01. INTRODUCTION

Being sessile organisms, plants are subjected to constant changes in the parameters of the environment: from daily and seasonal cyclic variances to sudden climatic fluctuations. Therefore, plants have evolved a vast composition of mechanisms to cope with the unfavourable conditions of the environment, in which they live. In the last years, a substantial progress in relation to our knowledge about the tolerance to conditions of low temperatures in plants has been achieved. Regardless the global warming of the Earth climate, the tolerance to low temperatures is of particular interest, because early warm periods in winter are observed more and more frequently, and that leads to interruption in winter dormancy of the agriculturally significant crops, damaging them after reversal of the low temperatures (Beniston, 2005; Eccel et al., 2009).

Cold stress exerts complex effect on plants. It damages mainly the cell membranes and proteins, resulting in large amount of disadvantageous effects on the plant cell and the whole plant organism, as well (Nishida and Murata, 1996). Conditions of low positive temperatures inhibit the growth of plants, the photosynthesis decreases, the roots stop absorbing water and mineral nutrients and as a consequence leaves lose their turgor and chlorosis is induced. Prolonged exposure to low temperatures and treatment with temperatures below zero induce necrotic spots on the leaf surface, due to damage of the membranes, formation of reactive oxygen species (ROS) and oxidation of structures and components of the cell. The main effect of the low temperatures is dehydration, caused by disruption of membrane functions and damage to membrane-associated proteins. The selective permeability of the cell is destroyed, so that the cell starts losing water and the roots are not able to restore the water balance. Plant cells lose their turgor and the plant wilts. Besides that, photosynthesis cannot function properly, when plants are exposed to light in combination with low temperatures. As a result, reactive oxygen species (ROS) form, additionally damaging the proteins, DNA and oxidizing the membrane lipids. A greater disruption of membrane permeability causes vacuole content to leak out (main part of which are the organic acids) and cell structure is damaged.

Depending on the temperatures to which plants are exposed, cold stress can be differentiated in two types: when temperatures are above zero (form 15 ºC to 0ºC, it is called *chilling* stress) and below zero (*freezing* stress). Except the deteriorating effect of low temperatures on cell components, when temperatures are below zero, additional danger from formation of ice crystals appears, as well as from mechanical disruption of the cell.

Low temperature stress exerts the greatest injuries on the process of photosynthesis. This was the reason to dedicate a big part of the current work on photosynthesis, photosynthetic activity, photosystem functioning in stress conditions, as well as the quantitative determination of structural components of photosynthesis, such as photosynthetic pigments and genes. Photosynthesis cannot function properly in conditions of low temperatures combined with light and as a result reactive oxygen species (ROS) form in large amounts. Regardless of the antioxidant system of plants ROS damage the cell components with a high rate, when their formation in the photosynthetic apparatus could not be neutralised. Therefore, in the current work we analysed the effect of low temperatures on the plants photosynthetic apparatus and the role of ROS in realization of the damages. Being the main stress hormone and inductor of the dormancy in plants, ABA and its degradation products were studied. ABA is responsible mainly for the closing of stomata and for plant resistance against dehydration (Beardsell and Cohen 1975). Considering that some of the effects of cold stress are also similar to the effects of dehydration, ABA accumulates in plants and regulates their functions after low temperature stress, as well. It is known, that ABA is also an important part of the plant acclimation to very low temperatures below zero (Mantyla et al. 1995; Gusta et al. 1996). Cytokinins (CK), in contrast to ABA are hormones of plant growth and development. However, it is highly possible that they affect the physiological processes in conditions of stress, as well (Hare et al., 1997; Davies et al., 2004). CKs are also the main regulators of the processes of ageing, as well as the photosynthesis. In *Arabis alpina*, particularly, in contrast to a large part of the plants from the Brassicaceae family, for example *Arabidopsis* cis-zeatins act as an important part of the hormonal regulation in low temperature stress conditions. Thus, as an addition to the analysis of the ABA content and the transcription of genes from the ABA metabolism, the study of CKs in the regulation of plants to low temperature stress draws a greater attention.