21 01

Hormonal regulation of rhizogenesis in young and mature clones of *Sequoia sempervirens in vitro*

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The rooting capacity in young and mature clones of *S. sempervirens in vitro* after wounding and treatment with indole-3-butyric acid (2.5×10^{-5} M IBA) was linked with the characterisation of the hormone levels of indole-3-acetic acid (IAA)-related compounds and abscisic acid (ABA) in the bases of cuttings (5 mm long) during the first 4 days of the root inductive period. HPLC-ELISA and MS methods were used.

Both clones rooted only in the presence of IBA but the auxin treatment was more efficient with young clone (60%, 10 days after treatment, 3 roots in average) than with mature one (30%, 13 days after treatment, only one root). High levels in IAA and IAA-aspartate (IAAsp) were measured in young clone whereas mature clone accumulated mainly IBA and indole acetonitrile (IAN). IBA treatment had no effect on ABA levels in young clone but induced high accumulation of ABA in mature clone. Hence, the different rooting capacity between clones could be related with quantitative changes in auxin and ABA metabolism.

21 02

Research on the vitality and quality of *Quercus robur* during storage and transport

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The aim of this research project is to study the effects of harvest-time, storage- and transport conditions on regrowth after replant and to investigate whether specific changes in physiological parameters during the post-harvest period can be used to predict vitality after replant.
To simulate various degrees of vitality, 3-year old oak-trees were divided into three groups. One group was pulled up one month before leaf-drop, the second group one month after leaf-drop. The last group was the control. On these three groups various physiological processes caused by environmental stress during dormancy of the oak-trees were studied. Hormonal regulation, water-potential and starch content are assumed to play an important role in dormancy and regrowth.
Among other things, last years experiments show that it is very well possible to create different levels of vitality. The experiments showed that pulling up trees before leaf drop decreases plant quality dramatic. Stress has a major effect on the physiological state of the buds. When the buds are dead, the rest of the tree may still be alive. Changes in vitality occurred in starch content in the taproot, bud-weight and free water content as determined by NMR-Imaging of the buds from six weeks before normal regrowth.

21 03

Seasonal variations of leaf water potential in irrigated mature carob-trees (*Ceratonia siliqua* L.)

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Variation of leaf water potential at dawn and midday was studied in mature carob-trees (*Ceratonia siliqua* L. cv. Mulata) submitted to a irrigation and fertilization experiment. Three levels of irrigation were tested: 0 %, 50 % and 100 % based on daily evaporation. For each water level two nitrogen amounts were applied - 21 and 63 kg (N) ha^{-1} $year^{-1}$. Leaf water potential was related to soil volumetric water content, maximum and minimum air temperature and daily evaporation between July 91 and August 93. The highest predawn and midday leaf water potential were obtained for the well-irrigated treatments. However, in spite of irrigation, some trees possessed low leaf water potentials during summer indicating a clear evaporative demand effect. The role of drought adaptation mechanisms of carob-tree is discussed.

21 04

Stresses and chlorophyll fluorescence in leaves of laurel forest trees.

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The effect of water stress and low and high temperature in leaves of *Laurus azorica* (Seub.) Franco, *Persea indica* (L.) Spreng, and *Myrica faya* Ait., was monitored with the chlorophyll fluorescence induction kinetic, using a portable fluorimeter (PEA, Hansatech, U.K.). Detached leaves were kept at room conditions for specific period to obtain different levels of relative water content. Temperature stress was achieved by exposing leaves for 30 minutes in plastic bags in a water bath at temperature steps of 2 k between -24°C and 54°C and determined immediately and 24 hours after the treatment.
The general effect was the reduction of the ratio variable to maximum fluorescence emission (at 692 nm) for all the treatments, nevertheless the effect of low temperatures was detected most accurately with slow fluorescence kinetic parameters. Discussion of different indexes are also shown.

21 05

The effect of nitrogen nutrition on the course of photosynthesis in apple trees and on the level of photosynthetic parameters

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Experiments were carried out in pots using three-year-old apple trees, cv. James Grieve on the rootstock M9. In spring, apple trees were fertilized separately with urea, ammonium nitrate and a liquid fertilizer Dam-390. 2 % solution of urea was applied in the autumn. Measurings of photosynthetic parameters were done on 3 July, 12 August and 24 September using the LI-6200 system. The obtained results indicate that both the nitrogen nutrition and a high content of chlorophyll in leaves did not show any effect on the photosynthetic rate. Trees fertilized with ammonium nitrate were the only exception because a significantly higher photosynthetic rate was measured on 12 August *i.e.* in the period of formation of flower buds.

21 06

The annual course of sap flow rate in laurel forest of Tenerife (Canary Islands)

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The sap flow rate was measured in six large trees of *Laurus azorica* (Seub.) Franco at the experimental site of laurel forest in Agua García, Tenerife continually over the whole year from May'93 to July'94. Sample trees were of different size covering the whole range of the species. Biometric parameters were applied to scale up the data from trees to the stand. Maximum daily transpiration was found about 5 to 50 liters per tree per day or up to 5 mm/day when expressed for the stand. The annual course of transpiration was very variable due to weather conditions and was mainly controlled by the evaporative conditions showing poor stomatal control. Contrasting to conditions in colder part of the globe, e.g. in central Europe, relatively high transpiration persists also over winter. Annual total of transpiration was thus higher here. Nevertheless the transpiration represents only smaller portion of stand water balance, what confirms important hydrological role of laurel forests for the island.

21 07

Effects of thinning on photosynthetic activity of a mountain Norway spruce stand

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During the growing season 1991 the measurement of the photosynthetic activity of shoots within the vertical profile of 34-years old Norway spruce (*Picea abies* [L.] Karst.) stand in thinned and control unthinned plots was carried out. The vertical heterogeneity of both canopies was responsible for a strong differentiation of PAR penetration and the photosynthetic activity, respectively. Generally, a higher values of parameters of the photosynthetic activity ($P_{Nmax.}$,α) of shoots, smaller differences between photosynthetic activity of the upper, middle and lower crown layers and significantly higher contribution of the middle and lower crown layer in the whole canopy photosynthetic production have been found for the canopy of the sparser thinned plot. Thinning was responsible for 20% decrease of the whole canopy LAI and this reduction of the amount of leaf area was connected with 52% reduction of the daily integral of the photosynthetic production compared with the control plot. Thus, thinning as the silvicultural treatment influencing spatial structure of the stand and canopy was manifested with significant changes on the level of shoot photosynthetic activity. The restoration of the photosynthetic activity in lower parts of canopy can be regarded as a very positive effect of thinning during the growing season of stand's reaction to thinning.

21 08

An example of acclimatisation of photosynthetic carbon assimilation of Norway spruce exposed to long-term elevation of atmospheric CO_2 concentration

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Young individuals (age of 12 years) of Norway spruce (*Picea abies* [L.] Karst.) were exposed during two growing seasons continuously to one of two CO_2 concentrations in open-top chambers under field conditions of a mountain spruce stand. Comprehensive analysis of CO_2 assimilation was carried out after 4 and 22 weeks of an influence of elevated atmospheric CO_2 concentration. Stimulation of light and CO_2 saturated rate of CO_2 uptake (P_{Nsat}) by 18 % under the influence of elevated CO_2 concentration from ambient to +350 $\mu l\ l^{-1}$ was observed only after 4 weeks of exposure. However, after 22 weeks the strong depression of P_{Nsat} by 28 % was obtained. The main expression of acclimatisation depression of photosynthetic activity under the influence of elevated CO_2 was observed on the level of the rate of RUBISCO carboxylation (decrease by 32 %, compared with the ambient CO_2 concentration) and electron transport rate (decrease by 30 %), respectively. The depression of the photosynthetic activity was accompanied with the decrease of nitrogen content (by 11 %) and the increase of carbohydrates (by 22 %) in needles after 22 weeks of elevated CO_2 concentration influence.

21 09

Vertical profiles of leaf characteristics in a laurel forest of Tenerife (Canary Islands).

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Different anatomical and physiological parameters were determined in leaves of tree species of a laurel forest in which the dominant trees were *Myrica faya* Ait., *Laurus azorica* (Seub.) Franco, *Persea indica* (L.) Spreng, and *Erica arborea* L. A tower of 16 m high was built and the samples were taken at different layers from the top down to the lower part of the canopy.
The studied parameters were the specific leaf weight (SLW), thickness, chlorophyll content and water potential. The SLW, thickness, and water potential decrease down through the canopy and also the chlorophyll content expressed by unit leaf area. These features together with the change in the ratio chlorophyll a/b denote the adjustment of the leaves to the different microclimatic conditions in every layer. Differences among the species are also shown.

21 10

Air pollution, photosynthesis and pH stat mechanisms of forest trees

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An annual cycle of the photosynthetic performance, the nutrient relations, and pH-stabilizing mechanisms of *Picea abies* and *Fagus sylvatica* in heavily damaged forest sites in the Ore Mountains (Krusne Hory, CR) was determined. For both species the total sulfur content increased drastically with leaf age. In 5-year-old spruce needles up to 3.5mg S g^{-1}dw were measured; in beech the S-content of the foliage increased from 1.5mg in spring to 2.7mg g^{-1} dw in autumn. The carboxylation and the light use efficiency of spruce showed a sharp drop from 0-year-old needles to 1-year-old needles with only a slight further decrease with needle age. For both parameters no linear decrease with needle age was found. In contrast, the photosynthetic capacity (A_{2500}) of spruce decreased linearly with time and revealed a good, negative correlation with the total sulfur content of the needles. Absolute values for A_{2500} were about 50% lower than those of comparable trees in the Fichtelgebirge (FRG). Anion analysis with beech leaves revealed that biochemical pH-stat-mechanisms were at work. Organic acids (malate), as well as nitrate concentrations decreased, when the sulfur content and concomitantly the H^+-concentration in the leaves increased. In the case of spruce, the massive accumulation of Ca^{2+} and other cations (Mg^{2+}, K^+, etc.) in older needles also indicated a functional biophysical pH-stat (H^+/Cat^+ exchange) at the root level.

21 11

Ethylene evolution in various phases of flower development in several trees and shrubs

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Ethylene evolution by generative organs at different stages of development in the following trees and ornamental shrubs were measured: *Ulmus glabra* Huds., *Jasminum sp.*, *Rhododendron japonicum* Suring., *Kolkwitzia anabilis* Graebn., and *Corylus avellana* L. var. "Fuscorubra".
An increased ethylene production was found during the intensive growth of flower buds (in *Kolkwitzia*), at the time of corolla unfolding (in *Rhododendron* and *Jasminum*), during the intensive pollen shedding period in bisexual flowers of *Ulmus*, and male inflorescences of *Corylus*. This phenomenon coincided, in most cases, with the intensive growth of some of the flower parts or the whole flower.
Ethylene forming enzyme (EFE) activity in Ulmus inflorescences was highest at the pollination period. The results suggest the involvement of ethylene in periods of flower ontogeny other than senescence.

21 12

Relationship between carbohydrate contents and desiccation tolerance of seeds of three *Acer* species

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Carbohydrate contents were measured during maturation and germination of seeds of Norway maple (*Acer platanoides* L.), silver maple (*Acer saccharinum* L.) and sycamore (*Acer pseudoplatanus* L.). Seeds of Norway maple are "orthodox" *i.e.* desiccation tolerant, seeds of sycamore and silver maple are "recalcitrant" *i.e.* desiccation sensitive. In model system sucrose is exceptionally effective in protecting membrane integrity in seeds during desiccation, as well as being one of the best vitrifying sugar. The oligosaccharide raffinose is known to enhance the protective effects of sucrose. In the present paper the role of sucrose and the others oligosaccharides in the desiccation tolerance of three species of *Acer* seeds is discussed.

21 13

Abscisic acid and abscisyl-β-D-glucopyranoside in relation to inwintering of *Picea abies*

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Seedlings of a northern and a southern population of *Picea abies* were grown continuously in the phytotron for 14 or 15 weeks at 20 °C and then treated for 1-9 days with 16 h nights or for 1-12 days with 5 h nights (northern only). Induction of budset, budrest and variation in abscisic acid concentration as response to long night treatments were assessed. The main results were: (1) 100% budset was induced after 1 long night (16 h) or 5 nights (5 h) in the northern population, whereas 4 long nights (16 h) were needed in the southern. (2) Budrest was attained after 3 and 9 nights (16 h) respectively. In 5 h nights the build-up of budrest was slower (northern). (3) A peak in free ABA was detected after 4 and 8 nights treatment (16 h), respectively and was neither due to release from conjugated ABA nor to water deficit in the seedlings (northern). No peak was observed after 5 h treatment (northern). (4) These results show a close correlation in time with budset and budrest reactions in *Picea abies*.

21 14

Deposition, mobilization, and interrelation of various storage materials in parenchyma cells of the wood of trees

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Perennial plants like trees show an accurately regulated transient accumulation of photosynthates and of various other storage materials. The well ordered seasonal accumulation processes of the main storage compounds, i.e., starch, sugars, protein, and fat, are illustrated for the parenchyma cells of the wood. Some of the physiologically essential but widely unsolved questions on the initiation of deposition and on the regulation of the accumulation level of individual storage compounds in the cells will be discussed. Results on the occurrence, subcellular localization, and spring time mobilization of storage proteins in trees are summarized and the prominent role of the apoplastic pathway in translocation of these mobilized nitrogen compounds in the wood during bud-break is demonstrated. The temperature-dependent interconversion of starch and sugars during cold adaptation in fall and in winter is shown as one example of the considerable metabolic activities during a period said to be dormant. Recent results on enzymes involved in the carbohydrate metabolism in the wood are presented and taken as a tool for getting better insight into the regulation of these metabolic events.

21 15

Patterns of radiolabelling in leaves and petioles of *Fraxinus* and *Sorbus*

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The radiolabelling of photoassimilates was analysed in leaflets and petioles (rhachis) of *Fraxinus excelsior* and *Sorbus aucuparia* after $^{14}CO_2$-pulses of 1-2 min and short chase-periods. In leaves of *Fraxinus*, the radioactivity of organic acids and sugar phosphates was more than 50 % of the label in the hydrophilic fraction after 1 min of chase, but deminished to less than 20 % after 10 min. Between 1 and 60 min chase, the radiolabel of starch and other insoluble molecules rised from 10 to 30 % and 3 % to 20 %, respectively. Mannitol and galactinol were the dominant soluble carbohydrates in the leaves and their radiolabel covered about 60 % of the neutral fraction. In the rhachis, the exported radioactivity was predominantly in soluble carbohydrates, especially in sugars of the raffinose-family (about 50%) and sucrose, whereas only small amounts of mannitol were labelled even after two hours. It is supposed that in *Fraxinus* mannitol is mainly involved in intermediary storage processes, while the oligosaccharides are the main substances for long-distance transport.
In *Sorbus*, sorbitol was the dominant water soluble carbohydrate in the leaf and carried about 90 % of the neutral fraction radioactivity after 25 min chase. In the rhachis (petiole), sorbitol was always the main compound with highest radiolabel followed by sucrose. Both, sorbitol as well as sucrose may be transported in the phloem path of *Sorbus*.

21 16

Ozone induction of birch (*Betula pendula* Roth) defense mechanisms at biochemical and gene expression level.

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Plants react to increased atmospheric ozone by inducing several stress reactions that are also induced by e.g., wounding and plant pathogens. We have exposed ozone sensitive and insensitive birch clones to ozone (150 ppb, 8 hours) and analyzed changes in enzyme activities (peroxidases, POX, SOD and glutathione reductase, GR), polyamine and phenylpropanoid concentrations, and gene expression (phenylalanine ammonium lyase, PAL, and chalcone synthase, CHS and genes controlling ethylene synthesis). Ozone exposure caused formation of necrotic lesions on the leaves of the sensitive clone. By twelve hours from the beginning of the ozone exposure, SOD, GR and POX activities increased in both clones significantly. The activities peaked at 24 hours. The ozone-sensitive birch clone had lower base-level GR activity than the insensitive clone and the increase was significantly higher. From the analyzed polyamines only putrescine levels were higher in the exposed sensitive clone, spermine and spermidine concentrations were similar between clones and treatments. PAL and CHS genes were induced by the eight hour ozone exposure decreasing rapidly afterwards. Induction of the genes was also reflected in the phenylpropanoid contents of the leaves. Ethylene synthesis controlling ACC synthase expression was also increased by the ozone-exposure.

21 17

Manganese forms in apple leaves

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Our investigation proves that the uptake of Mn by plants is a result of metabolic processes. Its active and rapid transfer in plants was observed. Mn is not linked with unsoluble organic ligands; in extracts it is presented in cation forms. The concentration of inorganic Mn in leaf tissues varied in rather a wide interval depending on the mineral nutrition and vegetation phase making 9 - 77 % of total Mn. The highest content of inorganic Mn in leaf tissues was observed during the period of the intensive growth. Sufficiently high content of inorganic Mn compounds during the intensive growth testified about its high mobility during this period. Evidently, owing to its high mobility plants do not succeed in assimilating Mn. In the stage of growth suppression the concentration of inorganic Mn forms varied in a rather narrow interval.

21 18

Existence of coniferous woody plants in forest ecosystems with periodical flooding of soils

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The influence of periodical flooding of forest land on physiological processes of Scots pine and Norway spruce in the taiga zone of European part of country has been studied. These studies indicated that the strategy of life of woody plants in these conditions include the variability of metabolic processes while changing overstrain of the oxygen stress, the utilization of products of incomplete dissimilation of wood matter on the reparation processes and structures partially broken in the moment of flooding of roots, the sink-source relations, the mesophyll building of adventive roots, negative geotropism of individual root branching-offs, the specific effects of CO_2 of the soil solution on metabolism of plants, *etc.*

21 19

Two concepts of positional control in cambium

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Morphogenetic fields responsible for positional control of cells in tree stem cambial region can be formed by quasistatic concentration gradients of specific factors (morphogens) or the vector fields resulting from transport of morphogens or propagation of morphogenetic waves. Thus, the morphogenetic field does not necessarily result from spatial distribution of morphogen molecules formed in organizing centers, but may be a consequence of the imposed pattern of energy distribution within the field. Auxin and other phytohormones may contribute to the formation of morphogenic field of any type mentioned above.