NITROGEN MANAGEMENT RESEARCH IN LOUISIANA SUGARCANE PRODUCTION SYSTEMS

Brenda S. Tubaña[1], Payton Dupree[1], Murilo Martin[1], Daniel Forestieri[1], Brandon White[1], Tapasya Babu[1], Sonny Viator[2], and Rich Johnson[3]

[1]School of Plant, Environmental, and Soil Sciences
[2]New Iberia Research Station
[3]USDA-ARS, Houma, LA

In Cooperation with
Sugar Research Station

SUMMARY

Field demonstration plots were conducted in 2014 at three locations, one in St. Gabriel and on two producers' fields in Donaldsonville, LA to test the performance of three nitrogen (N) decision tools for sugarcane production: 1) current LSU AgCenter N recommendation/farmer's standard practice, 2) N recommendation based on cane stalk N removal rate + soil nitrate level, and 3) optical sensor-based N recommendation. Another study was established to evaluate different sources of N fertilizer (UAN-dribble, UAN-knife-in, ammonium nitrate, urea, and coated urea) applied at 40, 80, and 120 lbs/ac. The highest net return from N fertilizer was attained in Donaldsonville 2 at $223/ac higher than the current/farmer's standard practice. However in the other two sites, the savings from applying lesser N rate did not offset the amount of sugar yield lost resulting in $47/ac and $95/ac lower net return than farmers' standard practice in Donaldsonville 1 and St. Gabriel, respectively. Overall, the N recommended based on optical sensor readings and stalk N removal rate + soil nitrate did not consistently deliver positive results. The application of UAN-knife-in at 80 lbs N/ac resulted in the highest sugar yield; the yield level was similar to plots applied with ammonium nitrate and coated urea (slow-release) but at a higher rate (120 lbs N/ac).

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

Performance Evaluation of Nitrogen Decision Tools

This study was established in 2014 at the Sugar Research Station in St. Gabriel (plot size: 9000 ft^2) and two locations in Donaldsonville, LA (plot size of site 1: 12,000 ft^2 and plot size of site 2: 33,000 ft^2) using cane variety L01-299 (1^{st} stubble). The treatments included the current LSU AgCenter N recommendation/farmer's standard practice, N recommendation based on stalk N removal rate + soil nitrate, and optical sensor-based N recommendations. All treatments were replicated three times at each site.

Across the three sites, the N rates recommended based on stalk N removal + soil nitrate and optical sensor were consistently lower than the farmer's standard N practice ranging from 40 to 93 lbs/ac (Table 1). However, positive effect on sugar yield and net return from N fertilization using the optical sensor-based recommendation was only observed in Donaldsonville 2 wherein the sugar yield attained was 9502 lb/ac translating to $223/ac higher net return than the farmer's standard practice. However, the savings from applying lesser N rate did not offset the amount of sugar yield lost resulting in $47/ac and $95/ac lower net return than farmers' standard practice in Donaldsonville 1 and St. Gabriel, respectively. Nitrogen recommendation based on stalk N removal rate and soil nitrate had similar net return in Donaldsonville 2 and $31/ac higher net return in St. Gabriel compared to farmer's standard practice. The availability of sufficient level of N is critical during the active growth of cane. Perhaps the poor performance of optical sensor- and stalk N removal + soil nitrate as N decision tool in Donaldsonville 1 and St. Gabriel can be attributed to late application of N (May 20 and 27, respectively) and high rainfall received near the date of application (May 28 – 5.86 inches of rain). It was observable also that theoretical recoverable sugar was reduced in these sites (data not shown). The N application rate did not affect stalk N content; however, higher stalk N content was observed associated with higher cane tonnage (Figure 1).

Effect of Nitrogen Source Applied at Different Rates on Sugar Cane Yield

Using the standard error to compare treatment means, the highest cane tonnage was attained with the application of UAN-knife in at 80 lbs N/ac and using ammonium nitrate and coated urea (slow-release) but at a higher rate (120 lbs N/ac) (Figure 2). Reduction in TRS was observed for plots which received higher N rates (80 or 120 lbs N/ac) using urea, ammonium nitrate and coated urea. For plots treated with coated urea at 120 lbs N/ac, high cane tonnage did not offset the large reduction in TRS in lower sugar yield than UAN-knife in at 80 lbs N/ac (Figure 3).

The monitoring of ammonium-N and nitrate-N level in the soil at 0-6 and 6-12 inches is summarized in Figure 4. At 21 days after N fertilization, both urea and ammonium nitrate showed clear pattern of ammonium and nitrate content of the soil taken from the two depths with respect to N application rate, i.e. ammonium and nitrate content of the soil increased with increasing N rate. As much as 180 lbs N/ac was measured from plots which received urea with N rate of 120 lbs/ac. The amount of ammonium and nitrate of soils collected from plots which received UAN as source showed no clear pattern with increasing application rate. The average amount of N was noted to be the lowest for UAN both knife-in and dribble applied (~40 lbs N/ac). Three months after N application, the measured amount of ammonium and nitrate in the soil was only ~20 lbs N/ac for all the plots. Based on the standard error value among replications for each treatment, a large variation was obtained from plots treated with urea, ammonium nitrate, and coated urea as opposed to UAN solution and this was more evident at the 0-6 inches depth (Table 2). This suggests that even distribution of N fertilizer was easier to achieve using UAN solution than granular source.

While there was no clear association between measured ammonium and nitrate content in the soils a few weeks after N application and sugar yield, our results showing knife-in UAN (at 80 lbs N/ac) with the highest sugar yield adds veracity of using knife-N UAN as the more effective source and method of N fertilization in Louisiana sugarcane production system.

Acknowledgement

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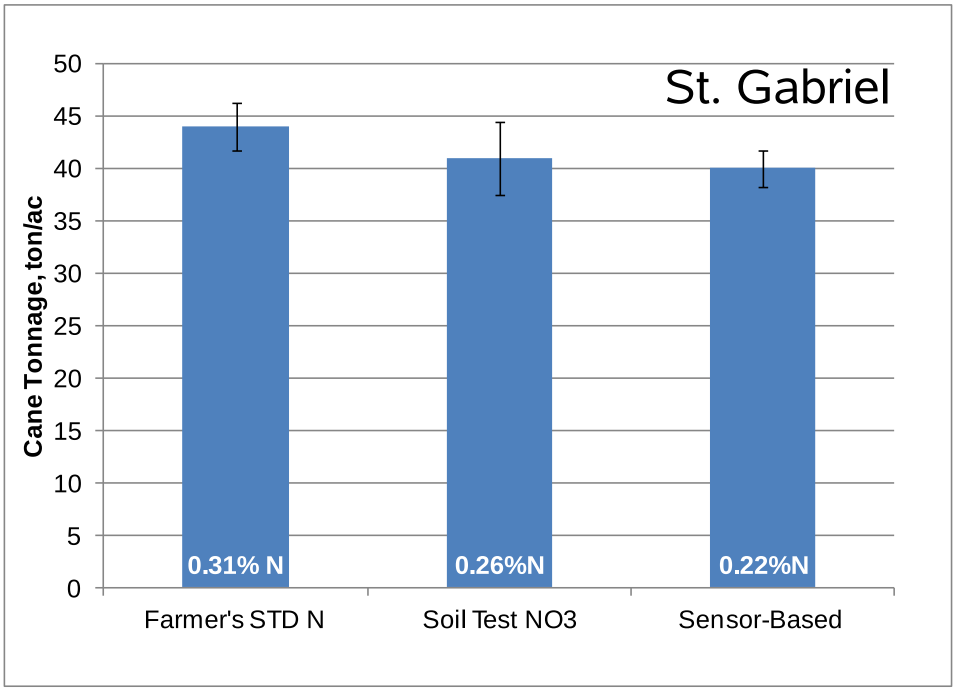
Table 1. Nitrogen rate, sugar yield, and net return of sugarcane applied with N rate based on farmers' standard practice, stalk N removal rate + soil nitrate and optical sensor readings.

Site	N Decision Tool	N Applied	Sugar Yield	Income: Sugar yield		Saving: N fertilizer		Net
		lbs/ac	lbs/ac	lbs/ac	$/ac	lbs/ac	$/ac	$/ac
Donaldsonville 1	Current/Farmer's Std Practice	120	6151					
	Current/Farmer's Std Practice	120	6080					
	Stalk N removal + Soil nitrate	58	5518	-633	-133	-62	37	-96
	Optical Sensor-Based	93	5851	-300	-63	-27	16	-47
Donaldsonville 2	Current/Farmer's Std Practice	120	8668					
	Current/Farmer's Std Practice	120	8349					
	Stalk N removal + Soil nitrate	57	8494	-174	-37	-63	38	1
	Optical Sensor-Based	40	9502	834	175	-80	48	223
SRS	Current/Farmer's Std Practice	120	8847					
	Stalk N removal + Soil nitrate	50	8796	-51	-11	-70	42	31
	Optical Sensor-Based	40	8165	-682	-143	-80	48	-95

SRS – LSU AgCenter Sugar Research Station
Raw sugar price - $0.21/lb
Price of N fertilizer - $0.60/lb
Current/Farmer's Standard Practice – reference to compute for economic return



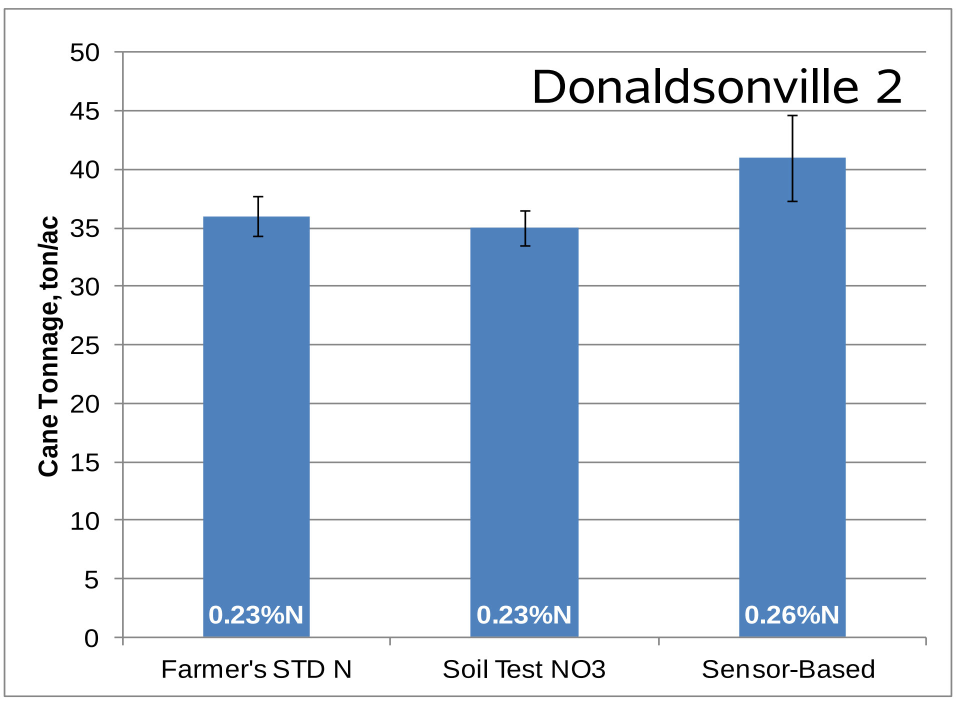


Figure 1. Average cane tonnage and stalk N content (values inside bar graphs) of cane applied with N rates determined by farmer's standard N practice, stalk N rate removal + soil test nitrate, and optical sensor readings.

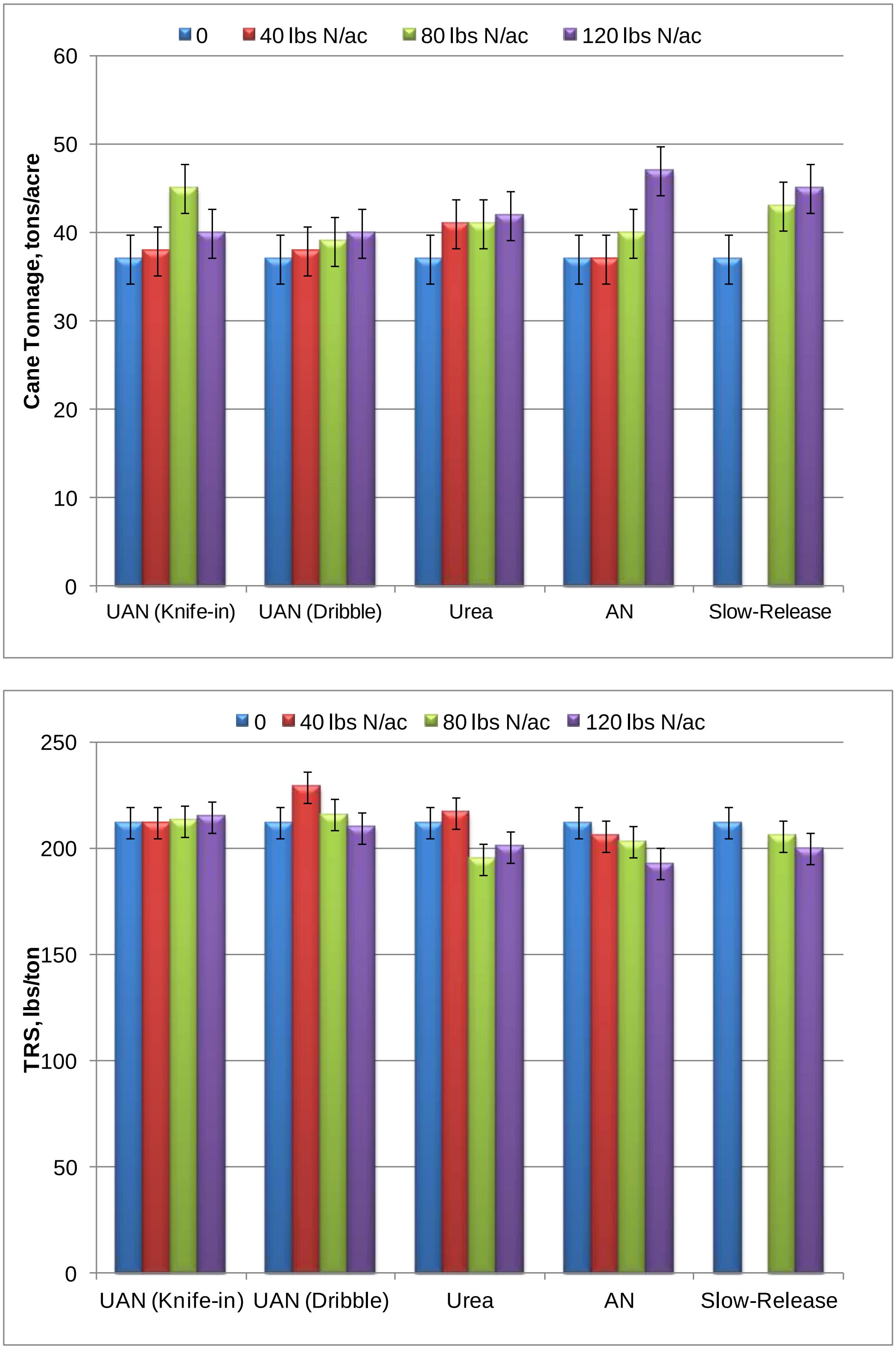


Figure 2. Cane tonnage and theoretical recoverable sugar of plant cane variety L01-299 applied with different N sources and rates, 2014, St. Gabriel, LA.

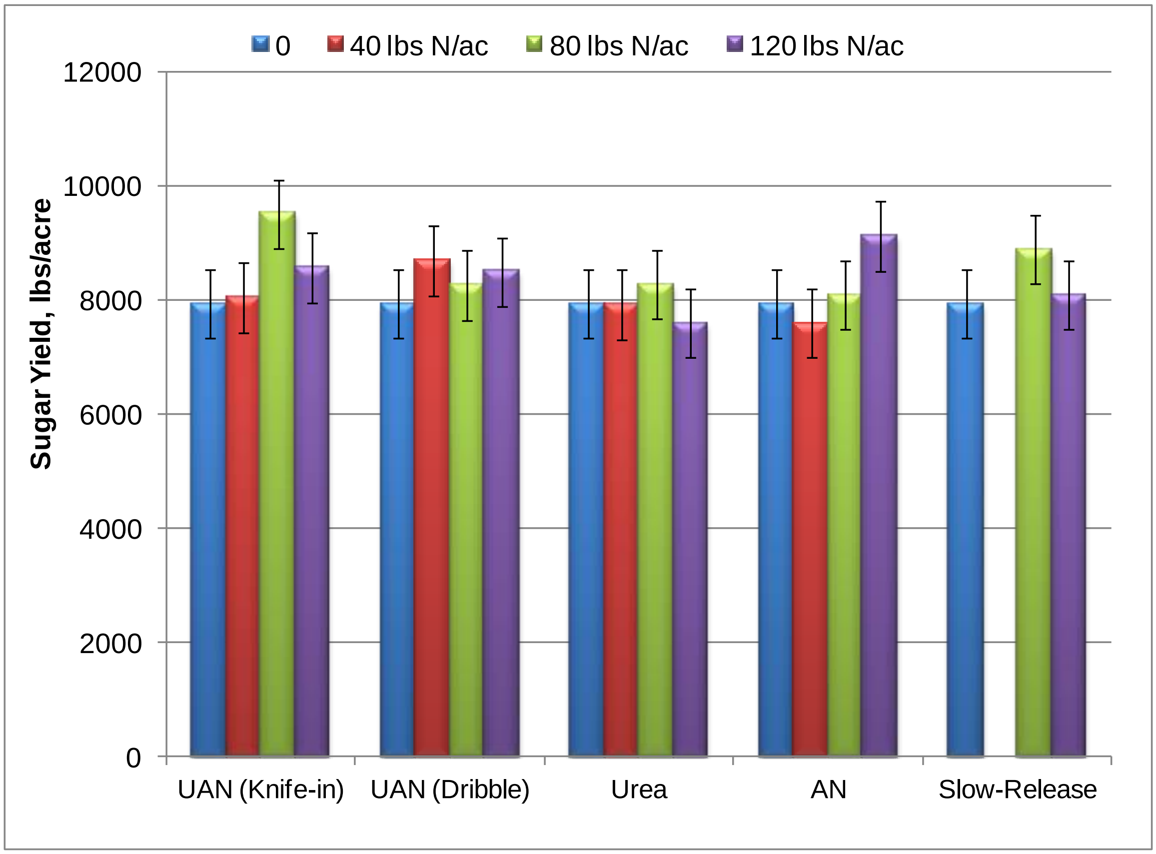


Figure 3. Sugar yield of cane variety L01-299 as affected by N source and rate, 2014, St. Gabriel, LA.

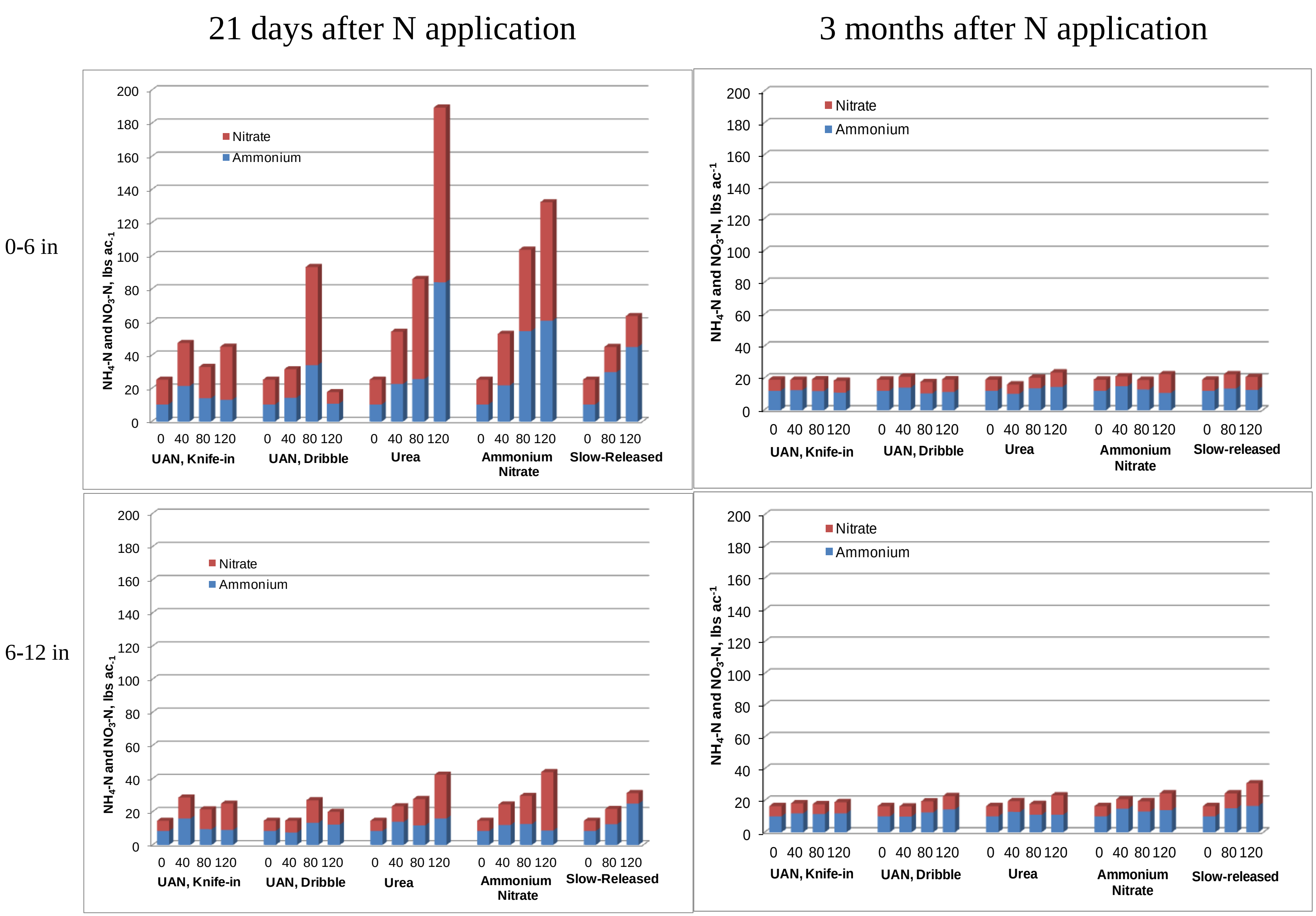


Figure 4. Soil ammonium and nitrate content at 0-6 and 6-12 inches deep 21 days and three months after N application using different N sources at varying rates.

Table 2. Standard error value of ammonium and nitrate content of soil at 0-6 and 6-12 inches 21 days after N application.

N Source	N Rate	0-6 inches		6-12 inches	
		NH_4-N	NO_3-N	NH_4-N	NO_3-N
	----------	----------	--lbs/acre--	----------	----------
Check	0	1.36	5.20	1.36	0.56
UAN (Knife-in)	40	8.40	14.58	6.52	9.32
	80	7.42	20.93	0.56	9.91
	120	4.53	26.57	3.34	9.16
UAN (Dribble)	40	4.23	10.32	1.08	2.91
	80	25.35	63.38	7.38	8.47
	120	1.14	1.15	3.43	3.87
Urea	40	23.52	38.22	7.00	8.88
	80	20.98	54.16	1.68	5.30
	120	72.61	71.70	11.45	12.54
AN	40	13.42	29.18	2.61	9.47
	80	36.34	36.20	4.04	10.66
	120	71.72	37.41	2.15	17.29
Coated Urea	80	97.34	68.44	4.26	5.69
	120	62.11	19.81	29.30	3.52

RESEARCH ON SOIL FERTILITY AND CULTURAL MANAGEMENT PRACTICES IN SUGARCANE PRODUCTION

Brenda S. Tubaña[1], Payton Dupree[1], Marilyn Dalen[1], Saoli Chanda[1], Murilo Martin[1], Wooiklee Paye[1], and Jeff Hoy[2]

[1]School of Plant, Environmental, and Soil Sciences
[2]Department of Plant Pathology and Crop Physiology

In Cooperation with
Sugar Research Station

Summary

Multiple field trials were conducted in 2014 to evaluate cane tonnage and sugar yield responses to different rates and sources of phosphorus and potassium fertilizer, and silicon fertilization rate and timing. Yield and quality parameters of different cane varieties planted using whole stalks and billets were also evaluated. Increasing rate of P fertilizer applied as triple superphosphate resulted in significant increase on sugar yield with 45 lbs/ac attaining the highest yield (P<0.01). These increases in yield corresponded with increases in P level in soil based on Mehlich-3 procedure. Among the sources, the application of phosphorus as MES in 2013 showed positive (residual) effect on sugar yield. An application at rate of 30 lbs K/ac as MOP maximized sugar yield. Evident increases in stalk K content and soil test K level with increasing K rate were observed. Spring application of Si as Plant Tuff at 0.75 ton/ac attained the highest sugar yield by as much as 1000 lbs/ac compared with control plot (no Si applied). There was an evident increase in soil Si for all the plots which received Si fertilizer. Among varieties, L 01-299 and L 03-371 obtained the highest cane tonnage, sucrose, Brix, and TRS (P<0.001). Varieties Ho 02-113, US 72-114, Ho 06-9001, and Ho 06-9002 on average, had ~2x the amount of fiber (20-22.4%) as L 01-299 and L 03-371 produced. Among cane varieties for biofuel/energy production, Ho 02-113 is the most promising because of its high yield potential (highest cane tonnage) and high TRS and fiber content.

Objective

This research was designed to provide information on phosphorus, potassium, and silicon fertilizer management to sugarcane to help growers maximize both economic yields and profitability of sugarcane production. In addition, the performance of different cane varieties in response to planting method (whole stalk vs. billets) was also documented. 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 P Fertilizer

The results of analysis of variance conducted for the primary quality components, cane tonnage, and sugar yield are presented in Table 1. Except for cane tonnage and sugar yield, all measured parameters were not significantly affected by P rates and sources (*P*<0.05). Within TSP as source of P, cane tonnage and sugar yield increased with increasing P rate. Both cane tonnage and sugar yield were optimized with the application of TSP at 45 lbs/ac. It is important to note that only modest amount of MAP and MESZ (20 lbs P/ac) was needed to attain similar cane tonnage and sugar yield level. For plots that were previously (2013) treated with 65 lbs P/ac as MESZ, the additional 20 lbs P/ac applied in 2014 was not necessary to attain maximum cane tonnage and sugar yield. Increasing P rate tended to increase TRS and may have played a role (minimal) in increasing sugar yield. It was evident that the amount of millable stalks (cane tonnage) had a greater impact in sugar yield than TRS. While the effect of P was not significant in population, there was a good agreement between cane tonnage and population response to P treatments. The concentration of select plant essential nutrients is reported in Table 2. Only S content of stalks was affected by the treatments wherein MES with 20 lbs P/ac application for the current year obtained the highest value of 0.1%. Similar results were obtained when the removal rate was subject for analysis of variance (Table 3).

Unlike in the previous year, the effect of P treatment (especially the rate) on soil test P level was very evident in 2014 (*P*<0.05; Table 4). Soil test S appeared to be increasing with increase P rate (TSP source); as source, MESZ obtained the highest soil test S level of 25.49 mg/kg. However, this increased in soil S was not reflected from the S content and removal rate of millable stalks (Table 3). For other nutrients, Zn level in soil (except the plots treated with MESZ) was testing very low. There were few plots with pH level <5.5. This year (2015), lime will be applied to raise the soil pH level of all the plots to ~6.5.

<u>Sugarcane Yield Response to Different Rate and Source of K Fertilizer</u>

The treatment effect on primary quality components, cane tonnage, and sugar yield is summarized in Table 5. While there was a significant effect of K treatments on % Brix (*P*<0.10), the nature of effect (reduction) could not be tied up with rates nor with source. The highest cane tonnage obtained was 48.7 ton/ac from plots treated with 180 lbs K/ac. However, this yield level was statistically the same as the 45.9 ton/ac yield of plots applied with 30 lbs K/ac thus suggesting that this was the optimal K application rate (*P*<0.05). With the same rate at 120 lbs K/ac, EM4-treated plots yielded 2.4 tons/ac and 771 lbs/ac higher cane tonnage and sugar yield than with the same rate of K as MOP (Figures 1A and 1B). It is important to note that for sugar yield, the level of confidence was set at *P*<0.15. The plant-essential nutrient content of stalks is summarized in Table 6. Only Ca and K content were affected by the treatments (*P*<0.10). An evident increasing K content of stalk was observable with increasing K rate (as MOP). Similarly, K removal rate also increased with increasing K rate (Table 7). Very similar pattern was observable on the soil test K and K rate suggesting that the fertilization effectively raised the plant-available K in the soil eventually increasing its uptake by sugarcane (Table 8).

Soil pH and nutrient content of soil determined by Mehlich-3 procedure are presented in Table 8. The treatments significantly affected soil test K and Zn (*P*<0.01). An evident increasing pattern of soil test K with increasing K rate as MOP was observed. This pattern was similar to cane tonnage and sugar yield response to K rate. Soil test K level was increased by at least 30 mg/kg with an application rate of 120 lbs K/ac regardless of source. Soil pH and the rest of plant-essential nutrients measured in the soil were generally at optimum level. The soil Zn level for all the plots except those treated with EM2 and EM4 was below the critical soil Zn level.

Effect of Silicon Rate and Time of Application on Sugarcane Yield

In 2014, this study has reached its 1st ratoon or 2nd cropping year. The treatments included different application rates of Plant Tuff® (12% Si) applied either once at planting, split (at planting and annual spring application), or only in spring (annually) (Figure 2). Based on the standard error, the annual application of 0.75 ton Plant Tuff/ac in spring resulted in the highest sugar yield. This can partly be attributed to higher amount of millable stalks produced (Table 8). This level of yield was significantly higher than control plots and those plots that received 0.25 and 1.0 ton/ac annually (in spring) and plots that received 0.5 ton/ac at planting + 0.25 ton/ac annually (in spring). If the comparison is confined within those plots that received Plant Tuff only in spring, the 0.75 ton/ac rate optimized sugar yield by as much as 1000 lbs/ac. In addition, the application at planting both at modest (0.5 ton/ac) and high (2 tons/ac) rates did not provide any advantage even when combined with modest rates of Plant Tuff application in spring. Based on the total Plant Tuff applied since the beginning of the field study (values in parenthesis in Figure 2), the 1.5 ton/ac out-yielded the plots that have received 2.0 ton/ac thus far.

There was an evident increased in soil Si across rates and time of application of Plant Tuff. The amount of Si extracted from soils collected from plots which received 2.0 ton/ac of Plant Tuff back in 2012 (at planting) remained elevated compared to control plots and those plots receiving Plant Tuff in spring. Similarly, the effect on pH was maintained at higher level compared to control plots. Among the plant-essential nutrients quantified in the soil, only Mg was significantly increased ($P<0.1$) (Table 2). Soil Ca and Zn tended to increase with increasing application rate wherein higher levels were observed on those plots receiving annual application in spring.

Yield and Quality Parameters of Different Varieties of Cane Planted as Whole Stalks and Billets

This study consisted of two planting methods (whole stalk vs. billets) and six different cane varieties (113, 114, 9001, 9002, 299, and 371) factorial treatment structure arranged in split-plot in a randomized complete block design with four replications. Planting method was assigned as the main plot and the variety as the sub-plot. This study was established at two locations at the Sugar Research Station; one of a silt loam (1st ratoon) and one on a heavy textured soil (plant cane). Based on the analysis of variance, planting method had no effect whereas variety showed significant influence on all measured variables for both plant cane and 1st ratoon cane (Table 9). Among varieties, L 01-299 and L 03-371 obtained the highest cane tonnage, sucrose, Brix, and TRS ($P<0.001$). Varieties Ho 02-113, US 72-114, Ho 06-9001, and Ho 06-9002 on average, had ~2x the amount of fiber (20-22.4%) as L 01-299 and L 03-371 produced. Among cane varieties for biofuel/energy production, Ho 02-113 is the most promising because of its high yield potential (highest cane tonnage) and high TRS and fiber content.

Acknowledgement

The authors wish to express appreciation for the financial support of Mosaic Co. and Edward Levy Co.

Table 1. Primary quality components, cane tonnage and sugar yield of variety L01-299 (1st stubble – 2nd harvest) at different rates and sources of phosphorus, 2014, St. Gabriel, LA.

Source	Rate lbs/ac	Population 1000/ac	Brix %	TRS lbs/ton	Sucrose %	Cane Tonnage ton/ac	Sugar Yield lbs/ac
Check	0	180.5	17.8	175.4	13.3	47.9	8396
TSP	10	166.5	17.5	168.2	12.9	48.6	8139
	20	207.7	17.9	180.4	13.6	46.8	8445
	45	195.9	18.0	181.9	13.7	52.2	9492
	65	224.4	17.8	178.7	13.5	53.0	9456
MAP	20	192.5	18.2	184.9	13.9	49.5	9160
	0	161.2	17.8	175.8	13.3	49.8	8763
MES	20	168.6	17.4	169.3	12.9	49.5	8384
	0	189.8	18.1	183.0	13.8	51.3	9388
MESZ	20	186.1	18.1	179.1	13.6	49.2	8801
	0	179.5	17.6	173.6	13.2	47.6	8523
Treatment effect (Pr>F)		0.3083	0.2592	0.1335	0.1461	0.0375	0.0072
Standard Error		18.9	0.211	4.19	0.252	1.76	371

Table 2. Concentrations of select plant essential nutrients in stalk of cane variety L01-299 at different rates and sources of phosphorus, 2014, St. Gabriel, LA.

Source	**Rate lbs/ac**	**Ca**	**Mg**	**P**	**K**	**S**	**B**	**Cu**	**Fe**	**Mn**	**Zn**
		%					**mg/kg**				
Check	0	0.0700	0.0662	0.0519	0.326	0.0646	0.410	2.200	20.91	6.554	7.227
TSP	10	0.0748	0.0731	0.0566	0.366	0.0722	1.102	2.106	28.70	6.573	7.194
	20	0.0586	0.0603	0.0521	0.270	0.0492	ND	1.912	19.35	6.082	5.021
	45	0.0610	0.0568	0.0503	0.367	0.0672	ND	1.845	23.05	5.846	6.123
	65	0.0634	0.0611	0.0572	0.329	0.0650	0.322	2.441	26.88	7.398	5.832
MAP	20	0.0664	0.0656	0.0564	0.312	0.0604	0.710	2.192	24.04	6.460	5.713
	0	0.0700	0.0662	0.0566	0.398	0.0745	0.457	2.401	31.71	6.782	7.619
MES	20	0.0790	0.0733	0.0504	0.352	0.1002	0.270	2.112	26.62	7.461	7.742
	0	0.0600	0.0592	0.0475	0.294	0.0683	ND	1.752	18.30	5.951	5.056
MESZ	20	0.0677	0.0637	0.0475	0.306	0.0801	0.308	2.059	31.87	5.570	6.685
	0	0.0686	0.0669	0.0520	0.325	0.0707	0.554	1.943	24.00	6.610	6.565
Treatment effect (Pr>F)		0.2480	0.2348	0.4227	0.6063	0.0658	0.2877	0.9378	0.3338	0.9937	0.1834
Standard Error		0.0064	0.0053	0.0048	0.0438	0.009	0.3137	0.459	4.440	1.306	0.865

Table 3. Stalk nutrient uptake of cane variety L01-299 at different rates and sources of phosphorus, 2014, St. Gabriel, LA.

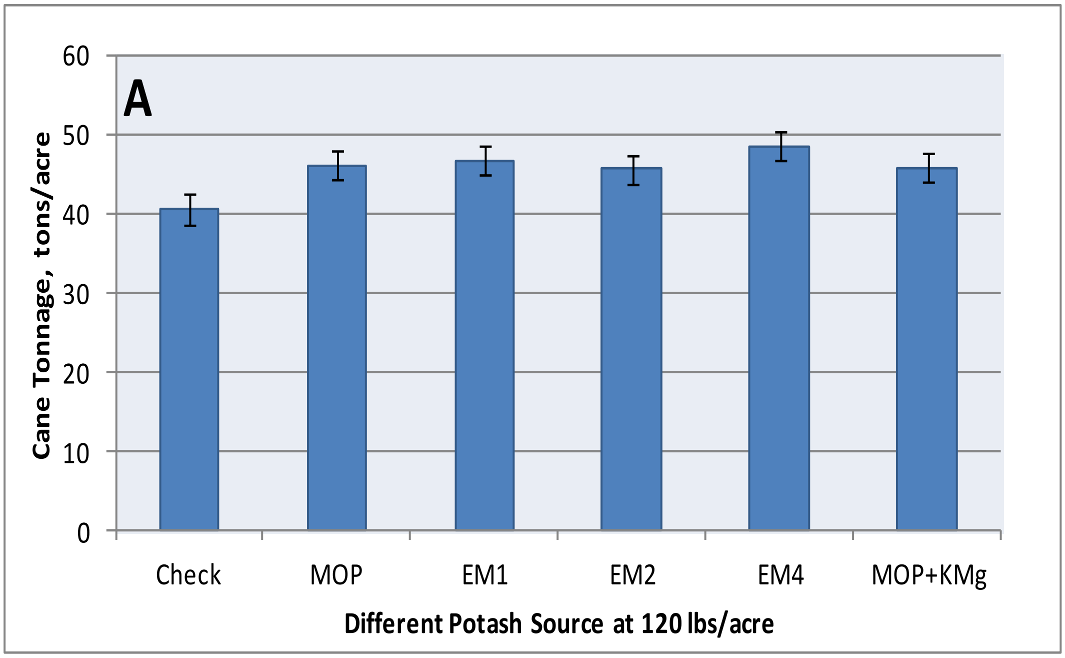
Source	Rate lbs/ac	Ca	Mg	P	K	S	B	Cu	Fe	Mn	Zn
		lbs/acre									
Check	0	51.3	48.8	38.3	241	47.6	0.0300	0.160	1.54	0.488	0.532
TSP	10	55.1	53.9	41.7	270	53.2	0.0800	0.158	2.12	0.482	0.532
	20	43.2	44.4	38.4	199	36.2	ND	0.140	1.43	0.452	0.368
	45	45.0	41.8	37.1	271	49.5	ND	0.135	1.70	0.430	0.450
	65	46.7	45.1	42.2	243	49.7	0.0225	0.180	1.98	0.548	0.430
MAP	20	48.9	48.3	41.6	230	44.5	0.0525	0.162	1.77	0.475	0.420
	0	51.4	48.8	41.7	294	54.9	0.0325	0.178	2.34	0.500	0.560
MES	20	58.3	54.1	37.2	260	73.9	0.0200	0.156	1.96	0.550	0.570
	0	44.3	43.6	35.0	217	50.3	ND	0.130	1.35	0.438	0.372
MESZ	20	49.9	47.0	35.0	225	59.0	0.0225	0.155	2.35	0.412	0.492
	0	50.6	49.4	38.3	240	52.2	0.0400	0.142	1.77	0.488	0.485
Treatment effect (Pr>F)		0.2479	0.2347	0.4236	0.6062	0.0658	0.2813	0.9347	0.3360	0.9938	0.1701
Standard Error		4.71	3.87	3.51	32.3	6.8	0.023	0.034	0.320	0.097	0.064

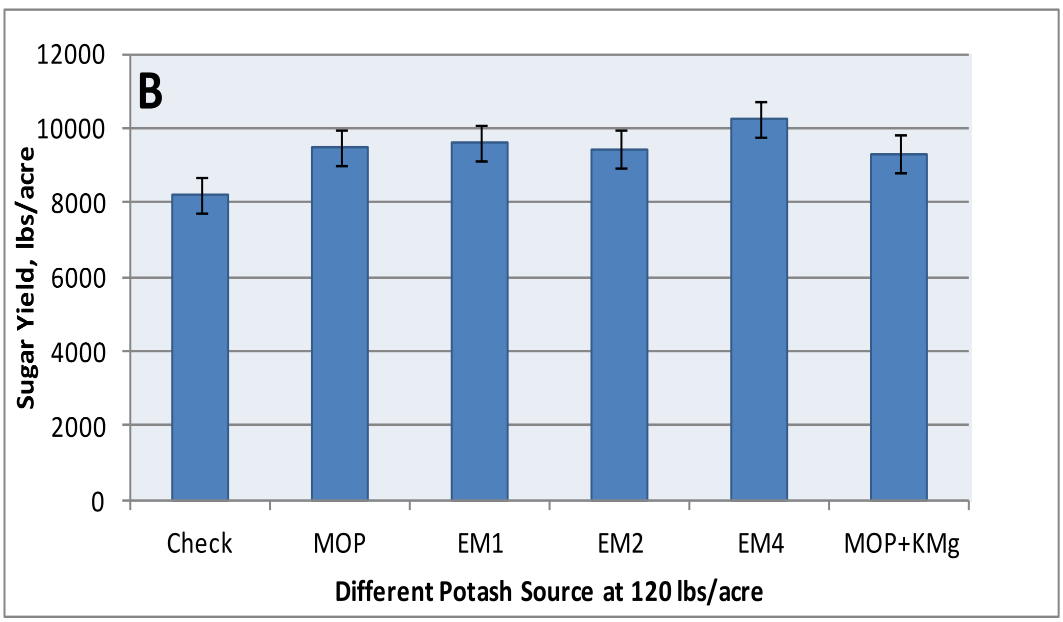
Table 4. Soil pH and Mehlich-3 extractable nutrients of soil samples collected after harvest.

Source	**Rate lbs/ac**	**pH**	**Mehlich-3 Extractable Nutrients, mg/kg**						
			P	**K**	**Ca**	**Mg**	**S**	**Zn**	**Cu**
Check	0	5.7	15.9	91.3	1492	293	9.41	0.119	1.572
TSP	10	5.8	19.6	92.7	1506	305	9.27	0.288	1.676
	20	5.7	23.2	85.8	1408	288	9.57	0.331	1.628
	45	5.6	31.6	98.3	1591	372	10.87	0.363	2.212
	65	5.3	49.9	121.9	1661	333	23.85	0.569	2.313
MAP	20	5.7	26.8	97.2	1542	315	11.85	0.755	1.890
	0	5.6	30.6	107.4	1675	348	18.11	0.555	2.398
MES	20	5.1	31.6	95.6	1468	290	10.74	0.341	1.868
	0	5.3	23.4	98.2	1493	291	10.64	0.497	1.827
MESZ	20	5.6	21.0	88.6	1456	284	10.38	0.624	2.101
	0	5.3	35.4	95.2	1412	273	25.49	1.112	1.866
Treatment effect (Pr>F)		0.6100	0.0119	0.2842	0.2929	0.3852	0.5472	0.2304	0.0702
Standard Error		0.2842	5.93	9.65	94	26	6.31	0.262	0.217

Table 5. Primary quality components, cane tonnage and sugar yield of variety L01-299 (1st ratoon – 2nd harvest) at different rates and sources of potassium, 2014, St. Gabriel, LA.

Source	**Rate lbs/ac**	**Population 1000/ac**	**Brix %**	**TRS lbs/ton**	**Sucrose %**	**Cane Tonnage ton/ac**	**Sugar Yield lbs/ac**
Check	0	146.9	18.3	202.6	14.7	40.6	8205
MOP	30	169.7	18.2	201.1	14.6	45.9	9247
	60	174.0	17.9	197.9	14.4	47.0	9330
	120	173.1	18.4	205.5	14.9	46.1	9485
	180	161.3	17.6	192.4	14.2	48.7	9364
	240	199.2	18.3	207.4	15.0	48.0	9943
EM1	120	183.5	18.4	204.4	14.8	46.7	9603
EM2	120	182.9	18.2	206.8	14.9	45.7	9441
EM4	120	212.9	18.5	211.9	15.2	48.5	10256
MOP+KMg	120	153.6	17.9	203.4	14.4	45.8	9312
Treatment effect (Pr>F)		0.1851	0.0508	0.3137	0.2079	0.0131	0.1197
Standard Error		19.1	0.232	5.21	0.280	1.83	493





Figures 1A and 1B. Tonnage (1A) and sugar yield (1B) of cane variety L01-299 applied with 120 K lbs/acre as muriate of potash (MOP), EM1, EM2, EM4, and MOP+KMag.

Table 6. Concentrations of select plant essential nutrients in stalk of cane variety L01-299 at different rates and sources of potassium, 2014, St. Gabriel, LA.

Source	**Rate lbs/ac**	**Ca**	**Mg**	**P**	**K**	**S**	**B**	**Cu**	**Fe**	**Mn**	**Zn**
		%					**mg/kg**				
Check	0	0.117	0.0738	0.0584	0.312	0.0868	0.382	2.174	32.26	6.084	8.058
MOP	30	0.090	0.0686	0.0565	0.266	0.0484	0.297	2.137	23.39	6.758	6.808
	60	0.120	0.0739	0.0616	0.362	0.0812	0.385	2.139	29.92	5.012	7.604
	120	0.116	0.0796	0.0687	0.372	0.0805	0.585	2.451	29.21	5.623	8.351
	180	0.137	0.0728	0.0575	0.427	0.0791	0.283	2.289	25.08	4.299	8.487
	240	0.160	0.0830	0.0693	0.479	0.0937	0.359	2.326	25.34	5.726	8.418
EM1	120	0.100	0.0693	0.0578	0.369	0.0753	0.255	2.208	28.66	8.682	8.467
EM2	120	0.156	0.0792	0.0622	0.395	0.0895	ND	2.389	25.21	4.611	7.915
EM4	120	0.104	0.0698	0.0568	0.311	0.0801	0.297	2.300	26.78	6.886	7.59
MOP+KMg	120	0.102	0.0713	0.0568	0.338	0.0941	0.272	2.011	28.50	5.271	6.708
Treatment effect (Pr>F)		0.0941	0.3909	0.5388	0.048	0.3974	0.9880	0.9312	0.6741	0.1217	0.7807
Standard Error		0.0182	0.0048	0.0067	0.0421	0.0125	0.306	0.226	3.66	0.977	0.886

Table 7. Stalk nutrient uptake of cane variety L01-299 at different rates and sources of potassium, 2014, St. Gabriel, LA.

Source	Rate lbs/ac	Ca	Mg	P	K	S	B	Cu	Fe	Mn	Zn
		lbs/ac									
Check	0	86.4	54.4	43.1	230	64.0	0.0275	0.160	2.38	0.448	0.592
MOP	30	66.2	50.6	41.7	196	35.7	0.0225	0.155	1.72	0.498	0.502
	60	88.8	54.5	45.4	267	59.9	0.0275	0.155	2.21	0.368	0.562
	120	85.8	58.7	50.6	275	59.3	0.0425	0.180	2.16	0.415	0.615
	180	101.1	53.7	42.4	315	58.3	0.0200	0.170	1.85	0.318	0.625
	240	118.0	61.2	51.1	353	69.1	0.0242	0.170	1.87	0.420	0.622
EM1	120	73.7	51.1	42.6	272	55.5	0.0200	0.164	2.11	0.640	0.622
EM2	120	114.8	58.4	45.9	291	66.0	ND	0.178	1.86	0.340	0.582
EM4	120	76.9	51.5	41.9	230	59.1	0.0225	0.168	1.98	0.508	0.558
MOP+KMg	120	74.9	52.6	37.7	250	69.4	0.0200	0.148	2.10	0.390	0.492
Treatment effect (Pr>F)		0.0941	0.391	0.586	0.048	0.3975	0.9895	0.9263	0.667	0.120	0.7931
Standard Error		13.4	3.56	4.93	31	9.2	0.0226	0.017	0.27	0.0718	0.066

Table 8. Soil pH and Mehlich-3 extractable nutrients of soil samples collected at harvest.

Source	**Rate lbs/ac**	**pH**	**Mehlich-3 Extractable Nutrients, mg/kg**						
			P	**K**	**Ca**	**Mg**	**S**	**Zn**	**Cu**
Check	0	6.43	19.5	75.3	1425	278	10.2	1.545	1.875
MOP	30	5.74	17.3	82.3	1429	288	11.0	1.193	1.822
	60	6.76	16.9	88.6	1602	330	10.0	1.379	2.00
	120	6.04	14.2	112.4	1444	286	10.2	1.314	1.990
	180	6.60	11.4	130.8	1513	322	10.2	1.285	1.977
	240	6.15	14.9	125.2	1384	279	9.8	1.355	1.845
EM1	120	5.81	25.0	108.2	1384	260	11.2	1.180	1.850
EM2	120	6.17	15.2	112.6	1472	304	10.3	2.667	1.991
EM4	120	5.84	22.9	120.6	1577	316	11.2	2.819	2.217
MOP+KMg	120	6.02	17.1	111.6	1333	307	10.8	1.258	1.842
Treatment effect (Pr>F)		0.6296	0.3166	0.0004	0.3574	0.3271	0.6663	0.0045	0.6273
Standard Error		0.386	3.79	9.53	84.9	22.2	0.658	0.351	0.145

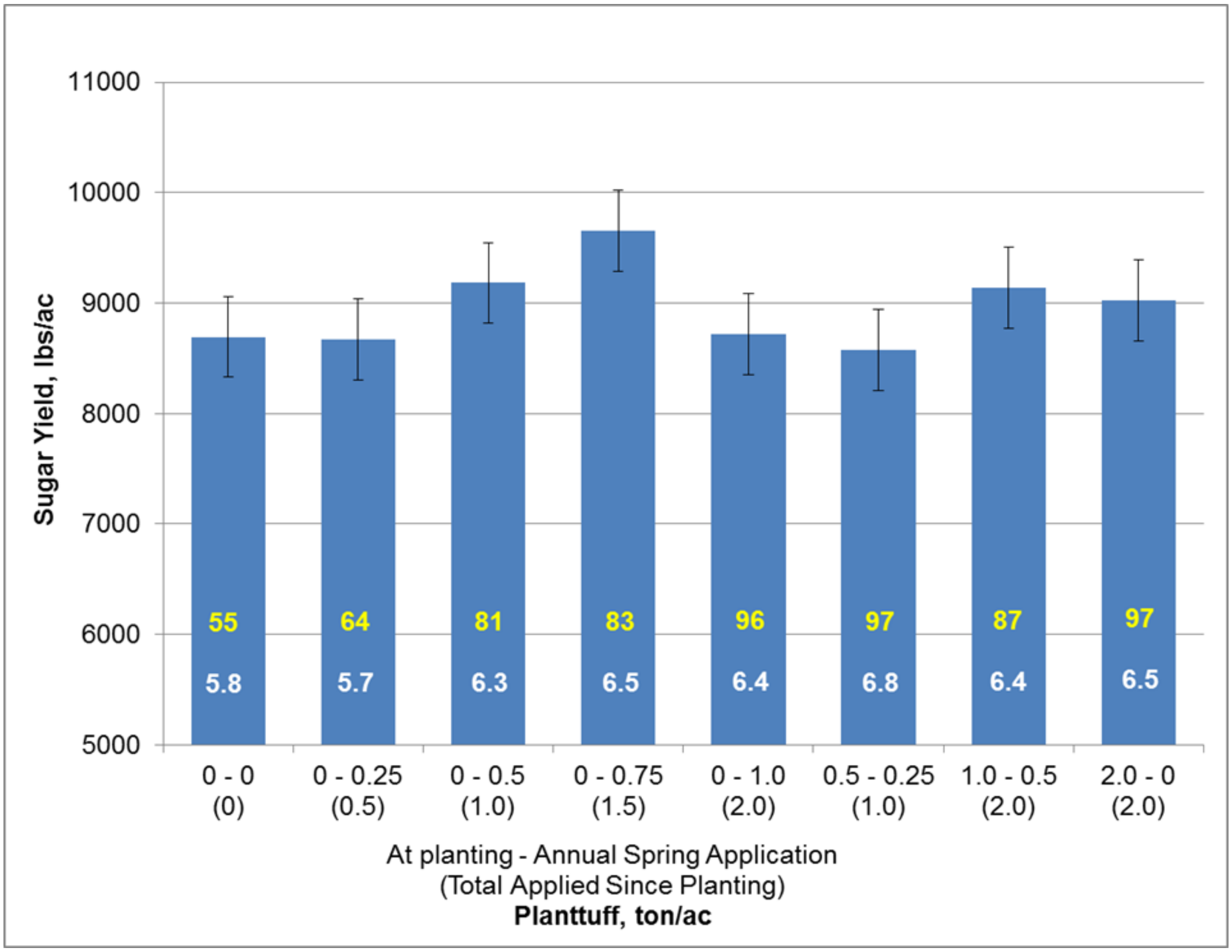


Figure 2. Effect of rate and time of Plant Tuff application on sugar yield of cane variety L01-299, St. Gabriel, LA, 2014. The values in yellow inside the bars correspond to soil Si (mg/kg) determined by 0.5 M acetic acid extraction procedure while the white ones are soil pH.

Table 8. Effect of rate and time of PlantTuff application on cane tonnage, pH and select extractable nutrient content determined by Mehlich-3 procedure, St. Gabriel, LA, 2014.

Plant Tuff®, ton/ac			Stalk Yield, t/ac	pH	P	K	Ca	Mg	S	Zn	Cu	Na
At planting	Spring	Total†			---------------------------mg/kg---------------------------------							
0	0	0	42.8	5.8	25	85	1481	291	10.5	1.16	1.97	10.9
0	0.25	0.5	42.4	5.7	33	91	1696	315	10.3	1.04	2.06	11.8
0	0.50	1.0	46.0	6.3	25	88	1715	326	13.1	1.56	1.99	11.8
0	0.75	1.5	45.9	6.5	28	88	1734	343	10.8	1.51	2.01	11.8
0	1.00	2.0	42.6	6.4	32	84	1740	336	11.2	1.46	2.02	10.4
0.5	0.25	1.0	42.2	6.8	26	89	1883	359	10.8	1.88	2.19	12.6
1.0	0.50	2.0	43.1	6.4	27	87	1781	339	10.8	1.39	2.04	11.4
2.0	0	2.0	44.1	6.5	24	92	1706	329	10.0	1.15	2.09	12.8
		P-value	***NS***	***NS***	***NS***	***NS***	***NS***	***<0.10***	***NS***	***NS***	***NS***	***NS***
		Standard Error	***1.27***	***0.29***	***7.2***	***11***	***113***	***27***	***0.9***	***0.21***	***0.16***	***1.95***

† - total of two cropping years

Table 9. Effect of planting method on sugarcane yield and primary components of different cane varieties.

Soil	Crop	Variety	Cane Tonnage Ton/ac	Total Recoverable Sugar, lbs/ton	Brix %	Fiber %	Sucrose %
Silt loam	1st Ratoon	Ho 02-113	25.4 bc	140 bc	16.6 bc	21.8 a	11.31 bc
		US 72-114	21.0 c	88 d	13.6 d	22.0 a	8.02 d
		Ho 06-9001	18.9 c	103 cd	16.0 cd	22.3 a	9.16 cd
		Ho 06-9002	21.2 c	137 cd	16.5 cd	22.4 a	11.20 bc
		L 01-299	38.7 a	185 ab	18.0 ab	12.5 b	13.82 ab
		L 03-371	34.9 ab	207 a	19.1 a	11.2 b	15.18 a
Analysis of variance							
Planting method (P)			NS	NS	NS	NS	NS
Varieties (V)			<0.001	<0.001	<0.001	<0.001	<0.001
P x V			NS	NS	NS	<0.01	NS

Clay	Plant cane	Ho 02-113	31.5 b	166 c	14.4 c	21.4 a	9.53 c
		US 72-114	30.9 b	63 e	11.7 d	21.0 a	6.27 e
		Ho 06-9001	16.1 c	95 cd	16.7 c	20.0 a	8.31 cd
		Ho 06-9002	16.5 c	89 d	13.4 c	21.5 a	7.96 d
		L 01-299	46.2 a	180 b	16.9 b	10.8 b	13.20 b
		L 03-371	40.2 a	212 a	18.7 a	10.9 b	15.23 a
Analysis of variance							
Planting method (P)			NS	NS	NS	NS	NS
Varieties (V)			<0.001	<0.001	<0.001	<0.001	<0.001
P x V			NS	NS	NS	NS	NS

SUGAR CROPS PRODUCTION MANAGEMENT RESEARCH AT THE IBERIA RESEARCH STATION

H.P. “Sonny” Viator[1], Richard Johnson[2], Brenda Tubana[3] and Paul White[2]

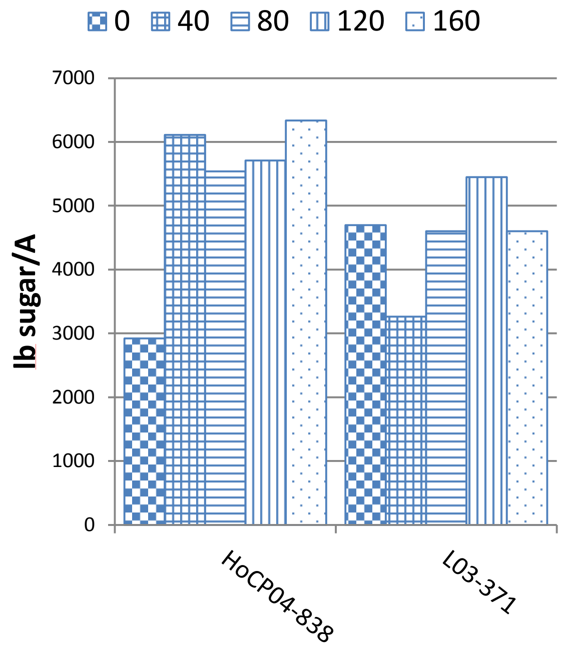
[1]Iberia Research Station – Jeanerette, LA
[2]USDA-ARS Sugarcane Research Unit – Houma, LA
[3]School of Plant, Environmental and Soil Science – LSU Baton Rouge, LA

SUMMARY:

Field trials consisted of **1)** N-rate application trials for the cultivars, L01-299, L03-371 and HoCP04-838; **2)** continuing evaluation of the long-term effects of post-harvest residue management on sugarcane; **3)** assessing the efficacy of the nutritional product, a Helena® Chemical foliar-applied product, on sugarcane; **4)** initiation of the evaluation of iron clay cow pea as fallow period cover crop; **5)** determining sweet sorghum feedstock logistics for bio refinery sustainability; and **6**) a precision farming study using multiple layers of geo-referenced data to compare different approaches for achieving uniform yield distribution. Cold damage resulting from the spring freeze lowered yield potential of the cultivars included in the N rate studies, especially L03-371. Stalk population was highly variable and it reflected in biomass yield measured. No significant differences were found between the 40, 80, 120 and 160 pounds of N application rates for any of the three cultivars. The long-term residue management study was in the second stubble phase of production cycle number four. This year burned plots yielded significantly more than plots for which residue was either retained or swept to the middles. Neither Gavilon G120® nor a Helena® Chemical bionutritional product was efficacious in producing enhanced yields compared to the checks. There were no significant differences observed for any of the variables evaluated. Iron clay cowpea grown during the fallow period of the sugarcane production cycle provided the equivalent of 40 lb N/A to the subsequent plant cane crop, demonstrating the likelihood of assigning a fertilizer credit to plowed down cowpea. Sweet sorghum hybrid yields were lowest of the three years of the study. A cool, wet spring and infestations of worms and aphids presented challenging conditions. Once again, highest fermentable sugar yields (2.2 tons per acre) were achieved by planting medium-maturity hybrids in May. For the precision farming study, biomass yield estimated by the combine yield monitor paralleled that of the weigh wagon, with the weigh wagon yield and the yield monitor yield averaging 37.9 and 35.6 tons of cane per acre, respectively.

I. NITROGEN RATE TESTS:

Newly released commercial varieties were evaluated for response to fertilizer N on heavy textured soil. For each trial a 0 lb N per acre check was compared to 40, 80,120, and 160 lb N per acre application rates. February and March freezes killed growth and undoubtedly resulted in damage to the advanced stubble crops in these tests and, therefore, stalk populations were low and highly variable. Second stubble L03-371 yield ranged from 3,363 to 5,450 pounds of sugar per acre and HoCP04-838 yield ranged from 2,921 to 6,336 pounds of sugar per acre. Third stubble yields of L01-299 ranged from 5,593 to 7,068 pounds of sugar per acre. There were no significant differences among the 40, 80, 120 and 160 pounds of N application rates for either test.



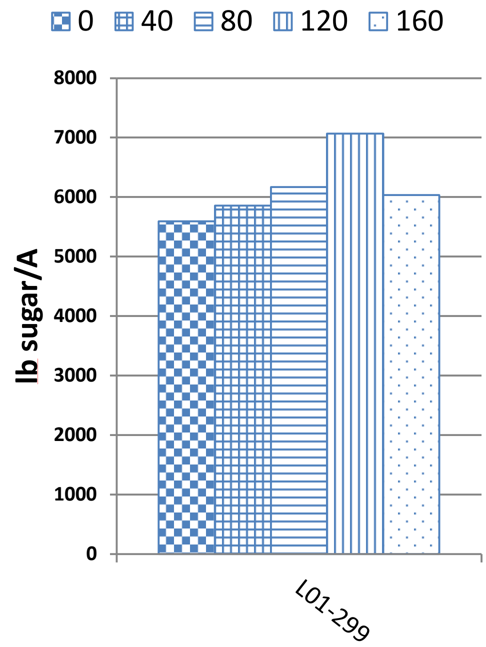


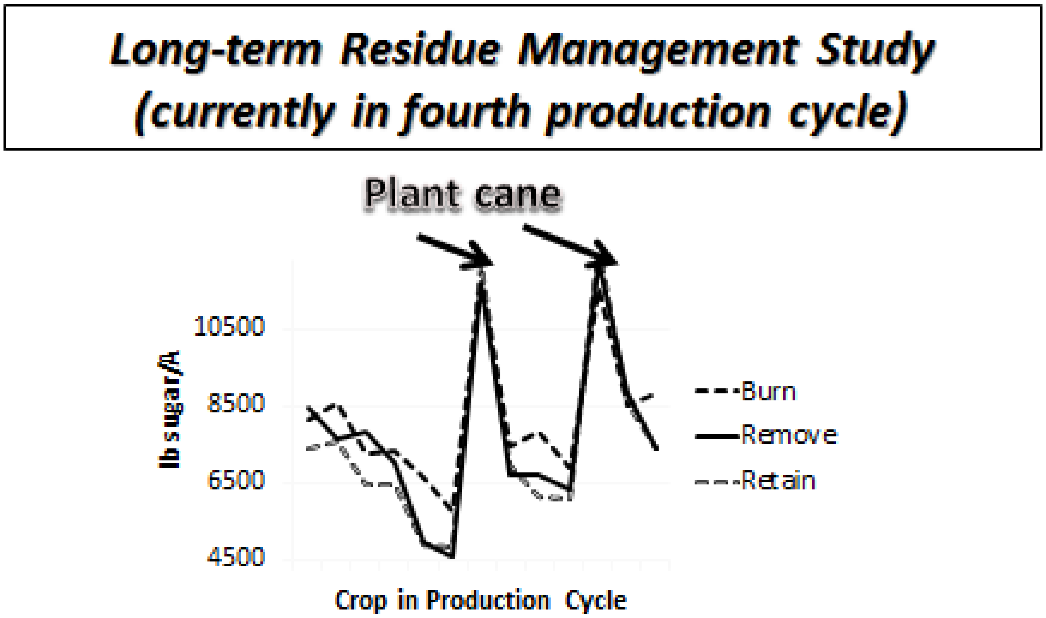
Fig. 1 – Response of 2nd stubble to N rates

Fig. 2 - Response of L01-299 3rd stubble to N rates

II. LONG-TERM RESIDUE MANAGEMENT STUDY:

A post-harvest residue management study was initiated in 1997 and has continued through the second stubble crop of production cycle number four. The study has clearly confirmed what other investigations have found, that 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, as shown by the spikes in plant cane sugar yield in the figure below. While burning does not always produce superior yields, for the second stubble crop in 2014 the burn treatment produced over 1,400 lb of sugar per acre more than the other two residue management treatments. Yields for the burned, residue retained and residue swept treatments were 8,829, 7,411 and 7,375 lb of sugar per acre, respectively.



III. EFFICACY OF HELENA® CHEMICAL CO. PRODUCT HM-0938-A ON PLANT CANE L01-299:

Helena® Chemical Co. bio nutritional product HM-0938-A is a foliar-applied experimental compound that is not commercially available. A field trial was conducted in 2014 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). Cultivar L01-299 was in plant cane and 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 millable stalk number, biomass weight and juice quality. There were no significant differences between the treatments (Table 2), either rate or timing, at the 0.05 level of probability for any of the variables.

Table 2. Evaluation of HM0938A applied to L01-299 plant cane					
Application rate	Application timing	Stalks/A	Tons/A	TRS	Sugar/A lb
0	0	43,124	41.5	233	9,668
1.0	May	43,814	41.4	231	9,603
1.5	May	42,798	47.3	234	11,199
2.0	May	42,326	45.6	249	11,323
1.0	June	42,761	49.6	225	11,199
1.5	June	44,141	42.0	240	10,009
2.0	June	39,095	41.1	246	10,071
P =			0.20	0.64	0.48

IV. EVAUATION OF IRONCLAY COWPEA AS A COVER CROP FOR SUGARCANE:

Iron clay cowpea, a mixture of two formerly separate cultivars, is a widely grown legume cover crop that is adapted to the climatic conditions of the Southeast. A field trial was conducted in 2013-14 to evaluate its suitability as a N-fixing cover crop for production during the fallow period prior to plant cane establishment. Cowpea seed was double drilled on sugarcane rows at the rate of 10 seed per linear foot of row on May 1, 2013. Peas were allowed to grow until July 31, when they were shredded. Sugarcane cultivar L01-299 was planted on September 7, 2013. Treatments compared were: 1) unfertilized plant-cane following a conventional fallow period; 2) plant-cane fertilized with 40 lb N per acre following fallow; 3) plant-cane fertilized with 80 lb N per acre following fallow; 4) unfertilized plant-cane following ploughed down cowpeas; 5) plant-cane fertilized with 40 lb N per acre following cowpeas; and 6) plant-cane fertilized with 80 lb N per acre following cowpeas.

As shown in the table below, there was a trend for plant cane benefiting from cowpeas grown during the fallow period to yield higher sugar per acre (*P = 0.12)* than plant cane following a conventional fallow. Also, plant cane benefiting from only cowpea without additional fertilizer N yielded equivalent to plant cane fertilized with 40 lb N/A following a conventional fallow period (9,643 vs. 9511 lb sugar/acre). This typically is called a “fertilizer credit”, a benefit which has not been assigned to legumes grown in rotation with sugarcane in recent previous experiments with green manure soybeans or sunn hemp. This study will continue through the ratoon phase of the production cycle to determine full-cycle effects and soil NO_3^- and NH_4^+- N levels will be associated with yield measured after legume incorporation. This research is in cooperation with Drs. Paul White and Chuck Webber of the ARS-USDA Sugarcane Research Unit in Houma, LA.

Table 3. Cover crop effects of iron clay cowpea on plant-cane L01-299				
Fallow period treatment	Plant cane N fertilizer lb/A	Cane yield[1] tons/acre	TRS[1] lb/ton	Sugar yield[1] lb/acre
Fallow	0	31	239	7490
Fallow	40	39	244	9511
Fallow	80	44	240	10542
Cowpea	0	40	239	9643
Cowpea	40	42	246	10307
Cowpea	80	43	243	10506
Cowpea vs. fallow, *P = 0.119*				
N rates 0, 40 and 80 lb N/A, *P = 0.024*				

V. A REGIONAL PROGRAM FOR PRODUCTION OF MULTIPLE AGRICULTURAL FEEDSTOCKS AND PROCESSING TO BIOFUELS AND BIOBASED CHEMICALS:

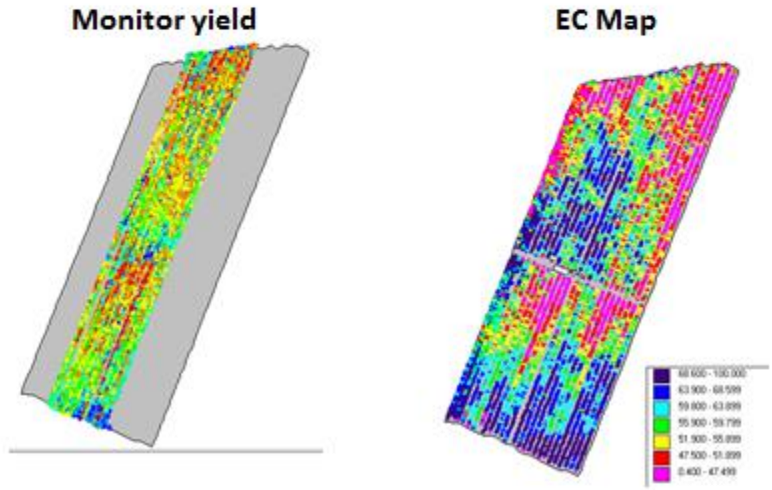
The LSU AgCenter received its largest grant ever, a $17.2 million award from the U.S. Department of Agriculture's National Institute of Food and Agriculture for a project to investigate energy cane and sweet sorghum for the production of biofuels and chemicals. The broad mission of the sweet sorghum research group is to "evaluate sweet sorghum hybrids for agronomic performance, inclusive of their ability to maintain juice quality into the fall season, produce commercial yields on marginal soil, respond to low-input sustainable production practices and deliver quantities of feedstock on a schedule that sustains the viability of the bio-refinery". While it is broad in scope and involves multiple disciplines and research stations, personnel at the Iberia Research Station are responsible for investigating and demonstrating the logistics of feedstock delivery. The test location was the Sugar Research Station because of its lab facilities and close proximity to the Audubon Sugar Institute, where plant samples were sent for fiber and sugar analyses. In 2014 hybrids of varying maturity were planted in early-April, mid-May and late May/early-June and harvesting with a John Deere combine was initiated when grain reached the hard-dough stage of development. The test was designed to provide a sustained feedstock supply from the initiation of harvest in July to late-October, which is typically the time for the occurrence of the first frost. Harvesting commenced with the early-maturity hybrids in late July and continued until the late May/June planting of the late-maturity hybrids were combine harvested in October of each year. In 2014, biomass and fermentable sugar yields were lowest of the three years of the study thus far, with sugar yield averaging 1.83 and 1.14 tons of fermentable sugar for 2013 and 2014, respectively. Cool, wet spring conditions and infestations of worms and aphids presented challenging conditions. Table 3 contains the fresh weight fermentable sugar yield in 2014 by planting date and maturity group. As has been the case in previous years, highest yields are realized by the medium maturity hybrids planted in May. Lowest yields are associated with early planted, early maturity hybrids. Despite low yields in 2014, feedstock was consistently available for the three-month period from late July to early November.

Table 4. Influence of planting date and maturity on fermentable sugar yield in 2014		
Date	Maturity	Fermentable sugar yield tons per acre
April	Early	0.31
	Medium	0.98
	Late	0.88
May	Early	1.09
	Medium	2.15
	Late	1.60
June	Early	0.76
	Medium	1.00
	Late	1.50

VI. PRECISION FARMING STUDY:

A precision farming study was initiated in 2014 to compare different approaches for achieving uniform yield distribution in a 37-acre field. The multiple layers of geo-referenced data included: 1) application of variable N rates to management zones derived from soil electrical conductivity (EC); 2) estimation of nutrient variability through the use of grid sampling; 3) measuring yield directly with the aid of a weigh wagon instrumented with electronic load cells; 4) estimation of yield with the aid of a yield monitor; and 5) evaluation of field variability using remote aerial imagery. The EC and grid sampling maps will be used to compare variability among nutrients and the yields maps and remote imagery will be used to assess spatial differences in production. Variable N rates will be compared to a uniform application rate of N. In an attempt to generate uniform yield distribution application rates of 100, 110 and 120 lb N/acre were made on the low EC, medium EC and high EC zones, respectively. While all data and comparisons are not yet compiled, a couple of interesting observations can be made on preliminary measurements. A comparison of the maps below shows an association between the soil EC and the yield estimated by the yield monitor. Note the similarity in color patterns in both maps, an association that suggests that highest yields (red color or intermediate shaded areas) were realized on the low EC area (lightest soil texture in the field that received the lowest rate of fertilizer N). Biomass yield estimation by the yield monitor was similar to the yield directly measured with the weigh wagon. Monitor yield and weigh wagon yield were 35.6 and 37.9 tons of cane per acre, respectively.

EC vs Yield



Monitor yield
EC Map
68.600 - 100.000
63.900 - 68.599
59.800 - 63.899
55.900 - 59.799
51.900 - 55.899
47.500 - 51.899
0.400 - 47.499

THE EFFECT OF SULFUR FERTILIZER ON SUGARCANE YIELD

Kenneth Gravois

LSU AgCenter, Sugar Research Station

Two sulfur fertilizer trials were conducted at Blackberry Farms, LLC in Vacherie, LA in 2014. The first site was with a plant-cane crop of L 01-283 on Sharkey clay; the second site was with a first stubble crop of HoCP 96-540 on Commerce silt loam. Prior to conducting the two trials, the soil was sampled at each site and sulfur levels were deemed to be low (<10 ppm). Two treatments were included: 1) 22 lbs S/acre, and 2) Control (no S fertilizer). The fertilizer source was 32% UAN and ammonium thiosulfate mixture 28-0-0-5 (N-P_2O_5-K_2O-S). The N rate was 120 lbs N/acre. Fertilizer was applied by tractor with a 5-row off-bar cultivator and injected into the furrow created by the off-bar. Application date was April 11, 2014. Each plot was 150 feet long and consisted of 5 rows – only the center three rows were harvested for the trial. The trial was replicated four times.

Standard cultural practices were followed during the 2014 growing season. Leaf tissues were analyzed for nutrient content (Tables 4 & 6) and sampling was done on July 23, 2014. A total of 20 leaves were sampled from each plot and the leaf selected was from the second top visible dewlap. The soil was sampled from each plot after harvest was completed (Tables 3 & 5).

The Commerce silt loam field trial was harvested on October 16, 2014; the Sharkey clay site was harvested on November 4, 2014. Plots were combine-harvested and weighed to determine cane yield (tons/acre). A 10-stalk sample was hand-cut out of each plot for a quality analysis. Each sample was then sent to the laboratory to determine Brix by refractometer and pol (Zº) by saccharimeter (Gravois and Milligan, 1992).

Data were analyzed with SAS (v 9.4) software. Replication was considered a random effect; treatment was considered a fixed effect. Least square means were estimated and tested for statistical significance (P=0.05) with the Student's t test using the PDIFF option of PROC MIXED.

Gravois, K.A. and S.B. Milligan. 1992. Genetic relationships between fiber and sugarcane yield components. Crop Sci. 32:62-67.

Table 1. Plant-cane data obtained on sugarcane variety L 01-283 from a sulfur field trial conducted at Blackberry Farms in Vacherie, Louisiana during 2014. The soil type was a Sharkey clay.

Treatment	Sugar Yield		Cane Yield		TRS		Stalk Weight	
	lbs/ac		Tons/ac		lbs/ton		lbs	
No Sulfur	8374	A	30.3	B	276	A	1.95	A
22 lbs/acre	8440	A	31.9	A	265	A	2.04	A
Pr>F	0.50		0.04		0.07		0.44	

Table 2. First-stubble data obtained on sugarcane variety HoCP 96-540 from a sulfur field trial conducted at Blackberry Farms in Vacherie, Louisiana during 2014. The soil type was a Commerce silt loam.

Treatment	Sugar Yield		Cane Yield		TRS		Stalk Weight	
	lbs/ac		Tons/ac		lbs/ton		lbs	
No Sulfur	10792	A	53.4	A	202	A	2.45	A
22 lbs/acre	10537	A	52.6	A	200	A	2.51	A
Pr>F	0.75		0.68		0.87		0.88	

Table 3. Soil test values for Sharkey clay site at Blackberry Farms in Vacherie, LA. The sugarcane variety was L 01-283.

	pH	P	K	Mg	S	Cu	Zn	Na
Treatment		ppm	ppm	ppm	ppm	ppm	ppm	ppm
No Sulfur	5.89	60.6	280.9	900.9	5.08	7.47	3.56	57.9
22 lbs Sulfur	5.99	60.4	293.5	896.9	4.60	7.45	3.62	55.8

Table 4. Leaf tissue values for Sharkey clay site at Blackberry Farms in Vacherie, LA. The sugarcane variety was L 01-283.

	N	P	K	S	Ca	Mg	B	Cu	Fe	Mn	Mo	Na	Zn
Treatment	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
No Sulfur	1.71	0.22	1.57	0.12	0.36	0.16	7.88	4.95	67.3	97.1	3.41	36.4	14.15
22 lbs Sulfur	1.63	0.23	1.85	0.17	0.36	0.16	8.00	4.94	67.7	104.8	2.17	40.0	15.04

Table 5. Soil test values at the Commerce silt loam site at Blackberry Farms in Vacherie, LA. The sugarcane variety was HoCP 96-540.

	pH	P	K	Mg	S	Cu	Zn	Na
Treatment		ppm	ppm	ppm	ppm	ppm	ppm	ppm
No Sulfur	6.22	17.6	163.1	225.4	7.50	2.52	1.60	47.0
22 lbs Sulfur	6.41	21.9	153.2	254.8	7.55	2.52	1.71	42.9

Table 6. Leaf tissue values for Commerce silt loam site at Blackberry Farms in Vacherie, LA. The sugarcane variety was HoCP 96-540.

	N	P	K	S	Ca	Mg	B	Cu	Fe	Mn	Mo	Na	Zn
Treatment	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
No Sulfur	1.97	0.22	1.35	0.13	0.42	0.17	4.86	6.90	64.1	79.4	3.74	44.9	20.1
22 lbs Sulfur	1.91	0.21	1.31	0.17	0.45	0.18	5.63	6.81	65.0	94.3	1.68	46.9	21.3