New plant gene editing approach improves speed, scalability and heritability

June 11 2020

Nicotiana benthamiana, also known as benth or benthi, is indigenous to Australia. Credit: The Voytas Lab.

Breeding plants for specific characteristics goes back thousands of years. For most of that time, the process has been slow and tied to the

agricultural cycle. Farmers identified plants with desirable traits, harvested seeds and hoped for a reprise of a specific trait in the next generation of seedlings. Gene editing made it possible to accelerate this process—to a point—but reliance on tissue culture, an expensive and time-consuming process, substantially limited innovation.

A study recently published in *Nature Plants* outlines a new approach that may significantly speed the development of new plant varieties by skipping tissue culture and boosting heritability. The technique, developed by Evan Ellison, a graduate student in the lab of Dan Voytas, a professor in the College of Biological Sciences' Department of Genetics, Cell Biology and Development, draws on the ability of RNA viruses to effectively deliver genetic information to plant cells. Ellison collaborated on the study with Voytas, a master's student in the Voytas lab, and colleagues at the University of California, Davis.

RNA viral vectors—natural viruses that are stripped down and disarmed before being repurposed—are one of several ways to deliver genetic information. Ellison's approach opens up a novel avenue for experimentation.

"Plant biology has a problem with scalability because you can only make changes to a few genes at a time," said Ellison. "This approach makes it easy to build these vectors and deliver them to plants, which means you can iterate dozens of times very quickly. It's cheaper, easier and less labor intensive."

Ellison turned to mobile RNA, or mobile motifs, that already exist in plants with an eye to making modifications more heritable.

"In plants you want to get as many cells edited as you can. I thought mobile motifs are kind of exactly what we want,'" he said, noting it underpins flowering and other critical functions and are adept at cell-to-

cell movement. Because of this, Ellison thought it might be particularly good at delivering gene editing reagents to create edited plants more efficiently.

Results suggest that the gambit paid off. With the mobile motif for flowering, heritable editing frequency ranged from 65% to 100% of progeny, a considerable improvement on current rates of heritability in gene-edited plants created using other techniques.

"I was completely dumbfounded when Evan first showed me his data demonstrating such high frequencies of gene editing," said Voytas. "The next step is to enable his method in a wide variety of crop plants so we can fully capture the potential of plant gene editing for crop improvement."

More information: Evan E. Ellison et al. Multiplexed heritable gene editing using RNA viruses and mobile single guide RNAs, *Nature Plants* (2020). DOI: 10.1038/s41477-020-0670-y

Provided by University of Minnesota