SOIL FERTILITY RESEARCH IN SUGARCANE

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In Cooperation with
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Summary

Several soil fertility trials were conducted in 2010 to evaluate the performance of recent cane varieties as affected by different sources and rates of nitrogen (N), phosphorus (P), and potassium (K). Nitrogen applied at a rate of 80 lbs N ac^{-1} significantly increased cane and sugar yield of 3rd stubble cane varieties HoCP96-540, L99-226 and LCP85-384. Different N rates and time of application did not affect yield of cane variety L01-283. The contrast analysis conducted on K source and rate effects suggests that application rate of 60 lbs K_2O/ac is expected to have higher cane and sugar yields than the check plot (0 K_2O/ac) at about 80% of the time. The absence of sugarcane response to N and P did not facilitate the testing of diammonium phosphate (DAP) by-product as source of N and P compared with the commonly applied N(urea ammonium nitrate, UAN) and P (triple superphosphate, TSP) sources. The initial analyses however suggest that applications of DAP by-product, UAN and TSP showed no significant differences in nutrient removal rate of sugarcane nor the Mehlich-3 extractable and total concentrations of selected nutrients/elements in the soil.

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

An experiment was conducted to determine the effect of spring-applied N fertilizer on the yield and yield components of 3rd stubble-cane of three cane varieties planted on a Commerce silt loam (Table 1). The responses of varieties LCP85-384, HoCP96-540 and L99-226 with different N rates (0, 40, 80, and 120 lbs N/ac) were evaluated. Sugarcane variety HoCP96-540 obtained the highest cane (35 tons/ac) and sugar (7844 lbs/ac) yield among the varieties tested. Across all varieties, N significantly increased both cane and sugar yield. Nitrogen applied at the rate of 80 lbs/ac maximized both cane and sugar yield. The higher sugarcane yield obtained by HoCP96-540 and plots which received 80 lbs N/ac could be attributed to higher production of stalks/ac.

The effects of different N rates (0, 40, 80, and 120 lbs N/ac) and time of application (April 15, April 29, May 13 and May 27) were tested on a plant cane variety L01-293 (Table 2). Both cane and sugar yields were not affected by N rate and time of application (P<0.05). Cane and sugar yields were numerically the highest when N was applied on April 15. The interaction effect of N rate and time of application on measured parameters was also not significant.

Response of Sugarcane to Different Sources and Rates of Potassium

This study was established on a silty clay soil that was tested low to medium for K and high for sulfur (S). The effects of two sources (sulfate of potash - SOP and muriate of potash - MOP) and four rates of potash (0, 60, 120 and 240 lbs K_2O/ac) on yield and quality of sugarcane variety HoCP96-540 were tested (Table 3). On average, potash application increased cane yield by 3 tons/ac however these increases were not significant. A contrast analysis was conducted between 0 and 60 lbs K_2O/ac for the two sources of potash. Results showed that at a traditional P value of 0.05, the cane and sugar yields of the two rates were the same. However, the P values obtain also suggest that 60 lbs K_2O/ac as SOP would yield higher than 0 lbs K_2O/ac and 60 lbs K_2O/ac as MOP about 80% of the time.

There was a slight decline in Mehlich-3 extractable K when compared with the 2009 values especially the check plots. Soil test S values were 50% lower than the 2009 data. The average soil test S value of plots which received 20 lbs S/ac was 20 ppm. A slight increasing soil test S trend can be observed with increasing SOP application. These differences in soil test S did not affect cane and sugar yields.

Yield and Nutrient Uptake of Sugarcane at Different Rates and Sources of Nitrogen and Phosphorus

Two experiments were established to evaluate the use of diammonium phosphate (DAP) by-product as source of P and N for sugarcane production. The first experiment was established in 2009 on a field with a soil testing medium for P. The soil was generally light in texture. Cane variety L01-283 was planted in late summer of 2009. In April 2010, treatments were applied to each plot. Treatments included two sources of N (UAN – urea ammonium nitrate, 32% N; DAP by-product) applied at rates of 40, 80 and 120 lbs N/ac. To isolate the effect of P in case sugarcane would be responsive to P application, treatments consisting of 40, 80, and 120 lbs N/ac as UAN with a minimum application rate of triple superphosphate (TSP) at 100 lbs P_2O_5/ac were included. Two N checks were included as well, one without TSP and one with 100 lbs P_2O_5/ac as TSP. The second experiment was established on a field planted with 1st stubble cane variety HoCP96-540, the most prevalent variety in the state. The soil has a light texture and with low-medium soil test P level. The treatments included two sources of P (TSP and DAP by-product) applied at 50 and 100 lbs P_2O_5/ac. A check plot was included in the treatment structure which was laid-out on a complete randomized design with three replications. At harvest, ten stalks were taken from the middle row for yield quality determination. Grab samples were taken from the shredded stalk for multi-elemental analysis by Nitric-Hydrogen Peroxide digestion procedure followed by ICP analysis. Soil samples were also collected post-harvest and analyzed for Mehlich-3 extractable and total concentration of selected nutrients/elements in the soil. There were no significant differences in cane and sugar yield among different rates and sources of N and P (Tables 4 and 5). Without any response to N and P, the effectiveness of the two sources of N and P could not be evaluated. However, changes on the extractable nutrients and total concentrations of selected elements/nutrients in the soil were determined (Tables 6 and 8). Mehlich-3 extractable P was higher (P<0.05) in plots which received P fertilizer. Other than P, DAP by-product application did not result in any increases on the amount of extractable nutrients nor the total concentrations of different elements in the soil. In general, the amounts of nutrients/elements removed by sugarcane were numerically higher with TSP as P source. However, these differences were not statistically significant (Table 9).

Our initial findings showed that there were no evident changes on the concentrations of different elements/nutrients both in the soil and harvested sugarcane stalk. It is important to note that repeated applications of any source of fertilizer may result in cumulative effect on the concentration of nutrients/elements in the soil especially those sources containing traces of elements that are not essential for plant growth. In this light, it is important to design a field study that will enable us to monitor and document cumulative effect of annual application of DAP by-product on nutrients and heavy metals concentrations in the soil and sugarcane stalks.

Acknowledgements
The authors wish to express appreciation for the financial support of Great Salt Lake Minerals, Syngenta, and USDA-AFRI.

Table 1. Effect of nitrogen on third stubble of three cane varieties planted on a Commerce silt loam at the Sugar Research Station, St. Gabriel, LA, 2010.

Treatment		**Population 1000/ac**	**TRS Lbs/ton**	**Purity %**	**Cane Yield ton/ac**	**Sugar Yield lb/ac**
Variety						
	L99-226	30.4	228	82	33.1	7556
	LCP85-384	36.9	217	81	33.2	7217
	HoCP96-540	39.0	222	82	35.4	7844
	P value	***P<0.001***	***P<0.001***	***ns***	***P<0.05***	***ns***
Nitrogen Rate, lb/ac						
	0	32.0	222	82	28.4	6298
	40	35.4	228	82	34.1	7795
	80	36.9	220	82	36.4	8065
	120	37.1	222	81	36.9	8068
	P value	***P<0.05***	***P<0.05***	***ns***	***P<0.001***	***P<0.01***

Table 2. Effect of different nitrogen rates and time of application on cane and sugar yield of variety L01-283 (plant cane).

Rate,	**Cane Yield, tons/ac**				**Sugar Yield, lbs/ac**			
Lbs N/ac	**April 15**	**April 29**	**May 13**	**May 27**	**April 15**	**April 29**	**May 13**	**May 27**
0	42	43	36	40	11134	11255	9709	10462
40	45	41	42	39	11658	10368	10714	10247
80	43	39	39	40	10955	9797	10142	10387
120	41	37	40	40	10397	9402	9963	10364
Average	***42***	***40***	***39***	***40***	***11036***	***10205***	***10110***	***10365***

Note: Both N rates and application time had no effect on cane and sugar yields.

Table 3. Yield and yield components of sugarcane variety HoCP96-540 (1st stubble) as affected by source and rate of potassium. Mehlich-3 extractable potassium of soil samples collected after harvest is also reported.

Source	**Potash Rate lbs K_2O/ac**	**Soil K**	**Population 1000/ac**	**TRS Lbs/ton**	**Purity %**	**Cane Yield Ton/ac**	**Sugar Yield lb/ac**
-	0 (Check 1)	213	29.8	252	87	35	8882
-	0 (Check 2†)	193	32.3	256	87	34	8681
SOP	60	231	36.7	263	88	40	10586
SOP	120	217	28.8	263	88	37	9761
SOP	240	237	28.7	262	88	38	9945
MOP	60	203	29.5	263	88	36	9338
MOP	120	223	30.5	261	88	37	9753
MOP	240	194	36.3	261	87	40	10392
MOP†	60	214	31.6	267	89	37	9969
MOP†	120	205	34.8	267	88	39	10488
MOP†	240	223	37.3	249	87	39	9701

† applied with 20 lbs S ac^{-1}

SOP: Sulfate of Potash, 0-0-50

MOP: Muriate of Potash , 0-0-60

Table 4. Effect of source and rate of nitrogen on yield and quality parameters of sugarcane variety L01-283 (plant cane).

Source^{NS}	**Rate**^{NS} **lbs N/ac**	**Sucrose %**	**Brix %**	**TRS lbs/ton**	**Cane Yield ton/ac**	**Sugar Yield lbs/ac**
Check	0	17.8	20.1	258	45.5	11710
Check w/ TSP	0	17.7	20.2	254	42.5	10780
UAN	40	16.5	19.3	234	46.6	10856
	80	18.1	20.4	260	40.9	10648
	120	17.5	20.0	252	46.2	11635
UAN w/ TSP	40	17.7	20.1	255	47.7	12140
	80	16.7	19.5	236	46.7	11178
	120	17.4	19.8	251	44.0	12201
DAP by-product	40	16.9	19.5	242	45.6	11017
	80	17.3	19.8	247	45.2	11162
	120	17.4	19.9	249	46.6	11546

TSP – triple super phosphate
UAN – urea ammonium nitrate
NS – not significant at 95% level of confidence

Table 5. Effect of source and rate of phosphorus on yield and quality parameters of sugarcane variety HoCP 96-540 (1st stubble).

Source^{NS}	Rate^{NS} lbs P_2O_5/ac	Sucrose %	Brix %	TRS lbs/ton	Cane Yield ton/ac	Sugar Yield lbs/ac
TSP	0	18.0	20	262	34	8878
	50	17.8	20	258	32	8361
	100	18.0	20	261	31	8258
DAP by-product	0	18.0	20	262	34	8878
	50	17.6	20	254	32	8261
	100	18.3	20	266	29	7669

TSP – triple super phosphate
UAN – urea ammonium nitrate
NS – not significant at 95% level of confidence

Table 6. Total concentration of selected elements in the soil applied with different sources and rate of nitrogen.

Source^{NS}	Rate^{NS}	Total Concentration														
	lbs N/ac	P, %	Ca, %	Mg, %	S, %	Fe, %	Zn, ppm	Cu, ppm	B, ppm	Mn, ppm	Ni, ppm	Pb, ppm	As, ppm	Ba, ppm	Be, ppm	Cr, ppm
Check	**0**	0.063	0.466	0.602	0.030	2.18	71.2	19.8	45	571	21.08	33.1	3.50	1091	0.493	17.8
Check w/ TSP	**0**	0.069	0.447	0.599	0.042	2.13	70.9	20.0	44	581	21.38	42.6	3.72	1626	0.460	18.1
UAN	**40**	0.062	0.447	0.579	0.023	2.17	67.6	18.7	43	542	20.25	32.0	3.79	689	0.408	16.5
	80	0.061	0.447	0.608	0.024	2.05	69.7	19.5	45	582	21.38	32.8	3.18	791	0.446	17.1
	120	0.061	0.438	0.609	0.047	2.29	73.1	20.7	45	598	21.55	34.9	3.77	2077	0.496	18.0
UAN w/ TSP	**40**	0.071	0.447	0.603	0.025	2.07	70.0	20.0	44	548	20.86	32.7	3.60	693	0.450	17.2
	80	0.070	0.477	0.605	0.030	2.16	71.0	19.8	45	558	21.61	32.4	3.42	878	0.515	18.6
	120	0.072	0.465	0.596	0.020	2.04	68.9	19.1	44	549	21.11	30.5	3.06	568	0.414	16.4
DAP by-product	**40**	0.079	0.482	0.590	0.039	2.15	70.6	19.6	44	572	21.09	38.4	3.28	1504	0.452	18.1
	80	0.078	0.455	0.604	0.037	2.25	72.8	20.2	45	592	21.50	34.2	4.01	1448	0.526	18.8
	120	0.065	0.453	0.578	0.023	2.06	69.3	19.4	42	556	20.85	32.3	3.43	651	0.472	15.4

Table 6. Total concentration of selected elements in the soil applied with different sources and rate of nitrogen.

Source[NS]	Rate[NS]	Total Concentration														
	lbs N/ac	P, %	Ca, %	Mg, %	S, %	Fe, %	Zn, ppm	Cu, ppm	B, ppm	Mn, ppm	Ni, ppm	Pb, ppm	As, ppm	Ba, ppm	Be, ppm	Cr, ppm
Check	**0**	0.063	0.466	0.602	0.030	2.18	71.2	19.8	45	571	21.08	33.1	3.50	1091	0.493	17.8
Check w/ TSP	**0**	0.069	0.447	0.599	0.042	2.13	70.9	20.0	44	581	21.38	42.6	3.72	1626	0.460	18.1
UAN	**40**	0.062	0.447	0.579	0.023	2.17	67.6	18.7	43	542	20.25	32.0	3.79	689	0.408	16.5
	80	0.061	0.447	0.608	0.024	2.05	69.7	19.5	45	582	21.38	32.8	3.18	791	0.446	17.1
	120	0.061	0.438	0.609	0.047	2.29	73.1	20.7	45	598	21.55	34.9	3.77	2077	0.496	18.0
UAN w/ TSP	**40**	0.071	0.447	0.603	0.025	2.07	70.0	20.0	44	548	20.86	32.7	3.60	693	0.450	17.2
	80	0.070	0.477	0.605	0.030	2.16	71.0	19.8	45	558	21.61	32.4	3.42	878	0.515	18.6
	120	0.072	0.465	0.596	0.020	2.04	68.9	19.1	44	549	21.11	30.5	3.06	568	0.414	16.4
DAP by-product	**40**	0.079	0.482	0.590	0.039	2.15	70.6	19.6	44	572	21.09	38.4	3.28	1504	0.452	18.1
	80	0.078	0.455	0.604	0.037	2.25	72.8	20.2	45	592	21.50	34.2	4.01	1448	0.526	18.8
	120	0.065	0.453	0.578	0.023	2.06	69.3	19.4	42	556	20.85	32.3	3.43	651	0.472	15.4

Table 7. Amount of selected elements removed by sugarcane (L01-283, plant cane) fertilized with different sources and rates of nitrogen.

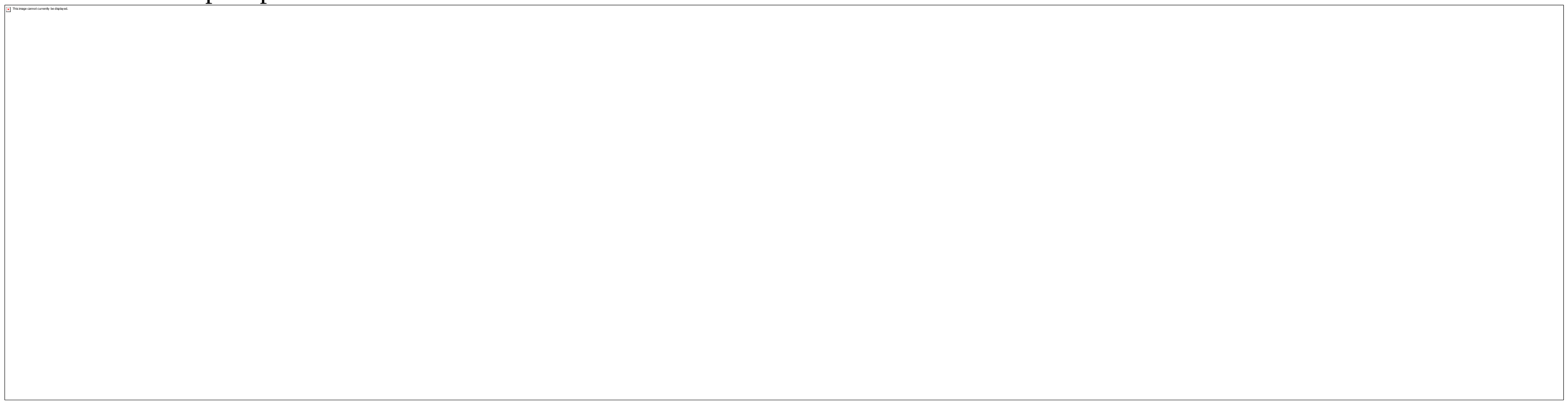
Source[NS]	Rate[NS]	lbs/ac												
	lbs N/ac	P	K	Ca	Mg	S	Cu	Fe	Zn	B	Mn	Mo	Ni	Pb
Check	**0**	57.9	420	65.8	63.7	67.5	0.20	6.5	1.02	0.42	0.882	0.018	0.007	0.004
Check w/ TSP	**0**	49.9	389	62.9	60.8	66.9	0.21	14.5	1.00	0.69	0.702	0.031	0.016	0.017
UAN	**40**	58.1	487	72.6	70.4	68.5	0.24	25.6	1.18	0.55	1.450	0.021	0.031	0.029
	80	46.9	460	68.4	62.8	64.8	0.19	26.1	0.99	0.34	1.090	0.020	0.044	0.039
	120	61.7	522	84.3	72.8	85.2	0.23	7.0	1.17	0.68	0.680	0.015	0.016	0.005
UAN w/ TSP	**40**	57.2	483	62.9	62.9	66.7	0.21	11.8	1.20	0.63	0.904	0.023	0.013	0.022
	80	62.2	489	68.4	67.9	79.9	0.24	11.2	1.29	0.52	0.664	0.023	0.013	0.014
	120	59.0	499	87.3	70.6	75.1	0.24	18.5	1.38	0.36	1.154	0.037	0.025	0.017
DAP by-product	**40**	51.8	509	67.4	61.9	74.9	0.22	11.0	1.24	0.70	1.251	0.013	0.015	0.015
	80	56.2	490	64.8	61.2	72.3	0.20	9.0	1.14	0.40	0.830	0.017	0.011	0.009
	120	57.0	506	67.2	62.8	75.7	0.22	5.9	1.09	0.58	0.738	0.017	0.007	0.004

Table 8. Amount of extractable and total concentration of selected elements in the soil applied with different sources and rate of phosphorus.

Source[NS]	Rate[NS]	Mehlich-3 Extractable						Total Concentration										
	lb P_2O_5/ac	P, ppm	K, ppm	Ca, ppm	S, ppm	Zn, ppm	Cu, ppm	Ca, %	Fe, %	Mg, %	Zn, ppm	B ppm	Cu, ppm	Mn, ppm	Ni, ppm	As ppm	Lead, ppm	Ba, ppm
TSP	**0**	43	240	3143	7.5	3.5	5.3	0.5	2.6	0.73	95.2	48.7	26.1	738	27.0	3.2	33.0	179.6
	50	52	250	3030	8.1	3.7	5.1	0.5	2.6	0.77	89.7	55.3	26.0	733	27.3	4.4	35.4	191.4
	100	48	242	3204	7.5	3.9	5.4	0.5	2.6	0.72	98.6	47.7	26.1	721	27.0	3.2	32.7	166.7
	average	***50***	***246***	***3117***	***7.8***	***3.8***	***5.2***	***0.5***	***2.6***	***0.75***	***94.2***	***51.5***	***26.0***	***727***	***27.2***	***3.8***	***34.1***	***179.0***
DAP by-product	**0**	43	240	3143	7.5	3.5	5.3	0.5	2.6	0.73	95.2	48.7	26.1	738	27.0	3.2	33.0	179.6
	50	68	248	3023	8.4	4.3	5.1	0.5	2.5	0.73	101.4	49.0	26.1	703	26.8	3.1	33.5	159.5
	100	52	239	3097	7.4	3.4	5.1	0.6	2.7	0.77	94.4	53.7	26.1	766	27.5	4.0	34.6	188.6
	average	***60***	***244***	***3060***	***7.9***	***3.8***	***5.1***	***0.5***	***2.6***	***0.75***	***97.9***	***51.3***	***26.1***	***734***	***27.2***	***3.5***	***34.1***	***174.0***

Average values – check or 0 P_2O_5 is not included.

Table 9. Amount of selected elements removed by sugarcane variety HoCP96-540 (1st stubble) fertilized with different sources and rates of phosphorus.



Average values – check or 0 P_2O_5 is not included.

THE EFFECTS OF FOLIAR-APPLIED HELENA CHEMICAL CO. NUTRITIONAL PRODUCTS ON YIELD OF L 01-283 GROWN ON BALDWIN SILTY CLAY LOAM

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SUMMARY:

Nutritional products marketed or scheduled to be marketed by Helena Chemical Co. were evaluated for efficacy on first ratoon L 01-283. The products were two foliar-applied plant nutrition compounds, identified using company designations as HM9310 and HM0607. Treatment identification, application rate and timing are shown in the table below. Both compounds were foliar applied 21 to 28 days after side-dressing of UAN 32% on April 23, 2010. The control plot average was a high 9,879 pounds of sugar per acre and the application protocols were not significantly different (P=0.45).

Side-dress fertilizer rate lb/acre	Product	Product rate per acre	Application protocol for product	Sugar yield[1] lb/acre
0	None	0		9,879 a
45	None	0		10,285 a
90	None	0		11,029 a
0	HM9310	7 gal	21-28 days after side-dress	9,159 a
0	HM9310+ HM0607	7 gal 6.4 oz	21-28 days after side-dress	9,907 a
45	HM9310	3 gal	21-28 days after side-dress	10,386 a
60	HM9310	2 gal	21-28 days after side-dress	10,142 a
90	HM9310	3 gal	21-28 days after side-dress	10,338 a
45	HM9310 + HM0607	3 gal 6.4 oz	21-28 days after side-dress	10,781 a
60	HM9310+ HM0607	2 gal 6.4 oz	21-28 days after side-dress	10,639 a

[1]Treatment means followed by the same letter are not significantly different.

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, L99-266 and HoCP96-540, were utilized in a N rate study on a Baldwin silty clay loam in 2010. The cultivar 'L99-266' was the highest yielding cultivar and L01-283 was lowest yielding and erratic. As is often the case with plant-cane the cultivars were somewhat insensitive to fertilizer input. As an average of the three cultivars the addition of N above 80 lb per acre did not result in a positive return.

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

	Application Rate in lb/acre				
Cultivar	0	40	80	120	Cultivar Mean
	lb/acre				
L01-283	8491	9762	9757	10703	9678 c[1]
L99-226	10874	13212	13277	11297	12165 a
HoCP96-540	10916	10527	10779	9929	10538 b
Rate Mean	10094	11167	11271	10643	

[1]Means in a column followed by a letter in common are not significantly different (P<.0001).

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