Analele Universităţii din Oradea, Fascicula: Ecotoxicologie, Zootehnie şi Tehnologii de Industrie AlimntarăVol. XIV B, 2015

ANTIOXIDANT SYSTEM RESPONSE ON ACTION OF UVB RADIATION ON PLANT SYSTEMS

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Abstract

The plants' development process is regulated by genetic and environmental factors, which affect the biosynthesis, metabolism, transport and signaling pathway of the auxins.

The phytohormones play a complex role, exerting direct effects – which influence the cellular division or growth – or indirect effects – interacting with other molecules or phytohormones.

In dicotyledonous plants, in the absence of light, the stalks elongate and the leaves remain small, sometimes being reduced to scales, whilst in monocotyledonous plants the stalks remain short and the leaves are elongated.

The low light intensity causes the discoloring of the etiolated plants, which lose their green color and turn to a pale yellow color, because the biosynthesis of chlorophyll is favored stimulated by light. The light's action is positively correlated with that of the temperature and the CO_2 concentration.

Key words: antioxidant system, phytohormones, UVB radiation,

INTRODUTION

The ultraviolet radiations do not have ionized properties, but when in contact with the genetic material, they transfer the latter enough energy to confer the nucleotides a state of excitement (mutagenic effect) .

The understanding of the relationship between cultures and the media has improved substantially over the last 20 years.

The anthropogenic factors are constantly changing and allow certain predictions for the future, supported by various studies, regarding the doubling of the CO2 atmospheric concentrations and the temperatures rising with 5,5˚C, till the end of the century (Băra C. I., 2008, Băra C. I., 2006, Pop, T.I. et al, 2011, Rao M.V. et al, 1996).

Throughout their evolution, plants have developed a coping mechanism, to avoid UV irradiation and regenerate after such radiations.

Studies in this regard claim that animals are not the only ones that use the UV-A and UV-B spectrums, but also plants, as an environmental element which

stabilizes their growth and development (Barnes P.W. et al, 1998, Băra, C. et al, 2003, Paul ND et al, 2003, Pallag A. et al, 2014, Pallag A. et al, 2014).

MATERIAL AND METHOD

It is believed that the cellular changes, including those caused by the UV-B radiations of different wavelengths, are associated with the overproduction of reactive oxygen forms, such as the superoxide radical (O_2) and the hydrogen peroxide (H_2O_2).

The measurements and sampling were carried out throughout the entire growth period, until the last month of treatment, from the third fully developed leaf (irradiation at a 280-310 nm wavelength).

The superoxide dismutase (SOD) enzymatic activity was determined spectrophotometrically (1-5) from 100 µl of plant extract.

The absorbance was determined for each stage of UV-B irradiation, insisting on the 287 nm wavelength for 25 minutes, after which 10 mM of mercaptoethanol solution were added to the 100 µl plant extract (Cachiţă C.D. et al, 2008, Caldwell M. M. Et al, 1983, Caldwell M. M. Et al, 1989, Rao M.V. et al, 1996, Rowland R.A., 1991).

The catalase (CAT) enzymatic activity was determined according to the method described by Aebi (1984), the reaction mixture consisting of 50 µl fresh plant extract, 50 mM potassium phosphate (pH 7,8), 10 mM H_2O_2 and enzymatic extract. The enzyme activity was determined by estimating the absorbance at 287 nm.

The antioxidant system's response is of great importance in the fight against the stress caused by the low temperature and UV-B radiation. It is because of this that our studies have focused on certain enzymes of the antioxidant system (glutathione reductase/GR, ascorbate peroxidase/APX, guaiacol peroxidase/POD, glutathione-S-transferase/ GST catalase/ CAT (Pallag A. et al, 2014, Rao MV, 2001, Rao MV ET AL, 1985, Rao M.V. et al, 1996).

RESULTS AND DISCUSSION

Role of the auxins in the organogenesis process is well known.

On the other hand, there is evidence in the specialty literature that supports the claim that the peroxidase intervenes in the 2,4 D degradation, with the forming of two compounds that migrate to the plant apices, leading to the development of the organs.

Therefore, the auxin excess has an inhibitory role on the activity of the peroxidases.

It has also been found that, of the two cytokinins studied in the media supplemented with BAP, the enzymatic activity was lower than in the media supplemented with kinetin.

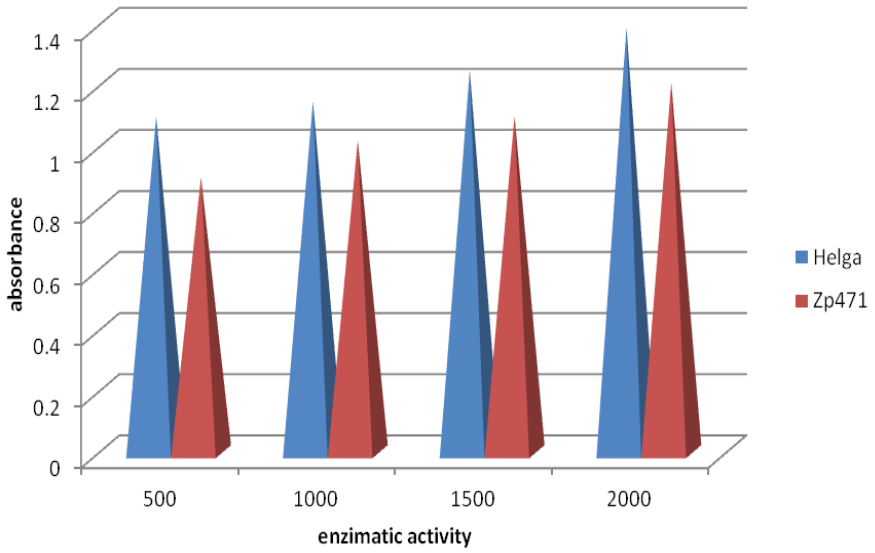

Fig.1. The variation of the catalase activity (CAT) throughout the development of the plants

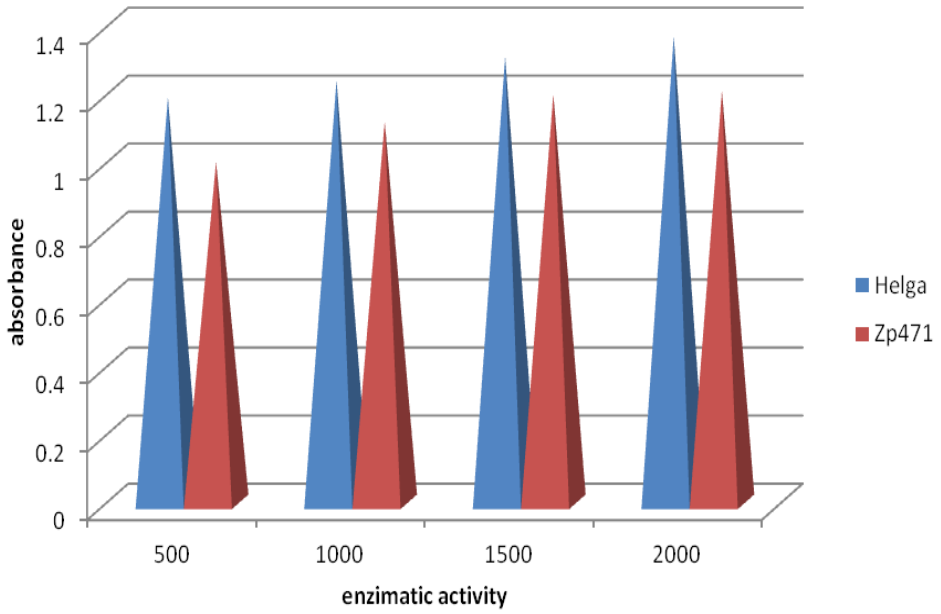

Fig.2. Superoxide dismutase activity variation, throughout the development of the plants.

In view of the fact that BAP resulted in a greater accumulation of callus, compared to the kinetin, we could conclude that the peroxidase's activity is inversely proportional to the callus proliferation capacity.

CONCLUSIONS

The plants' development process is regulated by genetic and environmental factors, which affect the biosynthesis, metabolism, transport and signaling pathway of the auxins.

The antioxidant system's response is of great importance in the fight against the stress caused by the low temperature and UV-B radiation.

It is because of this that our studies have focused on certain enzymes of the antioxidant system (glutathione reductase/GR, ascorbate peroxidase/APX, guaiacol peroxidase/POD, glutathione-S-transferase/ GST catalase/ CAT (Pallag A. et al, 2014, Rao MV, 2001, Rao MV ET AL, 1985, Rao M.V. et al, 1996).

The activities of the catalase and peroxidase are closely linked, both spatially and temporally, and represent bio-markers sufficiently sensible to highlight the processes of cellular differentiation in the plants studied under UV-B irradiation, in the early development stages.

These results show the dependence of these indicators to the cellular differentiation and re-differentiation processes, which take place in the callus, under the influence of phytohormones

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