

08 01

Early growth events and their preparation in germinating seeds of *Vicia faba minor*

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Radicle protrusion of *V. faba minor* seeds occurs by elongation of hypocotyl cells starting from apical cells onward. Six hours after radicle emergence the elongation of its basal cells begins. The hypocotyl and root grow only by cell elongation up to their length about 10 mm, then the mitotic activity in root meristem commences. As the early germination proceeds only by cell elongation, we studied the processes preparing for elongation and occurring in embryo axis. Axis imbibition up to 60 % water content (f.m.) resulted in successive activation of metabolic systems. Preparation of elongation in the axis within water content range of 60 - 72 % involves 1) accumulation of solutes providing for further water uptake; 2) activation of plasmalemma H⁺-ATPase necessary for acidification of cell walls and their loosening.

08 02

Regulation of gene expression of nitrite reductase by phytochrome and nitrate in germinating turions

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Turions are resting fronds of the duckweed *Spirodela polyrhiza* (L.) Schleiden. Control by light and nitrate of the appearance of nitrite reductase (NIR) was investigated. In phase I, immediately after transfer to germination conditions, a nitrate-dependent, but light-independent increase in NIR activity was demonstrated. After 72 h in darkness (phase II) responsiveness against phytochrome has been developed. However, the light effect on enzyme synthesis was only observed in the presence of nitrate. NIR transcript level was increased both by light and nitrate. The highest transcript level was detected when light as well as nitrate were provided (synergistic effect). The mode of coaction between the controlling factors is different in phase I and phase II and, consequently, depends on the developmental stage of plant organs.

08 03

Changes in protein synthesis during stratification and jasmonic acid treatment of *Acer tataricum* seeds

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Tataricum maple seeds are characterized by a deep physiological dormancy. A natural release of seeds from the dormancy is a result of a long cold stratification in wet conditions or jasmonic acid (JA) treatment. We studied the protein synthesis in seeds stratified at 4 °C, incubated at 22 °C and treated with JA. Seeds treated with JA at 4 °C germinated 15th-day while seeds kept at 22 °C did not germinate at all. The protein synthesis was measured *in vivo* by incorporation of ³⁵S-methionine in purified protein. At 4°C the protein synthesis intensity increased linearly until germination in embryonic axes while in cotyledons it intensified during stratification and then it decreased by the tenth day of germination. The JA treatment involved some increase in the translation activity in seeds reaching that of stratified seeds. Analysis of isotope labelled proteins using a two dimension gel electrophoresis allowed to find that the levels of specific proteins are similar both during the stratification and JA treatment.

08 04

Abscisic acid in germinating and maturing *Phaseolus vulgaris* seeds

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At the initial stages of the bean seed development abscisic acid (ABA) is concentrated mostly in seed coat, later on its level increases in embryo organs. By the moment of complete maturation a decrease in ABA content in all organs of the bean seed occurs. The decrease in the ABA level in maturing bean seeds involves a quick seed dehydration and seed entry into exogenous dormancy. Prior to the moment of radicle emergence in mature seeds ABA is practically absent in embryo organs and during a further development of the seedling its significant amount is accumulated only in the leaf and root. With the onset of those organs intensive growth their ABA content decreases. ABA role at all stages of seed maturation and germination appears to be related with the cell growth regulation through cell division and elongation. Besides ABA produces inhibiting effects on division and elongation processes that are compensated through the synthesis of IAA up to certain ratio with it.

08 05

The role of fructose-2,6-bisphosphate in the cyanide-mediated removal of apple embryonic dormancy

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The effects of HCN pretreatment on fructose 2,6-bisphosphate (F-2,6-P₂) content, on activity of fructose 6-phosphate 2-kinase (F-6-P, 2K, enzyme synthesizing F-2,6-P₂), as well as on activities of PPI- and ATP-dependent phosphofructokinases (PPI-PFK and ATP-PFK) were studied in cultured, dormant apple embryos. HCN sharply increased the F-2,6-P₂ level and F-6-P, 2K activity in embryonal axes. HCN pretreatment of embryos or the addition of F-2,6-P₂ to enzyme extract stimulated PPI-PFK activity, whereas the activity of ATP-PFK was slightly inhibited by HCN. It is proposed that the stimulation of glycolysis by endogenous HCN, being one of the first processes of apple embryo germination, is the result of F-6-P, 2K activation in axes, leading to F-2,6-P₂ accumulation which in turn enhances glycolysis by activation of PPI-PFK.

08 06

A cysteine proteinase from germinated wheat which degrades gliadin

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During germination, storage proteins are degraded by a battery of proteinases in order to supply amino acids to a growing embryo. Of these proteinases, cysteine endopeptidases (EC 3.4.22) strongly increase in activity during the germination of barley seeds (Koehler and Ho, 1988; Pouille and Jones, 1988; Phillips and Wallace, 1989; Wrobel and Jones, 1992). Far less is known about cysteine proteinases from wheat seeds because their isolation is hampered by enzyme lability (Shutov et al., 1984; Dunaevsky et al., 1989). We have studied the proteinase activity against gliadin, the main endospermatic storage protein, in dry and germinating seeds of wheat (*Triticum durum*, cv. Cresco). The activity was just detectable in dry seeds, it increased from the first day of germination to the third day and decreased after the fifth day. The gliadin degradation was parallel to the proteinase activity. The cysteine proteinase activity was clearly dominant and accounted for 88.6 % of the total activity, as demonstrated by the use of E-64. The cysteine proteinase was isolated from wheat endosperms excised from seeds germinated for four days, using in series, after protein extraction, ammonium sulfate precipitation, DEAE-anion exchange chromatography, SP Sephadex C-50 cation exchange chromatography and Rotofor preparative isoelectric focusing. The purified enzymes existed in different forms which could be separated by preparative isoelectric focusing and polyacrylamide gel electrophoresis.

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08 07

Evidence that nitrate reductase is associated with mitochondria in *Erythrina caffra* seeds and participation of mitochondrial metabolism in anaerobic germination

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Erythrina caffra is the only dicot known to be capable of anaerobic germination. Although glycolytic activity appears necessary for this we present evidence that mitochondrial activities such as utilization of acetate and protein synthesis occur anaerobically. High levels of mitochondrial enzyme activities and inter membrane electron transport were found in axes of anaerobically germinated seeds.

Part of the nitrate reductase activity in seed embryonic axes, which is enhanced by anaerobiosis, was found associated with mitochondria. Further evidence for mitochondrial associated nitrate reductase was obtained from results on immunoinactivation, immunoblotting and immunogold labelling. Nitrate substantially enhanced anaerobic protein synthesis in mitochondria. Taken together these results indicate that mitochondrial activity occurs anaerobically and may play a role in anaerobic germination. Nitrate and nitrate reductase appear to be involved.

08 08

Study of a 23.5 kDa glycosylated polypeptide variation during seed development, germination and plant growth of *Lupinus albus*

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The storage proteins, their composition and regulation has been object of study for several years due to their importance in nutrition.

A ConA-binding polypeptide (G23) was identified in *L. albus* seeds and was found to decrease during germination and plant growth. A polyclonal antibody raised against G23 was produced and purified by affinity. The variation in G23 content during seed development, germination and plant growth was screened by immunoblotting with the purified antibody. It was found that G23 accumulates in the seed after the 40th day after anthesis and that, being present in the seed, it is detected after imbibition until the 9th day in cotyledons, the 2nd day in roots and hypocotyls and faintly until the 5th day in leaves.

Studies on G23 structure are being performed in order to clarify its nutritional importance.

08 09

Cytological changes during *Daucus carota* and *Brassica napus* seed matriconditioning**A. DAWIDOWICZ-GRZEGORZEWSKA***Laboratory of Physiology of Plant Growth and Development, University of Warsaw, Krakowskie Przedmiescie 26/28, 00-927 Warszawa, Poland*

Benefits of solid matrix priming (SMP), in general, are earlier and more uniform germination, similarly as of PEG-conditioned seeds. It was already published that endosperm-containing seeds show particularly beneficial responses to the priming and suggested the "weakness of endosperm" (due to the hydrolysis of storage cell walls) as a possible main effect of priming. The present investigation shows that during the SPM some advancement in the catabolic (II) phase of germination is taking place in both, the embryonic axis and endosperm and includes the degradation of storage protein bodies and cell wall polysaccharides. Contrarily to the former opinion, we suggest that the main effect of SPM is resulting from the fact that embryonic axis becomes metabolically advanced in comparison with non conditioned seeds. The temporal and spatial observations indicated that mobilization of the storage compounds in the endosperm is stimulated by the metabolically advanced axis.

08 10

Seed germination strategies and the role of light in maritime plants**P. DELIPETROU, K. GEORGHIOU, and C. A. THANOS***Department of Botany, University of Athens, Athens 157-84, Greece*

The seed germination of 32 mediterranean maritime species was studied, with special emphasis on the effects of light. Based on data from laboratory experiments, and field observations, the following general remarks can be made: Most of the species had a similar temperature dependence pattern and germinated in the dark. Otherwise, their germination characteristics (primary and/or secondary dormancy, time course of seed germination) differed, reflecting the different strategies they follow for ensuring optimal survival. Photoinhibition of seed germination -or delay- was the dominant effect of light in maritime sand species. Light promotion of germination was observed in 2 maritime rock species. Six species were apparently indifferent to light, 4 of which hardcoated. Photoinhibition was typically proportional to the intensity (linear dependence on the logarithm of fluence rate) and duration of irradiation. Irradiations establishing low ϕ were generally more efficient in inhibiting germination, with the one notable exception of *Brassica tournefortii*. Secondary dormancy induced by continuous light was also observed. The results support an ecophysiological role of photoinhibition of seed germination as a phytochrome mediated-subtle regulation mechanism to avoid germination at or close to sand surface where the harsh conditions do not favour seedling establishment.

08 11

Protein bodies are the main lytic compartment of the cell of a seed storage tissue

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Protein bodies are specialized cellular organelles in which storage proteins and phytin are located during seed dormancy. We isolated pure and native protein bodies from dry seeds of buckwheat and white lupin and from the 4-day-old seedlings of buckwheat. The activity of a variety of acid hydrolytic enzymes, namely aspartic proteinase, acid phosphatase, α -D-mannosidase, N-acetyl- β -glucosaminidase were found to be located in the isolated protein bodies. The true marker enzyme for protein bodies was found to be only aspartic proteinase. In the protein bodies of dry buckwheat seeds a metalloproteinase was located, which was responsible for the first stage of hydrolysis of the main storage protein of buckwheat. Its proteinaceous inhibitor was also located in these protein bodies, thus preventing the storage protein from premature proteolysis. In the protein bodies of buckwheat seedlings a cysteine proteinase was detected, performing the second stage of the storage protein hydrolysis. The data obtained confirm the hypothesis of F. Matile that the protein bodies are the main lytic compartment of storage parenchyma cells, and may operate as autophagic organelles during germination.

08 12

Reversible sensitivity characterizes seed dormancy

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Emergence of seedlings from many species occurs during specific periods of the year. This phenomenon is the result of annual cycles of dormancy through which the seeds in the seed bank go. Loss of dormancy does not necessarily result in germination, it only occurs when the temperature window of the seeds overlaps with the actual field temperature. Dormant seeds have a very narrow window, loss of dormancy widens the window considerably. In many species light and nitrate are also required for successful germination. These factors only stimulate germination of non-dormant seeds, they do not affect the depth of dormancy. Sensitivity to light (via phytochrome) correlates with annual dormancy patterns, it is similarly reversible as the width of the temperature window. Further analysis of dose response relationships has led to an integrating model for dormancy cycling. Basic presumption of the model is that synthesis or activation of receptors for phytochrome and nitrate determines the sensitivity to these factors. Merit of the model is that it integrates the effects of three major factors that regulate dormancy and germination.

08 13

The effects of polystimulin A-6 on the germination of *Helianthus annuus* and *Brassica napus* seeds under saline conditions

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Polysitimulin A-6 (PSA-6) is a plant growth regulator with wide range of action. It has been reported that A-6 possesses of auxin-like activity. Also, it is known that PSA-6 has positive effect on the growth of plants under various stresses. The objective of this study was to test effect of different concentrations of A-6 and 2,4-D on the germination of *Helianthus annuus* and *Brassica napus* seeds under the salt conditions (with the concentrations of 0.2, 0.4, and 0.6 %). Before the germination of the seeds, they were soaked into PSA-6 and 2,4-D with the concentration of 10, 20, 30, 40, and 50 mg/l for 48 hours. The results showed that 2,4-D reduced the germination rate of both species under the salty conditions. Germination rates in *Helianthus annuus* ranged from 50% to 75%. Also poor growth forms observed in plants tested with 2,4-D e.g. seedlings had short stem, small leaves, and weak roots. On the other hand, PSA-6 had considerable impacts in improving of the seed germination of both species. Among tested concentrations, 10 mg/l (for *Helianthus annuus*) and 30-40 mg/l (for *Brassica napus*) were the best concentration for seeds germination. Seeds germination ranged in both speceis from 90% to 100%.

08 14

Seasonal and seed-age dependent fluctuations of ribonuclease activity in seedlings of *Vicia faba* ssp. *minor*

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Ribonuclease activity in roots of 3-d-old seedlings of *Vicia faba* L. ssp. *minor* was analysed for 3 years at monthly intervals. Seasonal fluctuations of RNase activity were noted, with minimum in winter and maximum at September. In consecutive years of seed storage there was a decrease of RNase activity in the autumn. In a 1st year after harvest the ratio max (Sept): min (Jan) activity was 7.7, in the 2nd year it was 2.7. Chilling stress doubled the RNase activity irrespective of season and the age of seeds.

08 15

The effect of ethephon, ACC, GA₃, GA₄₊₇ and BA on germination of redroot pigweed seeds

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Redroot pigweed seeds, collected in 1992, showed 0 -15 % germination in darkness at temperatures ranging from 20 ° to 30 °C. Ethephon (10⁻⁴ M) stimulated germination at 25 °C (53 %) and 30 °C (95 %). ACC (10⁻³ M) induced germination only at 30 °C (94 %). GA₃ (10⁻⁴ M) promoted germination at 20 °C (40 %), 25 °C (93 %) and 30 °C (94 %).

Likewise GA₄₊₇ was very effective as a stimulator of germination of dormant redroot pigweed seeds. BA had no effect on seed germination.

08 16

Protoplast isolation from carob (*Ceratonia siliqua* L.) endosperm. Effect of water stress, endosperm leachate and ABA on α-galactosidase and endo-β-mannanase activity and secretion.

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Endosperm galactomannan hydrolysis proceeds through the action of α-galactosidase and endo- and exo-β-mannanase. These hydrolases are produced in carob endospermic cells and are secreted in the wall containing galactomannan. Although the biochemistry of galactomannan hydrolysis is fairly well understood, nothing is known on the secretion of α-galactosidase and endo-β-mannanase. Protoplasts offer the ideal experimental material for such studies. Protoplasts from carob endosperms were isolated using Cellulase "Onozuka" R-10 and Macerozyme "Onozuka" R.-10. Protoplast vacuolation and the increase of α-galactosidase and endo-β-mannanase activities, in the protoplast extract and incubation medium, started after 2 d of protoplast incubation. After 5 d, protoplasts were highly vacuolated, having 1-3 large vacuoles, while the activities of both enzymes were comparable to the corresponding of whole endosperms. The effect of several factors, such as ABA, water stress, the leachate from carob endosperm and seed coat, on carob endosperm viability and on the production and secretion of α-galactosidase and endo-β-mannanase was investigated.

S114

08 17

Ethylene as inducer and regulator of potato tuber dormancy**N.P. KORABLEVA, T.A. PLATONOVA, M.Z. DOGONADZE***Bach Institute of Biochemistry, Russian Academy of Science, Leninsky pr. 33, Moscow 117071, Russia*

The obtained results show that the ethylene takes part in the induction and in the regulation of potato tuber dormancy and it is a mediator of the inhibiting action of abscisic acid (ABA). The evidence of ethylene role in the regulation of potato tuber dormancy is the influence of ethylene or of the inducers of its biosynthesis, in particular, epibrassinolide (EB) on the formation of 1-aminocyclopropane-1-carboxylic acid (ACC), of ethylene and of ABA in the tubers and in the apical points of growth of potato tubers. These changes exert influence on stretching and on thin structure of stem meristem cells of apical points of growth and prolong the period of deep dormancy of potato tubers.

08 18

Metabolic control of dormancy**S. LEWAK***University of Warsaw, Institute of Plant Experimental Biology, Krakowskie Przedmieście 26-28, PL-00.927 Warszawa, Poland*

Dormancy, being the temporal cessation of growth of plant meristems, is caused by a block, or a set of blocks, imposed on some cardinal processes indispensable for normal, harmonious course of each phase in plant development. Among these processes a network of metabolic pathways is of primary importance. The control of metabolic events, involved in dormancy maintenance and removal, by environmental and endogenous factors (mainly hormones) presents a way of dormancy regulation. Some examples of such regulation, related to seed dormancy, will be discussed and some questions will be asked.

08 19

Effect of GA₃, ABA and polyamines on *Solanum tuberosum* sprouting

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The number of main stems in a potato plant determine the subsequent number and size of the tubers formed. Potentially, every eye may give rise to at least one main stem, and the average eye number per tuber depends on cultivar. However, during the early stages of sprouting apical dominance is established, limiting the number of main stems. The possibility of modifying the early development stages was studied for 12 cultivars (3 early-Agata, Amati, Binella-, 3 middle early-Marfona, Cosmos, Arinda-, 3 middle late-Agria, Picasso, Cosmos- and 3 late-Crebella, Producent, Cornado-), by means of gibberellic acid, abscisic acid, putrescine, or spermine solution dips previous to sprouting. Tubers were planted on vermiculite and sprouting was weekly recorded. Gibberellic acid treated tubers sprouted earlier and developed more sprouts. Putrescine, spermine, and abscisic acid treatments initially delayed sprouting, but after a month an increase in sprout number was evident for most treatments. A strong cultivar dependence was also recorded.

08 20

Protein synthesis in germinating and maturing seeds

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Protein-synthesizing system functioning in embryonic organs of maturing and germinating bean seeds were studied. A progressive decrease in the number of polyribosomal informosomes at the final stages of maturation results in a practically complete absence of them in all organs of the mature seed embryonic axis. However, a small number of polyribosomes able to synthesize protein in the hypocotyl and root and a smaller number in the leaf were found even at the period of a complete maturation that appears to reflect some specificity of the protein-synthesizing system in seeds not possessing a deep physiological dormancy. By the time of a complete maturation of the seed, cells have a complement of preformed mRNA whose translation begins at the moment of the seed hydration and assures. In the phase of imbibition, the main synthesis of protein required for dormancy breaking. A quick incorporation of mRNA of free informosomes into polysomes during the first hours of germination is an evidence of a protein synthesis activation involving both reserved and newly synthesized matrices. Some differences in the ratio of polyribosomal and free mRNP in cells of seed individual organs are present. In organs with a different type of growth the pattern of the protein synthesis is similar and varies synchronously during the seed development that is an evidence of a synthesis regulation general mechanism.

08 21

Viability and ABA changes in aged sunflower seeds

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Viability and ABA changes were analyzed in sunflower (*Helianthus annuus* L. cv. Peredovik) seeds. All assays were carried out using artificially aged seeds (43°C and 75 % RH in controlled chamber) for up 1, 5, 9, and 11 days. Seed viability was reduced as ageing period increased. In addition an increase in the production of morphologically abnormal seedlings was also observed. Relative to unaged seeds (0,2 µg/g seed), an increase in ABA content determined by UV-HPLC was detected in aged seeds (from 0,25 to 0,36 µg/g seed, on day 1 and 11, respectively), showing a maximum in seeds aged for up 9 days. ABA isomer levels increased in a similar way. These changes may give a suitable indication on seed deterioration.

Acknowledgements - This work was supported by U.C.M. (Project No. MD/08/89-1472).

08 22

Ascorbate peroxidase activity in cotyledons from germinating sunflower seeds

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Ascorbate (AsA) peroxidase activity and AsA levels were determined in cotyledons from germinating sunflower (*Helianthus annuus* L. cv. Peredovik) seeds. In dry seeds the activity of AsA peroxidase and AsA levels were not detected, but increased rapidly during the germination, especially after radicle emergence. Thereafter an evident decrease was observed in both analysis. The evolution of AsA peroxidase activity and AsA levels showed a similar pattern. These results reflect that one of the first events during initial stages of growth is the production of antioxidants to avoid cellular damages.

Acknowledgements - This work was supported by U.C.M. (Project No. MD/08/89-1472).

08 23

Physiological and chemical characteristics of aged fennel seeds**M.A. PÉREZ-CEREZO, M. TORRES, A. VEGA* and J. SERRANO****

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Viability and chemical composition of volatile compounds of fennel (*Foeniculum vulgare* Mill.) seeds were analyzed. All assays were carried out using artificially aged seeds (40 °C and 75 % RH in sealed container for up 1, 3, and 6 d). Relative to unaged seeds, the viability was substantially reduced as ageing period increased, which was 33 % in 6 d old seeds. More than 30 components were identified in aged seeds by automatic thermal desorption (ATD) technique coupled to GC-MS system. These deterioration conditions did not affect significantly qualitative chemical composition. However, quantitative variations were detected in aged seeds which showed lower essential oil yields. This study allows us to obtain a suitable information on physiological age and potential vigour of aged seeds.

08 24

Effect of the radicle on isocitrate lyase activity, ATP levels and protein profiles of *Cucumis sativus* cotyledons during germination**G.P. PODGIETER* and J.G. CHRIS SMALL****

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Previous studies indicate that the radicle influences cotyledon metabolism of lipid rich seeds. In most studies, however, it is not clear whether these results were affected by the presence or absence of the testa and hence oxygen supply. The present study aimed at ascertaining whether the apparent effect of radicle removal (sink effect) could be separated from an oxygen supply effect (testa removal). Isocitrate lyase (ICL) activity and ATP levels markedly increased after germination (24 h). However, radicle removal resulted in a marked decrease in ICL activity and ATP levels. This effect was diminished to some extent when the testa was removed. Major changes occurred in protein profiles (SDS-PAGE) after 24 h incubation and the main trend was not affected by radicle removal. However, certain polypeptide bands which disappeared during seedling growth were prevented from doing so by radicle removal. It is concluded that induction of ICL activity and ATP production and the synthesis of certain proteins is inhibited by radicle removal. This inhibition is alleviated to some extent by removal of the testa.

08 25

Latent period peculiarities in some species of genus *Aconitum* L. in *Ranunculaceae*

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The peculiarities of dormancy and germination were studied in seeds of *Aconitum* L. species. It was established that the seeds of investigated species are distinguished by morphological and morphophysiological dormancy (by M. Nikolaeva's classification, 1968). Postembryology development occurs at 9 - 10 °C, germination at 0 - 3 °C. Gibberellic acid spreads the germination temperature range of the investigated seeds.

08 26

Effects of jasmonic and abscisic acids on lipases in apple seeds

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Effects of jasmonic (JA) and abscisic (ABA) acids on the germination and lipolytic activities were studied in embryos isolated from dormant apple seeds as well as from seeds after different periods of stratification. JA stimulated and ABA inhibited the dormant embryos germination. During light-triggered germination of dormant embryos, JA stimulated alkaline lipase activity (AlkL, the enzyme initiating the mobilization of lipid reserves) and its action was antagonised by ABA in vivo and in vitro. Acid lipase activity (AcL, the enzyme initiating the storage lipids mobilization during the cold-mediated breaking of dormancy) was stimulated by JA in vivo and also in vitro. The activity of AcL was not affected by ABA. It was concluded that both JA and ABA do not control the biosynthesis of studied enzymes but are involved in activation-deactivation mechanism of AlkL activity, whereas AcL is not under the control of ABA.

08 27

Germination of *Latuca scariola* L.**N. ROTH-BEJERANO***Department of Life Sciences, Ben-Gurion University, Ber-Sheva, Israel*

Germination of *L. scariola* is stimulated by a short illumination with red and blue light, the most efficient illumination being after 3 h of imbibition. A short illumination with far-red light inhibits the dark, red and blue light stimulated germination, indicating that Pfr is essential in germination processes. Germination caused by one short illumination is inhibited by Ca^{2+} and lanthanum. The inhibition by Ca^{2+} can be diminished by a second short illumination (after 6 h imbibition). Dark germination is stimulated to some extent by low concentrations (till 5 mM) of EGTA and inhibited by 10 mM, suggesting dual effect of cation chelation. These results may indicate that illumination affects Ca^{2+} re-distribution, necessary for germination.

08 28

Assay of germination inhibitors in dormant seeds**R.S. SARLACH* and V.K. RAI*****Department of Plant Breeding (Pulses Section), Punjab Agricultural University, Ludhiana-141004, India***Department of Bio-Sciences, Himachal Pradesh University, Shimla-171005, India***

Presence of germination inhibitors in dormant seeds of *Prunus padus* L., *Robinia pseudoacacia* L. and *Zanthoxylum alatum* Roxb. has been described using a method based on tetrazolium test. Performance of this test which is species specific as well as semi-quantitative in nature, has been compared with that of phytometer test and shown to be more precise. Leachate from *R. pseudoacacia* seeds inhibit the germination of *Triticum aestivum* seeds by ca. 100 % while that of *Vigna radiata* by only 47 %. Such differential behaviour of two phytometers, puts in doubt the effect of these inhibitors on the germination of seeds from which these were derived. Similar was the case with *P. padus* and *Z. alatum*. This method for germination inhibitor assay used, overcomes such weaknesses of phytometer test and is species specific, since TTC reduction by the embryoaxis of the same species is used to monitor the effect of germination inhibitors.

The ultrastructure and hormonal complex of embryo cells during a cold stratification of *Acer tataricum* L. seeds

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The ultrastructure and hormonal complex of embryo cells were studied during a cold stratification of *Acer tataricum* L. seeds. The first changes in the cell structure were observed between 50 and 60 days of stratification. They began with the lipid body break down, subsequent formation of glyoxysomes, membrane return to a lamellar structure, emergence of endoplasmic reticulum, dictyosomes and polysomes. By the end of stratification cell organelles acquire the organization typical of a functional cell. In parallel, the levels of IAA, GLS, ABA and cytokinins in embryo cell were studied. The presence of superoptimal concentrations of bound IAA in formed seeds and a decrease in the content of free and bound forms of native IAA, GLS and ABA following 4 months of cold stratification were shown. The dynamics of cytokinins was observed to display some increase in their content in the third month of stratification. A conclusion was made regarding a tendency in the hormonal complex changing to the balance retrieval assuring germination. The problem of correlative relations of the cell substructure with levels of individual types of phytohormones in cells will be discussed.

The maintenance of ascorbate peroxidase activity in non-dormant seeds of *Ginkgo biloba* L.

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Quiescent dry seeds of Angiosperms are known to lack ascorbate and ascorbate peroxidase, a typical plant enzyme which eliminates hydrogen peroxide utilizing ascorbate as electron donor. Quiescent seeds do not require the activity of this enzyme because their oxidative metabolism is very low and consequently the hydrogen peroxide generated is negligible. In all Angiosperm seeds, ascorbate peroxidase develops within a few hours of germination. On the contrary, the seeds of an archaic spermatophyta *Ginkgo biloba* L., considered the most ancient seed plant now living, always maintain a high water content and significant metabolic activity. Data here reported show that *G. biloba* seeds never lose ascorbate or cytosolic ascorbate peroxidase. Electrophoretic analysis of ascorbate peroxidase activity performed with a native-PAGE method shows the existence of three isozymes in *G. biloba* embryos. Thus it can be seen that the seeds of the archaic spermatophyta *G. biloba*, being hydrated and metabolically active, lack a dormant phase characteristic of all modern plants.

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Plant growth substances effects on germination of seeds with various types of dormancy

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For the purpose of studying the phytohormone role in the regulation of dormancy the germination of seeds with various deepness of dormancy was studied following their treatment with plant growth substances. IAA, GA₃ and kinetin in concentration of 1, 10, 50 and 100 mg l⁻¹ did not affect non-dormant seed germination (*Phaseolus vulgaris* L. and *Acer saccharinum* L.) while these growth regulators caused morphological changes in seedling roots. ABA inhibited the germination of *P. vulgaris* mature seeds as well as that of *A. saccharinum* immature seeds, a degree of inhibition was proportional to ABA concentration. However, in *A. saccharinum* mature seeds ABA slowed down their germination significantly less than in immature ones. Deep dormancy release in *Acer tataricum* L. seeds became possible by treating them with kinetin at concentration of not less than 10 mg l⁻¹. Following the kinetin treatment (100 mg l⁻¹) 30 % of those seeds germinated already after one month of stratification. ABA inhibited the germination completely even in stratified *A. tataricum* seeds.

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Ca²⁺ requirement in phytochrome-mediated rhizoid growth in *Dryopteris filix-mas*

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The roles of phytochrome and Ca²⁺ in rhizoid growth during spore germination in *Dryopteris filix-mas* were investigated. Continuous irradiation with red light for 36 h followed by a far-red pulse induced due to a first phytochrome-mediated response chlorophyll synthesis and an unequal cell division which formed a spore cell and a rhizoid initial. A second red irradiation was required for further growth of the rhizoid initial. This indicates that rhizoid growth is a second phytochrome-mediated response. The competence to initiate rhizoid growth was reached 60 h after the start of the first red irradiation; besides Pfr the divalent ion Ca²⁺ was required in the extracellular medium, too. A significant growth response was obtained ca. 12 h after the start of the second red irradiation, and Pfr presence of 6 h was able to initiate growth. If Ca²⁺ was depleted during the first or the first 3 h of Pfr presence, rhizoid growth is significantly reduced as compared to the Ca²⁺ control. This indicates, in contrast to the first Pfr-mediated response where no direct interaction to Ca²⁺ was found (1, 2), the existence of (a) Ca²⁺-requiring step(s) during the Pfr-initiated signal transduction chain leading to rhizoid growth.

1) Scheuerlein *et al.* (1989) *Planta* 178, 25–30;2) Iino *et al.* (1989) *Plant Physiol.* 91, 610–616.