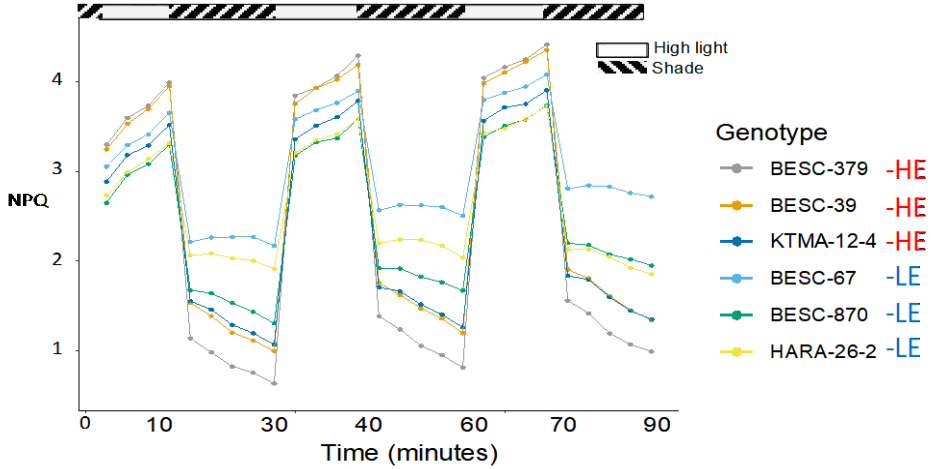
A Novel Gene, BOOSTER, Enhances Photosynthesis Efficiency and Plant Productivity

Background

- There is an incomplete understanding of the genetic mechanisms affecting induction and relaxation of photosynthesis in a field environment to improve plant productivity.

Approach

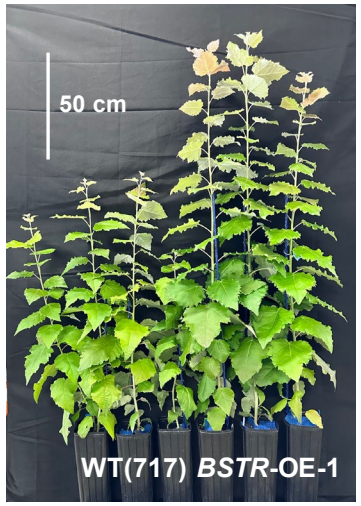
- Genome-wide association studies of non-photochemical quenching (NPQ) parameters in 743 different *Populus trichocarpa* variants in common gardens identified a nuclear-encoded genomic region, *BOOSTER* (*BSTR);* BSTR is associated with variation in photosynthesis under fluctuating light, such as occurs in field settings.



NPQ in high (**HE**) and low (**LE**) *BSTR* expressor poplar genotypes in response to fluctuating light.

Results

- *BSTR* facilitated anterograde signaling between nucleus and plastid, enhanced expression of Rubisco, and increased photosynthesis.
- In field conditions, poplar accessions with *BSTR* exhibited up to 35% greater height and 88% higher biomass.
- *BSTR*-overexpression (*BSTR*-OE) in 717 hybrid poplar resulted in up to 200% increased height over a 60-day period in the greenhouse. When overexpressed in Arabidopsis, *BSTR*-OE boosted biomass by 200% and seed production by 50%.



Three-month-old transgenic '717' hybrid poplar (right) overexpressing *BSTR* and wildtype (left) growing in a greenhouse.

Significance

- Our findings highlight BSTR's potential for broad applications in improving crop yield, addressing food and fiber security through enhanced photosynthetic efficiency.

Feyissa BA *et al. Developmental Cell* (2024), doi.org/10.1016/j.devcel.2024.11.002