EVALUATION OF N RATE AND TIMING OF APPLICATIONS ACROSS DIFFERING CLIMATES

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Abstract

Cotton (*Gossypium hirustum* L.) is a global source for natural fiber making it the most heavily traded commodity in the agriculture industry. Nitrogen (N) is a vital component that significantly effects lint quality, yield, and rate of maturity. The effects of inadequate N management indicate that further evaluation of N rate and timing of application should be assessed in an effort to improve current N recommendations. With the inclusion of varying climates, a more refined N recommendation could be determined utilizing site-specific data to increase the use efficiency of N application.

Introduction

Nitrogen (N) is a crucial element in cotton production, as it contributes greatly to photosynthesis regulation and crop development. Depending upon the level of severity, N deficiency can be detrimental to lint yield if not corrected in a timely and effective manner leading to increased boll shedding, decreased leaf area and photosynthetic rate. Advisedly excess N to has negative effects resulting in increased vegetative growth requiring the use of growth regulators to slow internode elongation. With the proper N management this additional cost could be avoided. The rather unpredictable climate in the cotton production areas of Oklahoma poses a great challenge on producers when considering application of N. Determining a point at which delaying or split applying N without a negative effect to lint yield, could increase nitrogen use efficiency (NUE) and possibly profitable return with respect to climatological differences.

Materials and Methods

This study was conducted during the 2020 & 2021 growing seasons. In 2020 the study consisted of three locations stretching across two climatological zones, Cimarron Valley Research Station near Perkins, OK, Fort Cobb Research Station near western Sandstone, OK, and Altus-Lugert irrigation district near Altus, OK. In 2021 all locations remained except the Perkins site, with the addition of the Oklahoma Panhandle Research and Extension Center, near Goodwell, OK. This experiment utilized a random complete block design, with 13 treatments in 2020 and 11 in 2021. Nitrogen fertilizer used in this study consisted of ammonium nitrate (34-0-0), with rates of 40, 80, 120, 160 lbs. ac $^{-1}$, and split applications occurring at pre-plant and pinhead square of 40/40 and 60/60 lbs. ac $^{-1}$.

Figures and Tables

Table 1. Contains by year information including variety and row spacing.

Location	Year	Variety	Row spacing (in)
Perkins	2020	DP1612	30
Ft. Cobb	2020	-	36
Altus	2020	NG5711	40
Ft. Cobb	2021	PHY300	36
Altus	2021	FM2398	40
OPREC	2021	DG3385	30

Table 2. Climatological data obtained through the Oklahoma Climatological Survey for the divisions of trail locations. Data shown is that of a normal climate for the growing season, and yearly totals.

Climate Division	Average	Climate Normals							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Annual
Panhandle	Precipitation	1.51	2.5	3	2.61	2.68	1.73	1.57	19.29
	Temperature	54.2	64	73.5	78.7	77.2	68.9	56.5	55.8
Central	Precipitation	3.27	3.56	5.32	5.19	3.08	3.2	3.91	38.87
	Temperature	49.4	58.7	67.9	76.3	81.5	81	72.3	59.4
Southwest	Precipitation	2.45	3.83	4.23	2.2	2.73	2.86	2.84	28.35
	Temperature	60.2	69.6	78	83.3	82.4	74.1	62.1	61.2

Table 3. Lint quality measurements in response to N rate and timing and economical return for all responsive locations for the 2020 growing season. Loan value was calculated using a base of 52.00 cents, while N cost utilized $0.45 lbs. Final return was calculated with respect to seed cost per acre.

Location	App	Mic	UI	Str	Loan value (cents/lb.)	Lint Return ($/ ac)	N Cost ($/ac)	Final Return ($/ac)
Perkins	CHECK	3.65	81.10	31.00	0.56	399.36	0	399.36
	20 Pre	3.31	80.33	29.83	0.50	353.92	9.00	344.92
	40 Pre	3.32	81.45	31.40	0.51	396.32	18.00	378.32
	60 Pre	3.24	81.10	30.58	0.49	357.94	27.00	330.94
	80 Pre	3.26	80.43	30.73	0.49	406.73	36.00	370.73
	100 Pre	3.25	80.40	30.45	0.49	406.15	45.00	361.15
	120 Pre	3.21	80.20	31.05	0.49	425.51	54.00	380.51
	20 Pin	3.46	81.80	32.13	0.51	424.82	9.00	415.82
	40 Pin	3.36	81.40	31.73	0.51	519.31	18.00	501.31
	60 Pin	3.13	80.43	30.55	0.49	355.26	27.00	328.26
	80 Pin	3.01	79.53	29.65	0.48	352.83	36.00	316.83
	100 Pin	3.07	80.45	30.65	0.49	339.42	45.00	294.42
	120 Pin	2.94	80.55	30.10	0.46	305.08	54.00	251.08
Altus	CHECK	4.99	81.70	30.28	0.52	307.78	0	307.78
	20 Pre	4.90	81.83	30.55	0.52	386.16	9.00	377.16
	40 Pre	4.89	82.58	30.38	0.52	421.67	18.00	403.67
	60 Pre	4.91	82.53	30.93	0.52	410.82	27.00	383.82
	80 Pre	4.91	82.68	31.00	0.52	378.87	36.00	342.87
	100 Pre	4.90	82.83	30.58	0.52	353.77	45.00	308.77
	120 Pre	4.84	83.38	31.45	0.52	331.34	54.00	277.34
	20 Pin	4.84	82.80	31.23	0.52	375.70	9.00	366.70
	40 Pin	4.84	82.58	30.35	0.52	365.72	18.00	347.72
	60 Pin	5.00	83.03	30.70	0.52	365.11	27.00	338.11
	80 Pin	4.86	82.40	31.10	0.52	364.23	36.00	328.23
	100 Pin	4.79	82.50	30.65	0.52	276.63	45.00	231.63
	120 Pin	4.90	82.38	30.55	0.52	398.47	54.00	344.47

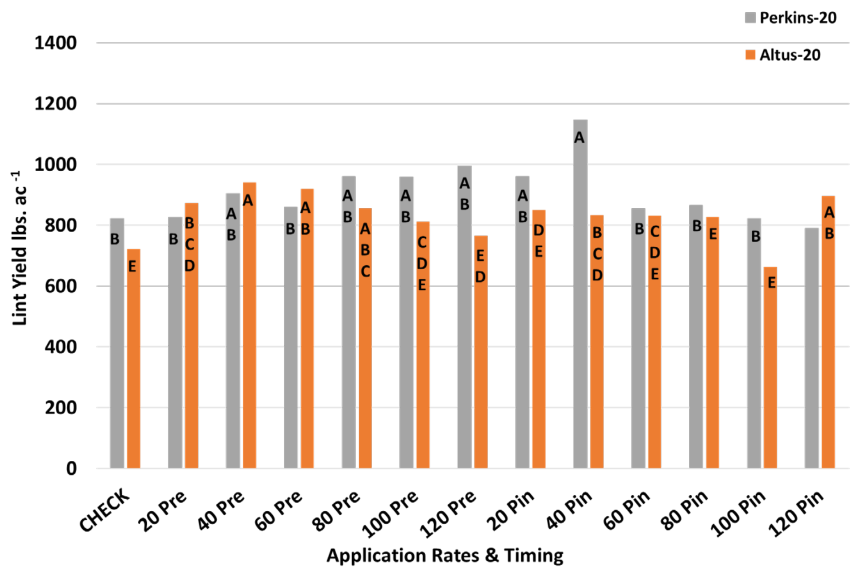

Figure 1. All responsive locations for the 2020 growing season lint yield in response to N rate and timing. Letters indicate level of significance at an alpha of 0.05. Treatments with the same letter are not significantly different.

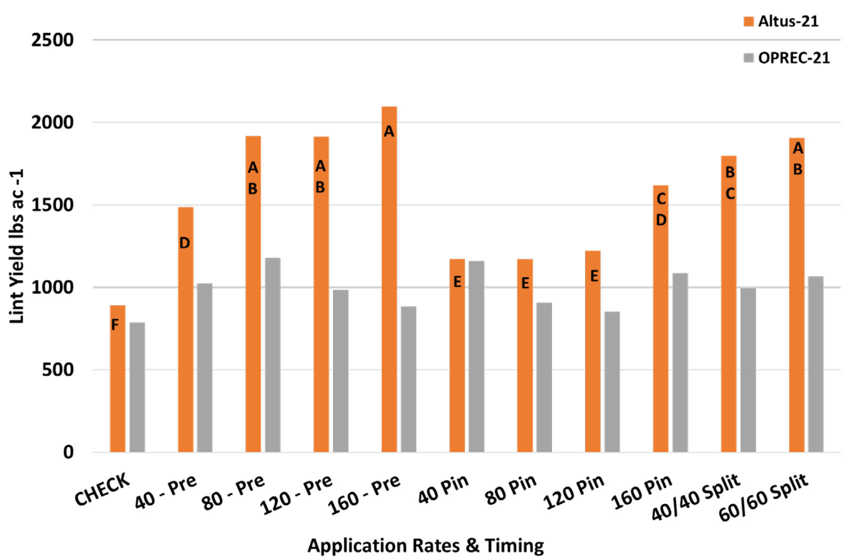

Figure 2. All responsive locations for the 2021 growing season lint yield in response to N rate and timing. Letters indicate level of significance at an alpha of 0.05. Treatments with the same letter are not significantly different.

Results and Discussion

This study was conducted to observe the effects of nitrogen rate and timing under diverse climatological conditions. While significant differences in lint yield were detected in response to N rate and timing, lint quality parameters indicated nonsignificant numerical differences. The differences noticed among quality parameter shifted focus onto the economic implications in the form of discounts, premiums, seed cost, nitrogen cost, and their effect on return on investment. The Perkins location showed a numerical increase in return for the application made at pinhead square at a rate of 40 lbs. ac^{-1} N, while the Altus location's highest return occurred as a pre-plant application of 40 lbs. ac^{-1} N. During the 2021 growing season only the Altus location denoted significant differences among lint yield, and showed an instance of excess N, as the pre-plant applications of 80, 120, and 160 lbs. ac^{-1} were statistically similar in yield to the split 60 lbs. ac^{-1} application. Further research is investigating soil and residue sampling to improve N rate recommendation.

Acknowledgements

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