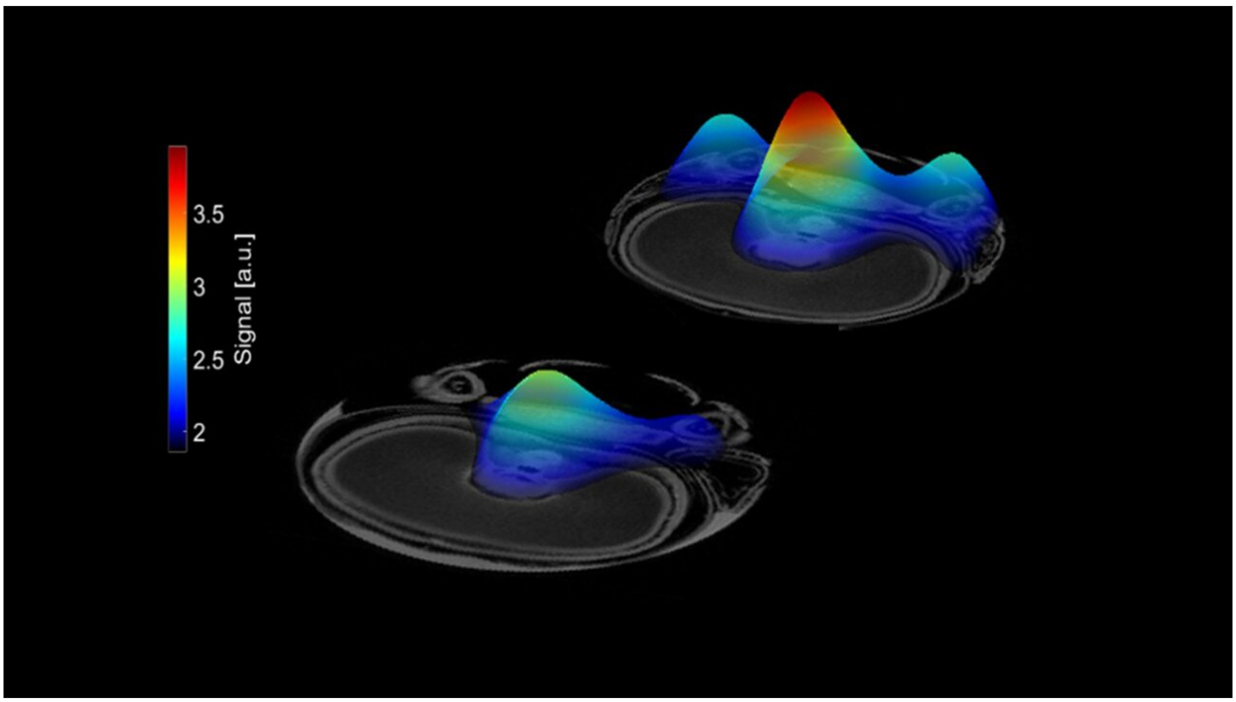
HvSWEET11b plays a multifunctional role in grain development of barley

March 20 2023



Visualization by Magnetic Resonance Imaging revealed changes in sucrose allocation within SWEET11b-affected grains (back image) when compared to wild type (front image) consistent with the changes to the cytokinin gradient across grains. Credit: IPK Leibniz Institute

Even though Sugars Will Eventually be Exported Transporters (SWEETs) have been found in every plant genome, a comprehensive understanding of their functionality is lacking. An international research team led by the IPK Leibniz Institute has therefore investigated the role that SWEETs play in barley grain development and looked into the question of which substrates are transported by the SWEET proteins in the seed.

They revealed that expressing HvSWEET11b in African clawed frog (Xenopus laevis) oocytes facilitated the bidirectional transfer of not only just sucrose and glucose, but also plant hormone cytokinin. The results have been published in the journal *Plant Cell*.

Sugars Will Eventually be Exported Transporter (SWEET) is a large family of proteins, which have been found in every sequenced plant genome. The main function of SWEETs is the transport of sugars like sucrose and glucose. This makes SWEETs important for various processes during a plant's growth and development. However, the SWEET family in barley was not characterized so far either in terms of its capabilities to transport specific substrates or their functional roles in grain's growth and development.

Barley is fourth most important cereal crop grown for its grains. To achieve high yield, the grains must be supplied by sugars and phytohormones from the mother plant. Of 23 barley SWEET genes, HvSWEET11b, HvSWEET15a, and HvSWEET4 are predominantly active in the developing grains. "HvSWEET11b protein functions not only as a sugar transporter but is able also to transport the plant hormone cytokinin," says Dr. Volodymyr Radchuk, first author of the study.

Plants carrying a homozygous mutation of HvSWEET11b fail to set any viable grain. The partial repression of HvSWEET11b transcription alters the allocation of both sucrose and cytokinin in the grain and results in fewer endosperm cells, lower starch and protein accumulation, and a reduction of the grain size at maturity. The dual substrate capacity of a single transporter protein provides the plant with an efficient means of coordinating the grain's development and filling.

Given the finding that HvSWEET11b mediates the transfer of sugars, and cytokinins in Xenopus oocytes and that changes in the development of HvSWEET11b-repressed grains are associated with perturbed sucrose and cytokinin flow through the maternal tissues toward the endosperm, HvSWEET11b likely plays a multifunctional role in grain development, depending on substrate availability.

"Our findings provide important insights into how plants can transport various compounds using only a limited number of transporters," says Dr. Ljudmilla Borisjuk, head of IPK's research group Assimilate Allocation and NMR. The dual function of HvSWEET11b in developing grains at the borders of two plant generations is an expression of the fact that the roles of sugars and phytohormones in plant development are highly integrated.

"The balanced transfer of sugars and plant hormones between generations is likely an important cue in the adaptation of plant growth to an ever-changing environment and opens a potential for further yield improvement."

More information: Volodymyr Radchuk et al, SWEET11b transports both sugar and cytokinin in developing barley grains, *Plant Cell* (2023). DOI: 10.1093/plcell/koad055

Provided by Leibniz Institute of Plant Genetics and Crop Plant Research