Functional Plant Science and Biotechnology

Abbreviation: Func. Plant Sci. Biotech. (FPSB)
Print: ISSN 1749-0472

Scope and target readership: *Functional Plant Science and Biotechnology* is an International journal open to papers of merit dealing with both basic and applied aspects and mechanisms underlying plant biology, particularly molecular and cell biology, structural biology, biochemistry, metabolism (photosynthesis and respiration), growth, morphogenesis, ecological and environmental physiology, biotechnology, and plant-microorganism interactions. Papers reporting research at all levels of plant organization are invited (i.e., molecular, subcellular, cellular, whole plant, canopy, ecosystem and global levels). We welcome manuscripts reporting question-based research using hormonal, physiological, environmental, genetic, biophysical, developmental or molecular approaches to the study of plant growth regulation, and productivity. Plant function should thus be analysed by either biochemistry, molecular biology, biophysics, cell or whole plant physiology, physiological ecology, together with structural, genetic, pathological and even meteorological aspects.

To network the different organizational levels of plant biology, *Functional Plant Science and Biotechnology* welcomes papers on aspects of experimental plant biology ranging from molecular and cell biology, biochemistry and biophysics, to ecophysiology from the molecular to the community level, including, *inter alia*:

1) Ageing and cell death;
2) Biochemistry and metabolism;
3) Ecophysiology;
4) Photobiology;
5) Uptake, transport and assimilation.

Global Science Books, Ltd.
Editorial Office
Miki cho Post Office, Kagawa ken, Kita gun
Miki cho, Ikenobe 3011-2, P.O. Box 7
761-0799, Japan

Head Office: Isleworth, United Kingdom
Accounting: Lagos, Portugal

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Journals web-page: http://www.globalsciencebooks.info/Journals/GSBJournals.html
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Cover photos: Top plate: The effect of age on kawakami maple *in vitro* morphogenic competence. Bottom plate: Xylogenesis during *ex vitro* acclimatization of black mulberry (Ďurkovič and Mišalová, pp 1-19).

Printed in Japan on acid-free paper.
Published: June, 2008.

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ABSTRACT

Invited Review: Temperate noble hardwoods are important economic resources of highly prized timber with excellent quality. Except for their economic value, they meet ecological functions for wildlife habitats or riparian buffers. This group of trees mostly does not form homogenous and continuous forest stands, they occur as an admixture associated with other main stand-forming species or may be found freely scattered in forests and semisteppes. The genepool of many noble hardwoods is subjected to extensive conservation efforts due to the rare occurrence, devastation of wild populations, and a demand for quality hardwood. Although the most extensive application of biotechnological tools in tree improvement has been made with some coniferous species and hardwoods of the genera *Populus* and *Eucalyptus*, tissue culture techniques may contribute to both genetic improvement and *ex situ* conservation strategies in noble hardwoods as well. In the past years the organogenic micropropagation of the juvenile planting stock dominated, recently *in vitro* regeneration of proven mature trees extends to a wider range of genotypes within the group. Somatic embryogenesis from leaves of mature trees opens a new route for micropropagation of superior genotypes with subsequent genetic transformation possibilities. Tree improvement and clonal propagation of noble hardwoods allows an increase in the availability and commercialization of selected genotypes carrying desired traits, mainly in rarely occurring species such as service trees or elms. Production of high quality trees and establishment in plantations may also ease the pressure of cutting elite genotypes from natural forests. For this reviewing purpose, the attention is focused on noble hardwood trees that belong to genera *Acer*, *Ulmus*, *Fraxinus*, *Prunus*, *Sorbus*, and *Juglans*.

ABSTRACT

Invited Review: Biotechnological tools have a large application potential in the breeding programmes and biodiversity conservation of *Araucaria angustifolia* (Bert) O. Ktze, an endangered native coniferous species from the Brazilian Atlantic Rain Forest. An overview is presented of *A. angustifolia* seed and somatic embryo developmental biology, including physiological, biochemical studies and proteomic approaches. Significant advances in plant regeneration via somatic embryogenesis have been made over the last decade. Recent works on the induction, proliferation, development and morphogenesis of pro-embryogenic masses (PEMs) have been used to explain their role in somatic embryo development. In order to increase the efficiency of PEM development, biochemical and molecular events were studied. Among the former, the metabolism of polyamines and nitric oxide, besides the synthesis of specific proteins, such as late embryogenesis abundant and storage proteins, seem to be involved in the regulatory mechanisms of this complex process. Seed-development studies were performed to better understand the molecular and physiological basis of embryogenesis and system manipulation for *in vitro* multiplication via somatic embryogenesis. Genomics and proteomics are new tools for improving *A. angustifolia* biotechnology and providing more insight.

ABSTRACT

Invited Mini-Review: Vitamin K-like compounds are widely diffused in plants, but their role and function are still partially unknown. Vitamin K_1, phylloquinone, is largely present in thylacoid membranes as an electron carrier inside the PSI redox chain. More recently, it has been found that Vitamins K_1 and K_3 may also affect the plasmalemma-bound H^+-ATPase and some redox proteins including b-type cytochromes. The antioxidant role of Vitamin K is also discussed.

ABSTRACT

Invited Review: Methionine is a nutritionally essential sulfur-containing amino acid whose low level in plants diminishes their value as a source of dietary protein for humans and animals. Methionine is also a fundamental metabolite in plant cells since, through its first metabolite *S*-adenosylmethionine (SAM), it controls the levels of several key metabolites, such as ethylene,

polyamines and biotin. SAM is also the primary methyl group donor that regulates different processes in plants. Despite its nutritional and regulatory significance, the factors regulating its synthesis and catabolism in plants are not fully known. In recent years, genetic molecular biology techniques have been used to increase and decrease the expression levels of several genes encoded to enzymes in the methionine metabolism in order to gain more knowledge about its role in plant metabolism, as well as to increase methionine level and thus improve the nutritional quality of plants. In this review, recent progress made in the molecular characterization of these genes is summarized, and specific examples are given of the regulation of metabolic pathways required for a tailor-made improvement of methionine content, with minimal interference on plant growth, phenotype and productivity. Several different manipulations of methionine biosynthesis and metabolism pathways, in addition to the expression of methionine-rich storage proteins and their effects on plant methionine content, are described. The studies have resulted in the identification of steps important for the regulation of flux through the pathways and for the production of transgenic plants having increased free and protein-bound methionine. These molecular approaches have provided new insights into the control of methionine level in plants, and in many cases, have resulted in significant improvements in the nutritional value of plants.

ABSTRACT

Invited Mini-Review: Ferulic acid, a cinnamic acid derivative, is a well-known allelochemical that is widely distributed in plants. Stress on plant roots by ferulic acid affects several physiological and biochemical aspects, such as water utilization, foliar expansion, root elongation, photosynthesis, cell respiration, membrane integrity and nutrient uptake, among others. Moreover, ferulic acid may be esterified with cell wall polysaccharides, incorporated into the lignin structure or form bridges that connect lignin with wall polysaccharides, rigidifying the cell walls and restricting cell growth. This review describes general aspects of allelopathy and focuses on the role of ferulic acid as an allelochemical and its supposed mode of action in plants.

ABSTRACT

Invited Mini-Review: Very small, or fine, particles are released into the air created by emissions from many natural and man-made sources, including power plants, traffic, agriculture, open fires, and volcanoes. There are hundreds of types and sources for fine particle matter (PM), affecting plants on various ways. Plants suffer from stomatal closure leading to cell/tissue changes, leaves' necrosis, and chlorosis. The first physiological reaction after PM deposition to the vegetation takes place on the leaf with reduced net assimilation efficiency. Long-term depositions change the photochemistry leading to retarded leaf growth. Deposits for many years over plants' surfaces lead to large-scale reductions in the assimilate balance. Additionally, there are few reports on abrasive effects of PM, especially under high wind speed, supporting secondary effects such as an increase in diseases and pest incidence after the protective leaf cuticle were removed physically. Changes in soil chemistry due to PM deposition in the rhizosphere also lead to a change in soil nutritional values. Finally, PM can affect over longer periods natural plant communities due to selective advantage of some species over others.

ABSTRACT

Original Research Paper: Action potential (AP) generation at the plasmalemma of *Chara corallina* has a strong influence on photoprocesses in chloroplasts. Under physiological conditions the AP generation transiently suppresses photosynthetic electron transport and reversibly increases thermal losses of chlorophyll excitations. However, these changes provoked by membrane excitation became irreversible in the presence of artificial electron acceptor methyl viologen (MV) in the external medium. Incubation of *Chara* cells under resting conditions in the presence of this herbicidal agent had no effect on kinetics of chlorophyll P700 photooxidation, indicating that permeation of MV divalent cations across the cell and chloroplast membranes is a limiting factor and makes MV inaccessible at the sites of its interactions with photosystem I. On the other hand, the AP generation in the presence of MV irreversibly modified the P700 photooxidation signals, as measured from the difference of absorbance changes at 810 and 870 nm (ΔA_{810}). The results suggest that permeation of MV into *in situ* chloroplasts is triggered

during or after AP generation. Photoinduced changes of cell membrane potential, similarly to ΔA_{810} signals, were insensitive to the presence of MV in the external medium until the application of the first excitatory stimulus. However, the AP generation in the presence of MV irreversibly modified cell electrical photoresponses, indicating that photosynthetic electron flow was redirected to MV reduction. In the herbicide-treated plants, the effect of AP on photosynthesis seems to be complex and includes permeability changes to MV in the system of membrane barriers comprising the plasmalemma and the chloroplast envelope.