



MAPPI: a new system to learn how a plant's leaves, stem and roots mutually communicate under environmental stress

*A team of researchers from the Università Statale and the Politecnico di Milano has developed a new optical imaging system for real-time visualisation of how a plant's leaves, stem and roots communicate with each other in response to environmental stress. Mappi (MAcro Plant Projection Imaging) offers the opportunity to study plants comparable in size to those grown in greenhouses (this has been very difficult to do until now), thus taking a decisive step towards understanding the response of plant organisms to climate change. The study was published in *Science Advances*.*

Milan, 09 February 2026 – How do the different parts of an adult plant communicate with each other when it suffers an injury, is waterlogged, burnt or exposed to environmental stress?

Today we can answer this question thanks to an **innovative optical imaging system developed by the Università degli Studi di Milano (University of Milan) together with the Politecnico di Milano**. The study was published in *Science Advances*.

The system, called MAPPI (MAcro Plant Projection Imaging), **allows simultaneous observation of leaves, stem and roots as the plant reacts to stimuli such as wounds, submergence, burns or other environmental stress**. Perpendicular double vision is an innovative feature. It allows to observe what is happening throughout the plant at the same time, overcoming the limitations of traditional instruments designed for small laboratory plants. **Hence the opportunity to study plants of a size comparable to those grown in greenhouses, which was previously very difficult**.

Unlike conventional imaging systems, **MAPPI is modular, inexpensive and open source, which makes it easily replicable in many laboratories**. Through the use of fluorescence, the platform allows real time visualisation of signals that are crucial for internal plant communication, e.g., changes in the concentration of calcium ions and the accumulation of glutamate, which act as cellular messengers. With this technology, researchers have shown that **signals do not only travel between leaves, but also bi-directionally between leaves and roots, revealing a much more complex communication network than expected**.

«MAPPI allows us to observe how these signals run through the entire adult plant, dynamics we could only guess until now», says **Alex Costa**, plant physiologist and professor in the Department of Biosciences, Università degli Studi di Milano, and lead author of the paper.

«MAPPI allows to overcome the limitations of traditional microscopy. It paves the way for new research into the physiology of adult plants», explains **Andrea Bassi**, professor in the Department of Physics at the Politecnico di Milano, and coordinator of the study together with Costa. «The aim is to make this technology accessible to the scientific community, facilitating studies on species of agricultural interest in conditions closely resembling natural ones».

The system is also **designed to be expanded with additional sensors** in order to simultaneously monitor multiple molecular signals. Hence, MAPPI is a decisive step forward in understanding how plants react to stress, **a key issue for agriculture in the future in a context of climate change**.



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