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Singapore's SMART researchers pioneer sensor multiplexing for Real-Time decoding of plant stresses

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Researchers from the Disruptive & Sustainable Technologies for Agricultural Precision (DiSTAP) Interdisciplinary Research Group (IRG) of Singapore-MIT Alliance for Research and Technology (SMART), MITâ??s research enterprise in Singapore, in collaboration with Temasek Life Sciences Laboratory (TLL) and Massachusetts Institute of Technology (MIT), have developed a cutting-edge nanosensor that allows for the real-time monitoring of salicylic acid (SA) during the early stages of stress response. SA is a crucial plant hormone for growth, development, and stress response to pathogens, temperature, drought, salinity, metals, UV light, and osmotic stress. The researchers also pioneered a method to multiplex, or combine, this sensor with others for simultaneous and real-time tracking of multiple plant hormone profiles and chemical signals.

This insight into the complex communication within stressed plants is vital in cultivating crops that are resilient to various stressors, including climate change. Traditional methods of stress detection in plants are reliant on laborious lab tests, time-consuming, and both destructive and disruptive to plant growth, while emerging technologies like chlorophyll fluorescence and hyperspectral imaging focus on the metabolic changes that occur when reparative measures are limited and only after the initial stress perception and signalling.

SMART researchers achieved double breakthroughs in plant health monitoring. Firstly, the development of the first-ever nanosensor, validated *in-planta* in living *pak choi* (commonly known as *Chinese cabbage)*, that specifically detects SA, a plant hormone key in mediating plant stress response and adaptation. Secondly, the researchers also pioneered a method to combine this sensor with others, paving the way for simultaneous and real-time tracking of multiple plant chemical signals and stress markers during early stress stages, which can, in turn, enable earlier diagnoses and, ultimately, improve plant stress tolerance and mitigate crop losses due to environmental stress.

This research and technology builds upon SMART DiSTAP's long-standing body of work with innovative plant sensors based on the concept of corona phase molecular recognition (â??â??CoPhMoRe) pioneered by the Strano Lab at SMART DiSTAP and MIT. This includes a breakthrough by DiSTAP in 2021 in the development of the first-ever nanosensor to enable rapid testing of synthetic auxin plant hormones;Â followed by another world-first in 2023 with the first-ever nanosensor designed to detect and distinguish gibberellins (GAs) â?? a class of hormones important for plant growth. This success of the CoPhMoRe concept has now been further advanced with this latest development of a highly selective plant nanobionic sensor for SA through a distinct and unique process of design, synthesis and testing.