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research highlights

REMOTE PHENOTYPING

Raman reveals stress

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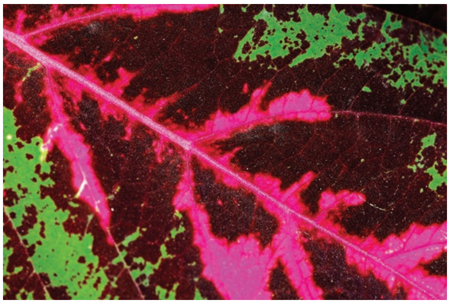
The ability to noninvasively determine the physiological status of a plant is important for basic research and agriculture alike. Currently, such phenotyping can only be practically achieved by relatively indirect methods. For example, methods to noninvasively follow the response of plants to various stresses have focused on gross physical features or measurements of the chlorophyll content of plants. Marlan Scully, of Texas A&M University, and colleagues have now developed a high-throughput system that employs Raman spectroscopy to directly follow multiple stress responses of plants.

Raman spectroscopy can be used to observe various pigments involved in plant stress responses, such as anthocyanins and carotenoids. The unique spectra of these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molecules means that their concentrations can be simultaneously determined from single Raman measurements of leaves. In addition to using a commercially available confocal Raman microscope for this purpose, the researchers custom-built a portable system capable of being operated in the field.

To demonstrate the efficacy of their system, they investigated coleus plants (*Plectranthus scutellarioides*) and various stressors such as high salt and light conditions, drought and cold. The Raman spectra obtained at various time points following the onset of stress clearly showed the different characteristics of the plants' particular responses to these abiotic stressors. Most striking was a negative correlation in the levels of anthocyanins and carotenoids. The accuracy of the spectroscopic measurements was confirmed by conventional chemical extraction.

Destructive analysis of plant material to measure levels of complex chemicals does not meet the needs of researchers who wish to follow physiological processes over time in individual plants. Nor does it provide the high-throughput, fast and easy-to-use tools needed by plant breeders and growers. This spectroscopic approach could form the basis of mobile and automated systems for incorporation into precision agricultural applications.

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