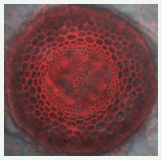


Aluminium accumulation and XET action in bean root tips

doi:10.1093/aob/mcw062

Two genes *PvXTH9* and *PvXTHb* have been suggested to regulate the polyethylene glycol-reduced cell-wall Al accumulation in root tips. Through the spatial and temporal analysis of Al-inhibited root elongation, Al accumulation, *XTH* genes expression and XET enzyme action in root tips, **Zhang *et al.*** (pp. 1–9) further demonstrated the regulatory role of *XTH* genes and XET enzyme in cell-wall Al accumulation. The results provide novel insights into the physiological and molecular mechanisms of cell-wall structure modification as a response of plant roots to osmotic stress that will assist mitigation of Al and drought stresses severely limiting crop yields on acid soils.

Arbuscular mycorrhizal growth responses and phosphorous efficiency in soybean genotypes

doi:10.1093/aob/mcw074

Arbuscular mycorrhizal (AM) fungi play a key role in phosphate (P) uptake of many crop species, but the mechanisms by which P uptake in the AM symbiosis is controlled are only poorly understood. **Wang *et al.*** (pp. 11–21) examined the effects of the phosphate acquisition efficiency (PAE) of soybean plants on P uptake and transport via the plant and mycorrhizal uptake pathway and demonstrate here that also soybeans with a higher PAE can highly benefit from an AM symbiosis, and that mycorrhizal P uptake benefits are much more determined by the AM fungal species than by the PAE of the host.

Plant design is affected by neighbourhood structure and light availability

doi:10.1093/aob/mcw078

Although neighbourhood structure and light availability are recognized as factors that limit survival and species coexistence, its relative importance on plant design is not well understood. **Guzmán and Cordero** (pp. 23–34) investigate the effect of these factors on biomechanics, allometry, branching and slenderness as properties of the plant design. They found that interference and size of the neighbourhood increase the density-specific stiffness and decrease the developmental stability, while the light availability decreases the branching and increases the slenderness. Because of this, the design must be considered as a key factor that contributes to the adaptation and coexistence in forest communities.

Phylogeny of chili peppers and wild relatives

doi:10.1093/aob/mcw079

Sweet and hot chili peppers and their wild relatives (*Capsicum* spp., Solanaceae) are native to the tropical and temperate Americas. Despite their worldwide importance, *Capsicum* taxonomy and phylogeny have been only partially analysed to date. **Carrizo García *et al.*** (pp. 35–51) explore the phylogenetic relationships between nearly all *Capsicum* species and analyse the evolution of key characters and the geographic diversification of the genus. The most comprehensive scheme of *Capsicum* interspecific relationships is presented, giving new insights about species affinities and the geographic origin of the genus.

History of the zucchini squash

doi:10.1093/aob/mcw080

Summer squash, the young fruits of *Cucurbita pepo*, are a common, high-value fruit vegetable. Of the summer squash cultivar-groups, the zucchini is today the most cosmopolitan but it is also the newest, having been traced to Milan, 1901. **Lust and Paris** (pp. 53–69) collected and searched books on agriculture and cookery dating from the sixteenth to nineteenth centuries to follow the horticultural development and culinary use of young *Cucurbita* fruits in Italy. By 1600, round and elongate young fruits of *C. pepo* were addressed as separate cookery items in Italian kitchens. These elongate squash probably refer to the cocozelles of southern and central Italy. The agricultural books by Cantoni (1855) and Tamaro (1892) suggest that the other elongate Italian squash, the zucchini, originated in northern Italy during the mid-nineteenth century.

A genetic linkage map of perennial ryegrass (*Lolium perenne*) based on GBS

doi:10.1093/aob/mcw081

Genetic linkage maps remain very important tools for gene discovery in many plant species. Whilst several genetic maps exist for perennial ryegrass, it has been difficult to integrate data across studies because of a lack of a reference genome sequence and common genetic markers. **Velmurugan *et al.*** (pp. 71–87) have developed a dense SNP-based genetic map of a reference mapping population of ryegrass using genotyping-by-sequencing. All markers on the genetic map are anchored to a draft genome sequence of one of the grandparents of the F2 population; thus future genetics studies using the population will be comparable.

Orchid conservation: further links

doi:10.1093/aob/mcw147

Fay (pp. 89–91) introduces the often complex interactions of orchids with mycorrhizal fungi, pollinators and host trees, considering also threats from human utilization and changing land use. The Orchidaceae present particular challenges for conservation. Furthermore, orchids, as one of the largest families of angiosperms (>26 000 species, species complexes and frequent hybrid formation) are complex to catalogue. Orchids are a fascinating subject for fundamental research with rapid species evolution, specific organ structure and development, but they also suffer from high levels of threat. Effective orchid conservation must take account of the beneficial interactions with fungi and pollinators and the potentially detrimental effects of over-collection and changes in land use.

Commonness, reproductive patterns and inbreeding depression of two *Jumellea* species

doi:10.1093/aob/mcw014

Population size reduction can threaten long-term persistence of plant populations through loss of genetic diversity and inbreeding depression. **Blambert *et al.*** (pp. 93–103) evaluate the consequences of population size reduction by comparing mating patterns, levels of genetic diversity and inbreeding depression of the rare and fragmented *Jumellea fragrans* and the widespread *J. rossii*. Population size reduction had a negative impact on genetic diversity of *J. fragrans*, but factors such as mating system or population history can limit the effects.

Mycorrhizal associations in recently diverged *Epipactis* species

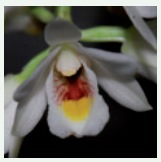
doi:10.1093/aob/mcw015

In orchid species that have populations occurring in strongly contrasting habitats, mycorrhizal divergence and other habitat-specific adaptations may lead to the formation of reproductively isolated taxa and ultimately to species formation. In this study, **Jacquemyn *et al.*** (pp. 105–114) used 454 amplicon pyrosequencing to investigate mycorrhizal communities associating with *Epipactis helleborine* in its typical forest habitat and with its presumed sister species *E. neerlandica* that almost exclusively occurs in coastal dune habitats. *E. helleborine* and *E. neerlandica* associated with strongly divergent mycorrhizal communities, so detailed experiments on habitat-specific adaptations in general and mycorrhizal divergence to the process of speciation in orchids are required.

Temporal dynamics of Corsican orchid communities

doi:10.1093/aob/mcw070

Orchids are particularly sensitive to environmental changes due to their narrow ranges in secondary-successional habitats, and partially cryptic which impede the observation during monitoring. Here **Vogt-Schilb et al.** (pp. 115–123) investigated how habitat change can impact orchid spatio-temporal distributions in Corsica, while taking into account imperfect detection. Two field surveys conducted 27 years apart (1982–1984 vs. 2009–2011) at the same 45 sites in Corsica show *contrasting* patterns in orchid dynamics at different spatial scales; while marked turnover of species composition was revealed locally, the regional species pool was maintained despite an overall increase in woody plant cover. The existing landscape mosaics of different ecologies maintain diversity at larger spatial scales. Furthermore, the study revealed great variation in detectabilities among orchid species and thus confirmed the relevancy of site-occupancy models accounting for imperfect detection.



Strengthening the taxonomic backbone of Thai orchid conservation

doi:10.1093/aob/mcw071

Pedersen *et al.* (pp. 125–133) present analyses of morphometric and AFLP data from populations of *Geodorum* (Orchidaceae) – a study conducted in preparation of the Flora of Thailand account. Patterns of phenetic variation and inferred hierarchical genetic differentiation suggest that *G. pulchellum* sensu Seidenf./ *G. siamense* should be treated as one variable species (meaning that the allegedly rare *G. pulchellum* sensu Seidenf. should not be given independent conservation priority). Well-supported classifications are crucial for conservation planning, and this study demonstrates that flora accounts can benefit from prior analytical approaches to intricate species complexes.

Floral scent chemistry in the orchid genus *Gongora*

doi:10.1093/aob/mcw072

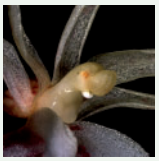
Floral scent is a key component of pollinator attraction and its chemistry modulates pollinator behavior and the formation of plant-pollinator networks. Neotropical *Gongora* orchids exhibit specialized pollinator associations with male euglossine bees, in which male bees visit orchid flowers to collect volatile chemicals that they store in hind-leg pouches to subsequently use during courtship display. Hence, *Gongora* floral scent compounds simultaneously serve as signaling molecules and pollinator rewards. **Hetherington-Rauth & Ramírez** (pp. 135–148)

conducted a comparative analysis of floral scent across the genus showing that scent molecules are largely species specific and qualitatively and quantitatively divergent among closely related taxa.

Relationship between soil nutrients and orchid mycorrhizal associations

doi:10.1093/aob/mcw082

Mycorrhizal associations are known to be influenced by soil nutrient availability but have been poorly studied in orchids. **Mujica *et al.*** (pp. 149–158) studied two terrestrial orchids of the genus *Bipinnula* from central Chile across a soil nutrient gradient. They found a significant relationship between soil nutrients and composition, taxonomic richness and phylogenetic diversity of mycorrhizal fungi, which supports the hypothesis that specialization is favored under high soil nutrient availability. Their findings help understand factors that promote the evolution of ecological specialization, a major question for evolutionary biologists since Charles Darwin.



Sexual and asexual reproduction in a mycoheterotrophic orchid

doi:10.1093/aob/mcw084

Sexual reproduction is common within Orchidaceae, though apomixis does occur in some genera allowing them to produce seeds that are clones of the mother. The reproductive embryology of mycoheterotrophic plants remains under-studied. **Krawczyk *et al.*** (pp. 159–172) provide evidence for the co-occurrence of sexual and apomictic reproduction in a population of mycoheterotrophic plants: *Epipogium aphyllum*. The authors investigated reproduction capability via open pollination, induced autogamy, autogamy *sensu stricto*, and autonomous apomixis. They report that although sexual reproduction dominates, incidental parthenogenesis is much more likely than natural self-fertilization, which is rare or unlikely. These findings suggest that *E. aphyllum* has the potential to produce seeds via both sexual and asexual means.

Plant Cuttings

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

Life's little certainties. . .

When Benjamin Franklin (diplomat, scientist, inventor, writer, founding father of the USA, etc.[1]) penned the phrase "In this world nothing can be said to be certain, except death and taxes"[2] in 1798, he – probably! – didn't have the precarious state of the world's phosphorus supply in mind. Yet, if we are to avoid deaths of millions of humans – many of which are as yet unborn – we might have to bite the bullet[3] and pay an appropriate – additional – 'tax'. To whom do we owe this rather doom-and-gloom laden prophesy? Eric Roy *et al.*[4], and their assessment of the consequences of increasing crop productivity in tropical regions as part of a global attempt to boost world food production by addition of inorganic phosphorus (Pi) fertilisers. Recognising concerns about feeding an increasing human population that's predicted to exceed 9.7 billion by 2050[5], from its present value of nearly 7.5 billion [6], it is acknowledged that food production needs to increase. Whilst all manner of solutions are actively being sought to achieve that most worthy of endeavours, an attractive option is to increase current productivity of tropical regions to match that of existing yields elsewhere on the planet. Whilst increases in yield can be achieved by addition of such essential plant nutrients as Pi[7,8], this comes with a cost whose magnitude I was previously unaware of. A large proportion of the added Pi is fixed [9] – rendered unavailable to plants – by the soil itself*. This additional amount – for which no benefit in terms of extra yield is seen – is what's been called a phosphorus tax by Roy *et al*. Whilst we might not like paying human-imposed taxes, we can usually do so out of earnings. Unfortunately, that isn't an option with nature's imposed Pi tax because the amounts of inorganic phosphorus available for its payment are finite[10]. So, in the long term, we can't just fertilise our way out of this particular problem. Although the research was conducted in a comparatively small area of Brazil, the global relevance – where 23 % of tropical soil area is considered to be P-fixing[11] ** – is clear. Such a situation underlines the need to consider all available options and technologies – and those we've yet to develop – if we are to avoid starvation of apocalyptic proportions ***.However, if anybody is looking to make an investment in the stock market, they might like to consider shares in a phosphate mine…

* An interesting question for plant nutrition students comes to mind, nitrogen- and phosphorus-fixation: Compare (and contrast…).

** Intriguingly, such P-fixing soils have the useful attribute of holding nitrate ions against leaching, which therefore makes that essential nutrient more available to plants. Infamously, when applying nitrates to the soil to boost crop production inappropriately, it's long been known that > 50% of what's applied may never be taken up by the plants (e.g.[12]) – a 'nitrogen tax' if you will. In this instance, much of the nitrate leaches from the soil into freshwater bodies where it may contribute to environmentally-damaging eutrophication[13,14]. So, P-fixing soils, not all bad news [discuss…]?

*** And is particularly unwelcome news coming on top of dire predictions about a four-fold increase in Pi inputs if *grasslands* are to