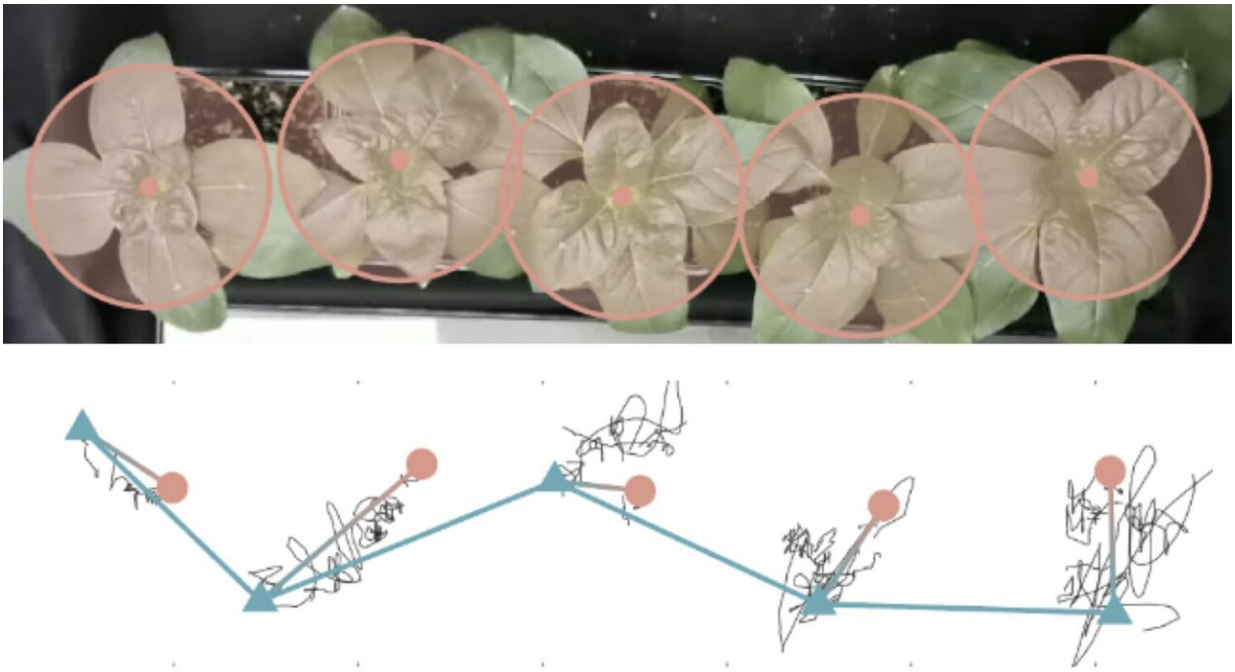
Why do plants wiggle? New study provides answers

August 15 2024, by Daniel Strain



Researchers mapped out the movements of five sunflower plants over the course of a week (black lines) before those plants eventually formed a zig-zag pattern (blue line). Credit: *Physical Review X* (2024). DOI: 10.1103/PhysRevX.14.031027

In a new study, physicists from the United States and Israel may have gotten to the bottom of a quirky behavior of growing plants—and a mystery that intrigued Charles Darwin himself during the later decades

of his life.

For many humans, plants might seem stationary and even a little dull. But green things actually move a lot. If you watch a timelapse video of a sunflower seedling poking up from the soil, for example, it doesn't just shoot straight up. Instead, as the sunflower grows, its crown spins in circles, twists into corkscrews and, in general, wiggles around—albeit very slowly.

Now, researchers co-led by Orit Peleg at CU Boulder and Yasmine Meroz at Tel Aviv University have discovered one role for these chaotic movements, also known as "circumnutations." In greenhouse experiments and computer simulations, the group showed that sunflowers take advantage of circumnutations to search the environment around them for patches of sunlight.

"A lot of people don't really consider the motion of plants because, as humans, we're usually looking at plants at the wrong frame rate," said Peleg, a co-author of the study and an associate professor in the BioFrontiers Institute and Department of Computer Science.

The team published its findings Aug. 15 in the journal *Physical Review X*.

The findings could one day help farmers to come up with new strategies for growing an array of crops in more efficient arrangements.

"Our team does a lot of work on social interactions in insect swarms and other groups of animals," said Chantal Nguyen, lead author and a postdoctoral researcher at BioFrontiers.

"But this research is particularly exciting because we're seeing similar dynamics in plants. They're rooted to the ground."

Darwin's cucumbers

Nguyen added that plants don't usually shift around like animals but, instead, move by growing in different directions over time. This phenomenon enchanted Darwin long after he returned from his voyage on the HMS Beagle, according to historical accounts.

In the 1860s, Darwin, who was then suffering from a range of ailments that limited his own mobility, spent days observing plants at his home. He planted seeds from cucumbers and other species, then traced how their crowns moved around from day to day—the resulting maps look wild and haphazard.

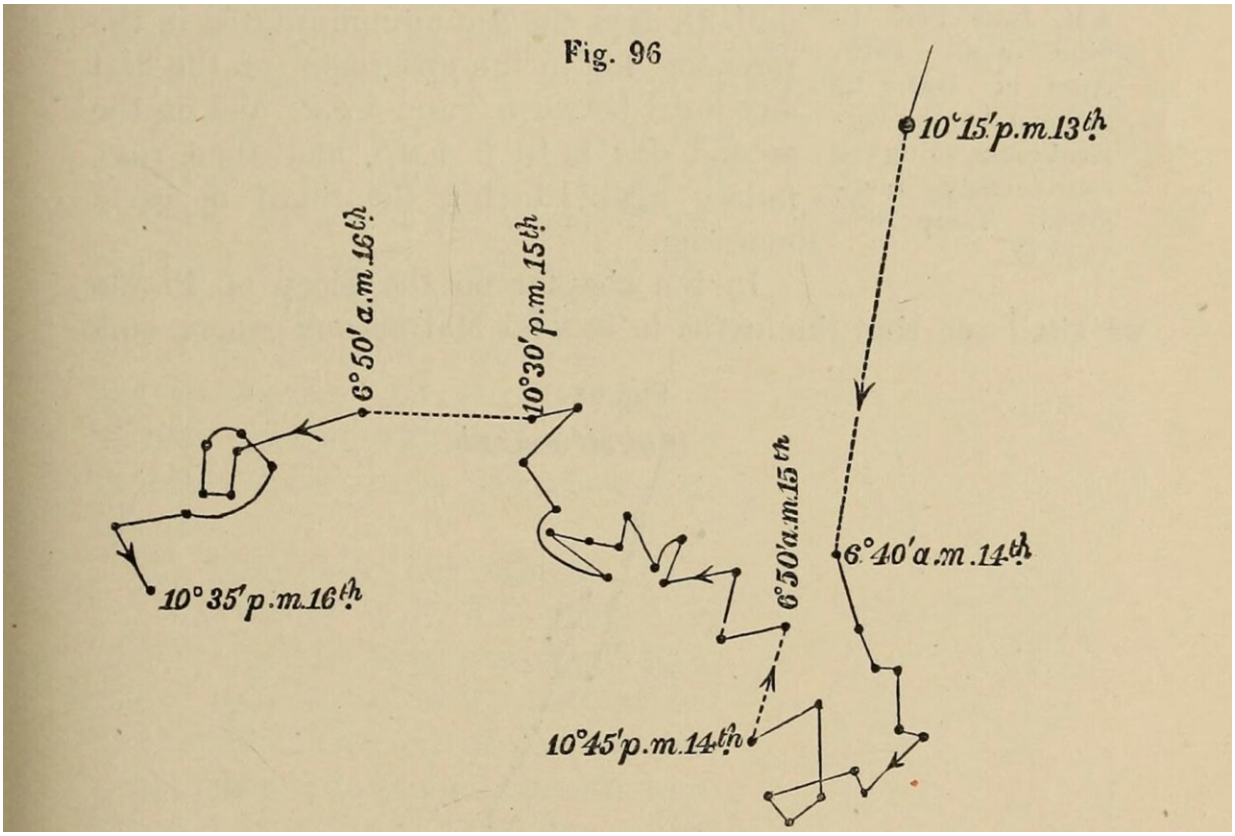
"I am getting very much amused by my tendrils—it is just the sort of niggling work which suits me," he wrote a friend in 1863.

Amused or not, Darwin couldn't explain why some of his tendrils twisted.

It's a mystery that has also perplexed Meroz, a physicist by training. One 2017 study pointed her in the right direction. In it, scientists led by the University of Buenos Aires grew lines of sunflowers under cramped conditions. They discovered that the plants naturally and consistently arranged themselves into a zig-zag pattern, almost like the teeth of a zipper. The arrangement likely helps the plants maximize their access to sunlight as a group.

Meroz wondered if plant wiggles could be the engine that drives such patterns in plant growth.

"For climbing plants, it's obvious that it's about searching for supports to twine on," said Meroz, a professor of plant sciences and food security. "But for other plants, it's not clear why it's worth it."



Darwin's illustration of the motion of a carnation over four days in June. Credit: "The power of movement in plants," 1896, by Charles Darwin and Francis Darwin

Here comes the sun

To find out, she and her colleagues grew five, one-week-old sunflowers in rows. Then, like Darwin before them, they mapped out how the plants moved over the course of a week.

Next, Nguyen and Peleg developed a computer program to analyze the patterns behind the sunflower growth. The researchers could also use

their computer simulations to see what would happen if the sunflowers moved more or less—in other words, if they wiggled haphazardly or in a slow and steady pattern.

If the digital plants didn't wiggle at all, the group discovered, they would all wind up all leaning away from each other in a straight line. If they wiggled too much, in contrast, they would grow in a random pattern. If they moved with just the right amount of randomness, however, the sunflowers formed that tell-tale zig-zag, which, in real life plants, provides a lot of access to sunlight. Nguyen explained that plants seem to circumnutate to find where the best light is coming from, then grow in that direction.

"When you add a little bit of noise into the system, it allows the plant to explore its surroundings and settle into those configurations that allow each plant to find maximum light exposure," she said. "That happens to lead to this nice zig-zag pattern that we see."

In future experiments, the researchers will test out how sunflowers grow in more complicated arrangements. Meroz, for her part, is glad to see plants get some credit for the movers and shakers they really are.

"If we all lived at the same time scales as plants, you could walk down the street and see them moving," she said. "Maybe we'd all have plants as pets."

More information: Chantal Nguyen et al, Noisy Circumnutations Facilitate Self-Organized Shade Avoidance in Sunflowers, *Physical Review X* (2024). DOI: 10.1103/PhysRevX.14.031027

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