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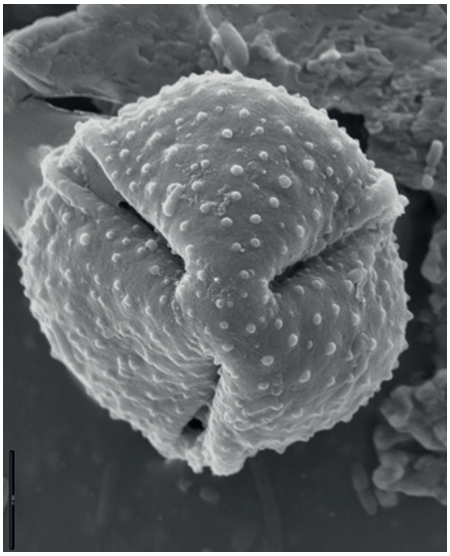
research highlights

PALAEONTOLOGY

Olden daisies

Proc. Natl Acad. Sci. USA http://doi.org/6t6 (2015)



FABIAN TRICARICO

The Asteraceae are the most diverse family of flowering plants containing over 23,000 living species including daisies, sunflowers, lettuce and artichoke. The expansion of this family was thought to have occurred during the Eocene period as the oldest fossil Asteraceae dated from 47.5 million years ago (Ma). However, Barreda *et al.* have now identified fossil pollen from Antarctica that pushes back the origin of the group a further 20 million years.

The pollen was found in rocks dated to 76–66 Ma collected from the James Ross and Vega islands in Antarctica, ironically the only continent on which living Asteraceae cannot be found. It appears to have come from *Tubulifloridites lilliei*, a species known from previous fossil pollen samples but whose place within the angiosperm family tree had not been determined. The new samples allowed Barreda *et al.* to identify *T. lilliei* as a member of the Asteraceae and a relative of the Barnadesioideae subfamily, modern members of which are endemic to South America and primarily pollinated by hummingbirds.

This classification of *T. lilliei* makes it the first example of an Asteraceae that would have been a contemporary of the dinosaurs. Like them, *T. lilliei* was widely spread during the Cretaceous but failed to survive the mass extinction that brought that period to a close. *CS*

EVOLUTION

Dryland orchid divergence

New Phytol. http://doi.org/6t5 (2015)

The expansion of dryland habitats in the late Miocene and early Pliocene, around 10 to 5 million years ago, coincided with the divergence of dryland plant lineages and the emergence of adaptive traits, such as the carbon-concentrating forms of photosynthesis. Ruth Bone and colleagues show that the evolution of crassulacean acid metabolism (CAM) photosynthesis in Afro-Madagascan orchids can be linked to the emergence of new niches around this time.

By temporally separating the processes of carbon capture and fixation by Rubisco, CAM plants are able to keep their stomata closed during the day, and thereby conserve water in arid environments. Bone *et al.* examined the evolution of CAM in Eulophiinae, a species-rich group of largely terrestrial orchids found in Africa and Madagascar. Combining stable isotope measurements of herbarium specimens, phylogenetic reconstructions and climate data they show that CAM evolved in four independent lineages of this orchid subtribe from the late Miocene onwards.

The researchers find that each of these CAM lineages occupies a different niche along an environmental gradient spanning dry forests and seasonally dry grasslands, suggesting that CAM evolution facilitated the spread of these orchids into newly emerging arid environments. *AA*

BARLEY DOMESTICATION

Double event

Cell **162,** 527–539 (2015)

Domestication of barley in the Near East involved converting the brittle rachis of wild plants to cultivars with non-brittle rachis that retain rather than disperse mature grains. Two tightly linked loci, *Btr1* and *Btr2*, are known to account for the brittle rachis phenotype but little is known about the specific genes involved. Mohammad Pourkheirandish *et al.* now identify two alleles that confer the non-brittle rachis produced during two spatially and temporally independent domestication events.

Using fine mapping, sequence analyses and transformation experiments, the researchers identified and validated two genes on chromosome 3H controlling brittleness. The recessive *btr1* allele contains a 1-bp deletion while the *btr2* allele has lost an 11-bp segment. Mutant analysis showed that *Btr1* regulates brittleness by affecting the thickness of cell walls and *Btr2* by affecting the disarticulation cell layer.

A survey of a large panel of wild barleys and cultivars showed that the two alleles, *btr1* and *btr2*, were retained after domestication and the non-brittle trait in all cultivars can be explained by either allele. In cultivars with only one non-brittle allele, low nucleotide diversity indicates that they were selected independently. The *btr1*-type emerged first by domestication from wild barley in south Levant, while the *btr2*-type was domesticated more recently further north. *JL*

STOMATA SIGNALLING

A pore within a pore

Plant Cell http://doi.org/6t4 (2015)

Stomata control some of the most crucial exchanges with the aerial environment: transpiration, CO_2 uptake and pathogen entry. The mechanical opening or closure of the two guard cells forming the stomatal pore depends on their osmotic pressure and volume. Complex molecular mechanisms tightly regulate this balance. Decades of research have implicated abscisic acid (ABA), ion flows, reactive oxygen species (ROS), kinases and other signalling components. Now, Maurel and colleagues show that water channel proteins (aquaporins) are also involved.

The effect of drought-inducible hormone ABA is multifaceted, and leads to fast stomatal closure after a decrease in guard cell volume. The authors show that this response and the parallel production of ROS are strongly impaired in two allelic plasma-membrane aquaporin mutants. The increase in water permeability induced by the hormone in isolated guard cell protoplasts is also lost in these mutants. Moreover, ABA-induced stomata closure and changes in water permeability are mediated by phosphorylation of the water channels on a single serine residue by OST1, a member of the SnRK2 kinase family acting downstream of ABA receptors.

This research highlights the underestimated physiological importance of aquaporins in plants. They allow quick hydraulic conductivity adjustments at the cellular level, much faster than the lipid bilayer would permit, helping plant survival in response to changing external conditions. *GT*

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