EVALUATING THE EFFECTS OF COMBINE-HARVEST RESIDUE MANAGEMENT ON SOIL AND WATER QUALITY AND SUGARCANE PRODUCTION IN LOUISIANA

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Specific Goals and Objectives:

Specific objectives of the project were to evaluate the effects of four combine-harvest residue management treatments on runoff water quality and sugarcane growth, development and yield at two sites within the Vermilion-Teche watershed and to educate the public, scientific community and the sugarcane industry concerning the research findings as they relate to opportunities for enhanced sugar production and a cleaner environment.

Description of Treatments and Water Sample Collection System:

Combine-harvest residue management treatments include two treatments designed to mitigate the adverse effects of retained residue – the application of stabilized urea plus composted tea and the shredding of the residue for accelerated decomposition – and two treatments currently employed by the industry – ground burning of the residue and post-harvest retention of the residue. A randomized block experimental design was used to statistically evaluate treatment effects. Two replications only were used for water quality sampling, but four replications were employed for cane and sugar yield determination.

At both sites edge-of-field collections were made using H-flumes and ISCO samplers instrumented with submerged probe flow modules. Samplers were calibrated to composite 300ml samples at a designated flow. Analyses were made for TSS, TDS, turbidity, TKN, nitrite and nitrate nitrogen, chloride, bromide, sulfate, total P and BOD5. Field determinations were made for EC, pH and DO.

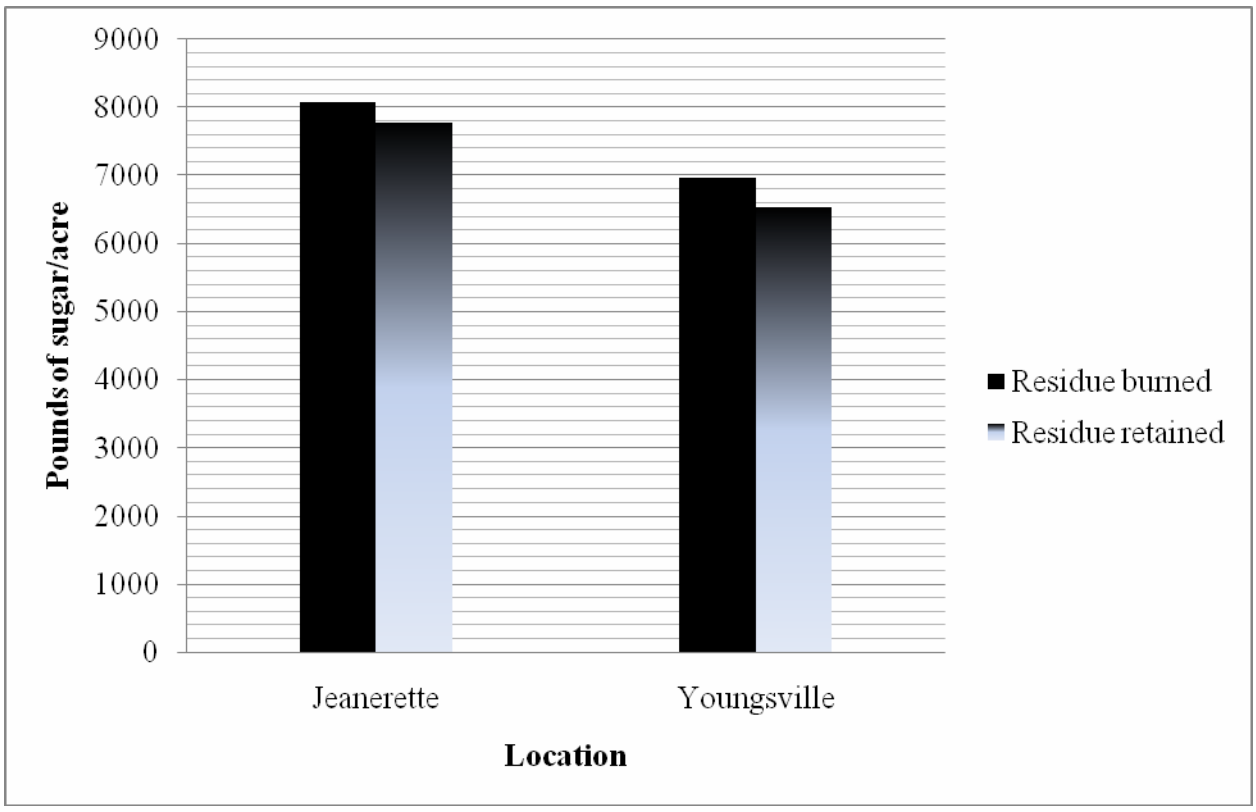
Crop agronomic data include the monitoring of crop development and the measuring of cane tonnage, sugar yield for two years.

Results:

Production of sugarcane tonnage and sugar:

Relative comparisons among the residue management treatments for sugar yields, as an average of two harvests, are shown in figure 1. Sugarcane yield was indifferent to residue management as none of the treatments was statistically superior.

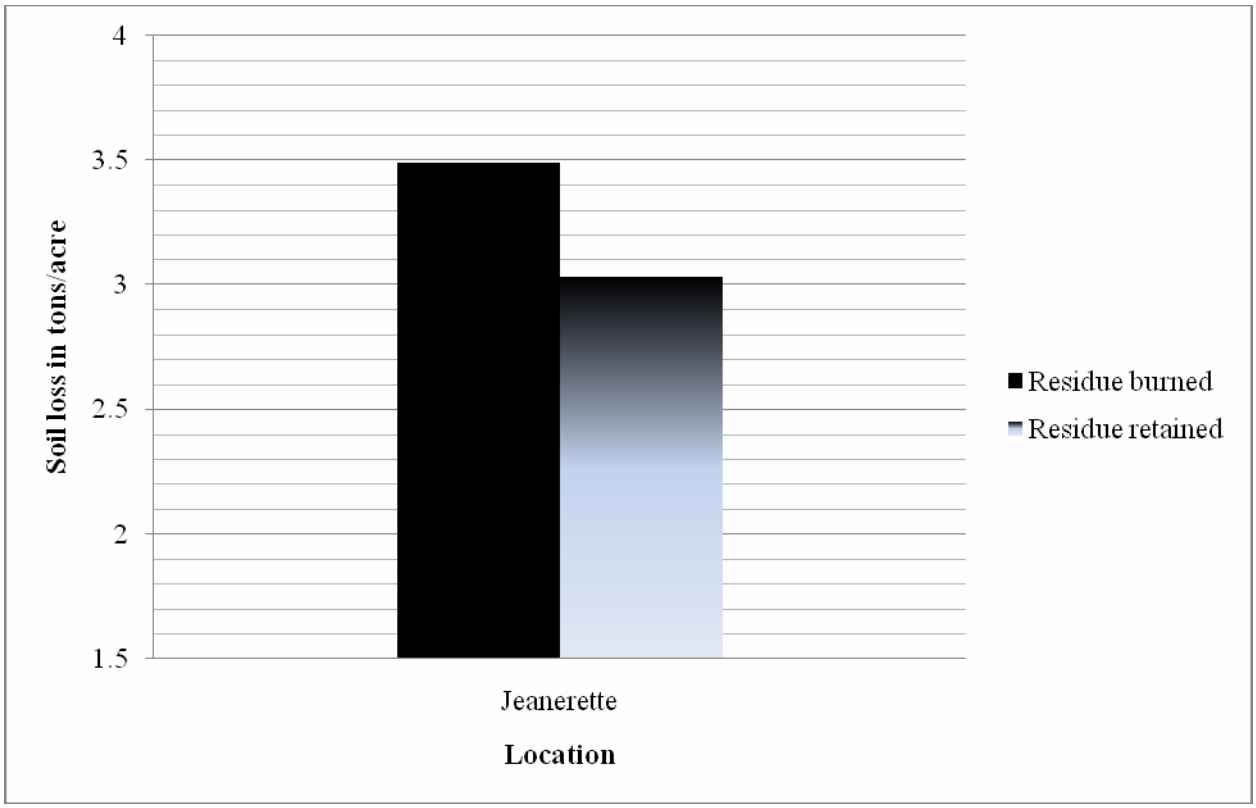
Figure 1 - Burning of residue consistently produced higher sugar/acre yields than residue retention as shown by location yields averaged over years. (Differences between the residue-burned and retained-treatments were not statistically significant but the trend for higher yield with burning is consistent with industry observations and previous research findings).



Water Quality Results:

Soil loss (Figure 2) and concentrations of nutrients in runoff were also similar among the residue management regimes. There were, however, seasonal differences in soil erosion between the residue-burned and residue-retained practices, especially at the Jeanerette site. From harvest until crop canopy closure in May/June of each spring, higher TSS was measured for the burned plots compared to the plots with retained residue. Prior to canopy closure, TSS totals for the burned plots were approximately twice that of plots in which soil was protected by residue. Even though TSS was not statistically different between the burned and residue retained plots, a cautionary comment is warranted concerning the seasonally high soil loss which accompanied residue burning. In both winter-spring periods in which runoff was sampled rainfall amounts were below normal, suggesting that the exposed soil in the burned areas would be subject to higher erosion rates with high rainfall.

Figure 2 - Soil loss, in tons of soil per acre, for the two industry-employed residue management practices was not significantly different (Youngsville site not included because of insufficient number of collections).



Observations:

The failure of the evaluated practices to influence yield or water quality parameters differentially gives the sugar industry options for residue management. Furthermore, soil loss measured in the series of studies was moderate and within the "acceptable" range of 2 to 5 tons of soil loss per acre per year. Without viable alternatives, growers will continue to burn until a management practice(s) is identified that utilizes the residue to reduce runoff while minimizing the impact of residue on the subsequent crops. Prescribed burning is a BMP that encourages growers to use proven guidelines to manage smoke and large particulates. Like a number of other agricultural industries that use prescribed burning, the Louisiana sugarcane industry will continue to research ways to eliminate burning. Currently, effort is being made to identify sugarcane varieties that tolerate the residue blanket and to search for amendments that alleviate the yield-limiting effects of the retained residue.

EFFECT OF RESIDUE MANAGEMENT ON SUGARCANE YIELD GROWN ON SHARKEY CLAY

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In this study we investigated the effect of sugarcane residue (mulch cover) resulting from the combine harvester on sugarcane yield (biomass and sugar) and quantified the decay of residue post harvest. Three residue management practices were implemented at the Sugar Research Station, where sugarcane variety HoCP91-555 was planted on October 21, 2003 on a Sharkey clay soil. The three treatments were; (i) burning the mulch after harvest, off-barring and cultivating in the spring; (ii) sweeping the mulch off the top of the row after harvest, off-barring and cultivating in the spring; and (iii) leaving the mulch on the field after harvest, off-barring and cultivating in the spring. The last treatment where the mulch is not removed may be best regarded as a no-till treatment which is a commonly used soil conservation measure. Sugarcane population, yield, and amount of mulch residue left on the soil surface were measured for each treatment. We summarize results for an entire growing cycle; i.e., plantcane, first, second and third stubble (2004-2007).

Yield

During the 2003 growing season, we implemented three cultural practices namely; burning of the mulch residue, sweeping, and no-till where the residue was not removed. To compare the yields of sugarcane biomass and sugar from sugarcane fields with three residue management practices grown on Sharkey clay at the Sugar Research Station, variety HoCP91-555 was planted on October 21, 2003. The site consisted of six plots (two replications × three treatments). Each plot consisted of six rows 400 ft length with blank rows between plots. Plantcane was harvested, using a combine harvester, on October 26, 2004. Following harvest, the residue on two plots was burned on October 26, 2004. In another two plots, the residue was removed from the top of the rows using a three-row sweeper. Using brushes with nylon bristles, a thin layer of surface soil was also removed along with the mulch and deposited in the adjacent furrows. In the remaining two plots, the residue was not removed. Based on six replications, the average yield for plantcane was 26.2 tons/acre and sugar yield of 5100 lb/acre.

The first stubble was harvested on October 20, 2005. This harvest was followed by sweeping two plots on January 26, 2006 and burning of another two plots according to our treatments. The yields from the first stubble were 30.5, 35.5, and 30.5 tons/acre, for the burn, no-till, and sweep treatments, respectively. The respective sugar yield for the three treatments were 5570, 5520, 5076 lb per acre. We found no statistical differences obtained for the sugar yield among all the treatments from first stubble (see Table 1). Moreover, these yields were higher than that for plantcane possibly due to late planting of the sugarcane in 2003.

Sugar yields for the second and third stubble years are given in Tables 2 and 3, respectively. These results indicated that for the burn treatment highest yields were consistently

obtained when compared to the sweep and no-till treatments. Although these results are consistent with earlier findings for HoCP91-555 grown on Commerce soil, the results were not significant at the 0.05 level.

Mulch Decay

Sampling of residue was terminated several months following harvest and when it was decided that due to low residue amounts and surface non-uniformity, accurate residue measure was not feasible. The collected residue was dried at 55°C for 24 hours and weighed. Results of the amount of mulch remaining on the soil surface versus age of mulch following harvest are given in Figure 1. For the plantcane, the residue decreased from 1.515 tons/acre at harvest to 0.668, 88 days after harvest. For the first stubble, the amount of residue was consistently lower than that for the plantcane. Specifically, the amount of mulch decreased from 1.387 to 1.262 tons/acre over a four month period. Similar results were obtained for the second and third stubble years as indicated in Figure 1. Moreover, these results are consistently lower than earlier results for HoCP91-555 grown on Commerce loam soil. To illustrate these differences, we present the mulch data from the Commerce loam soil in Figure 2. Similar to that for Sharkey soil, here we also include residue results following cane harvest for plantcane, first, second and third stubble years. Such differences may be attributed not only to the soil type but variation among growing seasons as well as combine setting during harvest.

Table 1. Sugarcane yields (HoCP91-555) for first stubble on Sharkey soil. Harvest was on October 20, 2005, and sweep and burn on January 24, 2006. Planted on October 21, 2003, and plantcane harvested October 26, 2004. Average yield for plantcane was 26.2 tons/acre and sugar yield of 5100 lb/acre.

TREATMENT	Rep. Number	Number of Stalks (1000/ acre)	Cane Yield tons/acre	Sugar Yield lbs/ acre
Burn	1	31.8	27.5	5860
	2	29.2	24.2	5280
Average		30.5	25.9	5570
No – Till	1	30.3	24.7	5138
	2	40.6	30.9	5902
Average		35.5	27.8	5520
Sweep	1	30.5	26.1	4941
	2	30.3	26.8	5210
Average		30.4	26.5	5076
LSD 0.05		NS	NS	NS

Table 2. Sugarcane yields (HoCP91-555) for second stubble on Sharkey clay soil. Harvest was carried out on November 2, 2006, and sweep and burn on January 5, 2006.

TREATMENT	Rep. Number	Number of Stalks (1000/ acre)	Cane Yield (tons/acre)	Sugar Yield (lbs/ acre)
Burn	1	27.8	27.0	6075
	2	34.7	26.2	5628
Average		31.3	26.6	5852
No – Till	1	28.5	26.2	5850
	2	26.3	20.1	4523
Average		27.4	23.2	5187
Sweep	1	33.1	27.8	6113
	2	30.7	24.6	5577
Average		31.9	26.2	5845
LSD 0.05		NS	NS	NS

Table 3. Sugarcane yields (HoCP91-555) for third stubble on Sharkey clay soil. Harvest was on October 16, 2007, and sweep and burn on November 22, 2006.

TREATMENT	Rep. Number	Number of Stalks (1000/ acre)	Cane Yield (tons/acre)	Sugar Yield (lbs/ acre)
Burn	1	36.4	27.6	4761
	2	35.8	25.2	4493
Average		36.1	26.4	4627
No – Till	1	35.7	28.1	4521
	2	33.9	24.0	4169
Average		34.8	26.1	4345
Sweep	1	31.0	22.7	3255
	2	31.9	24.6	3813
Average		31.5	23.7	3534
LSD 0.05		NS	NS	NS

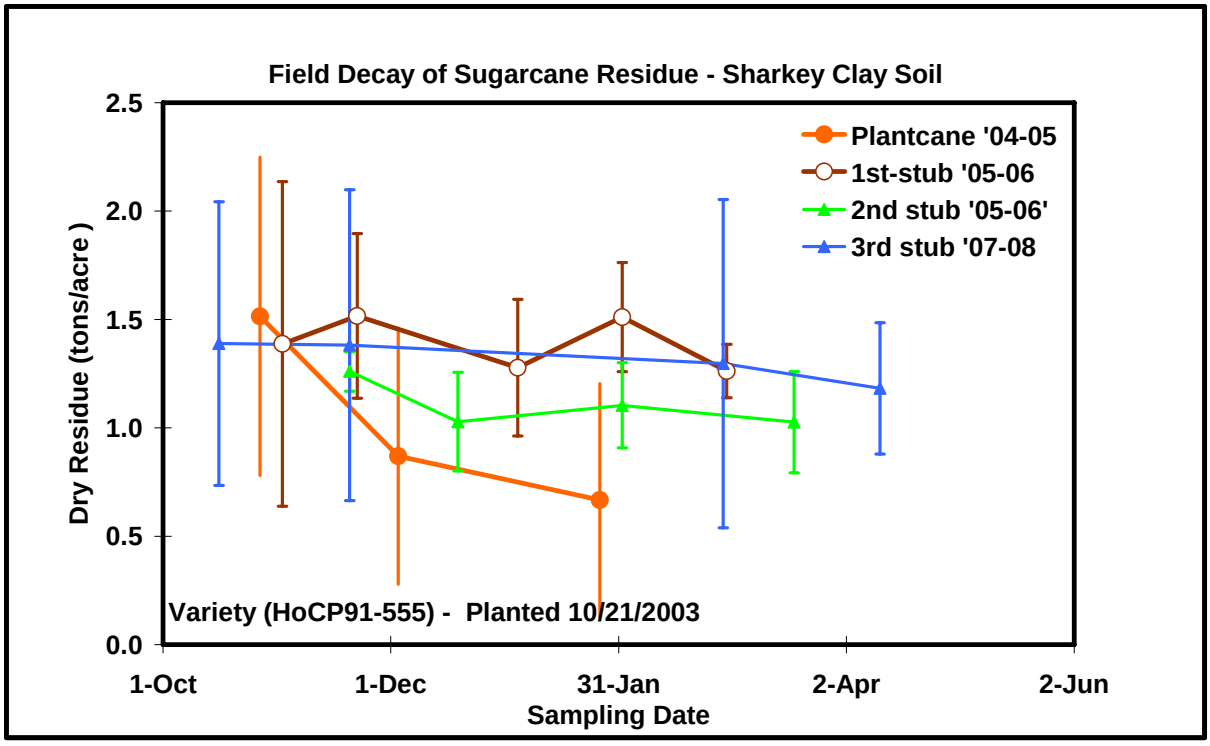

Figure 1. Field decay of sugarcane residue following harvest of HoCP91-555 grown on Sharkey clay soil for plantcane, first, second and third stubbles (2004-2008).

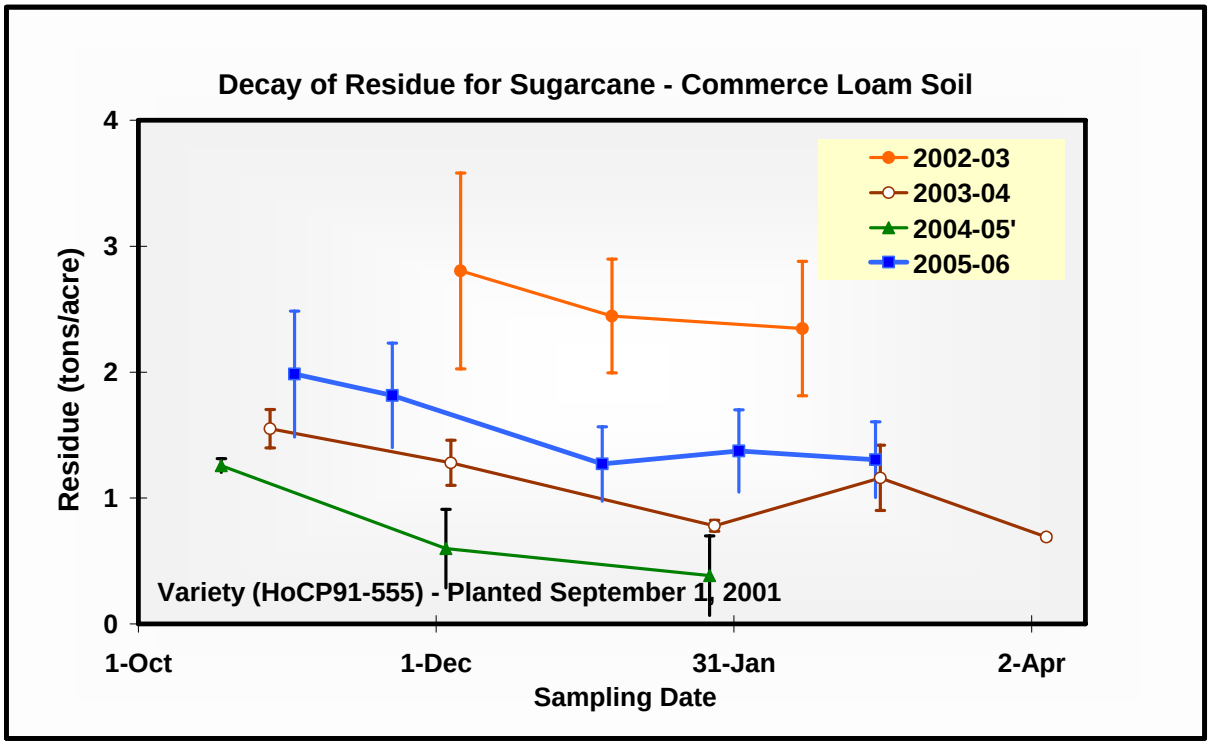

Figure 2. Field decay of sugarcane residue following harvest of HoCP91-555 grown on Commerce loam soil for plantcane, first, second and third stubbles (2002-2006).