

Julieta Cabello, 31, has obtained transgenic plants of agronomic interest tolerant to freezing, drought and salinity.

In four decades the world population will exceed 12 billion, and the FAO calculates that the production of food will need to increase by 70%. At the same time, the effects of climate change may make presently fertile land uncultivable and the quality and quantity of water available for crop production will likely have decreased rather than increased. In this context, transgenic crops capable of adapting to dry or saline land, and tolerating extreme temperatures offer an alternative to meet the needs of a growing population. In particular, a gene from sunflower identified by the young researcher, Julieta Cabello, could be used to generate particularly tolerant and productive varieties of soybean, wheat, maize and other plants of agricultural importance.

Cabello studied Biotechnology in the Faculty of Biochemistry and Biological Sciences of the National University of Litoral (Argentina) and specialised during her PhD research in the characterization of transcription factors involved in the response of plants to different types of abiotic stress, i.e. conditions of the physical environment which affect plant development, such as cold temperatures, drought and the excess of certain minerals in the soil.

During her PhD research, the young investigator discovered that a gene called HaHB1 could be used to obtain varieties resistant to different types of stress. In the first place, HaHb1 is a transcription factor that regulates the expression and repression of many other genes involved in the cascade of processes which take place in the plant when a particular stress occurs- such as cold, drought, salinity of the soil - until the commencement of the synthesis of the proteins which enable the plant to protect itself according to the particular stress situation. As the young researcher explains, HaHb1 provokes "a kind of domino effect", which leads to "complex phenotypes" that allow the plant to tolerate drought, salinity and cold stress.

Cabello observed that to endure such tough conditions, HaHB1 induces the expression of a type of protein known as "antifreeze proteins". During cold acclimation, ice crystals form in the apoplast of cells. These proteins bind to ice crystals, change their shape and inhibit their growth, preventing cell damage. In addition, "antifreeze proteins" have the capacity to stabilise cell membranes in periods of cold and drought, which avoids dehydration and tissue death. "This ensures that the membranes do not lose their semi-permeability and active functions at low temperatures, which is what happens in plants that do not contain HaHB1", says Cabello.

The investigator is convinced that this mechanism is what enables the [HaHB1] transgenic plants to tolerate the three types of stress : conditions of cold and drought, and of high salinity. In the latter case, she has found that the [HaHB1] transgenics are more tolerant of excess salt than wild type plants. She believes that there could be other benefits of the membrane stabilisation offered by HaHB1. "Salts, like low temperature, cause the plant to lose water, causing differences in the osmotic potentials inside and outside the cells", explains Cabello.

Plants more tolerant and with increased yields

However this gene had another surprise for Cabello : in carrying out tests in the model plant *Arabidopsis thaliana*, she discovered that not only does HaHB1 offer "increased tolerance of certain stresses", it also leads to plants which produce an increased yield of seed. According to the researcher, this characteristic is a "very valuable advantage" because often plants that have better tolerance of environmental stress have a reduced quantity of seed too. These combination of phenotypes has not biotechnological impact.

Cabello has published her discoveries in papers in *The Plant Journal* and *The Plant Biotechnology Journal*. Moreover, she is the lead inventor on two international patents covering the HaHB1 technology, and rights under these patents have been licensed to various multinational companies. According to the young researcher, these companies are currently transforming HaHB1 into various crops of agricultural importance such as maize, wheat, soybeans and rice, and have obtained "positive" results with some of these. "There are other transgenic crop plants in the market, however no products so far are resistant to abiotic stress; the companies still need to obtain regulatory clearances before launching seed sales of these type of [transgenic] crops" says Cabello.

In the opinion of the director of Threshold Ventures, Jonathan Baer, member of the judging panel for the MIT Technology Review's prizes for Innovators under 35 : Argentina and Uruguay, Cabello's project describes " a very good technology" which addresses a problem "of global importance" in food production. In the opinion of the expert, the innovator has a "solid academic training" and has achieved "significant progress in the development of the underlying technology to enable the industrial decision to obtain commercialisation licences".

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The HaHB1 technology is licensed to PBL and the subject of patent applications filed by PBL in various parts of the world. PBL has granted commercial exploitation rights for HaHB1 to various companies for certain crop species.

Information about availability of HaHB1 for crop licensing can be obtained by contacting PBL.

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