Measuring Tree Water Status in the Orchard





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Overview

- How we got here
  - Past research on tart cherry irrigation
- 2011 study (Measuring tree water stress)
  - Approaches
  - Conclusions
- Future plans

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Regulated Deficit Irrigation

- Deficit ≡ less coming in than going out

  deficit irrigation ≡ intentional drought stress
- Regulated ≡ specific timing and severity

- Why?
  - Save water
  - Induce some type of favorable crop response

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2007-2009

- Applied irrigation deficits
- Measured yield
- Tracked fruit through the plant
  - Pack out
  - Fruit quality

	Flow Rate (gph)	Inches/ Irrigation (12 h)
	7.7	0.5
	12.2	0.8
	15.6	1.0
	19.9	1.3
	25.8	1.7







- 2007
  - Warm early spring
  - Light bloom and good set
  - Moderate crop load
- 2008
  - Cool wet spring
  - Heavy bloom, but fruit set limited by frost
  - Moderate crop load
- 2009
  - Cool wet spring
  - Heavy bloom and very good fruit set
  - Huge crop load

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- 2007 – 2008 RDI treatments
  - Did not effect yield
  - Did not effect fruit size (packout)
  - Improved SS and color of fruit
  - Reduced visible trunk injury



- 2009 RDI treatments
  - No difference in yield
  - Reduced fruit size
  - Big difference in packout





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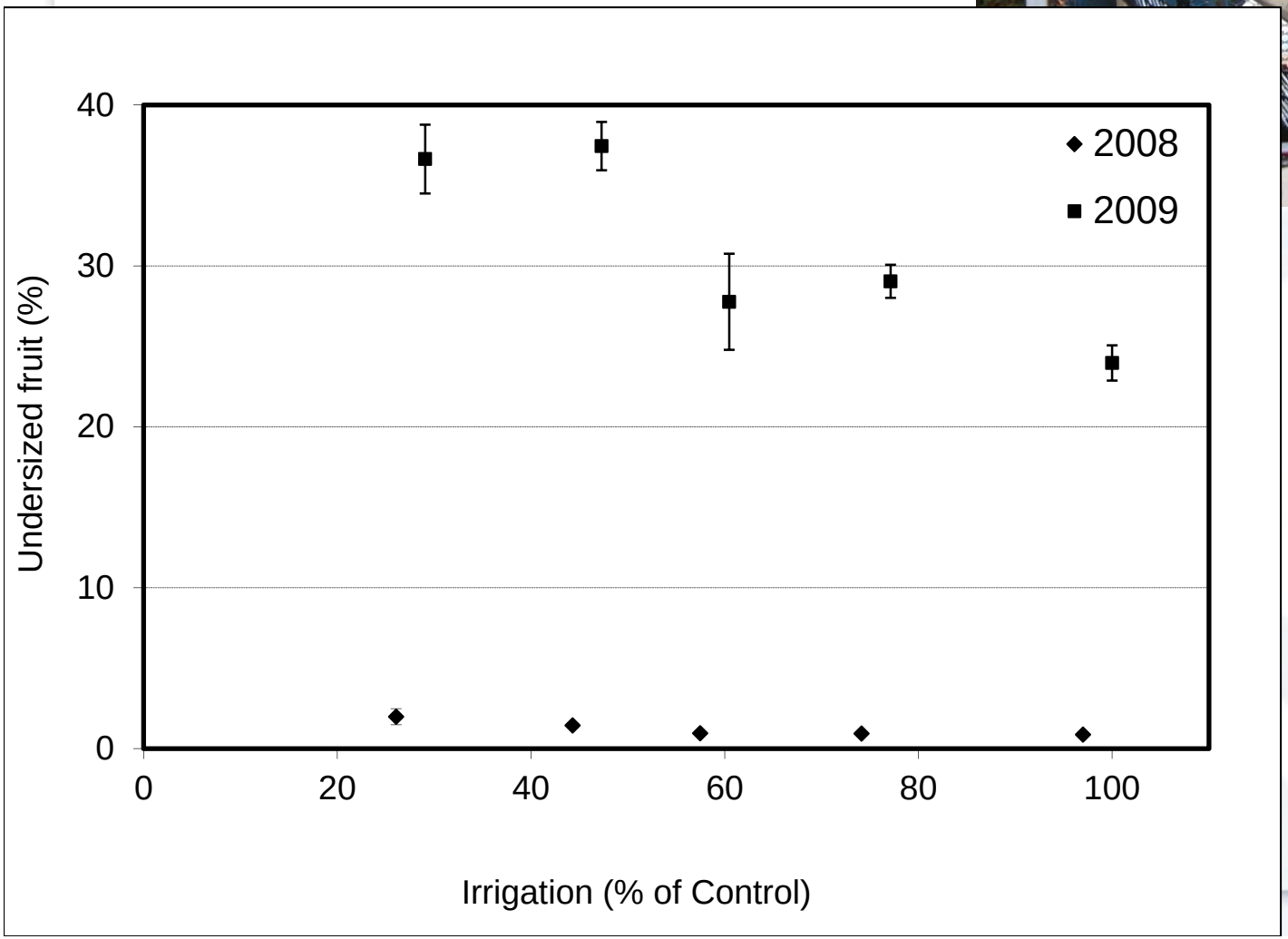
Undersized fruit





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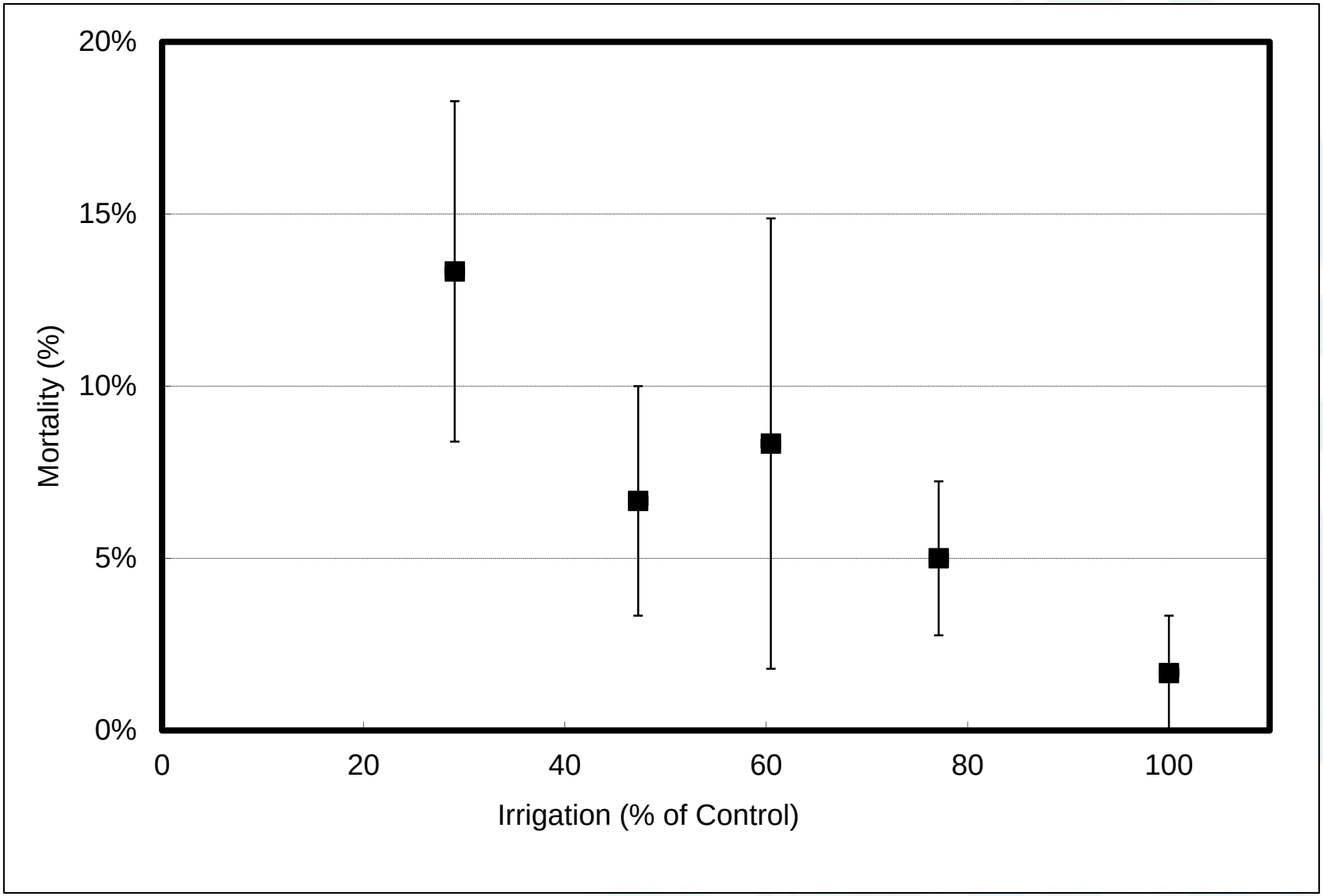
Tree Death



How stressed are the trees?

- Mid-day stem water potential
  - How hard is the tree “pulling” to get water?







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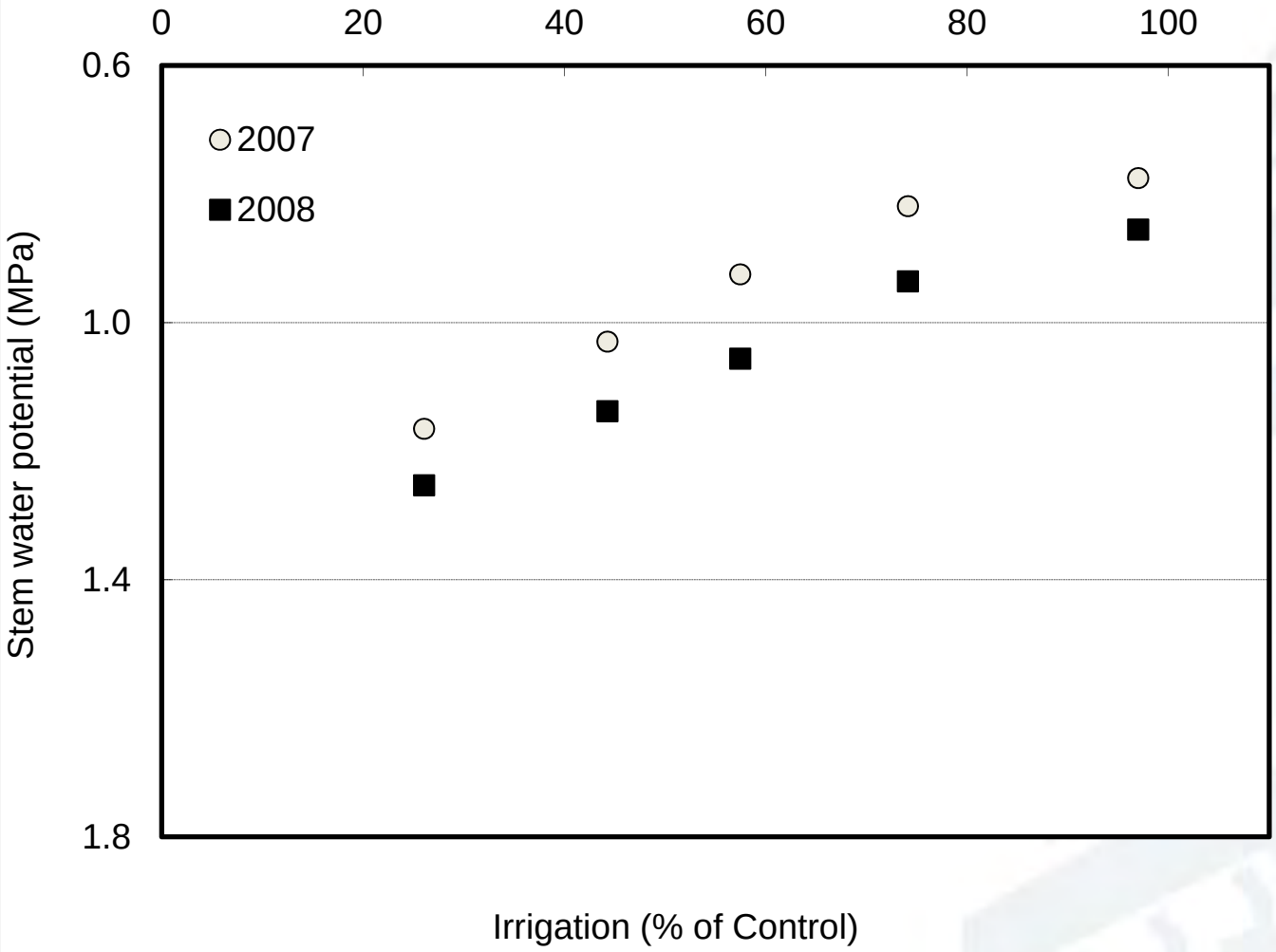
Mid-day stem water potential





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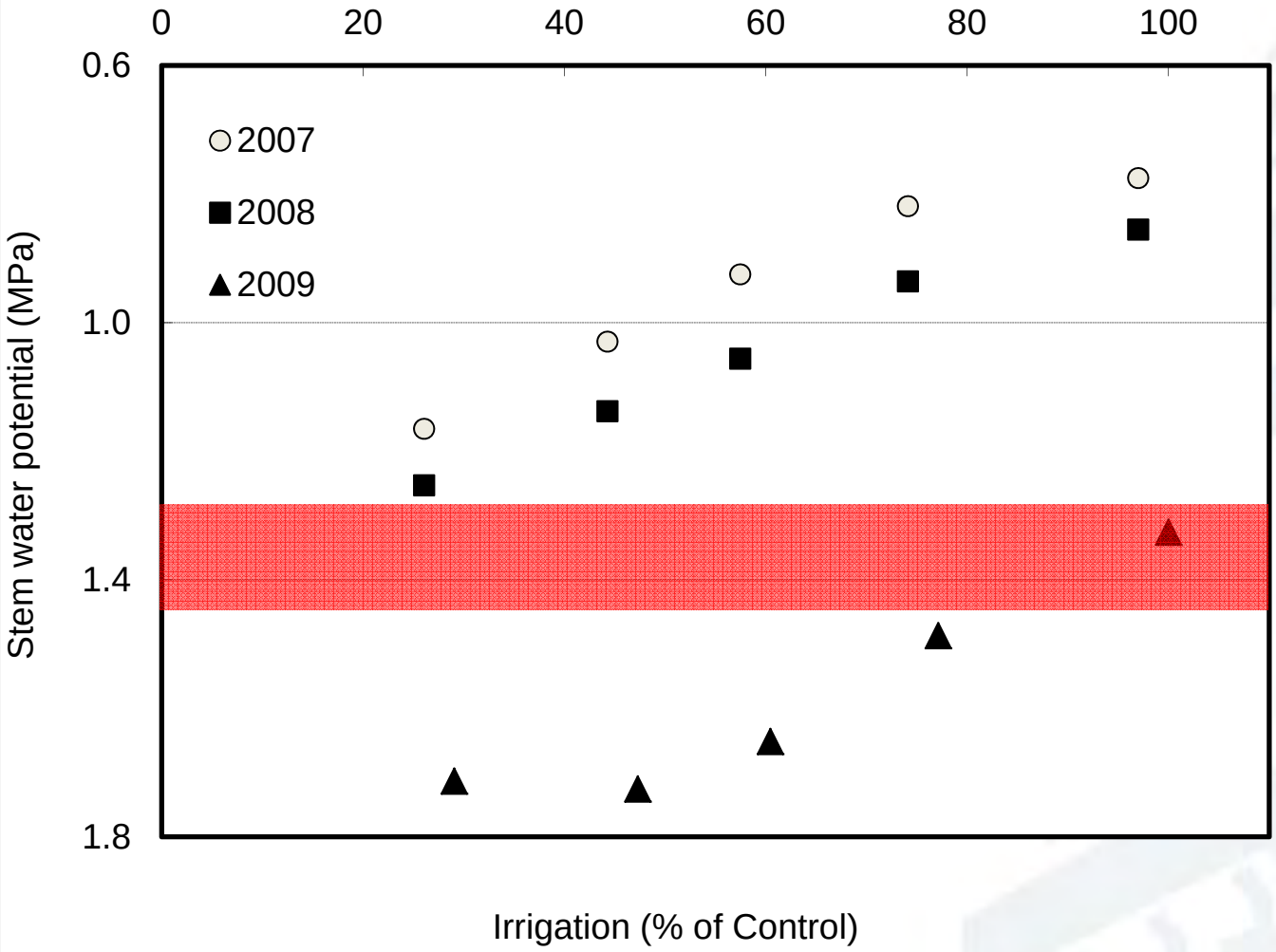
Mid-day stem water potential





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How stressed are the trees?

- Is there a better method
- Better = user friendly







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2011 Research

- Tart cherry orchard in 9th leaf

  Kaysville farm
- 4 replicate plots
- 14 different irrigation levels in each plot









2011 Research

Measurement methods

- Stomatal conductance
- Leaf temperature
- Leaf water potential
- Stem water potential











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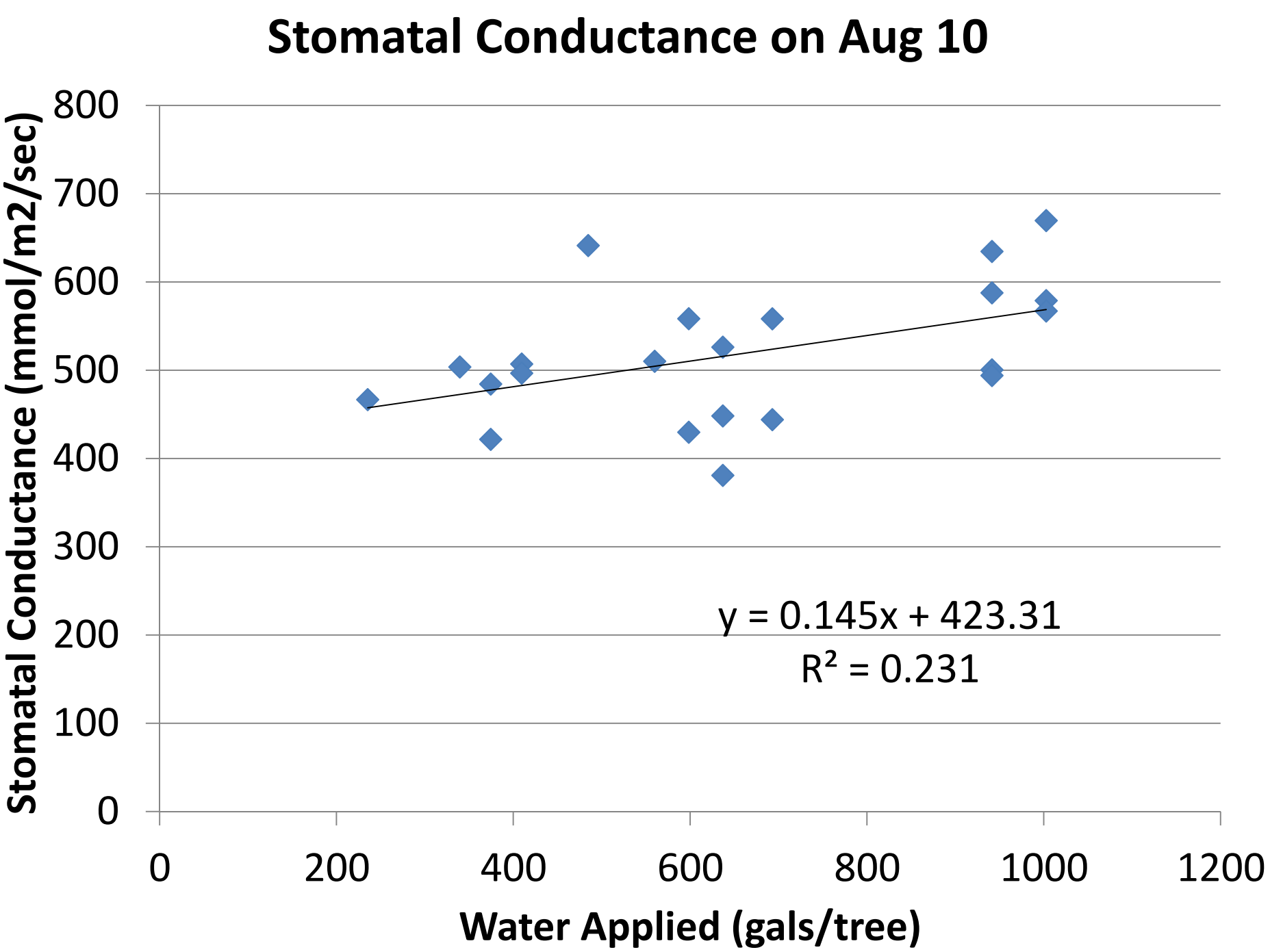
Stomatal Conductance on Aug 10
Stomatal Conductance (mmol/m2/sec)
800
700
600
500
400
300
200
100
0
0
200
400
600
800
1000
1200
Water Applied (gals/tree)
y = 0.145x + 423.31
R² = 0.231

Stomatal conductance

- Which leaves to measure?
- How many leaves per tree?
- Instrument accuracy?
- Huge leaf-to-leaf variability





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2011 Research

Measurement methods

- ~~Stomatal conductance~~





- ~~Leaf temperature~~

  Canopy temperature?



- ~~Leaf water potential~~

- Stem water potential





Canopy temperature



Sensor position

- Sensor positioning
  - Vertical (ground temp.)
  - Horizontal (sky temp.)
  - Upper part of tree, angled downward into canopy center
- Time of day
- Length of measurement





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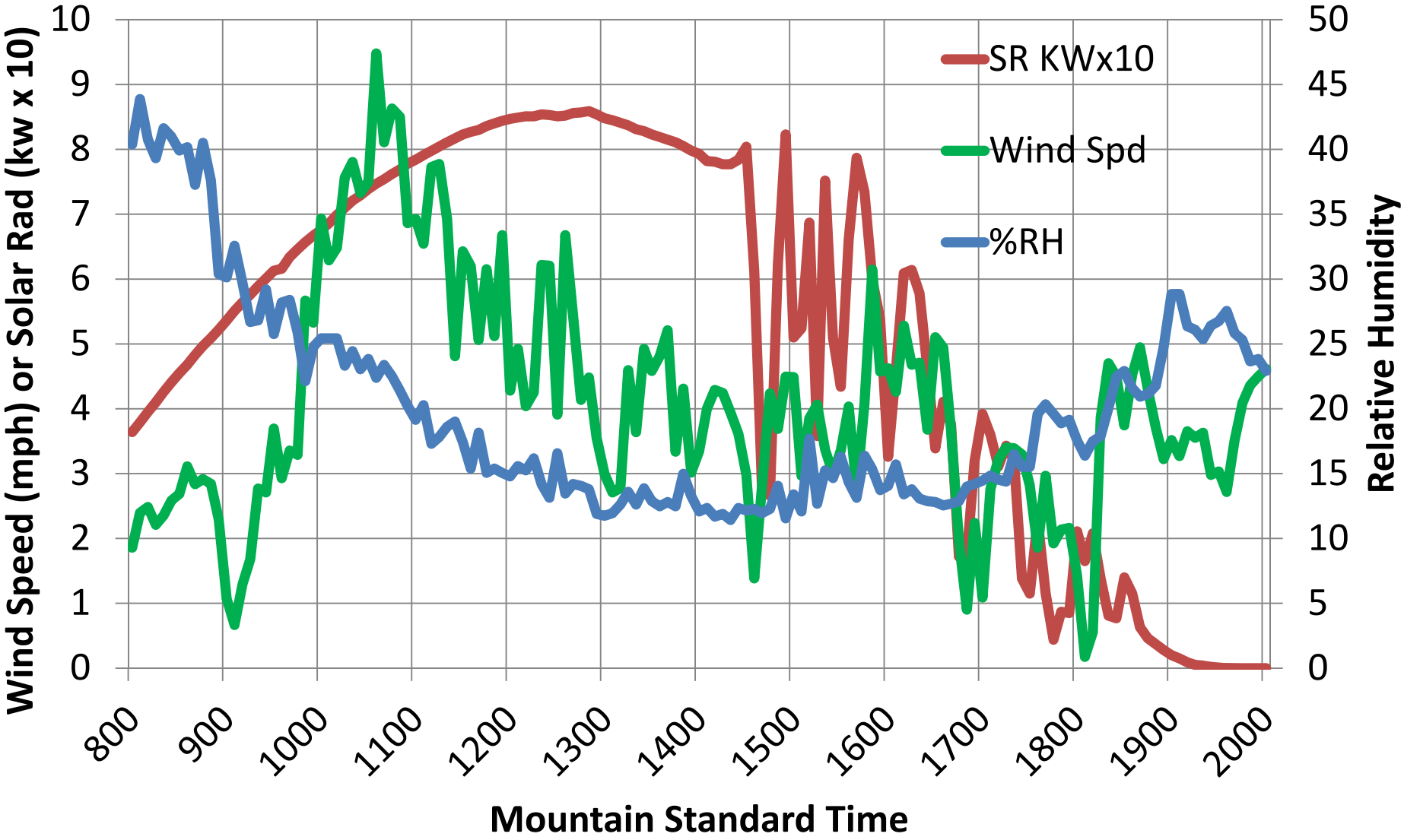
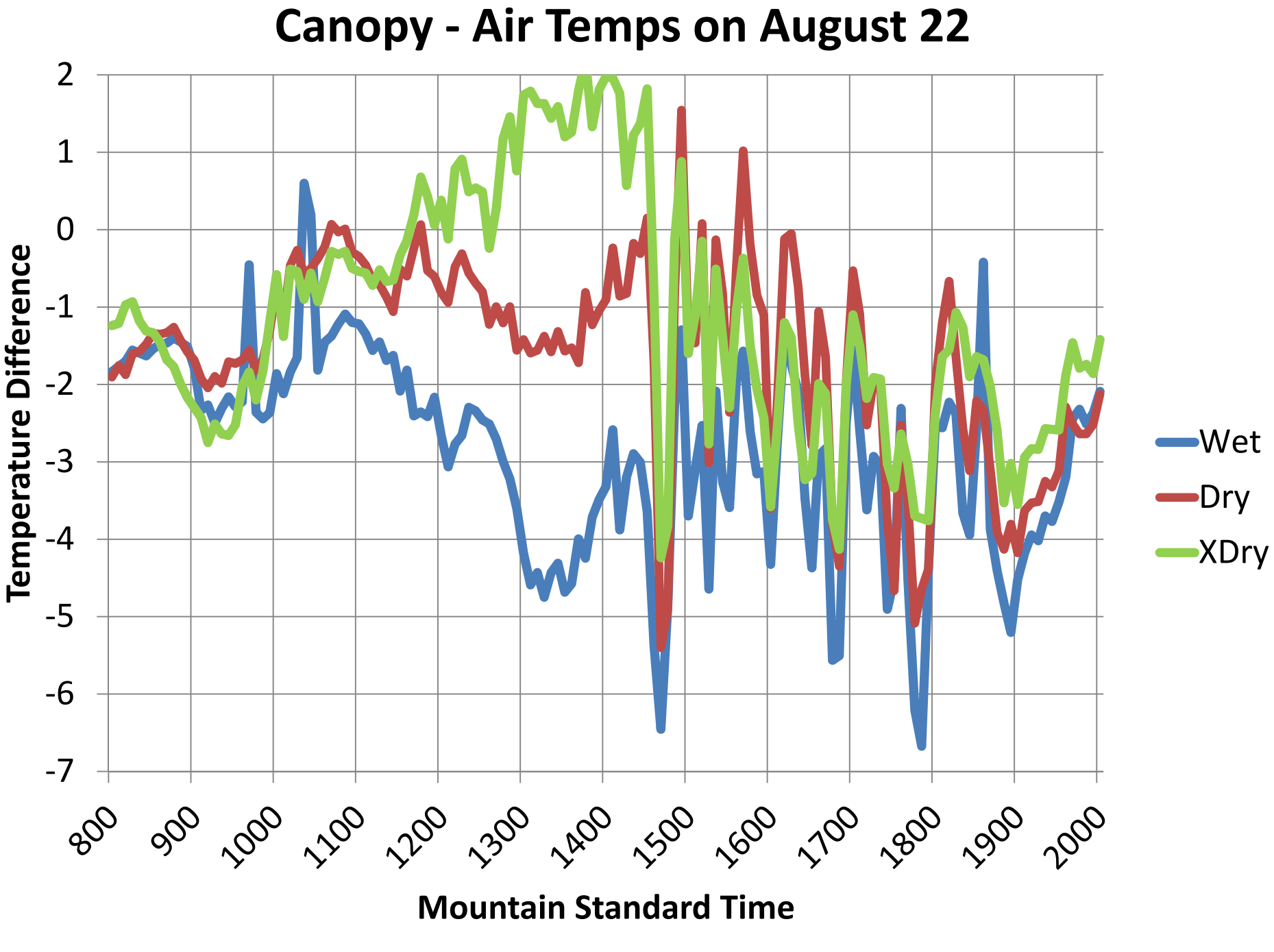
Weather Conditions on August 22




Canopy - Air Temps on August 22
Temperature Difference
2
1
0
-1
-2
-3
-4
-5
-6
-7
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Mountain Standard Time
Wet
Dry
XDry

Accuracy?

Canopy temperature

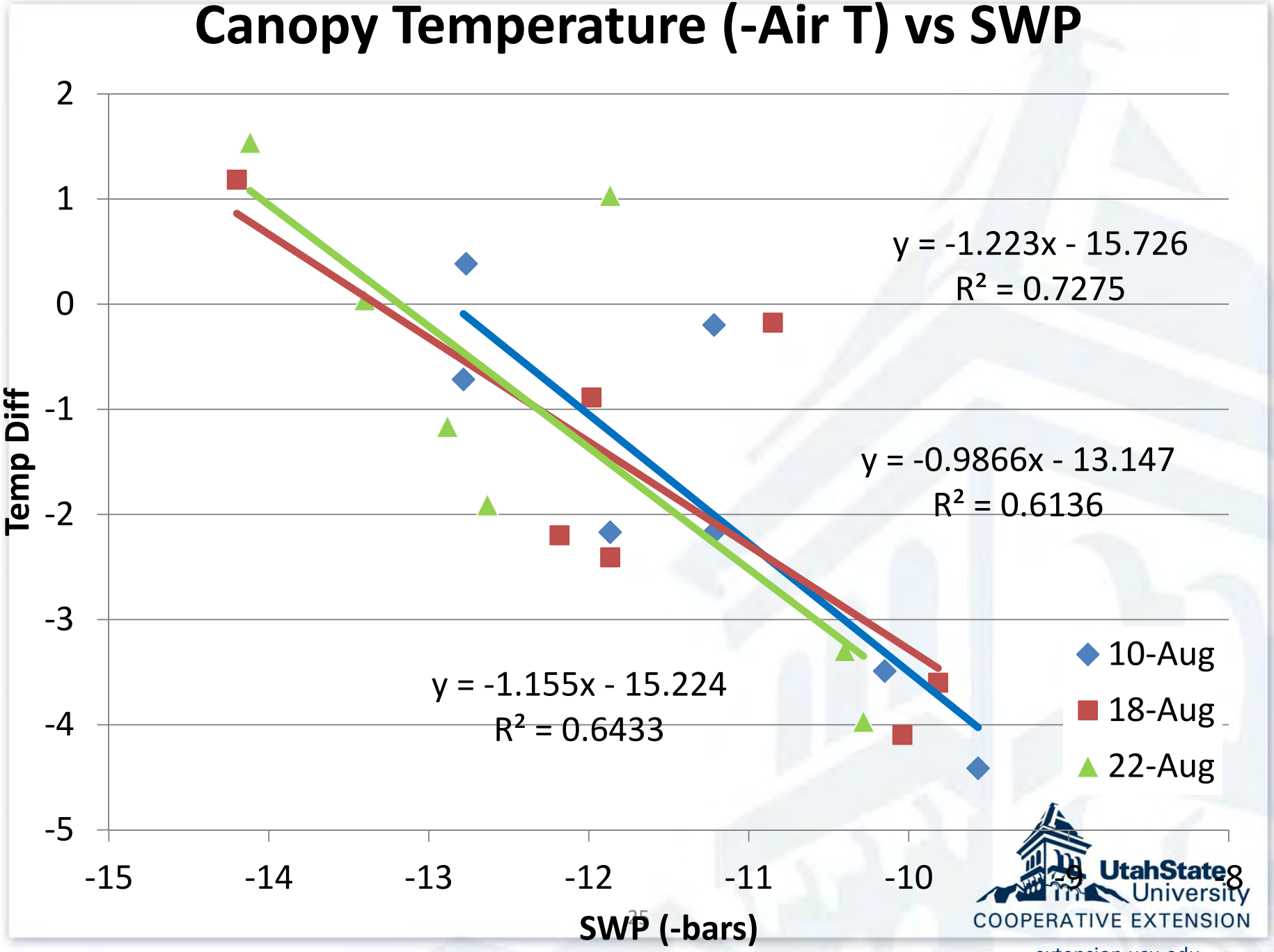
vs.

Stem water potential









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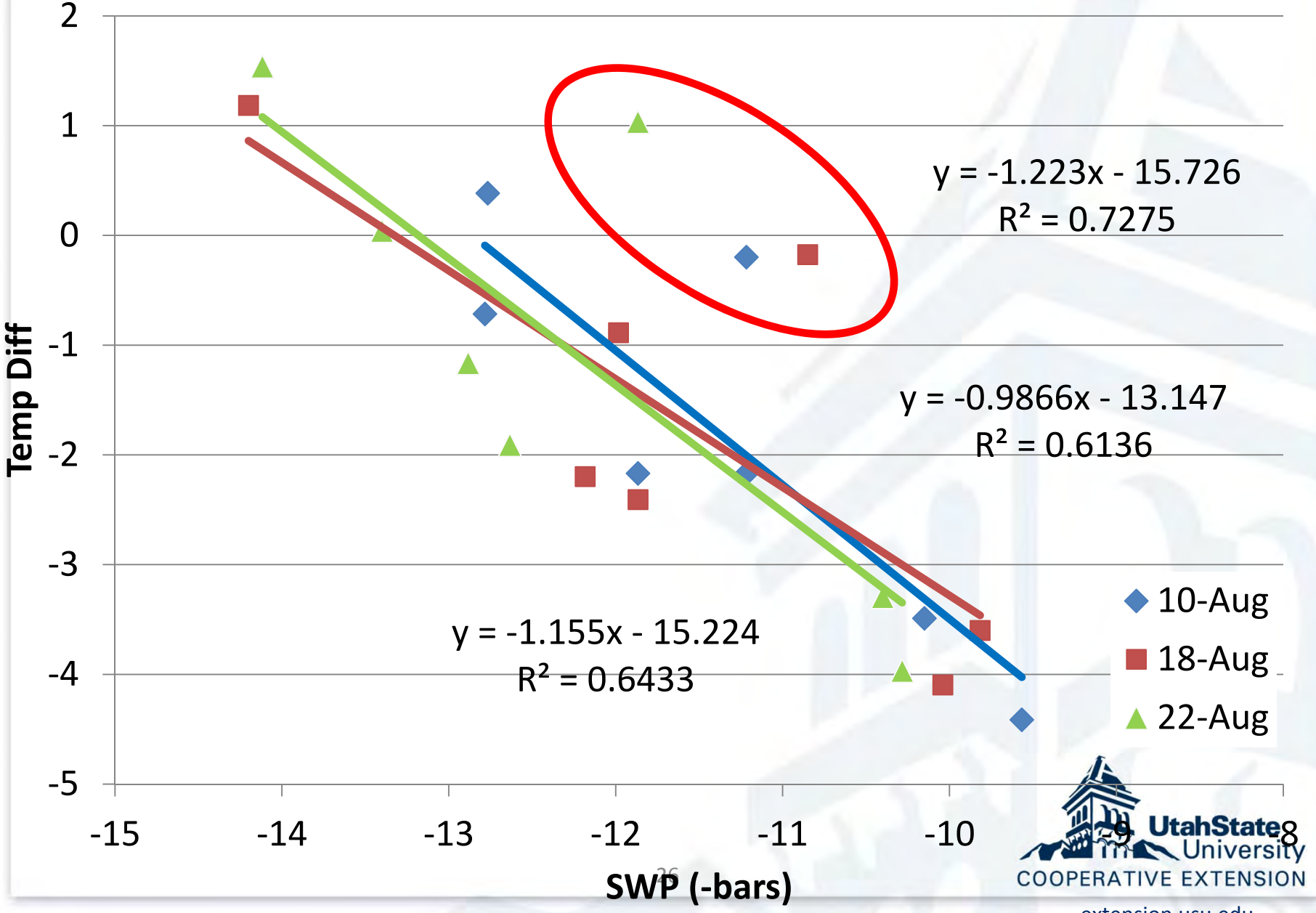
Canopy Temperature (-Air T) vs SWP



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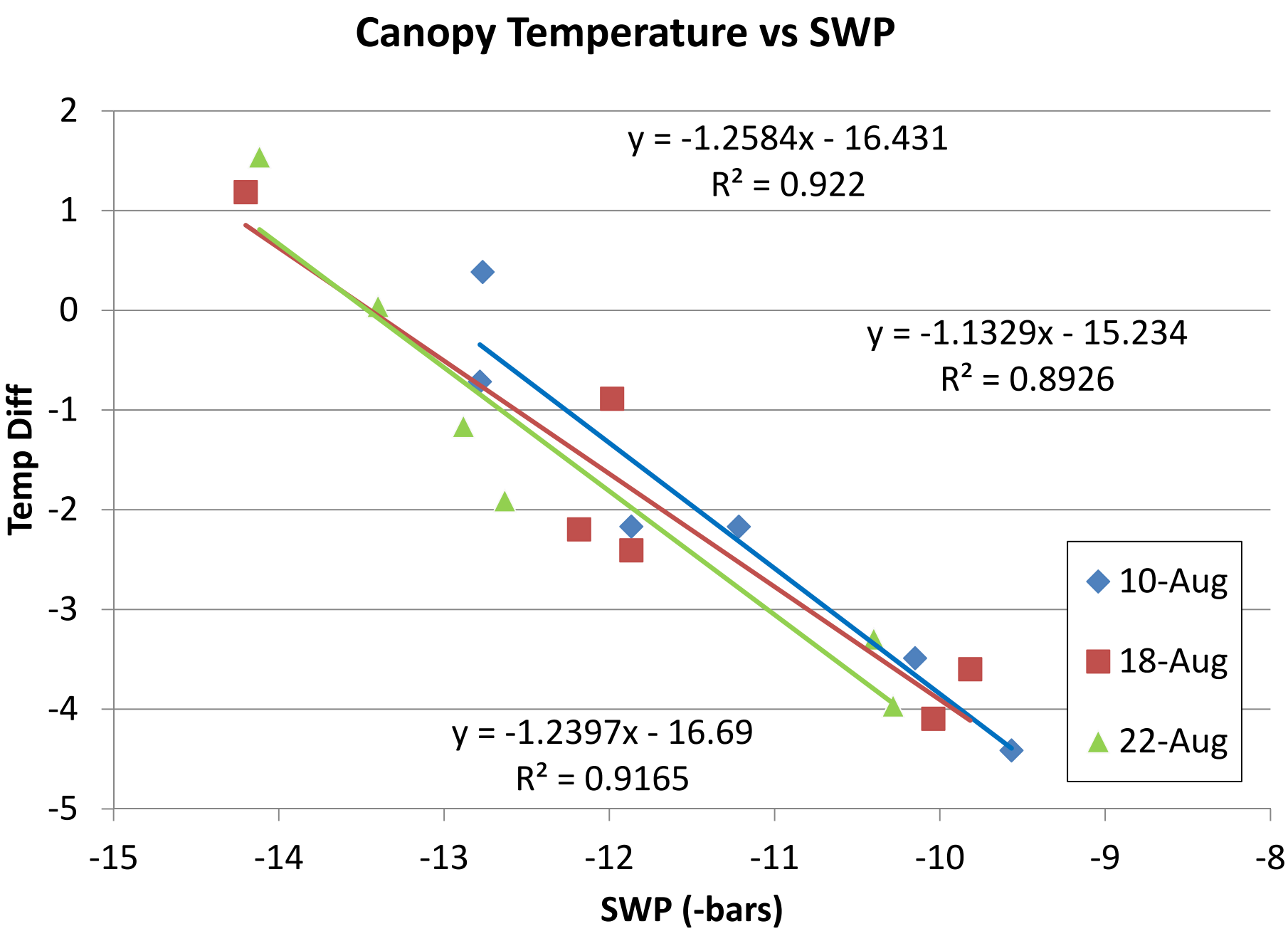
Canopy Temperature vs SWP
y = -1.2584x - 16.431
R² = 0.922
y = -1.1329x - 15.234
R² = 0.8926
y = -1.2397x - 16.69
R² = 0.9165
10-Aug
18-Aug
22-Aug
Temp Diff
SWP (-bars)
2
1
0
-1
-2
-3
-4
-5
-15
-14
-13
-12
-11
-10
-9
-8

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Future plans

- Repeat in 2012 to confirm results
- Next-generation sensors
  - Next IR sensor prototype (commercially available?)
  - SWP sensor prototype
- Sensors attached to weather stations
- Program stations to determine when to read

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