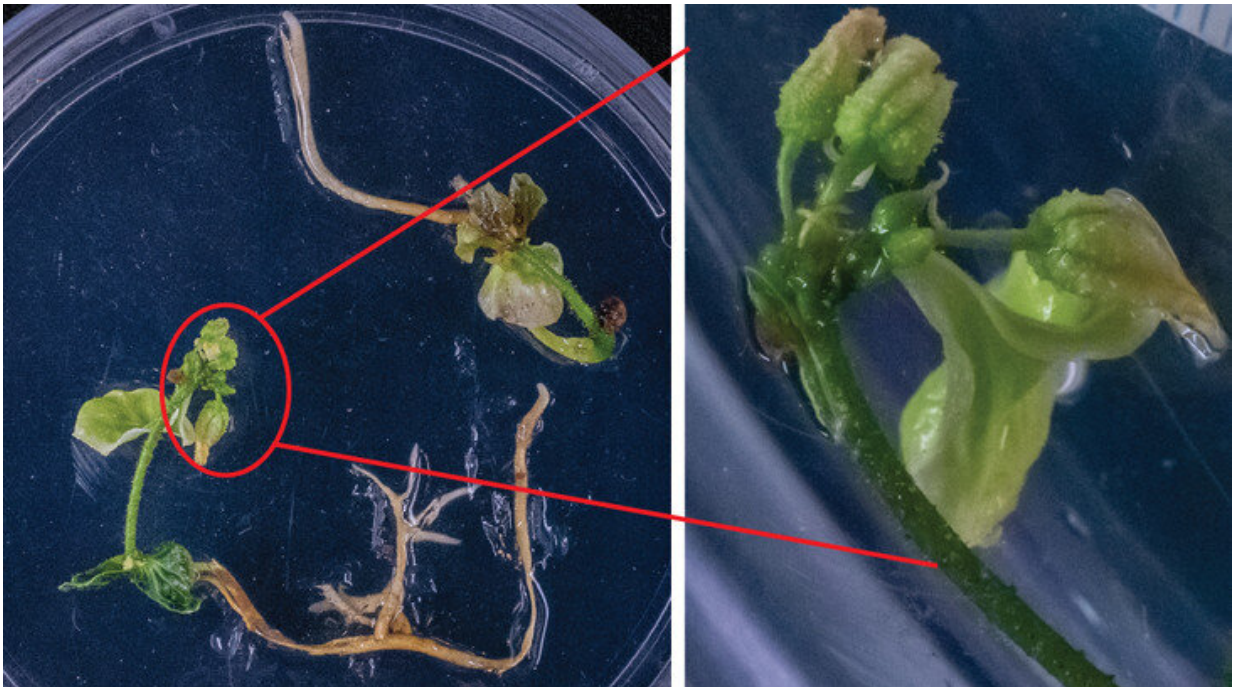


Discovery of flowering gene in cacao may lead to accelerated breeding strategies

May 17 2021, by Jeff Mulhollem



In the research, embryonic cacao, over expressing the florigen gene, develop tiny flowers in tissue culture. This study is significant because cacao trees typically don't flower until they are between three and eight years of age. Such early flowering promises to greatly speed up breeding to develop disease-resistant trees. Credit: Sarah Prewitt/Penn State

For the first time, Penn State researchers have identified a gene that controls flowering in cacao, a discovery that may help accelerate

breeding efforts aimed at improving the disease-ridden plant, they suggested.

Characterizing the Flowering Locus T gene in [cacao](#), responsible for the production of florigen—a protein that triggers flowering in most [plants](#)—is important, according to study co-author Mark Guiltinan, J. Franklin Styer Professor of Horticultural Botany and professor of plant molecular biology. He expects this advancement to enable scientists to develop disease-resistant trees faster, which is critical because 20% to 30% of the world's cacao crop is lost to disease annually.

"Breeding tree crops like cacao is very slow and can take 20 or more years to release a new variety," he said. "Knowledge of the mechanisms of flowering may lead to methods to accelerate cacao breeding and to develop trees that produce fruit sooner than conventional varieties, which takes two to four years. Each year we move closer to these goals as we continue to explore the [molecular biology](#) of the cacao tree."

To find the flowering gene in cacao, lead researcher Sarah Prewitt, doctoral candidate in plant science in the College of Agricultural Sciences, first looked at [genes](#) known to be responsible for flowering in the Arabidopsis plant, the genome of which has been studied widely for decades. Before finding the cacao flowering gene, she tested an Arabidopsis flowering gene in cacao to see how the plant developed.



The fungal disease black pod rot, shown here in cacao seed pods, is a serious problem in all areas of the world where the crop is grown. Caused by the fungus *Phytophthora*, black pod rot causes pod losses of up to 30% and kills as many as 10% of the trees annually. Researchers hope to breed disease-resistant trees, and finding the cacao flowering gene promises to speed up their efforts. Credit: PlantVillage, Penn State

Testing her theory, she overexpressed that gene to trigger very early flowering in cacao 'plantlets' in the lab and showed that those tiny flowers produced grains of pollen that were viable.

"To find the flowering gene in cacao, we used a bioinformatics

approach, taking the sequence of the gene from Arabidopsis and looking for similar genes in the cacao genome," Prewitt said. "I found the cacao gene that promotes flowering because the sequences look very similar."

Geneticists consider the function of the florigen flowering gene to be "highly conserved," Prewitt added. "That means the gene is extremely consistent—it does what it does in every plant genome that you look in," she said. "The florigen flowering gene certainly has been looked at in a lot of plants, and it's very reliable. It controls the timing of flowering."



This image shows an early flowering *Arabidopsis* plant from the study in which the researchers knocked out the florigen flowering gene and inserted the cacao florigen flowering gene they discovered. It demonstrates the ability to interspecies swap the two disparate plants' genes and shows the "conserved" nature of the florigen gene — meaning it performs the same function in both plants. Credit: Sarah Prewitt/Penn State

In findings published May 15 in *BMC Plant Biology*, the researchers reported on the role of cacao's single flowering gene, Flowering Locus T, demonstrated by gene-expression analysis. They also documented the results of their introduction of the flowering gene from *Arabidopsis* into cacao. Overexpressing that gene resulted in 'precocious' flowering in cacao tissue culture, they explained, which demonstrated the extremely similar function of florigen genes and the mechanisms that control flowering in both *Arabidopsis* and cacao.

While intriguing on a scientific level, the discovery of the cacao Flowering Locus T gene could have a potentially significant, real-world impact, Gultinan noted, by helping to improve the lives of millions of cacao farmers in developing countries sooner than previously thought possible. He pointed out that the breeding of cacao varieties with [high yields](#), [disease resistance](#), resilience to [climate change](#) and desirable quality traits is an important component of a broader goal to develop sustainable farming systems for cacao.

"Better cacao varieties can increase the income, and thus the well-being, of cacao farmers who live in some of the most impoverished regions of the world, such as West Africa," he said. "In turn, this will benefit the economies of these countries and the environment and will provide a sustainable source of the main raw ingredient for the chocolate industry."

More information: Yi Liu et al. Proanthocyanidin synthesis in *Theobroma cacao*: genes encoding anthocyanidin synthase, anthocyanidin reductase, and leucoanthocyanidin reductase, *BMC Plant Biology* (2013). [DOI: 10.1186/1471-2229-13-202](https://doi.org/10.1186/1471-2229-13-202)

Provided by Pennsylvania State University

Citation: Discovery of flowering gene in cacao may lead to accelerated breeding strategies (2021, May 17) retrieved 27 April 2024 from <https://phys.org/news/2021-05-discovery-gene-cacao-strategies.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.