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Sunflowers and all other flowering plants probably arose from a common ancestor.

PLANT SCIENCE

Debate blooms over Earth's first flower

Some scientists doubt a statistical prediction of the ancestral blossom's structure.

BY HEIDI LEDFORD

An ambitious effort to reconstruct the world's first flower has seeded a debate over what that blossom looked like — and, more broadly, which forms a flower can take.

The project, called eFLOWER, combined an unparalleled database of plant traits, reams of molecular data on evolutionary relationships, and complex statistical models to determine what the ancestor of all modern flowering plants might have looked like. When the study's results were published last August (H. Sauquet *et al. Nature Commun.* **8,** 16047; 2017), they drew intense interest from academics and the media.

But since then, researchers have raised questions about some of eFLOWER's predictions. On 31 January, plant morphologist Dmitry Sokoloff at Moscow State University and his colleagues published a reanalysis of the data that suggests a different arrangement of key female reproductive structures in the first flower (D. Sokoloff *et al. Am. J. Bot.* http://dx.doi.org/10.1002/ajb2.1003; 2018).

The debate centres on the finer points of flower architecture, but raises a broader concern about using statistical models and large data sets to tackle biological questions, says Pamela Soltis, a plant biologist at the University of Florida in Gainesville. "Things can be statistically possible without being biologically possible," she says.

Flowering plants are a remarkable evolutionary success. Although they appeared as recently as 140 million years ago — about 200 million years after the first seed plants — they now make up about 90% of all living ▶

land plants. But fossil flowers are scarce, and botanists have long speculated about what the first blooms might have looked like. "The flower was responsible for this massive diversification," says Soltis. "We can't understand how we got to where we are without understanding what the first one was like."

About eight years ago, the eFLOWER project enlisted a team of botanical experts to find out. The team catalogued more than 20 traits in nearly 800 species. They then matched these data with molecular studies of evolutionary relationships, and used statistical modelling to infer the features of the earliest flower.

BUDDING DOUBTS

The results painted a picture of a flower that was symmetric around a central axis and contained both male and female sex organs. The eFLOWER models also suggested that many organs in the first flower were whorled, meaning they were arranged regularly in concentric circles when viewed from above. But the authors also warned that statistical support for some of these findings was weak.

Even so, the idea of a whorled ancestral flower shocked some people, says Hervé Sauquet, a lead author on the eFLOWER paper and an evolutionary biologist now at the Royal Botanic Garden in Sydney, Australia. Many plant scientists expected that the bloom's organs would have been staggered in a spiral coiled around a central axis. "It was a long-held dogma that was never confirmed," he says.

But what puzzled Sokoloff was that in Sauquet's analysis, the flower's petals and male reproductive parts were arranged in whorls, yet the female reproductive organs, carpels, were arranged in a spiral. He had never seen this combination of whorled and spiral organs in a single flower. Moreover, he and his colleagues suggest that it might not be developmentally possible for plants to achieve two different arrangements of organs in one flower.

"Things can be statistically possible without being biologically possible."

That's because the organs emerge from the same region of the plant, Sokoloff says. In some whorled flowers, the position of the carpels dictates the position of the male reproductive organs. Sokoloff's team picked back through the eFLOWER database and found four examples in which whorled and spiral organs had been identified within the same flower. But after further analysis, they decided that each example contained only one type of reproductive organ.

Sauquet says that his team has since revisited those data and agreed with some, although not all, of Sokoloff's concerns. Repeating their analysis with an updated and expanded data set, they now find that all reproductive organs in the ancestral flower were probably whorled, he says. But some of the revised results had a relatively low degree of statistical support, just as the first analysis did. "It wasn't certain before, and it remains uncertain," Sauquet says. "We don't know the final answer yet."

Sokoloff says that a fundamental problem of eFLOWER's approach was evaluating each trait of a flower independently before assembling those traits into a coherent bloom. "They analysed the evolution of each character separately," he says. "But some combinations of characters are impossible."

Even so, Sauquet argues that the absence of a particular form in modern flowers does not mean that it never existed. "There are a lot of weird things that existed before that we cannot see nowadays," he says.

Settling the debate over the first flower will take a bigger database and more-sophisticated models, says Wenheng Zhang, who studies plant evolution at Virginia Commonwealth University in Richmond. But the eFLOWER effort is an example of how modern techniques can be married to classical morphology to tackle fundamental questions about plant origins, she says. "This kind of study redirects botanists to look at the morphology," Zhang says. "It just comes back to the basics." ■

SOUTH KOREA

Child authors spark probe

Researchers may have added relatives to papers to boost their chances at university.

BY MARK ZASTROW

The South Korean government is expanding an investigation into researchers who named their children as co-authors on papers. In some cases, the practice is thought to be intended to give the children an edge when applying to university, a highly competitive process in South Korea. The education ministry announced on 1 February that it would extend its original investigation, which last month identified 82 academic papers on which authors had named their children or relatives — many of them in middle or high school — as co-authors.

And on 4 February, the science ministry launched its own investigation into several of the country's elite technical universities, which had not been included in the education ministry's initial probe.

The 82 papers with child authors were uncovered in a month-long review of articles written by more than 70,000 full-time university staff members across arts and sciences over 10 years. The review was prompted by a single case of child authorship that came to light late last year, at Seoul National University.

The investigation results, released on 25 January, found examples from 29 South Korean universities. In 39 of the papers, the students seemed to have participated in the research as part of a programme related to their school curriculum; the other 43 appeared not to have, according to the investigation.

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