Researchers generate plants with enhanced drought resistance without penalizing growth

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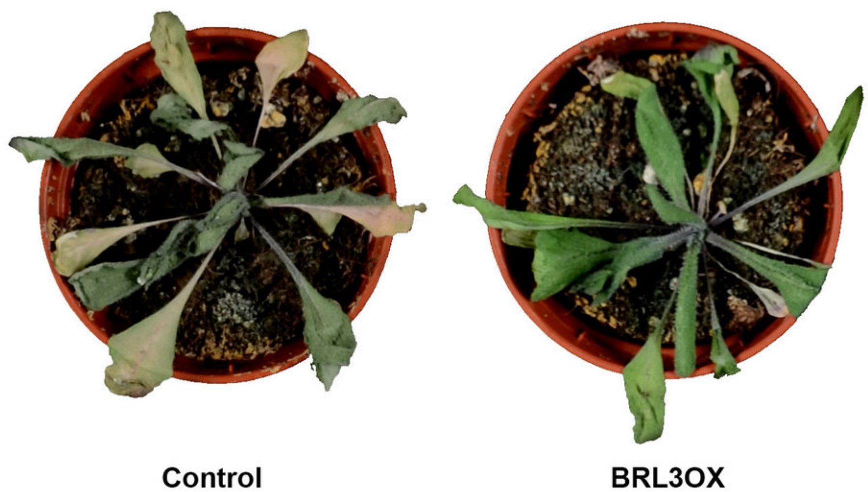

Arabidopsis thaliana plants after drought stress. On the left a control (wild-type) plant and on the right a plant overexpressing the vascular brassinosteroid receptor BRL3. Credit: CRAG

Extreme drought is one of the effects of climate change that is already occurring. This year, the decrease in rainfall and the abnormally hot temperatures in northern and eastern Europe have caused large losses in cereals and potato crops and in other horticultural species. Experts have long warned that to ensure food security, it is becoming necessary to use plant varieties that are productive in drought conditions. Now, a team led by the researcher at the Center for Research in Agricultural Genomics (CRAG) Ana Caño-Delgado has obtained plants with increased drought resistance by modifying the signaling of plant steroid hormones known as brassinosteroids. The study, published in the journal *Nature Communications*, is the first to find a strategy to increase hydric stress resistance without affecting overall plant growth.

Different receptors and different cells for different functions

Ana Caño-Delgado has been studying how the brassinosteroids regulate plant development and growth in the model plant Arabidopsis thaliana for more than 15 years. It is known that these phytohormones bind to different cell membrane receptors, causing a signaling cascade in the cell that produces effects such as cell elongation or division. Since 2016, her laboratory has used this knowledge to find strategies that confer drought resistance to plants. By modifying brassinosteroid signaling, researchers had so far achieved arabidopsis plants with increased drought resistance, but which were smaller than the respective control plants due to the complex action of these hormones on plant growth.

In the study, the researchers considered drought resistance and growth in Arabidopsis thaliana plants with mutations in different brassinosteroid receptors. Thanks to this detailed study, they have discovered that plants that over-express the BRL3 brassinosteroid receptor in the vascular tissue are more resistant to the lack of water than control plants, and unlike the other mutants, they do not present defects in their development and growth. "We have discovered that by modifying brassinosteroid signaling only locally in the vascular system, we are able to obtain drought-resistant plants without affecting their growth", explains Caño-Delgado.

Afterwards, CRAG researchers in collaboration with researchers from Europe, the United States and Japan analyzed the metabolites in the genetically modified plants and demonstrated that arabidopsis plants overexpressing the BRL3 receptor produce more osmeoprotective metabolites (sugars and proline) in the aerial parts and in the roots under normal irrigation conditions. When these plants were exposed to drought conditions, these protective metabolites quickly accumulated in the roots, protecting them from drying out. Hence, the BRL3 overexpression prepares the plant to respond to the situation of water scarcity, a mechanism known as priming, comparable to the effect of vaccines in the human body, which also prepare the body to respond to future pathogens.

Although this discovery was made with an Arabidopsis thaliana model, the research team led by Caño-Delgado is already working on applying this strategy in plants of agronomic interest, especially in cereals.

"Drought is one of the most important problems in today's agriculture. So far, the biotechnological efforts that have been made to produce plants more resistant to drought have not been very successful because as a counterpart to an enhanced drought resistance, there was always a decrease in plant growth and productivity. It seems that we have finally found a strategy that could be applied and we want to continue exploring it," concludes Caño-Delgado.

More information: Norma Fàbregas et al, Overexpression of the vascular brassinosteroid receptor BRL3 confers drought resistance without penalizing plant growth, *Nature Communications* (2018). DOI: 10.1038/s41467-018-06861-3

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