The benefits of stress ... in plants

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Chronic stress in humans has been implicated in heart disease, weight gain, and diabetes, among a host of other health problems. Extreme environments, a source of chronic stress, present a challenge even for the hardiest organisms, and plants are no exception. Yet, some species somehow manage to survive, and even thrive, in stressful conditions.

A recent article by Dr. Yuri Springer in the November issue of the American Journal of Botany finds that certain wild flax plants growing in poor soils have succeeded in balancing the stress in their lives—these plants are less likely to experience infection from a fungal pathogen. Walking the fine line between the costs associated with surviving under stressful conditions and the benefits that may be derived from growing in an environment with fewer interactions with antagonistic species is a tricky balancing act.

For plants, serpentine soils are one example of an extreme environment. Serpentine soils are those that provide a stressful medium for plant growth, due to features of the soil, such as a rocky texture, low water-holding capacity, high levels of toxic metals, and/or low levels of necessary nutrients.

Springer assessed the prevalence of fungal infections in species of the wild flax genus. Wild flax provides a model system to study serpentine tolerance; the species exhibit a range of tolerance to soil with low levels of calcium, a necessary nutrient for plant survival. He examined the correlation between disease symptoms and tolerance to serpentine soils in the context of evolutionary relationships among the species.

Springer found that wild flax populations growing in serpentine soils displayed a reduction in fungal infection. These results support the hypothesis that stressful environments may be attractive to plants because they provide a refuge from pathogens; however, the plants need to be able to survive in these extreme ecosystems. In wild flax, the fungal pathogen may have difficulty infecting plants that have low levels of calcium in their tissues due to low levels in the soil. Alternatively, the plants growing in a low nutrient soil may allocate much of their resources to defense against pathogens and herbivores due to the high costs of replacing tissue.

Based on the putative evolutionary history of the wild flaxes, tolerance to serpentine soils has evolved rapidly and repeatedly in the genus or was present in the ancestors of these wild flaxes and lost in several lineages. This is the first study to attempt to quantitatively explain how plants have evolved a specialization to serpentine soils and ultimately may help to explain floristic diversity in these unique environments.

More information: http://www.amjbot.org/cgi/content/full/96/11/2010

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