

NRCS – CIG Project

Title of Proposal: Implementation of New Strategies for Sugarcane Residue and N Fertilizer: Effect on Yield and Edge-of-Field Water Quality

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Justifications

Through NRCS – CIG funding (9/2012 through 2/2014), two management sites were established to monitor water quality, runoff, N and P losses over an entire sugarcane growing cycle. The sites are located on Bayou Lafourche in the Barataria Basin Coastal watershed in Assumption Parish, Louisiana. All sites were instrumented with water samplers, solar panels, H-type flumes, and weather stations. The participating producers continue to execute selected field operations during the growing season. Collection of water quality samples are carried out by the investigators. The project goal is to validate the value and feasibility of new production technologies.

Results from the 2013 growing season indicate positive and consistent sugarcane yield response to the new management strategies at two locations. Specifically, yields of first stubble cane in response to the use of a modified-sweeper were comparable to the conventional burn-treatment. Second, yields of plantcane based on sensor-based N exceeded those based on soil-N test and farmer practice. We recognize that recommendations for implementation of new best management strategies require consistent responses for an entire sugarcane growing cycle and for more than one location.

The information from this work will result in outreach activities for the adoption process by large-scale sugarcane producers. Results from this project will also generate information needed by NRCS, coastal zone managers and other state and federal regulatory agencies for maintaining water quality of Louisiana Gulf Coast estuaries.

ACCOMPLISHMENTS TO DATE

Yield Responses and Edge of Field Water Quality

Mulch Residue: During 2013, we implemented residue management strategies by use of a modified sweeper capable of removing sugarcane residue off the top of the rows with minimal soil surface losses and damage to stubble cane. This treatment was compared to the conventional burn and no-burn (or no-till) of sugarcane residue following harvest on sediment, N and P runoff losses.

Yield response for first stubble cane to sweep, no-till, and burn indicate indicated similar yields with the use of the modified sweeper when compared to the conventional burn treatment. This result was consistent for the two different locations as shown in Table 1. For Gravois Farm, the total yield for the sweep and burn treatments were 34.8 and 35.1 tons per acre, respectively. For Dugas Farm, the respective yields were 33.3 and 33.8 tons per acre. These results are in contrast to earlier work reported on sugarcane since 2001 with losses of yields from 9 to 14% when sweepers were used compared to the conventional burn treatment.

Completed analysis of runoff water samples, from edge of field of all treatments are attached. Analysis of samples, from recent events is currently being analyzed in the laboratory. Based on edge of field data, sediment losses of P and N from edge of field are comparable for all treatments. Based edge of field data, sediment losses of P and N from edge of field are comparable for sweep treatment when compared to the conventional burn and the no-till treatments.

N Recommendation Approach Treatments: Two large field trials were established in 2013 to test the performance of different N fertilizer recommendation approach in Donaldsonville, LA. The treatments investigated in this part of the study include the current LSU AgCenter N recommendation/Farmer's Standard Practice, no N application to plant cane, N recommendation approach based on soil test nitrate (NO₃) and sugar yield goal (T2), and N recommendation based on optical sensor readings. The plots were harvested on December 17, 2013 at Dugas farm site and on December 18 to 19, 2013 at Gravois farm site.

Results on these demonstration trials are presented on Table 2. Except for no-N application to plant cane, both cane tonnage and sugar yield obtained from plots under different N recommendation approach were comparable. Plant cane from Dugas farm site (44 tons/ac; 8800 lbs/ac) provided higher cane and sugar yield than Gravois farm site (39 tons/ac; 7900 lbs/ac). The soil test NO₃-based N rate recommendation for both Dugas (70 lbs/ac) and Gravois (90 lbs/ac) farm sites was lower than the N rate under the farmer's standard N practice (100-110 lbs/ac). On the other hand, the sensor-based N recommendation was higher by 10 lbs/ac in Dugas farm site and lower by 20 lbs/ac in Gravois farm site than the farmer's standard N practice. Plots under the sensor-based N recommendation obtained higher average sugar yield than the plots under farmer's standard N practice raising the net return by \$60 and \$66 per acre at Dugas and Gravois sites, respectively (Table 3). The N recommendation from soil test NO₃ earned higher net return at Dugas (\$223/ac) than farmer's standard N practice but lost \$23/ac at Gravois site.

Completed analysis of runoff water samples, from edge of field of the sensor based treatments are attached. Analysis of samples, from recent events is currently being analyzed in the laboratory. Based edge of field data, sediment losses of P and N from edge of field are comparable for all treatments. Except for two sampling dates (June 12 and July 11), nitrate concentrations in water samples were comparable across the four N recommendation approach. Similar pattern was observed for the concentration of ammonium.

WORK TO BE ACCOMPLISHED

The following tasks need to be accomplished for implementation of new best management strategies. It is recognized that implementation of new best management strategies must be based on consistent responses for an entire sugarcane growing cycle and for more than one location. The goals set in this project will achieve this. Two additional growing seasons will provide this needed data.

Specific Future Accomplishments

Mulch Residue

1. Carry out sweep of surface residue from two field plots in preparation for the second and third stubble years of a new residue management system. This will be accomplished as soon as soil surface dries to permit machinery with minimal disturbances.
2. Carry out Edge of runoff water sampling for the entire second and third stubble years (2014 ad 2015).
3. Analyze edge of field samples for sediment, N and P losses.
4. Calculate loading of individual constituents based on discharge data from in situ flumes on an event basis during the growing season.
5. Carry out statistical analyses and plot all results versus time for the sweep versus the no-till and conventional managements.
6. Carry out harvest and calculate yield and sugar results.

Sensor-Based

7. Continue the sensor based N treatments for the first and second stubble years (2014 and 2015) on Dugas and Gravois farm sites. The treatments are: N recommendation approach based on soil test nitrate (NO₃) and sugar yield goal (T2), and N recommendation based on optical sensor readings.
8. Carry out edge of field runoff water sampling for the entire second and third stubble years (2014 and 2015).
9. Analyze edge of field samples for sediment, N and P losses.
10. Carry out harvest and sugarcane yield data analyses of the sugarcane management treatments from two sites for tonnage and sucrose contents.
11. Carry out statistical analyses and plot all results versus time for all-sensor based treatments.
12. Write final report including a summary, overall findings, and farmer recommendations.

Table 1. Yield data for sugarcane under different residue management treatments. Harvest was on December 12 and 17, 2013 for the Gravois and Dugas sites, respectively.

Treatment	REP	POP	STALK Weight	TOTAL YIELD	SUCROSE	NORMAL BRIX	JUICE SUCROSE	PURITY	SAMPLE CRS	SAMPLE SUGAR
		1000/A	LBS.	TONS/A	%	%	%	%	LBS/T	LBS/ACRE
Gravois Farm										
BURN	I	32.4	1.78	35.1	17.9	16.8	14.3	85.1	204.6	7181
MULCH	I	30.2	2.06	28.9	18.0	16.8	14.3	85.1	204.6	7181
SWEEP	I	30.2	1.80	34.8	18.7	17.2	15.0	87.2	216.5	7534
Dugas Farm										
BURN	I	36.8	2.52	33.5	18.3	17.2	14.6	84.9	209.7	7025
	II	37.2	1.92	34.0	17.6	16.9	14.0	82.8	199.5	6783
	Average	37.0	2.22	33.8	18.0	17.1	14.3	83.9	204.6	6904
MULCH	I	35.4	1.98	33.9	18.0	17.1	14.3	83.9	204.6	6904
	II	35.9	2.21	31.3	18.7	17.5	14.9	85.1	214.8	6723
	Average	35.7	2.10	32.6	18.4	17.3	14.6	84.5	209.7	6814
SWEEP	I	36.3	1.82	34.1	18.2	17.2	14.6	84.9	209.7	7151
	II	36.8	1.66	32.4	18.4	17.3	14.7	84.8	211.4	6896
	Average	36.6	1.74	33.3	18.3	17.3	14.7	84.9	210.6	7024

Table 2. Yield data for sugarcane under different nitrogen recommendation approach. Harvest was on December 17 and 19, 2013 for Dugas and Gravois farm sites, respectively.

Treatment	REP	STALK		TOTAL	SUCROSE	NORMAL	PURITY	SAMPLE	SAMPLE
		POP	Weight	YIELD	%	BRIX	%	CRS	SUGAR
		1000/A	LBS.	TONS/A	%	%	%	LBS/T	LBS/ACRE
Gravois farm									
Farmer's Practice	I	34.6	2.16	37.4	15.1	18	82.4	202	7541
	II	38.0	2.01	38.2	15.1	18	82.4	199	7615
	III	37.6	2.10	39.4	15.0	17.8	82.9	217	8540
	Average	36.8	2.10	38.3	15.1	17.9	82.6	206	7899
No N – Plant Cane	I	39.6	1.46	28.9	15.3	18.1	83.2	204	5899
	II	41.4	1.68	34.7	15.8	18.3	84.6	200	6931
	III	44.3	1.42	31.4	15.2	17.7	84.3	199	6253
	Average	41.8	1.50	31.6	15.4	18.0	84.0	201	6361
Soil Test NO ₃	I	32.2	2.32	37.4	15.3	18.2	82.6	206	7719
	II	45.0	1.84	41.4	15.0	17.9	82.6	200	8290
	III	39.0	1.96	38.3	15.3	18.2	82.8	187	7155
	Average	38.8	2.00	39.0	15.2	18.1	82.7	198	7721
Sensor-Based	I	47.2	1.96	46.1	15.3	18.2	82.4	208	9614
	II	35.4	2.15	38.1	14.9	17.8	82.1	196	7479
	III	33.0	2.35	38.7	14.7	17.6	82.1	191	7418
	Average	38.5	2.20	41.0	14.9	17.9	82.2	199	8170
Dugas farm									
Farmer's Practice	I	33.8	2.39	40.3	17.7	20.1	86.6	204	8232
	II	34.9	2.48	43.4	16.8	17.5	86.1	180	7793
	III	40.3	2.34	47.2	16.5	17.7	84.2	196	9236
	Average	36.3	2.40	43.6	17.0	18.4	85.7	193	8420
No N – Plant Cane	I	38.5	1.32	25.5	17.1	19.3	87.3	207	5274
	II	35.0	1.76	30.7	17.9	18	87.3	209	6421
	III	37.9	1.91	36.2	16.5	16.7	85.5	173	6245
	Average	37.2	1.70	30.8	17.2	18.0	86.7	196	5980
Soil Test NO ₃	I	38.2	2.12	40.4	17.1	19.6	85.8	208	8399
	II	32.6	2.70	43.9	17.9	18.2	86.9	224	9839
	III	47.3	2.14	50.7	17.1	17.6	85.1	199	10103
	Average	39.4	2.30	45.0	17.4	18.5	85.9	210	9447
Sensor-Based	I	35.1	2.29	40.2	16.9	19.3	86.0	208	8374
	II	38.8	2.32	45.0	16.8	17.3	85.1	199	8952
	III	38.6	2.44	47.1	16.7	17.5	84.8	189	8921
	Average	37.5	2.40	44.1	16.8	18.0	85.3	199	8749

Farmer's Practice – Farmer's standard N practice

No N – no N application for plant cane

Soil Test NO₃ – N recommendation was based on soil test nitrate and stalk N removal rate

Sensor-based – N recommendation was based on sensor readings (normalized difference vegetation index).

Table 3. Nitrogen rate, sugar yield and net return of sugarcane under different N recommendation approach.

Site	N Approach	N Applied lbs/ac	Sugar Yield lbs/ac	Income: Sugar yield		Saving: N fertilizer		Net \$/ac
				lbs/ac	\$/ac	lbs/ac	\$/ac	
Dugas	Farmer's Practice	100	8420					
	Soil test NO ₃	70	9447	1027	205	-30	18	223
	Sensor-Based	110	8749	329	66	10	-6	60
Gravois	Current/Farmer's	110	7899					
	Soil test NO ₃	90	7721	-177	-35	20	12	-23
	Sensor-Based	90	8170	272	54	20	12	66

Raw sugar price - \$0.20/lb

Price of N fertilizer - \$0.60/lb

Farmer's Standard Practice – reference to compute for economic return