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THE INFLUENCE OF CERTAIN HEAVY METALS ON SEEDS GERMINATION AT *LENS CULINARIS* MEDIK AND *PISUM SATIVUM* L.

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Abstract. The paper presents the results of a study regarding the influence of Pb and Zn on the germination of seeds in two species with economic value of the Fabaceae family. We analyzed the following indicators: the percentage of germinated seeds in different intervals according to the species, the water and dry substance content, the contents of total mineral elements and the lengh of radicle at germinated seeds. The results obtained emphasize specific values of the analyzed indicators, according to the species and the experimental conditions.
Key words: lead, zinc, seeds germination, *Lens culinaris, Pisum sativum*

Introduction

This paper continues our research concerning the effect of the heavy metals treatment, performed in the previous years [10, 12], on species with an economic value, some of them *(Medicago sativa, Cannabis sativa)* with a phytoremediation potential. Of the heavy metals, we have chosen for our study lead and zinc.

According to Dou (1988) quoted by Jiang and collab. (2000), Pb does not play any physiological part for the plants, however, in small quantities it can stimulate growth in some plants. Several authors quoted by Jonak şi colab.(2004) have shown that Pb causes cellular disorders. According to other authors [3, 6, 9,11, 8] the toxic effects are associated with a delay in germination, disruption of mitosis, the inhibition of the enzymatic activity, the growth of the root in length, the induction of chlorosis, the reduction of the intensity of photosynthesis and respiration. Pb inhibits the synthesis of chlorophyll pigments and the activity of the enzymes in Calvin's cycle [5].

Zn is a component of enzymes: carboanhydrase, alcohol dehydrogenase, alkaline phosphatase, hexokinase; it stimulates the activity of certain enzymes (peroxidase, catalase, enolase, etc.), the synthesis of tryptophan - a precursor of auxin; it positively influences the process of photosynthesis, it regulates the metabolism of carbohydrates and proteins [2, 4, 3]; it plays a role in the stability of tertiary and quaternary structures, of the cytoplasm of ribosomes; it is involved in reducing nitrates [4]. Although Zn is a microelement with important functions in the life of plants, it can be toxic in high concentrations.

The paper presents the results of a study concerning the influence of the different concentrations of Pb and Zn on some physiological and morphological indicators at *Lens culinaris* Medik and *Pisum sativum* L.

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Material and methods

As a biological material, we used: seeds of *Lens culinaris* and *Pisum sativum* (Ialomița 1 variety).

For each species, five experimental variants have been created: a control variant (with distilled water) and four variants of heavy metal treatments. The heavy metals used were: Zn - as sulfate ($Zn\ SO_4$) in a concentration of 0,0003 % (the variant marked Zn1); 0,03 % (the variant marked Zn2); Pb - as nitrate ($Pb\ (NO_3)_2$) in a concentration of 0,0005 % (the variant marked Pb1) and 0,05 % (the variant marked Pb2). The duration of the treatment was 24 hours. After the application of the treatment, the seeds were placed to germinate in Petri dishes, on a filter paper humidified with distilled water, in laboratory conditions. For each variant, two replicas were used, each with 50 seeds.

The following indicators have been analyzed: the percentage of germinated seeds; the contents of water and of dry substance (gravimetrical method) [1], the contents of total mineral elements (dry calcination at 4500 C method) [1] after 24 hours of immersion into the solution of heavy metals/distilled water and 72 hours / 96 hours after the beginning of the experiment; the length of the root of the germinated seeds 72 hours / 96 hours after the beginning of the experiment.

Results and discussions

Lens culinaris germinate much easier in comparison with *Pisum sativum* seeds. In both analyzed species, germination is hypogeous.

After 24 ⁄ 48 hours the beginning of the experiment, higher value differences can be seen between the control variant and the treatment variants (figure 1; 2) which suggests a possible influence of the heavy metals on the absorption of water and on the processes specific to the first germination stage.

During the analyzed period, the percentage of germinated seeds progressively increases in both analyzed species; at the end of the experiment, its values are between 96 % and 100% in *Lens culinaris* (figure 1) and between 80% and 90 % in *Pisum sativum* (figure 2) . In the control variants, the percentage of germinated seeds has intermediate values to those recorded in the treatment variants. In comparison with *Lens culinaris, Pisum sativum* has a lower germination ratio. The germination differences noticed between the 2 species could be caused by the heavy metals treatment, by the species specificities, as well as by the characteristics of the biological material used.

The value of the water contents increases progressively during the analyzed period.

After 24 hours of immersion in a heavy metal solution, and respectively in distilled water, the values of the water contents are between 55.07 g % - 55.92 g % *in Lens culinaris* (figure 3) and 64.73 g% - 66.37 g % in *Pisum sativum* (figure 4). In comparison with the control variant, in the treatment variants the water content has smaller values in both analyzed species.

In *Lens culinaris,* 72 hours after the beginning of the experiment, the values of the water contents are between 58.95 %- 59.96 g %.

In *Pisum sativum,* 96 hours after the beginning of the experiment, the values of the water contents are between 71.88 g %- 72.67 g %. In comparison with the control variant, in the treatment variants the water content has higher values.

For the second studied interval, small value differences are recorded between M and the treatment variants in both test species.

For all the experimental variants, the values of the dry substance contents are lower in the second determination in comparison with the first determination (figure 3; 4). We consider that this could be caused by the fact that the spare substances in the endosperm and the cotyledons are hydrolyzed, mobilized and used as a respiratory sub-layer and for the synthesis of new substances necessary for the nutrition and growth of the embryo.

After 24 hours of immersion in heavy metal solution and respectively distilled water, the values of *the total mineral elements* are between 2.50 g % - 2.72 g % in *Lens culinaris* (figure 5) and 3.21 g% - 3.59 g% in *Pisum sativum* (figure 6).

In *Lens culinaris,* 72 hours after the beginning of the experiment, the values of the total mineral elements content are between 2.63 g% - 3.17 g%.

In *Pisum sativum,* 96 hours after the beginning of the experiment, the values of the total mineral elements content are between 3.56 g % - 3.81 g%.

In both test species, for the analyzed period, small value differences are recorded between the control variant and the treatment variants; the values of the total mineral elements content are higher for the second interval under study.

In the control variant, the values of *the medium radicle length* are higher than those in the treatment variants, a valid situation for both analyzed species (figure 7; 8).

We can notice that the root growth process is more sensitive than seed germination to the heavy metal treatment. The delay effect on the radicle length growth is more pronounced in the case of variant Pb2 ($Pb(NO_3)_2$ in a concentration of 0,05 %) for both species.

The studies performed by Dou (1998), Jiang şi Liu, (1999) (authors quoted by Kiran and Şahin (2005), show that low Pb concentrations (10^{-4} M and 10^{-5} M) inhibit the growth of the root in *Zea mays* and *Allium cepa.* According to Jiang and collab. (2000), the concentration of 10^{-3}M $Pb(NO_3)_2$ mildly inhibits the root growth in seedlings of *Brassica juncea;* this plant has the important ability to take Pb from the solution and to accumulate it in its root.

Conclusions

The results obtained emphasize specific values of the analyzed indicators, according to the species and the experimental conditions.

The treatment with lead and zinc delay the growth of the radicle in both test species.

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Explanation of figures

Plate I:

Figure 1. The percentaje of germinated seeds at content at *Lens culinaris*
Figure 2. The percentaje of germinated seeds at content at *Pisum sativum*
Figure 3. The content of water and dry matter at *Lens culinaris*
Figure 4. The content of water and dry matter at *Pisum sativum*

Plate II:

Figure 5. The content of total mineral elements at *Lens culinaris*
Figure 6. The content of total mineral elements at *Pisum sativum*
Figure 7. The length of radicle at *Lens culinaris*
Figure 8. The length of radicle at *Pisum sativum*

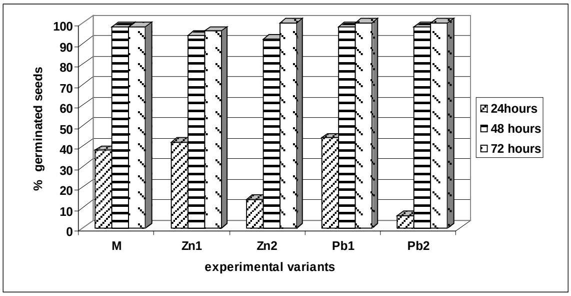

Figure 1

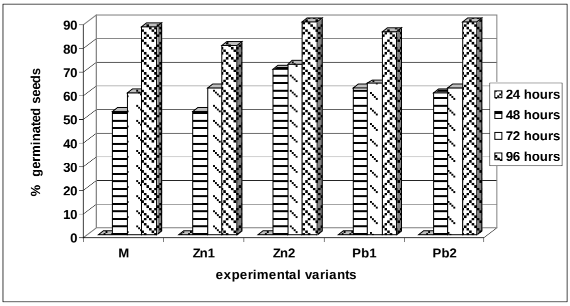

Figure 2

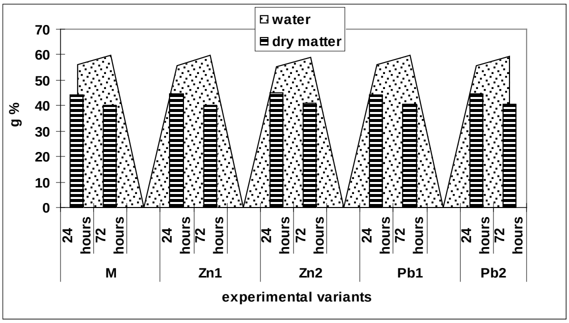

Figure 3

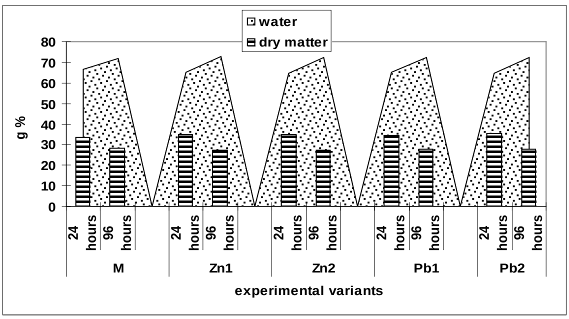

Figure 4

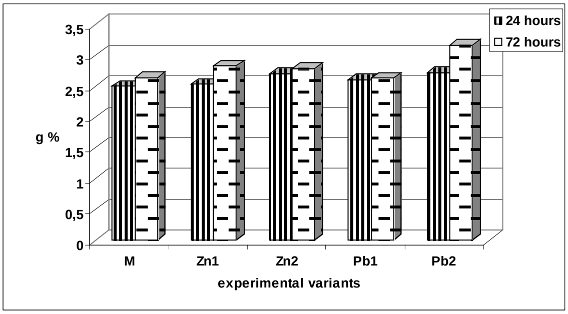

Figure 5

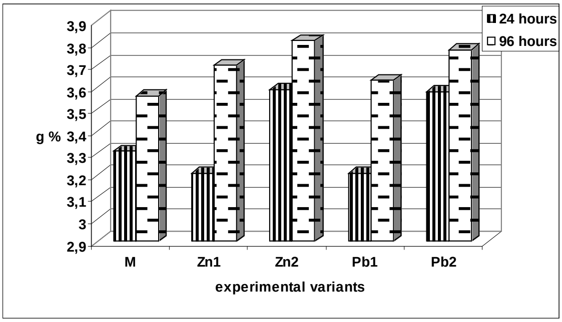

Figure 6

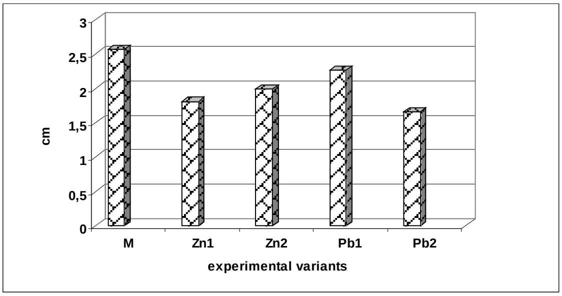

Figure 7

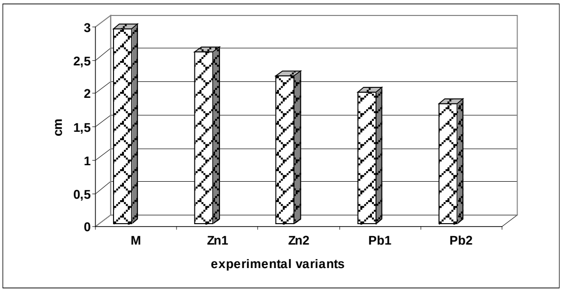

Figure 8