SECTION 1 - ECOPHYSIOLOGY

Calculation of net daily photosynthetic production in one needle generation of Norway spruce (*Picea abies*) stand

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P_N was measured by a gasometric system *LI-6200* (*Li-Cor*, USA) on intact C-1 shoots (a generation prior to the current one) in 35-year-old Norway spruce stand in the Beskydy Mts. Simultaneously, photosynthetically active radiation (PAR) was measured by PAR sensors *BPW 21* (*Elfa AB*, Sweden) at three canopy layers (sun, penumbral, shade) in 30 min intervals. Light response curves of P_N were constructed for the layers using the FOTOS program (Pirochtová and Marek 1991). Using the above mentioned data a daily course of P_N in each layer was established and total daily P_N calculated. Basic data required for estimation of forest stand needle area were obtained from destruction of 20 sample trees (Barták *et al.* 1992). Vertical distribution of C-1 needle area were calculated from data on vertical distributions of 1) dry needle mass in the samples and 2) needle projection area measured by photoplanimeter *LI-3000A* (*Li-Cor.*, USA). For each canopy layer the total C-1 needle area was calculated in each sample and regression between tree diameter at breast height and needle area was established. Using this regression and distributions of tree diameters a total leaf area of two stands of different densities (A: 161 600 and B: 200 500 trees km^{-2}, resp.) was calculated for each canopy layer. Total daily P_N was calculated by multiplying data on needle area by P_N in each layer. Results showed that total daily P_N in C-1 needle generation was found 3050 kg km^{-2} d^{-1} and 250 kg km^{-2} d^{-1} in stand A and B, respectively.

References:
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Relation between stress tolerance and nutrient utilization

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It was concluded that the tolerance of cereal cultivars to soil stresses (drought, waterlogging, low pH, aluminium toxicity, high temperature *etc.*) should be evaluated. The order of importance in evaluation the individual stress factors for plant production is given by environmental conditions. On the basis of laboratory and field experiments, attention is to be paid especially to the increased complex adaptability to the negative soil stresses. The higher the complex adaptability to the abiotic stresses, the higher the yield stability in field stress conditions (low decrease of yield). In cultivars with higher level of complex tolerance to abiotic stresses, a low demand for the concentration of macro- and micronutrients and minimum yield decrease on the sites with lower fertility prevail. In case of higher concentrations of macro- and micronutrients only a low level of utilization and an

average level of yield in this type of cultivars exist. On the basis of variability of root parameters of juvenile plants of different cereal cultivars at different concentration of macro- and micronutrients in laboratory experiment it was concluded that there is a very good prediction for nutrient demand and utilization. The most perspective traits of roots are volume, dry matter, depth of penetration, total root length and root:shoot ratio.

Trehalose synthesis by sporangiospores of *Pilobolus longipes*

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Either glucose or the nonmetabolizable glucose analog 6-deoxyglucose provokes, within one min a cyclic AMP signal in sporangiospores of *Pilobolus longipes*. The resulting elevated cyclic AMP levels release a phosphorylation cascade which triggers spore germination. Fructose was transported by ungerminated spores but exogenous fructose neither generated a cyclic AMP signal nor triggered germination. Instead, a large part of fructose metabolism was directed towards trehalose synthesis. Incubation of spores in 40 mM fructose for 30 min resulted in a 50% increase in trehalose content whereas exogenous glucose caused only a small increase in intracellular trehalose. When a cyclic AMP signal (generated by 6-deoxyglucose) accompanied exogenous fructose the result was reduced trehalose synthesis when compared with the effect of fructose alone. These observations suggest that trehalose synthesis is regulated by cyclic AMP. This is consistent with a report in the literature which describes the activity of trehalose 6-phosphate synthase in *Saccharomyces cerevisiae* as being reduced by cyclic AMP-dependent phosphorylation. In *P. longipes*, however, the initial rates of trehalose synthesis from ^{14}C-labeled fructose and ^{14}C-labeled glucose were not significantly different. Moreover, addition of 6-deoxyglucose along with fructose reduced the final amount of new trehalose synthesis but did not influence the initial rate of synthesis. Cyclic AMP signals, generated by either exogenous glucose or 6-deoxyglucose, produced large increases in activity of the glucose transport system. Competition studies showed that this system also transports fructose. This cyclic AMP-regulated transport was directed towards glycolysis and resulted in rapid depletion of exogenous hexoses. These results lead to the conclusion that cyclic AMP-regulation of trehalose synthesis is only indirect. More specifically, it appears that a cyclic AMP-dependent modification of a hexose transport system coupled with increased glycolytic flow associated with germinating spores consumes substrates which dormant spores direct towards trehalose synthesis. There is no evidence that the trehalose synthesis pathway itself is cyclic AMP-regulated.

Metabolic changes in potato plants infected with potato virus-Y in cultivars Jara and Adretta

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Activities of glucose-6-phosphate dehydrogenase, the regulatory enzyme of the oxidative pentose cycle, and ribonucleases, characterising rate and intensity of the host RNA degradation, were studied in potato plants under glasshouse conditions. Activities of both studied enzymes were significantly increased, to 160-200% in the susceptible cultivar Jara, and to 110-160% in resistant

cultivar Adretta. The PVY content significantly correlated with activities of the mentioned enzymes in these plants.

A contribution to the study of the aluminium effect on seedlings of the forest tree species

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In the course of two years Norway spruce (*Picea abies* L. Karst.) seedlings were cultivated in Mitschcerlich pots filled with rinsed river sand. The pots, being placed in a greenhouse, were irrigated by the Gericke nutritional solution with an addition of 20, 40 and 60 mg of aluminium per one litre of the solution. The aluminium has been added in the $Al_2(SO_4)_3.18\ H_2O$ form. When following the growth of the experimental seedlings, no statistically conclusive differences were found. These were found only with roots, *i.e.* between the control treatment and the treatment with 60 mg of Al only. The dieback of seedlings fluctuated around the value of 3% regardless of the experimental treatment. The content of Al in the root dry matter was determined at the last sampling and was somewhere between 0.9 and 2.6 mg Al per 1 g of dry matter with the control and the "60" treatments, respectively. Furthermore, attention has been paid to the ability of roots to regulate the pH value of the environment. Of the measured pH values regulation curves have been made. It is concluded that neither length nor height of the regulation zone were influenced by the aluminium concent in the cultivation substrate. On the other hand the optimum pH value decreased. From this finding it can be concluded that not even such high aluminium concentrations, as were chosen in our experiment, can influence the vitality of Norway spruce seedlings in the early phenophases.

Physiologically active metabolites of *Erysiphe graminis* f. sp. *hordei* Marchal fungus

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Erysiphe graminis, f. sp. *hordei* is an obligate ectoparasitic fungus living on barley which causes a significant loss in yield. The attacked plants respond to the fungus as early as in the preparasitic phase of host-parasite interaction (germination of conidia, appressoria formation). Proteosynthesis, enzyme activities as well as the host cell plasmalemma permeability is increased (Frič 1984, 1988). The last mentioned phenomenon is characterized by a "leakage" of electrolytes and some proteins from cells into the intercellular, *i.e.* substomatal spaces of leaves. These reactions are caused by fungal metabolites. Their relative molar mass is between 30 and 100 kD. They are stable up to 50 °C, at higher temperatures are gradually inactivated. These substances induce an increased exocytose of electrolytes from barley and maize cells as well as from erythrocytes. It is supposed that the mentioned substances are for the biotropic fungus very important from the view of ensuring sufficient nutrition from the host epidermal cells.

References:

Frič, F.: Acta phytopathol. Acad. Sci. hung. 19: 183, 1984.
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Photosynthate production and use in *Deschampsia caespitosa* at high and low nitrate availability in substrate

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Relative growth rate (RGR), net assimilation rate, and other basic growth analytical characteristics, together with CO_2 exchange rates were followed in plants of *Deschampsia caespitosa* (L). P.B., cultivated in controlled conditions. Two levels of nitrogen concentration in substrate (15 and 1.5 mol $NO_3^- m^{-3}$) were maintained during the experiment. High values of net photosynthetic rate, nitrogen productivity, and photosynthetic nitrogen use efficiency were found in plants even when nitrogen deficient. Significant decrease in RGR of N-deficient plants was primarily due to changes in biomass partitioning, namely to low values of leaf weight ratio. Specific dark respiration was slightly lower in all organs of N-deficient plants. Dark respiration amounted to about 25 % of daily net photosynthesis in control plants, and 22 % in N-deficient plants. The physiological characteristics of *Deschampsia caespitosa* help to explain its successful growth both in nutrient rich and nutrient poor habitats.

Differential tolerance of two populations of *Agrostis stolonifera* to copper

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Seeds of two populations of species *Agrostis stolonifera* were taken from the control, non-contaminated region (No. 1) and from the mine tailing with a high content of Cu (No. 2). The tolerance of seedlings was tested after sprouting and after 14 days of growth in nutrient solution with growing concentrations of Cu (0-12 μM). All concentrations of Cu caused inhibition of growth of roots in both populations. The inhibition, though, was the most considerable in population No. 1.The value of index of copper tolerance of each plant was estimated by rooting test:

$$IT = \frac{\text{root length in nutrient solution + Cu}}{\text{root length in nutrient solution - Cu}} \times 100$$

The frequency of differently resistant individual plants in both populations was evaluated on the basis of root length comparison. The genetic variability in population No. 2 was lowered for the benefit of resistant individuals. In population No. 1, the genotypes with a low IT dominate, but also individuals with higher IT are present. Their presence is a presumption of adaptation process taking place under a strong selection pressure of chronic effect of copper in substrate. Species *Agrostis* have a considerable genetic potential for adaptation to the mentioned stress conditions. Metabolic adaptation makes the growth and reproduction processes possible. In our experiments we observed that the reduction of chlorophyll by the effect of Cu in the population No. 2 is clearly less considerable compared to the population No. 1.

The regulation of pH by the roots of maize plants (*Zea mays* L.) cultivated in the nutrient solutions with cadmium

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The increasing degree of biosphere pollution by different polutants correlates with the content of mobile forms of metals in soils and with the negative influence on the growth and development of plants. In this connection, attention is being paid to a more detailed understanding of partial processes of metabolism which are negatively affected by heavy metals. The plants of *Zea mays* L. cv. LG 5 (from the production of *LIMAGRAIN, FAO* No. 240) were grown in the water culture in the Reid-York's nutrient folution with an increasing concentration of Cd (10. 100 and 1000 μM dm^{-3}). Six and seventeen day old plants were transferred to 0.05 N KCl media with the pH_i 2,3,4,5,6,7,8. After and 30 min exposure the pH_r was measured to compare the ability of roots to regulate the acidity of the media. Each value represented a mean of three replications. It was concluded that the range of regulative zone and the extent of optimal pH step into its acid region increased with the increasing concentration of Cd in the nutrient solution. The pH values of IEP were reduced at the same time. It can be assumed that changes in the regulatory ability of the plant tissue can affect the uptake of cations and anions.

Ecophysiological processes in fruiting and deblossomed apple trees

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Apple trees (*Malus domestica* Borkg., cv. Golden delicious, EM-9) were grown in compensation lysimeters located at an experimental area with a permanent meteorological station. At the beginning of the study (1986) the trees were two years old. Physiological data were collected for four years. Ecophysiological processes (water uptake and CO_2-exchange) were measured continuously during the growing seasons. Simultaneously with ecophysiological measurements, basic microclimatic factors were registered. Other quantitative characteristics (leaf area, dry mass of the leaves, shoots, roots and fruits, and leaf chlorophyll content) also were estimated. The time of day and irradiance at which the values of maximal net photosynthetic rate was attained were determined. The response curves for CO_2 uptake to irradiance were evaluated by the boundary line method. Fruiting trees showed higher values of water uptake (279 kg water $tree^{-1}$ $year^{-1}$), mean daily net photosynthetic rate (0.51 mg CO_2 m^{-1} s^{-1}), maximum daily net photosynthetic rate (0.71 mg CO_2 m^{-2} s^{-1}), photosynthetic CO_2 fixation capacity (0.94 - 1.31 mg CO_2 g^{-1} (chl *a+b*) s^{-1}), leaf area (2.158 m^2), dry mass of the trees (2770 g), and shoot-root ratio (2.93) than those values of deblossomed trees (135 kg(water) $tree^{-1}$ $year^{-1}$, 0.3431 mg CO_2 m^{-2} s^{-1}, 0.5033 mg CO_2 m^{-2} s^{-1}, 0.63 -0.93 mg CO_2 g^{-1}(chl *a+b*) s^{-1}, 1.352 m^2, 1577 g and 0.96, respectively). However, the values of dark respiration rate (including maintenance and growth respiration rate) as well as transpiration coefficient were lower for the fruiting trees. For these trees, the dark respiration rate was 21 % - 36 % of the maximum net photosynthetic rate. The maintenance respiration rate was 67 % of the dark respiration rate while the growth respiration rate was 33 % of the dark respiration rate. The values for specific leaf mass were 0.86 g dm^{-2} (fruiting trees) and 0.98 g dm^{-2} (deblossomed trees).

Daily net photosynthetic rates reached maximal values between 8 - 10 h (deblossmed trees) and 9 - 11 h (fruiting trees). We consider the proportionality between production and accumulation potentials to be among the most important internal factors which influence the whole physiological activity of fruit trees.

Growth depression of plant infected by fungus *Tilletia controversa* Kuhn

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One of the most important visual symptoms of dwarf bunt infection is the reduction of the wheat plants height. We are dealing here with the study of some other parameters not yet analyzed in this host-parasite combination. Different cultivars of winter wheat (Iris, Košútka, Viginta, Zdar) and dog's grass (*Elytrigia repens* (L.) Desv., locality Malý Horeš, and *E. intermedia* (Host.) Nevski, localities Malý Kamenec and Stupava) were used. Depression of the wheat plants height moved (depending on cultivar) from 53 to 59.3 %, of dog's grass from 38.4 to 52.7 %, the culm depression from 63.3 to 56.3 % and from 41.8 to 56.7 %, respectively, the spike depression moved from 13.5 to 27 % and from 15.8 to 27.2 %, respectively. Greatest differences occurred in the upper internodium depressed from 64 to 72.2 %, from 43.8 to 58.5 %, respectively. There has been a high significance in all parameters dealing with differences between healthy and infected plants. There were no differences in number of internodes. There is a great variability in the studied differences depending on various factors (race of fungus, species of host plant, cultivar) in the nature. The mechanism of these growth depressions is based in all probability on changes of growth regulators in infected plants, as a result of their balance defect.

The effect of different growing conditions on quantitative and qualitative composition of the essential oil of chamomile (*Chamomilla recutita* (L). Rauschert)

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The chamomile is one of the most important medicinal plants in the world. Pharmaceutically useful are primarily its flower anthodia - *Flos chamomillae*. The healing power of chamomile drug is due to the presence of essential oil constituents. Among them, the most valuable are (-)-α-bisabolol, chemazulene and beta-farnezene as estimated on the basis of their pharmacodynamic properties.The effect of various edaphic and climatic conditions on the essential oil content or quality was followed. Three-year field experiment (1988, 1989 and 1990) was performed with our diploid cultivar "Bona" in 3 various localities: Bracovce - a warm climatic region of the lowlands of East Slovakia, Košice - a warm climate of the basin of Košice with prevailing no winds, Nova Lubovňa - a montane region with a moderate warm climate. Essential oil was isolated by steam distillation and its mass was determined gravimetrically. Gas chromatography was used to characterize the main components of the chamomile essential oil. Different conditions of localities, where the chamomile plants were grown, influenced the yield of essential oil and its main components but had no effect on the composition of the essential oil.

Utilization of tobacco mesophyll protoplasts for the study of physiological changes induced by virus infection

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Changes in number of protoplasts, viability, protein and chlorophyll content and ribonuclease activity, associated with tobacco mosaic virus multiplication (TMV, *vulgare* strain) were studied in tobacco mesophyll protoplasts *in vitro* inoculated with TMV. The results showed that the number of protoplasts in the cultivation period slowly increased and the viability was decreased from 95 % to 67 % in control noninoculated protoplasts, and to 55 % in infected protoplasts. The protein content and chlorophyll content drastically decreased, the protein to 25-30 % and chlorophyll to 17-19 % of the content in the 3rd hour after inoculation. The ratio of chlorophyll *a/b* decreased from 2.11 in healthy (resp. 2.02 in infected) protoplasts to 0.79 (resp. 0.60) in the 30th hour after inoculation. The activities of ribonucleases in protoplasts quickly decreased but in the whole experiment they were higher in infected than in noninfected protoplasts. The activities of ribonucleases in the infected protoplasts in the interval 20-30 h after inoculation were increased to 132-146% of healthy control and corresponded with multiplication curve of TMV.

Physiological changes in potato leaf discs induced by infection of potato virus Y

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Changes in protein and chlorophyll content, ribonucleases and glucose-6-phosphate dehydrogenase activities were studied in healthy and potato virus Y infected discs cut from potato leaves. The infection evoked the strong decrease in proteins and chlorophyll content during a 5-d-long cultivation period. The activity of glucose-6-phosphate dehydrogenase, the rate limiting enzyme of the oxidative pentose phosphate pathway, and the activity of ribonucleases which characterized the rate and intensity of host rRNA degradation, were in this period markedly enhanced. The fact that the activity curves of both these enzymes were in linear relationship with the PVY multiplication curve indicates that not only nucleotides produced in the reaction of the oxidative pentose phosphate pathway but also nucleotides released in the process of host rRNA degradation were the main source of nucleotides necessary for PVY-RNA biosynthesis, in spite of a high photosynthetic rate.