04 01

Auxin-photoperiod interrelation on the control of flower neoformation from tobacco genotypes with a different photoperiodic requirement for flower induction

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Thin cell layers (TCLs) were excised from tobacco plants with a different photoperiodic requirement for flower induction (cv. Maryland Mammoth, strict short-day plant, cv. Maryland Catterton, quantitative short-day plant, and cv. Samsun, day-neutral plant). TCLs were cultured in the absence of hormones or in presence of various concentrations of auxin (IAA), and were exposed to: continuous darkness, 8 h light per day, and 16 h light per day. The aim was to find out whether there exists an interrelation between auxin and photoperiod on the control of flower formation from post-induced plants. No flower formation was obtained in the absence of IAA. At 10^{-6} M and $5x10^{-6}$ M of IAA the highest flower neoformation was observed. Short-day enhanced this response, but only in the genotypes with a short-day requirement in the inductive phase.

04 02

Effect of monochromatic light on growth of *in vitro* and *ex vitro* plants

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Some species of fruit plants are difficult to micropropagate due to not satisfactory shoot and root formation. Difficulties are met also with plants removed from glass, because of their poor development. The aim of these experiments was to investigate the activity of monochromatic light in regulation of morphogenesis of the cultured shoots *in vitro* and subsequent *ex vitro* growth of the plantlets.

Shoot cultures and *ex vitro* plantlets of sour cherry cultivars (*Prunus cerasus*) and blueberry (*Vaccinium corymbosum*) cv. Bluetta were placed under fluorescent light: white cool, white warm, blue, red and green. Reaction of *in vitro* plant material to red light appeared in shoot elongation, whereas under blue light area of laminae was stimulated. The plants growing *ex vitro* under red light showed epinastic reaction and later on they decline and finally died. The highest quality of crown and root system of *ex vitro* plants has been achieved under blue light.

04 03

Phytochrome regulation of the morphogenesis of forage plants

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During plant growth, as the competition for light increases, the photosynthetic active radiation intercepted by leaf area unit decreases but light quality is also altered due to the far red light reflected by neighbouring leaves. The effects of this change in light quality were investigated on two species which are usually intercropped, clover and fescue, in order to compare their adaptative strategy towards light competition. During the day, the plants received the same photosynthetic active radiation (140 μmol m^{-2} s^{-1}) but the spectral distribution of light was different: one batch received a light spectrum similar to full sunlight (control), the other one, light with a lower red/far red ratio (far red treatment). The far red treatment lowered the rate of tillering and ramification for the two species. The leaf appearance rate of clover was also decreased by the far red treatment but the fescue's one was unaffected. So that the inhibition of tillering could not be due to a reduced number of potential tillering sites. In comparison with fescue leaves which size was poorly modified, clover produced fewer but bigger leaves under simulated shading. Such experiments using diurnal treatments could allow the comparison and the quantification of the response of different species to simulated competition for light.

04 04

Regulation of photomorphogenesis at the transcriptional level

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Three hierarchically distinct levels of regulation will be discussed: a) DNA sequences (*I* box, *G* box) involved in the transcriptional regulation of photomorphogenesis-associated genes (*rbcS, cab*). b) Recognition of these sequences by specific transcription factors and its modulation by exogenous (light) and endogenous (circadian clock, tissue-specific) signals. c) Activities (*e.g.* protein kinases) possibility involved in this modulation.

04 05

Photoperiodism, leaf development and chloroplast ultrastructure in *Perilla ocymoides*

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The anatomical and ultrastructural changes in developing *Perilla* leaves at the controlled photoperiod were studied. The dimorphism of chloroplast thylakoids (regular and modified types) was correlated with photoperiodic conditions as well as with dynamic of structural changes in the leaf. The periods of tissue differentiation, proliferation and growth of chloroplasts are longer under continuous illumination (non-inductive regime) than under a short day (inductive regime). At the same time the modified structure of thylakoids in chloroplasts is preserved during the whole period of leaf development under continuous illumination and they are transformed into regular type under short day at the very early stage of leaf development. Thus, the presence of modified thylakoids shows the trends to vegetotropous development which is maintained under continuous illumination; the appearance of regular type of thylakoids at the early stge of leaf formation demonstrates the anthotropous development. It is suggested that structural features of thylakoids are connected with the involving of chloroplasts in elaboration of auxin, the level of which has a considerable influence on the leaf development.

04 06

The effect of the light and of the determinated by the mutation chlorophyll-deficiency on the phytohormones in pea plants

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The pea mutant of "*xantha*" type and the wild pea plants did not differ in their photomorphogenesis. In the light-grown mutant chlorophylls were absent, carotenoid content consisted about 12 % of their level in the wild green form. Chlorophylls and carotenoids were absent in the dark-grown mutant and wild plants. The light-grown mutant and wild plants (both their shoots and roots) did not differ in the IAA and cytokinin content; the ABA level was several times lower both in the light-grown mutant and in the dark-grown wild plants. In the dark-grown plants the level of IAA was several times higher, cytokinins accumulated in the roots preferentially. Thus, the content of hormones depended on the light, chlorophyll-deficiency affected the ABA only.

04 07

Structural studies on protochlorophyllide reductase

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The enzyme, protochlorophyllide reductase, catalyses the light-dependent step in chlorophyll biosynthesis and is currently attracting much interest as a potential regulator of light-dependent chloroplast development in higher plants. The enzyme also offers an ideal model for studying mechanisms of dehydrogenases. To facilitate the latter work we have recently developed a successful purification technique for the active enzyme. Structural and mechanistic studies on this preparation will be presented.

04 08

Osmotic effect on phytochrome-mediated nyctinastic closure of *Albizzia lophantha* leaflets

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The effect of osmotica (PEG_{6000}, sorbitol and mannitol) and their interaction with the effect of fusiccocin (FC) has been investigated in phytochrome-mediated nyctinastic closure of *Albizzia lophantha* leaflets. FC (1 to 100 µM) inhibited nyctinastic closure and enhanced reopening in the presence of Pfr. Sorbitol and mannitol (25-100 mM) increased nyctinastic closure for about 2 h and then enhanced reopening in the presence of Pfr. When sugar alcohols were applied together with FC, sorbitol and mannitol enhanced the FC inhibition of closure and a marked synergistic effect was observed. PEG_{6000} (25.5%) also increased closure but a further enhanced reopening and synergistic effect with FC was not observed. Data are discussed in relation to the monitored changes of external pH. Results could indicate that both FC and the reduction of external osmotic potential stimulate the activity of the extensor H^+ pump promoting the reopening.

04 09

Photocontrol of stem elongation and dry weight partitioning in *Phaseolus vulgaris* L. by the blue-light content of photosynthetically active radiation

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The spectral distribution of light is a major environmental factor controlling plant development. We examined the influence of blue light on the morphogenesis of *Phaseolus vulgaris*. At constant PAR, decreasing the fraction of blue light stimulated internode elongation and increased dry weight partitioning into internodes, mainly at the expense of leaf growth. Total plant growth was not affected by the changes in light quality. This indicates that the shift in dry weight distribution was a photomorphogenetic response and not caused by a change in photosynthesis. As R:FR was similar and about 9 in all light treatments, photomorphogenesis of the plants in our experiments was most probably controlled by a blue-light photoreceptor and not by phytochrome. During stem elongation the activity of acid invertase in the internodes increased. This enhancement was stronger in the faster elongating internodes in the light most deficient in blue and was accompanied by an increase in the ratio of concentrations of hexoses to sucrose. Osmolality increased about twofold during the initial phase of elongation, but was not affected by the quality of the light. We conclude that a stimulation of sucrose hydrolysis in internodes in blue-deficient light is a mechanism that contributes significantly to the maintenance of the osmotic pressure of the faster elongating cells.

04 10

Cytoplasmic contraction and chloroplast movements in *Lemna trisulca* leaves require actin/myosin contractile proteins

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Chloroplasts move forming definitive patterns in leaf cells upon blue light irradiation (phototranslocations). Two patterns are: (*1*) flat position, chloroplasts orient to light during low irradiance, (*2*) profile position, chloroplasts orient to avoid light at high irradiance. Chloroplast movements are deemed caused by actin/myosin interactions, but their mechanisms have lacked experimental confirmation. Our investigations of *Lemna* leaf cells discovered that cold buffered glycerol physiologically preserves phototranslocation patterns. Moreover, Mg-ATP treatment of glycerinated cells induced cytoplasmic concentration and "normal" chloroplast movements. The flat or profile chloroplast patterns in models determine subsequent motions. N-ethylmaleimide (NEM), an actin/myosin inhibitor irreversibility prevents movements. The experiments indicate actin/myosin interactions as fundamental mechanisms of phototranslocations and/or cytoplasmic contractility in leaves. Moreover, our results suggest a dynamic actin cytoskeleton contributes to chloroplast phototranslocations. Our electron microscopic investigations reveal cytoplasmic architectural fibers associating with chloroplasts.

04 11

Inter-organ and age-dependent variations in hook maintenance and opening

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The effect of excision of various organs (cotyledons, apex, hypocotyl, roots), with or without a short red light treatment, was monitored in etiolated seedlings of four plant species, as well as at different ages of radish seedlings. Large species- and age-dependent variations were observed, confirming the old results of other authors. The reason of these variations is considered in terms of a single transduction chain controlling hook maintenance, where the effects of adjacent organs and light refer to direct or allosteric modulation of a key rate-limiting step (enzyme).

04 12

Temperature and photoperiod interactions with the phenological development of sunflower genotypes

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Three sunflower hybrids and their parental forms have been cultivated in a field trial at two sowing times at 8-, 12-, 15-h illumination. Length of emergence-blooming phase in studied sunflower genotypes expresses variability, being influenced by photoperiod and temperature more than by other environmental factors.

The sum of temperature degrees is more indicative for a better estimation of phenological phases than sum of days.

The genotypes studied have revealed different reaction to daylenght and temperature. There are genotypes of long daylength (Decor, female of Decor), intermediate daylength (Select, female of Select, female of Turbo, male of Turbo, Select, Decor - the sample male line for all three hybrids), and neutral daylength (Turbo) at low temperature (15 - 20 °C) during floral initiation. There are genotypes of neutral daylength (Decor, Select, male of Turbo, Select, Decor) and intermediate daylength (female of Turbo, Select, Decor) at high temperature (20 - 25 °C) during floral initiation.

04 13

The development of wheat with different photoperiodic response

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In the soil culture in greenhouse winter, spring and alternative wheat was studied. The dependence of photosynthetic activity on different photoperiod was determined. Under a short day in autumn, the development of alternatives was slower than that of winter wheats. Alternatives had slight photoperiodic sensibility. This was expressed in higher leaf growth, water content, increasing photosynthetic surface and higher content of green and yellow pigments, but quality of soluble carbohydrates was insufficient. At spring sowing alternatives developed slower than spring wheats. According to photosynthetic parameters alternatives occupy an intermediate position between winter and spring wheats.

04 14

Approaching the circadian oscillator(s) in *Pharbitis nil*

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Circadian rhythms can be equated to the hands of a clock, driven by an underlying oscillator, which equates to the clock mechanism. Control of the phase of the rhythm, which results in entrainment, is assumed to result from the action of light on the oscillator. Thus to approach the clock mechanism one might follow forward the pathway from perception of light, or alternatively attempt to trace the transduction chain back from one or more rhythms.
In *Pharbitis nil* the photoperiodic induction of flowering involves a circadian rhythm in measuring the duration of darkness; this is suspended in light and runs from the onset of darkness. We have been examining other circadian rhythms as part of an approach to the oscillator underlying photoperiodic time measurement. A rhythm in stomatal aperture has been analysed by a simple automatic system, while a rhythm in *Cab* gene expression has been followed by northern blotting and hybridisation with a heterologous *Cab* probe.
The rhythms in stomatal aperture and in *Cab* expression are initiated by and continue to be detectable in continuous light, and appear to be phase-shifted at the light to dark transition. Preliminary analysis indicates that the phases of these two rhythms are responding in a similar way, which may indicate that they are driven by the same oscillator, but that this is different to the oscillator driving the photoperiodic rhythm.