THE EFFECT OF THE 280-319 NM WAVELENGTH UV-B TREATMENT ON THE ANTIOXIDANT ENZYMES' ACTIVITY THROUGHOUT THE DEVELOPMENT OF THE PLANTS

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Abstract

The UV-B waves are not only a stress factor, but, as part of the Sun's electromagnetic wave emissions, have useful information about the waves' relations with the environmental factors (the ozone layer, the irradiation angle, topographic factors and leaf development).The most susceptible nucleotides to the action of the UV radiation are the ones containing pyrimidine bases (thymine and cytosine).The effect characteristic to UV irradiation is the forming of pyrimidine dimers, which distorts the shape of the DNA molecule, perturbing the replication.Following these changes, the effect may be lethal if the reparatory process is not carried out. To counteract the negative UV radiation effects, the organisms and plants have regenerative mechanisms (photoreactivation, excision repair, recombination replicative repair).

Keywords: UV radiation effects, enzyme activity, antioxidants, maize plants

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1.INTRODUCTION

The utilized radiation dose and the action time varies, depending on the tested species, but the simplicity of the required gear and the *in vitro* obtained effects make UV irradiation the main method of inducing mutations.

The UV radiation can cause chemical bonds to break and photochemical reactions. The effects of the UV radiation on plants (particularly UV-B ones) vary, depending on the species and on the variety of said species.

Although with the increase of the UV-B radiation intensity, the growth and development of superior plants is usually negatively affected, the magnitude of the effect depends on the taxonomic position of the plant, on the growth culture medium conditions and on its ontogenetic stage of development.

Of all the studied plant species, between 30% and 50% are negatively affected by the increase in the amount of UV-B radiation. The remainder of the tested species were either not affected or seemed to benefit from the increased UV-B radiation levels. The effects of the increased UV radiation amount also include the reduction of the biomass, photosynthesis inhibition, the induction of secondary vegetal compounds, photomorphogenic and phonological changes.

2.MATERIAL AND METHODS

For the 287 nm wavelength, on the 1st, 4th and 7th days, samples were taken from the third, fully developed leaf, for the analysis of the antioxidant enzymes' activity: GR, GST, CAT, APX and POD, in accordance with the methods described in the specialty literature.

The increased ROS levels 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. The increase in the activity of the antioxidant defensive system, due to the negative effects of the environmental stressors, is developed over a long period of time; this process is called adaptation. Many of the agricultural plants of subtropical in origin (for example, corn, rice, tomatoes, peppers, squash, cucumbers etc.) are also found in the temperate zone, but are cultivated under less than optimal conditions. In this case, the reproduction of these plants must have the role of selecting the genotypes with the appropriate tolerance to the imposed conditions and, via them, creating varieties that are endurant.

Under the effect of the treatment with UV-B wavelength, the increase in the POD activity, by comparing the control batch and the treated one, for the Helga hybrid maize plants, was insignificant after a day of irradiation; it became significant after 4 days of irradiation.

3.RESULTS AND DISCUSSIONS

Based on the obtained results, we can conclude that all the antioxidant enzymes we have studied were activated at the 287 nm wavelength, even though each to a different rhythm and extent. The GR, GST and CAT enzyme activity peaked on the first day of irradiation (Fig. 1). The GR and CAT activity, to a more significant extent, increased twice, compared to the GST, where the growth was 1,5fold in relation to the control batch. The UV-B irradiation significantly decreased the activity of the guiacol peroxidase (POD) and glutathione-S-transferase (GST) enzymes, for both genotypes.

In the case of CAT, on the 4th day of treatment, one could notice a decreasing tendency in its accumulation in the leaves, whilst GR and GST remained active until the last day of treatment (Fig. 1). The APX activity increased to a great extent, due to activation under the wavelength action, reaching its peak in the 4th day. In the first day, the POD activity did not show any changes, whilst in the 4th day it only increased slightly, but not in a significant way.

Following the treatment we noticed differences in the activation of certain enzymes, regarding the accumulation degree and rhythm. Following the treatment, the GR, GST and CAT enzymes were similarly activated for the control plants as well as the treated ones, in the first day; however, in the 4th day, the UV-B effect determined differentiations between the control batch and the treated one, where statistically significant values were recorded. For the 7th day, all three enzymes decreased their activity, with more significant differences in the case of CAT (Fig. 1).

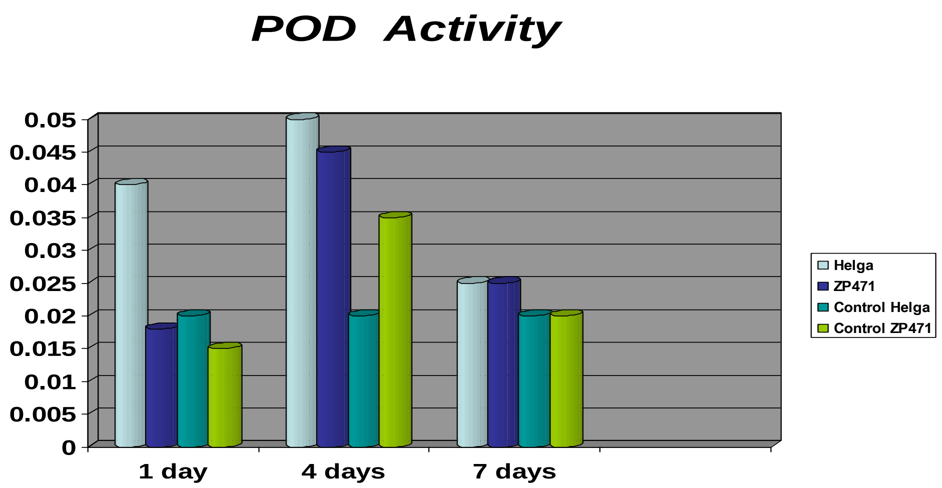
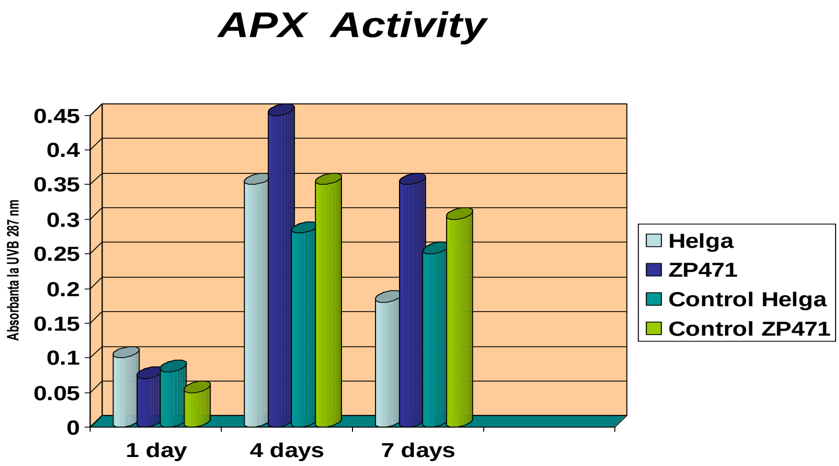
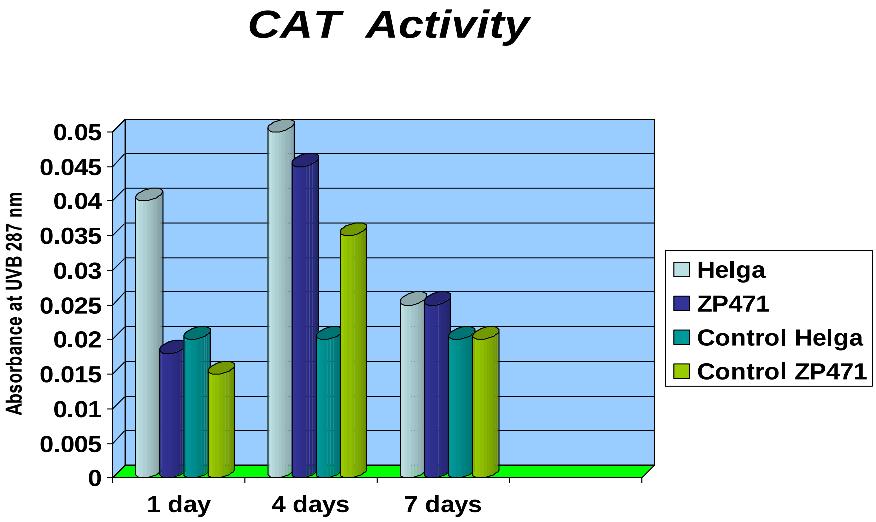


Fig. 1 The change in absorbance under the effect of the UV-B wavelengths, regarding the activity of the antioxidant enzymes for the HELGA and ZP471 hybrids





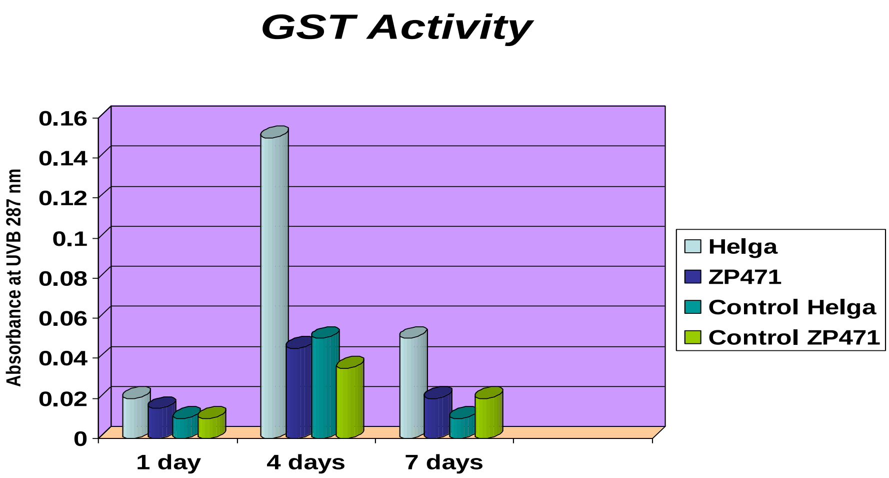


Fig. 1(cont). The change in absorbance under the effect of the UV-B wavelengths, regarding the activity of the antioxidant enzymes for the HELGA and ZP471 hybrids

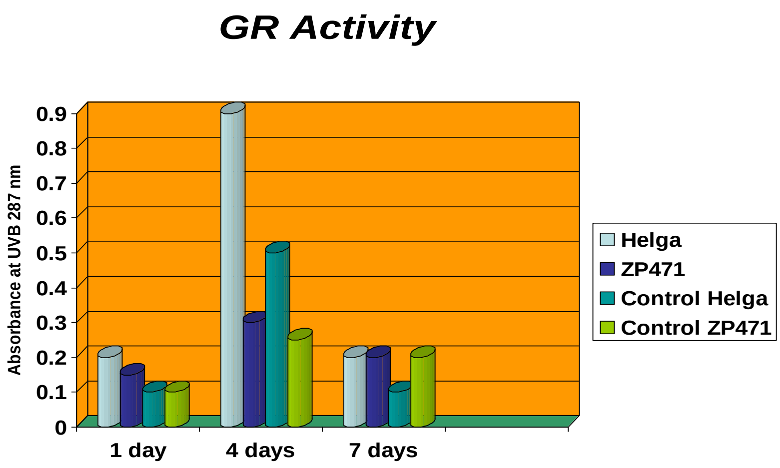


Fig. 1(cont). The change in absorbance under the effect of the UV-B wavelengths, regarding the activity of the antioxidant enzymes for the HELGA and ZP471 hybrids

The activity of the APX enzyme increased from the first day of treatment, with an ascending trend from day 2 to day 6, after which its activity decreased significantly, compared to the control batch.

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CONCLUSIONS

Based on the available data from the literature, we asked ourselves if the number of days under the influence of radiation and UV-B induce changes dependent on the spectrum used on the antioxidant system in plants.

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