SOIL FERTILITY RESEARCH IN SUGARCANE

Chuck Kennedy, Allen Arceneaux, Ben Legendre
Sonny Viator, and Alfred Guidry
in cooperation with
St. Gabriel Research Station, the Louisiana Cooperative Extension Service and
Sugarcane Farmers

SUMMARY

Several different field experiments were conducted in 2004 to test the effects of fertilizer inputs on the yield and yield components of current sugarcane varieties. Results of a two-location outfield test to determine the optimum rate of N fertilizer for LCP 85-384 indicated the optimum rate was on the low end of present recommendations. Because of the climatic conditions during the growing season in 2004, results of ratoon crop response to N application rates varied slightly from those of previous years in this large outfield study. Cane yield optimized at higher rates at the St. James location, but was similar to previous findings at Alma (Pointe Coupee). CRS declined with increasing N application rate at both locations. Thus, sugar yields were optimized at lower rates than cane yield. Remote reflectance and SPAD (chlorophyll) readings were also taken to assess these methods for monitoring N status of sugarcane. Nitrogen fertilizer rates from 0 to 120 lb N/ac had a marginal effect on cane or sugar yield of plant-cane crops for three varieties. Nitrogen use efficiency for biomass declined with increasing N rate, but was more variable for LCP85-384 than the other varieties Broadcasting full or split applications of stabilized urea (Super U) in early February and/or sidedressing full or split applications of regular urea in April into plots where harvest residue remained, was swept to middles, or burned resulted in no significant differences among treatments. The use of starter fertilizer applications at planting produced a response in plant-cane yields for LCP85-384. Additional products used in conjunction with normal fertilizer inputs were also studied.

OBJECTIVES

This research was designed to provide information on soil fertility in an effort to help cane growers produce maximum economic yields and increase profitability in sugarcane production. This annual progress report is presented to provide the latest available data on certain practices and not as a final recommendation for growers to use all of these practices. Recommendations are based on several years of research data.

RESULTS AND DISCUSSION

<u>Rates of spring-applied N fertilizer:</u>

The effect of N fertilizer rate on yield of LCP 85-384 was tested at two large outfield locations. The N rate for optimum cane yield ($\geq$ 90% of maximum yield and not statistically different) varied with location and was higher than found previously at one location (Fig. 1). The response of CRS to N application was negative with increasing N rate (Fig. 2). Thus, sugar yield reflected the decline in CRS and resulted in a response to N application rate that was similar to or less than that found in previous years for these locations (Fig. 3). Because of the

size of these tests, these locations were used to assess the possibility of using remote reflectance or a chlorophyll (SPAD) meter to rapidly assess the N status of the crop. Each method identified a response to N application by the crop (Figs. 4,5), but differences between locations indicate drawing a direct relationship between leaf N status and these methods may not work as well as establishing a direct relationship between these methods and relative yield.

The variety LCP85-384 produced numerically higher yield than CP70-321 and significantly higher than HoCP91-555. The response pattern indicated a trend for greater average N-use efficiency relative to the other two varieties at native N levels (Fig.6). LCP85-384, however, had less response to fertilizer N relative to the other varieties until a rate of 120 Lb N/a was applied. The lack of incremental response to applied N by this variety in this test would indicate that other factors may have interfered.

N application and Harvest Residue Management:

Cane yield of 3rd stubble LCP85- 384 was not significantly different among all treatments of [N application X residue management] treatments (Figs. 7, 8). All yields were lower than 24 T/a and 4500 lbs/a sugar. Thus, climatic limitations during the growing season may have affected a lack of response among the treatments.

Starter fertilizers:

The use of some starter fertilizers on billet-planted LCP 85-384 improved plant-cane yield and sugar compared to others (Fig.9, 10). The use of 15-45-45 or 0-45-45 lbs/a N-P_2O_5-K_2O at planting produced yields that averaged as high or higher than applying P and K in the spring. Applying only N as a starter was not effective and tended to depress yields. Additionally, using N rates > 15 lbs/a in starter formulations was not beneficial.

Fertilizer Adjuvants:

The use of Helena Corporation products in addition to standard fertility practices did not result in any significant yield response (Table 1). The application of Asset + Hydrahume did result in higher average yields than the check at both locations (not statistically significant).

ACKNOWLEDGMENTS

The authors wish to express appreciation for the financial support of the American Sugar Cane League and Helena Chemical Company.

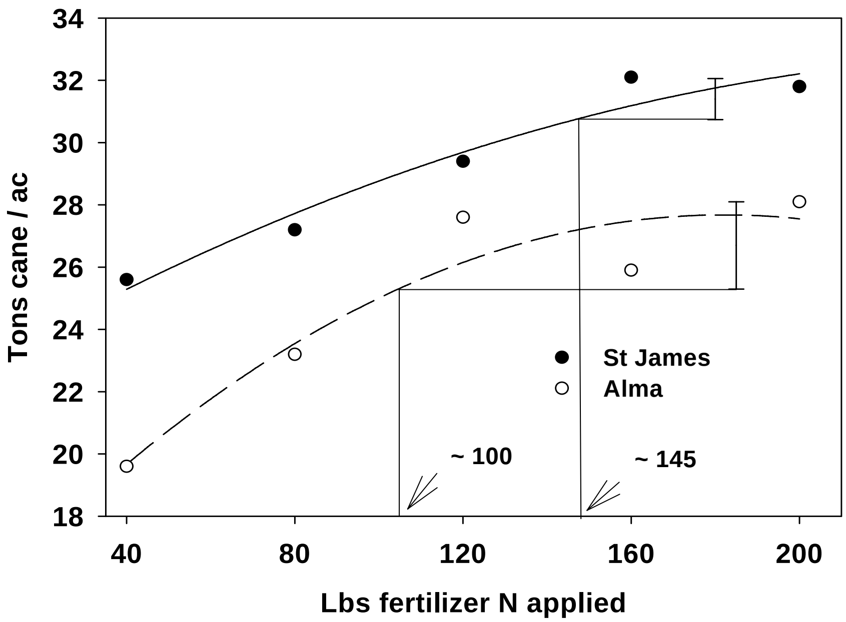


Fig. 1. The effect of fertilizer N application rate on cane yield of LCP85-384 stubble crops grown on light soil, 2004

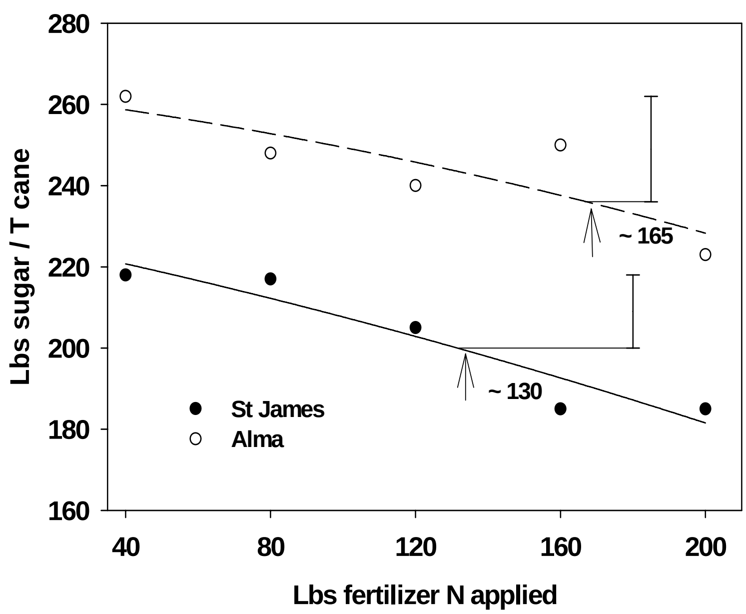


Fig. 2. The effect of fertilizer N application rate on CRS of ratoon LCP85-384 grown on light soil, 2004.

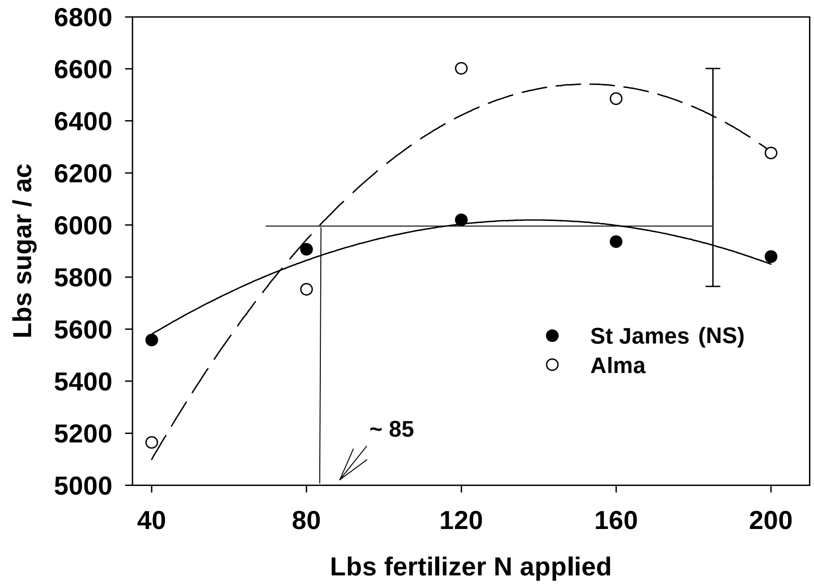


Fig. 3. The effect of N fertilizer application rate on sugar yield of ratoon LCP85-384 grown on light soil.

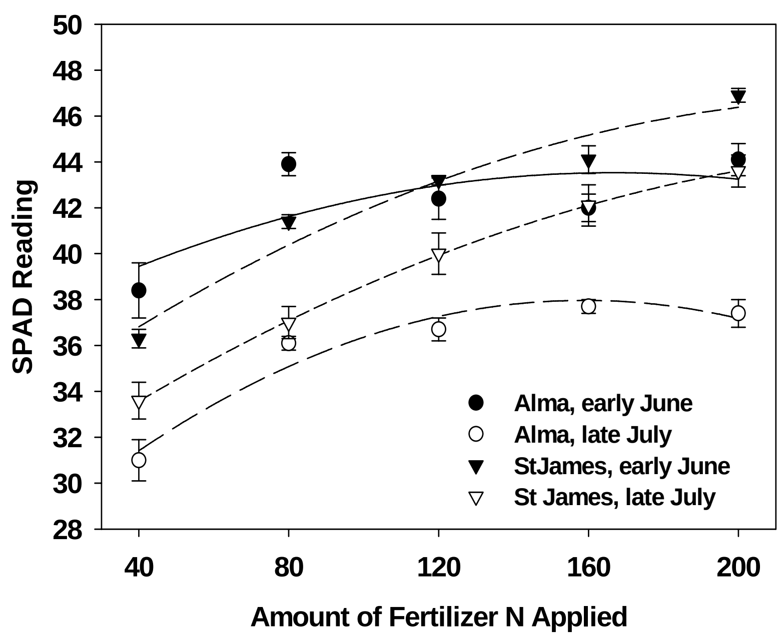


Fig. 4. Chlorophyll (SPAD) meter reading response to fertilizer N application rate.

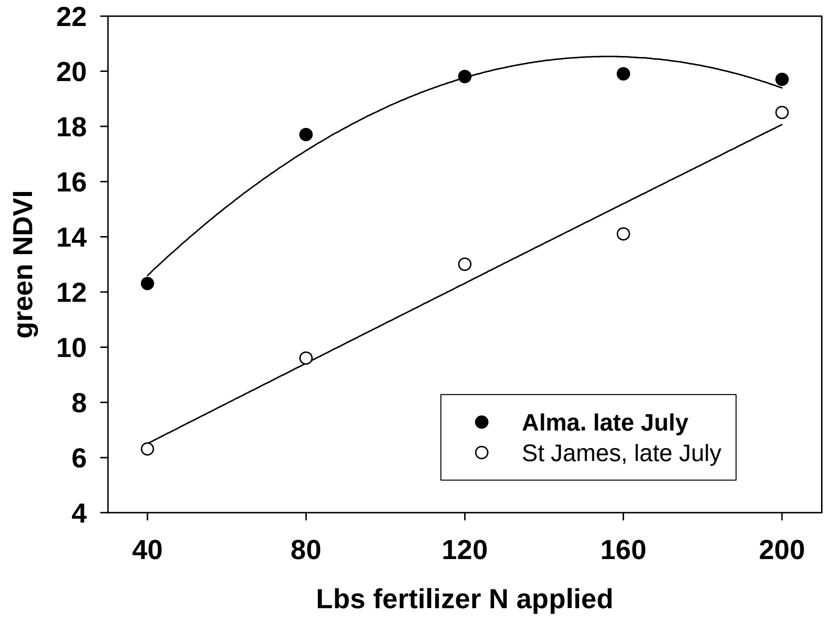


Fig. 5. Remote reflectance response to fertilizer N application rate.

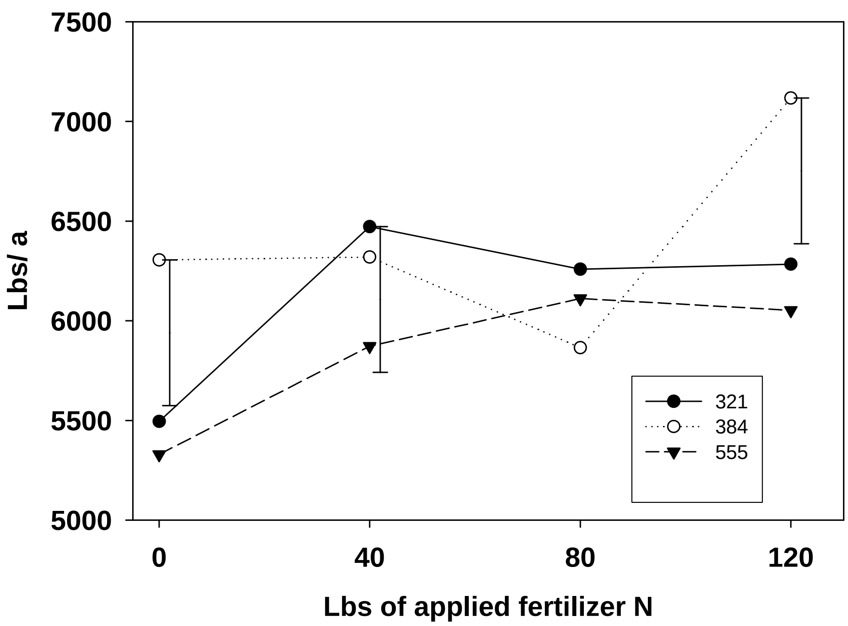


Fig. 6. Variety sugar yield response to fertilizer N application rate. ⌶ = LSD $_{0.05}$

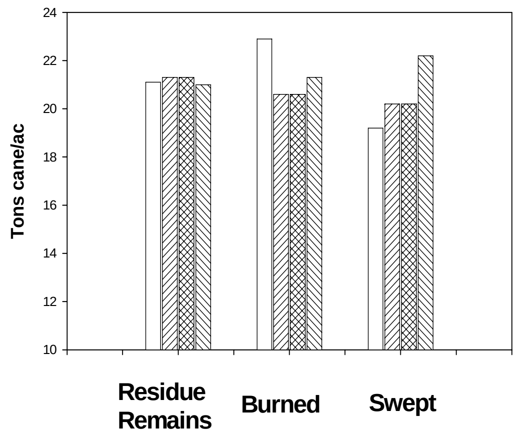
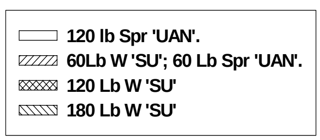


Fig. 7. The effect of N fertilization method and residue management on cane yield of 3rd stubble LCP85-384.



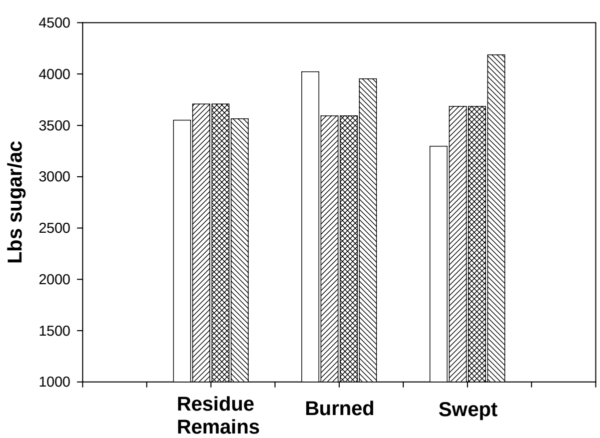


Fig. 8. The effect of N fertilization method and residue management on sugar yield of 3rd stubble LCP85-384.

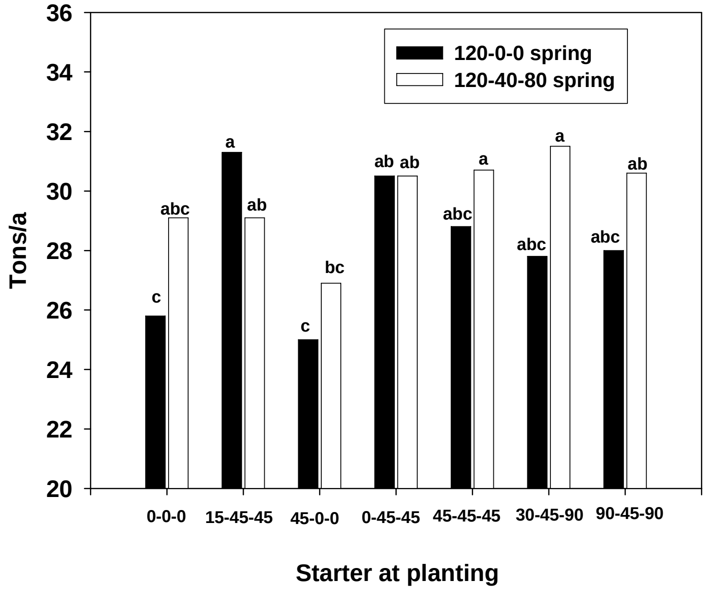


Fig. 9. The plant cane response of LCP85-384 to starter fertilizer applications in relation to different spring fertilizer inputs. Cane yield on clay soil.

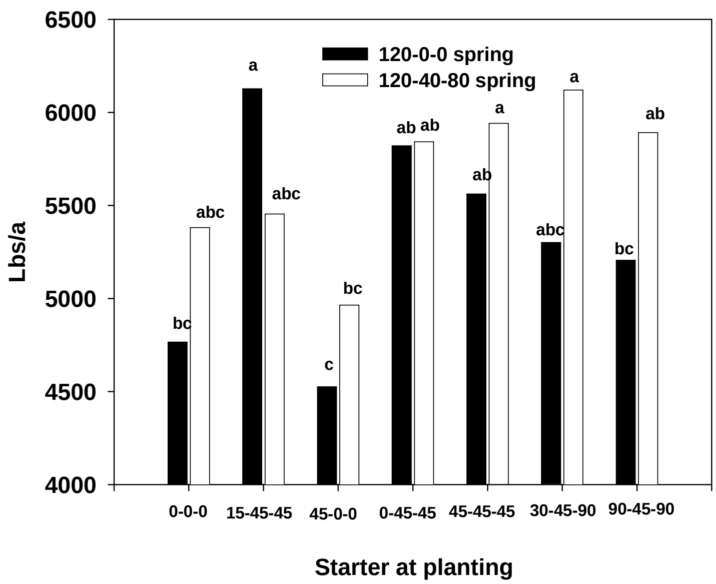


Fig. 10. The plant cane response of LCP85-384 to starter fertilizer applications in relation to different spring fertilizer inputs. Sugar yield on clay soil.

Table 1. The response of LCP85-384 and HoCP91-555 to soil- or foliar-applied adjuvants in addition to normal fertilization.

	Location†							
	St Gab	Iberia	St Gab	Iberia	St Gab	Iberia	St Gab	Iberia
Treatment	Stalk Population		Cane Yield		TRS		Sugar Yield	
	---No. x 10^{-3}------		-----Tons / a------		------Lbs / T------		-------Lbs/a-------	
Check‡	29.5	47.9	32.4	22.9	244	240	6494	5461
Asset¶	29.7	50.0	32.4	20.5	242	251	6428	5134
Hydrahume¶	27.2	51.1	30.6	22.9	245	233	6156	5253
Asset + Hyd.¶	29.8	45.9	33.0	28.0	247	250	6699	7020
25-0-0 CoRoN§	30.1	47.2	30.0	22.5	241	249	5896	5632
10-0-10 CoRoN§	29.8	47.1	30.3	24.1	242	239	6021	5752

† St Gab = HoCP91-555 plant-cane on light soil; Iberia = LCP85-384 stubble cane on light soil.

‡ The check consisted of 80 lb N + 80 lb K at St Gabriel and 140 lb N at Iberia. All plots received this input.

¶ Soil applied in April; Asset=8oz/ac, Hydrahume = 1:20 gpa

§ 1 gpa at lay-by and again14 d later.

THE RESPONSE OF LCP 85-384 TO THE APPLICATION OF SILICATE SLAG

H. P. Viator, John Richard and Greg Williams
Iberia Research Station

Summary of Experiment 1:

A silicate slag sugarcane study was planted on a Patoutville silt loam soil containing 63 ppm of silica (acetic acid extracted) in September 2000 with first progeny Kleentek variety LCP 85-384 billets. The six calcitic lime (Domino by-product) and silicate slag (a by-product of the steel industry) treatments are given in table 1. As an average of plant-cane and three stubble crops in the production cycle, plots receiving silicate slag at the rate of 2 tons per acre produced higher amounts of sugar (P=.05) and cane (P=.05) than both the check and limed plots. Placing slag beneath seed pieces at planting did not improve yields. The failure of the 2 T/A calcitic lime treatment to produce statistically comparable yields to the 2 T/A slag treatment suggests that the yield response to slag was caused by silica and not calcium. Other equivalent-rate slag and lime comparisons were not as convincing, though all slag treatments were numerically higher than the lime treatments. Also, leaf silica content (table 2) was higher for the slag treatments. The additional 3,320 pounds of sugar/acre over the four years clearly justifies the cost of silicate slag application at 2 tons/acre on this soil with low silica content.

Table 1. The effects of treatments on the yields of LCP 85-384 average over four crops in the cycle.

Treatment no.	Lime	Silicate slag	Placement	Sugar	Tonnage
	T/A	T/A		Lb/A	T/A
1	0	0	-	8969	35.3
2	1	0	Mixed into rows	8681	34.3
3	2	0	Mixed into rows	8613	34.9
4	0	1	Mixed into rows	9405	36.8
5	0	2	Mixed into rows	9799	38.8
6	0	1	Placed under cane	8962	36.8
LSD (.05) =				796	3.00

Table 2. Treatment difference for leaf silica content and HCL extracted silica.

Treatment No.	Lime	Silicate slag	Placement	Leaf silica	HCL extracted soil Si
	T/A	T/A		%	mg kg^{-1}
1	0	0		1.24	284
2	1	0	Mixed into rows	1.27	274
3	2	0	Mixed into rows	1.26	296
4	0	1	Mixed into rows	1.36	332
5	0	2	Mixed into rows	1.61	332
6	0	1	Placed under cane	1.73	321

Summary of Experiment 2:

A silicate slag rate study was initiated in 2002 with LCP 85-384 on a Jeanerette silt loam soil containing approximately 60 ppm (acetic acid extracted) of silica. Slag was applied prior to planting at the rates of 0, 0.5, 1.0, 1.5, 2.0 and 3.0 tons/acre. None of the plant-cane parameters responded significantly to slag. Both sugar (P=.006) and cane (P=.02) yield in first stubble, however, were significantly affected by the slag treatments, as shown in the table below. It is clear, based on the range in soil pH that slag functioned as a liming agent. Soil pH ranged from 5.3 for the check plots to 7.4 for the highest rate of applied slag. The design of the experiment does not allow for the partitioning of the effects of liming and silica on sugarcane yield. Leaf silica content increased with increasing rates of slag (data not shown) suggesting the increase in yield may have been partly due to the direct effects of silica.

Table 1. The effects of slag application rates on LCP 85-384 first stubble.

Treatment	Sugar	Cane	TRS	Soil pH
T/A	Lb/A	T/A	Lb/T	
Check	5745	23.8	242	5.3
0.5	6475	25.9	250	6.1
1.0	6680	26.5	251	6.3
1.5	6574	26.6	247	7.3
2	7308	29.0	252	7.1
3	6757	27.4	246	7.4
LSD (.05) =	702	2.74	NS	

SITE-SPECIFIC NITROGEN FERTILIZATION OF SUGARCANE

H. P. Viator, Iberia Research Station
R. G. Downer, Department of Experimental Statistics

SUMMARY

Site-specific management of sugarcane has lagged behind other commodities because of the unavailability of commercial yield monitors. Measures of spatially variable soil attributes associated with sugarcane yield have been both inconvenient and limited. The principal objective of this study was to determine the response of plant-cane to the application of variable rates of fertilizer nitrogen. An ancillary objective was to investigate the relationship of yield to measured soil attributes. Four N rates (0, 80, 160 or 240 pounds/acre) were superimposed in a randomized block design on a 25-acre field on which apparent soil electrical conductivity (EC_a) and soil nutrient levels were measured. The soil (Vertic Haplaquolls) had a silty clay loam surface layer and clayey subsoil. Absent a workable yield monitor, plot weights were measured using a field wagon equipped with electronic load cells. The growing season was characterized by moisture extremes, with excessive rainfall occurring in the spring, followed by a moisture deficit during the grand growth stage of summer. A multi-source regression was fit to the plot data. The three applied N rates were statistically equivalent and significantly higher in sugar per acre than the 0 lb/acre [rate]. Blocks (approximate surrogate for clay content), N application rates, average EC_a of the plots, soil sodium and the interaction of average EC_a and soil sodium were all significant in a model that explained 92% of the variability in sugar per hectare. This significant interaction is consistent with visual displays of EC_a and soil sodium for the experimental region and consistent with our understanding of the typical effect of these variables on yield. This model will be used in the upcoming growing season as a prescription for a variable N rate investigation. As is typical of seasons with exceedingly uneven moisture regimes, sugarcane underperformed on areas of the field with higher clay content (% clay ranged from 20.8 to 60.8 within the experimental area). Management options useful for mitigation of this dilemma are limited. The results suggest that the ability to predict the response of sugarcane yield on clay soil to nitrogen fertilizer is undermined by the inability to predict growing season climate. The data also suggest, as others have observed with different crops, that EC_a alone cannot be used to predict variation in sugarcane yield. Collateral observations and information must be included in the development of fertilizer prescriptions.

Research partially supported by a grant from the American Sugar Cane League.