Botanists Help Create Evolutionary "Supertree"

A group of scientists has created the first comprehensive evolutionary reconstruction of the many families of flowering plants, an achievement that could aid in the search for plant-based cures for diseases and improve agricultural crops.

The group, which includes two University of Florida botanists, published its results in the online edition of the *Proceedings of the National Academy of Sciences.*

UF botany Professor Doug Soltis said flowering plants are the largest group of plants, comprising at least 250,000 species, with the oldest originating at least 130 million years ago. Encompassing nearly all grain and vegetable crops, they are also by far the most nutritionally and economically important plants.

Specialists in flowering plants, known scientifically as angiosperms, have created hundreds of "phylogenetic trees" — evolutionary lineages outlining which species predate and give rise to others — for specific groups.

Until now, however, no one had merged them all into one "supertree" mapping out the entire history of flowering plants.

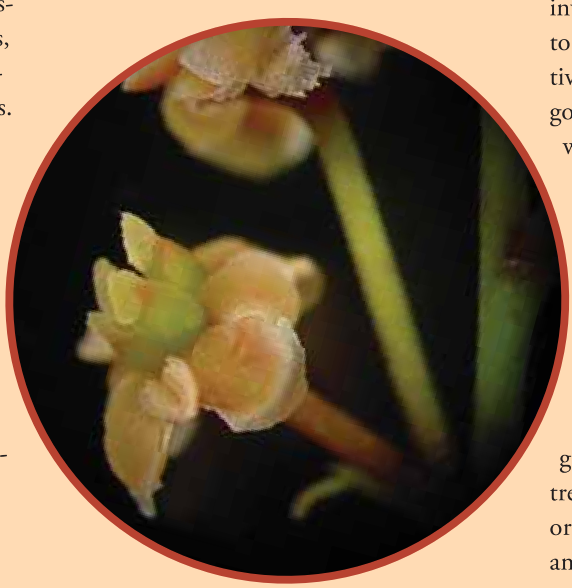
"This is the first crack at it," said Soltis, who coauthored the paper with Pamela Soltis, a curator at UF's Florida Museum of Natural History, and four British authors. "Now, we can take this and keep building on it and building on it. If we get enough data, eventually, years down the road, we can get all these 250,000 species of angiosperms into one (evolutionary) tree."

From a scientific perspective, the feat is important partly because it appears to help settle a long-standing debate about how flowering plants diversified into the extraordinarily varied forms they represent today, said Pam Soltis, who also is Doug Soltis' wife. Both researchers are members of the UF Genetics Institute.

Biologist Charles Darwin first recognized that flowering plants underwent a rapid period of diversification more than 100 million years ago.

Since then, scientists have debated whether that and similar diversification events resulted from key innovations in the plants' physiology or shape or rather from a series of smaller, less obvious or significant changes. For example, some have argued the appearance of the flower itself is a key innovation that spurred the success of flowering plants, while others have said the flower may represent several different innovations.

Pam Soltis said the supertree appears to come down on the side of many different innovations versus few significant or key innovations.



"When we look at those places within flowering plants where diversification has been high, there's nothing obvious that jumps out at us as some big morphological innovation at that point," she said.

Doug Soltis said the supertree is also important because it adds to a widespread effort to create similar trees for other large groups of species. Eventually, the goal is to create a comprehensive cross-species "tree of life," locking into place the evolutionary history and context of all living organisms, he said. The UF supertree research was funded in part by the National Science Foundation, which is also supporting the "tree of life" effort.

From a more practical perspective, the flowering plant tree may prove useful to both medical and agricultural scientists, he added.

"If, for example, you find that a particular cancer-curing drug is in a particular plant, you might want to ask, 'Where else can I find that chemical?,'" he said. "Because close relatives usually do similar things, you would begin your search at that place in the tree.

"It's also very useful if you are involved in crop plants. You might want to ask, 'What are the closest wild relatives to crop plants?' because you might go to those plants to find a gene that would help you improve disease resistance. We really can learn a lot by knowing how different species are related."

Doug Soltis said scientists build the trees using molecular data from the gene sequences of different species of plants. The Soltis' contribution to the supertree project was to gather and merge the many different trees using computer-driven algorithms, or formulas, designed to merge large amounts of molecular data.

"This is an interesting marriage of biology and math," Doug Soltis said. "The mathematicians have really set the stage for supertrees."

The other authors of the paper are scientists at the Silwood Park Campus of the Imperial College London in Berkshire, England, and the Royal Botanic Gardens in Kew, England.

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