SOIL FERTILITY RESEARCH IN SUGARCANE IN 2001

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SUMMARY

Four field experiments were conducted in 2000 to test the effects of rates of fertilizers on the yield components of current sugarcane varieties.

Fall- and spring-applied N-P-K fertilizer rates were tested at cycle intervals of fallow-planted cane on Commerce soil. In first stubble cane of HoCP 85-845, the use of plant cane starter fertilizer had no effect on yield when Spring fertilizer applications were made. Moreover, no differences occurred between complete N-P-K fertilizer application and N application only in the spring. Conversely, spring application of 160-40-80 NPK increased the average sugar yields of second stubble CP 70-321 by almost 14% over 160-0-0 averaged across starter fertilizers. Starter fertilizers with a lower N:P ratio had the best residual response when coupled with complete spring-applied fertilizer.

Results of a multi-location outfield test to determine the optimum rate of N fertilizer for LCP 85-384 indicated the optimum rate was on the low end of present recommendations. Several locations, however, did not respond to N inputs at all, indicating the possibility of other limiting factors.

OBJECTIVES

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

RESULTS AND DISCUSSION

Starter fertilizers in first and second stubble of fallow-planted cane:

An experiment was conducted to test the effects of NPK fertilizer rates applied as a starter fertilizer in the fall at planting time in addition to spring-applied fertilizers in fallow-planted cane. The starter fall rates were 0-0-0, 15-45-45, 45-0-45 (one test), 45-45-0 (one test), 45-45-45, and 30-90-90. Spring rates consisting of 160-0-0 and 160-40-80 were applied over each fall rate. Fall treatments were applied in the planting furrow. The spring treatments were applied in the off-bar furrow .

Sugar yield of second stubble CP 70-321 was increased by the highest amount of plant cane-applied starter fertilizer (30-90-90) coupled with spring-applied complete fertilizer (Table 1). Starter fertilizers with a higher proportion of P had more long-term effects, especially when supplemented with complete fertilizer in the spring. Alternatively, the use of plant cane-applied starter fertilizer had no residual effect on sugar yield of first stubble HoCP 85-845 (Table 2).

RATES OF SPRING-APPLIED N FERTILIZER

The effect of N fertilizer rate on yield of LCP 85-384 was tested at eight large outfield locations and at the St. Gabriel station. Sugar yield of fourth stubble cane at St. Gabriel was 22% lower at a N application rate of 160 lb/ac than at 120 lb N /ac. The reason for the decline was a drop in CRS at the higher N rate (Table 3). Cane yield response to N rate varied with location (Fig. 1, Table 3). Stubble crops tended to have more response to N input than plant cane. Lower yield at some locations indicated other factors may have been limiting and therefore lowered the response to N. Where there was a response, the N rate for optimum yield ($\geq$ 90% of maximum yield and not statistically different) was at the lower end of the recommended range or slightly below it. The response of CRS varied with location. Where there was a response, CRS declined with increased N application rate (Fig.2, Table 3). Sugar yield response reflected that of tonnage, but itwas modulated by declines in CRS. Therefore, fewer differences occurred for sugar yield among N fertilizer rates (Fig. 3).

Table 1. Effect of fall and spring applied fertilizer on the yield of second stubble cane CP 70-321 planted after a fallow year on Commerce soil on the St. Gabriel Research Station, 2001.

Fertilizer applied N-P$_2$0$_5$-K$_2$0		Second Stubble Cane - Fallow Planted					
		Cane	Stalk		Normal Juice		Sugar
Fall	Spring	Yield	No.	Wt.	Brix	Sucrose	Yield
lbs/A	lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	0-0-0	20.9	26.3	1.73	15.7	13.3	3923
	160-0-0	34.1	33.9	2.19	15.8	12.5	5913
	160-40-80	37.9	36.4	2.57	15.2	11.9	6207
15-45-45	0-0-0	20.9	25.7	1.55	15.4	12.8	3761
	160-0-0	35.2	33.3	2.29	14.9	11.3	5421
	160-40-80	43.6	34.6	2.02	15.2	11.9	7115
45-0-45	0-0-0	18.5	25.4	1.54	15.6	13.1	3416
	160-0-0	36.1	34.4	2.13	15.3	12.0	6001
	160-40-80	39.3	37.0	2.13	15.6	12.4	6796
45-45-0	0-0-0	23.0	26.5	1.65	15.8	13.5	4364
	160-0-0	38.2	35.4	2.18	16.0	12.9	6907
	160-40-80	40.3	37.1	2.06	15.7	12.7	7170
45-45-45	0-0-0	20.4	25.4	1.83	15.7	13.3	3827
	160-0-0	38.5	35.2	1.94	15.0	11.3	5901
	160-40-80	38.4	35.8	2.30	15.7	12.6	6715
30-90-90	0-0-0	26.3	27.2	1.59	15.8	13.1	4865
	160-0-0	44.9	35.9	2.15	14.8	11.2	6793
	160-40-80	46.0	36.0	2.56	15.6	12.6	8070
LSD .05 Treatments		3.8	3.1	0.37	0.8	1.1	834
		Mean Effect					
0-0-0		31.0	32.2	2.16	15.6	12.6	5348
15-45-45		33.3	31.2	1.96	15.2	12.0	5432
45-0-45		31.3	32.3	1.93	15.5	12.5	5404
45-45-0		33.8	33.0	1.96	15.9	13.0	6147
45-45-45		32.4	32.2	2.02	15.5	12.4	5481
30-90-90		35.1	33.0	2.10	15.4	12.3	6576

Table 1. Continued.

Fertilizer applied $N-P_20_5-K_20$		Second Stubble Cane - Fallow Planted					
		Cane	Stalk		Normal Juice		Sugar
Fall	Spring	Yield	No.	Wt.	Brix	Sucrose	Yield
lbs/A	lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
	0-0-0	21.7	26.1	1.65	15.7	13.2	4026
	160-0-0	37.8	34.6	2.15	15.3	11.9	6156
	160-40-80	40.9	36.2	2.27	15.5	12.3	7012
LSD .05 Fall		2.2	1.8	0.22	0.5	0.6	481
LSD .05 Spring		1.6	1.3	0.15	0.3	0.5	340

The fall fertilizer was applied in the planting furrow as a starter fertilizer in 1998 and spring fertilizer was applied in the off-bar furrow in the spring of each year.

Table 2. Effect of fall and spring applied fertilizer on the yield of first stubble cane HoCP 85-845 planted after a fallow year on Commerce soil on the St. Gabriel Research Station, 2001.

Fertilizer applied $N-P_20_5-K_20$		First Stubble - Fallow Planted					
		Cane	Stalk		Normal Juice		Sugar
Fall	Spring	Yield	No.	Wt.	Brix	Sucrose	Yield
lbs/A	lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
0-0-0	0-0-0	21.6	25.5	1.88	15.5	13.2	3997
	160-0-0	33.7	30.8	2.38	15.5	12.9	6103
	160-40-80	33.7	31.5	2.23	15.2	12.8	6012
15-45-45	0-0-0	19.4	26.0	1.63	15.5	13.1	3557
	160-0-0	32.8	31.4	2.11	15.5	13.0	5992
	160-40-80	35.0	33.6	2.15	15.3	12.6	6147
45-45-45	0-0-0	24.7	26.9	2.01	15.1	12.8	4386
	160-0-0	31.8	30.3	2.27	15.4	12.9	5722
	160-40-80	34.9	32.5	2.24	14.6	12.0	5732
30-90-90	0-0-0	20.4	25.0	1.99	15.3	12.8	3619
	160-0-0	31.0	32.5	1.93	16.0	13.6	5965
	160-40-80	33.2	32.7	2.26	15.2	12.8	5920

Table 2. Continued.

Fertilizer applied $\text{N-P}_2\text{0}_5\text{-K}_2\text{0}$		First Stubble - Fallow Planted					
		Cane	Stalk		Normal Juice		Sugar
Fall	Spring	Yield	No.	Wt.	Brix	Sucrose	Yield
lbs/A	lbs/A	T/A	1000/A	lbs.	%	%	lbs/A
LSD .05 Treat.		3.6	2.0	0.34	0.7	0.8	701
				Mean	Effect		
0-0-0		29.7	29.2	2.16	15.4	12.9	5370
15-45-45		29.1	30.1	1.97	15.4	12.9	5232
45-45-45		30.5	29.9	2.17	15.0	12.5	5280
30-90-90		28.2	30.1	2.06	15.5	13.0	5168
	0-0-0	21.5	25.7	1.88	15.4	12.9	3890
	160-0-0	32.3	31.2	2.17	15.6	13.1	5945
	160-40-80	34.2	32.6	2.22	15.1	12.5	5953
LSD .05 Fall		2.1	NS	0.20	0.4	0.5	NS
LSD .05 Spring		1.8	1.0	0.17	0.4	0.4	351

The fall fertilizer was applied in the planting furrow as a starter fertilizer in 1999 and the spring fertilizer was applied in the off-bar furrow in each crop year.

Table 3. Effect of nitrogen fertilizer rates on the fourth stubble yield of LCP 85-384 on the St. Gabriel Research Station, 2001.

Nitrogen Fertilizer	Fourth Stubble Cane - 2001				
	Cane Yield	Stalk Wt.	Normal Juice		Sugar Yield
			Sucrose	CRS	
lbs/A	T/A	lbs.	%	lbs/T	lbs/A
40	38.0	1.97	12.9	180.4	6860
80	38.1	1.75	13.1	184.1	7004
120	42.3	1.82	13.6	193.2	8183
160	38.2	1.72	12.1	166.8	6367
LSD .05	NS	NS	1.5	23.9	1596

The nitrogen fertilizer rates were applied to plots in the spring of each crop year.

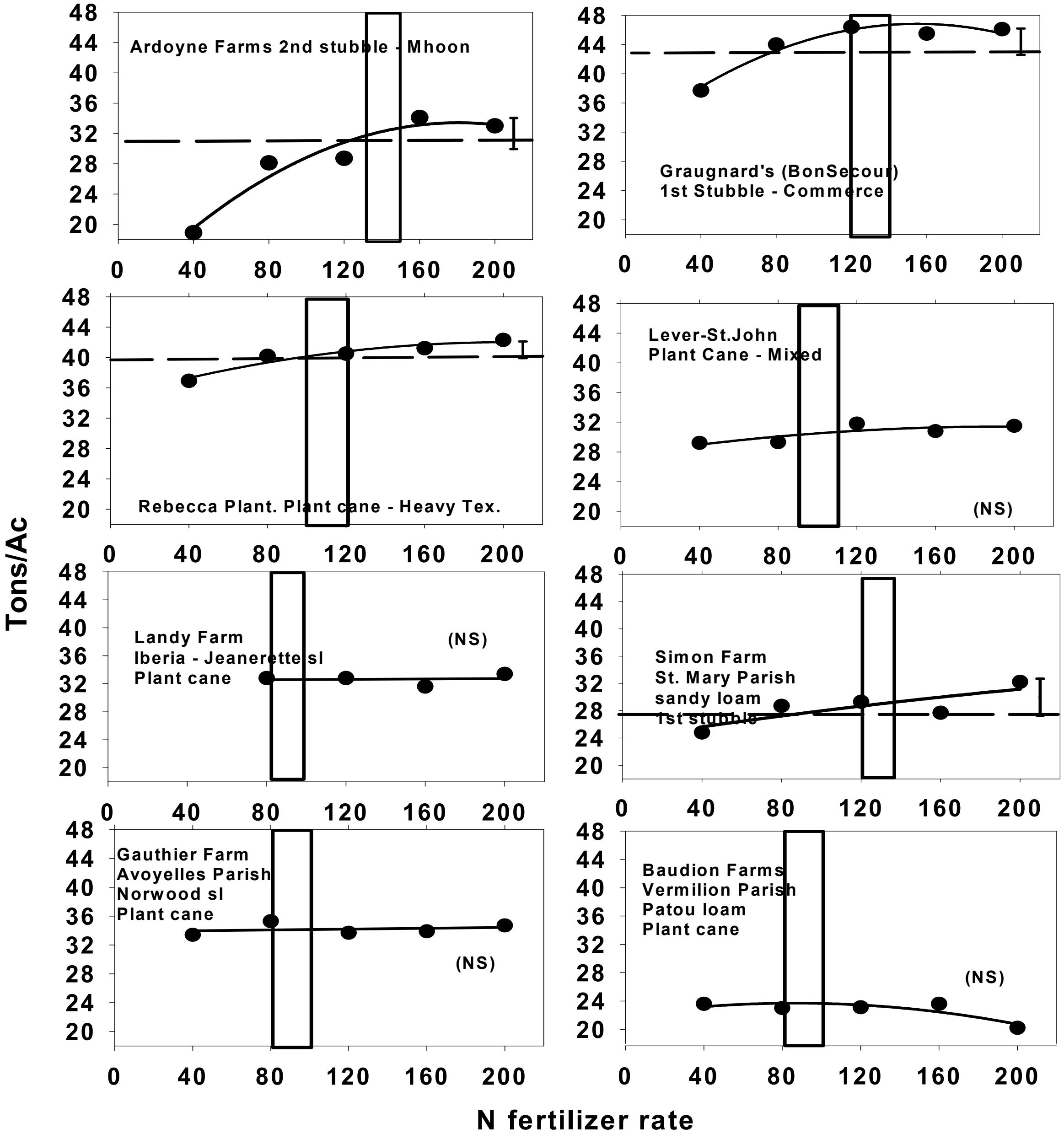

Fig. 1. The effect of N fertilizer rate on cane yield of variety LCP 85-384. Rectangles represent current recommended N fertilizer range. Error bars are LSD 0.05. Dashed line= ≥ 90% of max.

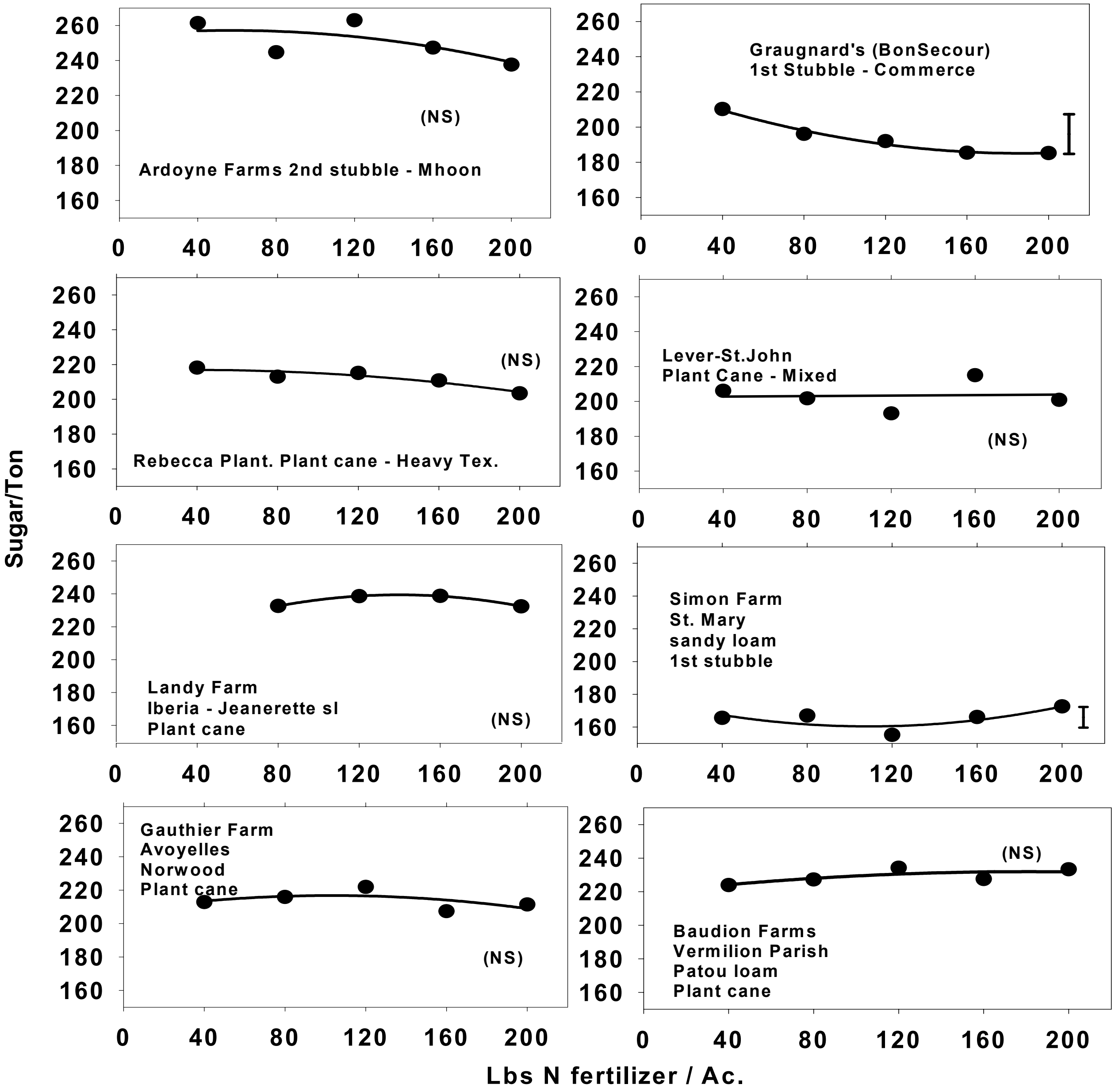

Fig. 2. The effect of N fertilizer rate on CRS of variety LCP 85-384. Error bar = LSD0.05; NS= not significantly different at $P \leq 0.05$.

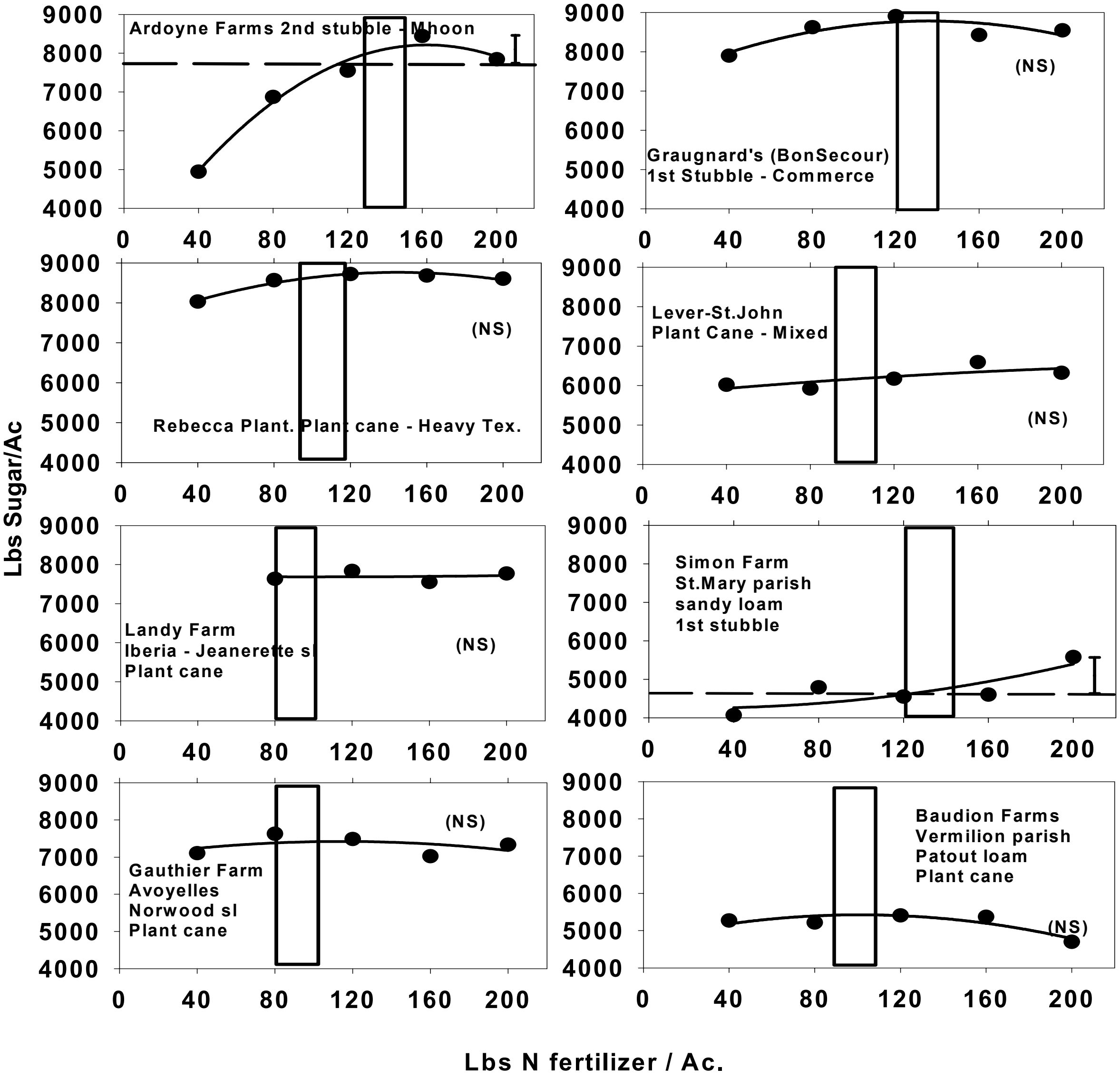

Fig. 3. The effect of N fertilizer rate on sugar yield of variety LCP 85-384. Rectangles represent current recommended N fertilizer range. Error bars are LSD 0.05. Dashed line= ≥ 90% of max. yield.

EFFECT OF POTASSIUM SULFATE VS. POTASSIUM CHLORIDE ON SUGARCANE YIELDS ACROSS TWO YEARS

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SUMMARY

Results in 2000 and 2001 for plant and first-stubble cane showed that applying potassium sulfate vs. potassium chloride at three different rates of K_2O (70, 140, and 210 lb/A) on a K deficient soil did not result in statistical ($P>0.10$) differences for stalk weights, plant population, CRS, cane yield, or sugar yield for sugarcane variety HoCP 85-845. Potassium application rates did not affect the measured cane yield parameters in 2000 or 2001 using either potassium source. Sulfur application also had no effect on sugarcane yields across the two years. Our results indicate that K fertilizer recommendations for sugarcane in Louisiana may be too liberal. The results also fail to support the assertion by some that potassium chloride is harmful to crop yields compared to potassium sulfate. Chloride addition in our study was associated with increased uptake of S.

INTRODUCTION

In recent years, certain advocates have convinced some sugarcane producers in Louisiana that potassium chloride is harmful to soil health and crop yields. These advocates have persuaded sugarcane producers to use potassium sulfate in the place of potassium chloride. Since potassium sulfate is more expensive (per pound of K) than potassium chloride, the sustainable ag advocates have advised producers to compensate for this by reducing their K application rates. They have further argued that this is justified because "K from potassium sulfate is more available than K from potassium chloride." No research in Louisiana has been done that supports or refutes the contentions about K put forward by sustainable-ag advocates. Consequently, this research was initiated.

OBJECTIVES

To compare potassium sulfate and potassium chloride fertilizer rates in their effects on sugarcane yield parameters, available soil K, and nutrient concentration and content of sugarcane at harvest.

MATERIALS AND METHODS

A Baldwin silty clay loam soil very low in K was selected for this study. Soil analysis showed that pH, organic matter, and exchangeable bases were 5.9, 0.67%, and 13.1 meg/100g; and P, Na, K, Mg, and Ca ppm levels were 83 (medium), 42 (very low), 113 (very low), and 406 (very high), and 1865 (low), respectively.

In September of 1999, sugarcane variety HoCP 85-845 (first progeny Kleentek) was planted at three stalks and a lap of two joints on 5-foot10-inch wide rows. The experimental treatments in Table 2 were imposed on the experimental site in May of 2000 and 2001. All treatments were replicated eight times in a Latin square experimental design. Plots consisted of three 5-foot10-inch by 30-foot rows with a 10-foot alley separating the ends of all plots. A blanket application of 120 lb N and 40 lb P_2O_5 /A was added along with the potassium fertilizer. Treatments 2, 4, and 6 used ammonium sulfate as a sulfur source so that S rate would not differ in comparisons between the two K sources. Ammonium nitrate was used as the primary N source. After fertilization, the sugarcane rows were hipped up and the cane was grown to maturity using standard cultural practices.

In September of 2000 and 2001, the number of millable stalks in each sugarcane plot were counted. In December of 2000 and November of 2001, the experimental plots were harvested with a two-row soldier harvester and weighed with a weigh rig. Ten stalks were randomly selected from each plot to measure average stalk weight and commercially recoverable sugar (CRS). Three additional stalks were also taken from each plot for nutrient analysis (after the plants were topped and stripped of leaves) to determine the effect of the treatments on nutrient uptake.

RESULTS AND DISCUSSION

Table 1 shows that potassium sources and potassium rates did not affect ($P>0.10$) any of the sugarcane yield variables measured across the two years. The % CVs for stalk weight, plant population, and CRS were good (below 10%), while those for cane tonnage and sugar yield were a little higher. The treatment x year interaction was not significant ($P>0.25$) for any of the measured variables.

Table 2 shows how the N, K, S, and Cl rates in the eight treatments (Table 3) were derived. Since K rates from potassium sulfate also included S, this difference was screened out by using ammonium sulfate as part of the nitrogen source (the remaining N was composed of ammonium nitrate) for the potassium chloride treatments. Consequently, each K rate, using both K sources, had the same amount of S (T2 vs. T3, T4 vs. T5, and T6 vs. T7). This resulted in the K sources differing only in Cl rates. Since some individuals claim that Cl is harmful to the soil and, thereby, decreases crop yields, this provided a means to test this claim. Comparison of T1 vs. T3, T5, and T7 (Table 2) are used to determine the effect of potassium sulfate rates on sugarcane yield variables (Table 3); and comparison of T1 vs. T2, T4, and T6 (Table 2) determined the effect of potassium chloride rates on sugarcane yields (Table 3). Comparison of T2 vs. T3, T4 vs. T5, and T6 vs. T7 (Table 2) shows the effect of Cl application on sugarcane yields (Table 3), and comparing T8 vs. T4 (Table 2) shows the effect of S application on sugarcane yields (Table 3).

Table 3 indicates that the yields obtained with HoCP 85-845 were respectable given the severe drought experienced in the summer of 2000 and the excess rainfall in June of 2001. The average stalk weights for this variety were very good. Across the two years, yield variables were not affected (P$0.10) by K rates or K sources. However, in each comparison of K source (T2 vs. T3, T4 vs. T5, and T6 vs. T7), the sugar and cane yields for potassium chloride were numerically higher than for potassium sulfate. The failure to obtain yield responses to potassium application rates in our study (on a soil testing very low in K) indicates that potassium fertilizer recommendations for sugarcane in Louisiana may be too liberal. This is confirmed by discussions held with Dr. Jim Wang, head of the LSU AgCenter's soil testing lab. We will continue the test in 2002 to see if this continues for second-stubble cane.

Table 4 shows that stalk weights, cane yield, and sugar yield decreased significantly (P#0.10) for first-stubble compared to plant cane, but the opposite was true for CRS and plant population. The decrease in cane and sugar yields with first-stubble cane may have been caused by the excessive rainfall received in the 2002 season.

Table 5 shows that the fertilizer treatments did not significantly (P$0.10) affect any of the stripped whole-plant nutrient concentrations, except for S. Table 6 shows that T #6 (86.1, 210, and 190.5 lb/A of S, K_2O, and Cl, respectively) had significantly higher (P#0.10) whole-plant S concentrations than T #'s 1 and 8.

Table 7 shows that the fertilizer treatments did not affect (P$0.10) whole-plant nutrient uptake for any of the nutrients, except for S. Table 8 shows that T #6 had higher (P#0.10) whole-plant S uptake than T #'s 1, 3, 5, 7, and 8. The only difference between T #6 and T #7 is that T #6 had 190.5 lb Cl/A added as fertilizer and T #7 did not receive Cl. Apparently, the Cl was responsible for the difference in S uptake between the two treatments.

Table 1. F-values and statistical parameters for effect of treatments and harvest years on sugarcane yield variables.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
main-plots						
Treatments (T)	7	1.57	1.52	1.10	1.04	0.75
HREP	7	1.76	2.97*	0.37	1.60	1.35
VREP	7	1.27	2.88*	1.48	0.87	0.21
sub-plots						
Year (Y)	1	74.12****	3.35$^{\sim}$	148.82****	125.63****	38.10****
TxY	7	0.62	0.30	0.37	0.38	0.48
RMSE for main-plots		0.2542	2082	8.941	3.771	847.4
% CV for main-plots		8.97	6.00	4.24	10.24	10.97
RMSE for sub-plots		0.2674	1941	8.249	3.666	798.9
% CV for sub-plots		9.43	5.59	3.91	9.955	10.34
Mean		2.835	34,700	210.7	36.82	7725

, $^{\sim}$, *, and **** denotes statistical significance at the P#0.25, 0.10, 0.05, and 0.0001 levels, respectively.

Table 2. Fertilizer treatments used in study.

T#	NH_4NO_3	$(NH_4)_2SO_4$	$(NH_4)_2SO_4$	$K_2(SO_{4)}$)	KCl	Cl	$K_2(SO_4)$	P
	------------lb N/A---------		------------lb S/A----------		K_2O/A	lb Cl/A	lb K_2O/A	lb $P_2O_{5/}$A
1	120	0	0	0	0	0	0	40
2	94.9	25.1	28.7	0	70	63.5	0	40
3	120	0	0	28.7	0	0	70	40
4	69.8	50.2	57.4	0	140	127.0	0	40
5	120	0	0	57.4	0	0	140	40
6	44.7	75.3	86.1	0	210	190.5	0	40
7	120	0	0	86.1	0	0	210	40
8	120	0	0	0	140	127.0	0	40

Table 3. Effect of fertilizer on sugarcane yield variables averaged across two years.

T#	S	K_2O	Cl	Stalk wt.	Plant pop.	CRS	Cane yield	Sugar yield
	-----------------lb/A---------------			lb/stalk	1000/A	lb/T	T/A	lb/A
1	0	0	0	3.06	34.5	206	39.5	8090
2	28.7	70	63.5	2.91	34.8	201	40.3	8110
3	28.7	70	0	2.93	34.1	206	38.9	7990
4	57.4	140	127.0	3.14	34.8	199	41.6	8270
5	57.4	140	0	2.97	34.4	202	39.9	8040
6	86.1	210	190.5	3.19	34.2	201	42.4	8510
7	86.1	210	0	3.02	33.1	198	39.0	7710
8	0	140	127.0	3.08	35.3	204	42.1	8570
LSD 0.10				NS	NS	NS	NS	NS
LSD 0.25				0.10	0.9	NS	NS	NS

NS denotes statistical non significance at the indicated probability level.

Table 4. Effect of harvest years on sugarcane yield variables averaged across treatments.

Harvest year	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
	lb/stalk	1000/A	lb/T	T/A	lb/A
Plant cane	3.04	34.4	202	40.4	8160
First-stubble	2.63	35.0	220	33.2	7290
LSD 0.10	0.08	0.6	2	1.1	240
LSD 0.25	0.06	0.4	2	0.8	160

Table 5. F-values and statistical parameters for effect of fertilizer treatments on nutrient concentrations of whole stalk sugarcane at harvest.

Source%	df	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
Treatments	7	0.65	1.09	1.11	0.78	0.66	0.70	1.52	1.07	0.93	2.40^{*}
HREP	7	1.29	3.56^{**}	3.68^{**}	1.34	$2.05^{\sim}$	1.70	7.86^{****}	0.74	$2.06^{\sim}$	3.57^{**}
VREP	7	0.84	0.52	0.52	0.67	1.11	1.00	1.59	3.22^{**}	1.71	1.74
RMSE		0.04931	0.03386	0.1935	0.01308	0.01456	0.8005	2.953	54.24	4.184	0.02227
% CV		22.49	27.83	31.53	20.96	19.42	26.66	34.743	51.07	22.78	29.38
Mean		0.2193	0.1217	0.6136	0.06239	0.07497	3.003	8.501	106.2	18.37	0.07580

, $^{\sim}$, *, **, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, and 0.0001 levels, respectively.

%The whole stalks were topped and stripped of their leaves.

Table 6. Effect of fertilizer treatments and sources on whole-plant nutrient concentrations at harvest.

T#	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	--------------------------%	-----------------------------				-----------------------ppm	------------------------			%
1	0.234	0.118	0.529	0.058	0.071	3.43	7.36	126	18.0	0.0534
2	0.220	0.142	0.760	0.070	0.082	3.25	9.87	97	20.6	0.0840
3	0.210	0.119	0.581	0.060	0.073	2.82	8.77	107	18.9	0.0751
4	0.240	0.107	0.551	0.068	0.081	2.73	7.85	90	16.4	0.0816
5	0.231	0.105	0.621	0.062	0.074	3.08	10.87	144	19.8	0.0770
6	0.203	0.123	0.655	0.061	0.072	2.79	7.18	102	17.4	0.0929
7	0.211	0.127	0.624	0.061	0.074	2.99	7.74	90	18.8	0.0783
8	0.206	0.133	0.588	0.060	0.073	2.90	8.37	96	17.1	0.0641
LSD 0.10	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0187
LSD 0.25	NS	NS	NS	NS	NS	NS	1.72	NS	NS	0.0130

Table 7. F-values and statistical parameters for effect of fertilizer treatments on nutrient uptake of stripped plant cane at harvest.

Source%	df	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
Treatments	7	0.53	1.09	1.09	0.68	0.67	0.41	1.50	1.23	0.55	2.83*
HREP	7	1.23	3.07*	3.21**	0.76	1.22	1.28	9.23****	0.92	2.46*	3.19**
VREP	7	1.28	0.86	0.95	0.97	1.37	1.40	2.33*	3.77**	2.66*	2.18$^{\sim}$
RMSE		13.95	8.907	49.76	3.767	4.190	0.02019	0.0732	1.384	0.1122	5.407
% CV		26.09	30.17	33.35	24.87	23.04	26.66	35.24	52.74	25.09	29.52
Mean		53.49	29.52	149.2	15.15	18.18	0.07260	0.2079	2.623	0.4470	18.32

, $^{\sim}$, *, **, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, and 0.0001 levels, respectively.

Table 8. Effect of fertilizer treatments on nutrient uptake of stripped plant cane at harvest.

T#	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	---------------------------------lb/A---------------------------------									
1	56.6	27.7	127	13.8	16.9	0.0809	0.174	3.11	0.424	12.7
2	52.6	34.3	183	16.5	19.4	0.0770	0.238	2.31	0.495	20.0
3	49.4	27.7	135	14.0	16.9	0.0654	0.210	2.56	0.443	17.2
4	59.7	26.7	137	16.8	20.3	0.0681	0.195	2.24	0.408	20.3
5	55.7	25.2	150	14.9	17.6	0.0739	0.268	3.71	0.484	18.0
6	52.1	31.2	167	15.6	18.2	0.0708	0.184	2.63	0.447	23.6
7	49.5	29.8	147	14.4	17.4	0.0703	0.183	2.12	0.441	18.4
8	52.2	33.6	148	15.3	18.8	0.0736	0.210	2.38	0.434	16.3
LSD 0.10	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.5
LSD 0.25	NS	NS	NS	NS	NS	NS	0.043	NS	NS	3.2

EFFECT OF COPPER AND POTASSIUM FERTILIZATION ON YIELD AND PLANT NUTRIENT STATUS OF SUGARCANE

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SUMMARY

Four rates of potassium chloride (0, 80, 160, and 240 lb K_2O/A) were applied to plant cane and first-stubble variety LCP 85-384 on a Jeanerette silt loam soil low in K near Parks, La. Potassium application rates did not affect ($P>0.10$) sugarcane stalk weights, commercially recoverable sugar, cane yield, or sugar yield across the two years. Communication with Dr. Jim Wang, head of the LSU AgCenter soil testing lab, indicates that potassium fertilizer recommendations for sugarcane in Louisiana may be too liberal. Our research results support this.

Because of excess rainfall in the spring of 2001, we were not able to apply the Cu treatments as planned. Our results also showed that increasing K fertilizer rates increased (P#0.10) leaf Mn concentrations.

JUSTIFICATION

Preliminary research (private communication with Therian LaFleur, Chastant Brothers, Inc.) shows that spraying sugarcane foliage with copper sulfate may increase plant potassium levels and result in higher cane yields.

It is generally assumed that sugarcane yields in Louisiana will not respond positively to micronutrient application. However, little research has been done to support this assumption. Also, no formal research in Louisiana has shown whether copper and potassium fertilizer applications interact positively to increase sugarcane yields. Continued research is needed to determine how the newer cane varieties respond to potassium fertilization of soils in Louisiana.

OBJECTIVES

Our project will test whether sugarcane yields in Louisiana respond to copper fertilization. The specific objective is to determine the effect of soil-applied potassium chloride and foliar-applied copper sulfate on plant nutrient status and sugarcane yield parameters across a cane production cycle.

MATERIALS AND METHODS

Sugarcane variety LCP 85-384 was planted in September 1999 at three stalks and a lap of two joints using first-progeny Kleentek seed cane. The experimental design was a Latin square split-plot with four potassium chloride rates as main-plots and three copper sulfate rates as sub-plots. All experimental plots consisted of three 6-foot by 50-foot rows, with 10-foot alleys separating the ends of the plots. The sides of each plot were buffered by three border rows. All treatments were replicated four times.

The soil used in the study was a Jeanerette silt loam with an initial analysis of 5.1, 14.8, and 0.66 for pH, sum of bases (meg/100g), and % organic matter available; P, Na, Mg, K, and Ca concentrations were 81 (medium), 47 (very low), 500 (very high), 144 (low) and 2027 ppm (low), respectively.

Potassium fertilizer rates (0, 80, 160, and 240 lb K_2O/A) were applied in May of 2000 and 2001 along with a blanket application of N, P_2O_5, and S at 120, 60, and 24 lb/A as ammonium nitrate, polyphosphate, and calcium sulfate, respectively. The cooperating producer (Richard Latiolais) did not wish to foliar apply the copper sulfate treatments in 2000 as planned because of the severe drought. We were unable to apply copper sulfate in the spring of 2001 because of excess rainfall that kept us out of the field until the sugarcane plants were too high to apply the copper safely with the equipment available.

Plant leaf tissue (the first leaf with a visible dewlap) was taken from all plots (for nutrient analyses) in August 2000 and 2001. Plant populations were not determined in September each year as originally planned, because of severe lodging. All plots were harvested with a two-row soldier harvester in early January 2001 and December of 2001 and weighed with a weigh rig. A 10-stalk sample was taken from each plot to determine average stalk weight and commercially recoverable sugar.

RESULTS AND DISCUSSION

F-values and statistical parameters for the test are given in Table 1. The results (Tables 1 and 2) show that potassium chloride fertilizer rates did not affect ($P>0.10$) stalk weights, CRS, cane yield, or sugar yield of sugarcane across the two harvest years. Vertical reps did a good job of removing variability from the test for CRS, cane yield, and sugar yield (Table 1). Harvest year effects were highly significant (P#0.01) for all the measured yield variables (Table 1), and the treatment by harvest year interaction was nonsignificant (P$0.10) for all the variables.

Table 2 shows that potassium application rates did not affect ($P>0.25$) sugarcane yield variables across the two harvest years. This is surprising since initial soil analysis indicated that soil potassium was low. Private communication with the head of the LSU soil testing lab (Dr. Jim Wang) indicates that our present soil testing recommendations for potassium may be too liberal in their diagnosis of potassium deficiency.

Table 3 shows that stalk weights, CRS, cane yield, and sugar yield were all significantly (P#0.10) lower for first-stubble compared to plant cane. This may have been partially caused by the excess rainfall received in the spring of 2001 and by the severe lodging in the summer and fall of 2001.

Table 4 shows that potassium fertilizer application rates affected ($P<0.10$) Mn leaf concentrations of plant cane, but did not affect the other nutrient concentrations. There was, however, a trend (P#0.25) toward significance for K, Mg, and Cu.

Table 5 shows that the 160 and 240 K fertilizer rates increased plant Mn leaf concentrations compared to the O and 80 K rates. There was also a trend (P#0.25) toward lower Mg and Cu leaf concentrations as K fertilizer rates increased.

Table 1. F-values and statistical parameters for effect of potassium chloride and harvest years on sugarcane yield variables.

Source	df	Stalk weight	CRS	Cane yield	Sugar Yield
<u>main-plots</u>					
Treatments (T)	3	0.03	1.75	1.60	0.78
HREP	3	4.62$^{\sim}$	0.99	0.26	0.15
VREP	3	0.83	7.16*	31.84***	17.58**
<u>sub-plots</u>					
Year (Y)	1	51.98****	7.10**	308.36****	296.52****
TxY	3	0.83	1.74	0.64	1.36
RMSE for main-plots		0.1966	7.907	1.999	511.6
% CV for main-plots		11.06	3.29	7.20	7.66
RMSE for sub-plots		0.2022	8.944	2.802	724.8
% CV for sub-plots		11.37	3.726	10.09	10.86
Mean		1.778	240.1	27.78	6675

, $^{\sim}$, *, **, *** and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001, and 0.0001 levels, respectively.

Table 2. Effect of potassium chloride on sugarcane yield variables across two harvest years.

T #'s	K rates	Stalk weight	CRS	Cane yield	Sugar yield
	lb K_2O/A	lb/stalk	lb/T	T/A	lb/A
1	0	1.77	240	27.8	6690
2	80	1.78	239	27.3	6550
3	160	1.78	243	27.5	6690
4	240	1.78	238	28.5	6770
LSD 0.10		NS[%]	NS	NS	NS
LSD 0.25		NS	NS	NS	NS

[%] NS denotes that the LSD was not significantly different at the indicated probability level.

Table 3. Effect of harvest year on sugarcane yield variables averaged across potassium fertilizer rates.

Harvest year	Stalk weight	CRS	Cane yield	Sugar Yield
	lb/stalk	lb/T	T/A	lb/A
Plant cane	1.93	243	32.8	7950
First-stubble	1.63	238	22.8	5400
LSD 0.10	0.07	3	1.0	250
LSD 0.25	0.05	2	0.7	170

Table 4. F-values and statistical parameters for effect of potassium chloride on sugarcane leaf nutrient concentrations of plant cane.

Source	df	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
Potassium	3	0.87	0.48	1.59	1.20	1.72	1.74	9.16****	0.85	0.68	0.35
HREP	3	0.30	2.46$^{\sim}$	3.62*	0.89	0.42	1.10	2.11	1.12	1.39	0.75
VREP	3	1.09	2.07	2.93*	1.15	1.91	4.54****	4.26*	2.97*	0.66	1.71
RMSE		0.09278	0.02903	0.1379	0.04099	0.01584	0.6429	3.683	8.590	2.322	0.01559
% CV		6.92	13.56	9.44	17.75	14.08	15.32	23.95	23.65	10.28	10.01
Mean		1.341	0.2141	1.461	0.2310	0.1125	1.196	15.37	36.31	22.60	0.1556

, $^{\sim}$, *, and **** denote statistical significance at the P#0.25, 0.10, 0.05, and 0.0001 levels, respectively.

Table 5. Effect of potassium fertilizer rates on leaf nutrient concentrations of plant cane.

K-rate	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
lb K_2O/A	--------------------------------%----------------------------------					---------------------ppm-------------------				%
0	1.38	0.222	1.49	0.234	0.118	4.29	13.3	39.6	22.6	0.159
80	1.34	0.211	1.42	0.240	0.116	4.44	12.2	34.7	21.8	0.154
160	1.32	0.215	1.41	0.238	0.112	4.19	16.8	34.7	23.1	0.154
240	1.33	0.208	1.52	0.212	0.104	3.84	19.2	36.3	22.9	0.156
LSD 0.10	NS	NS	NS	NS	NS	NS	2.5	NS	NS	NS
LSD 0.25	NS	NS	0.07	NS	0.008	0.31	1.8	NS	NS	NS

EFFECT OF GIBBERELLIC ACID[1] ON SUGARCANE YIELDS

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SUMMARY

Application of gibberellic acid (0.5, 1.0 and 2.0 qt/A three times during the growing season) to sugarcane variety LCP 85-384 did not significantly ($P > 0.10$) affect sugar yields or the other measured yield variables across four years. Cane tonnage was appreciably lower in 2001 with third-stubble compared with second-stubble in 2000. This may have been caused by excess rainfall received in June of 2001.

INTRODUCTION

Anecdotal data from Florida indicates that gibberellic acid may increase sugarcane yields by increasing stalk elongation. Some cane producers in Louisiana have expressed interest in using gibberellic acid. Our research was initiated to determine whether gibberellic acid can be used to increase sugarcane yields in Louisiana.

PROCEDURES

A gibberellic acid (SUL-15) study was initiated in the spring of 1998 using second progeny Kleentek variety LCP 85-384 plant cane. The six treatments used in the study are given in Table 2. The gibberellic acid rates used were 0.5 qt/A (0.5x), 1.0 qt/A (1.0x), and 2.0 qt/A (2.0x). The SUL-15 treatments were applied in 10 gallon/A of water along with a surfactant (1.5 pt of 820 surfactant per 100 gallons of water) using a high-clearance sprayer. The first application of SUL-15 was sprayed directly over the top of the cane, while the second and third applications were sprayed over the top and to the sides of the cane. In 1999 the study was continued on the 1998 research plots with first-stubble cane using the application dates shown in Table 2. Because of lodged cane, treatments 4 and 6 did not receive gibberellic acid in 1999 at the third application date (August 24).

The soil used in the study was a Baldwin silty clay loam with a pH of 4.5 and a soil analysis of 248, 30, 202, 2233, and 505 ppm, respectively, for P, Na, K, Ca, and Mg. The study used a 6x6 Latin square design with six replications. Experimental plots consisted of three 5-foot 10-inch by 50-foot rows with a 10-foot alley at the ends of the plots. All plots were separated on both sides by three 5-foot 10-inch by 50-foot border rows.

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[1] Research was partially supported by PRO-CHEM Chemical Company.

The cane was grown to maturity each year using recommended fertilizer rates and standard cultural practices. All plots were harvested in 1998, 1999, and 2000 with a two-row soldier harvester and weighed with a weigh rig. The test was harvested in 2001 (the center row of the three-row plots) with a combine harvester and a portable weigh wagon. A 10-stalk sample was randomly taken at harvest from each plot each year to determine stalk weight and commercially recoverable sugar (CRS) per ton of harvested cane. Plant height was also determined for this 10-stalk sample in 1998, 1999, and 2001. Plant populations were determined before harvest each year.

RESULTS AND DISCUSSION

Tables 1 and 3 show that the gibberellic acid treatments used in the study (Table 2) did not significantly ($P>0.10$) affect the measured yield variables. Harvest year affected all of the measured variables (Tables 1 and 4) in the study, and the year x treatment interaction was not significant ($P>0.10$) for any of the variables (Table 1).

Stalk weights, plant height, CRS, and sugar yield were highest (Table 4) for first-stubble cane (1999). Plant populations were larger with second-stubble cane (2000). Plant populations and cane tonnage were appreciably lower in 2001 with third-stubble compared to second-stubble in 2000. The decrease in tonnage may have been caused by the excess rainfall received in June of 2001.

Table 1. F-values and statistical parameters for effect of gibberellic acid treatments and harvest years on sugarcane yield variables.

Source	df	Plant pop.	Stalk weight	Plant[§] height	CRS	Cane yield	Sugar yield
main-plots							
Treatments (T)	5	0.59	0.94	0.51	1.54	0.46	1.01
HREP	5	1.63	0.07	2.77*	4.95**	2.38~	4.28**
VREP	5	4.01*	1.80	2.15	0.22	5.85**	5.84**
sub-plots							
Years (Y)	3	204.80****	119.55****	163.29****	141.93****	74.10****	83.47****
TxY	5	0.84	0.52	1.32	0.68	0.68	0.42
RMSE for main-plots		4174	0.2498	0.4248	12.23	3.809	926.3
% CV “ ” “		8.03	13.32	4.98	5.52	9.73	10.72
RMSE for sub-plots		4791	0.2122	0.3722	14.84	3.724	968.4
% CV “ ” “		9.21	11.32	4.36	6.69	9.51	11.20
Mean		52,000	1.875	8.536	221.7	39.16	8643

[§] Plant height was not measured for the 2000 crop.

, ~, *, **, and **** denotes statistical significance at the P# 0.25, 0.10, 0.05, 0.01, and 0.0001 levels, respectively.

Table 2. Gibberellic acid rates and timing for three years.

T#	For 1998[%]	For 1999	For 2000	For 2001
1	SUL-15 not applied			
2	1.0x SUL-15 applied on: 4/9	5/7	4/6	5/16
3	1.0x SUL-15 applied on: 4/9, 5/22	5/7, 6/24	4/6, 5/31	5/16, 7/16, 8/21
4	1.0x SUL-15 applied on: 4/9, 5/22, 7/6	5/7, 6/24, 7/24[~]	4/6, 5/31, 7/21	5/16, 7/16, 8/21
5	0.5x SUL-15 applied on: 4/9, 5/22, 7/6	5/7, 6/24, 7/24	4/6, 5/31, 7/21	5/16, 7/16, 8/21
6	2.0x SUL-15 applied on: 4/9,5/22, 7/6	5/7, 6/24, 7/24[~]	4/6, 5/31, 7/21	5/16, 7/16, 8/21

[%] The 0.5x, 1.0x, and 2.0x rates denote gibberellic acid rates of 0.5, 1.0, and 2.0 qt/A, respectively, for each of the indicated dates.

[~] The August 24 application was not applied on these two treatments because the cane was lodged.

Table 3. Effect of gibberellic acid treatments on sugarcane yield variables averaged across harvest years.

T#	Stalk weight	Plant pop.	Plant[%] height	CRS	Cane yield	Sugar yield
	lb/stalk	1000/A	ft.	lb/T	T/A	lb/A
1	1.84	52.1	8.58	217	38.9	8440
2	1.90	52.4	8.54	221	39.5	8650
3	1.92	51.4	8.52	222	39.5	8720
4	1.93	51.5	8.58	223	38.5	8520
5	1.82	51.6	8.40	221	38.8	8560
6	1.83	53.1	8.59	227	39.9	8980
LSD 0.10	NS	NS	NS	NS	NS	NS
LSD 0.25	NS	NS	NS	4	NS	NS

[%] Plant height are based on 1998, 1999, and 2001; treatments were not measured for plant height in 2000.

NS denotes that the treatments did not affect the indicated yield variables at the designated significance levels.

Table 4. Effect of harvest year on sugarcane yield parameters averaged across gibberellic acid treatments.

Year	Stalk weight	Plant pop.	Plant[%] height	CRS	Cane yield	Sugar yield
	lb/stalk	1000/A	ft.	lb/T	T/A	lb/A
1998	1.94	50.7	8.61	227	38.1	8,660
1999	2.39	36.8	9.28	245	43.9	10,720
2000	1.53	63.8	-	179	42.6	7,630
2001	1.63	56.7	7.67	236	32.0	7,560
LSD 0.10	0.08	1.9	0.15	6	1.5	380
LSD 0.25	0.06	1.3	0.10	4	1.0	260

[%] Plant heights at harvest were not made in 2000.

EFFECT OF NITROGEN FERTILIZER RATES AND LIME-STABILIZED SEWAGE SLUDGE ON LCP 85-384 SUGARCANE YIELDS

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SUMMARY

Applying 10 and 20 T/A (dry weight basis) of lime-treated sewage sludge under cane at planting reduced ($P< 0.10$) LCP 85-384 cane and sugar yields across two years. However, mixing 10 T/A of sludge into the row before planting had no effect (P$0.10) on cane or sugar yield when averaged across the two years.

INTRODUCTION

Research has shown that composted municipal waste can be safely and effectively used to grow sugarcane. However, municipalities in the Sugar Belt of Louisiana do not produce composted municipal waste. Consequently, if municipal waste is to be used, it will necessarily occur in the form of sewage sludge. At present, lime-stabilized (class B) sewage sludge can be used in sugarcane production only with a special permit. Such a permit was obtained by the Iberia Research Station and the City of New Iberia for a sewage sludge x nitrogen fertilizer study in Iberia Parish.

OBJECTIVE

To determine the effect of nitrogen fertilizer rates and lime-stabilized sewage sludge rates and placement on sugarcane yields.

MATERIALS AND METHODS

A Baldwin silty clay soil near Olivier was selected as the test site. The experimental design was a Latin square, split-plot with four replications. Experimental plots consisted of three 5-foot 10-inch by 30-foot rows with a 10-foot alley at the ends of each plot. All experimental plots were separated by three border rows that were fertilized according to recommended rates for plant cane and first- stubble. Main-plot treatments consisted of four different class B lime-stabilized sewage sludge rates (dry weight basis) and application methods (Table 2). One main-plot did not receive sludge; a second had 10 T/A of sludge broadcast over rows and incorporated into the soil; and the third and fourth main-plots received 10 and 20 T/A, respectively, of sewage sludge applied to opened rows immediately before planting first progeny Kleentek variety LCP 85-384 at three stalks and a lap of two joints in September of 1999.

Nitrogen fertilizer rates (0, 50, 100, and 150 lb N/A as ammonium nitrate) served as the split-plots. All experimental plots received a blanket application of P_2O_5, K_2O, and S at 40, 120, and 24 lb/A as polyphosphate, potassium chloride, and gypsum, respectively, in 2000. Fertilizer was applied to the plots in May of 2000. All the plots were inadvertently fertilized by the cooperating producer in 2001, so residual nitrogen fertilizer rate was the variable in 2001.

Plant cane was grown untill mid-November using standard cultural practices, and plant populations were taken in September from all plots. The experiment was harvested with a two-row soldier harvester and all plots were weighed with a weigh rig. A 10-stalk sample was taken from each plot to determine average stalk weight and commercially recoverable sugar (CRS) per ton of harvested cane. The same methods were used for first-stubble cane in 2001, and the cane was harvested on September 27.

RESULTS AND DISCUSSION

Table 1 shows that sewage treatments had a significant (P<0.10) effect on stalk weights, cane yield, and sugar yield. Nitrogen fertilizer and residual rates affected only cane yield. There was also a significant sludge x nitrogen interaction for stalk weight, CRS, and cane yield.

The relatively low CV's (below 10%) for CRS, cane yield, and sugar yield indicate that the experimental design did a good job of removing variability from the study.

Table 2 shows that the 10-under and 20-under sludge treatments significantly (P< 0.10) decreased stalk weight, and cane and sugar yield across the two years compared to the check. However, the 10-mixed sludge treatment did not affect (P$0.10) the yield variables relative to the check. The reason for the decrease in yield with sludge application may be related to the sensitivity of LCP 85-384 to over-fertilization with nitrogen in the sludge. Previous research with starter fertilizer on fallow-planted cane shows that applying more that 15 lb N/A in the furrow with cane at planting can reduce sugar yields.

Table 3 shows that increasing nitrogen fertilizer to 50 lb N/A and beyond increased (P< 0.10) cane tonnage, but it did not significantly affect the other yield variables.

Table 4 shows that plant populations and CRS were higher (P#0.10) for first-stubble cane (2001) compared to plant cane (2000). The reverse was true for stalk weights, cane yield, and sugar yield.

Table 5 shows the significant (P<0.10) interactive effect of sewage, N rates, and harvest year (Table 1) on sugar yields. In the year 2000 (plant cane), the 10-under sludge treatment decreased sugar yields compared to the check at 0 lb N/A, and at 50 lb N/A the 10-mixed and 20-under sludge treatments decreased sugar yields. In year 2001 (first-stubble) the sludge treatments did not affect (P$0.10) sugar yields compared to the check at any of the N fertilizer rates. However, at the 100 lb N rate, the 10-mixed sewage treatment produced higher sugar yields than the 10-under or 20-under sludge treatments.

Table 1. F-values and statistical parameters for effect of sewage sludge, nitrogen application rates and harvest year on LCP 85-384 yield variables.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
<u>main-plots</u>						
Sewage (S)	3	3.51$^{\sim}$	1.56	0.95	6.22*	4.80*
HREP	3	3.60$^{\sim}$	0.23	0.64	9.22*	6.57*
VREP	3	3.33$^{\sim}$	4.83*	5.88*	4.57$^{\sim}$	3.66$^{\sim}$
<u>sub-plots</u>						
Nitrogen (N)	3	1.98	0.53	0.55	2.27$^{\sim}$	0.88
SxN	9	2.33*	1.19	2.17*	1.97$^{\sim}$	0.85
<u>sub-sub-plots</u>						
Year (Y)	1	74.63****	57.23****	3.07$^{\sim}$	55.07****	20.87****
SxY	3	1.20	0.78	1.64	0.94	0.76
NxY	3	5.99**	0.79	0.93	1.94	0.76
SxNxY	3	0.74	0.33	0.93	1.36	2.07$^{\sim}$
RMSE for main-plots		0.1485	6191	12.11	2.305	578.6
% CV for main-plots		10.32	11.89	5.26	7.04	7.68
RMSE for sub-plots		0.1359	4490	8.366	1.901	571.1
% CV for main-plots		9.44	8.62	3.63	5.81	7.58
RMSE for sub-sub-plots		0.1600	5152	11.11	1.640	484.9
% CV for sub-sub-plots		11.12	9.89	4.82	5.01	6.43
Mean		1.439	52,060	230.3	32.74	7537

, $^{\sim}$,*, **, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, and 0.0001 levels, respectively.

Table 2. Effect of sewage sludge rates and placement on sugarcane yield variables averaged across N rates and harvest years.

Sewage sludge	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield
T/A	lb/stalk	1000/A	lb/T	T/A	lb/A
0	1.50	50.5	232	33.8	7820
10 - mixed	1.45	53.2	227	33.4	7590
10 - under	1.38	53.3	230	32.3	7430
20 - under	1.43	51.3	232	31.6	7300
LSD 0.10	0.07	NS	NS	1.1	280
LSD 0.25	0.05	NS	NS	0.7	180

NS denotes statistical non significance at the indicated P level.

Table 3. Effect of nitrogen fertilizer rates on sugarcane yield variables averaged across sewage treatments and harvest year

N-rate[3]	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield
lb N/A	lb/stalk	1000/A	lb/T	T/A	lb/A
0	1.42	51.5	231	32.0	7400
50	1.49	52.1	230	32.9	7550
100	1.42	52.8	231	32.8	7580
150	1.43	51.8	229	33.2	7620
LSD 0.10	NS	NS	NS	0.8	NS
LSD 0.25	0.04	NS	NS	0.6	NS

NS denotes statistical non significance at the indicated P level.

[3] Fertilizer rates were applicable only for plant cane in 2000. All plots were inadvertently fertilized with a blanket application of fertilizer in 2001, so that only residual N was a variable.

Table 4. Effect of harvest years on sugarcane yield variables averaged across sewage treatments and nitrogen fertilizer rates.

Harvest year	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
	lb/stalk	1000/A	lb/T	T/A	lb/A
2000	1.56	48.6	229	33.8	7730
2001	1.32	55.5	232	31.7	7340
LSD 0.10	0.05	1.5	3	0.5	140
LSD 0.25	0.03	1.1	2	0.3	100

Table 5. Effect of sewage sludge treatments, nitrogen fertilizer rates, and harvest years on sugar yields.

		Sewage Treatment			
Harvest year	N-rate[3]	Check	10-mixed	10-under	20-under
	lb N/A	------------------------lb/A--------------------------			
2000	0	7870	7930	7040	7250
2000	50	8470	7480	7880	7570
2000	100	8150	7530	7500	7830
2000	150	7930	8050	7770	7480
2001	0	7540	7260	7130	7180
2001	50	7350	7340	7360	6950
2001	100	7440	8090	7030	7090
2001	150	7820	7080	7710	7080
LSD 0.10 for effect of sewage treatments within year and N-rate.					800
LSD 0.25 for effect of sewage treatments within year and N-rate.					520

[3] The N rates indicated for 2001 are not applicable (only in a residual sense) since all research plots were inadvertently fertilized with a complete fertilizer in 2001.

EFFECT OF HIGH GYPSUM APPLICATION RATES ON SUGARCANE YIELDS FOR A HEAVY-TEXTURED SOIL

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SUMMARY

Applying up to 20 T/A of by-product gypsum to an Alligator clay soil did not significantly affect HoCP 91-555 sugar yields across two years. However, applying gypsum did result in lower ($P<0.10$) commercially recoverable sugar. Conversely, applying 5 T/A or more of gypsum each year increased cane tonnage across the two years.

INTRODUCTION

Research in Louisiana shows that application of high amounts of gypsum (5-10 T/A) can result in significant (12%) yield responses in stubble crops on heavy-textured soils. There is also a school of thought that says "optimum crop yields cannot be obtained on heavy-textured soils unless the Ca/Mg ratio of soil (based on % CEC) is close to 7:1." We conducted our study to test this theory and to determine the effect of gypsum application rates on crop yields and soil moisture and physical properties.

MATERIALS AND METHODS

An Alligator clay soil was selected for use in this study. Initial soil analysis (3385 and 630 ppm Ca and Mg, respectively, with a CEC of 21.2) indicated that it would require 17.3 T/A of gypsum to bring the Ca/Mg ratio (based on % CEC) up to the desired 7:1 value. To achieve this goal 0, 1.5, 5, 10, 15, and 20 T/A of gypsum were broadcast applied to experimental plots on August 23, 1999, and incorporated into the soil. Prior to incorporation the 1.5 T/A gypsum treatment also received 1.5 T/A of by-product lime and 15 gallon/A of a liquid biological solution. In May of 2000 this treatment also received 1 T/A of UL-L bagasse compost.

A 6x6 Latin square experimental design was used in the experiment. All treatments were replicated six times. Plots consisted of three 5-foot 10-inch by 40-foot rows, with a 10-foot alley at the ends of all plots. All experimental plots were separated by three border rows on each side that did not receive gypsum. The experiment was planted in September 1999 with first progeny Kleentek variety HoCP 91-555 at four stalks and a lap of two joints.

Cane was grown to maturity in 2000 and 2001 using standard cultural practices. Plant populations were determined in September each year. The test was harvested (plant cane) in early December, 2000 using a two-row soldier harvester, and plots were weighed with a weigh rig. In 2001, first-stubble cane was harvested on October 22 with a combine harvester and a weigh wagon. A 10-stalk sample was taken from each plot to determine average stalk weight and commercially recoverable sugar (CRS) per ton of harvested cane.

RESULTS AND DISCUSSION

Table 1 shows that the experimental treatments did not affect ($P>0.10$) stalk weight, plant population, or sugar yield. The treatments did, however, affect CRS (Table 1) as is shown by the lower ($P<0.10$) CRS values for all treatments receiving gypsum (Table 2).

Also, T #'s 2, 4, and 5, which received 5, 15, and 20 T/A of gypsum, respectively, all had higher cane yields than T #1 and T #6, which received 0 and 1.5 T/A of gypsum, respectively. Treatment #3 (10 T/A of gypsum) also had higher cane tonnage than T #1, which did not receive gypsum. Likewise, T #6 had higher cane tonnage than T #1. The above shows that gypsum was beginning to have an effect on cane tonnage.

Our experiment was initiated to determine whether adjusting the % base saturation of Ca/Mg to 7.0 would result in increased sugarcane yields. It was also meant to test the effect of gypsum on soil moisture and physical properties, and their influence on crop yields. We will continue our study with second-stubble cane in 2002 to determine the effects of our treatments on soil moisture and resistance to penetration by a soil penetrometer.

Table 1. Effect of gypsum rates and harvest years on F-values and statistical parameters for sugarcane yield variables.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
main-plots						
Treatments (T)	5	0.32	1.90	$2.25^{\sim}$	4.44^{**}	0.35
HREP	5	0.81	1.62	1.37	3.06^{*}	1.80
VREP	5	3.68^{*}	18.50^{****}	9.25^{****}	17.48^{****}	4.55^{**}
sub-plots						
Year (Y)	1	10.77^{**}	$22.61^{** **}$	234.45^{****}	1.70	86.05^{****}
TxY	5	0.65	0.05	1.95	0.18	1.00
main-plots						
RMSE		0.1655	2637	10.04	1.716	476.5
% CV		10.29	5.47	5.93	5.39	8.84
sub-plots						
RMSE		0.1792	4485	12.28	4.299	758.9
% CV		11.14	9.31	7.25	13.51	14.08
Mean		1.609	48,170	169.3	31.82	5390

, $^{\sim}$, *, **, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, and 0.0001 levels, respectively.

Table 2. Effect of gypsum treatments on sugarcane yield variables averaged across two years.

T#	Gypsum	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield
	T/A	lb/stalk	1000/A	lb/T	T/A	lb/A
1	0	1.58	47.4	178	29.9	5390
2	5.0	1.59	48.5	168	32.5	5460
3	10.0	1.61	47.3	168	32.1	5360
4	15.0	1.59	47.8	166	32.5	5430
5	20.0	1.62	50.1	168	32.6	5450
6	1.5[+]	1.66	47.8	168	31.2	5240
LSD 0.10		NS	NS	7	1.2	NS
LSD 0.25		NS	1.3	5	0.8	NS

[%] This treatment also received 1.5 T/A of Domino by-product lime when the gypsum was applied; 15 G/A (on 8/23/99) of liquid biologicals; and 1 T/A of UL-L compost in April, 2000.

EFFECT OF INORGANIC FERTILIZER AND FISH[1] EMULSION ON SUGARCANE YIELDS

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SUMMARY

Numerically highest ($P<0.10$) LCP 85-384 sugar yields across three years were obtained where 75 lb N/A and 5 gallon/A of fish emulsion were sidedressed in the spring. Spring-applied fertilizer and fish emulsion treatments, however, did not affect ($P>0.10$) stalk weights or commercially recoverable sugar. Fall-applied fish emulsion did not significantly ($P>0.10$) affect the sugarcane yield variables. Two large-plot studies showed that fish emulsion did not affect ($P>0.25$) sugar yields of first- and second-stubble sugarcane.

INTRODUCTION

Liquid fish emulsion is a by-product of the fish industry. This material is rich in nutrients and, therefore, should have value as a fertilizer in the growing of sugarcane. To date, little research has been conducted to determine whether fish emulsion has economic value in sugarcane culture.

OBJECTIVES

1) Determine the effect of placing various fish emulsion rates under cane at planting on sugarcane yields.

2) Determine the effect of fish emulsion on inorganic fertilizer requirements.

3) Determine if using fish emulsion in sugarcane production can increase the number of ratoon crops obtained from one planting.

MATERIALS AND METHODS

In September 1998 Kleentek variety LCP 85-384 sugarcane was planted at three stalks and a lap of two joints for a fish emulsion by inorganic fertilizer rate study at the Iberia Research Station. The experiment used a Latin square, split-plot design with four replications. Main plots consisted of the four spring-applied inorganic fertilizer and fish emulsion rates shown in Table 2. Split-plots consisted of the four fall-applied fish emulsion rates shown in Table 3. The fall-applied fish emulsion rates were applied to opened rows under cane at planting. The spring applied fertilizer and fish emulsion rates were applied to the inner off bar of each row receiving that particular treatment (Table 2) in April of 1999, 2000, and 2001.

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[1] Research was partially supported by Omega Protein, Inc.

Experimental sub-plots consisted of three 5-foot 10-inch by 40-foot rows with a 10-foot alley separating the ends of the plots. The sugarcane plots were grown to maturity using standard cultural practices.

Plant populations for each sub-plot were determined before harvest each year. The study was harvested each year using a two-row soldier harvester and the plots were weighed with a weigh rig. Ten stalks were randomly selected from each sub-plot for determination of commercially recoverable sugar (CRS) and average stalk weight.

In addition to the three-year study at the Iberia Research Station (Tables 1-3), two additional large-plot studies were initiated in the spring of 2001.

The first was at Gralyn Farms with first-stubble cane using the liquid N and liquid fish treatments given in Table 4. A second study was initiated at Rene Simon Farms with second-stubble cane. This study (Table 5) used the same fertilizer and fish rates as the first study.

Both studies used a liquid inorganic fertilizer source with a fertilizer element mix of 15-5-10-1.5 ($N\text{-}P_2O_5\text{-}K_2O\text{-}S$). In the treatments involving liquid fish emulsion (Tables 4 and 5), the fertilizer and fish emulsion were mixed together before being applied to the experimental plots. All the treatments were applied with a spray coupe that dribbled the liquid fertilizer/fish on both sides of the sugarcane rows. The experimental treatments were applied in mid-May.

Plant populations were taken for both tests before harvest. Ten whole stalks were taken from each plot prior to harvest for determination of commercially recoverable sugar (CRS). All experimental plots were harvested with a combine harvester and a portable weigh wagon. Only the center row of the three-row plots was used for yield determination.

RESULTS AND DISCUSSION

Table 1 shows that the spring-applied fertilizer and fish emulsion rates significantly (P< 0.10) affected plant population and cane and sugar yields of LCP 85-384 across the three years. However, the fall-applied fish emulsion rates did not affect (P$0.10) the five yield parameters measured. The spring by fall interaction was not significant (P<0.10) for four of the five yield variables (Table 1), though it was significant for CRS. The low % CV's (less than10) for CRS, cane yield, and sugar yield show that the statistical design did a good job of removing variability from the study.

Table 2 shows that the 0.75x fertilizer and 5 G/A spring-applied fish emulsion treatment had the highest numerical sugar yield across the three years. Further increasing the fertilizer rate from 0.75x to 1.0x (increasing nitrogen from 75 lb/A to 100 lb/A and not adding fish emulsion) did not affect (P$0.10) sugar yields. However, decreasing the fertilizer rate from 0.75x to 0.5x (reducing nitrogen fertilizer from 75 lb/A to 50 lb/A) resulted in reduced sugar yields.

Table 1 shows that the year x spring, year x fall, and year x spring x fall interactions were not significant (P>0.10) for sugar yield. There was a trend (P<0.25), however, toward significance for the year x spring x fall interaction for sugar yield (Table 3).

Harvest year affected (P#0.0001) all of the measured yield variables (Tables 1 and 3). Sugar yields for first-stubble were appreciably lower than those of plant cane, which is partially attributable to the severe drought in 2000. Also, sugar yields for second-stubble were appreciably lower than for first-stubble, which may have been caused by the extremely wet conditions of June 2001.

Tables 4 and 5 show that inorganic fertilizer and fish emulsion rates had no effect (P>0.25) on the sugarcane yield variables of the two large plot studies.

Table 1. F-values and statistical parameters for effect of inorganic fertilizer and fish emulsion on LCP 85-384 yield variables for two years.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
<u>main-plots</u>						
Spring (S)	3	1.69	5.51*	0.29	21.64**	16.76**
HREP	3	1.11	1.94	4.08$^{\sim}$	7.47*	1.61
VREP	3	3.80$^{\sim}$	1.68	4.44$^{\sim}$	10.71**	32.27***
<u>sub-plots</u>						
Fall (F)	3	0.26	1.44	1.90	1.20	0.24
SxF	9	1.13	0.72	2.38*	0.65	1.10
<u>sub-sub-plots</u>						
Years (Y)	2	184.56****	82.36****	1051.63****	208.98****	1294.71****
YxS	6	3.03**	7.14****	0.83	2.08$^{\sim}$	0.99
YxF	6	0.34	0.57	0.69	0.63	0.77
YxSxF	18	0.41	1.06	0.96	1.12	1.39
RMSE for main-plots		0.3113	7971	15.11	2.726	444.1
% CV for main-plots		15.44	15.39	8.98	6.68	6.34
RMSE for sub-plots		0.2055	5033	10.82	3.162	729.0
% CV for sub-plots		10.19	9.71	6.43	7.75	10.41
RMSE for sub-sub-plots		0.2400	4664	12.52	2.963	615.6
% CV for sub-sub-plots		11.90	9.00	7.45	7.27	8.79
Mean		2.016	51,810	168.2	40.78	7000

, $^{\sim}$, *, **, ***, and **** denotes statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001, and 0.0001 levels, respectively.

Table 2. Effect of spring fertilizer and fish emulsion rates on sugar yields for three years.

Fertilizer app. in spring[3]	Fish emulsion[P] app. in spring	Plant cane	First stubble	Second stubble	Total
	G/A	lb/A			
0x	0	9,390	6,750	3,790	19,930
0.5x	5	9,700	7,120	4,060	20,880
0.75x	5	10,210	7,310	4,190	21,710
1.0x	0	9,750	7,250	4,460	21,460
LSD 0.10		310	310	310	540
LSD 0.25		200	200	200	350

[3] The 1.0x fertilizer treatment consisted of 120 lb N/A as dry ammonium nitrate.
[P] Fish emulsion was applied as a liquid in the fertilizer off-bar on top of the dry ammonium nitrate.

Table 3. Effect of spring fertilizer and fish emulsion and fall fish emulsion rates on sugar yields for three years.

T#	Spring fert.	Fish emulsion appl. in spring	Fish emulsion appl. in fall	Plant cane	First stubble	Second stubble
		G/A	G/A	----------------lb/A---------------		
1	0.0x	0	0	9,040	6,720	3710
2	0.0x	0	25	9,960	6,650	3780
3	0.0x	0	50	9,320	6,660	3800
4	0.0x	0	100	9,250	6,970	3860
5	0.5x	5	0	10,060	7,220	4090
6	0.5x	5	25	10,200	7,180	4070
7	0.5x	5	50	9,800	6,590	3820
8	0.5x	5	100	8,850	7,370	4210
9	0.75x	5	0	10,390	7,110	4220
10	0.75x	5	25	9,840	6,920	3920
11	0.75x	5	50	10,030	7,580	4470
12	0.75x	5	100	10,590	7,640	4140
13	1.0x	0	0	9,520	7,550	4470
14	1.0x	0	25	9,700	7,690	4570
15	1.0x	0	50	10,000	6,800	3850
16	1.0x	0	100	9,760	6,970	4960
LSD 0.25 for effect of spring fertilizer treatments				410	410	410
LSD 0.25 for effect of fall fish treatments				610	610	610

Table 4. Effect of fertilizer rates and fish emulsion treatments on first-stubble yield variables at Gralyn Farms.

N-rate	Fish	Plant pop.	Cane yield	Stalk weight	CRS	Sugar yield	Lodging[3]
lb N/A	G/A	1000/A	T/A	lb/stalk	lb/T	lb/A	
90	0	55.5	20.3	1.27	245	4980	3.2
90	5	56.3	20.3	1.32	247	5020	3.3
120	0	58.9	21.7	1.27	243	5280	3.5
120	5	56.6	21.6	1.26	235	5050	3.3
LSD 0.10		NS	NS	NS	NS	NS	NS
LSD 0.25		NS	NS	NS	NS	NS	NS

[3] Lodging was based on a 1-5 scale where 1 had all plants erect and 5 had all plants lodged.

Table 5. Effect of fertilizer and fish emulsion treatments on second-stubble sugarcane yield variables at Rene Simon Farms.

N-rate	Fish	Plant pop.	Cane yield	Stalk weight	CRS	Sugar yield
lb N/A	G/A	1000/A	T/A	lb/stalk	lb/T	lb/A
90	0	65.1	25.2	1.17	235	5940
90	5	66.9	25.2	1.12	223	5640
120	0	68.4	24.7	1.13	224	5540
120	5	65.3	25.6	1.17	225	5750
LSD 0.10		NS	NS	NS	NS	NS
LSD 0.25		NS	NS	NS	NS	NS

EFFECT OF HARVEST YEAR, COMBINE RESIDUE MANAGEMENT[1], AND A NITROGEN STABILIZATION PACKAGE ON SUGARCANE YIELDS

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SUMMARY

Research across a three-year residue management study shows that spraying combine trash with 60 lb N/A as nitrogen stabilized urea (containing a urease and nitrification inhibitor), and applying the remaining urea (30 or 60 lb N/A) in the spring resulted in as good a sugar yield as where the trash was burned or raked off the row tops and all the urea nitrogen (120 lb N/A) was applied in the spring. Also, applying 90 lb N/A as urea treated with a urease inhibitor (Agrotain) in the spring resulted in as high a sugar yield as where 120 lb N/A of untreated urea was applied in the spring.

INTRODUCTION

Approximately 85% of the sugarcane acreage in Louisiana is now harvested with combine harvesters. Much of this cane is harvested green chopped, which results in a residue blanket on the soil surface that can reduce sugar yields (500 to 1250 lb/A) for the following crop if it is not removed or burned. Removing the residue blanket from the row tops and placing it in the furrow can cause cultivation problems the following spring. Many producers burn the residue blanket after harvest, which may result in air quality problems for the public. Burning the residue also results in loss of nitrogen and organic matter that could improve soil fertility and soil manageability if the residue blanket were not destroyed.

At present, the sugarcane combine residue blanket is more of a liability than an asset. The research in this study seeks to determine if there is a way to manage the residue blanket so that it becomes an asset instead of a liability.

OBJECTIVES

1) Compare the effect of burning combine harvest residue vs. spraying it with liquid super urea (which contains a urease and nitrification inhibitor) on sugar yields.

2) Determine if applying super urea to the trash blanket can reduce the nitrogen fertilizer requirements of sugarcane.

3) Determine the effects of nitrogen fertilizer and residue management on nutrient uptake into sugarcane

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[1] Research was partially supported by IMC Global Operations, Inc.

MATERIALS AND METHODS

In late January 1999, the six treatments in Table 2 were imposed on a Baldwin silty clay soil where LCP 85-384 plant cane had been harvested with a combine harvester in mid-January. The treatments were replicated six times in a 6x6 Latin square design. Experimental plots consisted of three 6-foot by 50-foot rows with 10-foot alleys at the ends of each plot. Three border rows also separated each plot on both sides of the plot. First-stubble cane was harvested with a combine harvester on Dec. 6, 1999. Treatments 1, 2, and 6 had their plots burned on Dec. 16, 1999, while treatment 4 and 5 plots had 60 lb N/A as super urea (stabilized with both a urease and nitrification inhibitor) sprayed on the residue blanket on January 6, 2000. In April of 1999, 2000, and 2001 treatments 1-5 received spring-applied urea nitrogen (Table 2) sprinkled by hand on the row tops. Treatment 6 urea (which contained Agrotain urease inhibitor) was also sprinkled on the row tops at the same time. All plots received a blanket application of 40 lb/A of P_2O_5 (as polyphosphate) and 120 lb/A of K_2O (as potassium chloride) in 1999, 2000, and 2001 with the spring N application.

Second-stubble cane was harvested with a combine harvester on Sept. 26, 2000. Liquid super-urea was applied to the plots of treatments 4 and 5 on Jan. 10, 2001. Rainfall prevented the burning of cane residue so the residue was raked off the plots on January 22, 2001.

The first-stubble, second-stubble, and third-stubble cane crops were grown to maturity using standard cultural practices. Cane tonnage in each experimental plot was estimated by harvesting 10-feet from the middle row of each plot in 1999 and 2000. Five stalks were randomly selected from the 10-foot section to estimate commercially recoverable sugar (CRS) and average stalk weights. Three stalks were also taken to analyze (after being stripped of leaves and tops) for nutrient uptake. To determine nutrient uptake, stripped cane stalks were considered to be 30% dry matter. Third-stubble cane was harvested with a combine on October 10, 2001, and weighed with a weigh wagon. Ten stalks were selected for determination of CRS.

RESULTS AND DISCUSSION

Table 1 shows that the trash management and fertilizer treatments (Table 2) did not significantly (P>0.10) affect CRS or cane and sugar yields across the three crop years. The treatments did affect (P<0.10) stalk weights and plant populations. The treatment by year interaction was not significant (P\$0.10) for any of the yield variables. The effect of harvest year on the yield variables was very significant (P#0.0001)

The % CVs for main-plots and sub-plots of stalk weight, cane yield, and sugar yield were large, which indicates that variability was brought into the study by using only a 10-foot section of the center row from each plot to estimate the yield variables in the first two years of the study.

Table 2 shows the effect of the trash and fertilizer treatments on the five measured yield variables. Sugar yields for T #s 4 and 5 (which had nitrogen stabilized liquid urea sprayed on the trash blanket in January each year after harvest) were as good as for T #1 where the trash blanket was burned and urea was applied to row tops in April each year. This indicates that spraying the trash blanket in the winter with N-stabilized urea may be an alternative to burning.

The results also show that applying 90 lb N/A as agrotain-treated urea in April each year to cane rows that had their trash blanket burned the previous January (T #6) yielded as well as T #1 where the trash had been burned and 120 lb N/A as untreated urea was added.

Table 2 shows that the stalk weights for T #4 were significantly (P<0.10) larger than for T #s 1,5, and 6. However, the plant population for the check (T #1) was higher (P#0.10) than for all the other treatments.

Table 3 shows that stalk weights, CRS, cane yield, and sugar yields were substantially higher for first-stubble cane in 1999 compared to second-stubble and third-stubble cane in 2000 and 2001, respectively. This can partially be attributed to the severe drought in 2000 and the excessive rainfall received in 2001.

Table 4 shows that the experimental treatments affected Mn and S concentrations in whole plants at harvest, but had no significant (P$0.10) effect on the other nutrients measured. Harvest year affected (P#0.10) all the whole plant nutrient concentrations, except Cu. The treatment by year interaction was significant (P#0.10) for Cu, but not for any of the other nutrients.

Table 5 shows that treatment #3 (not burning the combine residue and applying all the urea N dry in the spring) had significantly (P#0.10) higher Mn concentrations than all the other treatments. Treatment #6 (combine residue burned in the winter and 90 lb N/A as dry Agrotain urea applied in the spring) had more plant Mn than treatments 1, 2, and 4. As with Mn, plant S was also highest for T #3, which was larger than for T #4 and 5.

Table 6 shows that all the nutrient concentrations, except for Cu, were significantly (P#0.10) higher in second-stubble than in first-stubble. This may partially be because there was a severe drought in the second-stubble crop year (2000) that reduced the cane tonnage (Table 3) appreciably compared to the first-stubble crop year (1999).

Table 7 shows that the fertilizer and residue management treatments (Table 2) had a significant (P#0.10) effect on N, K, and Mn uptake into mature cane, but they did not affect the other nutrients. Harvest year affected the uptake of all nutrients except for Ca, Cu, and Zn. As with whole- plant nutrient concentrations, the treatment x year interaction for nutrient intake was significant only for Cu.

Table 8 shows that treatment #1 (cane residue burned in winter, 120 lb N/A as urea applied on row tops in the spring) had higher (P#0.10) nitrogen uptake than treatments 2 (residue burned in winter, 90 lb N/A as urea applied to row tops in the spring) and 5 (residue not burned, 60 lb N/A liquid super U sprayed on residue in winter and 30 lb N/A applied in spring).

Table 8 also shows that T #6 had more K uptake than all other treatments except for T #3. Also, T #'s 3 and 6 had more Mn uptake than T #'s 2 and 4.

Table 9 shows that second-stubble cane had higher nutrient uptakes of N, P, K, Fe, and S than first-stubble cane. The reverse was true for Mg and Mn.

Tables 10a and 10b show that the experimental treatments affected (P#0.10) Ca, Fe, and pH of the soil at the end of the experiment. Table 11a shows that T #2 had the numerically highest soil Ca level, which was statistically (P#0.10) higher than T #'s 3 and 4.

Table 11a also shows that T #3 had the highest soil Fe levels, which were higher (P#0.10) than all the other treatments, except T #6.

Table 11b shows that T #1 had the soil pH which was higher (P#0.10) than T #3.

Table 1. F-values and statistical parameters for effect of harvest years and residue and fertilizer management on LCP 85-384 yield variables.

Source	df	Plant[3] pop.	Stalk weight	CRS	Cane yield	Sugar Yield
main-plots						
Treatments (T)	5	2.58$^{\sim}$	2.32$^{\sim}$	1.04	0.75	0.55
HREP	5	2.54$^{\sim}$	1.26	0.67	1.65	2.24$^{\sim}$
VREP	5	9.88****	2.01	2.00	1.44	2.05
sub-plots						
Years (Y)	2	34.14****	52.80****	423.99****	75.31****	221.25****
T x Y	10	0.83	1.56	0.52	0.54	0.51
RMSE for main-plots		3815	0.2141	13.90	6.176	1250
% CV for main-plots		6.89	12.71	8.11	19.03	21.23
RMSE for sub-plots		4718	0.2569	15.65	6.260	1442
% CV for sub-plots		8.52	15.26	9.138	19.28	24.49
Mean		55,390	1.684	171.3	32.46	5888

, $^{\sim}$, and ****, denote statistical significance at the P#0.25, 0.10, and 0.0001 levels, respectively.

[3] The analysis for plant population involved only two years (2000 and 2001).

Table 2 . Effect of urea treatments and residue management on LCP 85-384 yield variables across three years.

T#	Residue blanket	Urea source	Urea applied to rows in	Urea N. rate	Plant[3] pop.	Stalk weight	CRS	Cane yield	Sugar yield
				lb/A	1000/A	lb/stalk	lb/T	T/A	lb/A
1	burned in winter	untreated urea	spring	120	58.6	1.65	165	33.6	5,900
2	burned in winter	untreated urea	spring	90	53.9	1.73	173	31.0	5,640
3	not burned	untreated urea	spring	120	54.7	1.70	172	31.4	5,640
4	not burned	Super U	winter spring	60 60	56.0	1.80	173	32.0	5,910
5	not burned	Super U	winter spring	60 30	53.9	1.57	175	32.4	6,040
6	burned in winter	Agrotain	spring	90	55.3	1.65	170	34.3	6,200
LSD 0.10					2.7	0.12	NS[%]	NS	NS
LSD 0.25					1.9	0.08	NS	NS	NS

[%] NS denotes that the means of the indicated variable was not statistically different at the indicated significance levels.

[3] Plant populations involved 2000 and 2001, but not 1999.

Table 3. Effect of harvest years on LCP85-384 yield variables averaged across fertilizer and residue management treatments.

Harvest year	Plant pop.	Stalk weight	CRS	Cane yield	Sugar Yield
	1000/A	lb/stalk	lb/T	T/A	lb/A
1999	-	2.03	233	42.8	10,000
2000	52.1	1.42	143	28.6	4,090
2001	58.6	1.60	137	26.0	3,570
LSD 0.10	1.9	0.10	6	2.6	570
LSD 0.25	1.3	0.07	4	1.7	390

Table 4. F-values and statistical parameters for effect of harvest years and residue and fertilizer management on whole plant nutrient concentrations of harvested cane for 1999 and 2000.

Source	df	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
<u>main-plots</u>											
Treatments(T)	5	2.15	1.06	1.01	1.43	2.03	0.49	4.99^{**}	0.33	0.73	3.78^{*}
HREP	5	0.62	1.54	1.14	8.66^{***}	8.34^{****}	0.70	7.15^{***}	$2.44^{\sim}$	1.40	3.75^{*}
VREP	5	3.41^{*}	7.17^{***}	1.47	0.52	1.73	0.24	11.55^{****}	1.03	1.61	3.23^{*}
<u>sub-plots</u>											
Years (Y)	1	233.66^{****}	173.04^{****}	6.54^{*}	103.80^{****}	78.24^{****}	2.60	28.42^{****}	29.05^{****}	14.74^{***}	183.49^{****}
TxY	5	1.09	0.34	0.61	0.77	0.73	$2.33^{\sim}$	1.36	0.76	0.23	1.58
RMSE for main-plots		0.04935	0.01590	0.2809	0.01076	0.01066	0.9962	1.960	27.10	6.915	0.006017
% CV for main-plots		30.52	19.74	68.70	11.47	12.35	34.81	24.27	46.62	49.43	14.01
RMSE for sub-plots		0.03138	0.02064	0.2627	0.01222	0.01201	0.9580	1.697	31.81	7.366	0.009507
% CV for sub-plots		19.40	25.62	64.23	13.12	13.91	33.47	21.02	54.73	52.67	22.14
Mean		0.1617	0.08056	0.4089	.09383	0.08632	2.862	8.076	58.13	13.99	0.04294

, $^{\sim}$, *, **, ***, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001 and 0.0001 levels, respectively.

Table 5. Effect of urea treatments and residue management on whole-plant nutrient concentrations averaged across 1999 and 2000.

T#	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	------------------------------%------------------------------					------------------------ppm------------------------				%
1	0.188	0.0722	0.325	0.0992	0.0923	3.03	7.3	52.0	15.5	0.0435
2	0.147	0.0865	0.559	0.0930	0.0846	2.48	7.1	57.7	12.2	0.0431
3	0.181	0.0813	0.422	0.0942	0.0885	2.92	10.1	57.7	14.3	0.0473
4	0.158	0.0827	0.354	0.0938	0.0828	2.83	6.8	55.6	16.4	0.0359
5	0.132	0.0808	0.382	0.0877	0.0806	2.99	8.4	67.1	12.3	0.0416
6	0.165	0.0799	0.413	0.0952	0.0892	2.95	8.9	58.2	13.3	0.0458
LSD 0.10	NS	NS	NS	NS	NS	NS	1.4	NS	NS	0.0043
LSD 0.25	0.024	NS	NS	NS	0.0052	NS	0.9	NS	NS	0.0029

Table 6. Effect of harvest year on whole plant nutrient concentrations averaged across treatments.

Harvest years	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	---------------------------	----------	%	----------	---------------------------	-----------------------	ppm	----------	----------------------	%
First-stubble	0.105	0.049	0.330	0.079	0.0738	2.63	7.01	37.9	10.7	0.0276
Second-stubble	0.218	0.113	0.488	0.109	0.0988	3.05	9.14	79.6	17.3	0.0587
LSD 0.10	0.013	0.008	0.105	0.005	0.0048	NS	0.68	12.9	2.9	0.0038
LSD 0.25	0.009	0.006	0.073	0.003	0.0033	0.28	0.47	8.9	2.0	0.0026

Table 7. F-values and statistical parameters for effect of harvest years and residue and fertilizer management on plant nutrient uptake of harvested cane for 1999 and 2000.

Source	df	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
<u>main-plots</u>											
Treatments(T)	5	2.26$^{\sim}$	0.47	5.28**	1.43	1.84	0.63	2.63$^{\sim}$	0.20	0.62	2.00
HREP	5	1.38	0.62	6.95***	4.14**	4.63**	0.50	5.48**	3.37*	1.43	0.71
VREP	5	2.41$^{\sim}$	4.06*	3.56*	0.43	0.56	0.07	5.36**	0.89	1.16	1.13
<u>sub-plots</u>											
Years (Y)	1	19.41****	54.22****	6.93*	2.67	3.36$^{\sim}$	2.88	3.03$^{\sim}$	7.28*	1.00	26.91****
TxY	5	0.73	0.99	0.80	0.89	0.86	2.61$^{\sim}$	1.68	0.54	0.45	1.08
RMSE for main-plots		12.14	3.805	14.42	4.203	3.994	0.03165	0.06312	0.5719	0.1706	2.264
% CV for main-plots		37.62	24.17	18.83	21.53	22.15	53.42	37.15	48.96	60.01	26.54
RMSE for sub-plots		10.62	3.764	22.53	4.196	4.292	0.02510	0.05410	0.6264	0.1408	2.271
% CV for sub-plots		32.90	23.91	29.43	21.49	23.80	42.37	31.84	53.64	49.53	26.61
Mean		32.27	15.74	76.56	19.52	18.03	0.05925	0.1699	1.168	0.2843	8.532

, $^{\sim}$, *, **, ***, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001, and 0.0001 levels, respectively.

Table 8. Effect of urea treatments and residue management on total nutrient uptake averaged across 1999 and 2000.

T#	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	--lb/A--									
1	38.1	15.0	67.6	21.6	20.0	0.0653	0.162	1.12	0.332	9.15
2	26.7	15.7	68.5	18.1	16.5	0.0468	0.137	1.09	0.237	7.87
3	35.9	16.1	85.3	19.2	18.0	0.0600	0.202	1.16	0.287	9.26
4	31.2	16.1	71.9	19.1	16.9	0.0564	0.137	1.11	0.320	7.36
5	25.6	14.7	74.3	18.1	17.0	0.0656	0.180	1.28	0.243	7.76
6	36.0	16.7	91.1	20.9	19.9	0.0625	0.201	1.24	0.287	9.71
LSD 0.10	8.5	NS	10.2	NS	NS	NS	0.044	NS	NS	NS
LSD 0.25	5.9	NS	7.0	NS	1.9	NS	0.031	NS	NS	1.10

Table 9. Effect of harvest year on total nutrient uptake averaged across treatments.

Harvest years	N	P	K	Ca	Mg	Cu	Mn	Fe	Zn	S
	------------------------------lb/A--------------------------------									
First-stubble	26.8	12.5	69.5	20.3	19.0	0.0669	0.181	0.98	0.268	7.12
Second-stubble	37.8	19.0	83.4	18.7	17.1	0.0529	0.159	1.37	0.301	9.98
LSD 0.10	4.2	1.5	9.1	NS	1.7	NS	0.022	0.25	NS	0.92
LSD 0.25	2.9	1.0	6.3	1.2	1.2	0.0074	0.015	0.18	NS	0.63

Table 10 a. F-values and statistical parameters for effect of residue and fertilizer management on soil nutrient variables.

Source	df	O.M.	Ca	Cu	Fe	Mg	Mn
Treatments(T)	5	0.25	$2.38^{\sim}$	0.47	3.82^{*}	1.11	1.98
HREP	5	32.64^{****}	29.15^{****}	9.33^{****}	0.59	16.90^{****}	0.82
VREP	5	$2.19^{\sim}$	17.73^{****}	1.95	14.00^{****}	1.82	4.51^{**}
RMSE		0.1096	167.8	0.07951	4.368	15.63	0.9256
% CV		8.03	7.26	13.17	17.39	5.38	12.34
Mean		1.359	2312	0.6036	25.12	290.5	7.498

Table 10 b. F-values and statistical parameters for effect of residue and fertilizer management on soil nutrient variables.........Continued

Source	pH	P	K	Na	S	Zn
Treatments(T)	$2.70^{\sim}$	1.38	2.13	0.97	1.52	0.78
HREP	3.81^{*}	1.85	4.50^{**}	2.98^{*}	5.13^{**}	2.82
VREP	11.06^{****}	5.03^{**}	5.33^{**}	0.40	1.66	2.16
RMSE	0.2781	33.93	12.17	2.565	4.775	0.05237
% CV	3.832	25.49	10.60	12.01	23.19	17.67
Mean	7.256	133.1	114.8	21.35	20.60	0.2964

, $^{\sim}$, *, **, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001, and 0.0001 levels, respectively.

Table 11 a. Effect of urea and residue management treatments on soil nutrient variables.

T#	OM[3]	Ca	Cu	Fe	Mg	Mn
	%	---ppm---				
1	1.35	2320	0.585	21.9	288	6.87
2	1.36	2470	0.572	22.5	285	7.01
3	1.35	2140	0.615	31.2	285	8.32
4	1.39	2280	0.630	24.0	287	7.67
5	1.33	2350	0.600	24.0	296	7.37
6	1.38	2310	0.620	27.1	301	7.76
LSD 0.10	NS	170	NS	4.3	NS	NS
LSD 0.25	NS	110	NS	3.0	NS	0.63

[3] Soil samples were taken on February 14, 2002 down to 6-inches.

Table 11 b. Effect of urea and residue management treatments on soil nutrient variables.........Continued

T#	pH	P	K	Na	S	Zn
		---ppm---				
1	7.45	150	120	20.9	18.5	0.290
2	7.37	132	115	21.6	22.9	0.293
3	6.93	139	114	21.1	17.4	0.280
4	7.36	130	105	20.2	23.6	0.323
5	7.24	104	109	21.0	20.6	0.277
6	7.19	144	125	23.3	20.5	0.315
LSD 0.10	0.28	NS	NS	NS	NS	NS
LSD 0.25	0.19	NS	8	NS	3.3	NS

NS denotes statistical nonsignificance at the indicated P level.

EFFECT OF POWER PERK ON SUGARCANE YIELD VARIABLES AND SOIL WATER AND PENETRATION RESISTANCE

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SUMMARY

Our results show that applying up to 20 G/A of Power Perk across sugarcane rows after planting had no effect on sugar yields, but applying 30 G/A of Power Perk across the rows reduced both cane and sugar yields, indicating that this treatment was too hot. Power Perk treatments did not affect ($P>0.25$) soil moisture or soil penetrometer resistance in 2001.

INTRODUCTION

Power Perk is a liquid product produced by OrganiCal Inc. and is registered as an agricultural mineral and soil conditioner. This product has a pH of approximately 0.4 and is meant to be diluted at least 1:20 with water before application. It is currently used on construction sites and golf courses as a soil conditioner to correct and/or increase water percolation in clay and saline/sodic soils. Promoters of this product claim that it will reduce the expansion index of clay soils so that water can percolate through it and, thereby, reduce resistance to root growth. Since the heavy-textured soils used to grow sugarcane in south Louisiana are known to have drainage problems, we decided to test this product.

OBJECTIVES

To determine the effect of Power Perk application rates and methods of application on:

1. Soil water concentration and soil penetration resistance.
2. Sugarcane yield variables across a four-year cane cycle.

MATERIALS AND METHODS

An Alligator clay soil was selected for use in the study. First progeny Kleentek variety HoCP 91-555 was planted at three stalks and a lap of two joints in September of 1999. The experiment used a 6x6 Latin square design with six replications. Experimental plots consisted of three 5-foot 10-inch by 40-foot rows, with a 10-foot alley at the ends of the plots. All treatment plots were separated from adjacent treatments by three border rows.

Experimental treatments (Table 2) were applied immediately after planting. The Power Perk was diluted 1:10 with water before application. Treatments 2-4 were applied as a broadcast spray (from furrow-to-furrow). Treatments 5 and 6 had their Power Perk applied two ways: half in a narrow (1-inch) band (in the furrow between the rows) and the other half in a 4-inch band on the row top.

Cane was grown to maturity in 2000 and 2001 using standard cultural practices, and plant populations were determined for each plot before harvest. The experiment was harvested in 2000 with a two-row soldier harvester and weighed with a weigh rig. In 2001 the plots were harvested on October 22 by a combine harvester and weighed with a portable weigh wagon. A 10-stalk sample was taken from each plot each year to determine average stalk weight and commercially recoverable sugar (CRS) per ton of harvested cane. Soil penetrometer resistance (using a soil pentrometer) and soil moisture (using dry weight differences) was measured down to 6-inch on August 28 and October 11
in 2001.

RESULTS AND DISCUSSION

Tables 1 and 2 show that the Power Perk treatments (Table 2) significantly ($P< 0.10$) affected stalk weight, CRS, and sugar yield. Harvest year affected (P#0.10) CRS and cane and sugar yields.

Table 2 shows that the 10 G/A Power Perk treatment (T #2) had a higher (P#0.10) plant population than all treatments except T #6. Likewise, T #2 had larger stalk weights than T #'s 1, 4, 5, and 6. Treatment #1 had the highest CRS, which was larger than that of the T #'s 2, 4, and 5. Cane tonnage was significantly (P#0.10) higher for T #2 than for T #'s 4 and 5. Likewise, T #'s 1, 2, and 3 produced more sugar than T #'s 4 and 5. Apparently, the 30T/A Power Perk treatment and applying Power Perk on the row top were too much for our cane.

Table 3 shows that plant cane had appreciably more CRS, cane tonnage, and sugar yield than did first-stubble cane. Excess rainfall in June of 2001 may have been the cause of the lower cane tonnage.

Tables 4-7 show that the Power Perk treatments did not affect (P$0.25) soil moisture or soil penetrometer resistance at the two sampling dates (August 28 and October 11) in 2001.

Table 1. F-values and statistical parameters for effect of Power Perk and harvest year on sugarcane yield variables.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
main-plots						
Treatments (T)	5	6.85***	1.58	2.58$^{\sim}$	1.84	4.02*
HREP	5	9.41****	0.42	4.03*	12.33****	11.05****
VREP	5	4.03*	1.45	6.36**	8.22***	9.31****
sub-plots						
Year (Y)	1	1.53	1.91	334.18****	94.46****	205.23****
TxY	5	0.31	0.90	1.38	0.26	0.36
RMSE for main-plots		0.1034	6061	7.265	2.590	427.1
% CV for main-plots		6.68	12.53	3.94	9.09	7.87
RMSE for sub-plots		0.1850	9507	7.946	3.816	689.3
% CV for sub-plots		11.96	19.65	4.31	13.40	12.69
Mean		1.547	48,370	184.5	28.49	5430

, $^{\sim}$, *, **, ***, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001, and 0.0001 levels, respectively.

Table 2. Effect of Power Perk rates and placement on sugarcane yield variables averaged across two years.

T#	Power Perk	Stalk weight	Plant population	CRS	Cane yield	Sugar yield
	G/A	lb/stalk	1000/A	lb/T	T/A	lb/A
1	0 - furrow to furrow	1.49	47.9	189	28.5	5560
2	10 - “ ” “	1.65	52.6	183	29.7	5600
3	20 - “ ” “	1.60	47.1	187	29.2	5650
4	30 - “ ” “	1.48	46.6	182	27.4	5170
5	5 in furrow +5 over row top	1.58	47.0	179	27.0	5050
6	10 in furrow + 10 over row top	1.48	49.1	186	29.4	5580
LSD 0.10		0.07	4.3	5	1.9	310
LSD 0.25		0.05	3.0	4	1.3	210

NS denotes non significance at the indicated P level.

Table 3. Effect of harvest year on sugarcane yield variables averaged across experimental treatments.

Harvest year	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
	lb/stalk	1000/A	lb/T	T/A	lb/A
Plant cane	1.57	49.8	202	33.1	6670
First-stubble	1.53	46.9	167	24.0	4230
LSD 0.10	NS	NS	3	1.6	280
LSD 0.25	0.05	2.6	2	1.1	190

NS denotes nonsignificance at the indicated P level.

Table 4. F-values and statistical parameters for effect of Power Perk application rates and placement on soil penetrometer resistance for first-stubble cane in 2001.

Source	df	Penetration
main-plots		
Treatments (T)	5	0.40
HREP	5	8.08***
VREP	5	2.95*
sub-plots		
Date (D)	1	307.25****
TxD	5	0.46
RMSE for main-plots		39.35
% CV “ ” “		10.29
RMSE for sub-plots		46.89
% CV “ ” “		12.26
Mean		382.5

*, ***, and **** denotes statistical significance at the P# 0.05, 0.001, and 0.0001 levels, respectively.

Table 5. Effect of Power Perk treatments and sampling date on soil penetrometer resistance for first-stubble cane in 2001.

T#	Power Perk	Sampling date	
		August 28	October 11
	G/A	---------lb/in.^{2}----------	
1	0 - furrow to furrow	286	498
2	10 - " " "	276	473
3	20 - " " "	292	483
4	30 - " " "	292	466
5	5 in furrow +5 over row top	280	504
6	10 in furrow + 10 over row top	277	461
LSD 0.10 for treatment within sampling date		NS	NS
LSD 0.25 " " " " "		NS	NS

NS denotes non significance at the indicated P level.

Table 6. F-values and statistical parameters for effect of Power Perk application rates and placement on soil moisture for first-stubble cane in 2001.

Source	df	soil moisture
main-plots		
Treatments (T)	5	0.99
HREP	5	0.73
VREP	5	0.59
sub-plots		
Date (D)	1	351.81****
TxD	5	0.76
RMSE for main-plots		1.525
% CV “ ” “		7.18
RMSE for main-plots		2.255
% CV “ ” “		10.61
Mean		21.25

**** denotes statistical significance at the P#0.0001 level.

Table 7. Effect of Power Perk treatments and sampling date on soil moisture in 2001.

T#	Power Perk	Sampling date	
		August 28	October 11
	G/A	------------%-------------	
1	0 - furrow to furrow	25.9	15.7
2	10 - “ ” “	26.9	15.1
3	20 - “ ” “	26.3	15.3
4	30 - “ ” “	26.3	16.9
5	5 in furrow + 5 over row top	26.5	16.7
6	10 in furrow + 10 over row top	26.2	17.7
LSD 0.10 for treatment within sampling date		NS	NS
LSD 0.25 “ ” “ ” “		NS	NS

NS denotes non significance at the indicated P level.

EFFECT OF NITROGEN FERTILIZER RATE AND TIMING ON PLANT CANE YIELD VARIABLES

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SUMMARY

Nitrogen fertilizer rates (60, 120, and 180 lb N/A) were applied to LCP 85-384 plant cane at four different dates (mid-February, mid-March, mid-April, and mid-May) in 2001. Nitrogen fertilizer applied in mid-March produced as much sugar yield as when nitrogen was applied in mid-April. Nitrogen fertilizer rates did not affect (P$0.25) plant cane sugar yields in the first year of our study.

INTRODUCTION

The recommended time for applying nitrogen fertilizer in Louisiana is April to mid-May. However, this recommended date for nitrogen fertilization was derived with sugarcane varieties that are no longer grown in Louisiana. Consequently, research is needed to determine if the optimal time for applying nitrogen is still applicable for the varieties now grown.

Also, recent research indicates that LCP 85-384 may require less than the recommended nitrogen rate for plant cane and first-stubble. We also need to know if there is an interaction between nitrogen application date and nitrogen fertilizer rates.

OBJECTIVES

1) To determine the optimal date for nitrogen application to sugarcane in Louisiana for variety LCP 85-384.

2) To determine the optimum nitrogen rate for LCP 85-384.

3) To determine if split applying nitrogen increases sugar yields of LCP 85-384.

MATERIALS AND METHODS

A nitrogen fertilization date by nitrogen application rate study was initiated with LCP 85-384 plant cane in 2001. The study was planted in August of 2000 using first-progeny Kleentek at three stalks and a lap of two joints.

The experiment used a Latin square, split-plot design with four replications. The main plots were application dates (mid-February, mid-March, mid-April, and mid-May); sub-plots were nitrogen fertilizer rates (60, 120, 180 lb N/A, plus a 60-60 split where half of the N was applied in mid-June). Experimental plots consisted of three 5-foot 10-inch by 50-foot rows with a 10-foot alley at the ends of the plots. There were also three border rows between each plot fertilized at the recommended fertilizer rate in April.

Sugarcane was grown till maturity (December 10) and harvested with a two-row soldier harvester and the research plots were weighed with a weigh rig. Ten stalks were taken from each plot for sucrose analysis. Plant populations were determined in September of 2001 for each plot.

RESULTS AND DISCUSSION

Table 1 shows that dates of nitrogen application affected ($P<0.10$) cane yields, but did not affect the other plant cane yield variables. Nitrogen fertilizer rates also did not affect (P$0.10) the yield variables, except for plant population. The application date by nitrogen rate interaction was not significant (P$0.10) for any of the yield variables. The low % CVs for the variables in the test indicate that the experimental design did a good job of removing variability from the study.

Table 2 shows that the mid-March and mid-April fertilizer dates yielded essentially the same cane tonnage and significantly (P#0.10) more tonnage than at the mid-February and mid-May fertilization dates. Likewise, the mid-March date yielded as much sugar as the mid-April fertilization date, indicating that it may be possible to fertilize a little earlier than what is recommended.

Nitrogen fertilizer rates had little effect on the plant cane yield variables (Table 3), except where the 120 and 180 lb N/A rates increased (P#0.10) plant population relative to the other treatments.

Table 1. F-values and statistical parameters for effect of nitrogen application dates and rates on plant cane yield variables.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
main-plots						
Dates (D)	3	0.31	0.80	3.04	4.55$^{\sim}$	1.77
HREP	3	0.51	2.58	1.37	0.70	0.37
VREP	3	2.95	5.10*	5.09*	5.33*	2.59
Rates (R)	3	0.48	3.16*	0.69	0.44	1.21
D x R	9	1.22	1.48	0.72	1.08	1.05
RMSE for main-plots		0.1975	3,750	7.171	2.478	623.1
% CV for main-plots		10.41	6.97	3.14	7.86	8.67
RMSE for sub-plots		0.1548	3,176	9.916	2.338	567.9
% CV for sub-plots		8.15	5.90	4.35	7.42	7.91
Mean		1.898	53,810	228.1	31.54	7183

, $^{\sim}$, and *, denote statistical significance at the P#0.25, 0.10, and 0.05 levels, respectively.

Table 2. Effect of nitrogen fertilization date on plant cane yield variables.

Fertilization date	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
	lb/stalk	1000/A	lb/T	T/A	lb/A
mid-Feb.	1.92	54.0	230	30.9	7100
mid-March	1.86	54.5	226	32.6	7360
mid-April	1.92	54.2	225	32.7	7340
mid-May	1.90	52.6	231	30.0	6930
LSD 0.10	NS[%]	NS	NS	1.7	NS
LSD 0.25	NS	NS	3	1.1	NS

[%] NS denotes that the means of the indicated variable was not statistically different at the indicated significance levels.

Table 3. Effect of nitrogen fertilizer rate on plant cane yield variables.

Fertilization rate	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield
lb N/A	lb/stalk	1000/A	lb/T	T/A	lb/A
60	1.91	52.5	231	32.0	7380
120	1.89	54.8	226	31.3	7020
180	1.87	55.3	228	31.7	7230
60-60[P]	1.93	52.7	228	31.2	7100
LSD 0.10	NS[3]	1.9	NS	NS	NS
LSD 0.25	NS	1.3	NS	NS	NS

[3] NS denotes that the means of the indicated variable was not statistically different at the indicated significance level.

[P] Half of the total nitrogen rate (60 lb N/A) was applied in mid-June.

EFFECT OF N-HIB CA FERTILIZER AND NITROGEN FERTILIZER RATES ON PLANT CANE YIELD VARIABLES

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SUMMARY

N-hib Ca and nitrogen fertilizer rates did not affect (P$0.10) stalk weights, plant populations, cane yield, sugar yield, or soil moisture in 2001. However, applying 120 lb Ca/A in a narrow one-inch band in the row furrow as aqua-cal did decrease (P#0.10) CRS.

INTRODUCTION

Previous research at the Iberia Research Station shows that including liquid calcium-chloride (N-hib Ca) in a liquid urea fertilizer program can result in increased sugar and cane yields. This research follows up that research and also looks at the effect on yields of spraying different rates of liquid urea and liquid N-hib Ca fertilizer rates on sugarcane combine residue.

OBJECTIVES

1) To compare urea sources, combinations, and rates on sugarcane yields.

2) To determine the effect of applying N-hib Ca plus urea to combine harvest residue on sugarcane yields vs. burning the residue and applying urea in the spring.

MATERIALS AND METHODS

LCP 85-384 sugarcane (Kleentek) was planted in September 2000 at three stalks and a lap of two joints in a 7x7 Latin square experimental design using the treatments listed in Table 2. Experimental plots consisted of three 5-foot 10-inch by 60-foot rows with 10-foot alleys at the ends of the plots. All plots were separated by three border rows on each side of the plot.

Half of the nitrogen from T #7 was applied on Feb. 5, 2001 in a narrow 1-inch band in the furrow on both sides of each of the three rows in the plot. The remaining half of the nitrogen was applied on June 14, 2001, along with the other fertilizer treatments (Table 2).

All the plots were grown till maturity using standard cultural practices. Plant populations were determined in September 2001. The plots were harvested on December 3, 2001, with a combine harvester and a portable weight wagon. Ten stalks were taken from the center row of each plot to determine average stalk weight and CRS.

RESULTS AND DISCUSSION

Tables 1 and 2 show that the experimental treatments did not affect (P$0.10) the measured yield variables, except for CRS.

Table 2 shows that applying aqua-cal (calcium hydroxide) in a narrow 1-inch band resulted in decreased CRS compared to T #5. This may have been because of the high pH of the calcium hydroxide.

Table 1. F-values and statistical parameters for effect of nitrogen fertilizer rates and sources on LCP 85-384 plant cane yield variables and soil moisture.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield	Soil moisture
Treatments	6	0.37	1.37	2.52*	0.78	1.46	1.82
HREP	6	1.58	5.57***	2.11$^{\sim}$	8.13****	5.33***	4.34*
VREP	6	0.36	2.15$^{\sim}$	2.79*	0.88	0.52	0.97
RMSE		0.2259	2,584	8.476	3.467	839.2	0.9204
% CV		11.34	5.65	3.76	11.60	12.46	4.29
Mean		1.992	45,700	225.6	29.89	6,735	21.44

, $^{\sim}$, *, **, ***, and **** denote statistical significance at the P#0.25, 0.10, 0.05, 0.01, 0.001 and 0.0001 levels, respectively.

Table 2. Effect of nitrogen fertilizer rates, N-hib Ca, and aqua-cal on plant cane yield variables and soil moisture.

T#	Urea[1]	N-hib Ca[2]	aqua-cal[2]	aqua-cal[2]	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield	Soil moisture
	lb N/A	lb Ca/A	lbN/A	lb Ca/A	lb/stalk	1000/A	lb/T	T/A	lb/A	
1	60	0	0	0	1.94	47.3	224	31.1	6920	21.3
2	120	0	0	0	1.97	44.3	224	29.3	6550	21.8
3	180	0	0	0	1.99	45.7	230	30.3	6940	21.2
4	60	20	0	0	2.07	44.5	225	29.4	6610	20.7
5	120	40	0	0	2.03	45.1	228	30.9	7030	21.8
6	180	60	0	0	2.01	46.2	232	30.5	7090	21.2
7	60	20	60	120	1.93	46.8	217	27.8	6000	22.1
LSD 0.10					NS	NS	8	NS	NS	NS
LSD 0.25					NS	NS	5	NS	530	0.6

[1] Liquid urea and N-hib Ca treatments were applied to the inside of the rows on June 14, 20001.

[2] Aqua-cal was applied to the inside and outside furrows of all three rows in the plot on February 5, 2001.

EFFECT OF CALCITIC LIME AND CALCIUM SILICATE SLAG RATES AND PLACEMENT ON LCP 85-384 PLANT CANE ON A LIGHT TEXTURED SOIL

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SUMMARY

Mixing 1 T/A and 2 T/A of calcium silicate slag into soil before planting or placing 1 T/A of slag under cane at planting resulted in significantly higher (P#0.10) sugar yields compared to the check. However, mixing 1 and 2 T/A of calcitic lime into the soil before planting did not increase (P$0.10) sugar yields relative to the check. The fact that sugar yields were higher where the slag was mixed into the soil vs. where lime was mixed into soil indicates that the yield response obtained from the slag was because of its silica content and not its ability to change soil pH. The increase in yields with application of slag was associated with higher levels of monosilicic acid concentration of soil.

INTRODUCTION

Silica (Si) is one of the most plentiful elements in the earth's crust. In the soil, Si is generally abundant as mineral quartz and clays, but its concentration in a soluble form is highly variable. Monosilicic acid is soluble in the soil, and it influences the chemical, physical, and biological properties of soils and plants. Soluble Si (monosilicic acid) apparently increases the plants' resistance against attack by insects and diseases, and it enhances plant tolerance to cold and water stress. Increasing soil silica can result in increased phosphorus uptake by plants, while decreasing the soil concentration of some toxic elements. Depending on the crop, production responses to silicate fertilizers can improve from 10% to 100%. Substantial sugarcane yield responses to silica have been obtained in Florida and Hawaii. Agricultural activity removes large quantities of Si (more than 100 lb/A each year) from soil. Monosilicic acid is used rapidly by the plant, and, unless replenished in the soil solution, plant available Si can be depleted. Crops under stress do not use Si efficiently, and Si deficient crops do not use other nutrients efficiently. Also, successive ratoon yields decrease more dramatically when plant available Si is low. Silica can also be used as a liming agent. Recent analysis of Si in 22 Louisiana soils show that all were deficient or very deficient in monosilic acid.

OBJECTIVE

To compare the effect of calcitic lime and calcium silicate slag rates and placement on soil and plant silica and sugarcane yields.

MATERIALS AND METHODS

A sugarcane study was planted in September 2000 with first progeny Kleentek variety LCP 85-384 billets. The six calcitic lime (Domino by-product) and calcium silicate slag (a by-product of the steel industry) treatments are given in Table 2. These treatments were replicated six times in a Latin square experimental design. Treatments 2, 3, 4, and 5 were incorporated into the rows before planting, and treatment 6 was placed under the cane at planting. Experimental plots consisted of three 5-foot 10-inch by 40-foot rows with a 10-foot alley at the ends of each plot. All experimental plots were separated by three border rows on each side of the plots.

The Domino lime and calcium silicate slag materials showed a calcium carbonate equivalent of 84.28% for the lime and 78.51% for the slag. The silicon content of the materials were 39,400 ppm for the lime and 133,000 ppm for the slag. The respective analyses of the lime vs. slag were: 0.39 vs. 0.50 ppm for arsenic; 0 vs. 0 ppm for cadmium; 53,970 vs. 8,430 ppm for calcium; 0.16 vs. 0.33 ppm for nickel; 1.12 vs. 8.05 ppm for copper; 0.57 vs. 0.73 ppm for lead; 5.95 vs. 14.38 ppm for iron; 0.03 vs. 0.04 ppm for zinc; 1.21 vs. 4.53% for organic matter; 788 vs. 378 ppm for magnesium; 0.20 vs. 0.94 ppm for manganese; 12.05 vs. 8.38 for pH; 1.99 vs. 5.74 ppm for phosphate; 112 vs. 56 ppm for potassium; and 61 vs. 23 ppm for sodium. Soil samples were taken from each plot and analyzed for monosilic acid. Plant leaf tissue was taken in August 2001 and analyzed for silica concentration.

The experiment was grown to maturity using standard cultural practices. The plots were harvested on November 27, 2001, using a combine harvester and a weigh rig. Ten stalks were taken from the middle row of each plot immediately before harvest for determination of stalk weights and CRS.

RESULTS AND DISCUSSION

Research results from the calcium silicate slag and calcitic lime study on a Jeanerette silty loam soil using LCP 85-384 plant cane showed that mixing 1 T/A of silicate slag into soil before planting resulted in a significant ($P<0.10$) increase (17%) in sugar yields (1080 lb sugar/A) compared to where the slag was not added (Table 2). Furthermore, mixing 1 T/A of calcitic lime into soil did not result in an increase in sugar yields, and the 1 T/A slag treatment produced 690 lb sugar/A more ($P<0.10$) than did the 1 T/A calcitic lime treatment. This clearly indicates that the yield response from the calcium silicate slag was caused by the addition of silica and was not caused by the addition of calcium or a change in soil pH.

In addition to the effect of silica on sugar yields, it also increased (P#0.10) cane tonnage relative to the check (Table 2; T#'s 4,5, and 6 vs. T1) and cane yields for the slag treatments relative to the lime treatments (T4 vs. T2 and T5 vs. T3). Likewise, the slag treatments mixed into the soil produced heavier (P#0.10) stalk weights compared to the check (T4 and T5 vs. T1) and the two lime treatments (T4 vs. T2 and T5 vs. T3). However, placing 1 T/A of slag under the cane at planting (T6) did not increase (P#0.10) stalk weights relative to the check (T1) or the two lime treatments (T#'s 2 and 3).

The experimental treatments did not affect (P$0.25) plant populations or lodging (Tables 1 and 2). However, the 2 T/A slag rate resulted in higher CRS (T5 vs. T1), but placing 1 T/A of slag under cane at planting produced lower CRS compared to T #'s 2, 3, 4, and 5.

Table 3 shows that the experimental treatments had a very significant (P#0.0001) effect on monosilicic acid content of soil (Table 4). All treatments receiving calcium silicate slag (T #'s 4, 5, and 6) had higher monosilicic acid concentrations than treatments (T #'s 1, 2, and 3) not receiving the slag.

While plant silica was not significantly (P$0.10) affected by the experimental treatments (Table 1), there was a trend (P#0.25) toward higher plant silica levels for treatments 5 and 6 (Table 4).

Table 1. F-values and statistical parameters for effect of calcitic lime and calcium silicate slag rates and placement on LCP 85-384 plant cane yield and growth variables on a Jeanerette silt loam soil.

Source	df	Stalk weight	Plant pop.	CRS	Cane yield	Sugar Yield	Lodging
Treatments	5	5.16^{**}	1.34	3.07^{*}	5.77^{**}	4.15^{*}	0.68
HREP	5	$2.55^{\sim}$	1.16	1.00	0.94	2.18	1.44
VREP	5	2.72^{*}	1.46	0.89	4.77^{**}	4.78^{**}	0.49
RMSE		0.1918	4241	9.791	2.672	554.3	1.025
% CV		9.71	7.38	4.47	8.50	8.07	72.33
Mean		1.976	57,450	218.9	31.45	6864	1.417

, $^{\sim}$, *, and ** denotes statistical significance at the P#0.25, 0.10, 0.05, and 0.01 levels, respectively

Table 2 . Effect of calcitic lime and calcium silicate slag rates and placement on LCP 85-384 plant cane yield and growth variables on a Jeanerette silt loam soil.

T#	Lime	Silica slag	Placement[1]	Stalk weight	Plant pop.	CRS	Cane yield	Sugar yield	Lodging[3]
	T/A	T/A		lb/stalk	1000/A	lb/T	T/A	lb/A	
1	0	0	-	1.90	54.9	215	28.9	6,230	2.0
2	1	-	mixed into rows	1.75	57.9	222	29.7	6,620	1.5
3	2	-	mixed into rows	1.97	57.6	224	28.0	6,290	1.0
4	-	1	mixed into rows	2.14	55.1	218	33.5	7,310	1.3
5	-	2	mixed into rows	2.23	57.9	227	31.9	7,220	1.5
6	-	1	placed under cane	1.88	60.6	207	35.5	7,330	1.2
LSD 0.10				0.19	NS	10	2.8	580	NS
LSD 0.25				0.13	NS	7	1.9	390	NS

[1] Soil test indicated that silica was critically (13.5 ppm) deficient. 0-20 ppm = critically deficient; 20-40 ppm = deficient.

[3] Lodging was rated on a 1-5 scale, where 1 had all plants erect and 5 had all plants lodged.

Table 3. F-values and statistical parameters for effect of experimental treatments on monosilicic acid concentration of soil and Si concentration of plant leaf tissue.

Source	df	Monosilicic acid	Plant silica
Treatments	5	9.83****	1.84
HREP	5	5.16**	0.41
VREP	5	2.05	0.23
RMSE		1.434	0.2290
% CV		9.12	15.20
Mean		15.72	1.506

, **, and **** denotes statistical significance at the P#0.25, 0.01, 0.0001 levels, respectively.

Table 4 . Effect of experimental treatments on monosilicic acid concentration of soil and silica concentration of sugarcane leaves.

T#	Lime	Silica slag	Placement[1]	Monosilicic acid	Plant silica
	T/A	T/A		ppm	%
1	0	0	-	13.4	1.39
2	1	-	mixed into rows	14.2	1.42
3	2	-	mixed into rows	14.8	1.38
4	-	1	mixed into rows	16.8	1.53
5	-	2	mixed into rows	17.9	1.64
6	-	1	placed under cane	17.3	1.67
LSD 0.10				1.4	NS
LSD 0.25				1.0	0.16