

How do plants know when it is the right time to flower?

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If you live in Europe, Japan or North America for example you will likely have seen all the spring flowers blossoming in the past months. By contrast, some plants - especially from hot climates, such as rice - prefer to flower when temperature is getting cooler. But how does a rice plant know when it is the right time to flower? In a recent study published in the Proceedings of the National Academy of Sciences, teams of researchers from Germany and Portugal have cracked this puzzle.

Using molecular genome editing methods (CRISPR/Cas9), the researchers removed the activity of key genes from the rice genome. This enabled them to show that genes called “ELF3” and “LUX” are essential for flowering in rice. These genes make proteins that directly switch off genes that prevent flowering. It turns out that ELF3 is inactivated in light: When days are long, there is little ELF3, so the floral repressors are active and block flowering. When days become shorter, the accumulation of ELF3 is enabled and flowering is activated.

The teams of researchers from the **Leibniz Institute of Vegetable and Ornamental Crops (IGZ)** in Germany and the **Instituto de Tecnologia Química e Biológica António Xavier at the New University of Lisbon (ITQB NOVA)** in Portugal worked together under the scope of the PhD program Plants for Life, with PhD student Luis Andrade, to decipher the molecular mechanisms underlying the regulation of the rice flowering time by the photoperiod.

“When we took away the genes encoding ELF3 and LUX, we were amazed, since we had created remarkable rice plants that never flowered.” Said the lead of the group in the ITQB in Portugal, Dr Nelson Saibo.

“This study shows how a major pathway, that controls the flowering of millions of rice plants and is ultimately a key source of nutrition for billions of people around the world, is actually controlled by a remarkably small number of master regulator genes, and how we are beginning to understand these key processes at a molecular level. How plants adapt to the environment is a major question, particularly during an era of climate change which is already altering plant flowering behaviour.” Said the lead author from the IGZ in Germany, Dr Katja Jaeger.

The full published study can be read here: [“The evening complex integrates photoperiod signals to control flowering in rice”](#)

Comprehending the connection between these changes in the components of the circadian clock and the different flowering times observed among the numerous rice varieties is the next step. *“That will then allow, in a more targeted way, to adapt the different rice varieties and their flowering times to certain environmental conditions or regions,”* says researcher Nelson Saibo. On-field application is also one of the main focuses for the future, as flowering is directly correlated with productivity. *“By controlling the rice life cycle, we can potentially reduce the risks for rice cultivation,”* says Luís Andrade. The manipulation of flowering time allows a better conciliation between the cultivation period and the environmental conditions, protecting the plants from potentially harmful situations, such as cold weather during the initial stages or drought and heat during the final growth stages, culminating in a likely increase in yield.

Dr Katja Jaeger is a senior scientist in the Wigge Group at the IGZ. Dr Jaeger has been studying how plants sense photoperiod for several years. In this study she performed an analysis using next-generation sequencing methods in collaboration with doctoral student Luis Andrade. The Wigge group at the IGZ is focused on understanding how plants sense and respond to environmental signals, especially temperature. This information may help in the breeding of crops resilient to climate change.

The IGZ is a research institute of the Leibniz Association and contributes to solving current global challenges such as biodiversity conservation, climate change, urbanization and malnutrition with scientifically sound findings from basic and applied research. The Institute is jointly funded by the Ministry of Science, Research and Culture of the State of Brandenburg ([MWFK](#)) and the Federal Ministry of Food and Agriculture ([BMEL](#)).

Dr Nelson Saibo heads the lab of Plant Gene Regulation at ITQB NOVA. He is mainly interested in understanding the molecular mechanisms underlying plant responses to their environment and use this knowledge to improve crop yield.

ITQB NOVA is a scientific research and advanced training institute in Portugal. Its mission is to develop scientific research and graduate teaching in Life Sciences, Chemistry, and Associated Technologies for the benefit of Health and the Environment, as well as to provide services to the community and develop university extension activities, including the promotion of science and technology.

Links:

↗ [Full published study](#)

↗ [IGZ](#)

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Links:

↗ [Full Study](#)

↗ [Leibniz-Institut für Gemüse- und Zierpflanzenbau \(IGZ\) e.V.](#)

↗ [Research Group „Temperature sensing in plants” at IGZ](#)

↗ [Instituto de Tecnologia Química e Biológica António Xavier \(ITQB\) of the Universidade NOVA de Lisboa](#)

↗ [Proceedings of the National Academy of Sciences of the United States of America](#)

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