Can clonal plants live forever?

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Despite the many cosmetic products, surgical treatments, food supplements, and drugs designed specifically to reverse the biological effects of aging in humans, long-lived aspen clones aren't so lucky. Researchers at the University of British Columbia have shown that as long-lived male aspen clones age, their sexual performance declines.

Dilara Ally, who conducted this research for her Ph.D., also showed that with that loss of sex and sexual fitness, ultimately the lineage could go extinct. The findings will be published next week in the online, open access journal PLoS Biology.

A clone is a group of genetically identical individuals that originate from a single ancestor without the need of sex (for instance cuttings from a plant). Although many organisms can propagate clonally, this feature is most common in plants. In aspen, asexual reproduction or clonality is achieved via underground lateral roots that eventually produce new clone members/ramets.

Although a clone can produce new members asexually and avoid meiosis (the stage where parental genomes recombine), it still continues to undergo cell division over the years. As the clone spreads and new trees replace old trees, the number of mitotic cell divisions increases, resulting in an accumulation of mutations along the way. Ally and colleagues used a molecular clock to estimate the age of individual clones. To do this they measured the number of accumulated mutations at microsatellite markers and calibrated the clock using an independent, geological estimate of time. By coupling estimates of clone age with a measure of male fertility, they found that long-lived aspen clones do indeed suffer reduced sexual fitness with age.

"One reason the evidence for aging in trees is scarce is because it is very difficult to obtain long-term demographic data. Imagine trying to follow cohorts of plants that live on average 100 years of age and don't start reproducing until they are 25 yrs; its impossible within the timeframe of a Ph.D. or even over an entire career," says lead author Ally, who will be taking a postdoctoral position at San Diego State University in the Fall.

The study is a major step toward answering some fundamental questions about aging in plants because it may offer an alternative way to collect data on long-lived clones, using molecular-based estimates of clone age. Ally and colleagues hope that given the advances in sequencing technologies, future research will apply the method to learn whether other plant species show similar sexual fitness declines with clone age.

More information: Ally D, Ritland K, Otto SP (2010) Aging in a Long-Lived Clonal Tree. PLoS Biol 8(8): e1000454. doi:10.1371/journal.pbio.1000454

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