RESEARCH ON SOIL FERTILITY IN SUGARCANE PRODUCTION

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Summary

Field trials were conducted in 2022 to evaluate cane and sugar yield response to different sulfur (S) rates and source, and potassium (K)-based starter and spring fertilization. For the S study, the treatments included three sources (K-thiosulfate [0-0-25-16 S], ammonium (NH_4) thiosulfate [12-0-0-26 S], and elemental sulfur [90% S] pellets) applied at 0, 20, 40, and 60 lbs/acre. For the K study, the treatments included two rates (15 and 30 lbs/ac) of K starter, applied in 2020 fall, with spring K application using MOP (80 lbs/acre) and Nachurs® high K additives as sources. The application of 15 lbs/acre starter K fertilizer tended to improve sugarcane yield even in the absence of spring K fertilization and had a positive carry-over effect on cane tonnage as opposed to 30 lbs/acre starter fertilization. The S trial showed that rate had a greater impact than source on sugarcane yield. Sugarcane applied with elemental sulfur at 20 lbs/acre obtained the highest cane tonnage (30.5 ton/acre). This was followed by K-thiosulfate with cane tonnage at 29.5 ton/acre but applied at rate of 40 lbs/acre. Similar response of sugar yield was observed. The results from this study suggest that both K-thiosulfate and elemental S are potential S sources for sugarcane production.

Objective

This research was designed to evaluate the effect of K-starter and spring K fertilization, S source, and S rate on sugarcane yield and quality components. This annual progress report is presented to provide the latest available data on certain nutrient management practices and not as final recommendation for growers to use.

Results

Sugarcane Response to Different Sulfur Sources and Rates

The impact of sulfur rate was more evident than the source on cane tonnage and sugar yield (Figure 1). The application at 20 lbs/ac using NH_4-thiosulfate and elemental sulfur increased cane tonnage by 2.2 tons/acre and sugar yield by 274 lbs/acre whereas 40 lbs S/acre as K-thiosulfate returned a 3 ton/acre and 339 lbs/acre increase in cane and sugar yield, respectively. Sulfur fertilization effect on soil S at harvest was not observed because of the mobile nature of S in the soil. It is possible that S losses occurred via leaching from the time of application and harvest thus the amount of S in soil was essentially the same across the treatment. Still, the check or untreated plot had the lowest soil S content at 11.6 mg/kg; this test value however is above the critical S level (10 mg/kg) in Louisiana soils (Table 1). Both NH_4-thiosulfate and elemental S application reduced soil pH; the K-thiosulfate also reduced soil pH but to a lesser extent. The K contribution from K-thiosulfate application was accounted and corrected by applying K as muriate of potash (0-0-60) at corresponding rates to all plots to match the highest K rate added to soil as K-thiosulfate.

Effect of Potassium Starter and Spring Fertilization

Cane and sugar yield tended to be higher with 15 lbs K/acre starter fertilizer application, with spring K fertilization (MOP and Nachurs® high K additives as sources) using the control as reference (Table 2). On average across spring K fertilization treatments, cane tonnage was increased by 3.3 ton/acre ($p<0.2$). It appeared that cane planted with K-starter at rate of 30 lbs/ac had lower tonnage and sugar yield than cane applied with 15 lbs K/acre starter fertilizer. There was a minimal (1.5 ton/acre) and not significant increase in cane tonnage from applying 30 lbs K/acre starter fertilizer. On the other hand, there were significant differences detected on stalk K content and removal rate with sugarcane under Farmer's standard and those received 15 and 30 lbs K/ac starter rates followed by spring application of MOP at 80 lbs/ac. While there was an apparent improvement on sugarcane K nutrition, and that the initial soil samples were tested low for K (average at 104 mg/kg), these did not translate to significant improvement in sugarcane yield. The post-harvest soil K levels were virtually the same across the treatments averaging 91 mg/kg, which is interpreted low for silt loam soil.

Acknowledgement
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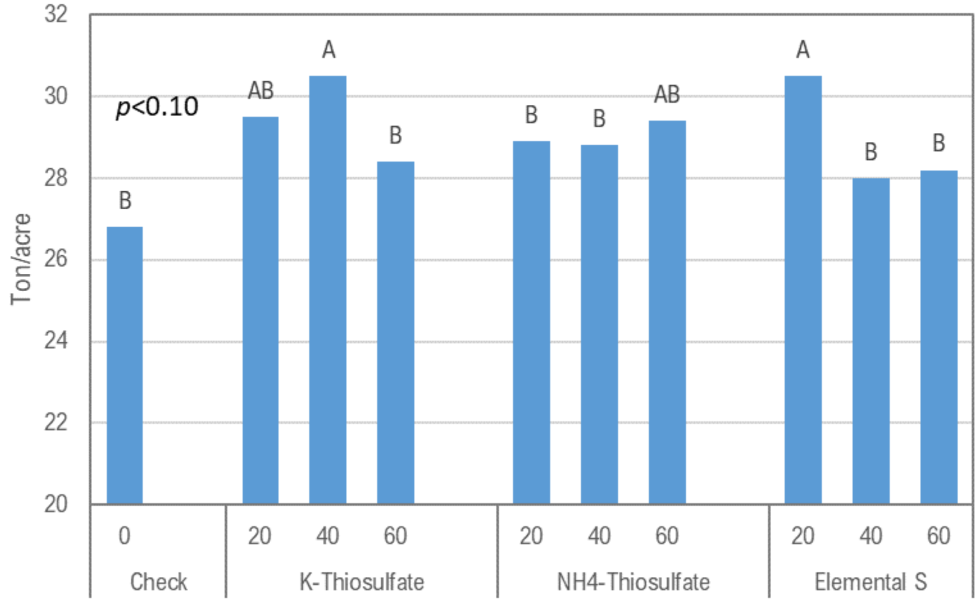

Figure 1. Cane tonnage of L01-299 third ratoon in response to sulfur source and rate, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

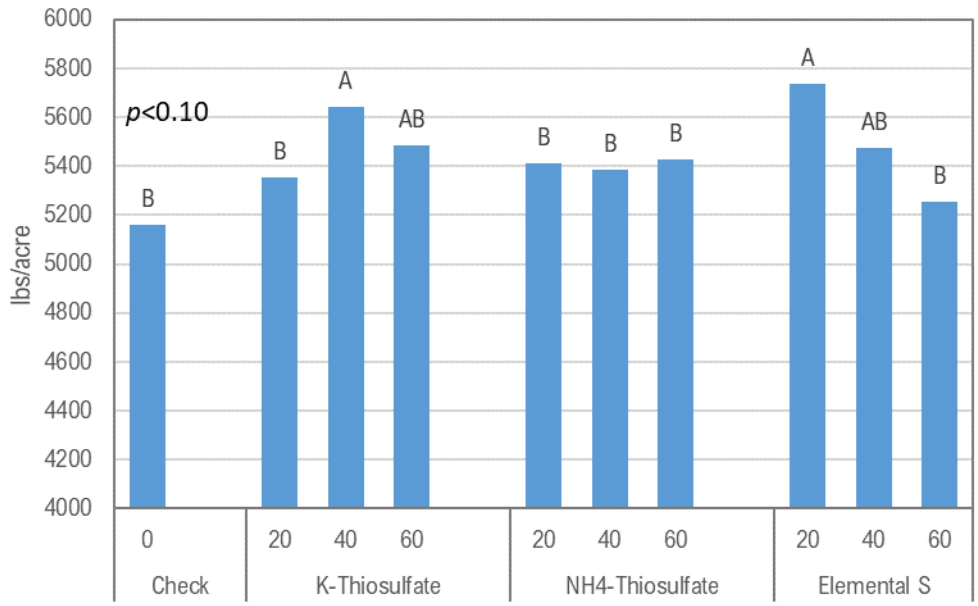

Figure 2. Sugar yield of L01-299 third ratoon in response to sulfur source and rate, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

Table 1. Mean pH, sulfur, and potassium of Commerce silt loam soil (post-harvest) treated with different sources and rates of sulfur, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

Source	Rate	pH	Soil S, mg/kg	Soil K, mg/kg
-	0	6.07	11.6	152
K-thiosulfate	20	5.56	12.6	137
	40	5.56	14.9	159
	60	5.32	14.2	138
NH_4-thiosulfate	20	5.33	14.3	150
	40	5.34	14.0	148
	60	5.39	14.2	142
Elemental S	20	5.31	13.3	162
	40	5.27	13.9	147
	60	5.61	12.3	139

pH: 1:1 soil/ water, wt./vol ratio

Soil K and S – based on Mehlich-3 extraction procedure followed by ICP analysis.

NITROGEN MANAGEMENT RESEARCH IN LOUISIANA SUGARCANE PRODUCTION SYSTEMS

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Summary

Field trials were conducted at the LSU AgCenter Sugar Research Station in St. Gabriel and on producer's fields in Napoleonville, LA to address the objectives of this project. The effect of N sources containing different N forms, *i.e.*, nitrate (NO_3), ammonium (NH_4), and urea was evaluated. Also, the performance of sensor-based N recommendation + N-rich strip technology (Sensor+N-Rich) and best management practices (BMPs) was compared to a Farmer's standard practice using a replicated strip trial on Commerce silty clay loam soil and on a production field in Napoleonville. Sugarcane response to increasing N rate (0, 40, 80, and 120 lbs/acre) was also evaluated to validate the LSU AgCenter current nitrogen recommendation for sugarcane. Cane tonnage, quality components, and sugar yield were determined at harvest. The effect of N source on sugarcane productivity was significant on Commerce silt loam soil but not on the Sharkey clay soil. Urea application returned the highest sugar yield suggesting its potential as N source in sugarcane production. Sugarcane on light textured-soil significantly responded or had greater response to N rate compared on heavy-textured soil with sugar yield optimized at a rate as low as 40 lbs N/acre. In the strip trial at the research station, the N recommendation by Sensor+N-Rich and BMPs was lower by 50 lbs N/ac than the Farmer's standard N practice but resulted in sugar yield reduction at a value of $82.90. For the Sugar Model Farm, 15 lbs N/ac was saved yet attained a 1,114 lbs/ac increase in sugar yield increasing the gross production value by $206 in reference to the Farmer's standard N practice. The outcome of these studies demonstrated that maximizing sugarcane productivity does not require high N application rates. The right application rate combined with the right choice of N source can optimize sugarcane yield.

Objectives

This project was designed to: 1) evaluate the potential of different N sources for sugarcane production in Louisiana, (2) evaluate the performance of Sensor+N-Rich as a N decision tool, and (3) validate the LSU AgCenter nitrogen recommendation for sugarcane.

<u>Effect of Nitrogen Sources on Sugarcane Productivity</u>

The effect of N source was significant on both cane and sugar yield on Commerce silt loam soil (p<0.05) while sugarcane on Sharkey clay soil did not respond to N fertilization (Figures 1 and 2). The application rate was set at 80 lbs N/acre for all the N sources used in this study. The application of urea (45-0-0) resulted in the production of the highest cane tonnage at 32.8 ton/acre and sugar yield at 7,562 lbs/acre compared to the other sources, *i.e.*, urea ammonium nitrate (UAN, 32% N) solution, Amidas® (40-0-0-5.5), and urea + ammonium sulfate (24-0-0-21) which only averaged at 28.5 tons of cane and 6,333 lbs sugar per acre. On the other hand, the 50:50 mixture of UAN and calcium nitrate solution or UAN-CN had comparable effect (not statistically significant) as urea on cane productivity with tonnage recorded at 29.6 ton/acre and sugar yield at 6710 lbs/ac. The untreated cane on Sharkey clay soil attained 28.4 ton/acre and 6,831 lbs

sugar/acre; these production levels were very similar to N-fertilized cane across sources. Similar to previous years' results, there were no significant differences among the treatment means for all the quality components (Brix, TRS, polarity, purity, and sucrose; data not shown). The lack of response of quality components to treatments like N source is commonly observed in sugarcane. If there is any, the common trend is that TRS declines with fertilizer rate or the unfertilized sugarcane having the highest TRS. Sugar yield is determined as the product of cane yield and TRS. The significant increase in sugar yield documented in this study was a result of improvement in cane tonnage.

Using the cane tonnage data on Commerce silt loam soil, the lowest amount of N needed to produce a ton of cane was 7.2 lbs using urea as N source. Higher N was applied using Amidas (13.3 lbs), UAN (11.1 lbs), and UAN-CN (10.1 lbs). The ultimate productivity is determined by sugar yield. An increase of 2,000 lbs per ac is approximately equivalent to $440 additional gross production value with the price per lb sugar at $0.22. The sugar yield of urea-treated cane was higher by 1,229 lbs/ac compared to the average yield of rest of the N-treated cane making the gross production value of this treatment (urea) higher by $270.38 per acre.

Evaluation of Nitrogen Recommendation Approach

A replicated strip (plot size: 5 rows x 400 ft long) trial was conducted to evaluate the impact of different BMPs on sugarcane productivity. The treatments included the farmer's standard N practice (Farmer's Standard; uniform application of N at 120 lbs/ac), sensor-based N recommendation in combination with N-rich strip technology (Sensor+N-Rich), and the BMPs which constituted the Sensor+N-Rich, sweep-residue and cover cropping. Table 1 shows the average stalk and sugar yield, and TRS for these treatments along with the N rate applied. While mean yields among these treatments were statistically the same, the Sensor+N-Rich and BMPs N rate recommendations were lower by almost 50 lbs N/ac than the Farmer's Standard, sweep-residue, and cover cropping. The equivalent saving was $40/acre but was not enough to offset the cost of sugar yield reduction at $82.90. At the Sugar Model Farm in Napoleonville, the average cane and sugar yield levels of the BMP blocks was higher than the Farmer's Standard (Figure 3). On average, the BMP received 15 lbs lesser N than the Farmer's Standard keeping the cane tonnage and sugar yield 3.2 ton/ac and 1,114 lbs/ac higher, respectively making the total gross production value of BMP higher by $206 than the Farmer's Practice.

Validation of the LSU AgCenter Nitrogen Recommendation for Sugarcane

Three N response trials were conducted in 2022: two on a mixture of silty clay loam and silt loam soil, and one on silt loam soil using Ho12-615 and L01-299 cultivars, both plant cane. The results in the silt loam soil showed that the application of N at 40 lbs/acre increased cane tonnage and sugar yield of Ho12-615 by 5.05 ton/acre and 1,397 lbs/acre, respectively (Figure 4). Further increase in N application rate did not result in better yield than what was attained in plot treated with only 40 lbs N/acre. In fields with heavy-textured soil, Ho12-615 cane tonnage did not respond to N rate and only attained minimal increase in sugar yield (+452 lbs/acre) when applied with 80 lbs N/acre (Figure 5). L01-299 cultivar recorded a 5.7 ton/acre increase in cane yield at 80 lbs N/acre application rate whereas sugar yield was maximized to 9,324 lbs/acre when N application rate was further increased to 120 lbs/acre; yield was higher by 41% and 12% in

reference to 80 lbs N/acre-treated cane and the unfertilized cane, respectively. The current LSU AgCenter N recommendation for sugarcane remains valid.

Acknowledgements

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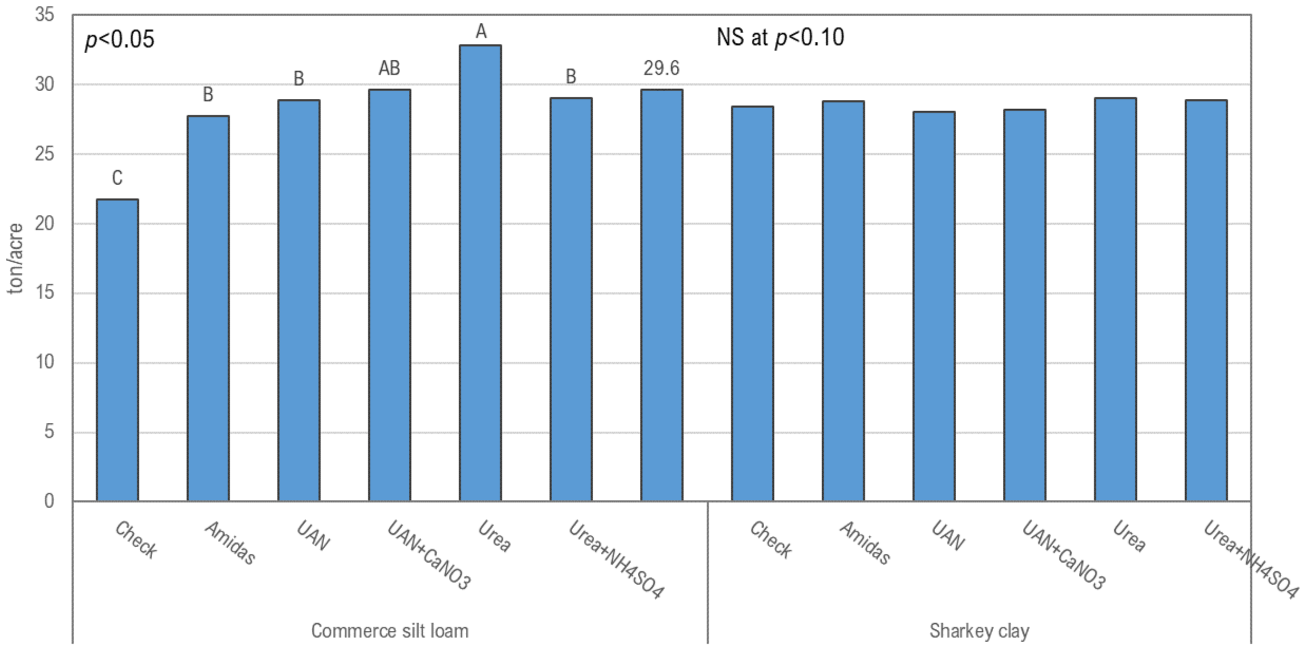


Figure 1. Effect of nitrogen source on tonnage of L01-299 first ratoon crop, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

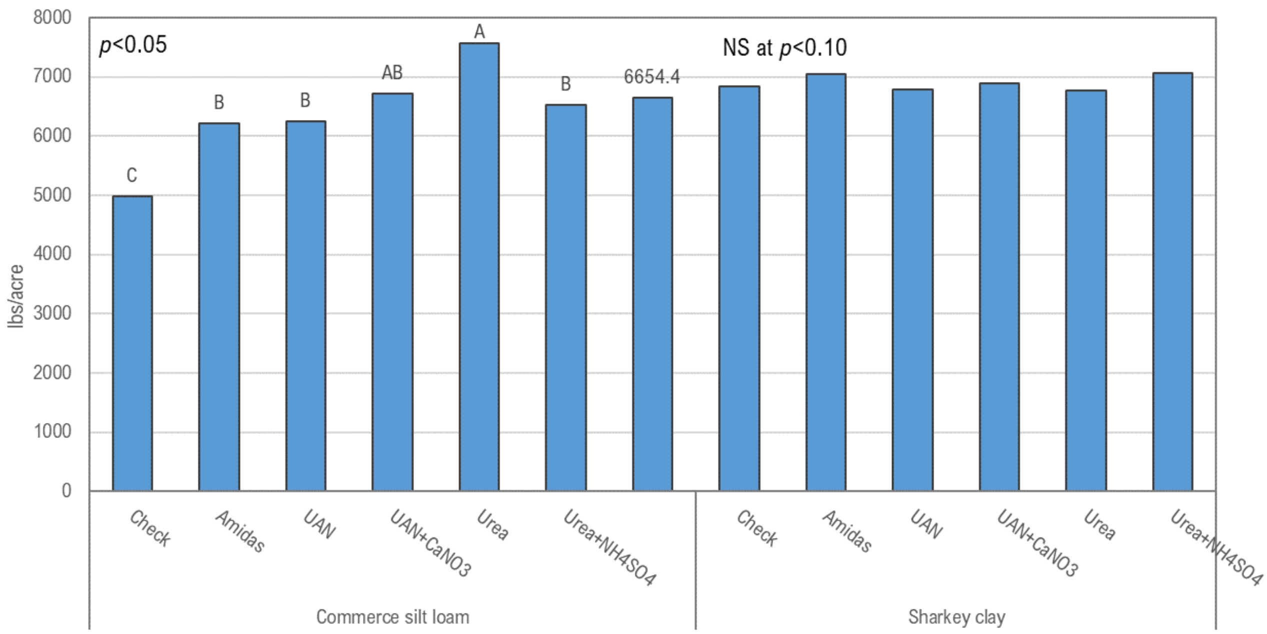
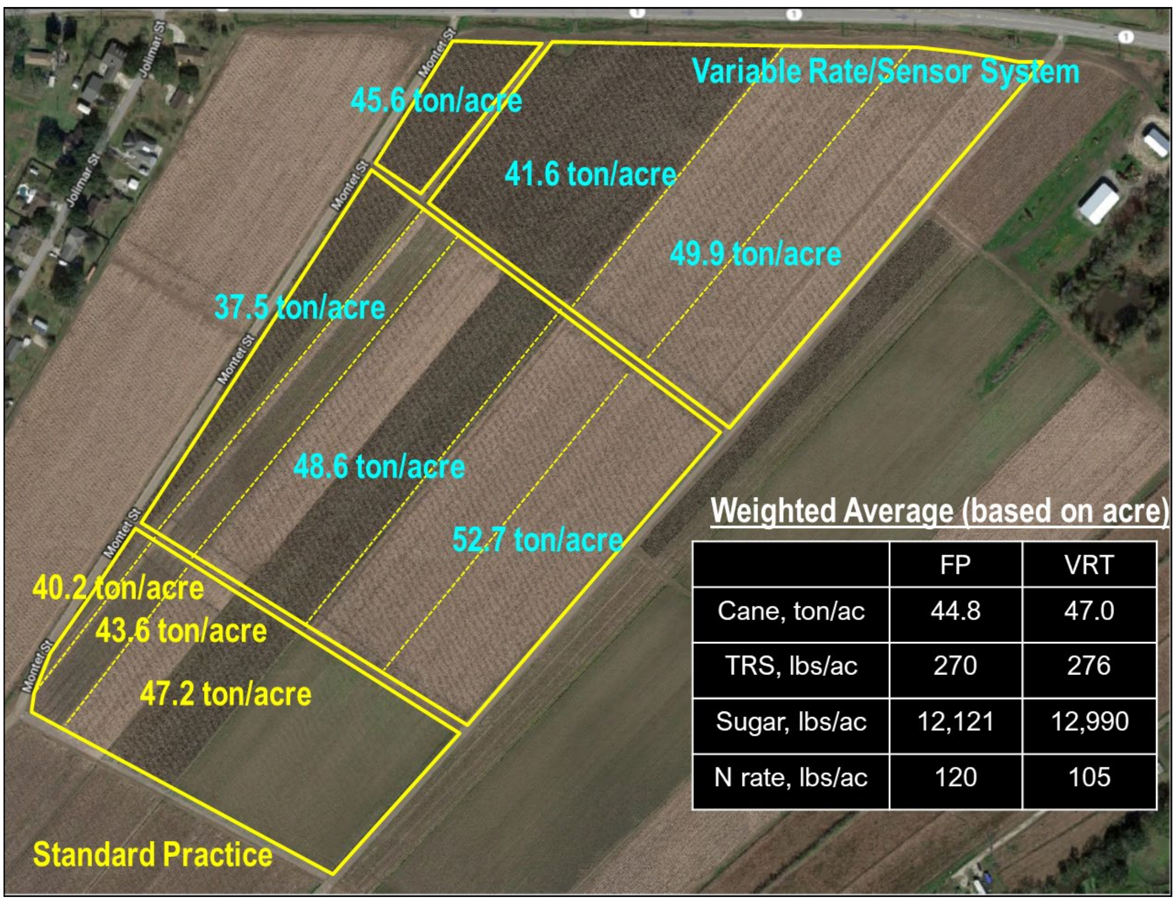


Figure 2. Effect of nitrogen source on sugar yield of L01-299 first ratoon crop, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

Table 1. Mean and analysis of variance of sugar yield and theoretical recoverable sugar of L01-299 second ratoon crop under different best management practices, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.

Treatment	N Applied lbs/ac	Cane Yield ton/ac	Sugar Yield lbs/ac	TRS lbs/ton cane
Farmer's Standard	120	26.7	6136	230
BMPs	76	24.8	5825	235
Cover Crops	120	26.2	5908	226
Sweep-Residue	120	26.3	5951	226
Sensor+N-Rich	66	25.0	5759	231
N-Rich Strip	120	29.7	6605	222
p<value	-	NS	NS	NS

Farmers' Standard: 120 lbs N/ac uniform application; burned residue
BMP's: cover cropping, sweep-residue, VRT
Sweet-residue: residues were swept off from the top of bed
NS: not significant at 0.05 level of confidence. The N-rich strip was not included in the analysis of variance.



	FP	VRT
Cane, ton/ac	44.8	47.0
TRS, lbs/ac	270	276
Sugar, lbs/ac	12,121	12,990
N rate, lbs/ac	120	105

Figure 3. The area distribution of harvested sugarcane in 2022 at the Sugar Model Farm in Napoleonville, LA.

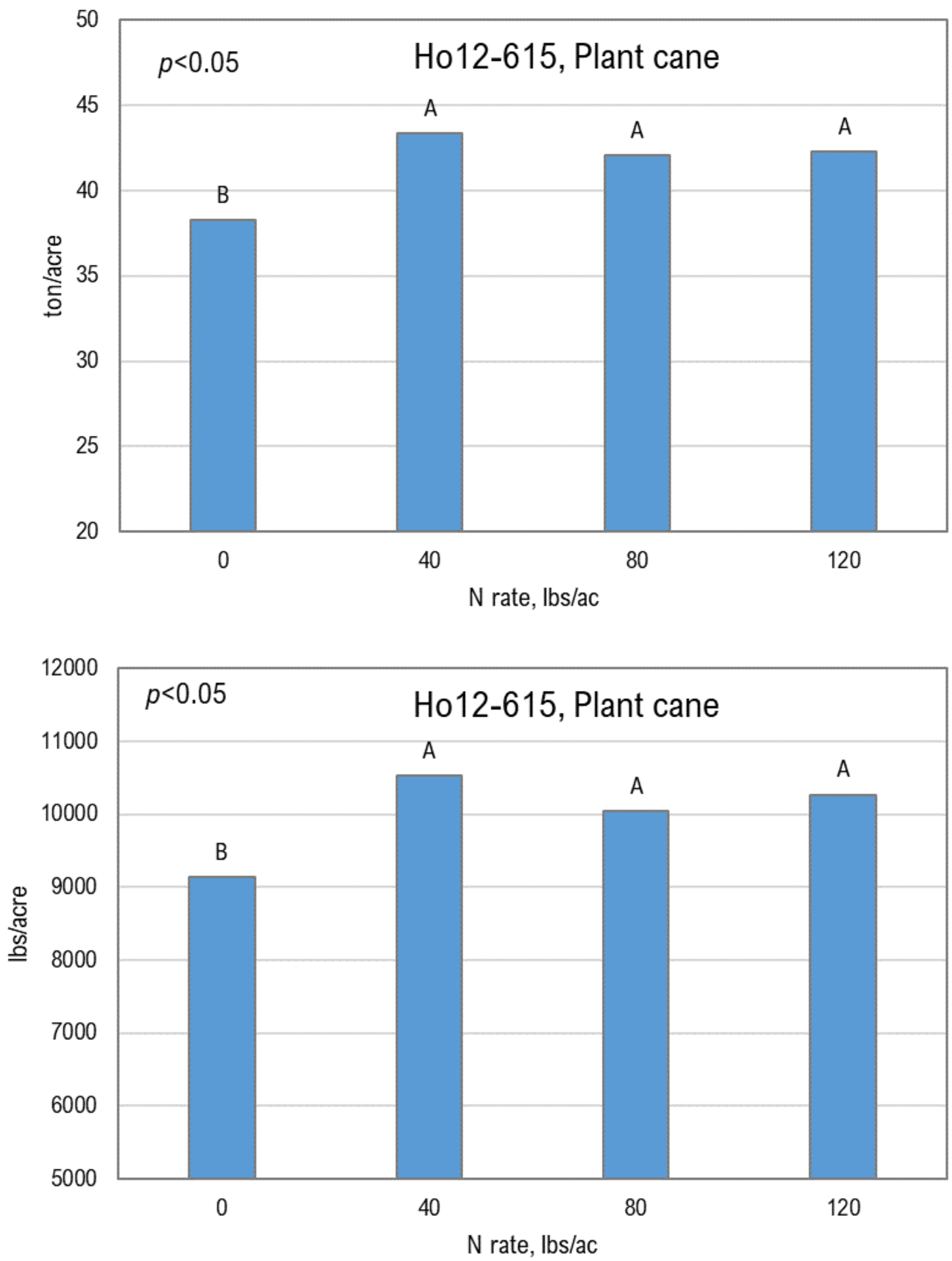
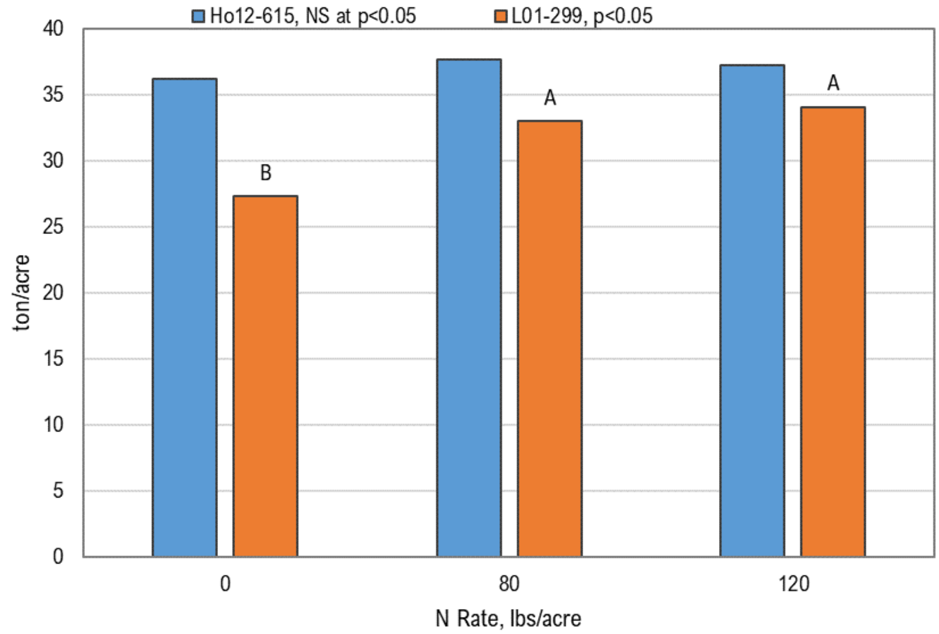


Figure 4. Cane tonnage and sugar yield **r**esponse of Ho12-615 plant cane to increasing nitrogen rate, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.



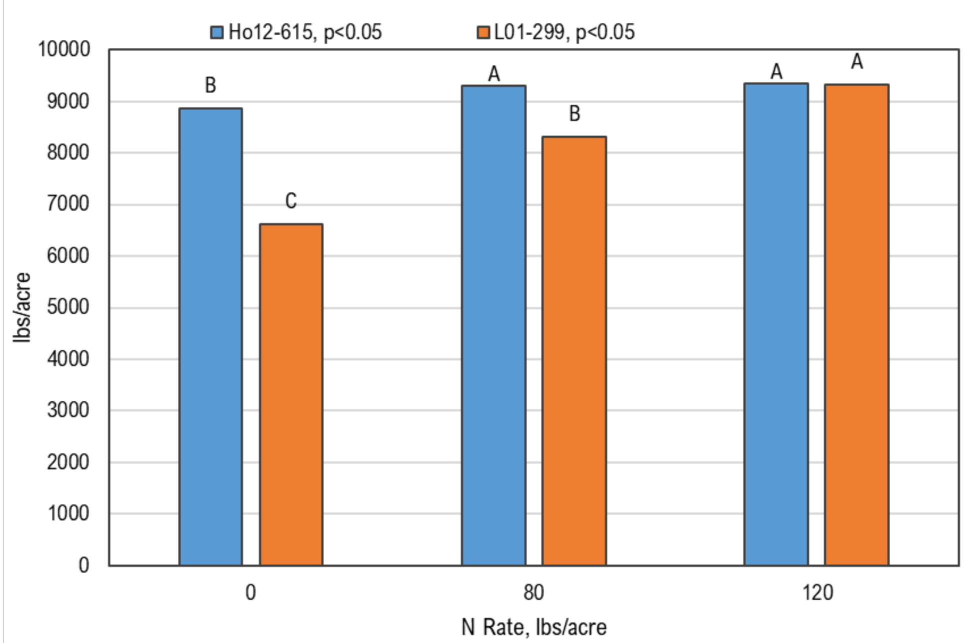


Figure 5. Cane tonnage and sugar yield response of Ho12-615 and L01-299 plant cane to increasing nitrogen rate, LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2022.