Pecan Irrigation

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What do all plants (including pecan trees) need most?

Photosynthesis

In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose (or sugar).

water + carbon dioxide + sunlight $\longrightarrow$ glucose + oxygen

$6\,H_2O$ + $6\,CO_2$ + radiant energy $\longrightarrow$ $C_6H_{12}O_6$ + $6\,O_2$
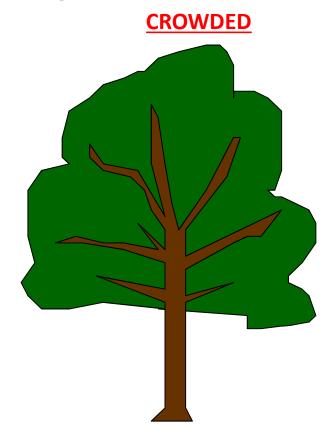
RADIANT ENERGY

OXYGEN

WATER
GLUCOSE

CARBON DIOXIDE

CARBON DIOXIDE

OXYGEN

WATER

Sunlight+Water = carbs =Tree growth and Nut Production

Effect of Sunlight and Air Movement on Yield---2012

OPEN

CROWDED

32% increase
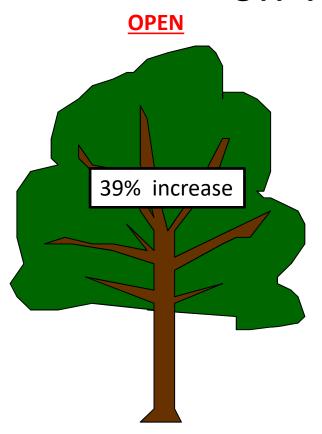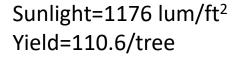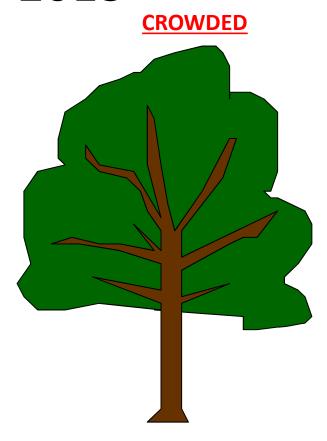
Sunlight=1843 lum/ft^2
Yield=137.4 lbs/Tree

Sunlight=1005 lum/ft^2
Yield=93.6 lbs/Tree

Effect of Sunlight and Air Movement on Yield---2013

OPEN

CROWDED

39% increase

Sunlight=1176 lum/ft^2
Yield=110.6/tree

Sunlight=996 lum/ft^2
Yield=68 lbs/tree

WHEN GROWING PECANS:
IF YOU HAVE TO CHOOSE BETWEEN WATER AND
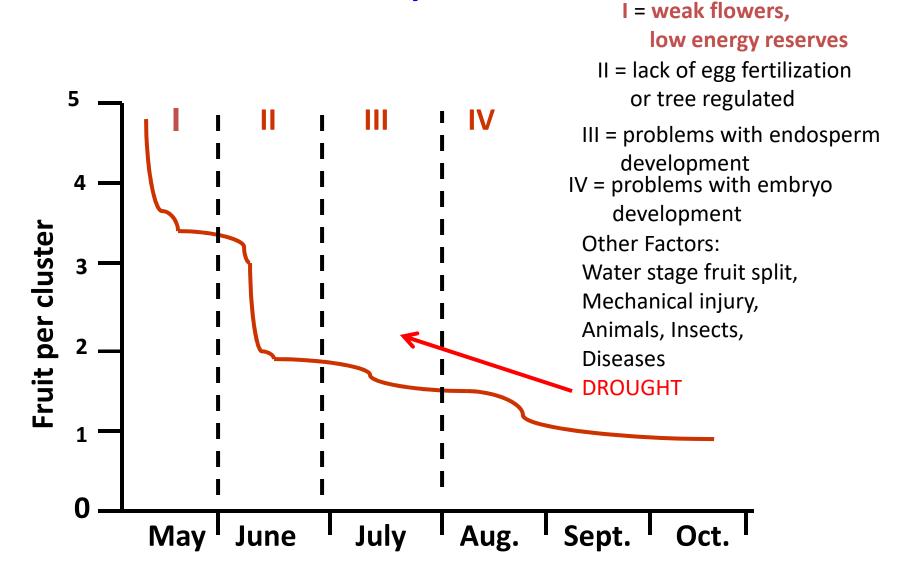FERTILIZER………

CHOOSE WATER!

And Remember: Its not <u>how much </u>you water, but <u>when</u>

What happens to pecans when drought occurs:

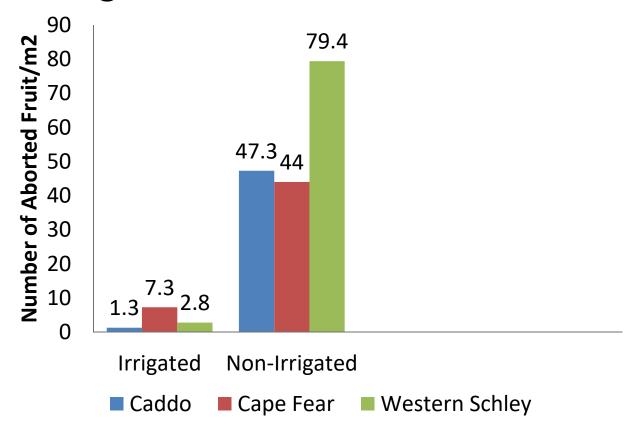| STAGE 1. Post-Pollination	STAGE 2. Early Nut Sizing	STAGE 3. Rapid Nut Sizing	STAGE 4. Late Nut Sizing	STAGE 5. Early Kernel Filling	STAGE 6. Kernel Filling	STAGE 7. Late Kernel Filling	STAGE 8. Shuck Split
1 week* after pollination	6 weeks after pollination	9 weeks after pollination	12 weeks after pollination	13 weeks after pollination	15 weeks after pollination	19 weeks after pollination	24 weeks after pollination
Early May	Early June	Mid June	Late July	Early August	Mid August	Mid September	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.
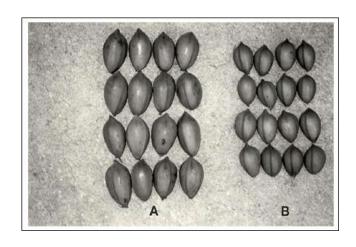
Fruit-drop Pattern

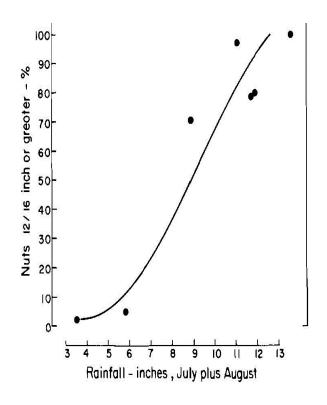I = weak flowers, low energy reserves

II = lack of egg fertilization or tree regulated

III = problems with endosperm development

IV = problems with embryo development

Other Factors:
Water stage fruit split,
Mechanical injury,
Animals, Insects,
Diseases
DROUGHT

Nut Sizing

July Drought Results in Greater Fruit Abortion

Sparks, 1989
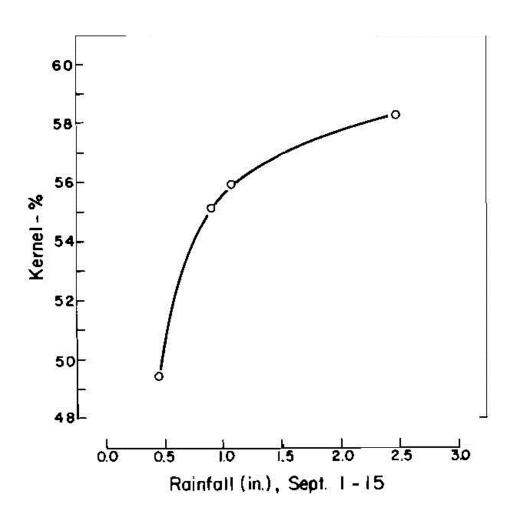
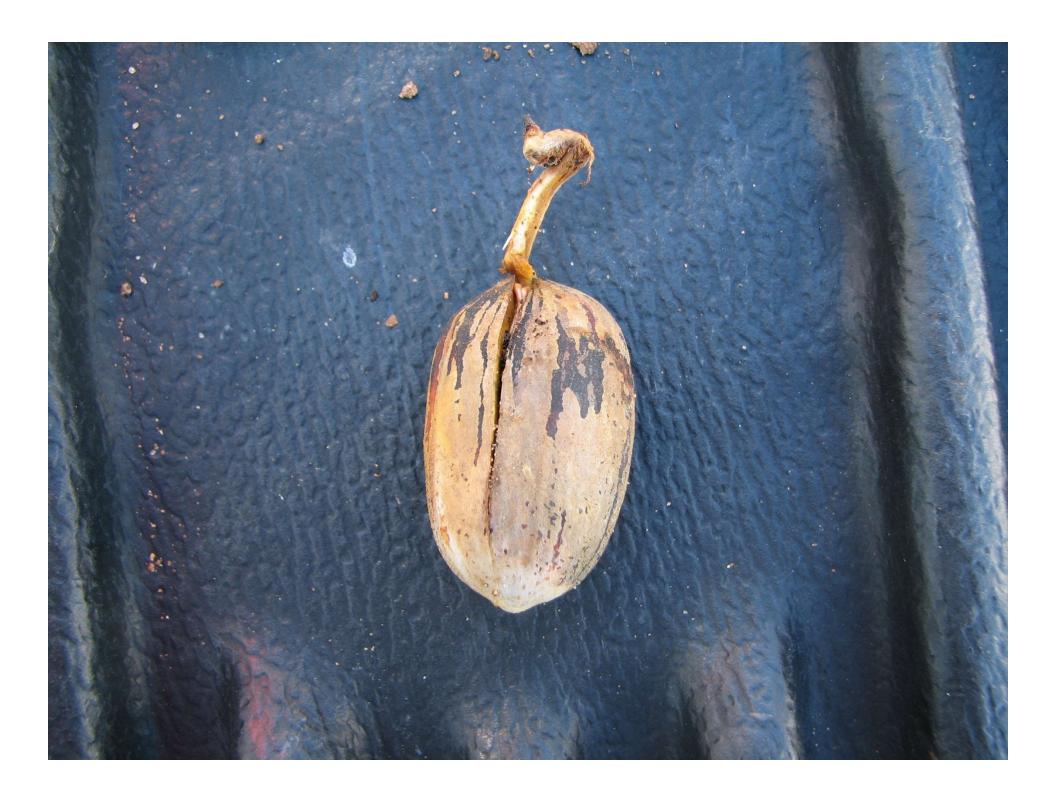September drought---leaf abcission/poor kernel filling

Effect of Drought During Nut Sizing

A=Irrigated
B=Non-irrigated

Effect of Drought During Kernel Fill

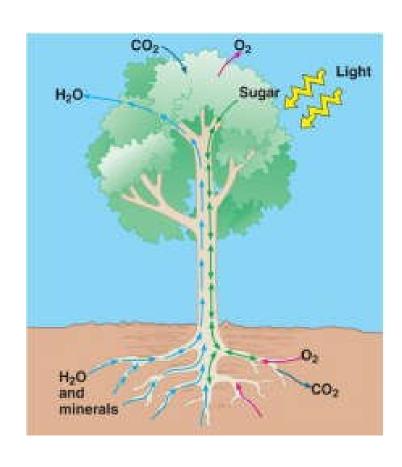Sparks, 1992

Stein, et al., 1989

Pecan Water Stress is a function of water + soil depth

How Do Pecan Trees Use Water?

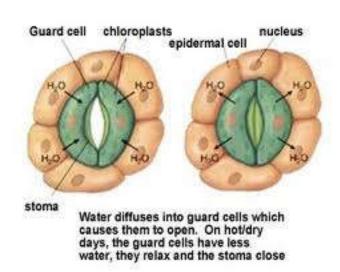Water diffuses into guard cells which causes them to open. On hot/dry days, the guard cells have less water, they relax and the stoma close

Pecan Water Use

- Pecans extract most of their water from the upper 32 inches of the soil profile
- Need 60" of water per year
  - In the SE, rainfall can account for 50-67% of needs
- Pecan trees can use as much as 350 gal/day
- Greatest demand is during August/September
- Pecan Irrigation systems are designed to be supplemental to rainfall
- At 12 trees per acre, Drip/Microjet system capacity should be 3600-4200 gallons/acre/day

Costs of Drip Irrigation

- System Parts and Installation: $800 per acre
- Well & Pump: 4" + 5 hp = $7800

    6"+30 hp = $34,000

- Operation Cost: $40-$60 per acre

Value of Fertilizer

Fertilizer Rate (lbs/acre)	Yield/Acre (lbs)	% Increase	Value of Increase (@$1.34/lb)
0	1696	0	0
400 lbs biennially	1837	8.3	188.94
400 lbs annually	2211	30	690.10
800 lbs annualy	1577	-7.0	-159.46

'Stuart'

Worley, 1974

Value of Irrigation

Water Application (Gal/Day/Acre)	Yield/Acre (lbs)	% Increase	Value of Increase (@ $1.34/lb)
0	1034	0	0
1200	1374	32	455.60
3600	1761	70	974.18

'Stuart'

Daniel, J.W. 1982
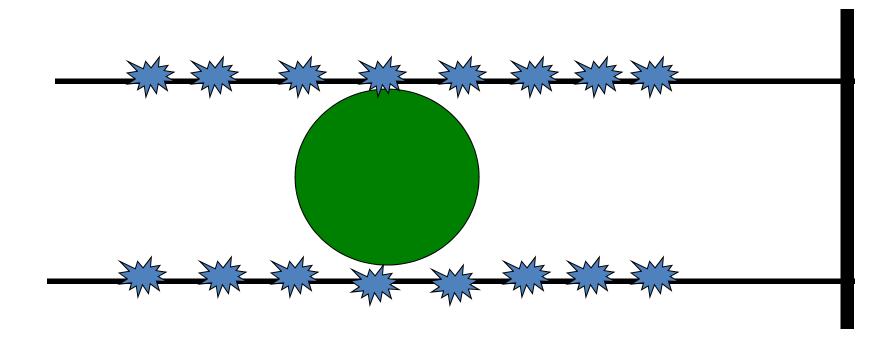
Pecan Irrigation Systems

- Solid Set
  - Expensive
  - Poor water use efficiency
  - Water large area quickly

- Sprinklers often in every other middle
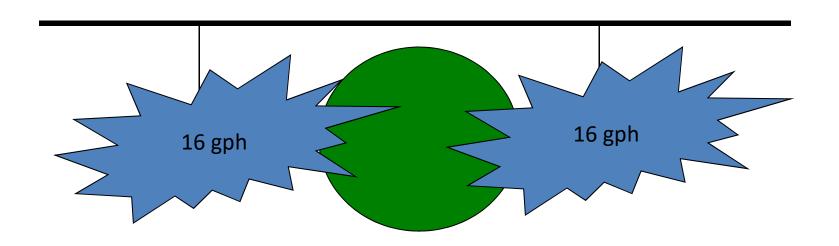- Pump capacity should be at least 75 gpm/A

Drip Irrigation

- Lateral lines normally 6-8 ft from tree
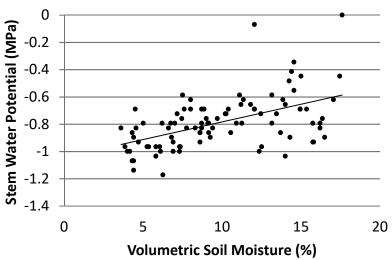- Most emitters used are 2 gph
- 8-16 emitters per tree

Pecan Irrigation Systems

- Microjet
  - Same benefits as drip
  - Larger wetted area
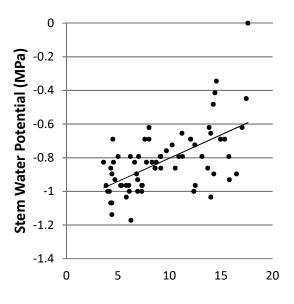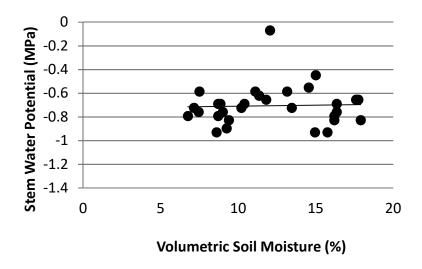 - Best system for establishment of young trees

16 gph

16 gph

Results

Relationship between stem water potential (ψ) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand (y=0.0259x-1.0421, R^2=0.28).

Relationship between stem water potential (ψ) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand from April-July 2012 (y=0.0277x-1.079, R^2=0.35).

- Water Stress on pecan occurred at about -0.78 MPa 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

- Pecan trees may undergo water stress due to crop demand during the kernel filling stage regardless of soil moisture

Relationship between stem water potential (ψ) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand from August-September 2012 (y=0.0017x+0.7263, R^2=0.0014).

Pecan Irrigation Schedule Recommendations for Bearing Orchards

Month	% Full Capacity	Gallons/acre/day
April	17%	612-680
May	26%	936-1040
June	33%	1188-1320
July	40%	1440-1600
August	100%	3600-4000
September	100%	3600-4000

*If you receive 1" or more of rain from bud-break to the onset of kernel-filling, turn the system off for 3 days.

*Throughout the kernel filling period, apply irrigation daily regardless of rain events up to 2". With a 2" rain during kernel filling, turn the irrigation off for 3 days.

Sandy Soils=Use higher end of rate
Clay Soils=Use lower end of rate

Summary

- IRRIGATION IS A <u>NECESSITY</u> FOR CONSISTENT PECAN PRODUCTION

- Water is key to many important processes involved in the development of a pecan crop

- Well capacity for pecans should be approx. 4000 gal/acre/day

- <u>Irrigation provides the most immediate results and the fastest return on investment of virtually any management practice you can use</u>