New research on newly formed plants could lead to improved crop fertility

January 6 2012, by Danielle Torrent

A new University of Florida study shows genomes of a recently formed plant species to be highly unstable, a phenomenon that may have far-reaching evolutionary consequences.

Published online this week in the Proceedings of the National Academy of Sciences, the study is the first to document chromosomal variation in natural populations of a recently formed plant species following whole genome doubling, or polyploidy. Because many agricultural crops are young polyploids, the data may be used to develop plants with higher fertility and yields. Polyploid crops include wheat, corn, coffee, apples, broccoli and some rice species.

"It could be occurring in other polyploids, but this sort of methodology just hasn't been applied to many plant species," said study co-author Pam Soltis, distinguished professor and curator of molecular systematics and evolutionary genetics at the Florida Museum of Natural History on the UF campus. "So it may be that lots of polyploids – including our crops – may not be perfect additive combinations of the two parents, but instead have more chromosomes from one parent or the other."

Researchers analyzed about 70 *Tragopogon miscellus* plants, a species in the daisy family that originated in the northwestern U.S. about 80 years ago. The new species formed naturally when two plants introduced from Europe mated to produce a hybrid offspring, and hybridization was followed by polyploidy.

Using a technique called "chromosome painting" to observe the plants' DNA, UF postdoctoral researcher and lead author Michael Chester discovered that while whole genome doubling initially results in a new species containing 12 chromosomes from each parent, numbers subsequently vary among many plants.

The paints are made by attaching different dyes to DNA of the two parent species. Once the dye is applied, there is a match between the DNA of the paint and of the chromosome. Under a microscope, the chromosomes appear in one color or the other (red vs. green) depending on the parent from which they originated. Sometimes chromosomes are a patchwork of both colors because DNA from the two parents has been swapped as a result of chromosomal rearrangements.

"One of the things that makes this so amazing is that where we expected to see 12 chromosomes from each parent (the polyploid has 24 chromosomes), it turns out there aren't 12 and 12, there are 11 from one parent and 13 from the other, or 10 and 14," Soltis said. "We're hoping through some ongoing studies to be able to link these results with the occurrence of another interesting phenomenon – the loss of genes – and also see what effect these changes have on the way the plants grow and perform."

The polyploid's two parent species, *Tragopogon dubius* and *Tragopogon pratensis*, were introduced to the U.S. in the 1920s. Because its flower only blooms for a few hours in the morning, *Tragopogon miscellus* is often referred to as "John-go-to-bed-at-noon," and its common name is goatsbeard. It looks like a daisy except for being yellow in color.

"People have looked at these chromosomes before, but until you could apply these beautiful painting techniques, you couldn't tell which parent they each came from," Soltis said.

Of the six populations examined from Washington and Idaho, 69 percent of the plants showed a deviation from the expected 12 and 12 chromosome pattern.

"In order for most plants to be able to interbreed successfully, their chromosomes need to match up," Chester said. "That doesn't necessarily happen when you don't have equal numbers, so there may be some chromosomal barriers to fertility that develop as a result of this sort of chromosomal variation. This mechanism may also explain low fertility in other plants, such as crops. This is something we are looking into with Tragopogon."

The two-year study was funded by the National Science Foundation. Other co-authors include Doug Soltis, a distinguished professor in UF's biology department, UF undergraduate biology student Joseph Gallagher and Ana Veruska Cruz da Silva of Embrapa Tabuleiros Costeiros in Brazil and the Florida Museum.

"Among all of the processes that generate biological diversity in the plant kingdom, genome doubling, or polyploidy, is among the most prevalent and important," said Jonathan Wendel, professor and chairman of the department of ecology, evolution, and organismal biology at Iowa State University, in an email. "This is an area that is receiving international focus and research attention, but the system Pam and Doug Soltis are working on is unique."

Provided by University of Florida

Citation: New research on newly formed plants could lead to improved crop fertility (2012, January 6) retrieved 11 July 2024 from https://phys.org/news/2012-01-newly-crop-fertility.html