

On the possible role of *Zea* cis-regulatory natural variation of *pp12*, a subunit of the NDH complex, in controlling photosynthetic traits

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Teosinte, the progenitor of maize, harbors a reservoir of allelic diversity that was lost during domestication and remains a resource for modern crop improvement. To evaluate this diversity in a temperate-adapted background, we developed a teosinte introgression population of ~2,100 BC₂S₃ lines derived from 81 georeferenced donor accessions spanning the *Zea* genus. These accessions are backcrossed into B73 such that each line carries ~12.5 % donor genome. We performed whole-genome sequencing of 1,400 lines at ~0.8× coverage and 3' RNA-sequencing of a representative subset and conducted a cis-eQTL scan across this subset. From this analysis, we identified *pp12*, a locus shown to encode a subunit of the chloroplast NDH complex and play a role in photosynthetic electron transfer in *Arabidopsis*¹.

To test whether this expression-level signal produces a phenotypic effect under field conditions, we designed a paired sister-line trial. Each pair has one line carrying the teosinte *pp12* allele and one carrying the B73 allele from the same BC₂ subfamily. We planted four replicates per line, with lines of a pair positioned adjacently to control for local field environment. We measured early plant height (EPH) at six timepoints spanning 27–56 days after planting, terminal plant height, and photosystem II maximum quantum efficiency (Fv/Fm). All phenotypes were spatially corrected using P-spline models fit via statgenHTP/SpATS. Downstream analyses combined per-timepoint linear mixed models, within-pair contrasts, and P-spline hierarchical growth-curve modeling. Together, this design allows us to evaluate the effect of teosinte *pp12* allele on early season vigor.

References

¹Ishihara, Seiko, Atsushi Takabayashi, Kunio Ido, Tsuyoshi Endo, Kentaro Ifuku, and Fumihiko Sato. 2007. "Distinct Functions for the Two PsbP-like Proteins PPL1 and PPL2 in the Chloroplast Thylakoid Lumen of *Arabidopsis*." *Plant Physiology* 145 (3): 668–79.