

# Functional Plant Biology

## Contents

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Photosynthesis, light energy partitioning, and photoprotection in the shade-demanding species *Panax notoginseng* under high and low level of growth irradiance

**Jun-Wen Chen, Shuang-Bian Kuang, Guang-Qiang Long, Sheng-Chao Yang, Zhen-Gui Meng, Long-Gen Li, Zhong-Jian Chen and Guang-Hui Zhang**

479–491

Ecologists have extensively studied the photoprotection of the shade-demanding species from high light with one objective being to elucidate photoprotective mechanisms of a typically shade-demanding species *Panax notoginseng*. In high-light-grown plants irradiated by high light, more electrons are consumed by non-net carboxylative processes that activate the component of nonphotochemical quenching. The present study shows an interesting aspect of photosynthesis and photoprotection in a shade-demanding species.

Barrier against water loss: relationship between epicuticular wax composition, gene expression and leaf water retention capacity in banana

**Megha H. Sampangi-Ramaiah, Kundapura V. Ravishankar, Shivashankar K. Seetharamaiah, Tapas K. Roy, Laxman R. Hunashikatti, Ajitha Rekha and Pandurangaiah Shilpa**

492–501

This study examines the quantitative and qualitative composition of cuticular wax and their relationship with leaf water retention in banana. The role of total cuticular wax content, wax compounds and their relationship with leaf water retention, followed by gene expression analysis are reported. The results shows that both cuticular wax content and composition plays an important role in maintaining leaf water content.

Hybrid variation for root system efficiency in maize: potential links to drought adaptation

**Erik J. van Oosterom, Zongjian Yang, Fenglu Zhang, Kurt S. Deifel, Mark Cooper, Carlos D. Messina and Graeme L. Hammer**

502–511

Root traits may enhance drought adaptation in maize. Root system efficiency (RSE) is defined here as a measure of canopy conductance per unit of investment in root biomass. The significant genotypic differences in RSE found in this study allow the design of breeding strategies to exploit this trait.

Phosphatidic acid synthesis, octadecanoic pathway and fatty acids content as lipid markers of exogenous salicylic acid-induced elicitation in wheat

**Christine Tayeh, Béatrice Randoux, Frédéric Laruelle, Natacha Bourdon and Philippe Reignault**

512–522

Salicylic acid (SA) induces plant defences and renders wheat resistant to the fungal pathogen responsible for the powdery mildew disease. It has been delivered here directly inside wheat leaf tissues in order to test its effect on the treated cells. Lipid metabolism is affected to a great extent by such a treatment and is proposed to be, at least in wheat, a useful marker of the induction of defences by SA, as a potential alternative to fungicides.

Changes in photosynthesis and carbohydrate metabolism in sugarcane during the development of Yellow Canopy Syndrome

**Annelie Marquardt, Gerard Scalia, Priya Joyce, Jaya Basnayake and Frederik C. Botha**

523–533

Yellow Canopy Syndrome is a still undiagnosed condition of sugarcane in Australia, causing significant yield losses. Plants are shown to have decreased photosynthetic activity and an increase in sugar levels in the leaves before yellowing, which is consistent with a disruption of phloem loading of sucrose causing a feedback regulation effect. Understanding the effects yellow canopy syndrome has in the plant is vital for future development of control methods and to reduce yield loss.

*Cover illustration:* The presence of bundle sheath extensions is a prominent feature in polar leaves as shown in the depicted leaf lamina sections. These bundle sheath extensions are thought to facilitate water exchange between leaf veins and epidermis, but they may also provide turgor-driven structural support to the leaf. We measured the scaling of vein area (yellow area in the left hand image) and the area of the bundle sheath extensions (pink areas in the right hand image) associated with these veins. Images by Caroline Brocius and Uwe Hacke.

Expression of a *Nicotiana tabacum* pathogen-induced gene is involved in the susceptibility to black shank  
**Roxana Portieles, Eduardo Canales, Osmani Chacon, Yussuan Silva, Ingrid Hernández, Yuniór López, Mayra Rodríguez, Ryohei Terauchi, Hideo Matsumura, Carlos Borroto, Jonathan D. Walton, Ramon Santos and Orlando Borrás-Hidalgo** 534–541

Plant diseases affect most plants in the nature and lead to yield losses in agriculture. We identified a plant gene that contributes to the plant susceptibility to pathogens. The inactivation of plant genes that contribute to disease susceptibility might trigger the resistance. This approach might provide novel strategies for disease resistance breeding.

*In situ* detection of laccase activity and immunolocalisation of a compression-wood-specific laccase (CoLac1) in differentiating xylem of *Chamaecyparis obtusa*  
**Hideto Hiraide, Masato Yoshida, Saori Sato and Hiroyuki Yamamoto** 542–552

Conifers forms a special secondary xylem, the so-called ‘compression wood’, to lift inclined stems and branches upward. Our *in situ* assays demonstrated a compression-wood-specific laccase of *Chamaecyparis obtusa* (Siebold & Zucc.) Endl. were localised to the highly lignified region of the compression wood cell wall (S2L), where laccase activity was also high. These findings suggested the compression-wood-specific laccase is responsible for the S2L lignification.

Stomatal conductance scales with petiole xylem traits in *Populus* genotypes  
**Caroline A. Brocious and Uwe G. Hacke** 553–562

Leaf hydraulics are increasingly being researched as a driver of overall plant performance and growth. Five *Populus* genotypes were studied to determine what aspects of leaf anatomy impact function. Calculated water flow through the petiole strongly correlated with gas-exchange measurements, suggesting that petiole structure influences leaf hydraulics.

Phosphite-induced reactive oxygen species production and ethylene and ABA biosynthesis, mediate the control of *Phytophthora capsici* in pepper (*Capsicum annuum*)  
**Peiqing Liu, Benjin Li, Ming Lin, Guoliang Chen, Xueling Ding, Qiyong Weng and Qinghe Chen** 563–574

The aim of this study was to elucidate the molecular mechanisms underlying phosphite (Phi)-induced resistance to *Phytophthora capsici*. We proposed that Phi-induced reactive oxygen species production, ethylene and abscisic acid (ABA) biosynthesis mediate the control of *P. capsici*, and ABA functions through *CaMPK17-1*-mediated MAPK signalling. We showed a novel aspect of Phi in the development of new protection strategies against *Phytophthora*.