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Scientists Map Genetic Mutation Depicted in Vincent van Gogh's Sunflower Series

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Researchers believe that Vincent van Gogh is depicting a genetic mutation of sunflowers in “Vase with Fifteen Sunflowers” (1888, oil on canvas). (Source: Wikimedia Commons [1]/National Gallery)

In the late 19th Century, many Impressionist artists like Claude Monet and Camille Pissarro painted prolific scenes of the environment, ranging from “Water Lilies” to an “Orchard in Bloom.” Perhaps one of the most appreciated post-Impressionists, Vincent van Gogh (1853-1890), also portrayed nature in many of his paintings. While Impressionists and post-Impressionists did not aim to realistically represent nature in their work, scientists at the University of Georgia suggest [2] the distinctive bands of yellow “double flowers” in van Gogh’s series of sunflower paintings accurately depict a genetic mutation of the plant.

John Burke, senior author of the research and professor of plant biology at the university’s Franklin College of Arts and Sciences, explains that he and his colleagues were initially

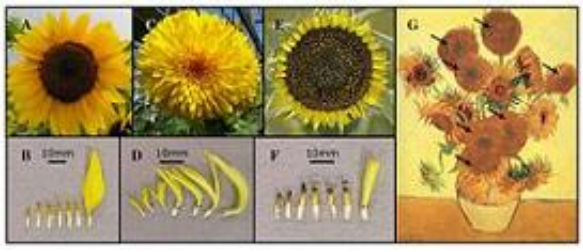
interested in studying the gene which allows the sunflower's Asteraceae family to develop different types of floret symmetry. A sunflower's florets, he adds, are commonly mistaken for petals.

"We started working on these guys and basically we found some suggestions that one individual gene might play a role in determining bilateral symmetry," Burke explains. "If you've worked on sunflowers as long as I have, you know about artists' different sunflowers. It turns out that van Gogh had captured a fairly well-known ornamental sunflower."

Contrary to popular belief, the sunflower's head is made of hundreds to thousands of florets (or flower). The most common sunflower phenotype is a head that contains a single spiral of large, flat, and sterile yellow ray florets surrounding a group of hundreds to thousands of individual disc florets. While ray florets are sterile, disc florets can mature into seeds. The mutants in van Gogh's paintings, Burke explains, have multiple levels of spiraling yellow ray florets and a smaller number of seed-producing disc florets.

Burke says that the so-called double flower mutations in the artist's work would probably not survive in the wild.

"They're nice to look at, but a true ray floret is completely sterile, so when gene mutations turn those disc florets into rays, the more sterile the plant will be," Burke says. "If it arose in the wild it wouldn't last too long. But if people are maintaining them in the ornamental sense, then they will go to great lengths to keep them around purely because they are attractive."



The most common, wild-type sunflower variety is shown in box A, and its florets are shown in B. Box C shows a double-flowered mutant variety, with its florets shown in D. Box E shows the tubular variety, with its florets shown in F. The arrows in box G indicate the double-flowered mutants depicted in van Gogh's "Vase with Fifteen Sunflowers." (Photo: John Burke, UGA)

To determine the gene causing the mutation painted by van Gogh 124 years ago, Burke and his colleagues crossed plants using the 19th Century techniques developed by van Gogh's contemporary, Gregor Mendel. They first crossed the common sunflower variety with the double-flowered variety and determined that the mutation was caused by a single dominant gene. But in subsequent generations, the offspring revealed a second mutation recessive to both the double-flowered and common version of the gene. This mutation results in elongated and yellow florets with the same reproductive structure of the interior florets. The scientists identified the genes responsible for these strange mutations and, using sequencing, found that in the first, double-flowered, mutation, the portion of the gene which normally signals for inner, disc florets is disrupted, causing the flower to produce more outer, yellow, and sterile florets where internal florets capable of reproduction would normally be located. In the second mutation, a "jumping gene" causes the plant to produce tubular ray florets instead of bilateral florets.

The second mutation's tubular ray florets might not be sterile like normal outer, yellow floret.

"We can see that it's producing pollen, but we don't know if it's viable," explains Burke. "They do look functional, but we don't know for sure yet."

Though many painters in van Gogh's time might evoke artistic license in rendering nature,

Burke doesn't think that's the case with the artist's sunflowers.

"I am not an art historian, but it seems really unlikely to me. If you look at his paintings and if you look at a picture of a double flower sunflower, it's a very accurate description of a well known ornamental type," Burke explains. "Everything that I see in that picture looks like everything we know about sunflowers."

The research was published on March 29 in the journal *PLoS Genetics* and was written by Burke and several university colleagues, including former post-doctoral researchers Mark Chapman, Shunxue Tang and Dorthe Draeger, current post-doctoral researchers Savithri Nambeesan and Jessica Barb, undergraduate Honors student Hunter Shaffer, and former professor Steven Knapp.

"Sunflowers," 1887, oil on canvas, by van Gogh. (Photo: Wikimedia Commons [3]/Public Domain)

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Links:
[1] http://en.wikipedia.org/wiki/File:Vincent_Willem_van_Gogh_127.jpg
[2] http://www.plosgenetics.org/article/info%3Adoi%2F10.1371%2Fjournal.pgen.1002628
[3] http://en.wikipedia.org/wiki/File:Vincent_van_Gogh_-_Sunflowers_(Metropolitan_Museum_of_Art).jpg