SUGAR CROPS PRODUCTION MANAGEMENT RESEARCH AT THE IBERIA AND SUGAR RESEARCH STATIONS

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SUMMARY:

Field trials consisted of **1)** continuing evaluation of the long-term effects of post-harvest residue management on sugarcane; **2)** assessing the efficacy of the nutritional product, HM-0938-A, a Helena® Chemical foliar-applied product; **3)** evaluation of source and amount of sulphur fertilizer; and **4)** assessing the influence of source of trash on sweet sorghum juice quality.

The long-term residue management study was in the plant cane crop of the fifth production cycle. Once again high plant cane yields demonstrate that the debilitating effects of retained residue do not carry over to the plant cane crops. Helena® Chemical’s foliar-applied nutritional product, HM-0938-A, applied at different times and rates did not produce differential sugar per acre yields for the second stubble crop or as an average of three years. Elemental sulfur (S90) applied at the rate of 75 lb S per acre produced higher sugar per acre yield than L 01-299 first stubble plots that received no S. But high application rates of S90 tended to suppress TRS. Fermentable sugar yields were equivalent among sweet sorghum treatments varying in source of vegetative material (whole plant, stripped stalks and stalks with just leaves or panicles). Comparing these treatments for sugar content on a dry weight basis, however, revealed that stripped stalks contained the greatest amounts of sucrose, glucose and fructose compared to the treatments with different sources of trash.

I. LONG-TERM RESIDUE MANAGEMENT STUDY:

A post-harvest residue management study was initiated in 1997 and has continued through the plant-cane crop of production cycle number five. The study has clearly confirmed what other investigations have found, that retention of post-harvest residue generated from green cane harvesting under Louisiana conditions has a negative effect on the cane and sugar yield of ratoon crops within a production cycle.

Generally, burning produces higher cane yield than retaining the residue, with sweeping the residue to the middles producing intermediate yields. What was known only anecdotally was that the negative effects of residue retention did not carry over to the plant-cane crop of subsequent cycles of production. This study consistently demonstrates yield recovery with the initiation of the plant-cane crop of each production cycle, and the plant-cane crop of cycle number five further confirmed that reality. While burning does not always produce superior yields, burning averages approximately 800 lb of sugar per acre more than the other two residue management treatments.

Efficacy of Helena® Chemical Co. Product HM-0938-A on Cultivar L01-299:

Helena® Chemical Co. bio-nutritional product HM-0938-A is a foliar-applied experimental compound that is not commercially available for use in sugarcane. A field trial was conducted in 2014 on plant cane and 2015 and 2016 on stubble crops to evaluate the efficacy of HM-0938-A foliar applied at three rates (1.0, 1.5 and 2.0 pt/A) and two timings (May and June applications) . Each year cultivar L01-299 was fertilized with 120 lb N per acre (32% UAN) prior to the applications of the product. Plots were 3-rows wide and 50 ft in length and replicated four times in a randomized complete block design. The soil type was an Iberia silty clay. Data were recorded for biomass weight and juice quality, and leaf N percentage only for 2015. As an average of three years, there were no significant differences among treatments for pounds of sugar per acre. Nitrogen content of leaves recorded only in 2015 did not reveal any meaningful disparities among the treatments, though average leaf N content was relatively low according to established critical values. Treatments will be applied again next year in third stubble.

Application rate pint/A	Application timing	Sugar/A lb	Leaf % N for 2015
0	0	9,054 a	1.08
1.0	May	8,869 a	1.15
1.5	May	9,503 a	1.05
2.0	May	9,427 a	1.04
1.0	June	10,053 a	1.14
1.5	June	9,241 a	1.17
2.0	June	8,880 a	1.11

Means in a column followed by a common letter are not significantly different at P = .05

Response of L 01-299 to Different Sources and Rates of Sulphur Fertilizer:

A field trial on L 01-299 first stubble was initiated in 2016 using two sources of sulphur, ammonium thiosulfate and elemental S, and three application rates, 25, 50 and 75 lb per acre, in addition to a control. The soil type was a Baldwin silty clay loam, soil that is typical of the "heavy" soil texture types used in the sugar growing region of Louisiana. The best treatment relative to the control was S90 applied at 75 lb per acre, which gave significantly more cane and sugar yield than the 0 application rate. Similar to N fertilization, however, the higher rates of S90 tended to lower TRS. These data confirm the recommended practice of applying sulphur on heavy soil and on stubble crops.

Source	Rate	TRS	Tons/A	Sugar/A lb
Control	0 lb/A	214 a	28.5 bc	6087 bc
ATS	25 lb/A	221 a	31.3abc	6864ab
ATS	50 lb/A	213 a	32.7ab	6948ab
ATS	75 lb/A	219 a	30.7abc	6712ab
S90	25 lb/A	221 a	27.8 bc	6158 bc
S90	50 lb/A	206 a	25.9 c	5365 c
S90	75 lb/A	208 a	35.7a	7433a

Means in a column followed by a common letter are not significantly different at P = .05

Influence of Source of Trash on Sweet Sorghum Juice Quality:

Samples of sweet sorghum varying in amount and source of vegetative material (trash) were processed to determine juice yield, Brix, and fiber. Calculations were also made for total fermentable sugar on a wet weight basis and sugars in juice content on a dry matter basis (sucrose, glucose and fructose determined by HPLC). In general, as vegetative material content increased, fiber, dry weight and juice yield increased, while Brix and purity decreased. As shown in the table below, total fermentable sugar production was not affected by trash, which theoretically suggests processing on a whole-plant basis should be possible without affecting sugar recovery (note that calculations for total fermentable sugar did not include an arbitrary milling extraction percentage). Harvesting, hauling and milling efficiencies, however, are favored by clean biomass represented by the stripped stalk data in this study, as trash is costly to separate and haul and interferes with recovery of sugars. Lower purity with additional trash also affects the quality end products at factories and refineries. On a dry weight basis, however, sugars in juice were affected by trash level. Compared to stripped stalks , the percentage reduction in sucrose averaged over years was 10.7, 21.8 and 29.3 %, respectively, for stalks with panicles, stalks with leaves and stalks with both panicles and leaves. Panicles contributed less to total biomass than leaves and, therefore, did not influence sugar recovery as adversely as leaves on a dry weight basis.

Trash treatment	Brix	Fiber	Purity	Dry weight	Juice yield	Total fermentable sugar	Sucrose	Glucose	Fructose
	%			Mg ha^{-1}			g g dry weight^{-1}		
Whole plant	14.5c	19.9a	83.2b	10.3a	43.0a	5.3a	0.43	0.06	0.03
Stalks + leaves	14.8ab	18.1ab	83.5b	9.1b	42.5a	5.3a	0.48	0.06	0.04
Stalks + panicles	15.1ab	17.3bc	86.4a	7.8c	38.9b	5.1a	0.55	0.06	0.03
Stripped stalks	15.3a	16.0c	87.6a	7.2c	38.7b	5.3a	0.61	0.07	0.03

Means in a column followed by a common letter are not significantly different at P = .05

RESEARCH ON SOIL FERTILITY IN SUGARCANE PRODUCTION

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Summary

Field trials were conducted in 2016 to evaluate millable stalk and sugar yield responses to different rates and sources of potassium (K) and silicon (Si). For the K response trial, treatments included muriate of potash (MOP) applied at 60, 120, 180, and 240 lbs K/ac, and 120 lbs K/ac application rate using Aspire, MOP + K magnesium (Mg) and MOP + boron (B) blend as K sources. The Si study consisted of dry and liquid sources of Si as treatments. Dry fertilizers (Wollastonite and three slags) were applied at rates which supplied 300 lbs Si/ac whereas liquid sources were either applied to soil (band), foliage, and mixed with urea ammonium nitrate solution (UAN). All treatments for these studies were replicated four times and arranged in a randomized complete block design. The effect of K fertilization on millable stalk, sugar yield, population, and fiber content was significant (*P*<0.05). However, based on mean separation procedure the differences among these variables for plots which received 30 to 240 lbs K/ac were not significant. At the same rate of 120 lbs K/ac, MOP + B blend tended to have the highest sugar yield compared to other sources of K i.e., MOP and MOP + KMg). Leaf Si content was significantly affected by Si treatment wherein the highest value was recorded from plots treated with wollastonite and two of the three slags. There were also notable changes on several soil chemical properties including soil Si, pH, and electrical conductivity (EC). Even with all these significant effects, the millable stalk and sugar yield were not affected by Si fertilization.

Objective

This research was designed to provide information on K and Si fertilizer management to sugarcane to help growers maximize yields and profitability of sugarcane production. This annual progress report is presented to provide the latest available data on certain practices and not as final recommendation for growers to use all of these practices.

Results

Sugarcane Yield Response to Different Rate and Source of K Fertilizer

The treatment effect on millable stalk, sugar yield, population, and fiber content was significant (*P*<0.05; Table 1). Based on mean separation procedure, the highest millable stalk yield was obtained from plots treated with 30 lbs/ac and 240 lbs/ac as MOP, and 120 lbs K/ac as Aspire and MOP + B blend. When it comes to sugar yield, the difference was only found significant between control and all K-treated plots (with the exception of MOP + KMg). Aspire and MOP + B blend-treated plots obtained significantly higher millable stalk than plots treated with MOP only and

MOP + KMg whereas on sugar yield, MOP + KMg had the lowest yield which was almost similar to the control.

The treatments had little effect on soil chemical properties; only calcium (Ca) and B content of soil were significantly affected by treatment (Table 2). Aspire treated-soil had the highest B content based on hot-water extraction procedure. While there were differences in soil Ca, it is likely that these differences did not interfere with cane growth because these Ca levels are non-limiting and that the resulting (Ca+Mg)/K ratios were considered normal (~18). Stalk B, K, and sulfur (S) content responded to the treatments. The B content of stalk was higher in control and 30 lbs K/ac treated plots than the rest of the treatments (Table 3). Even if the addition of B to soil enhanced B content and B uptake by cane, the inherent immobility of B in the plant may explain the lack of subsequent increase of B in the stalk (sink). While soil K was not significantly affected by the treatments, the trend was consistent with the stalk K content, i.e. the highest stalk K was obtained from the plots with the highest soil K.

The total amount of nutrients removed by stalk is reported in Table 4. The treatments which obtained the highest millable stalk yield also removed the highest amount of nutrients. For example, plots which received 30 lbs K/ac as MOP (50.7 ton/ac) and 120 lbs K/ac as MOP + B blend (51.1 tons/ac) had the highest copper (Cu), iron (Fe), Mg, and phosphorus (P) removed. On the other hand, the high %K and %S in stalk in addition to high millable stalk yield contributed to higher K and S removal rate by cane in several treatments. Aspire treated cane (49.1 tons/ac, 0.303% K in stalk) removed 91 lbs K/ac whereas cane treated with MOP + KMg (47.7 tons/ac, 0.0658% S in stalk) removed 19.5 lbs S/ac; these were the highest amount of K and S removed across the treatments.

There were significant positive responses to K sources but the lack of linear relationship between K rate and yield (millable stalk and sugar yield) made the interpretation of the results quite complex. The application of 30 lbs K/ac resulted in similar increase in sugar yield as those plots which received higher K rates (regardless of source). Keeping the K rate similar (120 lbs/ac), the blending of B with MOP resulted in higher yield than MOP + KMg but similar with MOP and Aspire. It seems that the addition of B had shown positive impact to sugarcane productivity but because the K with added B was applied at 120 lbs/ac and the optimal K requirement (based on yield data) was only 30 lbs/ac, a direct comparison was difficult to make. The soil samples were taken post-harvest and it is possible that the added K from fertilization was taken up by cane leaving behind soil K levels that were almost the same across the treatments. This is also true for soil B wherein only Aspire-treated plot maintained an elevated level of soil B.

Effect of Silicon Fertilization on Sugarcane Yield

The effect of Si application on yield, quality components, leaf Si, and stalk Si is reported in Table 5. Of all these variables, only leaf Si was significantly affected by the treatment. The application of wollastonite, slag 1 and slag 2 significantly increased leaf Si content of cane ($P<0.05$). Stalk Si on the other hand was not affected by Si fertilization. Brix, sucrose, and purity values were very similar across the treatments whereas theoretical recoverable sugar (TRS) tended to be higher in plots treated with solution Si 1 (foliar and mixed with UAN) and K_2SiO_3 foliar applications. On average, the millable stalk and sugar yield of Si treated plots were numerically higher by 3 ton/ac and 863 lbs/ac, respectively than those of the control. However, the high variability among the replicates within treatments did not produce a level of confidence that is high nor significant.

There were notable changes on several soil chemical properties brought about by the application of dry Si sources (Table 6). Soil Si, pH, and EC were increased in plots treated with dry Si sources. In addition to this, increases in Ca content of the soil was recorded for plots treated with dry Si source; this was also observed in plots treated with solution Si 1 (soil-band application). Solution Si 1 and 2 had significant positive impact on soil zinc (Zn) and Cu content. This change in soil Cu content was also observed in Cu measured in cane stalk (Table 7)). There was an apparent reduction in stalk manganese (Mn) content for cane treated with dry Si sources. The rest of the plant-essential nutrient content of the stalk were not affected by Si application. The removal rate of Si and some plant-essential nutrients by stalk showed no significant response to the treatments (Table 8). However, in terms of pattern, Si treated plot tended to have higher Si removal rate than the control; this was also true for all other nutrients except for Mn which tended to decrease for cane treated with dry Si source.

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Table 1. Millable stalk, sugar yield and primary components of L01-299 cane variety (plant cane) treated with different rate and sources of K, St. Gabriel, 2016.

Source	**Rate**	**Millable Stalk**	**Sugar yield**	**BRIX**	**Population**	**TRS**	**Sucrose**	**Fiber**
	lbs/ac	ton/ac	lbs/ac	%	#/ac	lbs/ton	%	%
Control	0	44.5 d	10922 c	20.4	38216 c	247	17.4	12.3 ab
MOP	30	50.7 a	12268 ab	19.6	45604 ab	234	16.6	12.3 ab
MOP	60	47.3 bc	12235 ab	20.2	46945 a	249	17.5	12.4 ab
MOP	120	46.2 cd	11958 ab	20.0	420811 abc	249	17.4	11.8 c
MOP	180	47.2 bc	11944 ab	19.9	38149 c	244	17.1	11.7 c
MOP	240	50.9 a	12569 a	19.6	38077 c	240	16.8	12.1 bc
Aspire	120	49.1 ab	12328 ab	19.8	42383 abc	244	16.9	11.8 c
MOP + KMg	120	47.7 bc	11670 bc	19.8	37846 c	236	16.7	12.5 ab
MOP + B Blend	120	51.1 a	12703 a	19.8	41241 bc	241	17.0	12.7 a
	P-value	**0.003**	**0.019**	**0.713**	**0.02**	**0.753**	**0.746**	**0.007**

TRS – theoretical recoverable sugar

Table 2. Chemical properties of soil treated with different rates and sources of K.

Source	**Rate**	**pH**	**Mehlich-3 Procedure, mg/kg**							**mg/kg**	**DTPA, mg/kg**			
	lbs/ac		Ca	Cu	Mg	P	K	S	Zn	B†	Cu	Fe	Mn	Zn
Control	0	7.5	1483 c	2.06	336	13.6	103	9.48	2.14	0.343 c	0.857	26	6.1	0.56
MOP	30	7.1	1734 ab	2.34	329	12.4	113	9.51	2.10	0.374 c	1.132	33	7.5	0.64
MOP	60	7.5	1518 c	2.04	328	12.7	110	9.11	1.88	0.383 bc	0.842	24	5.6	0.52
MOP	120	7.7	1840 a	2.16	334	12.4	119	9.24	2.21	0.326 c	0.942	27	6.2	0.58
MOP	180	7.6	1488 c	2.15	322	13.8	114	8.88	2.01	0.358 c	0.894	23	5.6	0.48
MOP	240	7.4	1455 c	2.06	317	12.8	116	8.96	1.95	0.327 c	0.893	27	6.2	0.54
Aspire	120	7.0	1506 c	2.47	335	15.0	130	9.62	2.26	0.529 a	1.196	33	8.1	0.70
MOP + KMg	120	7.4	1538 bc	2.30	350	13.1	112	9.61	1.98	0.475 abc	1.005	26	6.5	0.56
MOP + B Blend	120	6.9	1483 c	2.39	329	13.2	116	9.37	2.15	0.392 bc	1.156	32	7.6	0.68
	P-value	**0.196**	**0.05**	**0.64**	**0.65**	**0.56**	**0.107**	**0.394**	**0.296**	**0.068**	**0.373**	**0.282**	**0.335**	**0.344**

† - hot water extraction procedure

Table 3. Stalk elemental composition of plant cane variety L01-299 treated with different rates and sources of K.

Source	**Rate**	**B**	**Ca**	**Cu**	**Fe**	**Mg**	**Mn**	**P**	**K**	**S**	**Zn**
	lbs/ac	mg/kg	%	mg/kg	mg/kg	%	mg/kg	%	%	%	mg/kg
Control	0	2.03 a	0.055	1.83	18.2	0.064	7.06	0.0384	0.163 e	0.0390 c	6.18
MOP	30	2.18 a	0.064	2.01	22.6	0.069	6.65	0.0466	0.209 bcde	0.0418 bc	7.68
MOP	60	1.26 c	0.056	1.61	17.8	0.066	6.91	0.0426	0.199 cde	0.0389 c	5.63
MOP	120	1.61 abc	0.060	1.69	19.1	0.066	6.98	0.0370	0.181 de	0.0396 c	5.80
MOP	180	1.48 bc	0.059	1.87	21.4	0.066	6.85	0.0413	0.289 a	0.0445 bc	6.03
MOP	240	1.83 ab	0.058	1.73	18.0	0.064	7.01	0.0413	0.252 abc	0.0421 bc	6.31
Aspire	120	1.48 bc	0.056	1.80	20.7	0.062	6.72	0.0441	0.303 a	0.0411 bc	6.15
MOP + KMg	120	1.73 ab	0.060	1.74	20.5	0.067	7.39	0.0425	0.222 bcd	0.0658 a	7.24
MOP + B Blend	120	1.52 bc	0.058	1.76	21.3	0.067	7.23	0.0507	0.253 ab	0.0473 b	6.94
	P-value	**0.094**	**0.60**	**0.278**	**0.145**	**0.529**	**0.622**	**0.208**	**<0.001**	**<0.001**	**0.36**

Table 4. Stalk nutrient removal rate of plant cane variety L01-299 treated with different rates and sources of K.

Source	**Rate**	**B**	**Ca**	**Cu**	**Fe**	**Mg**	**Mn**	**P**	**K**	**S**	**Zn**
	lbs/ac	lbs/ac									
Control	0	0.053	14.9	0.049 b	0.491 c	17.3 d	0.190	10.4 c	44 d	10.6 d	0.167
MOP	30	0.067	20.0	0.063 a	0.700 a	21.3 a	0.205	14.5 ab	65 bc	12.9 bc	0.240
MOP	60	0.038	16.6	0.048 b	0.522 bc	19.5 abc	0.205	12.6 bc	59 cd	11.4 cb	0.167
MOP	120	0.045	16.9	0.048 b	0.533 bc	18.7 cd	0.198	10.4 c	51 cd	11.0 cb	0.164
MOP	180	0.043	16.9	0.054 b	0.612 ab	19.0 bcd	0.197	11.8 bc	84 a	12.7 bcd	0.174
MOP	240	0.057	17.9	0.054 b	0.554 bc	19.7 abc	0.218	12.8 bc	79 ab	13.0 bc	0.198
Aspire	120	0.044	16.5	0.054 b	0.613 ab	18.4 cd	0.202	13.4 ab	91 a	12.3 cd	0.185
MOP + KMg	120	0.052	17.8	0.052 b	0.605 ab	19.9 abc	0.219	12.6 bc	66 bc	19.5 a	0.217
MOP + B Blend	120	0.049	18.3	0.056 ab	0.673 a	21.1 ab	0.230	16.1 a	81 ab	14.9 b	0.221
	P-value	**0.139**	**0.142**	**0.097**	**0.018**	**0.044**	**0.128**	**0.048**	**<0.001**	**<0.001**	**0.144**

Table 5. Millable stalk, sugar yield and primary components of first stubble HoCP 04-838 treated with different sources of silicon, St. Gabriel, 2016.

Source	**Millable Stalk** ton/ac	**Sugar yield** lbs/ac	**BRIX** %	**TRS** lbs/ton	**Sucrose** %	**Purity** %	**Leaf Si** %	**Stalk Si** %
Control	28.2	7647	21.7	272	18.9	85.5	1.28 d	0.373
Wollastonite	32.5	8906	21.9	273	19.1	85.5	1.67a	0.382
Slag 1	32.0	8763	21.7	272	19.0	86.0	1.61 ab	0.440
Slag 2	31.0	8354	21.6	268	18.7	85.5	1.66 a	0.368
Slag 3	31.0	8415	21.7	270	18.9	85.8	1.32 cd	0.494
Solution Si 1, soil-band	32.0	8689	21.6	273	19.0	86.2	1.27 d	0.507
Solution Si 1, foliar	30.8	8507	21.7	276	19.1	86.2	1.36 cd	0.424
Solution Si 1, mixed w/ UAN	30.0	8290	21.9	276	19.2	86.2	1.34 cd	0.407
Solution Si 2, soil-band	32.0	8445	21.4	264	18.5	85.0	1.41 bcd	0.453
Solution Si 2, foliar	32.2	8685	21.7	268	18.8	85.0	1.53 abc	0.336
K_2SiO_3 foliar	30.0	8163	21.7	276	19.1	86.4	1.36 cd	0.396
P-value	**0.749**	**0.87**	**0.93**	**0.47**	**0.557**	**0.247**	**0.028**	**0.264**

TRS – theoretical recoverable sugar

UAN – urea ammonium nitrate solution

Table 6. Chemical properties of soil treated with different sources of silicon.

Source	**pH**	**EC** µs/cm	**Si**	**Ca**	**Mg**	**P**	**K**	**S**	**Zn**	**Cu**
			---------------------------------------	-------------	-------------	mg/kg	-------------	-------------	-------------	---------------------------------------
Control	5.5 de	41.7 c	19.7 e	615 d	148 cd	14.8	67	6.88	1.42 c	1.55 c
Wollastonite	6.13 ab	50.9 bc	35.8 bcd	770 abc	167 bcd	16.0	68	6.98	1.58 bc	1.68 bc
Slag 1	6.08 abc	78.4 a	40.6 abc	892 a	178 abc	15.2	76	7.90	1.71 ab	1.78 ab
Slag 2	6.00 abcd	58.3 bc	44.2 ab	770 abc	172 abc	15.4	72	7.87	1.50 bc	1.83 a
Slag 3	6.42 a	63.1 ab	51.1 a	825 ab	203 a	16.4	70	7.23	1.53 bc	1.81 ab
Solution Si 1, soil-band	6.04 cde	51.9 bc	29.2 cde	771 abc	193 ab	16.7	73	7.48	1.62 abc	1.83 a
Solution Si 1, foliar	5.64 bcde	48.8 bc	29.0 cde	703 bcd	172 abc	16.5	73	7.82	1.66 abc	1.80 ab
Solution Si 1, mixed w/ UAN	5.41 e	39.2 c	28.7 cde	652 cd	162 bcd	16.4	71	7.47	1.87 a	1.77 ab
Solution Si 2, soil-band	5.74 bcde	54.6 bc	31.4 cde	778 abc	174 abc	15.0	70	7.51	1.54 bc	1.73 ab
Solution Si 2, foliar	5.60 cde	44.0 bc	29.0 cde	676 cd	166 bcd	17.0	75	7.41	1.89 a	1.74 ab
K_2SiO_3 foliar	5.61 bcde	44.7 bc	25.5 cde	661 cd	147 cd	14.5	64	6.83	1.49 bc	1.61 c
P-value	**0.05**	**0.094**	**0.007**	**0.02**	**0.118**	**0.138**	**0.153**	**0.182**	**0.098**	**0.018**

Table 7. Stalk elemental composition of first stubble cane variety HoCP 04-838 treated with different sources of silicon.

Source	**Ca** %	**Cu** mg/kg	**Fe** mg/kg	**Mg** %	**Mn** mg/kg	**P** %	**K** %	**S** %	**Zn** mg/kg
Control	0.0745	1.58 b	27	0.094	24	0.054	0.212	0.038	9.13
Wollastonite	0.0807	1.34 c	29	0.090	18	0.052	0.217	0.031	8.06
Slag 1	0.0818	1.51 bc	28	0.091	19	0.054	0.245	0.034	8.92
Slag 2	0.0833	1.52 bc	29	0.102	20	0.054	0.209	0.038	8.34
Slag 3	0.0796	1.45 bc	26	0.103	17	0.050	0.193	0.039	7.64
Solution Si 1, soil-band	0.0868	1.85 a	32	0.099	22	0.053	0.232	0.033	8.02
Solution Si 1, foliar	0.0807	1.59 b	31	0.101	26	0.057	0.246	0.036	8.96
Solution Si 1, mixed w/ UAN	0.0742	1.53 bc	27	0.089	26	0.059	0.262	0.035	8.00
Solution Si 2, soil-band	0.0738	1.54 bc	27	0.099	22	0.046	0.180	0.029	7.60
Solution Si 2, foliar	0.0664	1.36 c	24	0.082	21	0.051	0.229	0.030	8.04
K_2SiO_3 foliar	0.0809	1.57 b	31	0.094	26	0.051	0.228	0.038	8.56
P-value	**0.918**	**0.043**	**0.58**	**0.802**	**0.057**	**0.720**	**0.411**	**0.319**	**0.792**

Table 8. Stalk nutrient removal rate of first stubble cane variety HoCP 04-838 treated with different sources of silicon.

Source	**Si**	**Ca**	**Cu**	**Fe**	**Mg**	**Mn**	**P**	**K**	**S**	**Zn**
	--- lbs/acre ---									
Control	209	42	0.087	1.52	52	1.34	30	119	21	0.506
Wollastonite	248	52	0.088	1.85	58	1.14	34	142	20	0.524
Slag 1	281	52	0.097	1.81	58	1.24	34	158	22	0.575
Slag 2	229	52	0.094	1.79	63	1.25	34	130	24	0.521
Slag 3	313	49	0.089	1.58	63	1.04	31	120	24	0.474
Solution Si 1, soil-band	323	56	0.116	2.03	63	1.44	34	146	21	0.508
Solution Si 1, foliar	261	50	0.099	1.89	62	1.58	36	154	22	0.560
Solution Si 1, mixed w/ UAN	246	44	0.090	1.60	53	1.53	35	156	21	0.476
Solution Si 2, soil-band	290	47	0.098	1.73	64	1.40	30	114	18	0.486
Solution Si 2, foliar	218	42	0.084	1.58	52	1.33	33	146	19	0.516
K_2SiO_3 foliar	235	48	0.093	1.82	56	1.53	30	137	22	0.510
P-value	**0.248**	**0.740**	**0.166**	**0.615**	**0.526**	**0.39**	**0.918**	**0.498**	**0.772**	**0.881**

NITROGEN MANAGEMENT RESEARCH IN LOUISIANA SUGARCANE PRODUCTION SYSTEMS

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In Cooperation with
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SUMMARY

Demonstration plots on a procedure's field in Donaldsonville planted to HoCP 96-540 (5 acres) and L 01-299 (23 acres) were fertilized with N based on a recommendation of sensor-based N decision tool (variable rate). The yield and net return data was compared with plots under the farmers' standard N practice (120 lbs N/ac). The trial on the effect of N source and application method on sugarcane yield was continued using the following sources: urea (45% N), urea-ammonium nitrate solution (UAN-32% knife-in and dribble), and ammonium-nitrate (AN-34% N) applied at rates of 40, 80, and 120 lbs N/ac; a control plot was included. Treatments were replicated and arranged in a randomized complete block design. The sensor-based/variable rate application system recommended between 50 to 120 lbs N/ac and none (0) to 90 lbs N/ac with average rates of 80 and 70 lbs/ac for HoCP 96-540 and L01-299, respectively. The resulting net return from N application based on sensor readings was $153/ac higher and $62/ac lesser than the farmers' standard N practice for variety HoCP 96-540 and L 01-299, respectively. The association between ground-based sensor readings and those that were derived from aerial-images taken by digital camera attached to a drone was weak. This was partially due to the limitation of digital camera (being passive-type sensor) in the presence of atmospheric noises such as cloud. Knife-in UAN continued to show better outcomes than the rest of the application method/source in terms of sugarcane productivity.

OBJECTIVES

This project intends to evaluate the performance of different decision tools for determining sugarcane N requirement and evaluate the effect of different N sources applied at varying rates on sugarcane productivity.

RESULTS

Nitrogen Optical Sensor Study

The optical sensor/variable N rate application system recommended between 50 to 120 lbs N/ac and 0 to 90 lbs N/ac with average rates of 80 and 70 lbs/ac for HoCP 96-540 and L01-299, respectively. With these application rates, sugar yield level for HoCP 96-540 was increased by about 600 lbs/ac whereas for variety L01-299, there was a reduction by 400 lbs/ac. The resulting net return from N application based on sensor readings was $153/ac higher and $62/ac lesser than the farmer's standard N practice for variety HoCP 96-540 and L 01-299, respectively.

An unmanned aircraft system (UAV) equipped with a digital camera was flown the same day where the normalized difference vegetation index (NDVI) readings were taken by GreenSeeker® ground-based sensors. The aerial-images taken by the digital camera were processed to generate NDVI map. The association between ground-based sensor readings and those that were derived from aerial-images was weak (Figure 1). Aerial image-based NDVI was lower than NDVI measured by ground-based sensor. The linear-plateau model showed that for GreenSeeker-NDVI values higher than 0.61, the aerial image-based NDVI capped at 0.35. The large difference in readings was partially due to the limitation of digital camera (being passive-type sensor) in the presence of atmospheric noises such as cloud.

Effect of Nitrogen Source Applied at Different Rates on Sugarcane Yield

Nitrogen source had no significant effect on yield, quality component, and N uptake (Table 1). On the other hand, both stalk and sugar yield linearly increased with increasing N rate. This response was not observed for theoretical recoverable sugar (TRS), Brix, and sucrose. Responses of these measured variables to increasing N rate were evaluated for each N source (Figure 2). It appears that the benefit of using the right source of N was only observed at lower N rates (i.e. 40 and 80). For example, a minimum of 80 lbs N/ac was needed to raise cane tonnage (from 27 to 35 tons/ac) and sugar yield (from 5726 to 7352 lbs/ac) for knife-in UAN whereas the other sources i.e., urea, AN, and dribble-UAN required 120 lbs/ac application rate to attain the same yield increase. Yield tended to level off with urea as source whereas with AN, yield increased with increasing N rate. With UAN-dribble, increasing N rate increased stalk yield but for sugar yield, there was no further increase observed at N rate higher than 40 lbs/ac.

Acknowledgement

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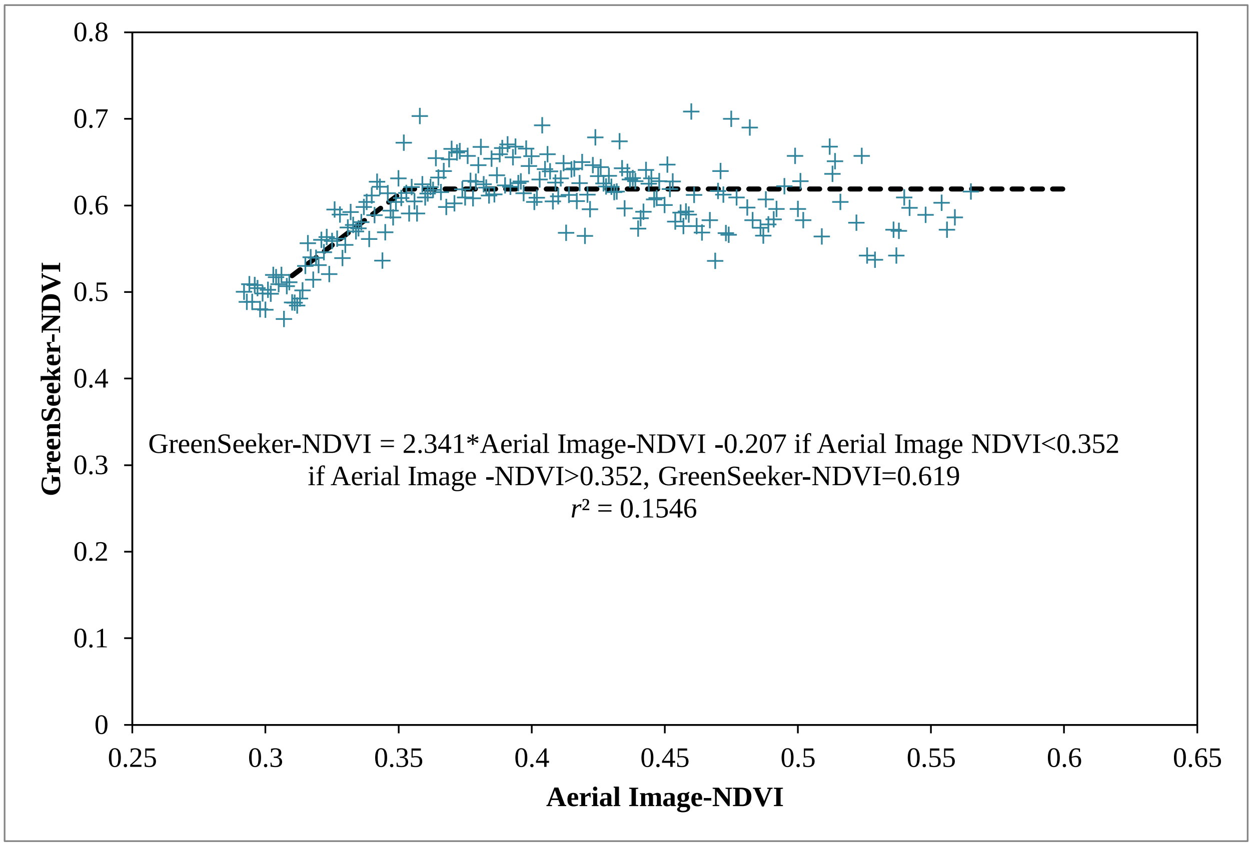

Figure 1. Relationship of normalized difference vegetation index readings taken by GreenSeeker® ground-based remote sensor and NDVI derived from aerial images.

Table 1. Yield, quality components, and N uptake of 2^{nd} stubble cane variety HoCP96-540 treated with different nitrogen rate and source, St. Gabriel, 2016.

Treatment	**Stalk Yield ton/ac**	**Sugar Yield lbs/ac**	**TRS lbs/ton**	**Brix %**	**Sucrose %**	**N Uptake lbs/ton**
N Source						
UAN Knife	30.8	6622	240	18.5	15.3	1.14
UAN Dribble	30.4	6367	235	18.3	15.1	1.36
Urea	30.8	6464	236	18.3	15.1	1.38
NH_4NO_3	32.1	6767	237	18.3	15.2	1.22
P-value	***NS***	***NS***	***NS***	***NS***	***NS***	***NS***
Rate						
0	29.9	5726	236	18.3	15.1	33.2
40	30.8	6646	241	18.5	15.4	43.2
80	31.7	6788	239	18.4	15.3	46.4
120	33.9	7102	234	18.2	15.0	49.2
Linear	***<0.001***	***<0.001***	***NS***	***NS***	***NS***	***<0.01***
Quadratic	***0.24***	***0.14***	***NS***	***NS***	***NS***	***NS***
Cubic	***0.32***	***0.27***	***NS***	***NS***	***NS***	***NS***

NS – not significant at 0.05 level of confidence.

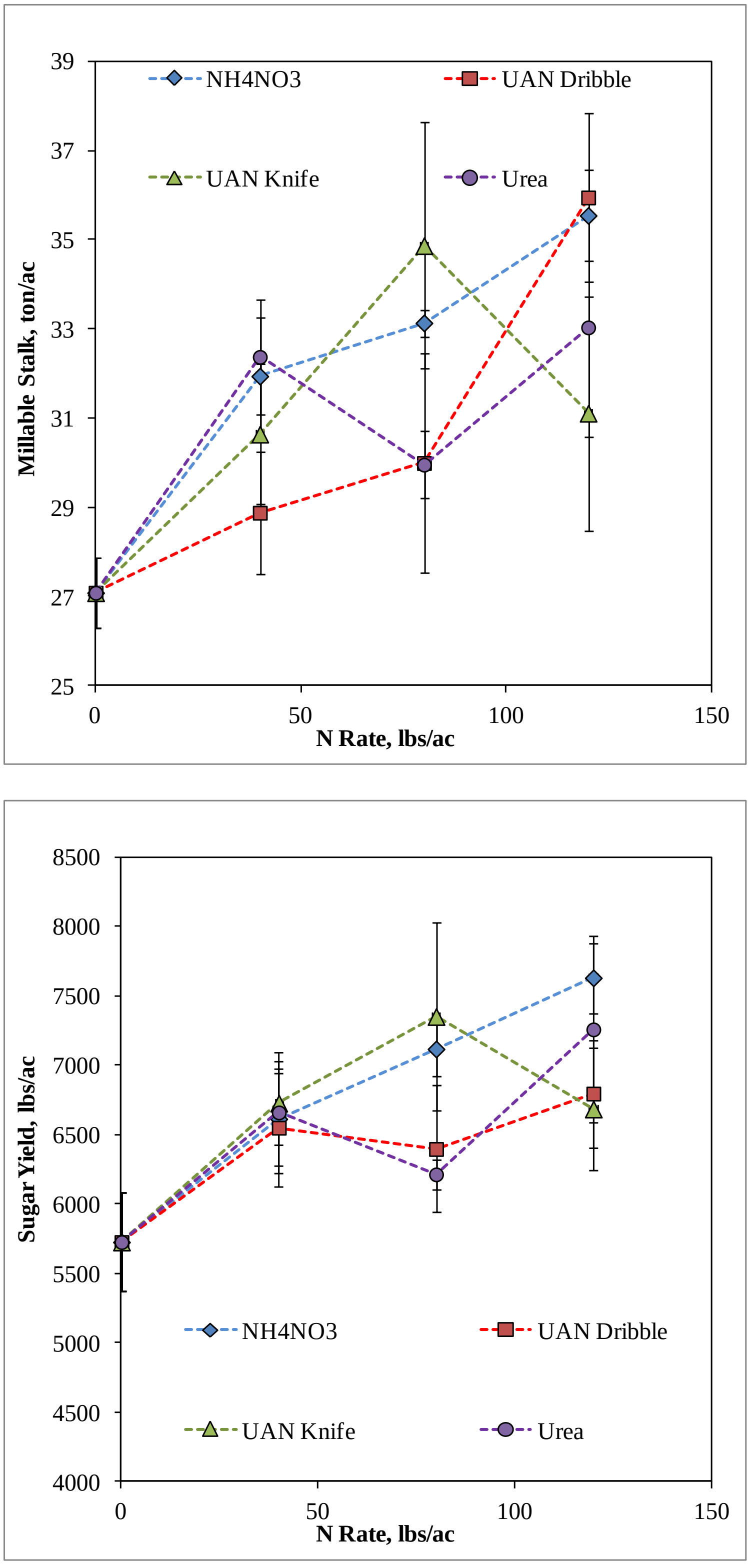

Figure 2. Millable stalk and sugar yield response of cane to varying rates and sources of nitrogen, St. Gabriel, 2016.