
Enhancing Nitrogen & Irrigation Efficiency of Pecan
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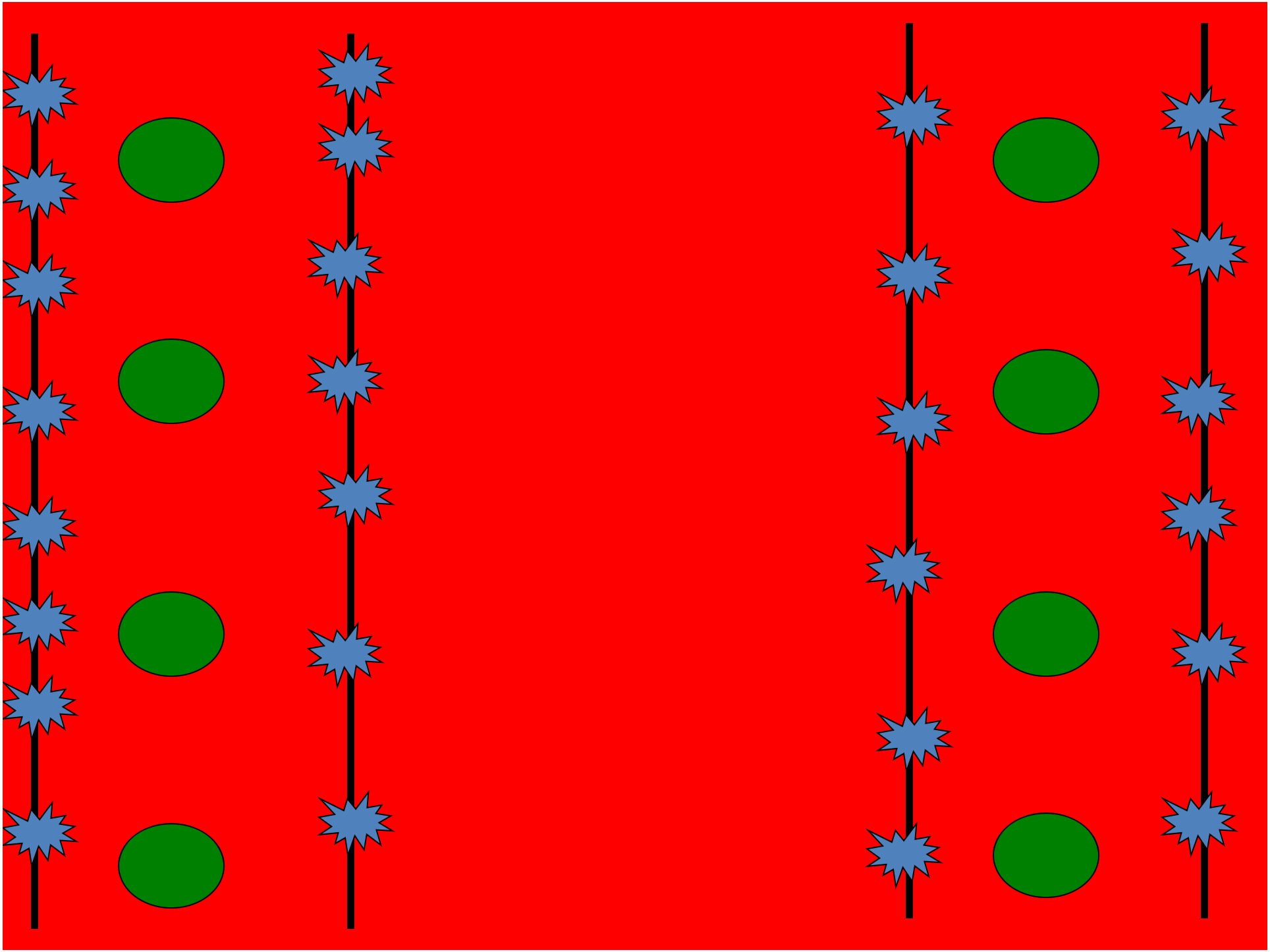
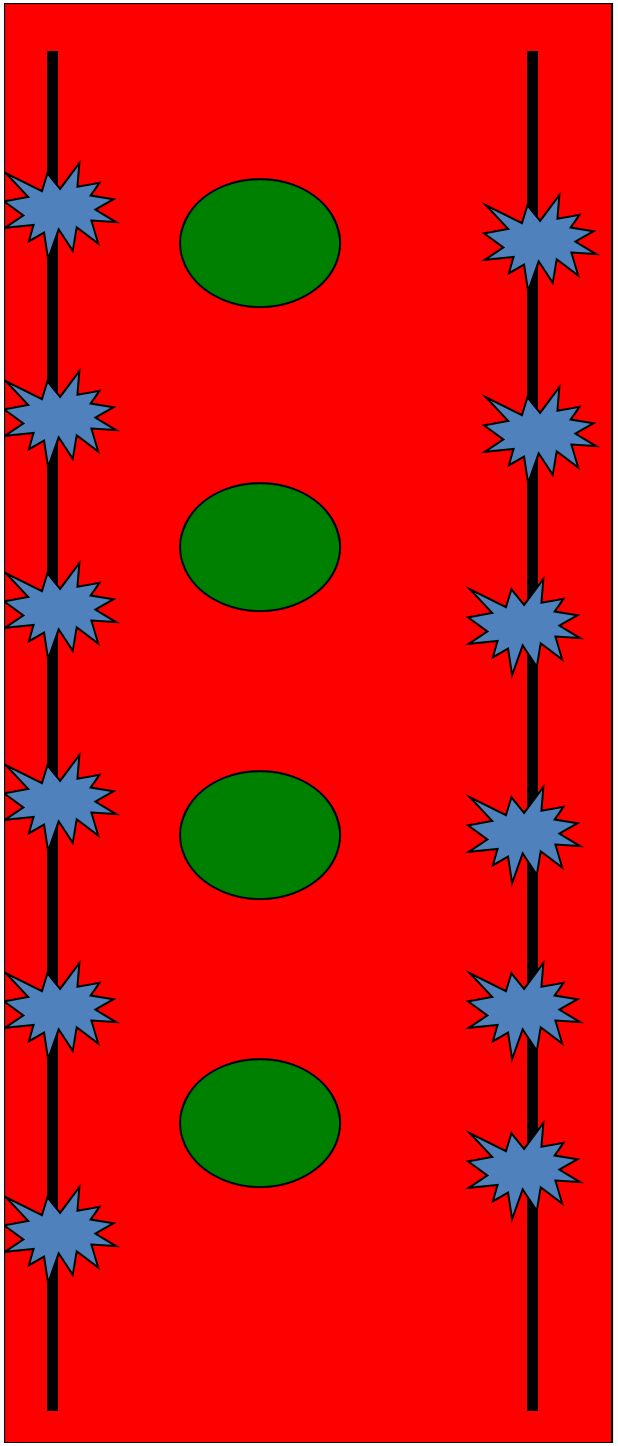
Nitrogen & Pecan

- Key to efficient fertilizer application:
  - Rate, timing, and placement
- Pecan response to N has always been widely variable
- Largely due to nutritional quality of the orchard in which study conducted
- In managed orchards, rarely a response to > 100 lbs N/acre

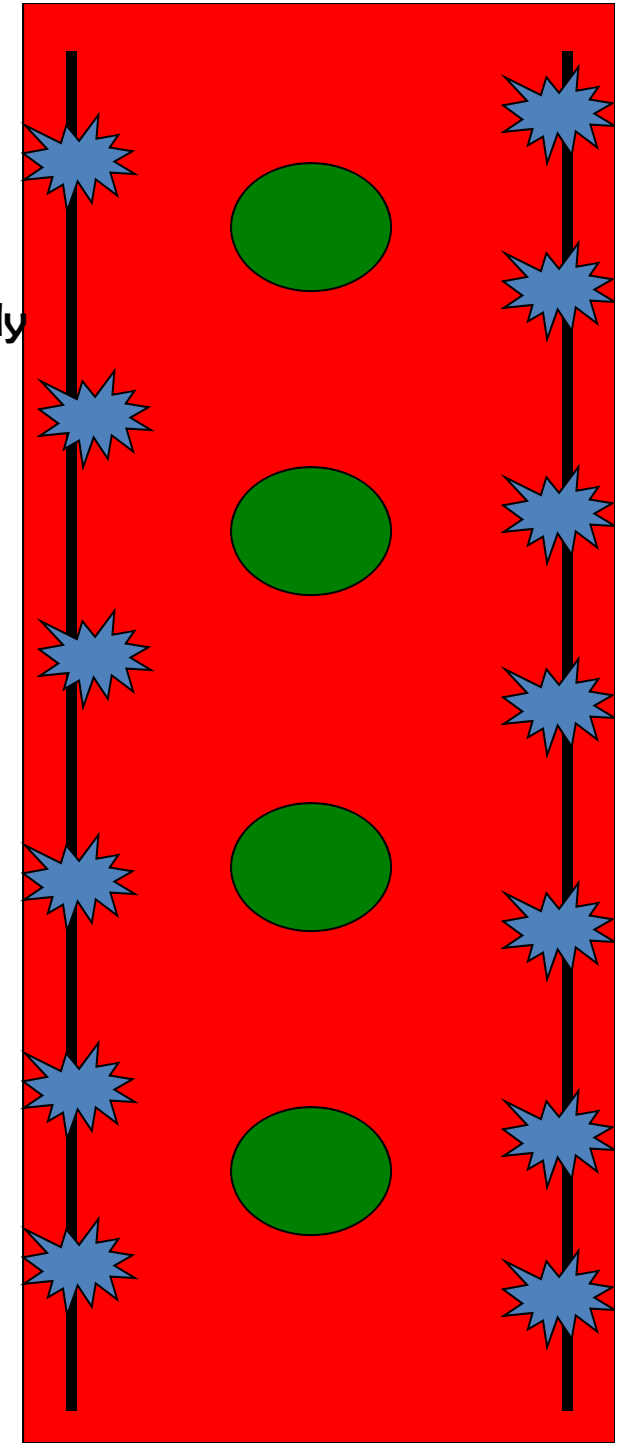
When should you apply N for pecan trees?

- Not in February!
- Application should be timed with tree demand
- 1st flush of growth in the spring uses N stored in tree
- Apply spring application within 2 weeks following budbreak





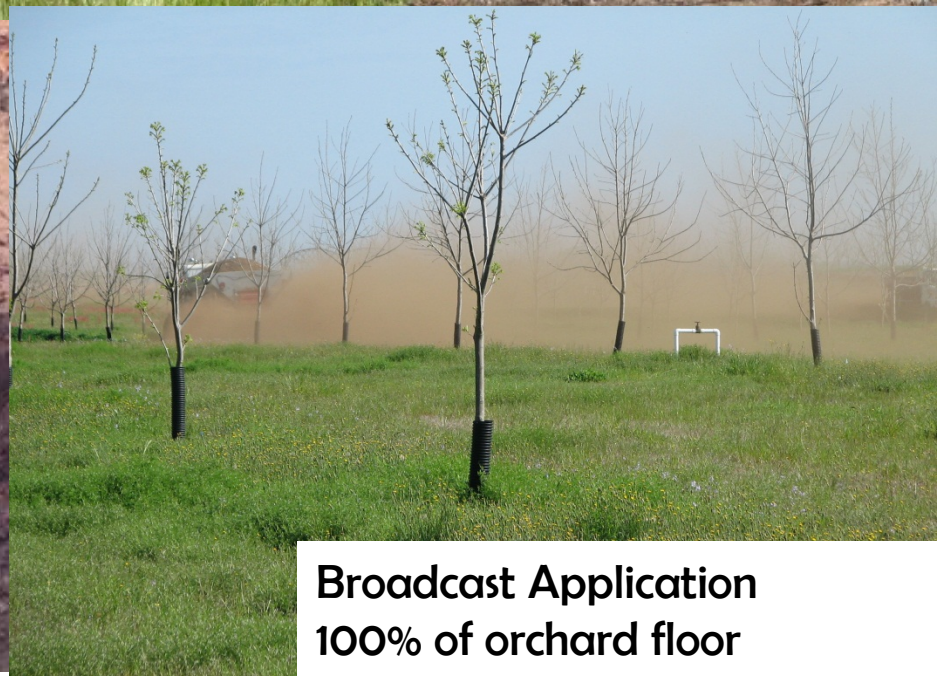
- 40 X 40
- 12 foot wide herbicide strip:
- 12/40 = 30%
- Can reduce area that you apply fertilizer to by 70% with band application



Broadcast Band Application
24% of orchard floor

Liquid 28-0-0-5 applied over herbicide strip
24% of orchard floor

Injection Through Drip System



Broadcast Application
100% of orchard floor

Field Rate Vs. Treated Area

2008-2011 2012

Treatment		Field rate (lbs/acre)	Treated area rate (lbs/acre)		Field rate (lbs/acre)	Treated area rate (lbs/acre)
Injection		18	70		31	125
Broadcast		70	70		125	125
Broadcast Band		18	70		31	125
Herb. Sprayer		18	70		31	125
Control		0	0		0	0

Fertilizer Application Method

Effect on Leaf N

Treatment	Leaf N 2008	Leaf N 2009	Leaf N 2010 (%)	Leaf N 2011	Leaf N 2012
Simulated Injection 28-0-0-5	2.98a	2.94a	2.73a	2.55a	2.69a
Broadcast Band Ammon. Nitrate	2.89ab	2.80a	2.52b	2.46ab	2.57a
Broadcast Ammon. Nitrate	2.85b	2.89a	2.60b	2.46ab	2.64a
Liquid N Herbicide Sprayer 28-0-0-5	2.80b	2.96a	2.42c	2.37b	2.52ab
Control	---	2.84a	2.42c	2.34c	2.37b

2008-2011 N rate for all treatments = 70 lbs/treated acre
2012 N rate = 125 lbs/acre

Funded by GACCP

Fertilizer Application Method

Effect on Yield

Treatment	Yield 2008 (lbs/tree)	Yield 2009 (lbs/tree)	Yield 2010 (lbs/tree)	Yield 2011 (lbs/tree)	Yield 2012 Average (lbs/tree)
Simulated Injection 28-0-0-5	129.6a	128a	134a	4.97b	193a
Broadcast Band Ammon. Nitrate	107.8a	144a	98b	10.9ab	166a
Broadcast Ammon. Nitrate	107.5a	176a	105ab	27.5a	148a
Liquid N Herbicide Sprayer 28-0-0-5	152.9a	115a	124ab	2.38b	151a
Untreated Control	---	152a	86b	0c	77b

2008-2011 N rate for all treatments = 70 lbs/treated acre

2012 N rate = 125 lbs/acre

Funded by GACCP

Agronomic N Use Efficiency (lbs nuts/acre/lbs N applied)*

Treatment	2008	2009	2010	2011	2012
Injection	118a	118a	123a	4.5c	99a
Broadcast	24b	39b	23b	6bc	18b
Broadcast Band	99a	133a	90a	10ab	85a
Herb. Sprayer	141a	106ab	114a	3c	78a
Control	---	---	---	---	---

Soil pH

Treatment	2010	2012
Injection	6.19b	7.08a
Broadcast	6.07b	6.92a
Broadcast Band	6.08b	6.98a
Herb. Sprayer	6.48a	7.03a
Control	6.10b	7.02a
Sample location Middles Strip	 6.51a 5.90b	 7.08a 6.93a
Sample Location X Treatment Interaction ($P \leq 0.05$)	P=0.13	P=0.84

Current N Recommendation for Pecans

- *Pecans can be fertilized with a significantly lower field rate of N than is currently used if applications are directed toward tree row with irrigation and weed control*

- 100-125 lbs N per acre (treated area) directed toward herbicide strip only
- Split with 60-75% applied in April; remainder in June or late August
- Increase by 25% on sandy soils

- Growing clover in the row middles allows you to eliminate the late season application after 3 years

Fertilizer N Injection of Mature Trees

- Inject liquid N if possible in 3-5 applications of about 8 gallons (25 lbs N) of 28% UAN per acre each time (based on 17 trees per acre).
- The first 3 should be applied every 10 days beginning about a week or 2 after budbreak.
- A fourth application could be made in June and a fifth in late August.

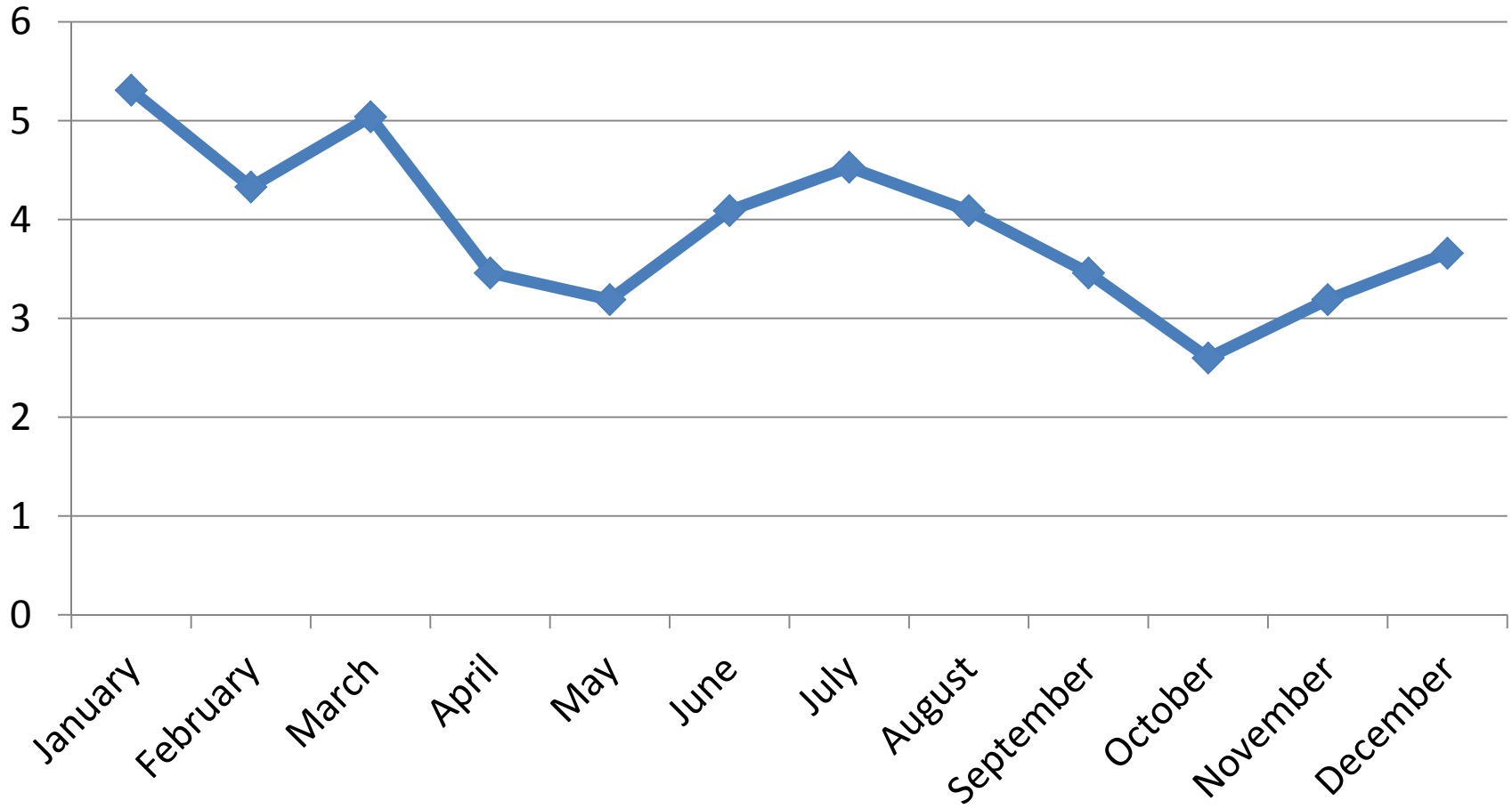
Pecans and Water

- Pecan trees require 350 gallons of water per day during PEAK DEMAND

New Mexico Vs. Georgia

- New Mexico
  - April-October
    - Et= 40”-57”
    - Average Rainfall April-October=7.37”
    - Additional water required to flush salt out of root zone
- Georgia
  - April-October
    - Et=35-40”
    - Average Rainfall April-October=25.4”

Average Rainfall Distribution
Tifton, GA



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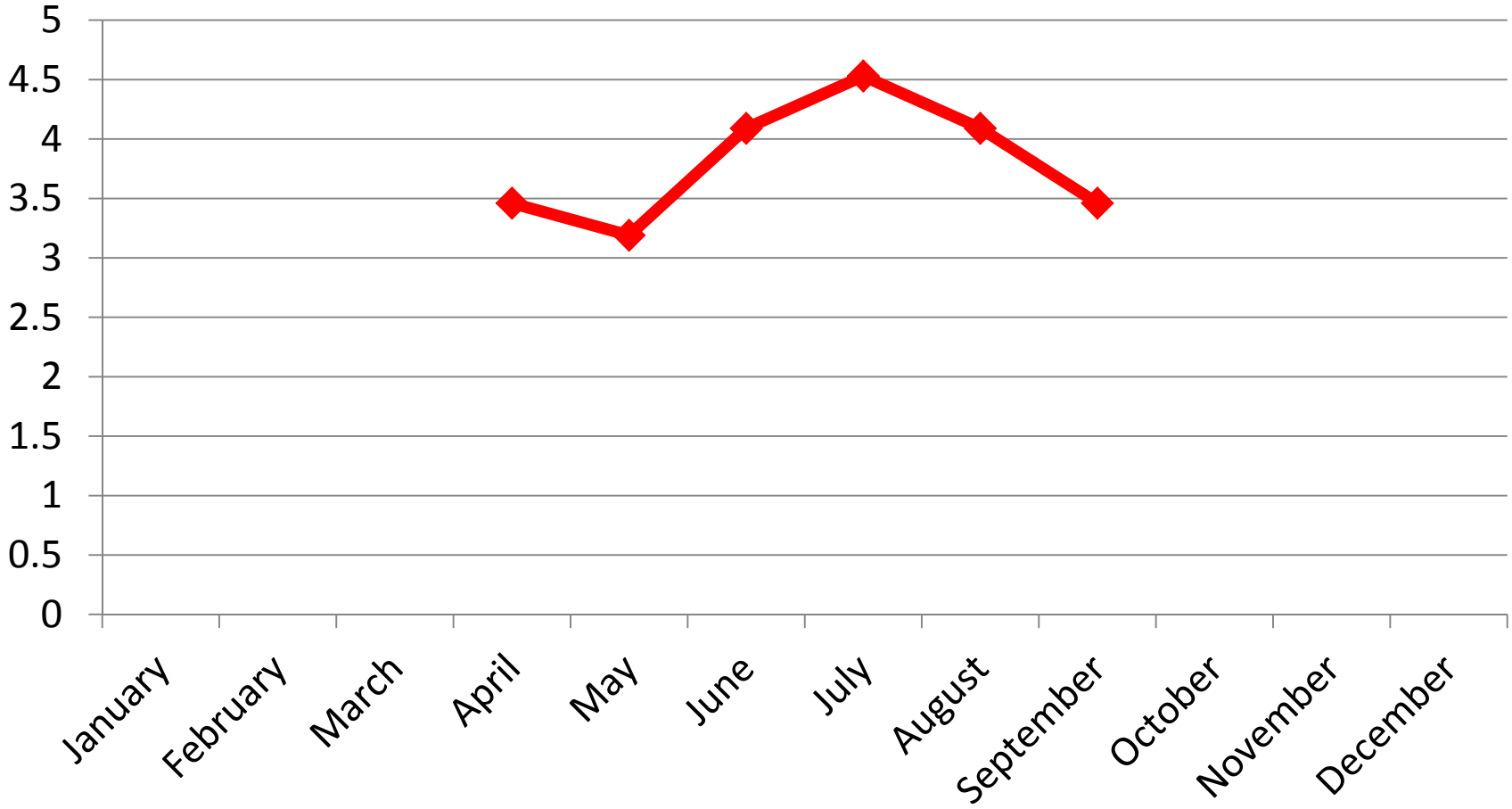
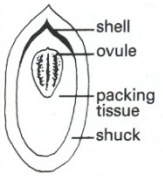
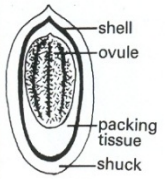
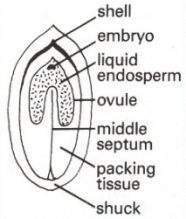
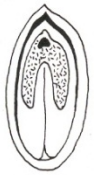
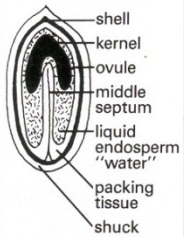
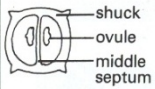
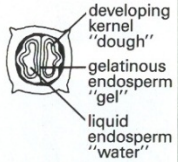


STAGE 1. **Post-Pollination**	STAGE 2. **Early Nut Sizing**	STAGE 3. **Rapid Nut Sizing**	STAGE 4. **Late Nut Sizing**	STAGE 5. **Early Kernel Filling**	STAGE 6. **Kernel Filling**	STAGE 7. **Late Kernel Filling**	STAGE 8. **Shuck Split**
							
							
							
1 week* after pollination Early May	6 weeks after pollination Early June	9 weeks after pollination Mid June	12 weeks after pollination Late July	13 weeks after pollination Early August	15 weeks after pollination Mid August	19 weeks after pollination Mid September	24 weeks after pollination Mid-Late October
Stigmas turn brown. Catkins drop. First nut drop occurs.	Nuts grow slowly. Fertilization occurs. Second nut drop.	Nuts grow rapidly, but no kernel development yet. Early water stage. Third nut drop.	Mid water stage. Shell hardening begins at tip.	Water stage. Shell hardening half complete.	Late water stage. Early gel and dough stages. Shell hardening complete.	Late "dough" stage. Kernel development near completion.	Kernel development complete. Nuts can be shaken from shucks.

*Dates vary with season, location, and cultivar. Diagrams modified from Wolstenholme, B. N., and J. B. Storey, 1970. Pecan Quarterly 4(4):15-19.

Current Drip Irrigation Schedule for Pecans

	Recommended Daily	*@ 30 gph/tree
April	7.5 hr	225 gal/day
May	8.5 hrs	255 gal/day
June	9.5 hrs	285 gal/day
July	11 hrs	330 gal/day
August	12 hrs	360 gal/day
September	12 hrs	360 gal/day

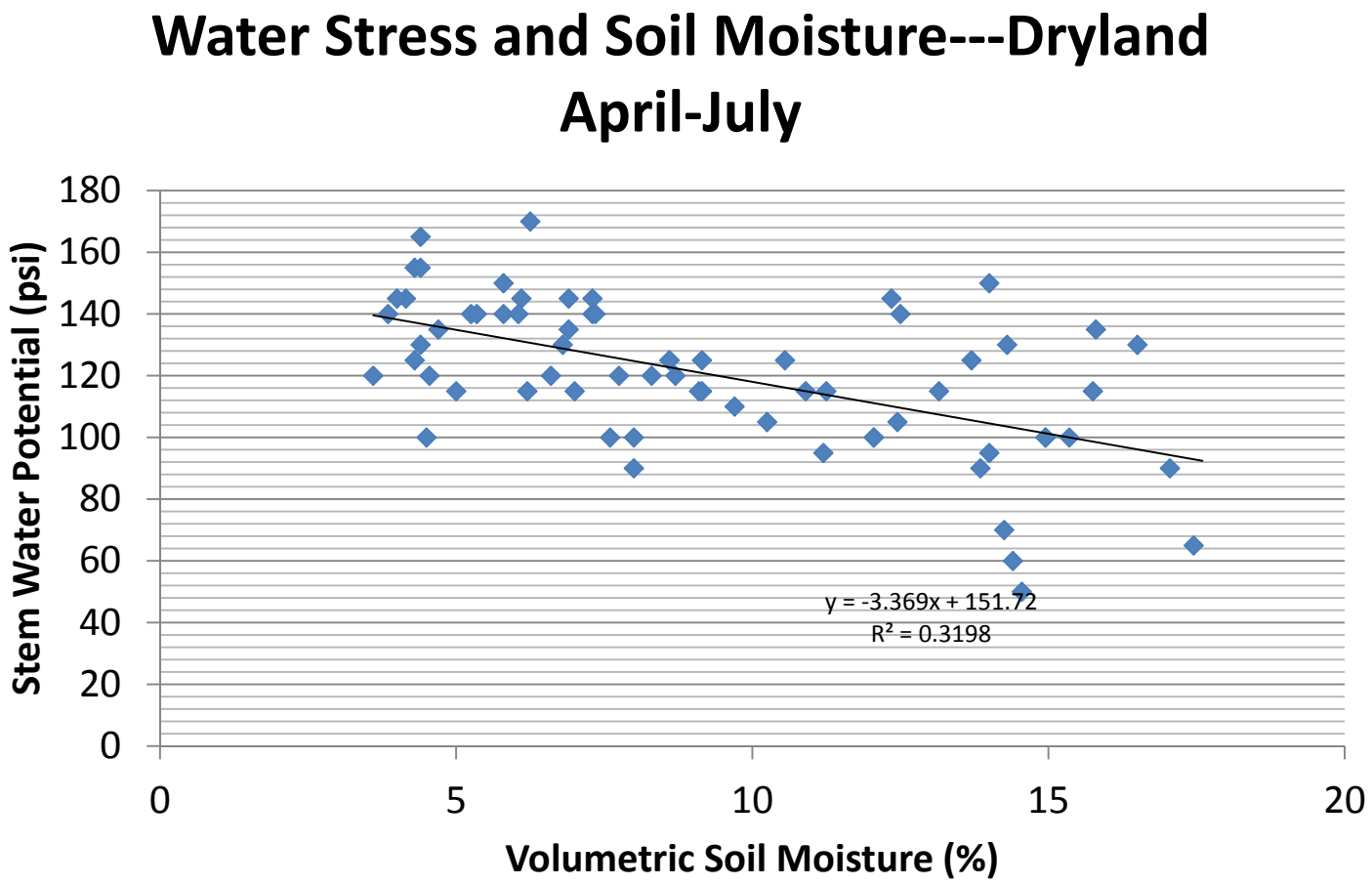
A Reduced Early-Season Irrigation Schedule for Pecans

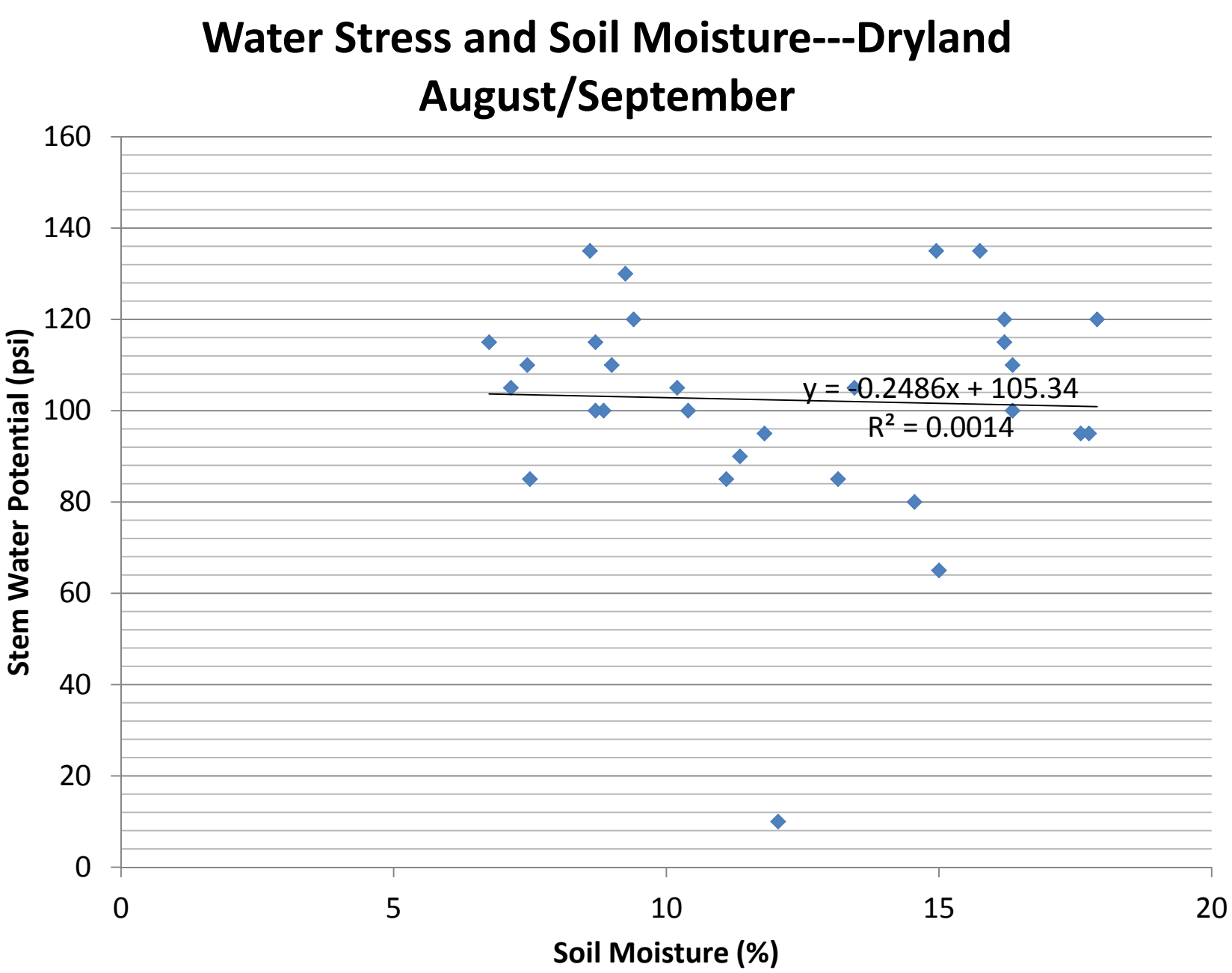
	Reduced	**Recommended**
	Every other day	Daily
April	4 hrs	7.5 hr
May	6 hrs	8.5 hrs
June	8 hrs	9.5 hrs
July	10 hrs	11 hrs
August	12 hrs*	12 hrs
September	12 hrs*	12 hrs

Two 15 gph microjets per tree (Total of 30 gph per tree)
25 Year old Stuart trees on Tifton Loamy Sand in Berrien CO., GA

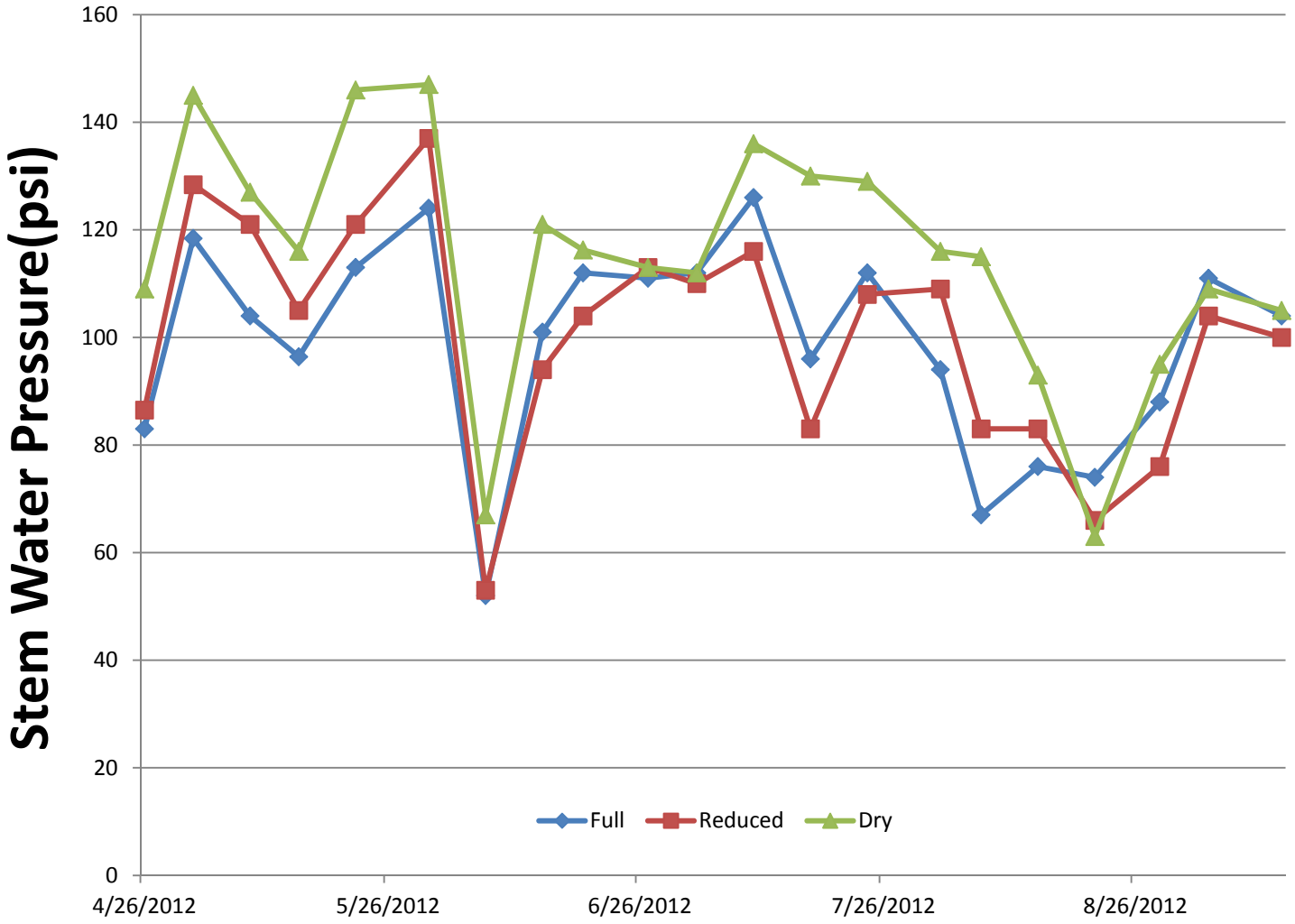
*All trees irrigated daily in August/September


Pump up pressure chamber
PMS Instruments
www.pmsintrument.com


Water Stress and Soil Moisture---Dryland
April-July
Stem Water Potential (psi)
180
160
140
120
100
80
60
40
20
0
0
5
10
15
20
Volumetric Soil Moisture (%)
y = -3.369x + 151.72
R² = 0.3198


Water Stress and Soil Moisture---Dryland
August/September
Stem Water Potential (psi)
160
140
120
100
80
60
40
20
0
0
5
10
15
20
Soil Moisture (%)
y = -0.2486x + 105.34
R² = 0.0014

Tree Water Stress



Effects on Yield, Nut Quality, and Shoot Length

Treatment	Average Water Stress (psi)	Yield (lbs/tree)	Nuts/lb	% Kernel	Shoot Length
Recommended	96.9b	81a	50.2a	46.5a	4.2a
Reduced	98.3b	62a	47b	46.5a	3.5b
Non-Irrigated	113a	49b	50.4a	44.8a	3.1b

Irrigation Water Use (gallons per tree)

	Reduced		**Recommended**	
April	1800	(60 gal/day)	6750	(225 gal/day)
May	2880	(93 gal/day)	7905	(255 gal/day)
June	3600	(120 gal/day)	8550	(285 gal/day)
July	4500	(145 gal/day)	10,230	(330 gal/day)
August	11,160	(360 gal/day)	11,160	(360 gal/day)
September	10,800	(360 gal/day)	10,800	(360 gal/day)
Total	34740		55,395	
Average Per Day	189		303	

The Reduced Irrigation Schedule provides a ***38% Reduction*** in irrigation water use with no significant effect on tree water stress, yield, or quality

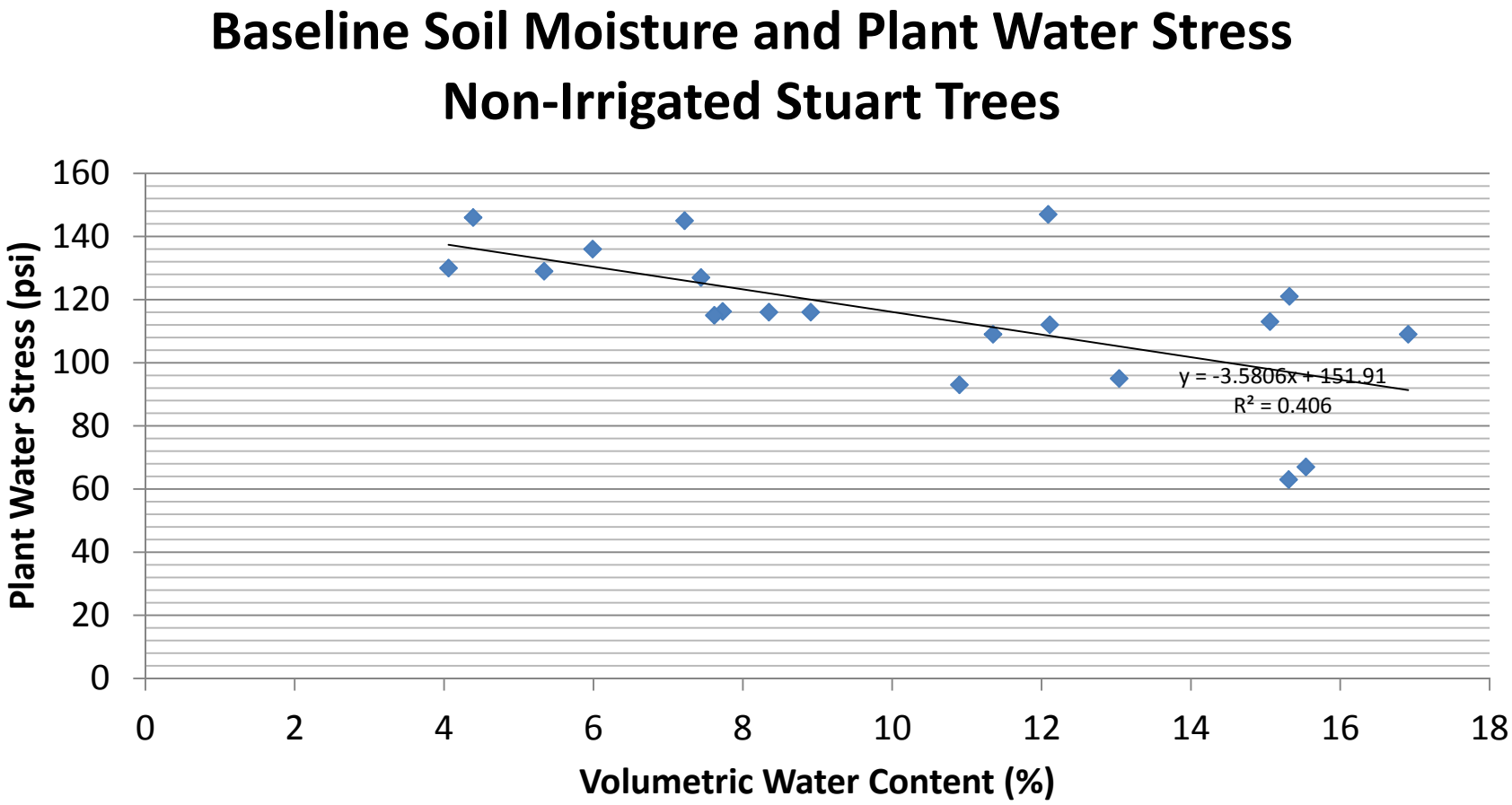
Irrigation Water Use (gallons per acre)*

	Reduced	Recommended	Rainfall
April	21,600 gal (0.8”)	81,000 gal (2.98”)	1.47”
May	34,560 gal (1.27”)	94,860 gal (3.49”)	3.32”
June	43,200 gal (1.59”)	102,600 gal (3.78”)	4”
July	54,000 gal (1.99”)	122,760 gal (4.52”)	4.94”
August	133,920 gal (4.93”)	133,920 gal (4.93”)	6.93”
September	129,600 gal (4.77”)	129,600 gal (4.77”)	2.89”
Total	416,880 gal (15.3”)	664,740 gal (24.5”)	23.55”

*12 Trees per acre

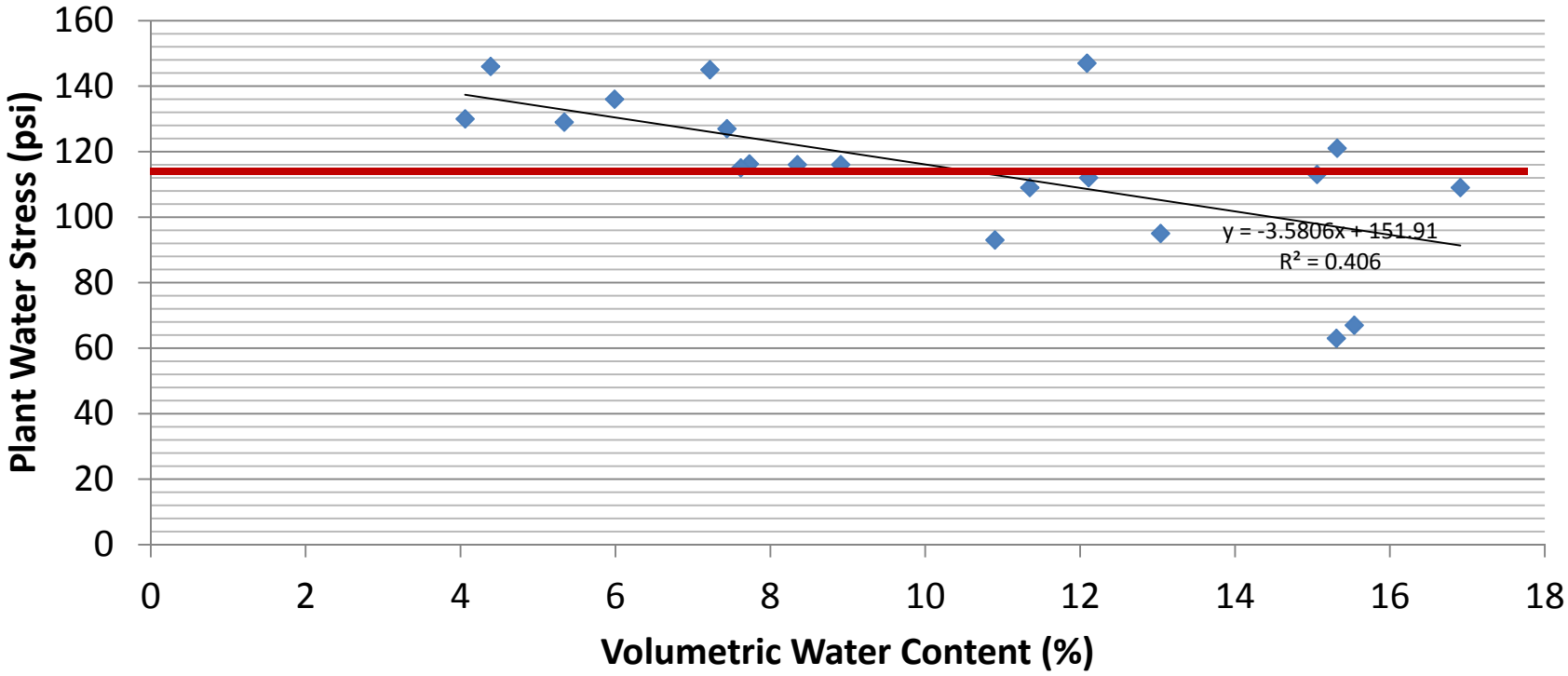
2012 Rainfall

	Tifton	**Ft. Valley**	**Albany**	**Baxley**
April	0.21”	0.67”	1.42”	2.07”
May	3.48”	1.18”	2.28”	6.43”
June	5.23”	5.13”	3.82”	5.15”
July	6.66”	1.52”	4.24”	3.35”
Aug.	13.4”	5.13”	6.2”	7.19”
Sept.	3.84”	2.72”	3.02”	2.34”
Totals	**32.82”**	**16.35”**	**20.98”**	**26.53”**



Averaged by date

Baseline Soil Moisture and Plant Water Stress
Non-Irrigated Stuart Trees



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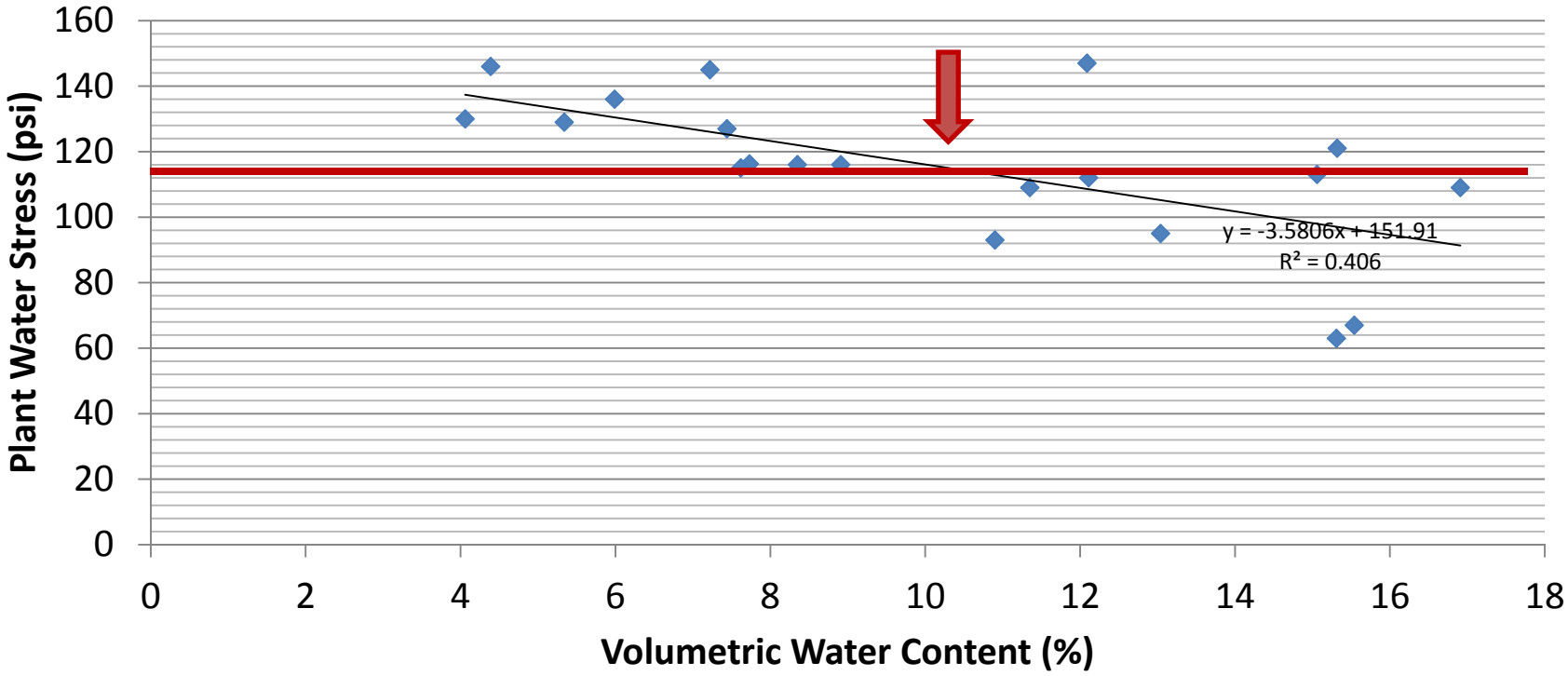
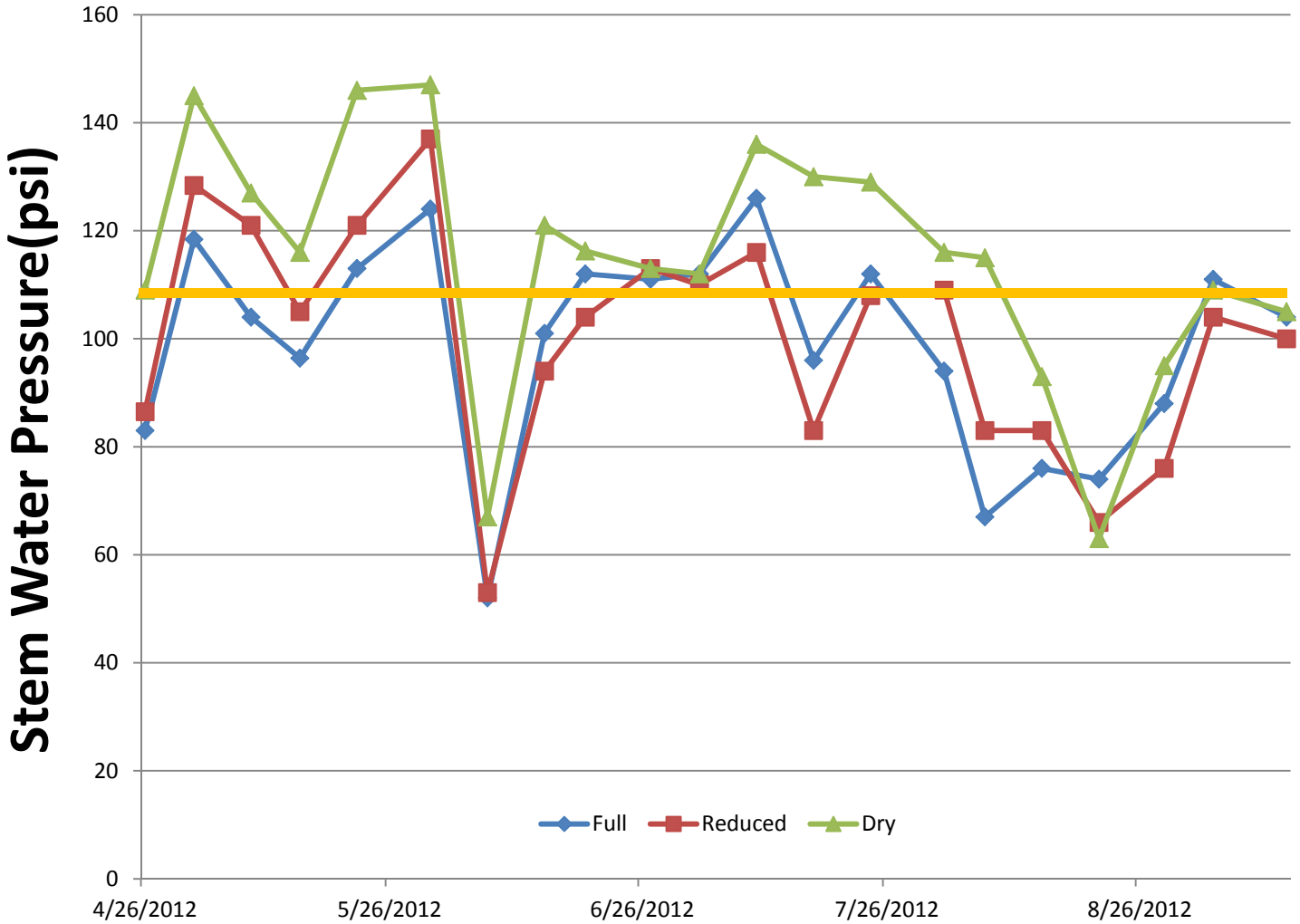


Tree Water Stress



Summary

- Water Stress on pecan occurred at about 113 psi (8 cb) using the pressure chamber to measure stem water potential
- Regression analysis suggests that irrigation scheduling for mature pecan trees may be needed when volumetric water content reaches 10-11% on Tifton loamy sand
- The Reduced Irrigation Schedule provides a 38% Reduction in irrigation water use with no significant effect on tree water stress, yield, or quality
- Pecan trees can handle some early season water stress with no effect on yield

The UGA® Pecan Team

Nuts meeting science head-on.