Researchers identify bacterium that protects rice plants against diseases

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Rice panicle: Rising global warming is problematic for the water-intensive cultivation of rice, the staple food for about half the world's population. Credit: Mengcen Wang

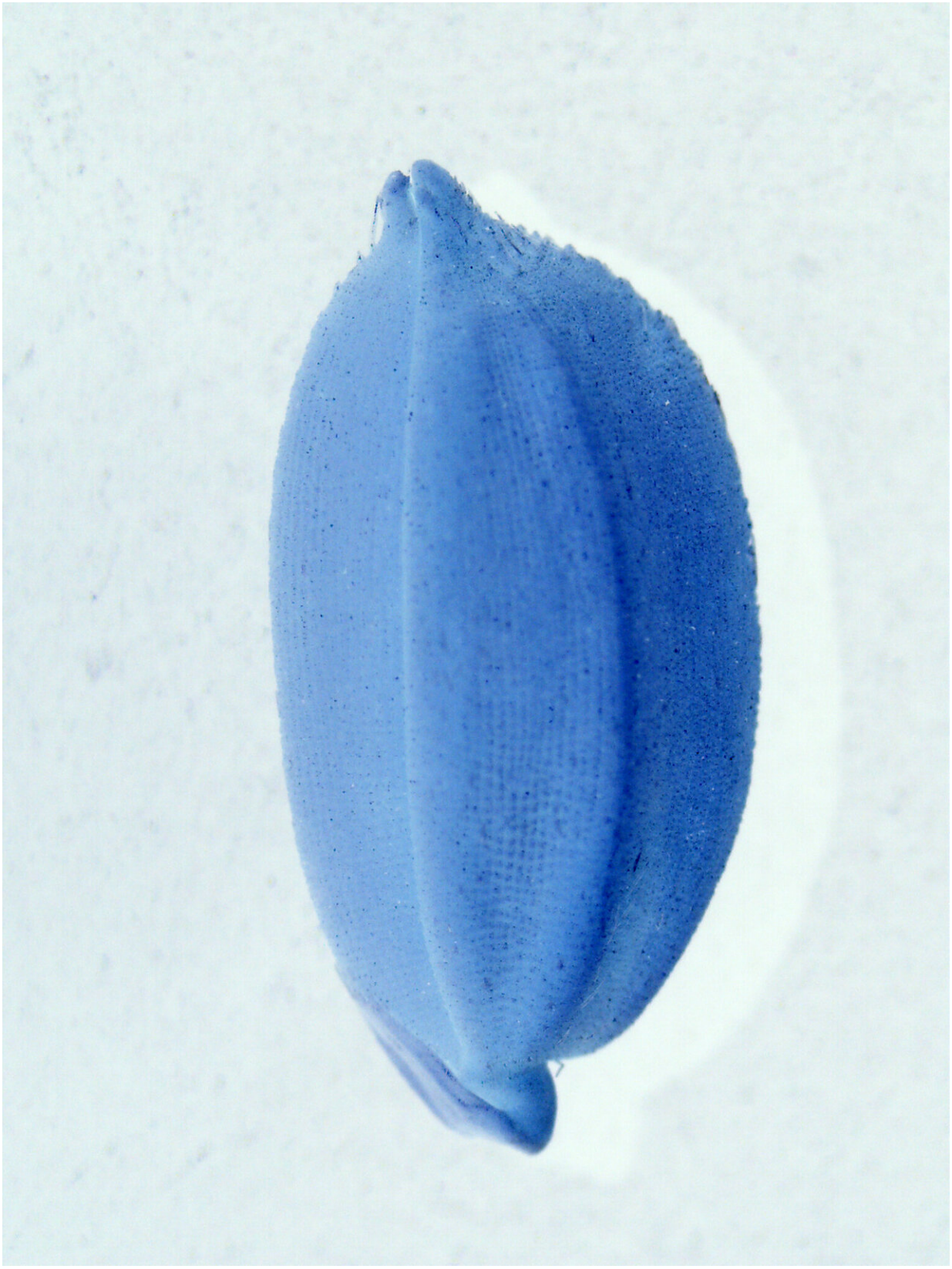
With their expertise in microbiome research, the researchers at the Institute of Environmental Biotechnology were able to demonstrate how a specific bacterium inside the seeds of rice plants effectively and in an eco-friendly way inhibits destructive plant pathogens.

Rice is the staple food of about half the world's population. The cultivation of the rice plant is very water-intensive and, according to the German aid organization Welthungerhilfe, around 15 percent of rice is grown in areas with a high risk of drought. Global warming is therefore becoming increasingly problematic for rice cultivation, leading more and more often to small harvests and hunger crises. Crop failures caused by plant pathogens further aggravate the situation. Here, conventional agriculture is trying to counteract this with pesticides, which are mostly used as a precautionary measure in rice cultivation. The breeding of resistant plants is the only alternative to these environmentally harmful agents—and currently only moderately successful. If the plants are resistant to one pathogen thanks to their breeding, they are usually more susceptible to other pathogens or are less robust under adverse environmental conditions.

Bacterium confers pathogen resistance

For this reason, an international research group which includes the Institute of Environmental Biotechnology at Graz University of Technology has been studying the microbiome of rice plant seeds for some time now in order to establish correlations between plant health

and the occurrence of certain microorganisms. The group has now achieved a major breakthrough. They identified a bacterium inside the seed that can lead to complete resistance to a particular pathogen and is naturally transmitted from one plant generation to another. The findings published in the scientific journal *Nature Plants* provide a completely new basis for designing biological plant protection products and additionally reducing harmful biotoxins produced by plant pathogens.



Rice seed: Tomislav Cernava conducts research at the Institute for Environmental Biotechnology at TU Graz. Credit: Lunghammer - TU Graz

The microbiome of rice

In conventional rice cultivation in the Chinese province of Zhejiang, it was observed that one genotype of rice plants (cultivar Zhongzao 39) sometimes develops resistance to the plant pathogen Burkholderia plantarii. This pathogen leads to crop failures and also produces a biotoxin that can cause organ damage and tumors in persistently exposed humans and animals. "Up to now, the sporadic resistance of rice plants to this pathogen could not be explained," says Tomislav Cernava from the Institute of Environmental Biotechnology at Graz University of Technology. Together with institute head Gabriele Berg and his institute colleague Peter Kusstatscher, Cernava has been investigating the microbiome of rice seeds from different cultivation regions in detail in the context of a collaboration with Zhejiang University (Hangzhou) and Nanjing Agricultural University in China as well as with the Japanese Hokkaido University in Sapporo.

Bacterial composition as a decisive factor

The scientists found that the resistant plants have a different bacterial composition inside the seeds than the disease-susceptible plants. The bacterial genus Sphingomonas in particular was found significantly more often in resistant seeds. The researchers therefore isolated bacteria of this genus from the seeds and identified the bacterium Sphingomonas melonis as the responsible agent for disease resistance. This bacterium produces an organic acid (anthranilic acid), which inhibits the pathogen and thereby renders it harmless. "This also works when the isolated Sphingomonas melonis is applied to non-resistant rice plants. This

automatically makes them resistant to the plant pathogen Burkholderia plantarii," explains Tomislav Cernava.

In addition, the bacterium establishes itself in certain rice genotypes and is then passed on naturally from one plant generation to the next. "The potential of this finding is enormous. In the future, we will be able to use this strategy to reduce pesticides in agriculture and at the same time achieve good crop yields," says Cernava.

More information: Haruna Matsumoto et al. Bacterial seed endophyte shapes disease resistance in rice, *Nature Plants* (2021). DOI: 10.1038/s41477-020-00826-5

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