Desert algae shed light on desiccation tolerance in green plants

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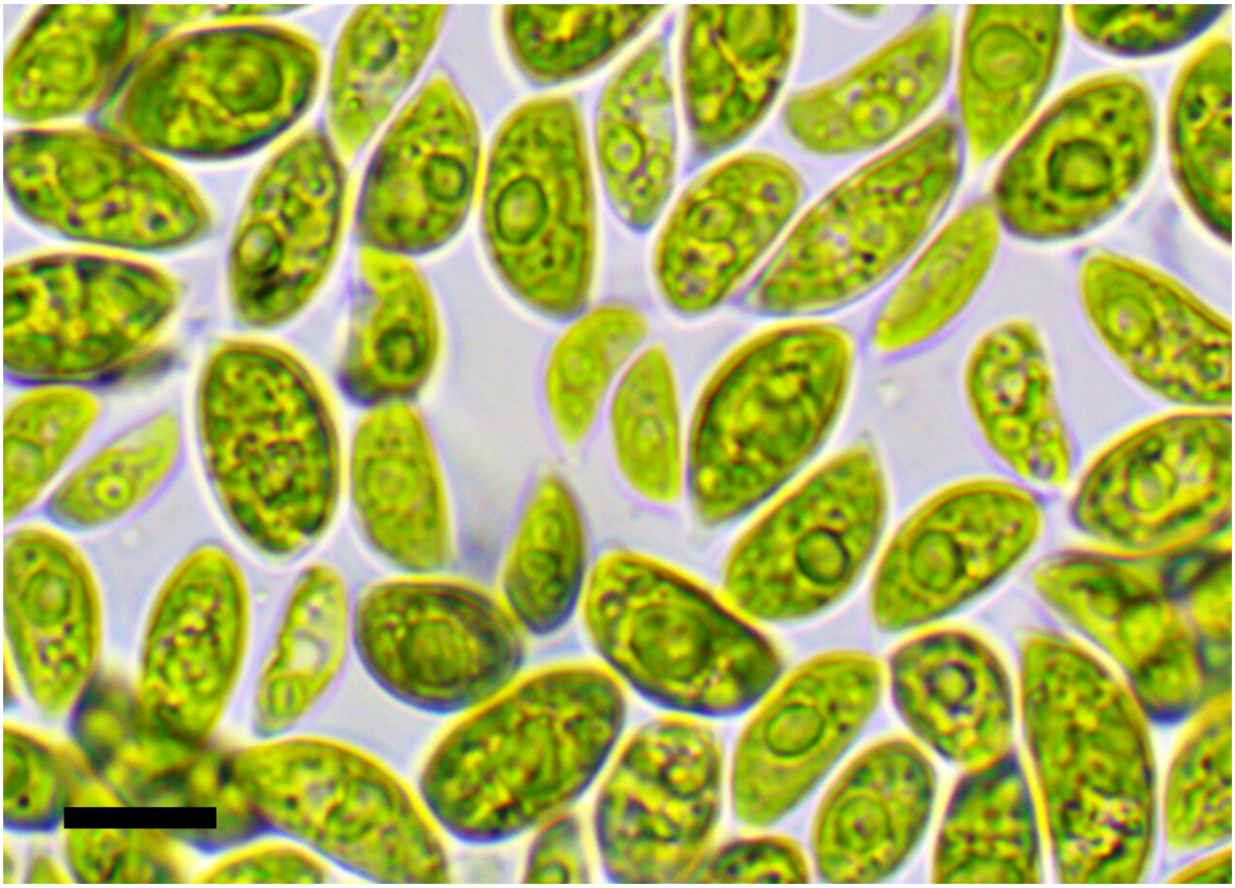

Desert derived green algae (Acutodesmus deserticola) in culture at the Marine Biological Laboratory. Credit: Elena Lopez Peredo

Deserts of the U.S. Southwest are extreme habitats for most plants, but,

remarkably, microscopic green algae live there that are extraordinarily tolerant of dehydration. These tiny green algae (many just a few microns in size) live embedded in microbiotic soil crusts, which are characteristic of arid areas and are formed by communities of bacteria, lichens, microalgae, fungi, and even small mosses. After completely drying out, the algae can become active and start photosynthesizing again within seconds of receiving a drop of water.

How are they so resilient? That question is at the core of research by Elena Lopez Peredo and Zoe Cardon of the Marine Biological Laboratory (MBL), published this week in *Proceedings of the National Academy of Sciences*. Given the intensified droughts and altered precipitation patterns predicted as the global climate warms, understanding the adaptations that facilitate green plant survival in arid environments is pressing.

Working with two particularly resilient species of green microalgae (Acutodesmus deserticola and Flechtneria rotunda), Peredo and Cardon studied up- and down-regulation of gene expression during desiccation, and added a twist. They also analyzed gene expression in a close aquatic relative (Enallax costatus) as it dried out and ultimately died. Surprisingly, all three algae—desiccation tolerant or not—upregulated the expression of groups of genes known to protect even seed plants during drought. But the desiccation-tolerant algae also ramped down expression of genes coding for many other basic cellular processes, seemingly putting the brakes on their metabolism. The aquatic relative did not.

Peredo's and Cardon's research suggests this new perspective on desiccation tolerance warrants investigation in green plants more broadly. Upregulation of gene expression coding for protective proteins may be necessary but not sufficient; downregulation of diverse metabolic genes may also be key to survival.

Desert landscape in US Southwest. Credit: Zoe Cardon

More information: Elena L. Peredo el al., "Shared up-regulation and contrasting down-regulation of gene expression distinguish desiccation-tolerant from intolerant green algae," *PNAS* (2020). www.pnas.org/cgi/doi/10.1073/pnas.1906904117

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