Physiological Response to Drought Stress and Water Use in Two Redbud (*Cercis*) Ecotypes

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Introduction

Drought tolerance is an important adaptation for landscape plants. Redbud is an major landscape plant with two ecotypes (*Cercis canadensis canadensis* and *Cercis canadensis texensis)* that respond differently to substrate water availability.

Our current studies have focused on growth and water use in Pot-in-Pot grown redbud plants during various time regimes for cyclic irrigation.

Understanding the relative differences in whole plant physiology between redbud ecotypes will help interpretation of cyclic irrigation field data.

The objective of the study was to measure gas exchange and water use between two ecotypes of *Cercis canadensis*.

Materials and Methods

Redbud plants: Three each *Cercis canadensis* 'Appalachian Red' and *Cercis canadensis texensis* 'Oklahoma Red' liners were grown in 7-gallon containers filled with 85% pine bark: 15% peat (vol/vol) in greenhouse over a three-day dry down experiment repeated 3 times

Substrate moisture sensors: EC5 in three representative containers per irrigation treatment.

Acquisition of water content: Campbell CR-1000 data logger. Irrigation was scheduled to replace

Physiological measures: Hourly sap flow (Sapflow meter) using Dynamax sensor,
Canopy photosynthesis using (Licor-6400).
Relative water content, leaf water potential, and stomata count.

Results

Table 1: Gas exchange and transpiration

Photosythesis (µmol $CO_2 m^{-2} \cdot s^{-1}$)	Stomatal Conductance (mmol•m^{-2}•s^{-1})	Transpiration (ml. plant $^{-1} \cdot$ day^{-1}) (greenhouse)	Stomata count
	'Appalachian Red'		
7.7	0.129b	1510a	11b
	'Oklahoma'		
11.8a	0.153a	851b	25a

Table 2: Water use and sap flow

Relative water content	Sap flow (cm hr^{-1})	Leaf water potential (kPa)	Daily water use (ml . plant $^{-1} \cdot$ day^{-1}) (pot in pot)
		'Appalachian Red'	
59.5b	0.84a[z]	20.7a	4616a
		'Oklahoma'	
69.8a	0.49b	15.3b	3660b

Sap flow showed a similar trend to direct transpiration measurements with 'Oklahoma' transpiring almost twice as much water as 'Appalachian Red'.
'Oklahoma'' redbud plants had thicker, broader, heavy leaves and higher number of stomata per unit leaf area compared to 'Appalachian Red' plants which may be related to the observe higher relative leaf water content, stomatal conductance and net photosynthesis under drought stress conditions.

Fig 1. Average daily water use per day of redbud liners grown in 7 gallon pot-in-pot containers watered in the morning for over a 8 day non rainy period in August-September, 2014

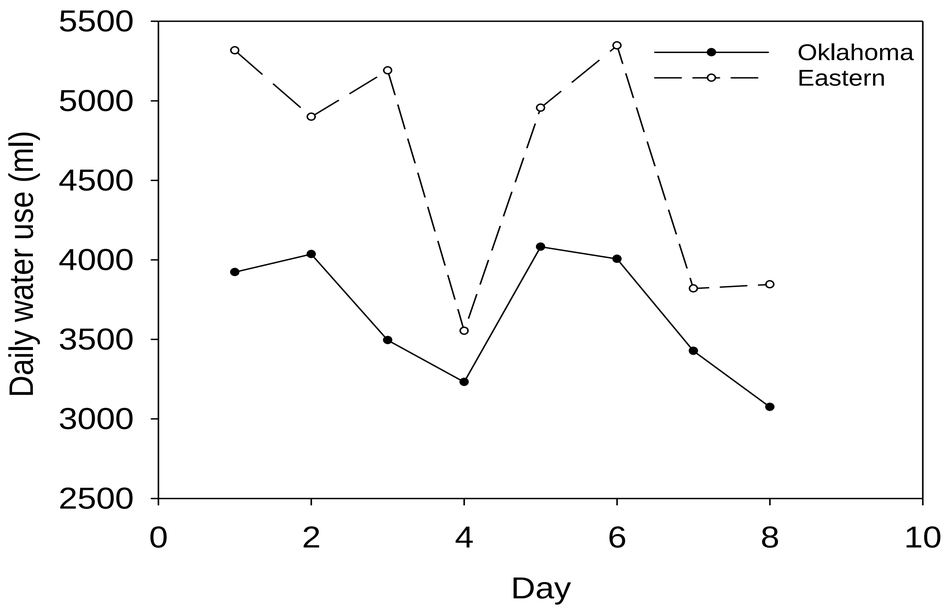
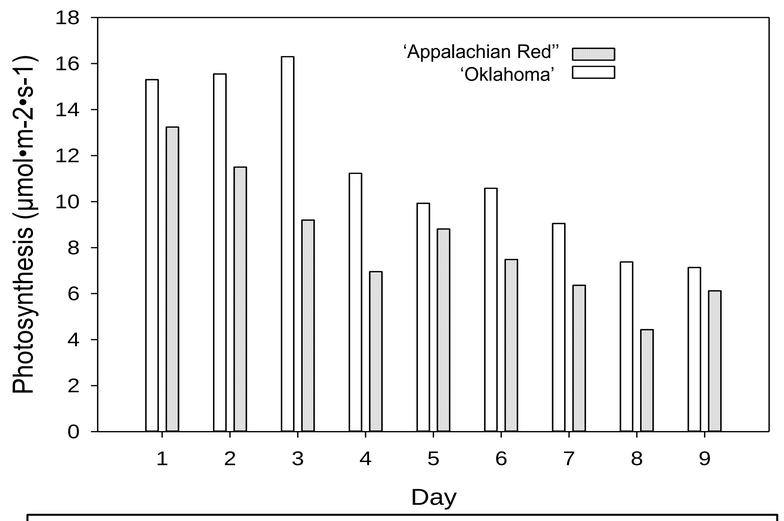


Fig: 2 Photosynthesis of redbud liners grown in drying substrate in 7 gallon containers for nine consecutive days in green house.



Photosynthesis rate decreased linearly in both cultivars with 'Oklahoma' showing a higher photosynthetic rate through out the drying event.

Conclusions

- 'Oklahoma' maintained around 35% higher net photosynthesis compared to 'Appalachian Red'.
- 'Oklahoma' lost 26 g of water per plant per day through transpiration compared to 42 g of water for 'Appalachian Red'.
- 'Oklahoma' maintained a photosynthetic rate at 90% or greater of maximum rate even under substrate water content of 0.27 $m^3 \cdot m^{-3}$, whereas 'Eastern' showed a significantly reduced photosynthesis rate beginning at substrate water contents of 0.31 $m^3 \cdot m^{-3}$.
- The 'Oklahoma' redbud maintained physiological and morphological properties favoring higher drought tolerance than eastern redbud as the root substrate dried.

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