THE EFFECT OF THE TREATMENT WITH DIFFERENT WAVELENGHTS ON THE RELATIVE CHLOROPHYLL CONTENT DURING THE DEVELOPMENT OF THE *Zea Mays L.* PLANTS

Maria Orodan[1], Violeta Turcuş[1], Osser Gyongyi[2*], Anamaria Pallag[3] Aurel Ardelean[1]
[1]College of Natural Sciences, Engineering and Computer Sciences, "Vasile Goldis" Western University of Arad, Liviu Rebreanu Street, no. 91-93, Arad, Romania
[2]College of Medicine, Dentistry and Pharmacy, "Vasile Goldis" Western University of Arad, Henri Coanda Street, no. 31, Arad, Romania
[3]College of Medicine, Dentistry and Pharmacy, Western University of Oradea, Romania
*E-mail: gyongyiosser@ymail.com

Abstract
The UV-B radiation causes a net inhibition of the photosynthesis (Telvini 1993), physiological effects including the reduction of carbon assimilation during photosynthesis, the alteration of the stomatal function, but also of the phytohormones' and foliar chemistry's activity. (Teramura 1991) Numerous lab studies have shown that this inhibition seems to result from a malfunction in the photosynthetic cycle, it being affected by the gas exchange at the leaf level. (Teramura 1990; Tevini and Teramura 1989). In our experiments we sought to answer the question whether the treatment with UV-B radiations, of different wavelengths, between 280 – 310 nm, has a stressful effect on plants, resulting in changes in the photosynthetic activity and chlorophyll content, and if there are any differences between the control plants and the treated ones. All measurements were performed on days 1, 3 and 4 of the treatment, on young plants, the samples consisting of leaves collected from the plants which had the third leaf fully developed. Light-dependent stage (light reaction), chlorophyll absorbs light energy, which stimulates some electrons in pigment molecules, transferring them in layers with higher levels of energy. They leave the chlorophyll and passed through a series of molecules to form NADPH (enzyme) and the ATP molecule that stores energy. The oxygen resulting from the chemical reaction is released into the atmosphere through the pores of the leaves.

Keywords: photosynthetic activity, UV-B radiations, photosynthetic system, chlorophyll, light reaction, ATP molecule, chemical reaction, energy

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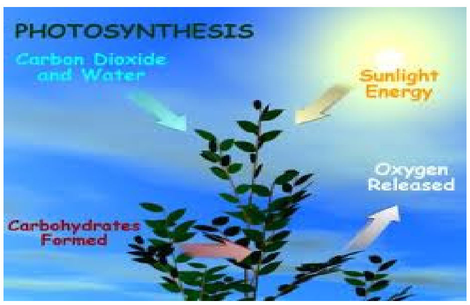
1. INTRODUCTION

In the wild, plants are subjected to certain stress factors, out of which the UV-B radiations (230-320 nm) play an important role, because more and more UV-B reach the Earth's surface due to the depletion of the stratospheric ozone layer. (Deckmyn et al., 1994, Caldwell et al., 1998). Changes in the photosynthesis process were highlighted. (Bornman, 1989, Tevini, Teramura, 1989, Teramura, Sullivan, 1994, quoted by Visseret, 1997).
The harmful effects on plants caused by the abiotic stress factors in conjunction with the UV stress, is reflected in alterations of the pant's physiology, causing a reduction in their growth and a decrease in their bioproductivity (Khan, 2003). Chloroplast damage by overexposure to UV-B radiation can lead to the decrease in the chlorophyll content; this involves ultrastructural changes, a decrease of the photosynthetic protection pigments, thus affecting the photosynthesis process (Sullivan and Rozema, 1999). Different culture species have the capacity of tolerating UV-B radiation and retaining chlorophyll in leaves, the results varying for monocotyledonous, in comparison to dicotyledonous ones (0-33% in monocotyledonous species, compared to 10-78% in dicotyledonous species). (Tevini et al., 1981) The variation in the amount of chlorophyll can be attributed to the dosage ratio of UV-B radiation and to the light spectrum (photosynthetic active radiation – PAR), this explaining the degree of damage caused by the

UV-B radiation. (Cassi-Lit et al., 1997, Heo et al., 1994, Tevini et al., 1991).

2. MATERIAL AND METHODS

We have analyzed the effect on photosynthesis through the fluorescent induction, the intracellular carbon dioxide concentration and the relative chlorophyll content measurements. All analyses were performed on days 1, 3 and 4 of the treatment, on young plants, on their third developed leaf. According to results, it can be stated that, for most low wavelength values, the lowest values of chlorophyll variation and of the CO2 concentration, of the batch of control plants, have been measured.



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3. RESULTS AND DISCUSSION

Data from our experiments, showing significant growth, both for the photosynthetic capacity as well as for the intracellular carbon concentration (Fig. 1, Table 1, 2) assimilated at wavelengths of 287-290 nm confirm the observations from literature, but point out the importance of these readings in selecting tolerant corn genotypes tolerant to UVB, which can be productive in such conditions. Based on the values in the table we can state that the intracellular CO2 concentration correlates with the photosynthetic activity for days 3 and 4 of treatment (Table 1, 2), compared with the control batch, and for days 1 and 3 for the plants treated with the wavelength 287 nm, values were also correlated for both corn hybrids. (Table 1, 2) Increased UVB radiation may lead to irreversible effects in the DNA structure, alterations of the photosynthetic apparatus and of other targeted molecules in the cell. Some of the effects on the photosynthesis are given by the changing of the chlorophyll and stomatal density and the reduction of the foliage surface of the plants. The main protection mechanism against UVB includes the accumulation of compounds that can absorb this radiation. In the case of two wavelengths (285 nm and 287 nm) we have noticed a significant increase of the chlorophyll content in treated plants, in comparison to the treated batch, throughout the 3 days of measurements, after a period of 1 day of wavelengths exposure.

Table 1. The intracellular concentration shift of CO_2 in the Helga hybrid

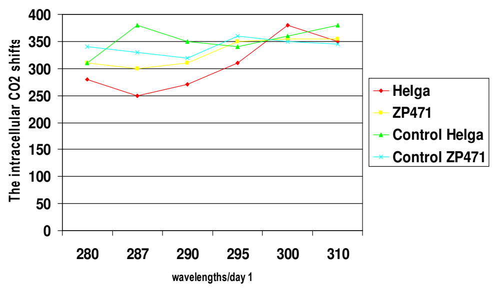
Corn plants	The UV-B wavelength	The intracellular $C0_2$ concentration Cj(μmol CO_2 air mol)			**Period Day**		
		Day 1	Day 3	Day 4	1	3	4
Control	280nm	310	350	450			
Helga	280nm	280	330	430			
Control	287nm	380	360	460			
Helga	287nm	250	270	240	****	***	****
Control	290nm	350	340	370			
Helga	290nm	270	290	280	**	**	***
Control	295nm	340	340	340			
Helga	295nm	310	310	300	*	*	**
Control	300nm	360	350	380			
Helga	300nm	380	310	360			
Control	310nm	380	340	370			
Helga	310nm	350	340	340			

Table 2. The intracellular concentration shift of $C0_2$ in the ZP471 hybrid

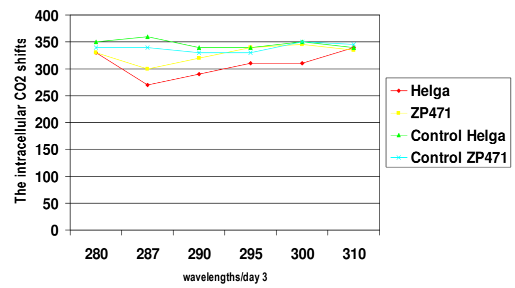
Corn plants	The UV-B wavelength	The intracellular $C0_2$ concentration Cj(µmol CO_2 air mol)			Period Day 1		
		Day 1	Day 3	Day 4	1	3	4
Control	280nm	340	340	440			
ZP471	280nm	310	330	430			
Control	287nm	330	330	310			
ZP471	287nm	300	300	240	**	**	***
Control	290nm	320	330	320			
ZP471	290nm	310	320	280	*	*	**
Control	295nm	360	350	320			
ZP471	295nm	350	340	310			
Control	300nm	350	355	315			
ZP471	300nm	355	345	315			
Control	310nm	345	345	300			
ZP471	310nm	355	335	305			

** significant readings in comparisson to the control batch at P<0.05 and 0.001*

Day 1 (A)



Day 3(B)



Day 4(C)

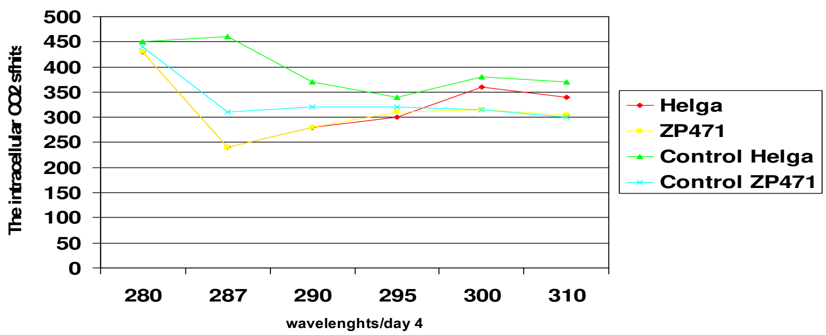


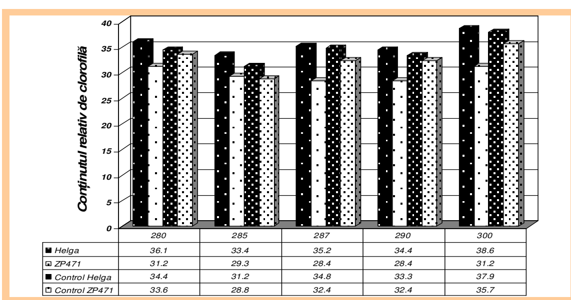
Figure 1. The intracellular CO_2 shifts (CJ) according to the wavelenghth changes in day 1 (A), 3(B), 4(C) in corn plants for the control and treated batches .*significant values in comparison to the control batch at P<0.05

Tabele 3. The realtive content of chlorophyll, for radiations between 280-300 nm

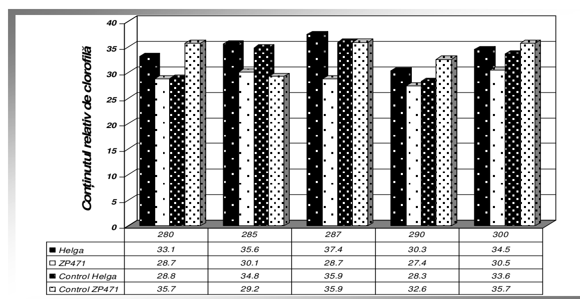
Corn plants	The UV-B wavelength	**The relative chlorophyll content**			**Period**		
		Day 1	Day 3	Day 4	1	3	4
Control	280nm	34,4	28,8	33,8			
Helga	280nm	36,1	33,1	34,6	**	***	
Control	287nm	31,2	34,8	28,3			
Helga	287nm	33,4	35,6	29,7	***	**	**
Control	290nm	34,8	35,9	33,9			
Helga	290nm	35,2	37,4	34,8	***	*	***
Control	295nm	33,3	28,3	30,1			
Helga	295nm	34,4	30,3	31,2			*
Control	300nm	37,9	33,6	32,6			
Helga	300nm	38,6	34,5	33,8	*		
Control	310nm	34,4	28,8	33,8			
Helga	310nm	36,1	33,1	34,6	**	***	

** significant readings in comparisson to the control batch P<0.05 şi 0.001.*

Day 1



Day 3



Day 4

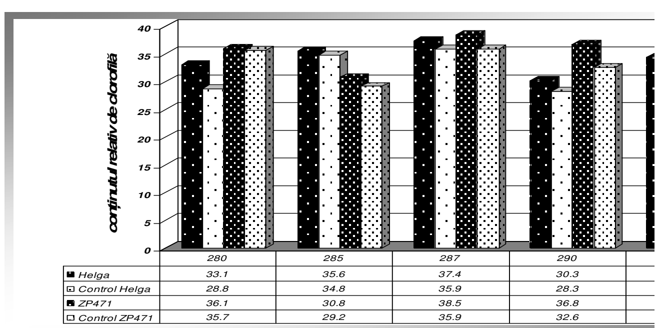


Fig. 2 The relative content of chlorophyll after 4 days of treatment to corn plants, treated with different wavelengths. Significant readings in comparison with the control batch for P<0.05, 0.01 and 0.001

4. CONCLUSIONS

We can conclude that the decrease in the content of chlorophyll ceases after 4 days of irradiation, this being due to the activity of certain antioxidant enzymes, especially the APX enzyme, whose activity increases, thus eliminating the oxidative stress due to wavelengths (Table 3, 4).

The CO_2 accumulation is linked to the increased photosynthetic capacity.

Tabele 4. Conținutul The realtive content of chlorophyll, for radiations between 280-300 nm

Corn plants	The UV-B wavelength	**The relative chlorophyll content**			**Period Day 1**		
		Day 1	Day 3	Day 4	1	3	4
Control	280nm	33,6	35,7	35,7			
ZP471	280nm	35,6	36,1	36,1	**	**	**
Control	287nm	28,8	29,2	28,2			
ZP471	287nm	31,3	30,8	30,8		***	
Control	290nm	32,4	35,9	35,9			***
ZP471	290nm	35,8	38,5	35,5	***	*	
Control	295nm	32,4	32,6	34,2			
ZP471	295nm	34,2	36,8	35,3	***		
Control	300nm	35,7	35,7	34,7			
ZP471	300nm	39,5	36,1	35,9			
Control	310nm	33,6	35,7	35,7			
ZP471	310nm	35,6	36,1	36,1	**	**	**

** significant readings in comparisson to the control batch $P<0.05$ şi 0.001.*

5. ACKNOWLEDGMENTS

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