Study of Chlorophyll Pigments in Beans (*Phaseolus vulgaris*) in terms Of Heavy Metal Complexation with Various Forms of Sulfur, in Order to Reduce Their Toxicity

Lucia MIHALESCU^{1*}, Zorica VOȘGAN¹, Oana MARE ROȘCA¹, Monica MARIAN¹, Anca DUMUTA¹, Aurel MAXIM², Mirela CORDEA²

¹Department of Biology, Technical University of Cluj Napoca, North University Center of Baia Mare, no.76, Victoriei Street, Romania

²University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania

*Corresponding author: luciamihalescu@yahoo.com

Bulletin USAMV series Agriculture 72(2)/2015
Print ISSN 1843-5246; Electronic ISSN 1843-5386
DOI 10.15835/buasvmcn-agr: 11388

ABSTRACT

In this paper we intended to find the effect of the complexation of heavy metals with various forms of sulfur on the content of chlorophyll pigments in dwarf beans (*Phaseolus vulgaris* var. *Compressius ellipticus*). The effect of two heavy metals, cadmium and respectively lead, in different concentrations, on the content of chlorophyll pigments in the leaves of beans plantlets, by extracting the pigments by the hot process. These were the variants: V₁ Cd 1mg/l, V₂ Cd 1mg/l + 100mg Cys, V₃ Cd 1mg/l + 100mgK₂SO₄, V₄ Cd 50mg/l, V₅ Cd 50mg/l+100mg Cys, V₆ Cd 50mg/l+100mgK₂SO₄, V₇ Pb 1mg/l, V₈ Pb 1mg/l+100mg Cys, V₉ Pb 1mg/l+100mg K₂SO₄, V₁₀ Pb 50mg/l, V₁₁ Pb 50mg/l+100mg Cys, V₁₂ Pb 50mg/l+100mg K₂SO₄, V₁₃ – control sample. Following the experimental research, we can state that the contents of chlorophyll pigments in leaves is negatively influenced by organic sulfur (cysteine) and positively influenced by inorganic sulfur (K₂SO₄), towards inhibition and, respectively, stimulation. Cysteine inhibits with 7% at high concentration of Cd (50mg/l), and K₂SO₄ stimulates with 1.2% at the same concentration of Cd. In case of Pb (1 mg/l), cysteine inhibits it with 5%, and inorganic sulfur with 1% less as the control. Inorganic sulfur in combination with high concentration of Pb stimulates the pigments production in leaves with 3% more than the control, and concentrated Cd inhibits it with 15%.

Keywords: beans, chlorophyll, inhibit, stimulate, sulf.

INTRODUCTION

The eco-physiologists were always interested in knowing the characteristics of plants that inhabit soils with high concentrations of heavy metals (Dobrota *et al.*, 1999). The object of intense research is the transfer of metals inside the trophic chains of plants - animals – humans (Onac, 2000). Heavy metals represent major targets of phytoremediation, a new branch of the vegetal physiology (Chanez *et al.*, 1997).

AIMS AND OBJECTIVES

The aim of this paper was to trace the effect of the complexation of heavy metals with various forms of sulfur on the content of chlorophyll pigments in dwarf beans with elliptical forms. The objectives were based on the monitoring of two heavy metals, cadmium and respectively lead, in different concentrations, on the content of chlorophyll pigments in the leaves of beans plantlets.

Tab.1. The content of chlorophyll pigments in the experimental variants

Variant	Fresh mass	Extinction	Fresh substance (mg/g)
V1 Cd (1 mg/l)	2.914	0.7219	11.26
V2 Cd (1 mg/l)+Cys	3.077	0.6721	10.49
V3 Cd (1 mg/l)+K ₂ SO ₄	2.907	0.7610	11.87
V4 Cd (50 mg/l)	2.757	0.6423	10.02
V5 Cd (50 mg/l)+Cys	3.659	0.7020	10.95
V6 Cd (50 mg/l)+K ₂ SO ₄	2.573	0.7617	11.89
V7 Pb (1 mg/l)	2.506	0.7518	11.73
V8 Pb (1 mg/l)+Cys	2.454	0.7121	11.12
V9 Pb (1 mg/l)+K ₂ SO ₄	3.869	0.7422	11.58
V10 Pb (50 mg/l)	2.387	0.7415	11.57
V11 Pb (50 mg/l)+Cys	3.412	0.7117	11.11
V12 Pb (50 mg/l)+K ₂ SO ₄	2.230	0.7717	12.04
V 13 – Control sample	3.871	0.7521	11.74
Standard		0.5445	8.50

MATERIALS AND METHODS

A dwarf variety with elliptical beans (*Phaseolus vulgaris* var. *Compressus ellipticus*) was used. These were the variants: V₁ Cd 1mg/l, V₂ Cd 1mg/l + 100mg Cys, V₃ Cd 1mg/l + 100mgK₂SO₄, V₄ Cd 50mg/l, V₅ Cd 50mg/l+100mg Cys, V₆ Cd 50mg/l+100mgK₂SO₄, V₇ Pb 1mg/l, V₈ Pb 1mg/l+100mg Cys, V₉ Pb 1mg/l+100mg K₂SO₄, V₁₀ Pb 50mg/l, V₁₁ Pb 50mg/l+100mg Cys, V₁₂ Pb 50mg/l+100mg K₂SO₄, V₁₃ – control sample. We used the hot process of extracting the pigments from the leaves of each variant. The extinction was measured by a spectrophotometer.

RESULTS AND DISCUSSION

In Tab.1 is shown the content of chlorophyll pigments in the 13 studied experimental variants.

From the obtained results we found that at low concentrations of Cd (1mg/l), cysteine inhibits the contents of chlorophyll with 11% less than in the control, and inorganic sulfur stimulates with 1.1% more than in the control. Cysteine inhibits with 7% at high concentration of Cd (50mg/l), and K₂SO₄ stimulates with 1.2% at the same concentration of Cd. Concentrations of Cd(50mg/l) + inorganic sulfur mostly stimulate the generation of chlorophyll pigments with 1.2%, and Cd(50mg/l) mostly inhibits with 15%. In case of Pb (1 mg/l),

cysteine inhibits it with 5%, and inorganic sulfur with 1% less as the control. Inorganic sulfur in combination with high concentration of Pb stimulates the pigments production in leaves with 3% more than the control, and concentrated Cd inhibits it with 15%.

CONCLUSION

The contents of chlorophyll pigments in leaves is negatively influenced by organic sulfur (cysteine) and positively influenced by inorganic sulfur (K₂SO₄), towards inhibition and, respectively, stimulation. The variant Pb (50mg/l) + organic sulfur presented maximum amount of chlorophyll in leaves, and the variant Cd (1mg/l) + inorganic sulfur presented a minimum amount of chlorophyll in leaves with 11% less than the control.

REFERENCES

1. Chanez RL, Malik M, Li YM, Brown SL, Brewer EP, Angle JS, Baker AJ (1997). Phytoremediation of soil metals. *Curr. Opin. Biotech.* 8: 279-284.
2. Dobrota C, Yamashita M (1999). *Cresterea si dezvoltarea plantelor*. Ed. Gloria Cluj Napoca.
3. Onac S (2000). Consideratii generale privind influenta unor metale grele (Cd, Zn, Pb, Cu), asupra unor procese fiziologice la plante. Referat. Univ. Babes Bolyai, Cluj Napoca: 58-63.