

Delivery and Processing Quality of Trash by Different Sugarcane Varieties

G. Eggleston¹, M. Grisham², T. Tew, A. Antoine¹ and R. Triche³

¹USDA-ARS, Southern Regional Research Center, New Orleans, LA 70124, USA

²USDA-ARS, Southern Regional Research Center, Sugarcane Research Laboratory, Houma, LA 70360, USA

³SPRI, New Orleans, LA 70124, USA

Currently, there is a shift world-wide from the harvesting of burnt to unburnt (green) sugarcane. With increased pressure from public and environmental agencies to further restrict or curtail burning in the U.S. and many other countries, even more unburnt sugarcane with extra impurities (trash, i.e., leaves and tops) are expected to be delivered to factories, putting added burdens on processors to deal with and/or remove them during processing. The effect of changing to “green” harvesting on processing has not been properly or fully characterized and, therefore, very few solutions to minimize the detrimental processing effects of trash have been developed or implemented. Sugarcane plants from the first ratoon crop of five commercial sugarcane varieties (LCP 85-384, HoCP 96-540, L 97-128, L 99-226, and L 99-233), with varying yield and harvest (including lodging and leaf sheath adherence) characteristics, were harvested at the USDA Ardoyne Farm in Shriever, LA on Nov 17, 2006. Four sample tissues from four replicates were collected: brown, dry leaves (BL), green leaves (GL), growing point region (GPR), and stalk (S). Juice was extracted from each tissue type. There were significant differences ($P < .05$) among the varieties for average stalk weight (range = 1.46-2.48 lb) but only L 99-233 had significantly less stalk TRS. Total trash (GPR + GL + BL) varied with variety from 16.4 to 19.8% and, generally, reflected leaf sheath adherence ability. A significant correlation ($R^2 = 0.63$, $P < .05$) only existed between starch and total polysaccharides in the GL tissue, indicating other polysaccharides than starch are predominant in S, GPR, and BL. Unlike for the other tissue, there were no significant differences among the five varieties for ash in BL. Clarification and other processing properties of the different tissues are also discussed.

Impact of Subfreezing Temperatures on the 2006 Louisiana Sugarcane Harvest

B. Legendre¹, T. Tew², H. Birkett³, G. Eggleston⁴, C. Finger², and J. Stein³

¹Louisiana State University Agricultural Center Sugar Research Station/Audubon Sugar Institute, St. Gabriel, Louisiana 70776, USA

²USDA-ARS, Southern Regional Research Center Sugarcane Research Laboratory, Houma, Louisiana 70360, USA

³Louisiana State University Agricultural Center, Audubon Sugar Institute, St. Gabriel, Louisiana 70776, USA

⁴USDA-ARS, Southern Regional Research Center, New Orleans, Louisiana 70124, USA

The exposure of sugarcane to damaging frosts occurs in over 20 of the 79 sugarcane producing countries, but is most frequent on the mainland of the United States. The frequent winter freezes in the sugarcane area of Louisiana forced the industry to adapt to a short growing season (7-9 months) and a short milling season (about 3 months). The Louisiana sugarcane industry experienced an unprecedented series of subfreezing temperatures during the first week

of December 2006. Absolute low temperatures across the sugarcane producing parishes during this period ranged from 20°F (-6.6°C) at the Dean Lee Research Station at Alexandria to 29°F (-1.7°C) at Houma (north to south) and from 24°F (-4.4°C) at Lake Charles to 27°F (-2.8°C) at Thibodaux (west to east). There was approximately 30-40% of the crop still to be processed at the time of the freeze events. Previous research had shown that the nature and extent of damage to sugarcane by subfreezing temperatures depends upon the intensity and duration of the freeze events. Temperatures between 32°F (0°C) and 28°F (-2.2°C) do little more than affect the terminal bud and tender leaves. Temperatures between 27°F (-2.8°C) and 26°F (-3.3°C) kill the growing point and the top third of the stalk. There is generally only a narrow band of green remaining in the leaves. A temperature between 25°F (-3.9°C) and 23°F (-5.0°C) kill most stalk tissue, lateral buds and leaves while temperatures below 22°F (-5.6°C) kill all stalk tissue and generally cause the stalk rind to split. Following freeze injury, dead tissue becomes vulnerable to the invasion of microbes, i.e. *Leuconsostoc* spp., *Fusarium* spp., etc., which often lead to deterioration of the juice and a reduction in the yield of recoverable sugar per ton of cane. The entry of these microbes is facilitated by dead lateral buds and by freeze cracks.

The impact of the subfreezing temperatures on commercial (LCP 85-384, HoCP 91-555, Ho 95-988, HoCP 96-540, L 97-128, L 99-226 and L 99-233) and candidate (HoCP 00-950 (officially released for commercial planting in Louisiana on April 26, 2007), TucCP 77-42 and CP 89-2143) varieties was measured at the USDA-ARS, SRRC Sugarcane Research Laboratory Ardoyne Farm, Houma, Louisiana. The concentration of total polysaccharides, notably dextran, of the juice is one of the more sensitive criteria in determining the resistance of varieties to deterioration following freezing temperatures. It appeared that there were significant differences in total polysaccharides with the candidate variety CP 89-2143 having the lowest concentration (4,264 ppm on Brix) and TucCP 77-42, the highest (7,085 ppm on Brix) at 6 weeks after the initial freeze event, December 5. However, there were no differences in dextran concentration among all varieties on the initial sampling date, December 11, 2006 and the last sampling date, January 19, 2007. When all data were analyzed, to include Brix and purity of juice, the yield of theoretical recoverable sugar per ton of cane, juice pH and titratable acidity, polysaccharide, dextran and mannitol, three varieties, L 99-226, HoCP 00-950 and TucCP 77-42, appeared inferior in cold tolerance, when compared to the standard, LCP 85-384. Both L 99-226 and HoCP 00-950 have high yields of theoretical recoverable sugar per ton of cane and per acre. Although it appeared that the subfreezing temperatures at the Houma site had minimal impact on yield of recoverable sugar per ton of cane for most commercial varieties, one must note that much of the state experienced temperatures considerably lower that undoubtedly caused considerably more deterioration and, consequently, a greater loss of recoverable sugar than found at Houma.

Most of the remaining cane in the field at the time of the freeze events was harvested, albeit, with a lower yield of recoverable sugar per ton of cane. Prior to the freeze, the average yield of recoverable sugar per ton of cane for the State for the week ending December 2, 2006 was at 212.5 lb/ton (106 kg/ton). However, for the week ending December 30, the average yield for the State was 168.5 lb/ton (84 kg/ton). Although it is postulated that the freeze events of early December had a significant impact on lowering the yield of recoverable sugar per ton of cane, another factor to consider was the considerable trash, to include field soil, in harvested cane following the freeze events, the result of wet field conditions caused by excessive rainfall.

Descaling of Mill Evaporators – Is Clarified Juice Softening a Good Option?

V. Kochergin¹, J.F. Alvarez²

¹ Louisiana State University Agricultural Center Sugar Research Station/Audubon Sugar Institute, St. Gabriel, Louisiana 70776, USA

² Sugar Cane Growers Cooperative of Florida, Belle Glade, FL, USA

Several research studies have been performed in the cane industry in the last two decades attempting to justify ion exchange removal of scaling components from the clarified juice. The method has been accepted for industrial use in the beet sugar industry, resulting in multiple operating benefits. Presence of suspended solids in the clarified juice has raised concerns about the applicability of the ion exchange softening in the cane sugar industry. Disposal of waste regenerant and presence of silica in the cane juice were also listed among the hurdles preventing broad use of the method in cane factories.

Results of the previous studies indicate that new equipment designs utilizing shallow resin beds may exercise higher tolerance to the presence of suspended solids and, thus, will be more applicable for clarified juice streams. The data from our previous studies will be discussed with the purpose to define the goals for a future research program. Juice pretreatment, equipment design, resin selection, influence of the juice compositional analysis on the process performance and scaling characteristics are going to be discussed as a part of the proposed project.

Why Aluminum?

B. Aguilar¹ and J. Amador²

¹ Rio Grande Valley Sugar Growers, Inc., Santa Rosa, TX, USA

² Texas A&M University Research and Extension Center at Weslaco, Weslaco, TX, USA

The weight of aluminum is 1/3 that of steel. Obviously, things made from aluminum, such as trailers, weigh considerably less than those made from iron and/or steel. The Rio Grande Valley Sugar Growers, Inc., a Texas sugar cooperative established in 1972, will produce this year approximately 180,000 tons of 96 pol sugar from 1.7 million gross tons of cane harvested from 41,500 acres. Currently in its 34th season, the cooperative had used from the beginning a cane transport system consisting of a flat trailer on which were placed two heavy iron boxes, each box carrying approximately 10 tons of cane. The tare weight of the truck, trailer and boxes was 40,040 lbs. This system turned out to be quite expensive to operate, given the increased cost of fuel, tires, and other supplies. Last year, the decision was made to replace the iron boxes and flat trailers with thirty four 48-foot aluminum trailers, each having a total tare weight, including the truck-tractor, of only 25,900 lbs. Each trailer, using four super single tires, now carries 29 gross tons of cane per load. Thus, almost 50% more cane is brought to the mill in each trip while still abiding by highway weight standards. This has resulted in significant savings for the cooperative, since the average number of trips per day was reduced by 30% with its concomitant saving of fuel and wear and tear of the equipment. With fewer trips being made annually, fewer personnel was needed to operate the system, resulting in additional savings in labor costs. In spite of the cost of the new trailers and the substantial changes that had to be made to the cane yard in order to receive the new trailers and rear-end dump the cane, it is projected that the new

system will pay for itself in 4.5 years and result in annual savings in the neighborhood of \$1 million in years to come. In this presentation, besides showing the new equipment in the field and at the cane yard, we will show how the system operates, at times unloading 30 tons of cane in 4 ½ minutes.

Fuels from the Thermochemical Conversion of Sugarcane Bagasse

J.White and B. Stradi

Louisiana State University Agricultural Center Sugar Research Station/Audubon Sugar Institute,
St. Gabriel, Louisiana 70776, USA

Rising energy demand and volatility in world oil prices have created an environment that is conducive to the development of alternative fuel sources. Thermochemical conversion of biomass feedstocks provides a cheap, efficient route for the production of biofuels. Under a grant from the Department of Energy, the Audubon Sugar Institute has been investigating the use of sugarcane bagasse as a thermochemical conversion feedstock candidate. A design of experiments has been performed that evaluates the impact of key process parameters over a broad range of temperatures and pressures that correspond with the primary thermochemical processes of pyrolysis, liquefaction, and gasification. A comprehensive evaluation of thermochemical conversion process conditions over such a P-T span has never before been undertaken. The product yield and distribution along with the apparent rate kinetics are the primary process indicators. Another objective of this research project has been the characterization of thermochemical conversion products, including phenols, aldehydes, furans, and permanent gases. Finally, the effects of supercritical water conversion on sugarcane bagasse and cane trash are being explored.

Ethanol Production from Lignocellulosics

G. DeQueiroz and B. Stradi

Louisiana State University Agricultural Center Sugar Research Station/Audubon Sugar Institute,
St. Gabriel, Louisiana 70776, USA

Much has been said about the need for the production of ethanol and other biofuels from lignocellulosic sources. Although many ideas are available, the actual technological maturity to bring those ideas out of the laboratory and into the production plant is still in development. A current effort is the production of ethanol from sugarcane bagasse using a dilute ammonia treatment. Sugarcane is a good test subject because it is resistant to chemical and enzymatic treatments. The results demonstrate that the concerting of pretreatment and biological needs is essential for a successful use of lignocellulosics for ethanol production. The current levels of ethanol production achieved thus far range from 4-7 % (v/v) for tests at the 20-liter volume level. At higher solid loadings and sensible management of inhibitors, this process promises to become a serious contender for the state-of-the-art technology to manufacture ethanol from lignocellulosics.

Louisiana Milling Results (2005 & 2006)

H. Birkett and J. Stein

Louisiana State University Agricultural Center Sugar Research Station/Audubon Sugar Institute,
St. Gabriel, Louisiana 70776, USA

Mill extraction tests (which include 12 tandems and 2 diffusers) were conducted at all of the Louisiana raw sugar factories during 2005 and 2006. Prepared cane and bagasse samples leaving each mill in the tandem were collected and analyzed for pol, moisture and fiber content. Ash content was also determined on prepared cane and last mill bagasse samples. Preparation index (pol percentage open cells) was measured on the prepared cane samples using the ASI method. Results show wide variations in all of the milling parameters. Most of the factories have one or more mills that perform poorly, indicated by increasing moisture and/or low individual mill extraction.

Optimization of α -Amylase Application in U.S. Factories

G. Eggleston¹, B. Montes², A. Monge³, D. Guidry⁴ and A. Antoine¹

¹USDA-ARS, Southern Regional Research Center, New Orleans, LA 70124, USA

²Alma Plantation LLC, Lakeland, LA 70752, USA

³Cora Texas factory, White Castle, LA 70788, USA

⁴Leighton factory, Thibodaux, LA 70302, USA

In recent years there have been warnings by some U.S. refineries that there may be a penalty for high starch concentrations in raw sugar if starch control is not improved. Most commercial α -amylases used by the U.S. sugar industry to control starch have intermediate temperature stability (up to 85 °C with an optimum ~70 °C) and are produced from *Bacillus subtilis*. Commercial α -amylases from *Bacillus licheniformis* and *stearothermophilus* are also available with high temperature stability (up to 115 °C), but can cause unwanted carry-over activity into raw and refined sugars, molasses, and food products. Full characterization of commercial α -amylases are reported. α -Amylase is typically applied to the last evaporator of U.S. factories. However, encouraging results were obtained when a working solution (diluted 3-fold in water at the factory) of a “concentrated” α -amylase (*B. subtilis*) was applied to the second-to-last evaporator at a Louisiana factory in the 2006 season. Greater starch hydrolysis was obtained than adding it to the last evaporator alone, particularly at a 5 ppm dosage. A second factory trial across the 2007 processing season is planned to confirm the results, and standardize α -amylase dosage at different times in the season.