PEROXIDASE ACTIVITY IN DIFFERENT PARTS OF THE CROWN OF SILVER FIR TREES

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The relict trees of silver fir (*Abies alba* Mill.) growing at the polluted locality Kamenec p. Vt. of the Vtačnik Mountain Range have been subjected to the comparative enzymological study aiming in description of the physiological aspects of silver fir declining in the area. There is not available any data concerning spatial distribution of peroxidase activity in silver fir trees but the enzyme itself has been reported to function as an indicator of the detrimental effect of emissions on forest trees (HANTGE, 1992). As a preliminary step in studying this process, the specific peroxidase activity in different parts of the crown in silver fir trees has been analyzed.
It follows from the results obtained so far that the highest level of peroxidase activity is localized in the needles at the bottom of the crown as evidenced in two of the three analyzed trees. The third individual has deviated in this respect exhibiting the most intensive peroxidase activity in the needles from the middle part of the crown. In general, it seems however that there exists an increasing gradient of the enzyme activity in direction from the top towards the bottom of the crown.

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SESILITY AND CLONALITY OF PLANTS IN CONDITIONS OF ENVIRONMENTAL STRESS

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Plants as sessile organisms (rooted fixed or sedentary organisms), have no choice of enviromental conditions (in opposite of mobile organisms/animals); they are exposed to the conditions of the enviroment in which they grow. These plants are able to tolerate enviromental stress due to morphological and physiological adaptations and/or they can avoid the stress by dormancy or storage of limiting resource, e.g. water in dry conditions (drought). Those two mechanisms of resistance against enviromental stresses (viz. mechanism of tolerance and mechanism of avoidance) are completed by defence strategy against herbivores. Physical, chemical, morphological and behavioural defences can increase chance of survival of the sedentary organisms.

Plants are not absolutely immobile organisms: they are able actively change a site by clonal growth; it is better to call them as "organisms with limited mobility". Most of the flowering plants are modular organisms: they grow by the repeated production of modules (e. g. leaves, branches) and form branching structures; precise program of their development is not predictable. Genetically individual (genet) is a population of modules which grow by vegetative growth from another modules; due those growth genets have potentially indeterminated age (they are "organisms with limited mobility"), they are able to forage enviromental resources (foraging) and they can survive in conditions of enviromental stress by plastic responces of acclimatized modules or ramets. The clonal growth, persistence of clonal interactions (allowed assimilate transport among ramets), together with physiological sectoriality, facilitate survivorship and growth of genets in conditions of enviromental stress, colonization of vacant habitats and intra- and interspecific completition for enviromental recources.

Limited mobility and clonality of plants have to be accepted in plant (and plant parts) research in condition of enviromental stress, as well as explanations of the results obtained and behaviour of the plants.

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SEASONAL VARIATION IN PEROXIDASE ACTIVITY OF SILVER FIR (*ABIES ALBA* MILL.) NEEDLES

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Oxidative stresses in plants due to air pollution are caused by the ability of NO_2, SO_2 and O_3 to initiate free radical reactions in both the atmosphere and cells (MEHLHORN et al., 1987). Active oxygen produced so far can react in several types of reactions in the cell initiating cell damage at many metabolic sites. It is these toxic intermediates which cause the initial damage to plant cells during oxidant exposure (WINGSLE, 1991). Except for the fat-soluble compounds tocopherol and carotenoids as well as for the water-soluble glutathione, the enzymatic antioxidants glutathione reductase, superoxide dismutase and partially also peroxidase are also engaged in the plant`s defence against oxidative injury (POLLE et al., 1999). The high activities of glutathione reductase and superoxide dismutase were shown to confer enhanced stress resistance in transgenic plants of tobacco and poplar (PITCHER, ZILINSKAS 1996, FOYER et al., 1995) but recent data suggest that the genetic constitution for maintenance of high antioxidative protection is also of importance for stress compensation in Norway spruce (POLLE et al., 1999). As a preliminary step in studying peroxidase activity level of silver fir stands in polluted area, a seasonal variation in enzyme activity was compared in several individuals of the species growing at the Vtačnik Mountain Range. Peroxidase activity of 1-year-old needles of silver fir varies throughout the growing season reaching its maximum in June after which a deep decline follows during July. The most important contribution of presented results concerns the established dynamics of peroxidase activity which prevails in 1-year-old and in current year needles of silver fir during the year. Of no less importance is also the finding of considerable individual variation in enzyme activity between tested individuals. It seems therefore that except for the ecological conditions, the genotype-specific response of studied trees to the acting environmental factors should be taken into account in comparative enzymological studies as well.

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MODIFICATIONS OF SOME PHYSIOLOGICAL PARAMETERS OF WHEAT IN STRESS CONDITIONS

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As a result of the investigation and quantification of the plant production process, some periods of vegetation with markable changes of environmental conditions can be seen which interfere with the course of physiological processes and, in this way, they influence interrelationships among them. We have quantified both a range and a depth of activity of unfavourable factors (water deficiency, high temperature, deficiency of mineral nutrients) on functional manifestation of individual plants and plant canopy, adaptability of plant organs on unfavourable conditions and possibilities to reduce their impact on of plant production ability. Ecophysiological methods of measurement of leaves and plants characteristics (leaf elongation rate, gas exchange, diffusion resistance, water and osmotic potential, water deficit, residual water deficit, chlorophyll content, SPAD index) confirmed the existence of such interrelationships. Simulation of water stress during the earlier growth phases by polyethylene glycol (PEG 6000) and abscisic acid (ABA) seems to be an appropriate way for the identification of differences in water use by cereals. Application of the methods enables to manifest plant responses which are comparable with plant responses measured after their gradual dehydration and can be used in evaluation of plant tolerance against stresses.

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GENOTYPIC VARIATION IN PROLINE CONTENT AND OSMOTIC ADJUSTMENT FOR DROUGHT TOLERANCE IN BARLEY PLANTS

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Plant water deficit is a component of several different stresses, such as drought, salinity, high and low temperature which severely limit growth and crop productivity. In many plants, free proline accumulates in response to the imposition of a wide range of abiotic and biotic stresses. In the whole-vegetation pot experiments with spring barley cultivars Kompakt (Slovakia), Dobla and Albacette (Spain), the slow plant dehydration was evoked after anthesis by withholding water. The water (*WP*) and osmotic (*OP*) potentials, relative water content (*RWC*) and free proline content were daily measured and turgor potential (*TP*) was calculated from *WP* and *OP*. Cultivar differences in osmotic potential at turgor loss point supported by free proline data as well as relationship between *RWC* and *OP* could serve properly for an assessment of cultivar ability to adjust osmotically and to withstand the drought. Protection role of osmotic adjustment might be a factor for maintaining maximal and actual photochemical efficiency of PSII determined by chlorophyll *a* fluorescence. The aim of this work is to discuss the evolution and function of osmoprotection under abiotic stresses.

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THE INFLUENCE OF SEVERE SOIL DROUGHT ON GROWTH PROCESSES AND ANTIOXIDATIVE ACTIVITY IN FLAG LEAVES OF WINTER TRITICALE

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The effect of 3-week soil drought on some antioxidative enzymes in flag leaves of four triticale (*Triticosecale* Wittmack) cultivars: Bogo, Presto, Tewo and Ugo were studied. Protein level and superoxide dismutase (SOD) and catalase (CAT) activities (% of control – non-drought plants) were dependent on the variety and the treatment (drought or 2- or 4-week recovery). Dry mass of shoots and length of main stem were restricted by drought treatment during the whole experiment, in all genotypes. Drought resulted in the increase in SOD and CAT activities (~ 20 % of control) together with the protein level in cv. Bogo. In cv. Presto, a slight increase in superoxide dismutase activity was observed. Tewo and Ugo cvs. showed a drop in protein amount and antioxidant activities (20-30 % of control). Following recovery, antioxidant activity decreased, and prolongation of recovery resulted in various patterns of changes in SOD and CAT activities and drop in dry matter content, probably as a result of ageing processes.

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ACCLIMATION BY SUBOPTIMAL TEMPERATURE PROTECTS MAIZE HYBRIDS AGAINST CHILLING

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The response of chilling-resistant (KOC 9431) and chilling-sensitive (K103 x K85) maize hybrids to 8-day temperature acclimation (hardening, 15°C) and chilling (5°C) was examined. Control plants were chilled without 15°C hardening. Before exposure to chill, leaf membranes were affected by acclimation – values of electrolyte leakage of acclimated plants were of ca 50 % of control. Following 6-d chilling, acclimation diminished leaf membrane injuries of chilling-sensitive, and inhibited the depression of CO_2 assimilation of chill-resistant hybrid.
The increase in carotenoids pool and carotenoids/chlorophylls ratio, and the drop in Fv/Fm of leaves of chill-resistant hybrid, suggest dissipation of excess light energy via the xanthophyll cycle. During chilling, catalase activity was decreased by hardening, whereas enhanced activity of superoxydismutase and ascorbate peroxidase may result in more efficient defence mechanism against chill-related oxidative stress in temperature-acclimated plants. The recovery of seedlings was not affected by acclimation.

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SOME MOLECULAR BIOLOGY ASPECTS OF PHOTOSYNTHESIS

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Molecular mechanism of photosynthesis is examined in details at present and mechanics of the photosynthesis regulation are also observed (FURBANK, R.T. et al., 1997) Transgenic plants become the element of research (RUUSKA, S.A. et al., 2000). Photosynthesis as an oxido-reductive process demands substrate as permanent electrons donor on one side and co-enzymes, which are acceptors of these electrons on the other side. It is very photolysis of water whereby the light phases is saturated by electrons and protons. Contemporaneously the oxidation of water occurs, oxygen gives up 2 electrons into this process and as electro-neutral get into atmosphere. Translocation of protons into thylakoid cavity is realised by electrons translocated from water on $NADP^+$. Together with OEC (oxygen evolving system) participate on rise of proton gradient utilised for ATP synthesis. These reactions are realised in stroma of chloroplasts. Reduction of nicotine-amid co-enzyme ($NADP^+$) conducted by acceptation of 2 electrons and 1 proton.

$$2\,H_2O + 2\,NADP^+ + h\nu \rightarrow O_2 + 2\,NADPH + 2\,H^+$$

Reduced NADPH + H^+ together with ATP are used in stroma of chloroplasts for assimilation and reduction of CO_2. Bisfunctional enzyme ribulose-1,5-bisphosphate carboxylase constituting up to 60 % of soluble leaf protein catalyses assimilation of CO_2 on ribulose-1,5-bisphosphate and the first step of photorespiration metabolism by oxidation of the same substrate. This reaction provides C circulation in nature and together with other enzymatic reactions seeks formation of basic energetic substrates – sucrose and assimilative starch. Glucose is dehydrogenated by biological oxidation in glycolysis and Krebs cycle. CO_2 is released into the atmosphere and electrons from reduced co-enzymes pass to respiration chain connected with oxidative phosphorylation. It follows from this, that at the beginning and at the end of energetic metabolism is water which is the donor and the acceptor of electrons.

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REDOX REGULATION OF SUPEROXIDE DISMUTASES AND ASCORBATE PEROXIDASE GENE EXPRESSION DURING EXCESS EXCITATION ENERGY AND HIGH SALINITY IN NTERMEDIATE C_3-CAM PLANT MESEMBRYANTHEMUM CRYSTALLINUM L.

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Exposure of *Mesembryanthemum crystallinum* plants performing C_3 mode of photosynthesis to 1 h excess light (2200 μmol photons m^{-2} s^{-1}) caused reversible photoinhibition of photosynthesis. The use of electron transport inhibitors indicates that redox status of the plastoquinone pool regulates, at least in part, Cu/Zn*SOD*, Fe*SOD* and *APX1* gene expression. However, this regulation has an inverse relationship to that observed in *Arabidopsis* and *Nicotiana* plants. In *M. crystallinum*, mRNA levels for these genes were induced in dark or by DCMU while in *Arabidopsis* and *Nicotiana* plants in light or by DBMIB. After salt-induced C_3-CAM transition transcript levels for Fe*SOD* is strongly up-regulated. In contrast, high salinity does not affect chlorophyll *a* fluorescence parameters and it does not cause dramatic changes in mRNA levels for Cu/Zn*SOD* and *APX1* genes. We have also found that CAM performing *M. crystallinum* shows similar resistance to photoinhibition as plants in C_3 mode of carbon assimilation. All these results indicate that photosynthetic apparatus in *M. crystallinum* is pre-adapted to high salinity stress. The redox status of the plastoquinone pool and another unknown mechanism play an important regulatory role in C_3 – CAM intermediate plants.

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