TITLE:

Testing of Variable-rate Nitrogen and Variable-rate Water in Irrigated Cotton at AG-CARES, Lamesa, Texas, 2002.

AUTHORS:

K.F. Bronson, J.W. Keeling, T. Wheeler, R. K. Boman, J.D. Booker, J. Mabry, Associate Professor, Professor, Associate Professor, Professor, Extension Specialist, Professor, Research Associate and Technician.

METHODS AND PROCEDURES:

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 52 lb N/ac, Average Variable-rate of 55 lb N/ac Zero-N
Irrigation rates:	64, 75, and 85 % ET replacement, LEPA on a 3.5 day schedule
Planting date:	May 9
Harvest date:	October 17

SUMMARY

Soil test calibration for key nutrients like nitrogen (N) and phosphorus (P) 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. Response of lint yield to N fertilizer was only observed at the high (85 % ET) irrigation rate. Lack of N response at lower irrigation rates means growers should reduce N inputs if water availability decreases. Soil profile nitrate-N was 65 lb N/ac in the top 24 inches in the spring of 2002. These results suggest that this is near the critical soil nitrate-N test level, i.e. if soil test nitrate is greater than 65 lb N/ac, no N fertilizer should be added. Yields were similar with variable-rate or blanket-rate N approaches. There was no advantage to the variable-rate N approach vs. the conventional blanket-rate treatment in terms of yield or in amount of N fertilizer applied. In-season chlorophyll sensing results continue to demonstrate strong potential to identify cotton plant N status and need of N from squaring to peak bloom.

RESULTS

Lint yield responded to in a linear fashion to irrigation rates (Table 1). Nitrogen fertilizer response, however, was only observed at the highest water rate (85 % ET). This is similar to the report of Bronson et al. (2001) with surface drip irrigation. Soil profile NO_3^--N was 65 lb N/ac in the top 24 inches in the spring of 2002. These results suggest that this is near the critical soil NO_3^--N test level, which is 62 lb/ac in California (Hutmacher et al., 2001). Yields were similar with variable- or blanket-rate N. There was no advantage to the variable-rate N approach vs. the conventional blanket-rate treatment in terms of yield or in amount of N fertilizer applied.

There was no effect of irrigation rate on leaf N, chlorophyll meter readings and green reflectance or on green vegetative index (GVI) (green reflectance/near infrared reflectance). The two N-fertilizer treatments had enhanced values for leaf N, chlorophyll meter readings, and GVI at peak bloom (Table 2). Green (570 nm) reflectance was depressed by N fertilizer. Red vegetative index (percent reflectance at 820 nm/percent reflectance at 650 nm), however showed a response to irrigation rate (data not shown). Table 3 shows partial correlation between chlorophyll meter readings, reflectance at key bands and leaf nutrients. Chlorophyll meter readings had high correlation with leaf N as reported previously by Bronson et al. (2001). Green (550 or 570 nm) reflectance had only weak negative reflectance with leaf N. Negative correlation means that lighter green (leaves deficient in N) reflect more green light than dark green, high N leaves. Correlation with leaf P was greatest with red (630 nm) reflectance. Zinc showed a negligible, though significant correlation with red reflectance. Leaf iron (Fe) and potassium (K) did not correlate with reflectance or chlorophyll meter readings.

Correlation analysis between lint yields and soil test P, Zn, and Fe show no relationships. Profile NO_3-N from the 0-24 in. or the 0-36 in. did not correlate with lint yields, even when restricting the analysis to zero N fertilizer plots and the high irrigation level.

This is the first year of this nutrient management research project where field-length plots of irrigation and N treatments were successfully applied (first two years entailed P treatments). Valuable information has been generated on this project regarding critical soil test nitrate and P levels as well as the potential of chlorophyll sensing technologies. We plan to repeat this study with the N and water treatment structure in the 2003 growing season at Lamesa, TX.

References

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Table 1. Lint yields as affected by N and water management, AG-CARES Lamesa, TX, 2002

N treatment	Water management (%ET)			
	64	75	85	Means
	------------------ lb /ac ------------------			
Blanket-rate	796	940	1090	942
Variable-rate	870	912	1120	967
Zero-N	796	883	1003	894
Means	820	912	1071	
LSD (*P*=0.05)	NS	NS	76	43

Note: Spring soil NO_3^--N in 0-24 and 0-36 in. was 65, and 87 lb N/ac
NS is not significant at *P* = 0.05

Table 2. Peak bloom leaf N, chlorophyll meter readings, and spectral reflectance as affected by N management, AG-CARES Lamesa, TX, 2002

N treatment	Leaf N	SPAD	R570	GVI
	%			
Blanket-rate	4.59	45.5	9.40	5.08
Variable-rate	4.63	46.2	9.41	5.11
Zero-N	4.26	44.3	9.73	4.85
LSD (*P*=0.05)	0.15	1.2	0.20	0.11

SPAD is chlorophyll meter readings
R570 is percent reflectance at 570 nm
GVI is percent reflectance at 820 nm/percent reflectance at 550 nm

Table 3. Partial correlation of chlorophyll meter readings and spectral reflectance on cotton leaf nutrient concentrations at peak bloom, AG-CARES, Lamesa, TX, 2002

	Leaf N	Leaf P	Leaf Zn
SPAD	0.63**	-0.37**	
R570	-0.30**	-0.36**	
R630		-0.57**	0.18*
R700			0.20*

SPAD is chlorophyll meter readings
R570, R630, and R700 are percent reflectance at 570, 630, and 700 nm, respectively
*, and ** are significant at the 0.05 and 0.01 levels of probability, respectively.