

The signaling pathways that make plants more resistant to flooding

June 9 2022



Arabidopsis thaliana. Credit: DataBase Center for Life Science (DBCLS)/Wikimedia Commons, [CC BY 4.0](#)

Extreme weather phenomena are on the rise worldwide, including frequent droughts and fires. Floods are also a clear consequence of climate change. For agriculture, a flooded field means major losses: about 15% of global crop losses are due to flooding.

As part of a collaboration between Freiburg, Utrecht in the Netherlands, and other institutes, Junior Professor Dr. Sjon Hartman from the Cluster of Excellence CIBSS—Center for Integrative Biological Signaling Studies at the University of Freiburg, has now discovered that a signaling molecule can make plants more resistant to flooding. The gaseous plant hormone ethylene causes the plant to switch on a kind of molecular emergency power system that helps it survive the lack of [oxygen](#) during flooding.

The team had previously demonstrated that ethylene sends a signal to the plant that it is underwater. Pretreating the experimental plants with the hormone improved their chances of survival. The results, which appeared in the journal *Plant Physiology*, should help to combat waterlogging and flooding in agriculture and, for example, to develop resistant plant varieties.

Tracking the adaptations to wet conditions

Plant species differ greatly in their ability to survive periods of flooding or waterlogging. "In the case of potatoes, the roots die after two days due to a lack of oxygen. Rice plants are much more resistant, able to survive their entire lives in waterlogged [paddy fields](#)," Hartman explains. The *Arabidopsis thaliana*, a [model organism](#) for plant research, can be used

to study the genes and proteins that make up this adaptation.

"Plants notice that they are surrounded by water because the gas ethylene, which all plant cells produce, can no longer escape into the air," Hartman continues. The researchers showed this in previous studies at Utrecht University. Receptors throughout the plant subsequently respond to increased concentrations of the hormone.

Simulating flooding with oxygen deprivation

The team simulated flooding by placing *Arabidopsis* seedlings in a bell jar without light or oxygen. When the seedlings were previously exposed to ethylene gas, the root tip cells survived longer. The treated plants stopped root growth and switched [energy production](#) in the cells to oxygen-free metabolic processes. In addition, the ethylene caused the cells to be better protected against harmful oxygen radicals that accumulate in oxygen-deprived [plants](#). This was revealed by analyses of gene activity and protein composition of the cells.

"Taken together, these rearrangements that [ethylene](#) triggers improve plant survival during and after flooding," Hartman summarizes. "As we better understand these signaling pathways, we can learn to make crops more resilient to flooding to combat climate change."

More information: Zeguang Liu et al, Ethylene augments root hypoxia tolerance via growth cessation and reactive oxygen species amelioration, *Plant Physiology* (2022). [DOI: 10.1093/plphys/kiac245](https://doi.org/10.1093/plphys/kiac245)

Provided by University of Freiburg

Citation: The signaling pathways that make plants more resistant to flooding (2022, June 9)
retrieved 11 May 2024 from <https://phys.org/news/2022-06-pathways-resistant.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.