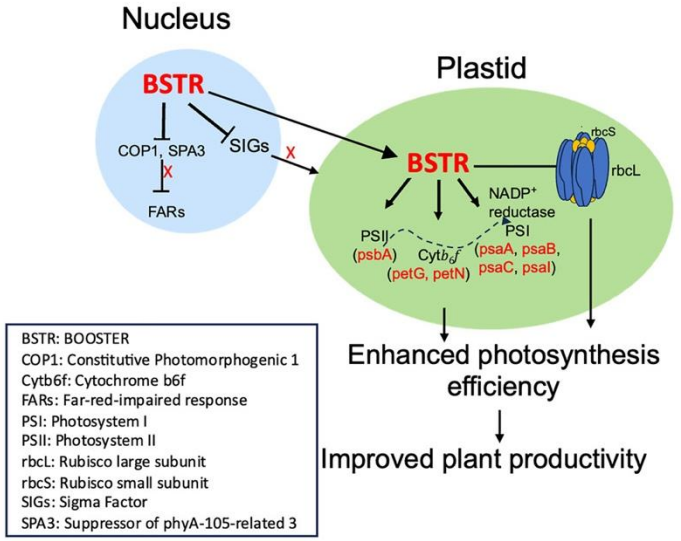
An Orphan Gene BOOSTER Enhances Photosynthetic Efficiency and Plant Productivity

Background/Objective

- There is an incomplete understanding of the genetic mechanisms affecting induction and relaxation of photosynthesis in a field environment, and a more comprehensive description is required to aid efforts to improve plant productivity.
- In this study, researchers focused on poplar, a fast-growing crop and a candidate for making biofuels and bioproducts, and leveraged a diversity panel to screen for genotypic variation in non-photochemical quenching (NPQ) dynamics and identify candidate regulators.

Approach

Genome-wide association studies (GWAS) of non-photochemical quenching parameters in 743 *Populus trichocarpa* accessions identified a nuclear-encoded genomic region associated with variation in photosynthesis under fluctuating light.



A working model of BSTR-mediated enhanced photosynthesis efficiency and plant productivity.

Results

This process identified that a substantial portion of the sequence for the Rubisco large subunit had been transferred to the nuclear genome and created a chimeric gene, *BOOSTER (BSTR)*, which impacts photosynthesis. Higher expression of *BSTR* facilitated anterograde signaling between nucleus and plastid, which corresponded to enhanced expression of Rubisco, increased photosynthesis, and up to 35% greater plant height and 88% biomass in poplar accessions under field conditions.

Significance/Impacts

In this study, we provided genetic and physiological evidence demonstrating the impact of *BSTR* in enhancing photosynthesis efficiency and biomass gain. Our data suggest that *BSTR* has potentially broad application to increase crop yield to meet food, fuel, and fiber security.

Feyissa et al. 2024. "An Orphan Gene BOOSTER Enhances Photosynthetic Efficiency and Plant Productivity." *Developmental Cell*. DOI: 10.1016/j.devcel.2024.11.002.