Sucrose trafficking and water use in poplar is modulated by a key transporter

U.S. DEPARTMENT OF ENERGY | Office of Science

Background

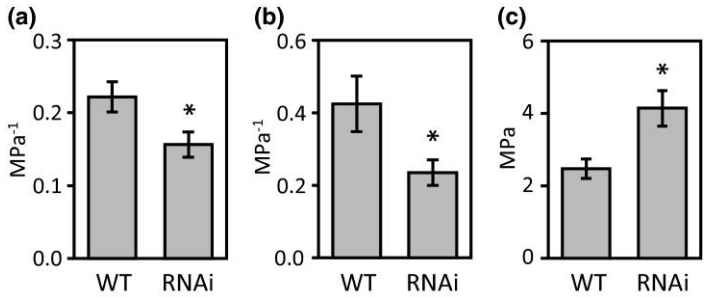
- The tonoplast sucrose transporter, PtaSUT4 is highly expressed in leaves of *Populus tremula* x *alba* (INRA 717-IB4) and its inhibition by RNA-interference (RNAi) alters sucrose homeostasis.
- The role of PtaSUT4 is unexplored in modulating sucrose partitioning between the vacuole and the cytosol for specific physiological outcomes such as modulating carbon accrual and water use.

Conclusions

- *SUT4*-RNAi in poplar increased leaf bulk modulus of elasticity and decreased leaf storage water capacitance relevant to turgor control and ability to make osmotic adjustments, respectively.
- Leaf mesophyll cell volume and packing was altered in *SUT4*-RNAi plants (TEM images).
- The ability of *SUT4*-RNAi source leaves to increase their transpiration rates, a common response to partial defoliation, was reduced compared to wild type.
- Photosynthesis and utilization of non-structural carbon reserves based on dry mass reductions after partial defoliation were similar in wild type and *SUT4*-RNAi plants.
- Stem growth reduction after partial defoliation was greater in *SUT4*-RNAi plants and was comparable to the reduction in plant water uptake.

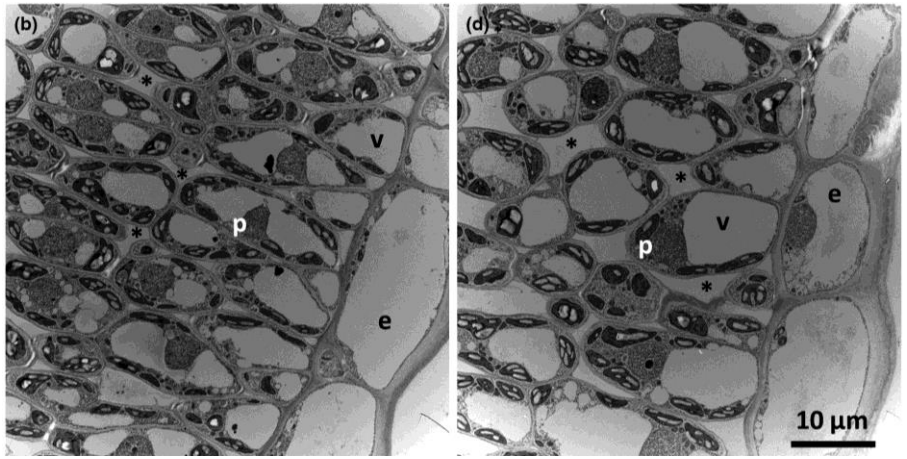
Significance

- *PtaSUT4* expression modulates carbon utilization for nutrition in growth and for leaf hydraulics. This occurs along a leaf expansion gradient or in response to an acute drought treatment. These results provide another genetic tool for control of poplar sustainability.



(Top) Storage water capacitance before (a) and after (b) turgor loss, and bulk modulus of elasticity (c) of fully expanded leaves. Data are the mean and standard error of n = 5 plants. Asterisks indicate significant difference ($P < 0.05$).

(Bottom) TEM images (3200X) of a fully expanded leaf from WT (left) and RNAi (right) plants. e, epidermal cells; p, palisade mesophyll cells; v, vacuoles; asterisks denote intercellular gaps



THE CENTER FOR BIOENERGY INNOVATION

Harding SA, Frost CJ, Tsai C-J (2020) Defoliation-induced compensatory transpiration is compromised in *SUT4*-RNAi *Populus*. *Plant Direct* 4:e00268. https://doi.org/10.1002/pld3.268