Defying the laws of Mendelian inheritance

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Two articles published in F1000Research support controversial claims that could redefine what we know about Mendelian inheritance in single Arabidopsis thaliana plants.

In 2005, Susan Lolle and colleagues from Purdue University published a paper in *Nature*, concluding that Arabidopsis thaliana plants do not obey the laws of Mendelian inheritance (the idea that all genes are inherited from their parents). Instead, Lolle found that these plants were demonstrating genetic traits from older generations, which shouldn't be possible according to our current understanding of how genes are passed on.

At the time of publishing, the paper was recommended by 20 F1000Prime Faculty Members, and it is still one of the all-time top 10 papers on the site despite also being dissented. In the wider scientific community the paper was met with some criticism, alternative theories to explain the findings were offered, and there were calls for more evidence. Many believed the findings to be the result of contamination from other seeds, the introduction of unrelated genetic material into the breeding line (out-crossing), or another novel DNA-based genetic phenomenon.

Lolle and new colleagues from the University of Waterloo have now published a follow-up paper on *F1000Research*, having spent several years conducting numerous experiments that they believe provide further evidence to support the original findings and disprove some of the other suggested theories. In Lolle et al.'s paper, "*De novo* genetic variation

revealed in somatic sectors of single Arabidopsis *plants*", they have used DNA markers to demonstrate the presence of multiple genetic traits in single *Arabidopsis* plants. The article has now been approved by three independent leading names in the field, Andy Pereira (University of Arkansas), Igor Kovalchuk (University of Lethbridge), and David Oppenheimer (University of Florida), who provided formal referee reports and it will now be indexed in PubMed, Scopus and other major indexers. All peer review for *F1000Research* is conducted post-publication; referees' comments are openly published and can be viewed (and commented on by others) at the bottom of each article, and authors have the opportunity then to modify their article and publish a new version as appropriate.

A separate article by Carina Barth and her former group at West Virginia University (Barth is now with ConRuhr North America) has been published at the same time on *F1000Research*, and may go some way to supporting Lolle's findings, although the referees were more mixed in their reaction to this study. In their article "*The novel* Arabidopsis *thaliana svt2 suppressor of the ascorbic acid-deficient mutant vtc1-1 exhibits phenotypic and genotypic instability*", Barth et al. attempted to isolate *Arabidopsis* plants that could in some way compensate for a diminished capacity to synthesize vitamin C in order to better understand the genetic regulation of this process in those plants that do perform the function. They found that a number of their plants compensated by apparently reverting back to an ancestral genome containing the trait responsible for successful biosynthesis of vitamin C, even though they had been bred from plants with a defect in this trait. They conclude that this kind of genetic instability could be explained by hidden information somewhere in the organism's genome, perhaps even Lolle's RNA cache theory.

These papers could have significant implications for plant biology, genetics and agriculture. If confirmed, the findings will completely alter

our understanding of how organisms inherit their genes. In addition, the findings could have practical implications for the future. These theories could be adapted to help us better understand how plants (and crops) cope with environmental stress, with relevance to global warming, the moving crop belts and global food security.

More information: De novo genetic variation revealed in somatic sectors of single Arabidopsis plants [v1; ref status: indexed, f1000r.es/kw]
Marianne T Hopkins, Aaron M Khalid, Pei-Chun Chang, Karen C Vanderhoek, Dulcie Lai, Meghan D Doerr, Susan J Lolle
f1000research.com/articles/2-5/v1

The novel Arabidopsis thaliana svt2 suppressor of the ascorbic acid-deficient mutant vtc1-1 exhibits phenotypic and genotypic instability [v1; ref status: indexed, f1000r.es/o2]
Chase F Kempinski, Samuel V Crowell, Caleb Smeeth, Carina Barth
f1000research.com/articles/2-6/v1

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