TITLE:

Testing of Variable-rate Nitrogen and Variable-rate Water in Irrigated Cotton at AG-CARES, Lamesa, Texas, 2003.

AUTHORS:

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METHODS AND MATERIALS:

Experimental Design:	Randomized complete block with 3 replications
Plot size:	27 ft wide (8, 40-inch rows) and > 500 ft long.
Experimental area:	35 ac
Soil type:	Amarillo sandy loam to sandy clay loam
Variety:	Paymaster Roundup® Ready 2326
Soil sampling:	Quarter-ac grid
N fertilizer rate:	Blanket-rate of 91 lb N/ac, Average Variable-rate of 88 lb N/ac Zero-N
Irrigation rates:	74, 80, and 86 % ET replacement, LEPA on a 3.5 day schedule
Planting date:	May 8
Harvest date:	October 14

RESULTS AND DISCUSSION:

Nitrogen (N) and phosphorus (P) management need updating for today's cotton production systems that include LEPA irrigation, conservation tillage and transgenic varieties. Additionally, new tools are needed to rapidly assess in-season N status of cotton. Lint yields were 603, 738, and 851 lb/ac for 74, 80, and 86 % ET replacement irrigation levels, respectively. We did not see any benefit of reducing irrigation in the bottomslope, where yields are usually the greatest. Variable-rate irrigation based on landscape position did not appear beneficial for the second year in a row. Response of lint yield to N fertilizer was observed at all irrigation levels for variable-rate N and at 80 and 86 % ET for blanket-N. Soil profile nitrate-N was 30 lb N/ac in the top 24 inches in the spring of 2003, well below the estimated critical soil nitrate-N test level of 65 lb N/ac, i.e. if soil test nitrate is greater than 65 lb N/ac, no N fertilizer should be added. Averaged across irrigation levels, yields were greater with variable-rate than with blanket-rate N. An average of 88 lb N/ac was applied to variable-rate N strip plots, compared to 91 lb N/ac applied to blanket-rate N plots. We calculated $19/ac greater return to N fertilizer with variable-rate vs. blanket-rate N fertilization for the 2003 growing season. Nitrogen fertilizer response did not differ by landscape position. In-season chlorophyll sensing results continue to demonstrate potential to identify cotton plant N status and need of N from squaring to peak bloom.

Lint yield responded to in a linear fashion to irrigation rates (Table 1). Lint yields were 603, 738, and 851 lb/ac for 74, 80, and 86 % ET replacement irrigation levels, respectively. We did not see any benefit of reducing irrigation in the bottomslope, where yields are usually the greatest. Variable-rate irrigation based on landscape position did not appear beneficial for the second year in a row.

Soil profile NO_3^--N was 30 lb N/ac in the top 24 inches in the spring of 2003. This is well below the critical soil NO_3^--N test level, which is 62 lb/ac in California (Hutmacher et al., 2001).

Response of lint yield to N fertilizer was observed at all irrigation levels for variable-rate N and at 80 and 86 % ET for blanket-N (Table 1). Averaged across irrigation levels, yields were greater with variable-rate than with blanket-rate N. An average of 88 lb N/ac was applied to variable-rate N strip plots, compared to 91 lb N/ac applied to blanket-rate N plots (Table 2). We calculated $19/ac greater return to N fertilizer with variable-rate vs. blanket-rate N fertilization for the 2003 growing season (Table 2). This calculation does not consider the greater sampling and analysis costs of variable-rate fertilization or the cost of the retro-fitting a liquid fertilizer applicator to do variable-rate fertilization (~$10,000). Nitrogen fertilizer response did not differ by landscape position. Table 3 shows that the new N seeker radiometer estimated leaf N and cotton biomass at early bloom better than the Cropscan MSR16 radiometer or the chlorophyll meter. The green vegetative index –4 calculated from reflectance with the Cropscan MSR16, however, correlated best with leaf P.

REFERENCES:

Hutmacher, R.B., R.L. Travis, R.L. Nichols, D.E. Rains, B.A. Roberts, B.L. Weir, R.N. Vargas, B.H. Marsh, S.D. Wright, D.S. Munk, D.J. Munier, M.P. Keeley, F. Fritschi, R. L. Delgado, and S. Perkins. 2001. Response of acala cotton to nitrogen rates in the San Joaquim valley of California. The Scientific World. 1(S2):691-698.

Table 1. Lint yields as affected by N and water management, AG-CARES Lamesa, TX, 2003

N treatment	Water management (%ET)			
	74	80	86	Means
	---------- lb /ac ----------			
Blanket-rate	577	770	867	738
Variable-rate	643	756	910	769
Zero-N	590	687	777	685
Means	603	738	851	
LSD (*P*=0.05)	51	51	51	30

NS is not significant at $P = 0.05$

Table 2. Returns to fertilizer (no costs of VRT equipment or extra soil sampling and analysis; $0.24/lb N and $0.60/lb lint)

	N rate	Cost N	Delta yield	Gross return to N fert	Net return to N fert
	lb N/ac	$/ac	lb/ac	$/ac	$/ac
Blanket-N	91	21.84	53	31.80	9.96
Variable-N	88	21.12	84	50.40	29.28

Table 3. Correlation between chlorophyll meter sensing technologies/indices and leaf N and P, and biomass at early bloom, AG-CARES Lamesa, TX, 2003

	Leaf N	Leaf P	Biomass
SPAD	0.37**	-0.35**	-0.21*
R550	-0.47**	0.32**	NS
GVI-4	NS	-0.41**	0.34**
NDVIR-8	-0.28**	NS	0.48**
NRVIR-N seeker	-0.46**	NS	0.58**

- SPAD is chlorophyll meter readings
- R550 is percent reflectance at 550 nm with CropScan MSR16
- GVI-4 is percent reflectance at 820 nm/percent reflectance at 550 nm (Cropscan MSR16)
- NDVIR-7 is (R780-R670)/(R780+R670) using percent reflectance at 780 and 670 nm with Cropscan MSR16
- NDVIR – is (R780-R670)/(R780+R670) using percent reflectance at 780 and 670 nm with Nseeker