New plant species gives insights into evolution

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A new University of Florida study shows when two flowering plants are crossed to produce a new hybrid, the new species' genes are reset, allowing for greater genetic variation.

Researchers say the study, to be published March 17 in *Current Biology*, could lead to a better understanding of how to best grow more stable and higher yielding agricultural crops.

"We caught evolution in the act," said Doug Soltis, a distinguished professor in UF's biology department and study co-author. "New and diverse patterns of gene expression may allow the new species to rapidly adapt in new environments."

The study shows the new plant species had relaxed control of gene expression in its earliest generations. But today, after 80 years of evolution, control has been regained, allowing for the production of different patterns of gene expression in different plants. The new species was remade in UF greenhouses as well as studied in its natural habitat.

Researchers analyzed Tragopogon miscellus, a species in the daisy family that originated naturally through hybridization in the northwest U.S. about 80 years ago. The new species formed when two species introduced from Europe mated to produce a hybrid offspring. The species mated before in Europe, but the hybrids were never successful. However, in America something new happened – the number of chromosomes in the hybrid spontaneously doubled, and at once it became larger than its parents and quickly spread.

"No one had extended this to natural populations and the rapidity at which this can occur, and that's pretty astonishing," said Jonathan Wendel, professor and chairman of the department of ecology, evolution, and organismal biology at Iowa State University. "That species is such a beautiful model for that."

Hybridization with chromosome doubling is a prominent mode of species formation and through this study scientists can better understand how different plant groups originated.

"Understanding the impacts this process has on genome structure may help understand how best to breed crops for high and stable yields," said study co-author Pat Schnable, director of the Center for Plant Genomics at Iowa State University.

Before discovering their relaxed gene expression, the team had expected the artificial hybrids to exhibit a combination of the parents' genes, said study co-author Pam Soltis, curator of molecular systematics and evolutionary genetics at the Florida Museum of Natural History on the UF campus.

"What we found was a surprise," said lead author Richard Buggs of Queen Mary University of London, who worked on the study as a postdoctoral researcher at the Florida Museum. "It's as if hybridization and chromosome doubling hit a reset button on gene expression, turning them all on -- this could allow subsequent generations to experiment by switching off different genes."

The expression of the hybrid plant's genes in all tissues at all times allowed natural selection to shape what would emerge generations later, Pam Soltis said. With this form of hybridization, there is the opportunity for parental patterns to be equalized, as if the hybrid has a fresh chance to exhibit a wide variety of genetic expressions over time.

Its two parent species, Tragopogon dubius and Tragopogon pratensis, were introduced to the U.S. in the 1920s. The researchers started making the artificial hybrids in 2004 and the plants take about one year to grow from seed to being able to produce seeds, Pam Soltis said.

"Tragopogon miscellus is unique because we actually know when it originated," Pam Soltis said. "Museum collections tell us when the parent species were introduced, allowing us to infer the age of the hybrid species."

The researchers studied 144 duplicated gene pairs from the 40-generation-old Tragogogon miscellus, whose common name is goatsbeard. Because the flower of the plant only blooms for a few hours in the morning, it is often referred to as "John-go-to-bed-at-noon." It looks like a daisy except for being either purple or yellow in color.

"The Soltises are showing at the genetic level how this really important process of genome doubling generates new biological diversity," Wendel said. "This leads to new questions and the design of new experiments that can help us understand the ecological and evolutionary consequences of the genetic changes they're observing."

Provided by University of Florida

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