The potential for hybrid poplar as a biofuel in Southern Arizona

Shiach, I.M.; Monson, R.K.; Moore, D.J.P.
University of Arizona; shiach@email.arizona.edu

Background

- Hybrid poplar trees are fast growing, can be grown as a biofuel
- Hybrid poplar clones from different geographical regions may respond differently to a climate like Southern AZ (long growing season, high light)
  - Lines from more southern states will have higher diurnal heat tolerance
  - If northern lines can adapt to high heat, may produce more biomass due to long growing season

Site Design

- Biosphere 2, near visitor parking lot
- Near Oracle, AZ
- 122 hybrid poplar trees, 10 genotypes
- Irrigated 3.75 gallons/day with RO water

Group	Clone	Parent (F/M)	Cross	Cold Tolerance
North	50-194	WA/IL	TxD	Moderate
	57-276	WA/MO	TxD	Moderate
	180-372	WA/MN	TxD	High
South	49-177	WA/TX	TxD	Low to Moderate
	49-177A	WA/TX	TxD	Low to Moderate
	199-586	WA/OK	TxD	Moderate
Europe	309-74	WA/Europe	TxN	Moderate to High
	311-93	WA/Europe	TxN	Moderate to High
	DN-34	Euro-Americana/EA	DxN	?
	R-270	Unknown/Europe	DxN	High

T: Populus trichocarpa (black cottonwood)
D: Populus deltoides (eastern cottonwood)
N: Populus nigra (black poplar)

Results

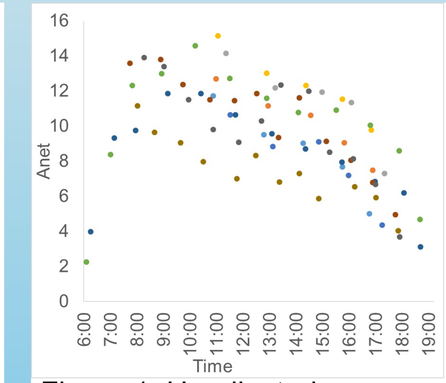


Figure 1: Unadjusted average diurnal Anet, 10 genotypes, summer 2013

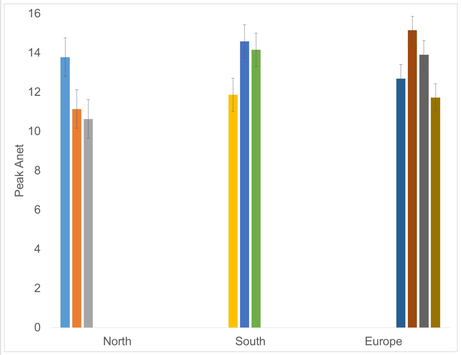


Figure 2: Average peak diurnal Anet, summer 2013

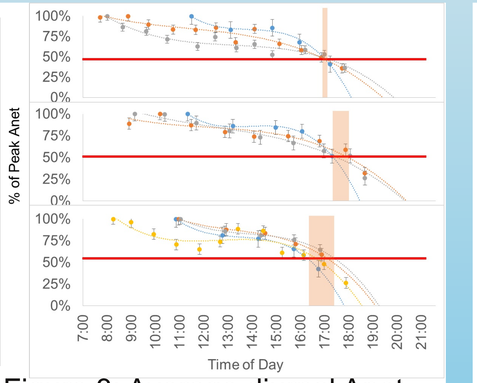
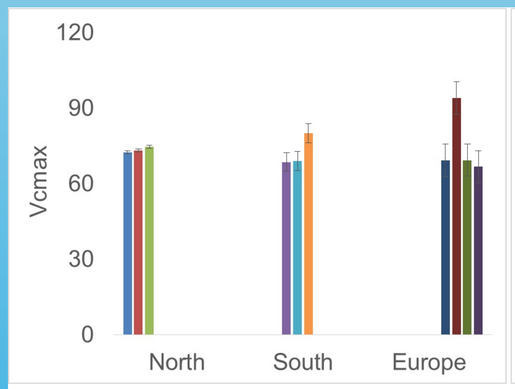
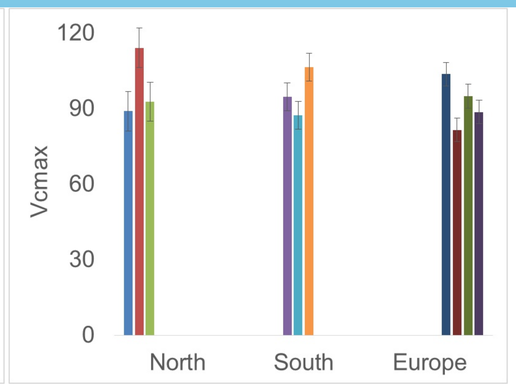


Figure 3: Average diurnal Anet scaled to peak Anet. Highlighted region shows time range that group falls below 50% peak Anet



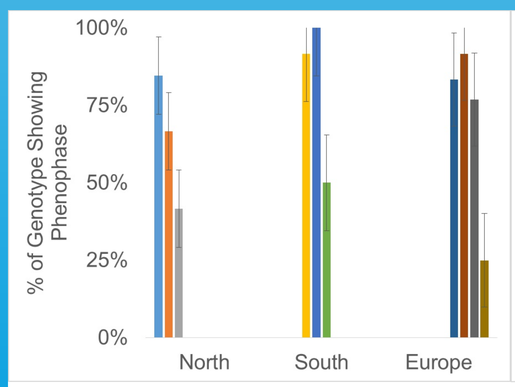
June



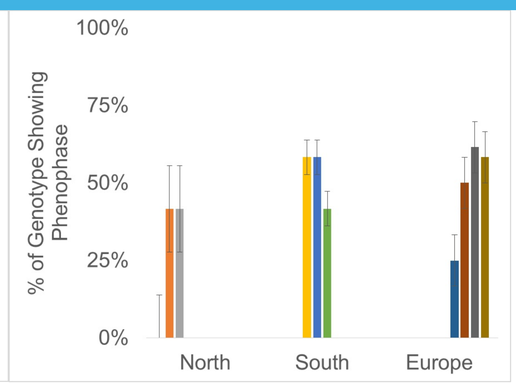
August

Figure 4 (left): Average Vcmax (photosynthetic capacity) from June 2013

Figure 5 (right): Average Vcmax from August 2013



Falling Leaves



Colored Leaves

Figure 6 (left): Nature's Notebook (National Phenology Network) observations, genotypes with falling leaves

Figure 7 (right): Nature's Notebook observations, genotypes with leaves showing late-season colors

Discussion

- Southern lines are active slightly later in the day than Northern and European lines
- No clear distinction between Northern, Southern, and European lines in terms of photosynthetic capacity (Vcmax)
- Northern lines showed slightly later beginnings of leaf senescence than Southern and European lines
- More data needed (seasonal Vcmax, biomass collection) to determine if Northern lines produce the most biomass
- Poplar can be grown in Southern Arizona
  - Despite drought and nutrient stress, no casualties so far
  - However, high water use

Future Work

- Seasonal pattern of Vcmax
  - Leaf age
- Diurnal Asat
  - Seasonal pattern
  - Behavior across the whole day
- Phenology observations
  - Ground-based
    - Leaf senescence
  - Camera-based
    - Spectral changes
- Chlorophyll analysis
- Leaf Area Index
- Biomass collection

Acknowledgements

We would like to thank David Moore, Russ Monson, Shirley Papuga, Amberly Neice, Mohamed Khairy, the Moore-Trouet lab group members, Greg Barron-Gafford and his lab, Kyle Hartfield, David Quanrud, the many volunteers who have helped us out, and the staff at Biosphere 2.