Overexpression of key cellulose biosynthesis precursor enzyme, UGPase, reveals altered sugar and secondary metabolism in *Populus*

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Background

- BESC researchers undertook a first-of-its-kind study of overexpressing a native UDP-Glucose (substrate for cellulose biosynthesis) provision enzyme, UGPase, in *Populus* plants.

Approach

- Metabolic profiling by GCMS of hundreds of plant metabolites was performed along with composition analysis and sugar release.

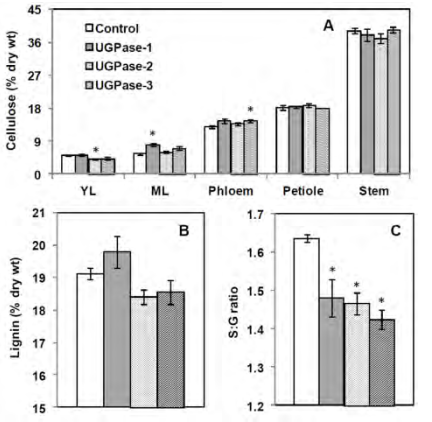
Outcome

- Transgenic plants had pronounced growth and metabolic changes relative to control plants. Our results support a role for UGPase in carbohydrate metabolism, secondary metabolism and plant growth and development, but surprisingly, not directly in cellulose deposition. S:G lignin ratios, mannose levels, and xylose release from transgenic stems were reduced, although overall cellulose and lignin levels were unaffected.

Significance

- This study provides evidence that manipulation of sugar metabolizing enzymes, such as UGPase, can have qualitative and quantitative effects on secondary metabolic pathways of shikimate, phenylpropanoid, and lignin biosynthesis.
- A cross-collaborative BESC effort is investigating the substrate preferences and reaction kinetics of UGPase to understand the observed pleiotropic phenotype. In integration with assessments of effects of other gene sequence and expression variations, our studies are yielding critical insights into biomass formation in *Populus*.

Control *UGPase2*



	Cellobiose	Glucose	Xylose	Galactose	Arabinose	Mannose
Control	3.543 ± 0.057	35.12 ± 0.625	15.6 ± 0.165	1.685 ± 0.044	0.919 ± 0.021	1.927 ± 0.045
UGPase-1	3.44 ± 0.171	34.13 ± 0.854	15.6 ± 0.179	1.616 ± 0.08	0.948 ± 0.051	**1.36** ± 0.056
UGPase-2	3.439 ± 0.116	33.28 ± 0.824	15.8 ± 0.242	1.753 ± 0.102	0.967 ± 0.049	**1.492** ± 0.064
UGPase-3	3.668 ± 0.14	34.07 ± 0.596	16.1 ± 0.227	1.275 ± 0.305	0.987 ± 0.029	**1.589** ± 0.074

Morphology and cell wall composition of *Populus deltoides* plants overexpressing UGPase relative to control plants. Unknown phenolic-glycoside conjugates accumulated.

Payyavula RS, Tschaplinski TJ, Jawdy SS, Sykes RW, Tuskan GA and Kalluri UC, "Metabolic profiling reveals altered sugar and secondary metabolism in response to UGPase overexpression in *Populus*". *BMC Plant Biology* 14:265, 2014. doi:10.1186/s12870-014-0265-8

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