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Times Three: USU Scientists Note Odd Genetic Pattern in Western Aspen

From left, USU scientists Richie Gardner, Carol Rowe, Karen Mock, Paul Wolf; USDA FS RMRS scientist John Shaw and USU scientist Hardeep Rai are among the authors of an Oct. 31 paper describing a curious genetic pattern in western aspen.

USU scientists documented the genetic phenomenon triploidy in more than half of clonal colonies of quaking aspen in areas of Utah and Colorado's forests.

As in years past, aspen, favored yet beleaguered icons of North America's western forests, fail to disappoint as the trees splash brilliant fall colors across the region's landscapes. But the enduring toll of drought remains evident, as scientists study the quakies' ebb, including a mysterious syndrome dubbed "Sudden Aspen Decline."

Recent findings by a Utah State University-led team of scientists add to the puzzle with the discovery of a curious genetic pattern among aspen of the arid forests of the American West's mid-section. The team has documented the genetic phenomenon triploidy in more than half of clonal colonies of quaking aspen (*Populus tremuloides*) in areas of Utah and Colorado's forests.

Triploidy describes the presence of three sets of chromosomes in an organism, instead of the usual two: a set from the mother and a set from the father.

"In many plants, triploidy isn't unusual but this kind of frequency is rare, especially in trees," says Karen Mock, associate professor of conservation genetics in USU's Department of Wildland Resources and Ecology Center. "The pattern we're seeing in aspen is also striking; these triploids are especially common in dry western landscapes."

With USU colleagues Paul Wolf, Colin Callahan, Hardeep Rai, Carol Rowe, Ron Ryel and Richie Gardner, along with John D. Shaw and Stewart

Sanderson of the USDA Forest Service Rocky Mountain Research Station, Nurul Islam-Faridi of the USFS Southern Institute of Genetics and Michael Madritch of Appalachian State University, Mock published findings in the Oct. 31, 2012, edition of the online journal *PLoS ONE*.

Triploidy causes an array of conditions across species but a usual trait is sterility or at least reduced fertility. Although a triploid aspen clone may sucker from roots, the scientists say, it is unlikely to produce viable seed.

Aspen reproduce both sexually (from seed) and asexually (from roots), says Shaw, biological scientist with the RMRS Interior West Forest Inventory and Analysis program in Ogden, Utah.

“With its tiny seeds, aspen has trouble reproducing sexually without adequate moisture,” he says.

Shaw, whose program collects inventory data on forests throughout the United States, notes the tree commonly establishes from seed in Alaska, northern Canada and the eastern United States, but reproduction by suckering is more common in the West.

Mapping latitude, glacial history, climate and regional variance in clone sizes, the scientists wonder if triploidy might enable very large clones — like Pando, the gigantic aspen clone in Utah’s Fishlake National Forest thought to be the world’s largest organism — to persist.

“The correlation with climate makes us wonder what advantages triploids might have in western landscapes,” says Mock, the paper’s lead author. “Do triploids grow faster? Or can they live longer or handle drought better than diploids? Are they less or more susceptible to climate changes than diploids?”

Wolf, professor in USU’s Department of Biology, notes triploid plants often have larger cells, which might affect how plants cope with different conditions.

“It’s possible triploid aspen can better absorb water than diploids and are therefore better suited to withstand dry conditions, but they may be especially vulnerable to severe drought,” he says.

Mock says the team's study is derived from more than eight years of data collection from a patchwork of inventories conducted by Forest Service personnel, a NASA Biodiversity program, university researchers and "a heck of a lot of volunteers."

Emerging technologies, such as microsatellite genotyping, cytological tools — chromosome-counting techniques — developed by team member Islam-Faridi and flow cytometry protocols developed by team member Rai, are accelerating the team's work, Mock says.

"Determining ploidy levels in aspen clones is tedious, time-consuming work, but these new techniques are streamlining the process," she says. "Though our findings come from many years of study, they provide an important starting point as we go forward. What we're learning will help us understand both the past and the future of aspen in the West."

Related links:

- USU Department of Wildland Resources
- USU Quinney College of Natural Resources
- USU Department of Biology
- USU College of Science
- USU Ecology Center
- Western Aspen Alliance

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