Wearable sensors for advanced plant phenotyping

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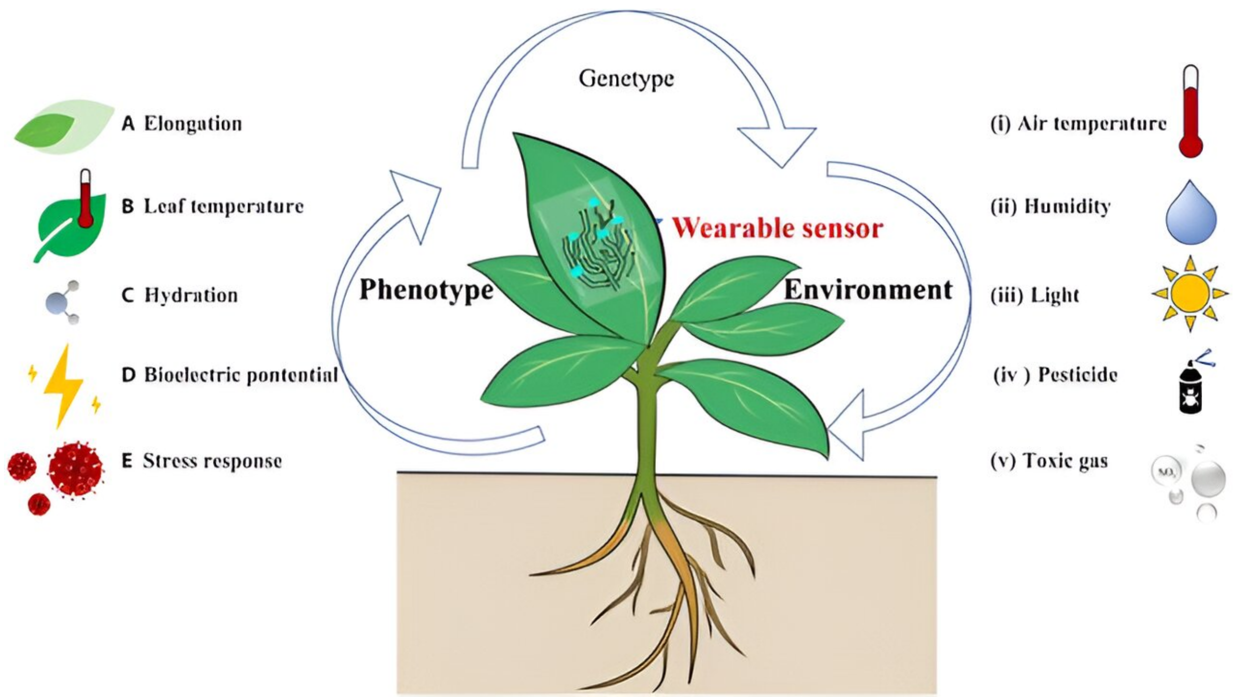

Wearable sensors for monitoring plant phenotypes and environment. Credit: *Plant Phenomics*

In response to increasing global food demands, improving crop yields through efficient phenotyping is imperative. Optical imaging-based phenotyping has markedly progressed plant breeding and crop management, yet encounters limitations in spatial resolution and accuracy due to its noncontact approach.

Wearable sensors, utilizing contact measurement, present a promising alternative for in-situ monitoring of plant phenotypes and their surroundings. Despite early achievements in monitoring plant growth and microclimate, the complete potential of wearable sensors in plant phenotyping remains largely unexplored.

In July 2023, *Plant Phenomics* published a review article titled "Wearable Sensor: An Emerging Data Collection Tool for Plant Phenotyping." This paper aims to explore wearable sensors' capabilities in monitoring various plant and environmental factors, emphasizing their high resolution, multifunctionality, and minimal invasiveness, while addressing existing challenges and proposing solutions.

Wearable sensors offer a transformative approach in plant phenotyping, overcoming limitations of traditional noncontact methods like optical imaging. They provide high spatial resolution, multifunctionality, and minimal invasiveness, enabling the measurement of various plant phenotypes like elongation, leaf temperature, hydration, bioelectric potential, and stress response.

Innovations such as stretchable strain sensors and flexible electrode sensors adapt to plant growth and morphology, facilitating real-time, in-situ monitoring.

Unlike optical imaging, wearable sensors are less susceptible to environmental factors, providing more precise data. In leaf temperature and hydration monitoring, wearable sensors use wireless communication and advanced materials for robust and accurate measurements.

Bioelectric potential measurement has seen advancements with flexible electrode sensors that minimize plant damage and enable continuous monitoring. Stress response detection is enhanced through sensors that monitor early signs of diseases or environmental stress like UV radiation and ozone exposure.

Wearable sensors also excel in environmental monitoring, assessing factors like air temperature, moisture, light, and pesticide presence. Multimodal sensors on lightweight, stretchable platforms gather real-time data, crucial for understanding the microenvironment affecting plant growth.

While wearable sensors hold great promise in plant phenotyping, they encounter challenges such as interference with plant growth, weak bonding interfaces, limited signal types, and small monitoring coverage. Solutions like lightweight, soft, stretchable, and transparent materials, along with advanced bonding technologies and integration of diverse sensing modalities, are proposed.

As wearable sensor technology continues to evolve, it is expected to play a crucial role in accelerating plant phenotyping, providing deeper insights into plant-environment interactions.

More information: Cheng Zhang et al, Wearable Sensor: An Emerging Data Collection Tool for Plant Phenotyping, *Plant Phenomics* (2023). DOI: 10.34133/plantphenomics.0051

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