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Peculiar poppies

Plant biologists puzzle over the curious genetics of flowers

Photo Credit: Rick Fatica

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by DEANNA KERSLAKE

They call them beautiful monsters. As they grow and develop, some of their tissues mix to form one strange organ. Others spawn multiple organs or barely develop at all. These “beautiful monsters” are a species of California poppy flowers injected with a virus that strikes at the heart of it all — their genes. Ohio University senior plant biology major Sara Wreath spends her days picking apart the terribly twisted flora to learn more about flower development and evolution.

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Additional information:

Steven Gleissberg Plant Development and Evolution Research Lab (Features a related video on this research)

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Wreath is a researcher in Stefan Gleissberg’s Plant Development and Evolution Research Lab. She studies the FLORICAULA gene in the California poppy, which represents an earlier stage of evolution than its relatives, such as the pea and tomato, whose gene functions already have been documented. The researchers hope to understand how evolution has affected the gene’s function over time. Wreath has studied three batches of the flowers.

“I really like the hands-on experience,” Wreath says as she heads to the growth chamber to check on her latest batch of blooms. “Genetics is really fascinating.”

In organisms from California poppies to humans, development occurs through a transfer of information from DNA to RNA to protein. DNA contains code that instructs how, when, and where structures should form in the individual. RNA copies code from DNA and facilitates the formation of protein, the actual “stuff” that will make up the organism. This process is a highly integrated, delicate cascade of events, with one event triggering the next. If step one doesn’t happen, the results can be detrimental to the normal development of the organism.

A new technique known as virus-induced gene silencing (VIGS) allows Wreath to inactivate a specific gene (out of around 25,000) and record the consequences. With help from Conny Bartholmes, a doctoral student in the lab, Wreath learned the molecular biology techniques used in the experiment, including how to inject the virus into the young seedlings. After a few weeks, they began to bloom.

Such viruses exist naturally, so plants have developed a defense mechanism against them, Wreath and Gleissberg explain. Because most viruses have double-stranded RNA (as opposed to single-stranded RNA that organisms make naturally), plants can detect the double-stranded and destroy it. VIGS takes advantage of this.

When Wreath introduces a normal plant gene into the virus and injects it into the poppy, the plant turns on its defenses and now recognizes the gene as an intruder. The poppy then not only destroys the virus, but its own normal RNA as well. This, in essence, “silences the gene” and throws a wrench into the cascade of developmental events.

The virus-injected flowers ranged from those that resembled typical wild flowers to those that were far from normal.

“In flowers with a silenced FLORICAULA gene, development is not completed normally, and they can repeat development over and over again,” Wreath says.

However, the virus doesn’t always totally debilitate the targeted gene — sometimes it only partially silences it. This leads to variation in the mutant flowers, which explains why some flowers make multiple sepals while others have small, shriveled petals.

“It is obvious that the lack of a functional FLORICAULA gene messed up poppy flower development, indicating that this single gene is of major importance for poppy development,” says Gleissberg, an assistant professor of environmental and plant biology.

Wreath, who graduated from Ohio University in the spring, will assist Gleissberg with a paper he’ll write about these findings, she says.

Researchers have used information about the FLORICAULA gene to prompt poplar trees to flower and produce fruit much quicker, which could be useful in speeding up breeding efforts, Gleissberg notes. Continued experiments also can help plant biologists unravel how a gene controls development and how its developmental duties have changed over the course of evolution, he adds. Beyond their striking appearance, these “beautiful monsters” have a lot to tell.

This story appears in the Autumn/Winter 2008 issue of Perspectives magazine. Deanna Kerslake is a student in the E.W. Scripps School of Journalism.