



### Defence dichotomy: coping with herbivores in air and water (Review)

doi:10.1093/aob/mcw061

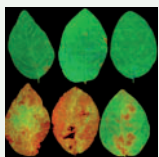
Plant defence against herbivores is a crucial theme in the evolution of both plants and animals, yet it is expressed very differently in water and on land. Spines, hairs, and distance signalling are common in land plants but very rare in submerged aquatic plants. To account for this hitherto unrecognized dichotomy, **Vermeij (pp. 1099–1109)** suggests that animal sensory capacities are in part to blame. Herbivores, pollinators and plant dispersers on land often rely on long-range visual or olfactory signals, whereas aquatic herbivores do so on a much smaller scale, all because of the contrasting properties of air and water. Both contact and long-range defences of plants are much more developed in land plants, whose ecological connections with animals are far more complex than in water. Host specialization by small herbivores is very high on land, but generally less in marine ecosystems, especially in the tropics.



### Temperature requirements of pollen germination shape species distributional ranges

doi:10.1093/aob/mcw041

Although plant distribution patterns are well documented, our understanding of the ecophysiological mechanisms that control the geographical ranges of plant species remains poor. Using a largely ignored method, the performance of the male gametophyte *in vitro*, **Rosbakh and Poschlod (pp. 1111–1120)** assessed whether the thermal range of pollen germination and tube growth control species distribution ranges along an elevational gradient. They found a strong and positive relationship between temperature conditions at collection sites and the minimum temperature for both pollen germination and pollen tube growth. In addition, a significant correlation between maximum temperature of pollen tube growth and temperature of flowering month was apparent.

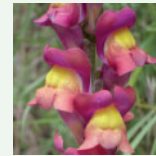


### Enhanced water stress tolerance of plum plants transformed with cytosolic ascorbate peroxidase genes

doi:10.1093/aob/mcw045

Cytosolic antioxidant enzymes are a target to give durable resistance to water stress in commercial plum trees. **Diaz-Vivancos et al. (pp. 1121–1131)** show improved tolerance to moderate or severe drought in transgenic lines, correlating with reduced leaf-drop, better photosynthetic performance (PSII quantum yield) and a tighter control of water use efficiency. The two lines transformed with multiple copies of superoxide dismutase and ascorbate peroxidase genes suggested an enhanced capacity to cope with drought-induced oxidative stress. The

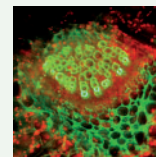
transformed lines may be a valuable rootstock for improving plum crop yields in adverse environments.



### Selection and evolution of flower colour

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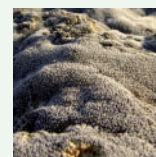
We currently know little about the evolution of flower colour when multiple pigment families are present. **Ellis and Field (pp. 1133–1140)** examined the patterns of evolutionary transitions between anthocyanin-pigmented (red, pink, blue and purple) and yellow flowers in the tribe Antirrhineae. A phylogenetic comparative analysis points to selection for either yellow or anthocyanin pigmentation at different times. Nevertheless, these transitions are constrained to move through an unpigmented intermediate step. These findings suggest fluctuating selection favouring flowers with a single pigment over those with zero or two pigments.



### Photosynthesis in midrib and interveinal lamina

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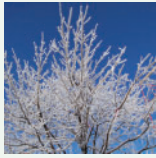
Except in  $C_4$  plants, photosynthetic activity is attributed mainly to leaf mesophyll cells, and photosynthesis in veins of  $C_3$  and CAM (Crassulacean acid metabolism) plants is usually neglected. **Kuźniak et al. (pp. 1141–1151)** studied the photosynthesis-related properties of the midrib and the interveinal lamina cells in leaves of *Mesembryanthemum crystallinum*, a  $C_3$ -CAM intermediate plant. The vascular system of  $C_3$ - and CAM-performing plants contained photosynthetically-competent parenchyma cells but with limited photosynthetic activity. The midrib chloroplasts resembled those in the bundle sheath of  $C_4$  plants. The authors propose different metabolic roles for midrib chloroplasts in  $C_3$  and CAM plants of *M. crystallinum*.



### Response of desert moss to increasing nitrogen deposition

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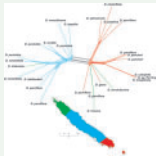
*Syntrichia caninervis* dominates species in moss crusts in many northern hemisphere desert ecosystems, which are facing disturbance from increasing N deposition. **Zhang et al. (pp. 1153–1161)** give evidence from simulated N deposition experiments suggesting that low amounts of added N increase shoot length and leaf size of *S. caninervis*, whereas high doses reduce almost all growth parameters. Moss shoot density increased but population biomass decreased with high N. Responses of physiological parameters were similar to the growth indices. Therefore, low amounts of added N ( $0\text{--}0.5\text{ g N m}^{-2}\text{ year}^{-1}$ ) may enhance moss growth and vitality, while higher amounts have detrimental effects.



### Tree crown architecture and ice accretion

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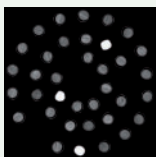
Despite a longstanding interest in tree species' vulnerability to ice storms, analyses of the influence of crown structure on within-crown variation in ice accretion are rare. **Nock *et al.* (pp. 1163–1173)** test the hypothesis that intra-crown ice accretion can be predicted by a measure of sheltering by neighbouring branches. Empirical results and simulations confirmed a key role for crown architecture in determining intra-crown ice accretion. As suspected, droplets are attenuated by passage through the crown, and thus higher branches accumulate more ice. This is the first step in developing a modelling approach to investigating intra-crown and inter-specific variation in freezing rain damage.



### Whole plastid genomes and nrDNA of *Diospyros* species from New Caledonia

doi:10.1093/aob/mcw060

Some plant groups, especially on islands, have been shaped by strong ancestral bottlenecks and rapid, recent radiation of phenotypic characters. **Turner *et al.* (pp. 1175–1185)** have used complete plastid genomes and nrDNA to unravel phylogenetic relationships between 22 closely related *Diospyros* species from New Caledonia. The structure of the phylogenetic trees constructed indicates those species as being most probably the result of rapid radiation. A significant geographic clustering of the genetic information, especially from plastid genomes, was found. This could indicate transfer of plastid genomes due to hybridization and introgression following secondary contact.



### Core business: X-ray CT toolchain for tree-ring analysis

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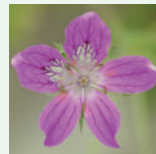
Disentangling tree growth requires more than ring width only. Although X-ray densitometry is an established technique to determine key wood density parameters, tedious manual procedures hamper fast analyses. **De Mil *et al.* (pp. 1187–1196)** present an X-ray computed tomography toolchain to enable high-throughput density profiling of large sets of increment cores. The obtained 3D archive is analysed via software routines with which traditional tree-ring analysis as well as semi-automated density-based pattern matching can be performed. The toolchain allows fast assessment of newly sampled increment cores, without any surface treatment or visual inspection. This offers the opportunity for large-scale screening of lesser-studied tree species, and improving current chronologies with sub-annual density information.



### Competition effects on plastic and genotypic responses to [CO<sub>2</sub>]

doi:10.1093/aob/mcw064

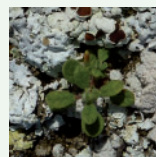
Plant–plant interactions could mediate vegetation responses to rising atmospheric CO<sub>2</sub> concentration ([CO<sub>2</sub>]), because some plants benefit more from [CO<sub>2</sub>] elevation than others. We investigated how changes in performance due to elevated [CO<sub>2</sub>] are modified by aboveground plant–plant interactions. **Van Loon *et al.* (pp. 1197–1207)** grew *Plantago asiatica* seeds originating from natural [CO<sub>2</sub>] springs and from ambient [CO<sub>2</sub>] in mono-stands of both origins as well as mixtures of both origins in climate rooms under different [CO<sub>2</sub>] levels. Their results showed that plant performance to elevated [CO<sub>2</sub>] was mainly determined by plastic responses and not by genotypic responses. However, this pattern was highly modified by plant–plant interactions.



### Do sequence repeats undermine plastid genome stability?

doi:10.1093/aob/mcw065

Although a few plant lineages have lost one copy of the plastid genome (plastome) inverted repeat (IR), its near ubiquity among streptophytes has fostered speculation about its functional role and consequent evolutionary significance. To evaluate hypotheses of its persistence, **Blazier *et al.* (pp. 1209–1220)** sequenced plastomes of *Erodium* (Geraniaceae), where several species have lost the IR structure and found that the plastomes of one derived clade surprisingly contained a large IR. Comparative analyses across the genus suggest that the IR *per se* does not stabilize plastome structure but rather, like bacterial endosymbiont genomes, increased proportions of non-IR recombinogenic repeats likely contribute to genomic instability in *Erodium*.



### Soil seed bank assembly at multiple scales

doi:10.1093/aob/mcw039

In gypsum soil communities, above-ground vegetation and seed banks are tightly connected, but mechanisms involved in their organization may differ. **Peralta *et al.* (pp. 1221–1228)** investigated the effects of water addition, biological soil crust cover (BSC), above-ground vegetation and the *Stipa tenacissima* tussocks on soil seed banks at two spatial scales. BSC has a filtering role at fine spatial scale on seed bank structure: it decreased seed abundance and species richness in the persistent seed bank, and it determined complete seed bank species composition. The heterogeneity of BSCs promotes niche differentiation and thereby potentially enhances species coexistence and species diversity.



## Gas exchange measurements on *Miscanthus* leaves

doi:10.1093/aob/mcw042

*Miscanthus* has a high yield potential, but even though it is less cold sensitive than other C<sub>4</sub> species, it emerges later in spring than C<sub>3</sub> species. **Xiurong *et al.* (pp. 1229–1239)** identified one *Miscanthus sacchariflorus* with a level of cold tolerance similar to *Miscanthus × giganteus*. They also found a positive linear correlation between net photosynthesis and shoot growth rate as well as specific leaf area. These are relatively easy to measure and useful for the screening of productivity and cold tolerance. The *Miscanthus* genotype with high cold tolerance can be useful for breeding of new interspecies hybrids or cultivation in temperate climates.



## Is hyperaccumulation of nickel worthwhile in non-serpentine soils?

doi:10.1093/aob/mcw050

Ni-hyperaccumulating species produce high-Ni litters and potentially influence important ecosystem processes such as decomposition. According to the elemental allelopathy hypothesis of hyperaccumulation, the restriction of the majority of metal hyperaccumulators in metaliferous soils may be dependent on litter decomposition. **Adamidis *et al.* (pp. 1241–1248)** using for the first time mixed-species litters containing hyperaccumulated Ni: (1) indicate the presence of Ni-resistant decomposers on serpentine soil, (2) demonstrate the selective decomposition of low-Ni parts of litters on non-serpentine soils and (3) give support to the elemental allelopathy hypothesis, presenting the potential selective advantages acquired by metal hyperaccumulators through litter decomposition on serpentine soils.

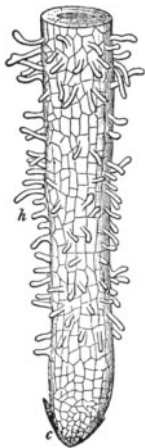
## Plant Cuttings

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*News in Botany*: Nigel Chaffey presents a round-up of plant-based items from the world's media

### What are root hairs for?



A reasonable question. After all, root hairs – close-tipped tubular extensions of epidermal cells of roots<sup>[1,2]</sup> – are numerous. So much so that, in what is now a classic paper, Howard Dittmer estimated that a single plant of rye (*Secale cereal*<sup>[3,4]</sup>) may have 14,335,568,288 (!) of these structures over the entirety of its root system<sup>[5]</sup>. And the standard answer to that question is that they “greatly increase the surface area of roots. As such, they are widely believed to play an important role in plant nutrition by facilitating the absorption of water and nutrients” from the surrounding soil<sup>[6]</sup>. But, is that all they do? The suggestion that they might have a role in anchorage of the plant (a function mainly attributed to the root proper) was considered unlikely by Peter Bailey *et al.*<sup>[7]</sup>, at least in *Arabidopsis* and *Allium cepa* [onion<sup>[8]</sup>]. However,

that view has been challenged by Glyn Bengough *et al.*<sup>[9]</sup> Working with ‘normal’ plants of *Zea mays*<sup>[10,11]</sup> and mutants devoid of root hairs, they conclude that these epidermal outgrowths do assist in the anchorage of root tips to soil particles during soil penetration, and help roots to penetrate soils of relatively low soil density. Another interesting aspect of the Bengough *et al.* paper is that its literature review appears to be remarkably thorough, something that is often lacking in today’s scientific papers. And in so doing they highlight a particular problem in modern-day research where statements – which are factually correct – are frequently made without due credit being given to the originating author. For example, in their paper’s Introduction Bengough *et al.* mention two 21<sup>st</sup> century papers that state that root hairs have an anchorage role, but which don’t cite sources supporting that notion. And, as every student who has failed to cite their sources in an assignment knows,

this is extremely poor practice, which could result in a charge of plagiarism<sup>[12]</sup>. A third paper fared slight better in citing Clifford Farr’s early 20<sup>th</sup> century contribution “Root Hairs and Growth”<sup>[13]</sup> as evidence for that root-hair-anchorage notion. Unfortunately, Farr’s cited source – an 1883 paper in German by F Schwarz\*\* – “appears to contain largely *qualitative statements* about the *potential* role of root hairs in anchorage, *rather than a quantitative experimental study* on anchorage” (Bengough *et al.*’s words, P Cuttings’ emphasis). I suspect we’ve all done this sort of thing, provided a source that looks like it’s the correct one, but which we’ve not necessarily thoroughly checked to see if it is ‘fit for purpose’...? But, as evidence-based scientists we shouldn’t be satisfied with that, we ought to do a proper job. If literature is not correctly sourced – or not cited at all! – we risk losing an important element of science which is the connection with and continuity between that which has gone before and which provides the foundations upon which our present-day work is built. To use a building analogy, if the supporting foundations are not firm and properly in place, the stories<sup>[14]</sup> that we try to construct thereupon are all the weaker. They – Bengough *et al.* – also clearly distinguish their own work – on root-hair anchorage and root penetration of soil – from that of Bailey *et al.*, which looked at uprooting of whole plants. But, isn’t this just splitting hairs<sup>[15]</sup>? No, just careful, objective, scientifically rigorous work – a lesson from which we can all learn. Your journal club discussion question for this month then is: How far back should one follow the literature to ensure legitimate support for ‘facts’ one states in a scientific paper?

\* Which poses another question, do aerial roots – e.g. those of tree-dwelling epiphytes such as certain orchids<sup>[16,17]</sup> – have root hairs? Answers, please, on a post-card (remember them you ‘net natives’<sup>[18,19]?</sup>) to: P Cuttings, The Phytoinvestigatorium, Leicester, The North, United Kingdom (just to the north-east of ‘Europe’).

\*\* “Die wurzelhaare der Pflanzen”<sup>[20]</sup> (which I’ve not managed to track down for you, dear reader(s) (sorry!)).