SOIL FERTILITY RESEARCH IN SUGARCANE

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In Cooperation with
Sugar Research Station

Summary

Soil fertility trials were conducted in 2011 to evaluate the performance of recent cane varieties as affected by different sources and rates of nitrogen (N), silicon (Si), and potassium (K). Studies evaluating the use and application of remote sensing technology in sugarcane production were also conducted. Nitrogen applied at a rate of 80 lbs N ac^{-1} significantly increased sugar yield of 1st stubble cane varieties L 99-226 and L 01-283 in St. Gabriel, LA while 120 lbs N ac^{-1} maximized sugar yield of L 01-283 in Jeanerette, LA. HoCP 96-540 for both sites required only 40 lbs N ac^{-1} to maximize yields. When applied in mid-May (the latest), 80 lbs N ac^{-1} raised both cane and sugar yield of L01-283 1st stubble crop. Potassium applied to plots at a rate of at least 60 lbs ac^{-1} as muriate of potash (MOP) + 20 lbs S ac^{-1} obtained the same sugar yield as those plots which received 120 lbs K_2O as sulfate of potash (SOP). The application of calcium silicate slag to cane varieties HoCP 96-540, LCP 85-384, and L 01-283 had shown significant effect on yield of sugarcane grown on Commerce silt loam but no on Sharkey clay. The used of N-Boost, a natural, microbial-based N utilization enhancer, had improved stalk N content and uptake (P<0.05) but not cane and sugar yield of L 01-083 cane variety. The effect of molasses fermentation by-product on N requirement of sugarcane and stalk N uptake was also evaluated for cane variety HoCP 96-540. Our results in remote sensing studies showed that different vegetation indices can be used to characterize sugarcane biomass. Categorizing variety according to canopy structure showed benefit in terms of improving the accuracy of the biomass prediction models.

Objectives

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

Results

Effect of Nitrogen Rate and Application Time on Sugarcane Yield

Responses of varieties HoCP 96-540, L 99-226, and L 01-283 to different N rates (0, 40, 80, and 120 lbs N ac^{-1}) were evaluated at two sites: St. Gabriel and Jeanerette, LA. Across all varieties, N significantly increased both cane and sugar yield. Nitrogen applied at the rate of 80 lbs ac^{-1} maximized sugar yield of cane varieties L 99-226 and L 01-283 in St. Gabriel (Figure 1).

A higher rate of 120 lbs N ac^{-1} was required by L 01-283 to maximize sugar yield in Jeanerette, LA (Figure 2). For both sites, variety HoCP 96-540 required the lowest N application rate to maximize sugar yield.

The effects of different N rates (0, 40, 80, and 120 lbs N ac^{-1}) and time of application (April 15, April 29, May 13, and May 27) were tested on a cane variety L 01-283. Figures 3 and 4 showed the cane and sugar yield responses at different levels of N applied at different times. There were observable cane and sugar yield responses to N application when applied on April 15, April 29 and May 13; where the optimal N rates ranged between 40 to 80 lbs N ac^{-1}. For plots treated on May 27, the check plot had higher cane and sugar yield than plots which received 40 and 80 lbs N ac^{-1}. While the highest N rate (120 lbs N ac^{-1}) had highest yield for this application time, the difference with check plot's yield was relatively minimal compared with earlier times of application.

Response of Sugarcane to Different Sources and Rates of Potassium

Table 1 summarizes the effect of different sources and rates of potassium on sugarcane yield (HoCP 96-540), extractable K and S, and stalk K and S uptake. There were no significant differences in cane yield among treatment means. On the other hand, the application of 240 lbs K_2O as MOP without S obtained the highest sugar yield at 6352 lbs ac^{-1}. This yield was not significantly different from plots which received 120 lbs of K_2O either as SOP or as MOP (with 20 lbs S ac^{-1}). It is important to note that the application of SOP also supplied S at rates of 24, 48 and 96 lbs S for K_2O rates as SOP of 60, 120, and 240 lbs ac^{-1}, respectively. Soil test K across treatments was at sufficient level. While K was applied annually, the soil test K levels after 3 years were only raised, on average by 42 ppm. There were observable differences on soil test S; plots which received 120 and 240 K_2O ac^{-1} as SOP had almost twice as much soil S when compared with checks and plots which received 20 lbs S ac^{-1}. This was also reflected on the concentration of S in stalk. Based on contrast analysis, the application of SOP had significantly raised available S in soil, and S uptake by sugarcane. However, this benefit was not translated to cane and sugar yield, especially for plots which received 96 lbs S ac^{-1}.

Response of Sugarcane to Calcium Silicate Slag Application

This study was established in 2009 on two different soil types (Sharkey clay and Commerce silt loam) at the LSU AgCenter Sugar Research Station, St. Gabriel, LA to evaluate the benefits of Si fertilization to sugarcane grown on alluvial soils in south Louisiana. The Si source was calcium silicate ($CaSiO_3$) slag which is a by-product from high temperature electric arc furnace production of elemental phosphorus from rock phosphate. Three rates of $CaSiO_3$ (1, 2, and 4 tons ac^{-1}), including a control, were superimposed to three 6ft-row x 40 ft-long plots prior to planting in fall 2009. After incorporation of the slag material, three cane varieties (LCP 85-384, HoCP 96-540, and L 01-283) were planted. The treatments, four $CaSiO_3$ rates and three varieties, were arranged in a randomized complete block design with four replications. Nitrogen and potassium were applied as urea ammonium nitrate (UAN, 32% N) and muriate of potash (KCl, 52% K), respectively in spring of 2011. At harvest, cane tonnage, sucrose, theoretical recoverable sugar (TRS), and sugar yield were determined. Soil samples, flag leaf and sub-samples of shredded stalks were collected and analyzed for Si content. There were observable differences among varieties on Si content in flag leaf and cane stalk (Table 2 and 3). Silicon

content of flag leaf and stalk of cane variety HoCP 96-540, on average, had 2.2% and 0.43% respectively, whereas the other varieties had >2.5% Si in flag leaf and >0.50% Si in stalk. In general, $CaSiO_3$ application showed significant effect on sugarcane grown on Commerce silt loam but not on Sharkey clay. In 2011, acetic acid-extractable Si of Commerce silt loam was affected by $CaSiO_3$ application and so as the cane tonnage and sugar yield ($P<0.10$, Table 2).

<u>Effect of Foliar Application of N-Boost on Sugarcane</u>

Table 4 shows all measured parameters at midseason (leaf N, chlorophyll content and height) and harvest (yield, TRS, stalk N and uptake) as influenced by different rates of N and source of foliar N applications. There were no significant differences obtained among measured variables except leaf N content at 2nd sampling, and stalk N content and uptake (P<0.05). Nitrogen rate of 80 lbs ac^{-1} tended to maximize both cane and sugar yield, with or without N-Boost application. The results of contrast analysis showed that plant height measured at first sampling was significantly increased with foliar application of N-Boost ($P<0.05$, Table 5). With *P*-values of <0.35, cane yield (0.3480), TRS (0.3081), and chlorophyll content (1st sampling) of sugarcane which received N-Boost foliar application would be higher than without N-Boost foliar application more than 65% of the time. *P*-value of 0.1958 for sugar yield implies that N-fertilized plots with N-Boost foliar application would yield about 400 lbs ac^{-1} higher than plots without N-Boost more than 80% of the time. Similarly for stalk N uptake (P-value = 0.2760), plots which received foliar N-Boost would have 4 lbs N ac^{-1} higher stalk N uptake than plots without N-Boost for more than 70% of the time.

<u>Effect of molasses fermentation-by product on sugarcane N requirement and stalk nutrient uptake</u>

The treatment structure and results of analysis of variance (ANOVA) are reported in Table 6. Based on ANOVA, only N uptake showed significant response to treatment effect ($P<0.05$) while cane yield tended to respond to the treatments (*P*-value = 0.1169; Table 6). By comparing treatment means using LS means PDIFF option in SAS, the check plots (without and with MFP) were significantly lower ($P<0.05$) compared with plots which received 40 and 80 lbs N ac^{-1}, respectively (Figure 5). Based on this result, the required N to maximize cane tonnage was higher with MFP application than without MFP application. A more evident effect of N rate than N source on sugarcane stalk N uptake was observed (Figure 6). Cane stalk N uptake between none treated and MFP treated plots were statistically similar. Contrast analysis showed that the performance of cane was not enhanced with 20 gal ac^{-1} application of MFP (Table 6). To add veracity to these observations, soil pH and Mehlich-3 extractable nutrients were quantified from soils collected at harvest (Table 7). Similarly, no differences were detected among treatment means for all measured parameters. The same results were obtained when contrast analysis was done to specifically compare the impact of MFP application on these soil parameters.

Nutrient content of the shredded stalk was also determined (Table 8). Nitrogen, P, Ca and Mg were significantly different among treatment means ($P<0.05$). The highest N content was 0.404 % from cane which received 60 lbs UAN ac^{-1} and 40 gal MFP ac^{-1}. This is the same plot which had the highest N uptake but lowest TRS (231 lbs ton^{-1}; Table 6). The low TRS value was not compensated even with having the highest cane yield value to maximize sugar yield. These

results imply the potential negative effect of excessive N on TRS and overall sugar yield. Treatments tended to affect also the K, S, Cu and Mn content of cane stalks. Based on the contrast analysis, cane with MFP had higher Mg content than cane without MFP. Potassium, S, Ca and Cu tended to be higher in cane applied with MFP than without MFP. Cane applied with UAN + MFP had significantly higher P, S and Cu content but lower Al content than cane applied with UAN only (P<0.10). Potassium, Ca and Mg content tended to be higher (with P-values <0.30) in cane applied with UAN + MFP than cane applied with UAN only.

The response of cane to N fertilization in 2011 for this study was very minimal. This might be due to limited moisture during the period where cane was actively growing. Moisture is needed to activate N in fertilizer and perhaps since the field did not receive sufficient amount of moisture immediately after UAN and MFP application, the effect of N on cane was not evident. While the concentration of some nutrients in cane showed positive responses to MFP application (Table 6), the lack of significant effect on both sugar and cane yield limits us to associate these benefits to MFP application. In most cases, if not all, that if moisture is limiting, any treatment applied to crops is masked and therefore complicates the interpretation of crop response or any measured biological parameters. The variation and interference of other growth environmental factors such as moisture have been among the many reasons why field validation study needs to be conducted in multiple sites and year.

Using Normalized Difference Vegetation Index in Characterizing Sugarcane Biomass

This study was initiated in 2010 to determine if sugarcane canopy reflectance can be used to estimate sugarcane green biomass using remote sensor. In 2011, canopy reflectance readings were collected from V x N trials established in St. Gabriel and Jeanerette, LA. Different wavelengths within the blue, green, red, red edge, and near infrared regions of the spectrum were evaluated. Among these wavebands, red edge and near infrared regions obtained the highest association with biomass across varieties and sampling times with correlation coefficient (r) values ranging from 0.73 to 0.93. Several indices were computed using these wavebands. The results showed that simple ratio (SR), normalize difference vegetation index (NDVI), and perpendicular vegetation index (PVI) using the red and red edge wavebands established high associations with biomass across varieties three weeks after N fertilization. The association of biomass and these vegetation indices declined at later sampling times in variety with wider leaf angle and shorter stature (droopy-leaf canopy structure – L99-226). This observation was not evident for variety with narrow leaf angle and taller stature (erect-leaf canopy structure – HoCP 96-540). Categorizing variety according to canopy structure showed benefit in terms of improving the accuracy of the biomass predictive model (Figure 7).

Acknowledgements
The authors wish to express appreciation for the financial support of Great Salt Lake Minerals, Syngenta, Donaghys, ED & F Man Liquid Products Corp., American Sugar Cane League, and USDA-AFRI.

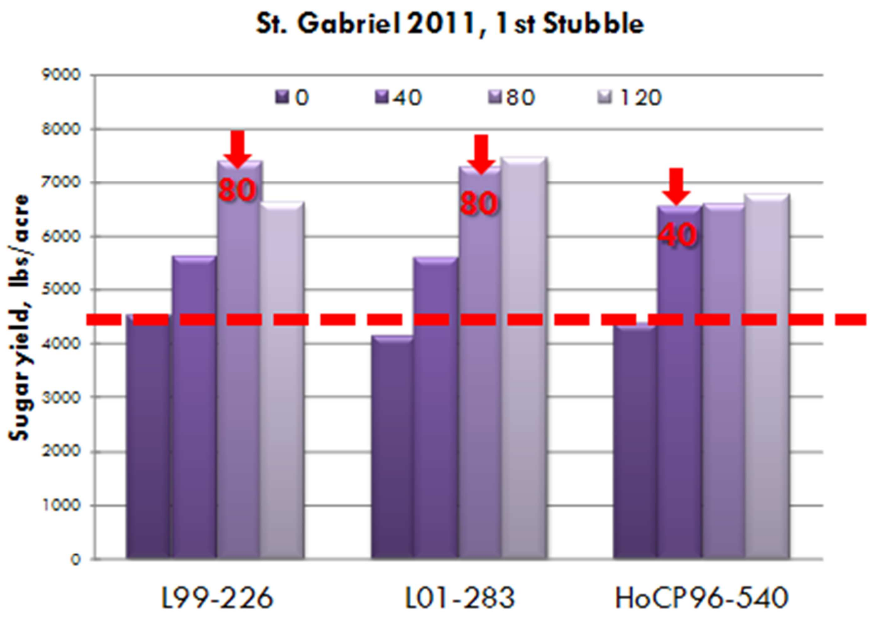

Figure 1. Sugar yield response of cane varieties L 99-226, L 01-283, and HoCP 96-540 to different N application rates established at the LSU AgCenter Sugar Research Station in St. Gabriel, LA, 2011.

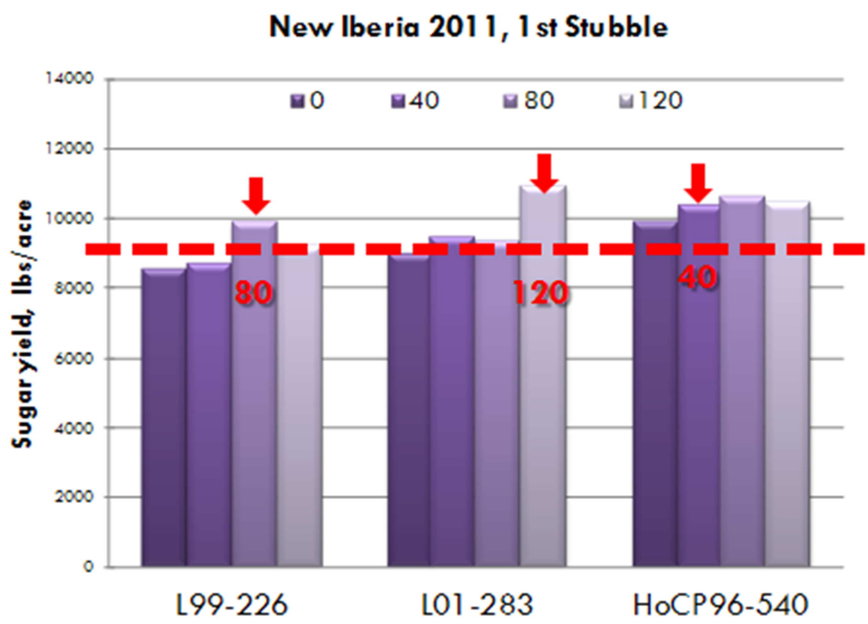

Figure 2. Sugar yield response of cane varieties L 99-226, L 01-283, and HoCP 96-540 to different N application rates established at the LSU AgCenter New Iberia Research Station in Jeanerette, LA, 2011.

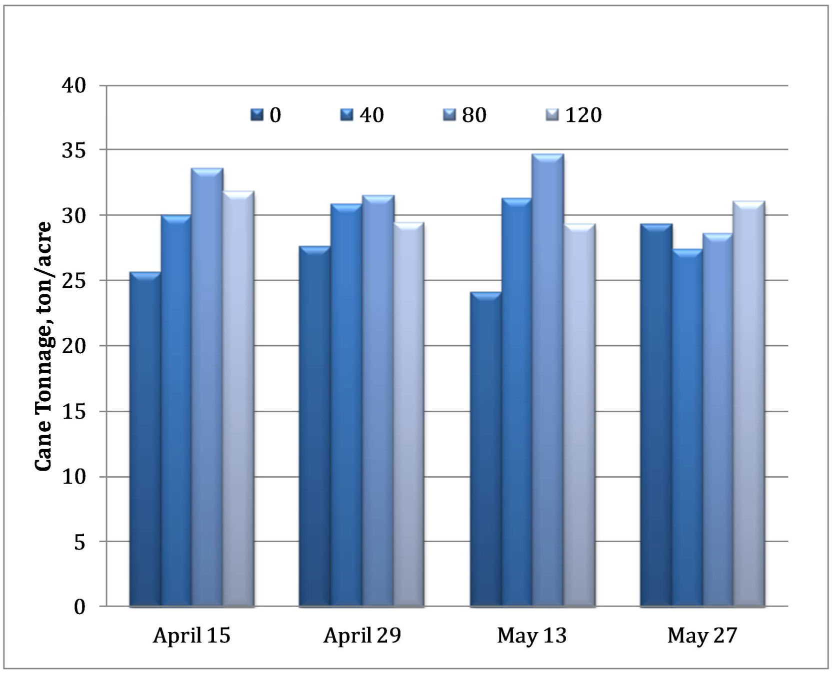

Figure 3. Effect of different N rates and time of application on cane yield of 1st stubble crop of cane variety L 01-283, St. Gabriel, 2011.

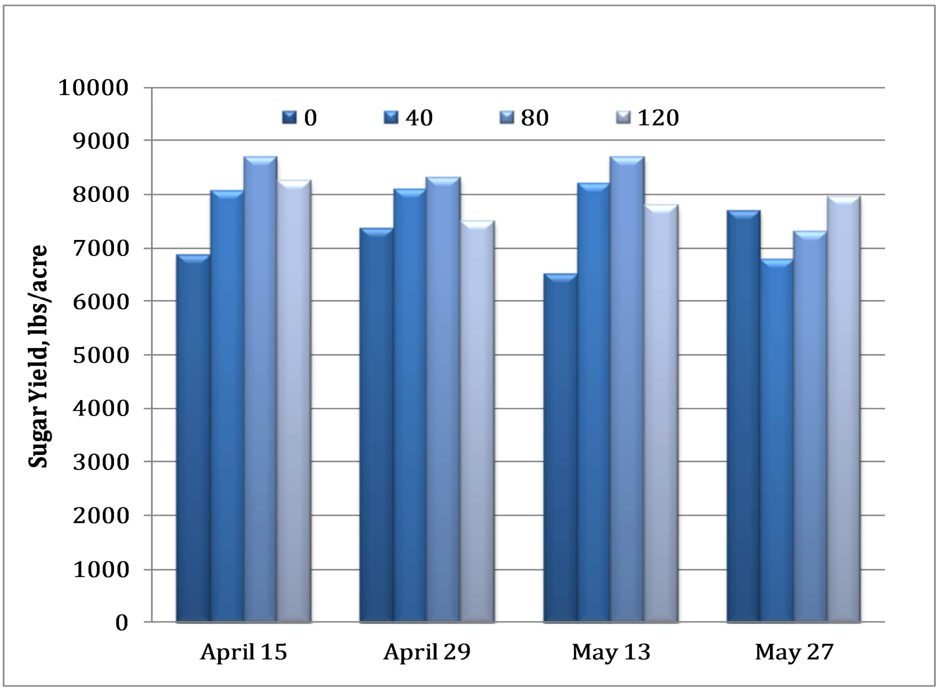

Figure 4. Effect of different N rates and time of application on sugar yield of 1st stubble crop of cane variety L 01-283, St. Gabriel, 2011.

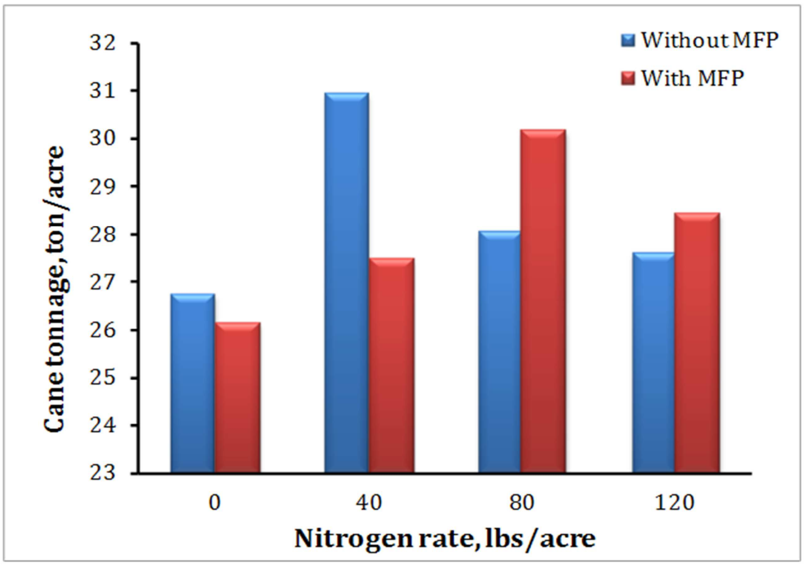

Figure 5. Cane tonnage of 2nd stubble HoCP 96-540 in response to different N rates with or without the application of molasses fermentation by-product.

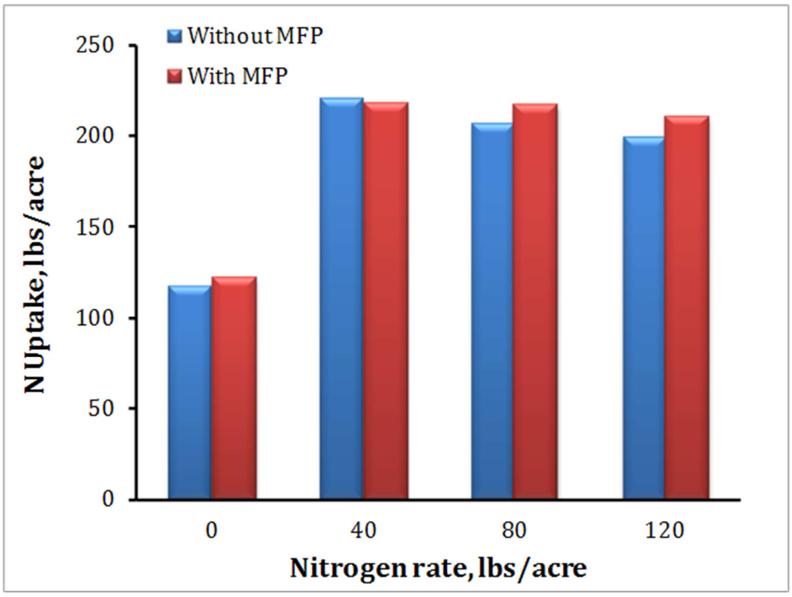

Figure 6. Nitrogen uptake (cane stalk) in response to different N rates with our without the application of molasses fermentation by-product to cane variety HoCP 96-540.

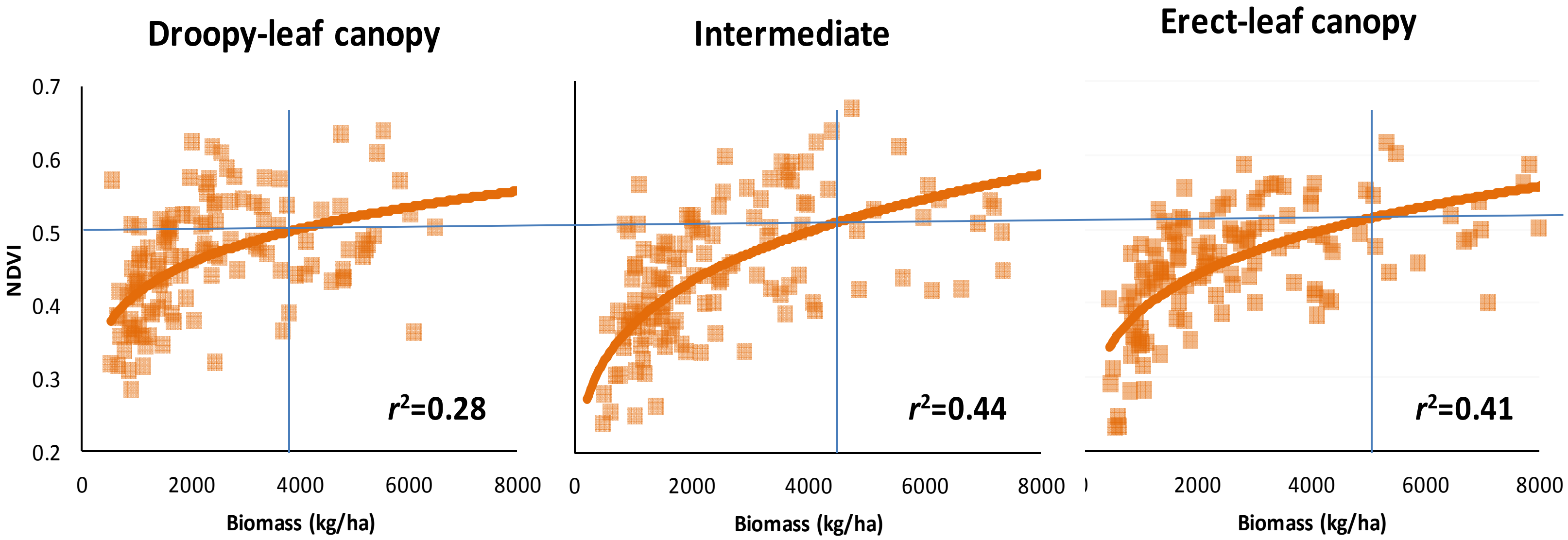

Figure 7. Relationship of normalized difference vegetation index (NDVI) readings to biomass of cane varieties with different leaf-canopy structure (Droopy-leaf canopy – L 99-226; Intermediate – L 01-283; and erect-leaf canopy – HoCP 96-540) .

Table 1. Effect of different sources and rates of potash on yield, quality parameters, and K and S uptake of sugarcane variety HoCP 96-540, and Mehlich-3 extractable K and S of soils after harvest in 2011, St. Gabriel, LA.

K Source	**K Rate**	**Sulfur**	**Soil K**	**Soil S**	**TRS**	**Sucrose**	**K in stalk**	**S in stalk**	**K removal**	**S Removal**	**Cane**	**Sugar**
	lbs K_2O/ac	**lbs S/ac**	**ppm**	**ppm**	**lbs/ton**	**%**	**%**	**%**	**lbs/ac**	**lbs/ac**	**ton/ac**	**lbs/ac**
Check 1	0	0	243 c	15.2 b	244	17.1	5.09 b	1.01 b	2319	464	22.8	5223 b
Check 2	0	20	245 c	17.1 b	243	17.0	5.71 b	1.14 b	2837	562	24.8	5527 b
SOP	60	(24)	230 c	16.5 b	245	17.2	6.10 a	1.23 a	2684	541	22.0	5395 b
SOP	120	(48)	282 b	33.6 a	243	17.0	6.09 a	1.49 a	2808	685	24.4	5943 ab
SOP	240	(96)	329 a	28.7 ab	237	16.1	6.84 a	1.54 a	3041	678	23.2	5219 b
MOP	60	0	255 b	16.0 b	230	16.2	6.83 a	1.06 b	3076	477	22.6	5205 b
MOP	120	0	275 b	16.2 b	237	16.4	7.10 a	1.11 b	3187	500	22.3	5311 b
MOP	240	0	276 b	14.3 b	243	17.0	6.01 a	1.00 b	3121	523	26.1	6352 a
MOP	60	20	293 b	18.3 b	230	16.2	7.01 a	1.29 b	3390	634	24.2	5395 ab
MOP	120	20	282 b	17.9 b	243	17.1	6.07 a	1.14 b	2828	538	24.5	6073 ab
MOP	240	20	312 a	18.6 b	241	17.0	6.36 a	1.11 b	2889	503	22.7	5489 b
Analysis of Variance			*P-values*									
Treatment			0.0989	0.2816	0.6473	0.5081	0.023	0.0007	0.2109	0.1002	0.207	0.0527
Constrast Analysis			0.5294	0.0241	0.2189	0.5253	0.3427	<0.0001	0.1623	0.0085	0.6112	0.6373
SOP vs MOP												

Notes:
Application of 60, 120 and 240 lbs K_2O as SOP also supplied the plots with 24, 48 and 96 lbs S/acre, respectively.
Treatment effect and contrast analysis was significant if P-value<0.10.
For Soil K, Soil S, K in stalk, S in stalk and Sugar - means within column followed by different letters indicate significant differences at P<0.10

Table 2. Effect of calcium silicate slag application on sugarcane grown on a Commerce silt loam soil, St. Gabriel, 2011.

Variety	CaSiO3 ton/acre	TRS lbs/acre	Sucrose %	Cane ton/acre	Sugar lbs/acre	Flag Leaf Si %	Stalk Si %	Si Stalk Uptake, lbs/acre	Soil Si† mg/kg
L01-283	0	261	18.6	35.5	9248	2.33	0.406	287	99
	1	262	18.5	37.4	9771	2.73	0.428	323	90
	2	263	15.8	37.9	9976	2.64	0.455	346	89
	4	254	18.0	36.7	9311	2.68	0.449	329	106
	mean	***260***	***18.4***	***36.9***	***9577***	***2.60***	***0.434***	***321***	***96***
LCP85-384	0	244	17.3	27.8	6777	2.48	0.420	234	95
	1	248	17.6	27.9	6918	2.31	0.430	240	97
	2	262	18.5	34.0	8885	2.25	0.400	270	104
	4	248	17.5	31.8	7872	2.41	0.450	289	179
	mean	***250***	***17.7***	***30.4***	***7613***	***2.36***	***0.425***	***258***	***119***
HoCP96-540	0	254	18.0	36.8	9258	2.06	0.416	315	93
	1	257	18.1	36.9	9498	1.72	0.379	280	110
	2	258	18.2	38.0	9806	2.12	0.365	278	84
	4	253	17.5	38.9	9848	1.80	0.385	299	104
	mean	***256***	***17.9***	***37.7***	***9625***	***1.93***	***0.386***	***293***	***98***
Analysis of Variance (*P*-values)									
CaSiO3 rate (R)		0.0739	0.0581	0.0835	0.0146	0.8853	0.5401	0.3336	0.0939
Variety (V)		0.0181	0.0076	<0.001	<0.001	<0.001	0.0017	0.0006	0.2210
R x V		0.6239	0.4955	0.5883	0.2498	0.0458	0.1554	0.3162	0.3305

† - *Acetic acid extractable silicon*

Table 3. Effect of calcium silicate slag application on sugarcane grown on a Sharkey clay soil, St. Gabriel, 2011.

Variety	CaSiO3 ton/acre	TRS lbs/acre	Sucrose %	Cane ton/acre	Sugar lbs/acre	Flag Leaf Si %	Stalk Si %	Si Stalk Uptake, lbs/acre	Soil Si† mg/kg
L01-283	0	258	18.20	12.1	3129	2.76	0.635	153	145
	1	255	18.03	14.3	3333	2.66	0.598	177	154
	2	258	18.14	13.3	3442	2.84	0.629	168	172
	4	257	18.13	14.8	3800	2.66	0.652	193	194
	mean	***257***	***18.13***	***13.6***	***3426***	***2.73***	***0.628***	***172***	***167***
LCP85-384	0	256	18.07	13.1	3359	2.32	0.624	162	163
	1	253	17.97	13.4	3378	2.55	0.640	170	152
	2	255	18.01	14.8	3782	2.38	0.664	197	162
	4	263	18.55	13.2	3461	2.42	0.671	175	180
	mean	***257***	***18.15***	***13.6***	***3495***	***2.42***	***0.650***	***176***	***164***
HoCP96-540	0	251	17372	15.7	3919	2.02	0.559	172	167
	1	251	17.75	16.8	4212	1.80	0.536	178	158
	2	258	18.24	18.1	4670	1.90	0.499	180	183
	4	256	18.11	20.5	5269	1.96	0.578	237	193
	mean	***254***	***17.96***	***17.8***	***4517***	***1.92***	***0.543***	***192***	***175***
Analysis of Variance (*P*-values)									
CaSiO3 rate (R)		0.1647	0.1574	0.1104	0.0577	0.1658	0.9591	0.0197	0.1674
Variety (V)		0.3613	0.3325	<0.001	<0.001	<0.001	<0.001	0.1677	0.2988
R x V		0.6510	0.4687	0.5286	0.6311	0.4852	0.2437	0.2407	0.7648

† - Acetic acid extractable silicon

Table 4. Analysis of variance for all parameters measured to determine the effect of foliar application of N-Boost on sugarcane.

Trt No.	N Rate, lbs/A	Foliar Application		TRS, lbs/t	Cane Yield, t/A	Sugar Yield, lbs/A	Plant Height, cm		Chlorophyll Reading		Leaf N Content, %		Stalk N Content, %	Stalk N Uptake, lbs/A
		06/09/11	07/11/11				1st	2nd	1st	2nd	1st	2nd		
1	0	0	0	259	34	8851	164	256	43.6	46.1	1.55	1.66	0.266	25
2	0	N-Boost	N-Boost	255	34	8613	164	255	43.8	47.9	1.53	1.72	0.299	25
3	40	0	0	256	34	8408	161	252	44.2	47.6	1.62	1.79	0.345	27
4	40	N-Boost	N-Boost	260	34	8928	165	251	45.1	47.1	1.70	1.76	0.363	32
5	80	0	0	250	38	9414	161	255	45.4	48.1	1.72	1.88	0.396	36
6	80	N-Boost	N-Boost	251	39	9780	168	259	46.3	47.7	1.58	1.92	0.418	42
7	80	UAN	UAN	244	33	8194	171	258	45.5	47.7	1.71	1.84	0.394	31
8	80	Both	Both	248	35	8658	172	252	45.9	48.0	1.79	1.79	0.384	31
9	120	0	0	255	36	9243	154	251	45.6	47.8	1.69	1.81	0.396	37
10	120	N-Boost	N-Boost	252	37	9260	161	254	46.2	48.9	1.67	1.86	0.445	41
11	160	0	0	251	35	8803	154	254	44.2	48.5	1.64	1.86	0.367	33
12	160	N-Boost	N-Boost	255	38	9683	169	264	45.1	47.5	1.70	1.71	0.366	35
			Pr>F	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	*****	*******	******

Notes:

TRS – theoretical recoverable sugar, lbs per ton of cane tonnage

1st –one month after 1st foliar application

2nd – one month after 2nd foliar application

Both – Both N-Boost and UAN were applied

N-Boost – 5 pint/A

UAN – foliar application at rate of 10 lbs N/A as urea ammonium nitrate (UAN)

*Pr>F, ns – not significant; *, ** and *** - significant at 0.05, 0.01 and 0.001.*

Table 5. Contrast analysis of N-fertilized cane (40, 80, 120 and 160 lbs N/A) with and without foliar application of N-Boost.

Variables	With Foliar N-Boost	Without Foliar N-Boost	*P*-Value
Cane, t/A	37	36	0.3480
Sugar, lbs/A	9413	8967	0.1958
TRS, lbs/t	255	253	0.3081
% N leaf, 1st sampling	1.665	1.663	0.9783
% N leaf, 2nd sampling	1.815	1.834	0.5878
Plant height, cm (1st sampling)	166	157	0.0200
Plant height, cm (2nd sampling)	257	253	0.4553
Chlorophyll content, (1st sampling)	45.7	44.8	0.3001
Chlorophyll content, (2nd sampling)	47.8	48.0	0.3641
% N Stalk	0.398	0.376	0.1560
Stalk N Uptake, lbs/A	37	33	0.2760

TRS – Theoretical recoverable sugar

Table 6. Analysis of variance and contrast analysis of yield and quality parameters of 2nd stubble HoCP96-540 applied with different N rates using urea-ammonium nitrate (UAN) and molasses fermentation by-product (MFP) as sources, LSU AgCenter Sugar Research Station in St. Gabriel, 2011.

Trt. No.	N Rate lbs/acre	MFP Rate gal/acre	Cane Yield ton/acre	TRS lbs/ton	Sucrose %	Sugar yield lbs/acre	N Uptake lbs/acre
1	0	0	26.7	247	17.3	6596	117
2	40	0	31.0	247	17.4	7624	220
3	80	0	28.0	238	16.9	6709	206
4	120	0	27.6	245	17.3	6758	200
5	0	20	26.1	242	17.2	6337	122
6	40	20	27.5	242	17.1	6671	218
7	80	20	30.2	241	17.0	7270	217
8	120	20	28.4	239	17.0	6802	211
9	30	20	26.4	250	17.6	6592	148
10	60	40	31.0	231	16.6	7164	251
11	90	60	30.8	240	17.1	7409	197
		P-value	***0.1169***	***0.4898***	***0.6505***	***0.4634***	***<0.001***
CONTRAST ANALYSIS							
Cane without MFP			28.3	244	17.2	6922	186
Cane with MFP			28.1	241	17.1	6770	192
		P-value	***0.7893***	***0.4179***	***0.4494***	***0.5966***	***0.4567***
Cane fertilized w/ UAN			28.9	243	17.2	7031	209
Cane fertilized w/ UAN + MFP			29.4	240	17.1	7055	198
		P-value	***0.6539***	***0.5286***	***0.6204***	***0.9419***	***3592***

Table 7. Analysis of variance and contrast analysis of soil pH and Mehlich-3 extractable nutrients of soil samples collected at harvest from plots applied with different rates of N and molasses fermentation by-products, St. Gabriel, 2011.

Trt. No.	**N Rate lbs/acre**	**MFP Rate gal/acre**	**Soil pH**	**Mehlich-3 Extractable Nutrients, ppm**							
				P	**K**	**Ca**	**Mg**	**S**	**Zn**	**Cu**
1	0	0	6.60	25	132	1705	427	8.19	2.12	2.55
2	40	0	5.98	28	126	1633	383	8.95	2.04	2.46
3	80	0	6.13	28	119	1509	363	7.20	1.95	2.30
4	120	0	6.41	27	125	1673	407	7.82	2.13	2.59
5	0	20	6.56	29	126	1625	384	8.07	2.11	2.56
6	40	20	6.30	26	109	1431	342	8.29	1.91	2.15
7	80	20	6.19	29	118	1552	360	8.97	2.07	2.35
8	120	20	6.06	30	129	1601	378	9.06	2.05	2.45
9	30	20	6.06	25	120	1558	369	8.76	2.09	2.40
10	60	40	6.06	26	123	1544	361	8.42	1.92	2.30
11	90	60	6.01	24	112	1420	339	8.30	1.82	2.10
		P-value	***0.5831***	***0.9363***	***0.9524***	***0.9199***	***0.8080***	***0.8761***	***0.9602***	***0.9025***
CONTRAST ANALYSIS										
Cane without MFP			6.3	27	126	1630	395	8.04	2.06	2.48
Cane with MFP			6.3	28	120	1552	366	8.60	2.04	2.38
		P-value	***0.9912***	***0.5804***	***0.5256***	***0.4347***	***0.2323***	***0.3251***	***0.8473***	***0.5577***
Cane fertilized w/ UAN			6.2	28	124	1605	385	7.99	2.04	2.45
Cane fertilized w/ UAN + MFP			6.0	25	118	1507	357	8.49	1.94	2.27
		P-value	***0.5211***	***0.2671***	***0.5869***	***0.3951***	***0.3202***	***0.4414***	***0.5023***	***0.3548***

Note:
Cane without MFP – treatments 1 to 4
Cane with MFP – treatments 5 to 8
Cane fertilized w/ UAN – treatments 2 to 4
Cane fertilized w/UAN + MFP – treatments 9 to 11

Table 8. Analysis of variance and contrast analysis of stalk nutrient content of 2nd stubble HoCP96-540 applied with different rates of nitrogen using urea-ammonium nitrate (UAN) and molasses fermentation by-product (MFP) as sources, LSU AgCenter Sugar Research Station in St. Gabriel, 2011.

Trt. No.	N Rate lbs/acre	MFP Rate gal/acre	Stalk Nutrient Content N	P	K	S	Ca	Mg	Fe	Zn	Cu	Mn	Na	Al
			----%----						----ppm----					
1	0	0	0.219	0.085	0.482	0.082	0.059	0.071	37	11.88	2.49	5.54	55	19
2	40	0	0.356	0.062	0.355	0.078	0.068	0.086	35	9.65	2.49	7.37	20	20
3	80	0	0.368	0.053	0.345	0.065	0.058	0.079	43	8.27	2.09	7.07	20	26
4	120	0	0.362	0.069	0.401	0.077	0.070	0.088	45	9.80	2.62	7.32	21	24
5	0	20	0.233	0.086	0.470	0.083	0.061	0.076	34	11.90	2.79	6.17	38	19
6	40	20	0.396	0.066	0.386	0.080	0.068	0.091	32	9.27	2.39	6.36	44	18
7	80	20	0.360	0.069	0.451	0.090	0.071	0.097	50	9.66	2.48	6.67	22	20
8	120	20	0.370	0.062	0.399	0.075	0.068	0.089	39	10.04	2.51	6.37	29	21
9	30	20	0.281	0.076	0.452	0.086	0.063	0.082	34	9.82	2.50	5.62	35	19
10	60	40	0.404	0.067	0.397	0.076	0.077	0.095	37	10.24	2.73	7.82	29	18
11	90	60	0.319	0.072	0.400	0.089	0.067	0.093	36	10.38	2.62	7.09	30	21
		P-value	***<0.001***	***0.0014***	***0.2659***	***0.2755***	***0.0374***	***0.0043***	***0.5554***	***0.3312***	***0.1816***	***0.2538***	***0.5810***	***0.5727***
CONTRAST ANALYSIS														
Cane without MFP			0.326	0.067	0.396	0.075	0.064	0.081	40	9.90	2.42	6.82	29	22
Cane with MFP			0.340	0.071	0.426	0.082	0.067	0.088	39	10.22	2.54	6.39	33	20
		P-value	***0.3445***	***0.3688***	***0.2835***	***0.1550***	***0.2040***	***0.0304***	***0.7764***	***0.6430***	***0.2675***	***0.3394***	***0.6223***	***0.2104***
Cane fertilized w/ UAN			0.362	0.061	0.367	0.073	0.065	0.084	41	9.24	2.40	7.25	21	23
Cane fertilized w/ UAN + MFP			0.335	0.072	0.416	0.084	0.069	0.090	36	10.14	2.61	6.84	31	19
		P-value	***0.1077***	***0.0161***	***0.1376***	***0.0522***	***0.2295***	***0.1310***	***0.2591***	***0.2566***	***0.0910***	***0.4354***	***0.2774***	***0.0905***

Note:
Cane without MFP – treatments 1 to 4
Cane with MFP – treatments 5 to 8
Cane fertilized w/ UAN – treatments 2 to 4
Cane fertilized w/UAN + MFP – treatments 9 to 11

EVALUATION OF THE USE OF GREEN MANURE SOYBEANS GROWN IN ROTATION WITH SUGARCANE IN A SUB-TROPICAL ENVIRONMENT

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SUMMARY:

Soybeans [*Glycine max* (L.) Merr] is the most commonly grown crop during the fallow period of sugarcane (*Saccharum* sp.) production cycles in Louisiana. The majority use is for harvest as a grain crop but it also has been used as a green manure crop for almost a century. The objective of a series of three experiments was to determine the influence of soybean green manure grown during the fallow period on the sugar and cane yield of plant-cane. A secondary objective was to associate the levels of soil nitrate (NO_3^--N) and ammonium (NH_4^+-N) at fertilization time in the spring with plant cane yields following both a conventional fallow period and the incorporation of soybean manure grown immediately prior to planting the next cycle of sugarcane production. Treatments compared at experimental sites 1 and 2 included plant-cane grown both with and without N fertilizer after a conventional fallow period and plant-cane grown both with and without N fertilizer after the incorporation of soybean green manure. At experimental site 3 the effects of fallowing and soybean green manuring were evaluated using only N-fertilized plant-cane. Neither plant-cane yields (cane and sugar) nor recoverable sugar levels (TRS) were significantly affected by the addition of soybean biomass to the soil in the fall. Also, the additive effect of the combination of incorporation of green manure and additional fertilizer N did not result in higher plant-cane yield or TRS compared to the unfertilized plant-cane after fallow. While there were site differences for soil NH_4^+–N and NO_3^-–N concentrations, differences between treatments within sites for soil inorganic N levels were not significant except for NO_3^-–N at site 3. It seems justified to conclude that soil N was not a limiting factor for plant-cane growth and development, as there was a slight tendency for the unfertilized plant-cane following a conventional fallow period, expected to be the least N-rich environment, to yield the highest (see chart below). Failure of sugarcane to respond to applied N indicates the capability of the fallow period to make N readily available in quantities sufficient for plant-cane growth.

Research supported in part by a grant from the American Sugar Cane League

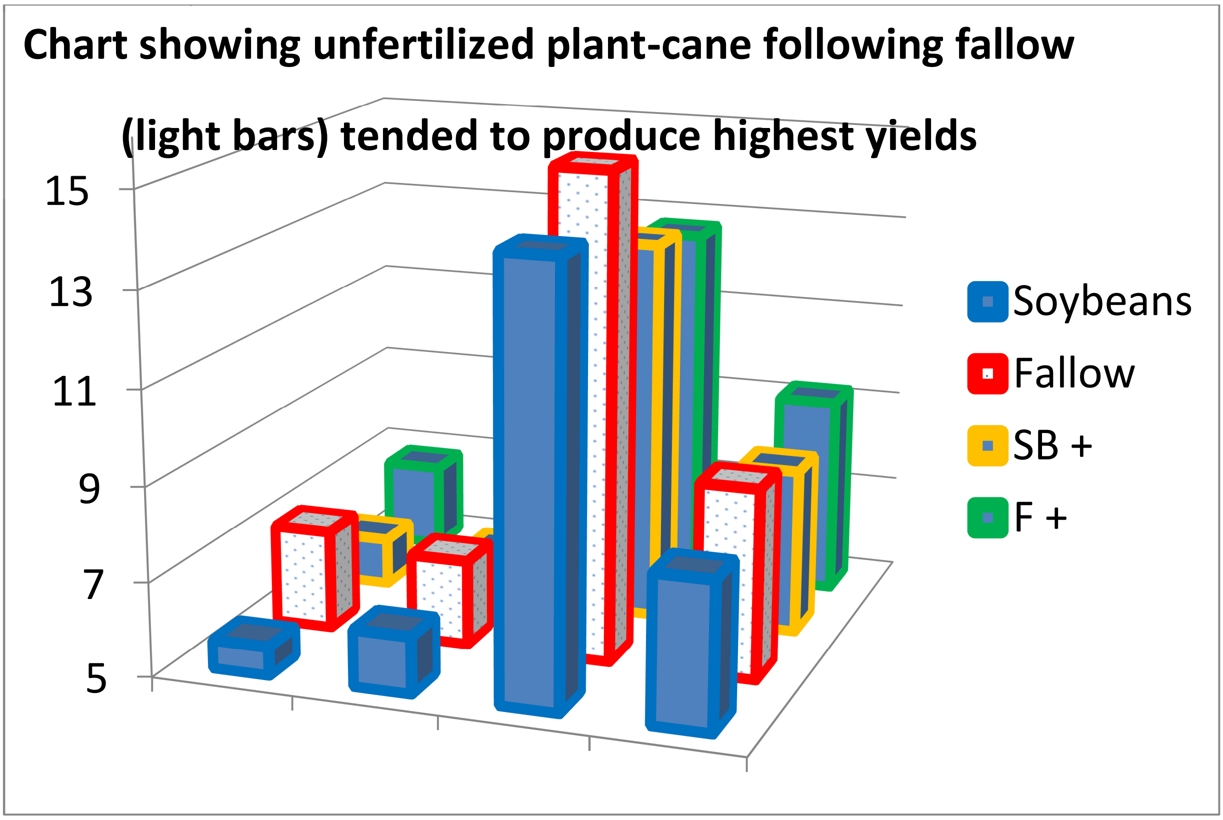
Chart showing unfertilized plant-cane following fallow
(light bars) tended to produce highest yields
15
13
11
9
7
5
Soybeans
Fallow
SB +
F +

VARIETAL RESPONSE TO NITROGEN APPLICATION RATES

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SUMMARY:

In a continuing effort to evaluate the response of sugarcane cultivars to applied nitrogen (N) fertilizer, three cultivars, L01-283, L99-226 and HoCP96-540, were utilized in a N rate study on first stubble on a Baldwin silty clay loam in 2011. There were no significant differences among varieties or application rates. The CV for this test was 24%, which is considered high for such an application rate study and may indicate that caution needs to be exercised when interpreting the results. Sugarcane is often insensitive to fertilizer N inputs, but this insensitivity is normally found in plant-cane and not stubble crops.

Table 1. Effects of nitrogen application rate on sugar per acre yield of first-stubble L01-283, L99-226 and HoCP96-540

	Application Rate in lb/acre				
Cultivar	0	40	80	120	Cultivar Mean
	lb/acre				
L01-283	10185	9467	8770	10944	9842[1]
L99-226	9466	10355	9919	11847	10397
HoCP96-540	9927	10369	9523	10470	10072
Rate Mean	9859	10064	9404	11087	

[1]Means in rows and columns are not significantly different (P=0.05).

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

EVALUATION OF NANO-GRO™ ON SUGARCANE YIELD

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In 2010, the LSU AgCenter was approached to test the effect of Nano-Gro™ on sugarcane growth and development. Nano-Gro™, a homeopathic pre-planting and growth enhancing treatment for plants, was provided by the company RSI.

A yield trial was planted on September 21, 2010 at the Sugar Research Station in St. Gabriel, Louisiana. Seed-cane of HoCP 96-540 was used for the trial. For planting, 22-stalk bundles of sugarcane were hand cut for plot (experimental unit), and the experimental design was a randomized complete block (four replications). Treatments included soak times (0, 30 seconds, 60 seconds, and 120 seconds) in a proprietary compound provided by the company. The test was planted immediately after planting.

Standard cultural practices were followed during the 2011 growing season. Plant population counts were made in the fall of 2010 and early spring of 2011. Millable stalk counts were done on August 3, 2011, and the field trial was harvested on December 10, 2011 for the plant-cane crop. 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 NIR analysis in the laboratory to determine sucrose content (lbs sugar per ton of cane) and fiber content (%).

Data were analyzed with SAS (v9.2) software. Replication was considered a random effect; variety was considered a fixed effect. Least square means were estimated and tested for statistical significance (P=0.05) with the PDIFF option of PROC MIXED.

Treatment	Population Aug3	Height Aug3	Diameter Dec10	Height Dec10	Sugar per Acre	Cane Yield	Sucrose Content	Fiber Content
	Stalks/acre	inches	inches	inches	lbs/acre	tons/acre	lbs/ton of cane	%
30-sec	41,064	85.0	1.12	107	11551	43.2	266	12.3
60-sec	37,737	85.8	1.06	110	10277	40.5	254	11.6
120-sec	35,771	82.7	1.10	105	10470	41.0	256	11.5
Control	43,333	83.8	1.04	101	11677	44.6	263	12.3
Prob > F	0.163	0.603	0.396	0.207	0.711	0.869	0.090	0.178