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THE HEAVY METALS INFLUENCE ON GERMINATION AND GROWTH PROCESSES AT *PISUM SATIVUM* L.

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Abstract
The aim of this paper is the study of microelements influence: Pb, Co, Cd, Hg, Zn on peas seeds. These seeds were germinated in different concentration of heavy metals solutions: $PbCl_2$, $CoCl_2$, $HgCl_2$, $CdCl_2$, $ZnSO_4$. The experiment was repeated for three times. The germination faculty, the roots length, the amount of water and dry matter in roots were determined. All the used heavy metals have a negative influence on the plants.
Keywords: heavy metals, germination, peas

1. Introduction

The accumulation of heavy metals like: Pb, Co, Cd, Hg, Zn in plants could lend to deficiencies in metabolically processes. The accumulation is selective and depends of species and the pH - solution (more intense for pH acid). The modification of the membrane permeability by the heavy metals is possibly due to the inhibited of ATP – azei activity.

For plants, the tolerance for high concentrations of heavy metals is achieving by the exclusion of heavy metals from symplast [1] or by their accumulation in the root and the transport inhibition in air organs [2].The tolerant plants ousts by the roots the organically substances (organically acids, glucide, amino acids, phenols, etc), witch determined the heavy metals precipitation from soil, like chelates.

The aim of this paper is the study of microelements influence: Pb, Co, Cd, Hg, Zn on the germination faculty, the roots length, the amount of water and dry matter in roots for peas.

2. Method and samples

The role of the microelements Pb, Co, Cd, Hg, Zn on the main physiological processes on peas was established by using the following experimental variants:

Table1. The variants with different concentrations of lead chloride ($PbCl_2$)

Variant	The nutritive solution
V_1	Sol. Knop: 0,25g/l KH_2PO_4; 0,125g/lKCl; 0,25g/l $MgSO_4$ x H_2O;1g/l Ca $(HNO_3)_2$; 0,0125g/l $FeCl_2$.
V_2	Sol Knop + 10,71mg/l $PbCl_2$ x H_2O
V_3	Sol Knop + 21,43mg/l $PbCl_2$ x H_2O
V_4	Sol Knop + 42,87mg/l $PbCl_2$ x H_2O

Table 2. The variants with different concentrations of cobalt chloride ($CoCl_2$)

Variants	The nutritive solution
V_1	Sol. Knop
V_2	Sol Knop + 33,57mg/l $CoCl_2$ x H_2O
V_3	Sol Knop + 67,14mg/l $CoCl_2$ x H_2O
V_4	Sol Knop + 134,28mg/l $CoCl_2$ x H_2O

Table 3. The variants with different concentrations of $CdCl_2$

Variants	The nutritive solution
V_1	Sol. Knop
V_2	Sol Knop + 16,28mg/l $CdCl_2$ x H_2O
V_3	Sol Knop + 32,57mg/l $CdCl_2$ x H_2O
V_4	Sol Knop + 65,14mg/l $CdCl_2$ x H_2O

Table 4. The variants with different concentrations of mercury chloride ($HgCl_2$)

Variants	The nutritive solution
V_1	Sol. Knop
V_2	Sol Knop + 10,82mg/l $HgCl_2$ x H_2O
V_3	Sol Knop + 21,65mg/l $HgCl_2$ x H_2O
V_4	Sol Knop + 43,30mg/l $HgCl_2$ x H_2O

Table 5. The variants with different concentrations of $ZnSO_4$

Variants	The nutritive solution
V_1	Sol. Knop
V_2	Sol Knop + 22,03mg/l $ZnSO_4$ x H_2O
V_3	Sol Knop + 44,06mg/l $ZnSO_4$ x H_2O
V_4	Sol Knop + 88,12mg/l $ZnSO_4$ x H_2O

The results have been statistically interpreted by using the SPSS 10, 0 programmes for Windows. The length of roots was established by linear measurements. The results have been illustrated using the Microsoft Excel.

3. Results and Discussions

The influence of heavy metals on the germination faculty was observed by the submerging the peas seeds in nutritive solution with different concentrations of heavy metals. One can see (fig.1) that all the peas seeds from the experimental variants (V_2-V_4) – with heavy metals - have a low germination faculty compared with the standard (V_1). The significant

differences appear for $p < 0.05$, for all cases. Figure 2 graphically presents the results obtained for the roots length, with different concentrations of heavy metals (variants V_2, V_3, V_4 and V_5) compared with standard Knop solution, V1.

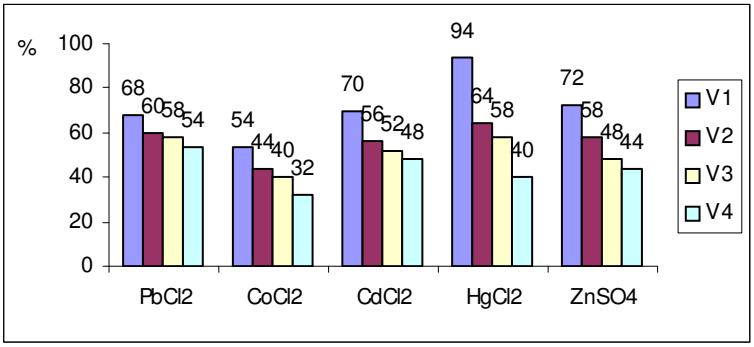

Figure 1: The influence of heavy metals on the germination faculty

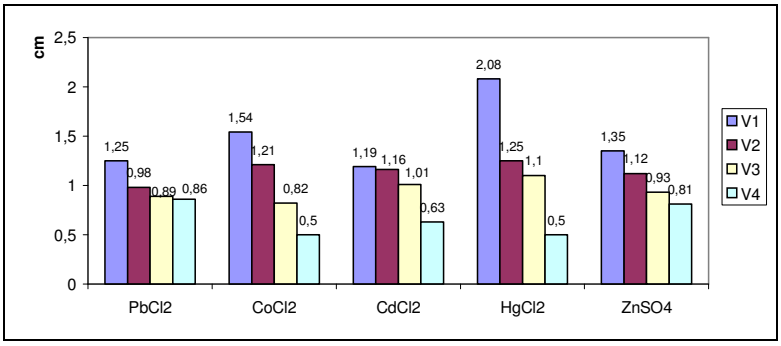

Figure2. The influence of heavy metals on the roots length

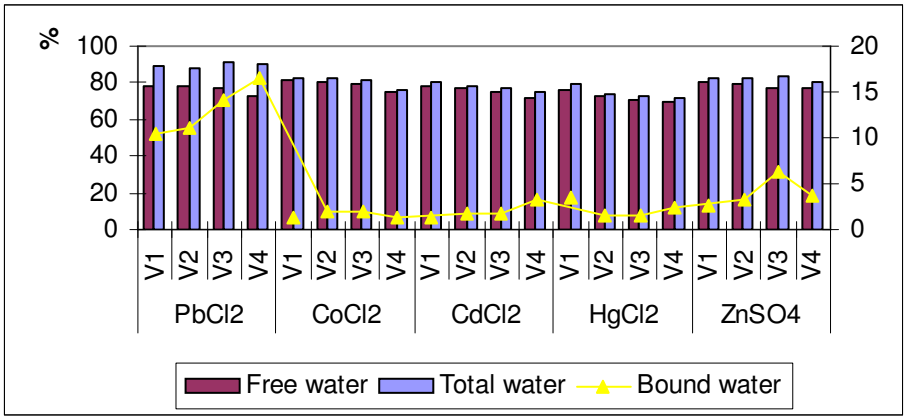

Fig. 3. The heavy metals influence on free water, bound water and total water on peas

We can see that the roots length decreases for the experimental variants with heavy metals, compared with the standard (V1 – Knop solution). The amount of tested lead has not a

significant influence on the roots dimension on peas. For the other cases, the significant differences appear for $p < 0.05$. From fig.3 one can see that the free water amount decrease for the peas plantlets from the experimental variants with heavy metals, compared to the V1-standard. Figure 4 graphically presents the results obtained for the dry substance from peas plantlets maintained in different concentration of heavy metals.

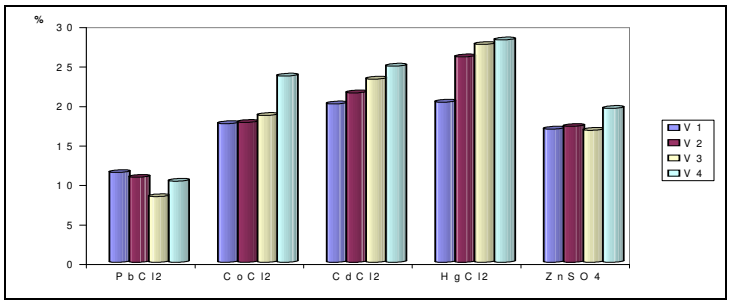

Figure 4. The heavy metals influence on the dry substance on peas

The experimental variants (V_2-V_4) with lead chloride had low values compared to the standard, with significant differences for $p< 0.05$. For the Co Cl_2, $CdCl_2$, $HgCl_2$, shows that the presence of heavy metals determined a crease for the dry substance amount in peas, compared with the standard lot V1. For the $ZnSO_4$, the V4 variant presents a higher value, compared to control, with significant differences for $p< 0.05$.

4. Conclusions

- All the substances tested manifested inhibitory effects on the germination faculty and on the roots length. The most pregnant inhibition of these processes took place in the case of peas seeds in the presence of $HgCl_2$;
- The heavy metals determined the decrease of the free water and total water from peas plantlets;
- The dry matter amount is higher in the peas plantlets maintained in heavy metals (unless the PbCl2), compared to standard.

References

[1] Taylor G. J. *Exclusion of metals from the symplasm: a possible mechanism of metal tolerance in higher plants.* J. Plant Nutr. 10, (1987), 1213–1222.

[2] Urquhart, C., *Genetics of lead tolerance in Festuca ovina*. Heredity 26, 19–33 (1971).