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THE INFLUENCE OF UV-B RADIATION OF DIFFERENT WAVELENGHTS OF THE ZEA MAYS L. HYBRID PLANTS

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ABSTRACT. Many agricultural plants of subtropical origin (eg, corn, rice, tomatoes, peppers, squash, cucumbers etc.) are also grown in the temperate zone, but in less optimal conditions. In this case, the reproduction of these plants must also take into consideration selecting genotypes tolerant to the new conditions, and through them creating tolerant varieties. The activity increase of the antioxidant defense system, due to negative effects of environmental stressors, develops over a long period of time, a process called adaptation. The elevated levels of the reactive oxygen species (ROS), determine the significant increase of the antioxidant enzymes' activity, a process by which the plants are protected against the damaging effects of the oxidative stress.
KEYWORDS*: UVB radiations, oxidative stress, wavelengths, temperature, thermal stress*

INTRODUCTION

In recent years, considerable interest has been shown regarding the UV radiations in the aquatic systems from regions with low temperatures, where there can be noticed a significant increase in the UVB level (282-315 nm) resulting from the depletion of the protective ozone layer. (***Mandronich***, 1995). In literature, there are some data obtained from superior plants, according to which low temperatures determine a severe photoinhibition, under the influence of the available photosynthetic radiation (***Krause*** 1988, 1994). Based on the data available from the literature, we questioned whether the low temperatures and UVB influence induce changes dependent on the spectrum used on the antioxidant system on plants.

Through our experiments we sought to answer the question whether the treatment with UV-B type radiations, of different wavelengths of 282-315 nm, under low temperature conditions (7-8,5 ^{0}C), has a stressful effect on plants and induces the activation of the antioxidant enzymes, and if there are differences in this regard between the control and treated plants.

We should note that in the specialty literature there is no data regarding the complex characterization of the 285 nm UVB effect, and our data bring an important contribution to the characterization of the UVB spectrum from a biochemical point of view

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).

MATERIALS AND METHODS

The effect of the thermal stress but also the activity of the antioxidant system has been investigated for two hybrids *Zea Mays L.*, Helga and ZP471.

In order to extract and evaluate the activity of the enzymes, 0.5 g of plant material (leaves without the main nervure) was triturated with quartz sand, adding 2.5 ml of MgCl2 solution, with a concentration of 3 mM, cold, EDTA 1 mM, containing 0.5 mM of TRIS-HC1 (pH 7.4) buffer solution, in a chilled mortar. The homogenized mixture was centrifuged (4°C, 15 minutes, 1500 rpm), then the supernatant was divided into Eppendorf tubes. Until measurements were due, the samples were stored on ice, measurements being conducted at room temperature.

The enzyme activity is given by the change in absorbance, caused by 1 g of enzyme protein, throughout 1 minute (ΔA min $^{-1}$g $^{-1}$ protein).

In order to determine the enzyme activity, the absorbance changes were monitored at wavelengths

between 282-315 nm, with precise specifications at 285 nm.

The enzymatic activity was calculated using the formula: A[U/mg] = (dA/dt x V total x 1000) / ε x V enzimei; ε = extinction coefficient.

The enzymatic activity was measured on the 4th day, from the samples taken from the 3rd leaf, and analyzed comparatively for the two hybrids, under different UV-B type wavelengths, within a temperature interval of Δt (7-8,5^{0}C).

RESULTS

Under the effect of the UV-B treatment, the enzymatic activation had been noticed only for the 285 nm wavelength, slightly increasing and exceeding the control group values.

For the ZP471 hybrid, only the 285 nm wavelength induces the GST activity increase with significant differences, suggesting an increased tolerance of this hybrid which has also been noticed in other experimental circumstances.

The CAT activity following the exposure of both the control group as well as the treated group to UV-B had initially increased, with significant differences at 285 nm, but constantly remained at low values, without significant differences for other wavelengths and the same temperature gradient.

There is a significant increase in the case of the Helga hybrid, which leads to the conclusion that this hybrid is more resilient to the oxidative stress, after which it gradually returns to lower values, insignificantly different compared to the witness group.

The APX activity did not change significantly for the control plants, regardless of the low temperature variation imposed by the experimental conditions.

However, under the effect of the treatment for all wavelengths, the APX enzymatic activity registered higher and more significant values compared to the control group. The highest activity was registered for the 282-295 nm wavelengths.

The POD activity also showed no major changes for the different wavelengths imposed for the witness group.

However, under the effect of the treatment, at the 287 nm wavelength, it reached its maximum enzymatic activity, exceeding the values recorded in the control group.

When plants are subjected to a biotic or abiotic stress, the reactive oxygen species will accumulate excessively leading to the oxidative alteration of the cells.

In this respect, the antioxidants and the antioxidant enzymes function to interrupt the uncontrolled oxidation in each organ.

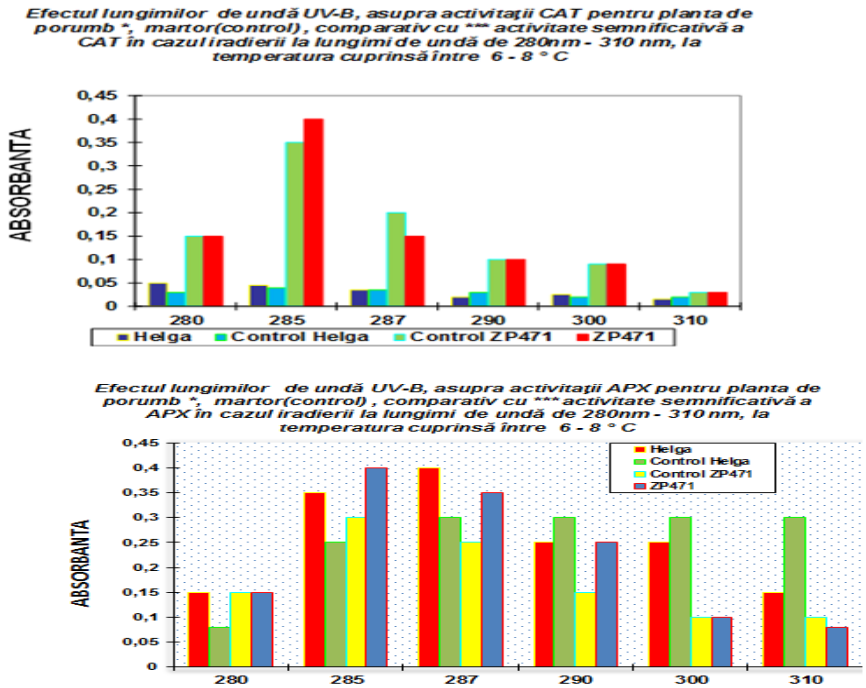

Figure 1. ***The degree of change of the antioxidant system enzymes' activity in the plant extract of Zea mays L., hybrids Helga and ZP471, under the influence of the UV-B type radiation and of low temperatures.***

CONCLUSIONS

The studied UVB spectrum determines the increase of the APX concentration from the plant extract at low temperatures, indicating the high level of peroxide at the cellular level, compared to the plants irradiated under normal temperature circumstances

The data obtained from the experiments suggest that at low temperatures, in the imposed experimental conditions, there is major stress manifested upon the plants.

In contrast, the exposure to different wavelengths determines the accumulation of peroxide

in the plant cells, which becomes toxic and leads to the activation of the antioxidant enzymes.

These effects are obvious for the 285 nm wavelength.

We should note that in the specialty literature there is no data regarding the complex characterization of the 285 nm UVB effect, and our data bring an important contribution to the characterization of the UVB spectrum from a biochemical point of view.

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