

Water Use Efficiency & Irrigation Timing for Southern High Plains Sunflower



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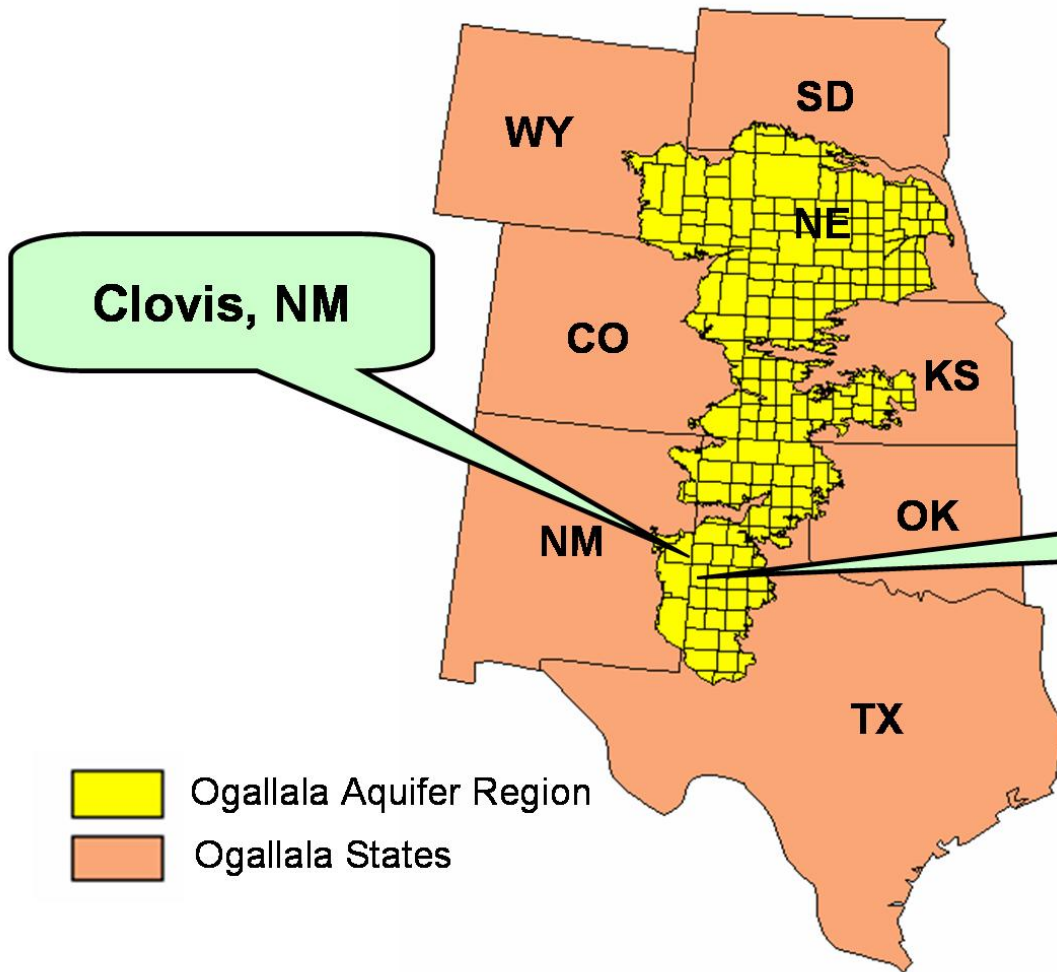
Crop Stress Physiology

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Ogallala Aquifer



Experimental Locations

Median rainfall, May-Aug.
or June-Sept., ~9"

Clovis, NM

Lubbock, TX





“Water is Our Future”

- In the Southern High Plains the Ogallala aquifer is declining at the rate of 7" per year (1980-2005)
- Irrigation/Underground Water Conservation Districts
 - Regulate well drilling (number of permits and/or how close wells can be)
 - **Increasingly**, limit on how much water you can pump (18 or 24 acre-inches per year are most common)
- “Desired Future Condition”—Goal is to have ½ of water in 2060 that is present now

Irrigation Crop Water Use Efficiency

Crop Value per 1 acre-inch, January 2009

<u>Crop</u>	Unit/A for <u>1" irrig.</u>	"Average" <u>unit</u>	Net <u>Price</u>	Return <u>1" irrig.</u>
Cotton <i>transgenic</i>	50-90 lbs/A	65	\$0.48	\$31.20
Sorghum	350-425 lbs./A	400	\$5.92/cwt	\$23.72
Wheat	3-4 bu/A	3.5	\$5.50/bu	\$19.25
Corn	7-10 bu/A	8.0	\$4.07/bu	\$32.56
Sunflower (oilseed)	100-200 lbs./A	150	\$15.60/cwt	\$23.40



Irrigation Costs

- Current pumping costs \$9-12 per acre-inch
- But most farmers don't know for sure how much it costs them on their own pivots
- Subsurface drip irrigation and pivot drag socks—both very efficient methods of water application—have not reduced water use
- Bottom Line—**We are selling water**, not corn or sunflower or cotton

And by the way....

- If we are pumping Ogallala irrigation water to make fuel (grain-based ethanol, biodiesel, eventually cellulosic ethanol), **is that truly renewable energy?**

Sunflower Irrigation

- Critical at 20 days before flowering (bud stage, R3) to 20 days after flowering (petal drop, R6)
- High water use begins at bud stage, peaks at flowering
- Typical farmer is most comfortable irrigating at the 7-8" range with a yield goal at 1,600-2,000 lbs./A

Sunflower & Avail. Water



- 1" water = ~140 lbs. (KS/CO) yield /A in normal year; first 5 inches needed to get sunflower to point of seed production
- Early bud (1/2") to petal drop, esp. at initial flower
- Example—
 - ~5" soil water at planting, 8" of rainfall during physiological growth
 - ~13" total available - 5" for vegetative growth = 8" for seed production
 - Potential = $140 \times 8 = \sim 1,120$ lbs./A

Objectives

- Develop sunflower water use and seed yield relationships for the Southern High Plains Region.
- Assess the effect on yield of concentrating irrigation at a) vegetative stage or b) reproductive stage vs. season long limited irrigation.





0 in.

3 in

Clovis, 2007

9 in.

12 in.



Lubbock, TX & Clovis, NM



- Irrigation Amounts & Timing (Triumph 859HOCL):
 - Season-long—0, 3, 6, 9, 12 inch (uniformly distributed, R2-R6)
 - Targeted—6" in either vegetative or reproductive stage
- Planting & Maturity Dates
 - 2007: 6/26 (both), maturing ~10/8
 - 2008: Clovis 5/5, mature ~8/18; Lubbock, 5/19, mature ~8/28
- Growing Season Rainfall
 - 2007: Clovis, 12.2"; Lubbock, 8.8"
 - 2008: Clovis, 8.2"; Lubbock, 3.5"
- Irrigation Management:
 - Clovis—surface drip system with water meters
 - Lubbock—metered hand watering from bulk tank
- RCBD, 4 reps; neutron probe @ 7', readings ~21 days

2007 Irrigation Results

Irrig. (inches)	Lubbock, TX			Clovis, NM		
	Ht. (in)	lbs./A	% Oil	Ht. (in)	lbs./A	% Oil
0	58	1,784	39.0	42	1,344	40.8
3	60	1,831	38.6	51	1,938	38.7
6	61	2,177	39.4	50	2,502	37.0
9	59	2,028	39.1	52	2,146	39.6
12	60	1,930	39.2	57	2,717	37.5
6 Early	60	1,986	38.5	53	2,530	37.2
6 Late	56	2,003	38.3	46	2,488	38.3
Signif	*	NS	NS	*	*	NS
LSD _(0.05)	4			8	790	

2008 Irrigation Results

Irrig.	Lubbock, TX			Clovis, NM		
(inches)	Ht. (in)	lbs./A	% Oil	Ht. (in)	lbs./A	% Oil
0	59	1,998	39.3	37	1,810	29.1
3	62	2,282	38.7	45	2,774	33.8
6	68	2,497	39.4	44	3,701	34.2
9	67	2,409	39.3	50	3,742	35.8
12	68	2,530	39.5	50	4,057	38.0
6 Early	66	2,126	38.2	47	3,285	34.6
6 Late	64	2,400	39.9	42	2,299	32.7
Signif	NS	NS	NS	*	*	*
LSD _(0.05)	4			6	946	2.3

Conclusions (2 Year)

- Lubbock—slight trends in yield with irrigation, but surprisingly not significant; oils not affected
- Clovis—significant upward trend in yield with irrigation, WUE in the range of 120-180 lbs./in; oil content increased in 2008
- Timing—no difference @ Lubbock; site-years opposite at Clovis
 - Response depends on pre-plant moisture
- Neutron probe analysis for WUE to begin

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