An Assessment of After Harvest Sucrose Losses from Sugarcane Field to Factory

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ABSTRACT

Sucrose losses between harvesting and milling begin soon after cutting, increasing with the time the cane remains in the field or in the mill yards. The deterioration rate depends upon the environmental conditions, the cane variety and the management of the harvesting system. In addition, it has been established that leaves and trash also contribute to increase sucrose losses. Sucrose losses in chopped and whole-stalk cane were studied, using burned and nonburned cane of the commercial var. MZC 74-275. The sucrose lost in burned and nonburned whole stalks of all varieties while in the field ranged from 0.01-0.023% units of sucrose % cane per hour. Statistical analyses showed that for 1% of trash in clean cane, there is an average sucrose loss of 2.0 kg/t of cane. Results of research conducted in Colombia indicated that mechanical harvesting of nonburned cane increased the trash in cane delivered to the factory, resulting in lower sugar yields. A commercial study of sugar losses from field to the sugar factory showed under Columbian condition, that 1.2 units of sucrose lost were observed for an average delay time of 40 hours after burning—cutting and milling, this loss tend to increase if more trash or extraneous matter were incorporated with the harvesting of cane. The establishment of reliable methodologies based on HPLC, NIR and microbiology analysis for estimating sugar losses and trash in commercial cane provided useful information for investment decisions to increase overall sugar yield in some sugar mills.

Keywords: Sugar losses, burning, trash, sugar yield

INTRODUCTION

The Colombian sugar industry is investigating in evaluating the effect of sucrose losses attributed to burning practices and the time the cane is left in the field or mill yards prior to milling. Significant differences occur in the losses of sugar when different harvesting systems are used simultaneously by different producers or sugar mills. An immediate effect of the cane harvest, especially in mechanical harvesting, is the incorporation of a large amount of trash and greater exposure to microbial attack by bacteria such as Leuconostoc, which reduce factory yield as has been reported by different authors in Australia, the USA (Louisiana), South Africa (Egan and Rehbein, 1963; Irvine and Legendre, 1973; Wood, 1973) and India (Solomon et al., 1997, 2004, 2006). Similarly, recent studies in Columbia (Larrañondo et al., 1999; Osorio et al., 1997), using periodic samples of juices and high performance liquid chromatography (HPLC) analyses made it possible to establish levels of sucrose losses (sucrose % cane), ranging from 2.0-6.0% at 48 h after burning and cutting whole cane (manual harvesting). In India, the loss in CCS were reported to be 0.35, 1.0 and 1.32 unit per day for early, mid and late-milling seasons, respectively (Solomon et al., 2006).

It is also generally accepted that the levels of extraneous matter can be attributed to the harvesting system, the loading of the cut cane and the variety. With regard to the impact of extraneous matter on the sugar production, trials carried out with the sugarcane variety showed increases in 0.80 units in the fiber % cane, 0.02 units in the non-sucroses joint to an average sucrose decrease in 0.20 units for each 1% of dirt incorporated in the clean cane (Larrañondo, 1999, 2001).

CENICANĂ then conducted a study to establish a series of mathematical equations based on sucrose losses for different varieties and levels of trash in order to provide guidelines that would reduce the sucrose losses in the period between cutting and milling.
MATERIALS AND METHODS

Sucrose losses after burning and cutting of cane left piled in the field

Given that the variability in the weight, length and sucrose content of the stalks, samples had been an obstacle for the precise determination of sucrose losses after harvest, a strategy of “nondestructive” sampling of the stalks was designed, based on taking small amounts of juice periodically, extracted using a sharp pointed instrument, from three different parts of stalks previously marked before the harvest and piled for 120 h after the burning–cutting under commercial conditions in the field. The samples of juices extracted from five stalks (approx. 6 ml) were analyzed via HPLC, using a minimum of three replications during the trial period. The samplings and evaluations of sucrose were done before and after the burning and every 24 h thereafter, based on the time of the cut. Similarly, the stalk samples were weighed to observe the weight losses. In these first trials (four) of piling the cane in the field, uniform lots (22.7 ha) of commercial cane were selected of var. MZC 74-275 with ages ranging from 12-13 months.

Other stalk samples (20/day) of var. MZC 74-275 were analyzed every 24 h after harvesting by direct analysis of cane (DAC) in order to determine the variations in nonsucrose % cane, purity and fiber % cane.

The rate of deterioration and determination of sucrose lost per hour in the field for unburned whole stalks of different varieties were also evaluated in var. V 71-51, CC 85-92, CC 87-434, CC 84-75, CC 91-1999, CC 85-68 and PR 61-632. The sampling and evaluations were done using the same method described above for var. MZC 74-275.

Effects of the trash and commercial determination of sucrose losses in different varieties and cutting systems

Based on the commercial information of several varieties (MZC 74-275, CC 85-92, PR 61-632 and V 71-51) supplied by different mills, a multiple linear correlation analysis of the pol % cane or recoverable sugar was estimated in function of the trash level and time until processing in order to establish a mathematical equation that would estimate the impact of these two factors on sucrose losses under various harvesting conditions. Similarly, a commercial-scale trial was conducted using var. CC 85-92 (age 13.2 months) to compare the harvesting systems: mechanical cutting/burning, mechanically harvested/green cane, manually harvested/clean green cane, manually harvested/semiclean green cane, manually harvested/burned. For this purpose, about 200 t of cane for each harvesting system were delivered to the factory; and during the milling, samples of prepared cane were taken and analyzed in the lab to determine the levels of sucrose and estimated recoverable sugar (ERS % cane). During the trial, the values of trash and time until processing were recorded for each harvesting system as well as the weight losses of stalk samples.

Sucrose losses attributable to time after harvest in a commercial trial conducted under Colombian conditions

Changes in the post-harvest sucrose concentration of variety CC 85-92 (plant crop) were evaluated over a 40-hour period in 15 plots. The variety was manually harvested (whole stalks) at 12 and 13 months, with burning. Precipitation during harvesting was moderate, averaging 11.6 mm. The amount of extraneous matter incorporated to the cane during harvesting was recorded. Samples of commercial cane (stalks) were taken before harvesting, after burning, when weighed on the scale, and during milling. Samples of shredded cane and juice were also taken and analyzed in the lab by DAC and HPLC to determine the percentages of sucrose, purity, fiber, reducing sugars, organic acids, dextrans, ethanol, levels of mesoaerobics, lactic bacteria, and yeast.

RESULTS AND DISCUSSION

Sucrose losses after burning and cutting

The methodology of nondestructive sampling of stalks for monitoring and diagnosing sucrose losses in burned cane, cut and stored in the field, made it possible to establish a range of 0.2-6.4% sucrose (sucrose % cane) lost in the first 48 h after cutting, and 3.5-9.0% in 72 h, equivalent to an average reduction in sucrose % cane of 0.5 and 1.0 unit, respectively (Fig. 1). In addition, the average percentages of sucrose losses,