The molecular mystery of mast flowering (Viewpoint)

Annals of Botany 125:
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doi: 10.1093/aob/mcaa004

Mast flowering is synchronized highly variable flowering by a population of perennial plants over a wide geographical area. The ΔT (delta *T*) model predicts that a temperature difference in successive summers acts as a cue to determine each year's flowering intensity. **Samarth *et al.*** suggest an epigenetic 'summer memory' as a possible molecular mechanism responsible for the induction of mast flowering in response to a positive ΔT cue. A positive differential summer temperature cue may result in sufficient deposition of the active histone marks at the loci of floral promoter genes to activate their transcription and, consequently, induce flowering.

Authors: Samarth, Dave Kelly, Matthew H. Turnbull, and Paula E. Jameson

Specific leaf anatomy may not be a requisite for strong CAM (Research in Context)

Annals of Botany 125:
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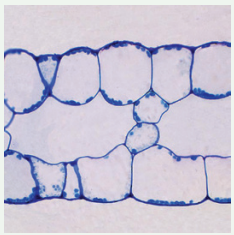
doi: 10.1093/aob/mcaa008

The leaf of a crassulacean acid metabolism (CAM) plant is assumed to be thick, with large mesophyll cells and vacuoles. **Herrera** evaluates the link between mesophyll characteristics and CAM mode using published values of the carbon isotopic ratio as an indicator of CAM, leaf thickness, leaf micrographs and other evidence of CAM operation. Based on 81 species from relatively unrelated families, neither leaf thickness, nor cell density, area, the proportion of intercellular space, nor the length of cell wall facing these helped explain the degree of CAM expression, suggesting that relationships between leaf anatomy and CAM mode should be interpreted cautiously.

Author: Ana Herrera



Leaf structure in an aquatic C_4 plant without Kranz anatomy

Annals of Botany 125:
869–879, 2020
doi: 10.1093/aob/mcaa005

Ottelia alismoides (Hydrocharitaceae) is the only aquatic plant known to have three CO_2-concentrating mechanisms. Under low CO_2 the leaves perform both C_4 and CAM photosynthesis whereas under high CO_2 only C_4 photosynthesis takes place. **Han *et al.*** utilize light and transmission electron microscopy to investigate the leaf anatomy and chloroplast ultrastructure of *O. alismoides* leaves underlying C_4 photosynthesis. They find that in leaves of *O. alismoides* epidermal and mesophyll cells contain chloroplasts and have large air spaces but lack the typical C4 Kranz anatomy. Sufficient structural diversity within the leaf of *O. alismoides* supports this dual-cell C_4 photosynthesis.

Authors: Shijuan Han, Stephen C. Maberly, Brigitte Gontero, Zhenfei Xing, Wei Li, Hongsheng Jiang, and Wenmin Huang

For a Commentary on this article see this issue, pp. iv–vi.

Clines in seed predation in *Quercus robur*

Annals of Botany 125:
881–890, 2020
doi: 10.1093/aob/mcz207

The factors driving latitudinal variation in plant–herbivore interactions have been long discussed. **Moreira *et al.*** tested for latitudinal variation in seed predation and putative seed defensive traits in *Quercus robur* (Fagaceae) by sampling 36 populations distributed along a 20º latitudinal gradient in Europe. Including climatic correlates, they find that seed predation increased while seed defences decreased towards lower latitudes, patterns associated with latitudinal variation in temperature but not precipitation. This suggests a temperature-driven mechanism shaping latitudinal variation in plant–seed–predator interactions, and elucidates the generative processes underlying geographic variation in plant–herbivore interactions.

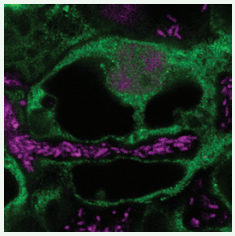
Authors: Xoaquín Moreira, Luis Abdala-Roberts, Hans Henrik Bruun, Felisa Covelo, Pieter De Frenne, Andrea Galmán, Álvaro Gaytán, Raimo Jaatinen, Pertti Pulkkinen, Jan P. J. G. Ten Hoopen, Bart G. H. Timmermans, Ayco J. M. Tack, and Bastien Castagneyrol

Variation in seed traits in Mediterranean oaks in Tunisia

Annals of Botany 125:
891–904, 2020
doi: 10.1093/aob/mcz211

In Mediterranean trees, seed traits that govern germination niche breadth and their impact on the geographical range of the species remain largely unexplored. To address this issue **Amimi *et al*.** analysed relationships between seed traits and species ranges in four Mediterranean oak species (*Quercus canariensis*, *Q. coccifera*, *Q. ilex* and *Q. suber,* Fagaceae) sampled in 22 Tunisian woodlands. Seed sensitivity to freezing, germination time at low temperatures, the ratio of pericarp mass to acorn mass and the embryonic axis hexose content were identified as key functional traits displaying large inter-specific variability that may contribute to Mediterranean oak distribution in Tunisia.

Authors: Nabil Amimi, Stéphane Dussert, Virginie Vaissayre, Hana Ghouil, Sylvie Doulbeau, Carlo Costantini, Youssef Ammari, and Thierry Joët

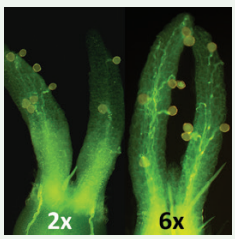


Cytokinins in pea nodulation

Annals of Botany 125:
905–923, 2020
doi: 10.1093/aob/mcaa022

Nod factor signalling is tightly interconnected with phytohormonal regulation that affects the development of nodules in legumes. Since the mechanisms of this interaction are still far from understood, **Dolgikh *et al.*** investigate the distribution of cytokinin and auxin in pea (*Pisum sativum,* Fabaceae) nodules. Their findings suggest that enhanced cytokinin accumulation during the later stages of symbiosis development may be associated with bacterial penetration into the plant cells and subsequent plant cell and bacteroid differentiation.

Authors: Elena A. Dolgikh, Pyotr G. Kusakin, Anna B. Kitaeva, Anna V. Tsyganova, Anna N. Kirienko, Irina V. Leppyanen, Aleksandra V. Dolgikh, Elena L. Ilina, Kirill N. Demchenko, Igor A. Tikhonovich, and Viktor E. Tsyganov



Polyploids have similar pollen tube growth rates to their diploid relatives

Annals of Botany 125:
925–935, 2020
doi: 10.1093/aob/mcaa007

Polyploidy has cell-level effects that might disrupt single-cell performance traits such as pollen tube growth rate (PTGR). **Williams and Oliveira** compare developmental determinants of PTGRs in diploid–polyploid species pairs of *Betula* (Betulaceae) and *Handroanthus* (Bignoniaceae), measuring pollen tube wall dimensions and production rates. Polyploid pollen tubes were 13–25 % wider and produced cell wall material 18–22 % faster, resulting in an apparent stasis in PTGR. Williams and Oliveira conclude that larger genome size imposes higher materials costs and slower PTGR, but gene duplication compensates for these costs, enabling the evolution of increased energetic capacity. Recurrent polyploidy cycles may have enhanced tube energetics, leading to similar PTGRs in angiosperms.

Authors: Joseph H. Williams and Paulo E. Oliveira

Transcriptome-based study on the phylogeny and evolution of Apioideae

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937–953, 2020
doi: 10.1093/aob/mcaa011

Relationships among the major lineages of Apioideae are unresolved with conflict between nuclear and chloroplast DNA results. **Wen *et al.*** made a phylogenetic analysis under coalescent-based methods using 3351 single copy genes generated from the transcriptome, obtaining a well-highly supported species tree. Combining with morphology and anatomy, the results suggest that Apioideae evolved in two directions: anemochorous and hydrochorous (with epizoochorous as a derived mode). Dating analysis suggests that uplift of the Qinghai–Tibet Plateauand climate change probably drive rapid radiation speciation and diversification of Apioideae in the QTP region.

Authors: Jun Wen, Yan Yu, Deng-Feng Xie, Chang Peng, Qing Liu, Song-Dong Zhou, and Xing-Jin He

No carbon limitation after lower crown loss in *Pinus radiata*

Annals of Botany 125:
955–967, 2020
doi: 10.1093/aob/mcaa013

Biotic stressors can lead to different defoliation patterns in trees. Foliar pathogenic infection, unlike insect herbivory, results in lower crown loss. **Gomez-Gallego *et al.*** analyse the role of the lower crown to better understand the impact of foliar pathogens on conifers. A 2-year artificial defoliation experiment in two genotypes of *Pinus radiata* (Pinaceae) showed effects of lower-crown defoliation on carbon assimilation and allocation. While the two genotypes were similarly susceptible to the foliar disease red needle cast, they had different tolerances to defoliation. In one genotype, neither growth nor carbon storage was altered, presumably conferring resilience to foliar pathogens.

Authors: Mireia Gomez-Gallego, Nari Williams, Sebastian Leuzinger, Peter Matthew Scott, and Martin Karl-Friedrich Bader

Similar plasticity to drought in populations of a gypsophile

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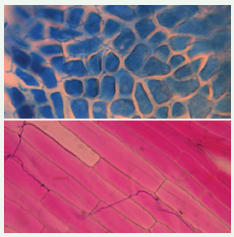
969–980, 2020
doi: 10.1093/aob/mcaa020

Plants experiencing contrasting environmental conditions may accommodate this through phenotypic plasticity, local adaptation, or both. **Matesanz *et al.*** investigate genetic differentiation and plasticity in response to drought in four populations of gypsum specialist *Lepidium subulatum* (Brassicaceae). Using a common garden experiment, they characterized fitness and functional plasticity in response to two contrasting treatments that realistically reflect soil moisture variation in gypsum habitats. Rather than ecotypes specialized to local climatic conditions, these populations are composed of highly plastic general-purpose genotypes. Significantly, patterns of plasticity among populations suggest past selection due to similarly high levels of climatic variation within sites.

Authors: Silvia Matesanz, Marina Ramos-Muñoz, Mario Blanco-Sánchez, and Adrián Escudero



Fungal endophyte transmission and plant–herbivore interaction

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Epichloë fungal endophytes protect plants against herbivores. Symbiosis prevalence in populations has been studied by comparing the differential performance of symbiotic and non-symbiotic plants, but far less attention has been given to how factors affect the endophyte transmission rate. **Gundel *et al.*** evaluate the endophyte effect on fitness of the grass *Poa autumnalis* (Poaceae) facing artificial folivory, and symbiont transmission to seeds, in a common garden experiment. Endophyte presence increased tolerance to damage and boosted fitness. Folivory increased vertical transmission and hyphal density within seedlings, suggesting induced protection for progeny. Their results reveal a new mechanism by which herbivores could influence the prevalence of microbial symbionts in host populations.

Authors: Pedro E. Gundel, Prudence Sun, Nikki D. Charlton, Carolyn A. Young, Tom E. X. Miller, and Jennifer A. Rudgers

Interspecific hybridization between *Camelina sativa* and *C. microcarpa*

Annals of Botany 125:
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doi: 10.1093/aob/mcaa026

Camelina, *Camelina sativa* (Brassicaceae), is an oilseed crop with narrow genetic diversity, Crosses with its closest relative, *Camelina microcarpa*, maycreate novel crop traits. **Tepfer *et al***. study the progeny of crosses between camelina and two *C. microcarpa* accessions. The F1 plants produced little viable pollen, pollen meiosis was strikingly abnormal, and very few F2 seeds were produced. The F2 plants displayed highly variable morphology, nuclear DNA amount, and fertility. Remarkably, certain F2 plants bore seeds with modified lipid composition. Due to the anomalies observed, these *C. microcarpa* accessions are not promising sources of crop diversity.

Authors: Mark Tepfer, Aurélie Hurel, Frédérique Tellier, and Eric Jenczewski