with 230% higher than in Pb I Test and 260% higher in Pb II Test, figure 5.

Zn concentrations in the contamination tests are 255% higher in Pb I Test than in the control sample (25.7 mg/kg), respectively 340% higher in the Pb II Test. However, the total content of Zn in plants is lower than the phytotoxic concentration (200 mg/kg). So, as the concentration of Pb increases in soil, the mustard plant extracts more Zn from the soil to use it in the growth and photosynthesis processes (figure 6).

Copper bioaccumulates only in leaves, so TF leaves/root = 1.86 (Pb I Test) > TF leaves/root = 1.72 (control sample) > TF leaves/root = 1.24 (Pb II Test). The values of Cu concentrations in mustard plants do not exceed the value of phytotoxic Cu concentration in plants (20 mg/kg), being in the range of normal values.

Nickel does not accumulate in any of the air or underground components of the mustard both in the control and in the contaminated samples.

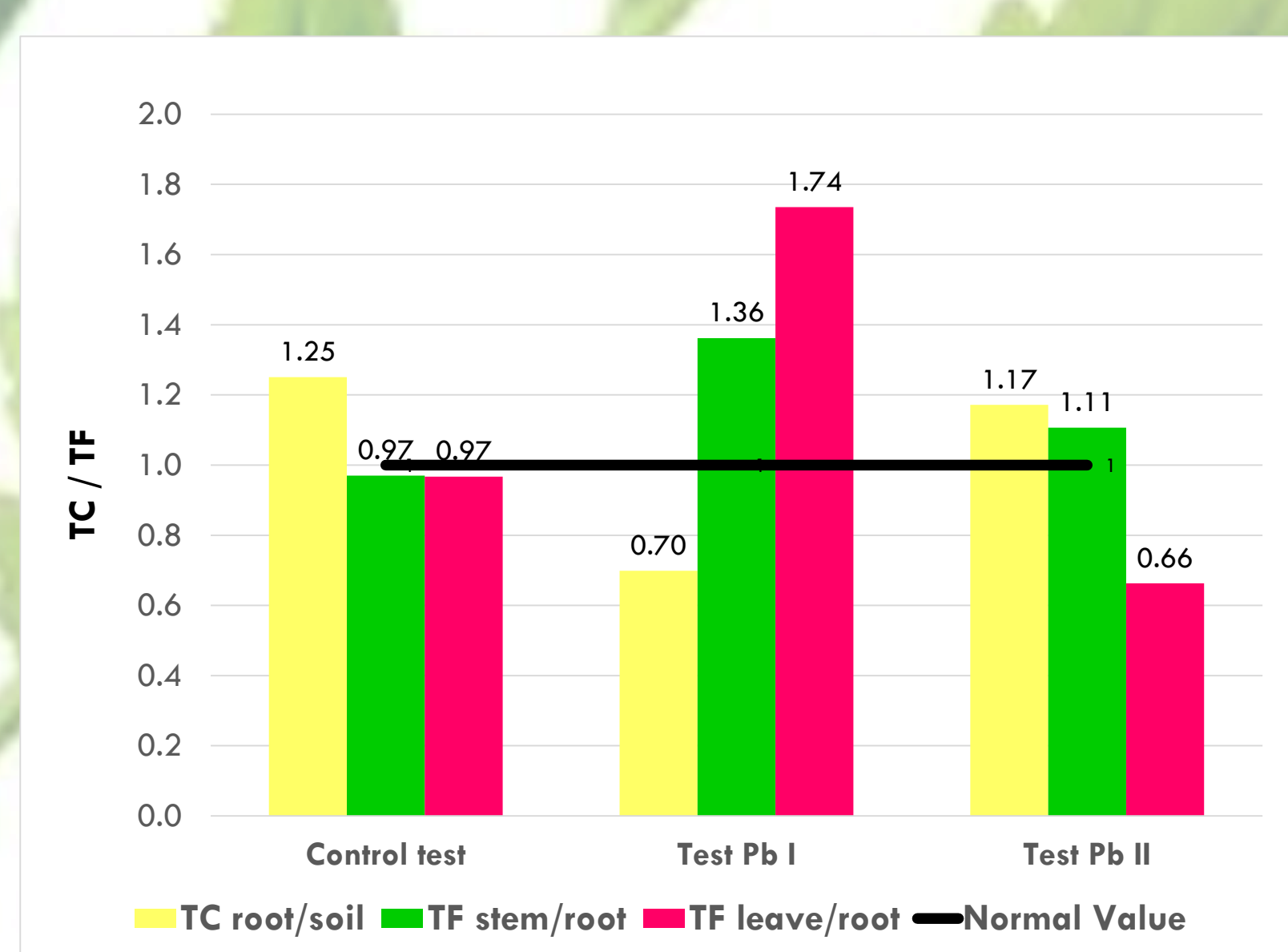


Figure 6. TC/TF for Zn

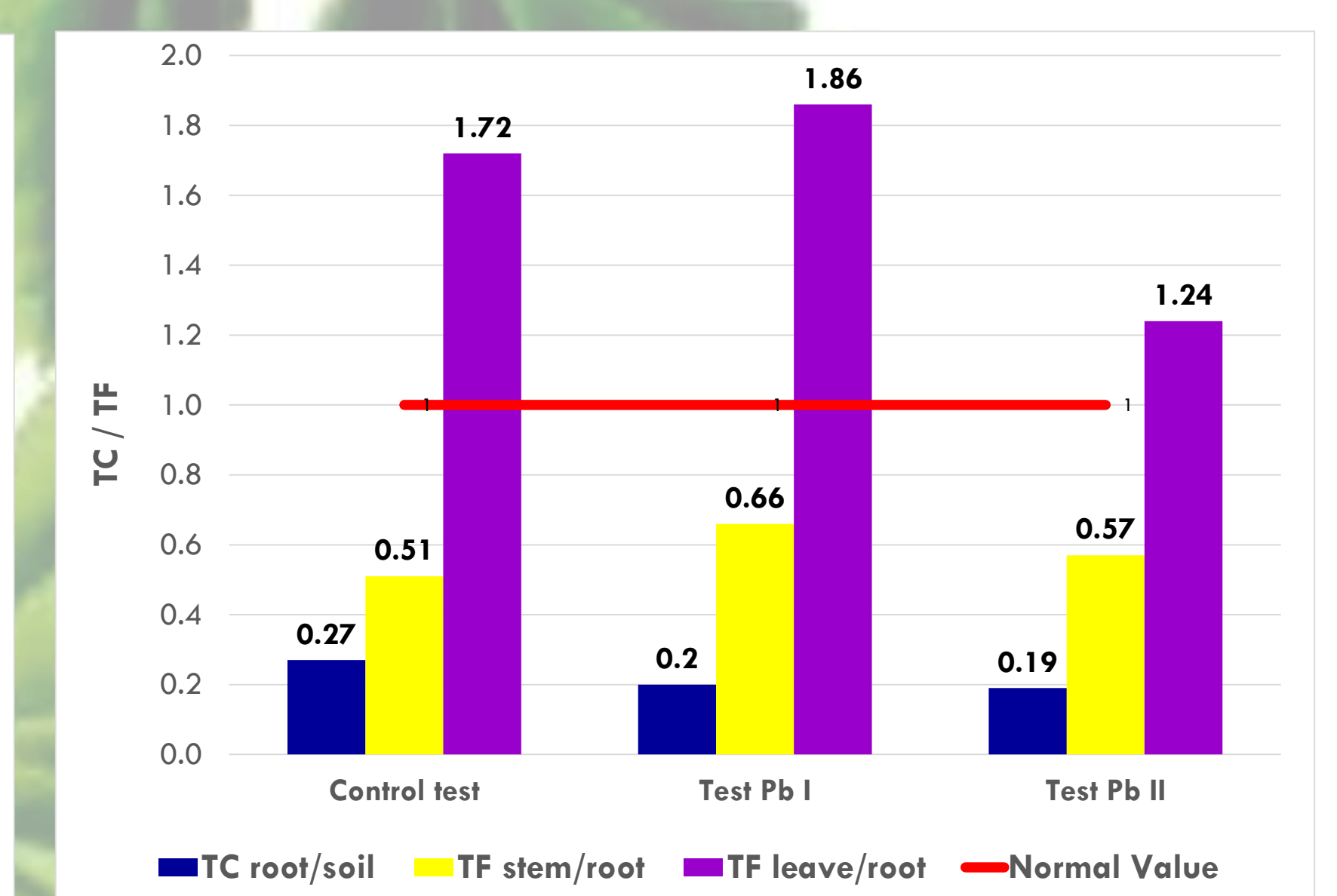


Figure 7. TC/TF for Cu

## CONCLUSION

The experiment tests confirms that the added Pb content remains in proportion of 96% in soil. Excessive concentrations of lead in the soil led to decreased germination process [3], a fact confirmed also by the results of this study. The presence of essential metals at values within the normal range for soil increases the adaptation and tolerance of mustard plants to Pb toxicity, through competitive or antagonist processes. The study showed that certain metals (Zn, Ca, Mg, Mn) were found in higher concentrations in plants subjected to Pb pollution than in the control sample indicating antagonistic effects and Pb toxicity limiting. The greater the stress due to the toxicity, the greater the amount of extracted metal to compensate for the toxic effects

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