Scientists engineer plant microbiome for the first time to protect crops against disease and cut use of pesticides

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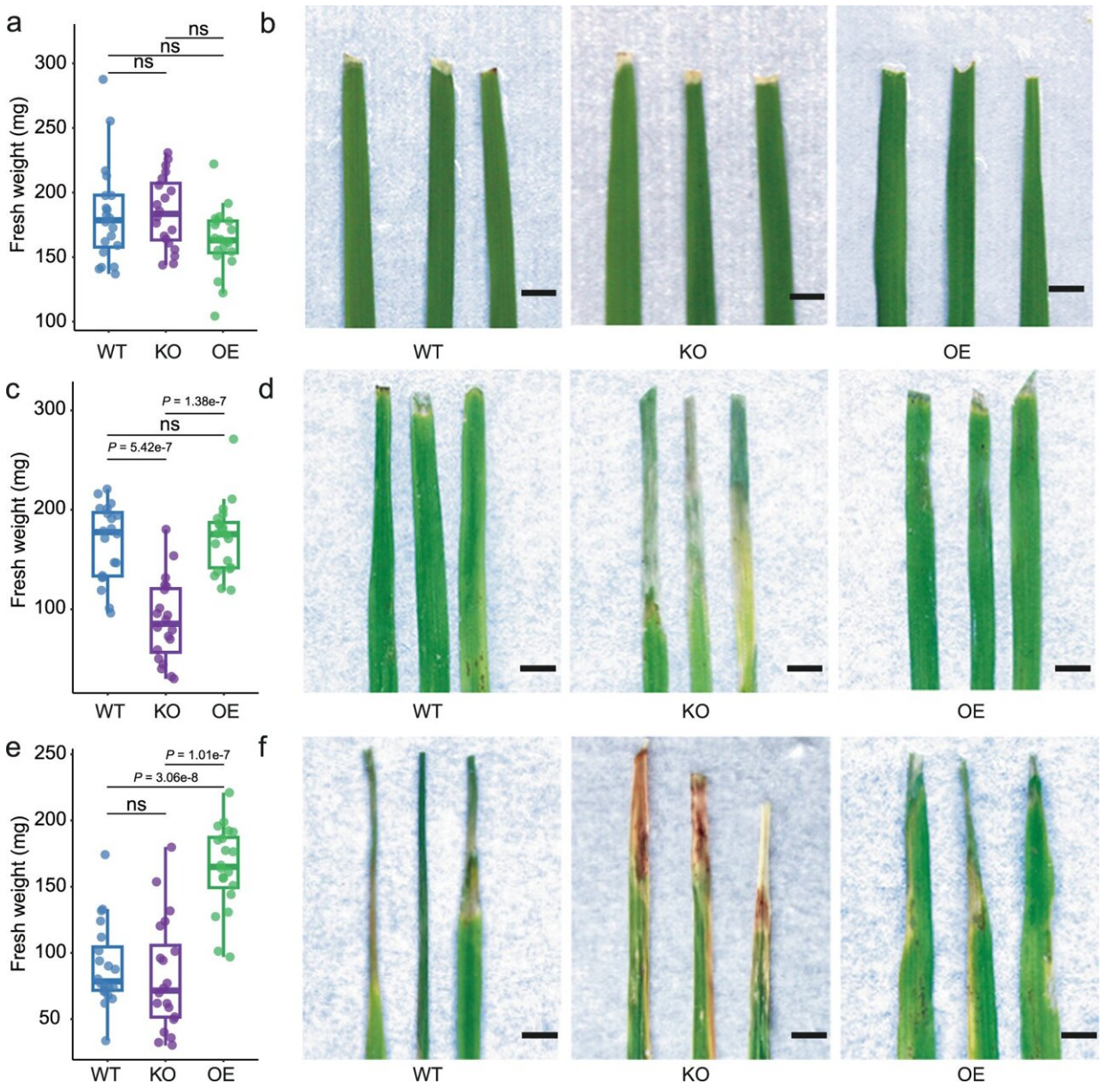

SynCom inhibits TJ1 under 4-HCA presence in vivo. Credit: *Nature Communications* (2024). DOI: 10.1038/s41467-023-44335-3

Scientists have engineered the microbiome of plants for the first time, boosting the prevalence of 'good' bacteria that protect the plant from disease. The findings published in *Nature Communications* by researchers from the University of Southampton, China and Austria, could substantially reduce the need for environmentally destructive pesticides.

There is growing public awareness about the significance of our microbiome—the myriad of microorganisms that live in and around our bodies, most notably in our guts. Our gut microbiomes influence our metabolism, our likelihood of getting ill, our immune system, and even our mood.

Plants too host a huge variety of bacteria, fungi, viruses, and other microorganisms that live in their roots, stems, and leaves. For the past decade, scientists have been intensively researching plant microbiomes to understand how they affect a plant's health and its vulnerability to disease.

"For the first time, we've been able to change the makeup of a plant's microbiome in a targeted way, boosting the numbers of beneficial bacteria that can protect the plant from other, harmful bacteria," says Dr. Tomislav Cernava, co-author of the paper and Associate Professor in Plant-Microbe Interactions at the University of Southampton.

"This breakthrough could reduce reliance on pesticides, which are

harmful to the environment. We've achieved this in rice crops, but the framework we've created could be applied to other plants and unlock other opportunities to improve their microbiome. For example, microbes that increase nutrient provision to crops could reduce the need for synthetic fertilizers."

The international research team discovered that one specific gene found in the lignin biosynthesis cluster of the rice plant is involved in shaping its microbiome. Lignin is a complex polymer found in the cell walls of plants—the biomass of some plant species consists of more than 30% lignin.

First, the researchers observed that when this gene was deactivated, there was a decrease in the population of certain beneficial bacteria, confirming its importance in the makeup of the microbiome community.

The researchers then did the opposite, over-expressing the gene so it produced more of one specific type of metabolite—a small molecule produced by the host plant during its metabolic processes. This increased the proportion of beneficial bacteria in the plant microbiome.

When these engineered plants were exposed to Xanthomonas oryzae—a pathogen that causes bacterial blight in rice crops, they were substantially more resistant to it than wild-type rice.

Bacterial blight is common in Asia and can lead to substantial loss of rice yields. It's usually controlled by deploying polluting pesticides, so producing a crop with a protective microbiome could help bolster food security and help the environment.

The research team is now exploring how they can influence the presence of other beneficial microbes to unlock various plant health benefits.

More information: Pin Su et al, Microbiome homeostasis on rice leaves is regulated by a precursor molecule of lignin biosynthesis, *Nature Communications* (2024). DOI: 10.1038/s41467-023-44335-3