

Common weed may be 'super plant' that holds key to drought-resistant crops

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Portulaca oleracea, an edible plant grown almost any where in the United States. Blooms yellow, small flowers. Credit: [ZooFari](#)/Wikimedia Commons, [CC BY-SA 3.0](#)

A common weed harbors important clues about how to create drought resistant crops in a world beset by climate change.

Yale scientists describe how *Portulaca oleracea*, commonly known as purslane, integrates two distinct metabolic pathways to create a novel type of [photosynthesis](#) that enables the weed to endure [drought](#) while remaining highly productive, they report August 5 in the journal *Science Advances*.

"This is a very rare combination of traits and has created a kind of 'super plant'—one that could be potentially useful in endeavors such as crop engineering," said Yale's Erika Edwards, professor of ecology and [evolutionary biology](#) and senior author of the paper.

Plants have independently evolved a variety of distinct mechanisms to improve photosynthesis, the process by which [green plants](#) use sunlight to synthesize nutrients from carbon dioxide and water. For instance, corn and sugarcane evolved what is called C4 photosynthesis, which allows the plant to remain productive under high temperatures. Succulents such as cacti and agaves possess another type called CAM photosynthesis, which helps them survive in deserts and other areas with little water. Both C4 and CAM serve different functions but recruit the same biochemical pathway to act as "add-ons" to regular photosynthesis.

What makes the weed purslane unique is that it possesses both of these evolutionary adaptations—which allows it to be both highly productive and also very drought tolerant, an unlikely combination for a plant. Most scientists believed that C4 and CAM operated independently within leaves of purslane.

But the Yale team, led by co-corresponding authors and postdoctoral scholars Jose Moreno-Villena and Haoran Zhou, conducted a spatial analysis of gene expression within the leaves of purslane and found that

C4 and CAM activity are totally integrated. They operate in the same cells, with products of CAM reactions being processed by the C4 pathway. This system provides unusual levels of protection for a C4 plant in times of drought.

The researchers also built metabolic flux models that predicted the emergence of an integrated C4+CAM system that mirrors their experimental results.

Understanding this novel metabolic pathway could help scientists devise new ways to engineer crops such as corn to help withstand prolonged drought, the authors say.

"In terms of engineering a CAM cycle into a C4 crop, such as maize, there is still a lot of work to do before that could become a reality," said Edwards. "But what we've shown is that the two pathways can be efficiently integrated and share products. C4 and CAM are more compatible than we had thought, which leads us to suspect that there are many more C4+CAM species out there, waiting to be discovered."

More information: Jose Moreno-Villena et al, Spatial resolution of an integrated C4+CAM photosynthetic metabolism, *Science Advances* (2022). [DOI: 10.1126/sciadv.abn2349](https://doi.org/10.1126/sciadv.abn2349).
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