

## SUGARCANE RESPONSE TO 21-DAY FLOODS APPLIED PRIOR TO HARVEST

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### ABSTRACT

Some Florida sugarcane (*Saccharum* spp.) growers apply short-duration (less than 1 day) floods prior to harvest to prevent fires that occur sporadically on their organic soils after preharvest burns. Extending these floods in duration may reduce yields but could provide freeze protection and water-management options with beneficial environmental impacts. The purpose of this study was to compare the effects of continuous drainage with 21-day floods, initiated 46 days prior to harvest, on sucrose content, stalk number, and stalk weight of two sugarcane cultivars. During the plant-cane and first-ratoon crops, pots of cultivars CP 72-2086 and CP 80-1827 at Canal Point, FL, were continuously drained or treated with 21-day floods in monthly intervals from September through February. Yields of theoretical recoverable sucrose (TRS), measured as kg sucrose Mg<sup>-1</sup> cane, increased for CP 80-1827 after September and October floods of the plant-cane crop but decreased after the January flood. Floods in October reduced TRS in the plant-cane crop for CP 72-2086. Flooding did not affect the TRS of either cultivar in the first-ratoon crop. Flooding reduced overall (mean of plant-cane and first-ratoon crops) stalk number by 0.7 stalks pot<sup>-1</sup>. However, the largest reductions in stalk number occurred in the first-ratoon crop with the November through January floods. Stalk weight was not affected by flooding. Further research is needed to identify flood durations that would not reduce yields, to conduct cost-benefit analyses that include agronomic and environmental benefits of pre-harvest flooding, and to validate these pot results in commercial fields.

### INTRODUCTION

Growers in Florida burn sugarcane prior to harvest to reduce leaf and other non-stalk material sent to mills. In the Everglades Agricultural Area (EAA) of Florida, the upper 21 cm of soil profiles range from 33 to more than 85 % organic matter (Zelazny and Carlisle, 1974). Preharvest sugarcane burns cause fires to ignite sporadically on these highly organic soils. When this occurs, growers have the added harvesting cost of sending equipment through fields to extinguish fires. Some growers apply a short-duration (less than 1 day) flood 20-30 days prior to harvest to reduce the risk of these soil fires. Draining for 20-30 days provides sufficient time so that fields are not too wet to support harvesting equipment, while still leaving sufficient soil moisture to reduce the soil-fire risk. Some growers also consider that these floods may improve sugarcane emergence in successively planted fields when applied to a final-ratoon crop in dry years.

Extending these pre-harvest floods for longer durations may provide additional agronomic and environmental benefits. Freezes in Florida can cause substantial losses to the Florida sugarcane crop, including complete loss of some fields (Tai and Miller, 1986; and Tai, 1993). Additional water storage on farm would increase the flexibility of farm managers to apply timely

floods as freeze protection of recently sprouted sugarcane plantings, recently harvested regrowth, and mature sugarcane ready for harvest.

Generally, during the Florida harvest season of October through April, it rains infrequently, and after heavy rains, farmers have the equipment and infrastructure to pump excess water to public canals. However, after widespread heavy rains, harvests may be delayed because voluntary and regulated pumping restrictions used as best management practices to reduce on-farm P export (Rice et al., 2002) often leave some fields flooded for several days. Having designated fields already flooded would enable growers to drain fields scheduled for harvest by pumping excess water to fields that are already flooded. This would not result in excess P discharge to public canals because water movement would be restricted to farm canals and ditches.

The extra on-farm water storage may also partially alleviate public south Florida water-storage issues. During the winters, Lake Okeechobee is usually maintained at higher than ecologically desired water levels in order for it to store water for urban and agricultural uses. At times it is necessary to drain high water levels from Lake Okeechobee, resulting in discharges to the east and west with adverse ecological consequences. Plans are underway to use public funds to provide additional water storage options that would resolve these problems. Another option would be to compare costs/benefits of using public funds to pay EAA farmers for water storage with costs/benefits of using public funds to buy additional land and build and maintain new water-storage facilities.

The purpose of this study was to compare the effects of continuous drainage with 21-day floods, initiated 46 days prior to harvest, on the sucrose content, stalk number, and stalk weight of two sugarcane cultivars. It was hoped that results would help develop agronomic information that could later be used in cost-benefit analyses aimed at quantifying the profitability of these on-farm winter floods for Florida sugarcane growers and public water managers.

## **MATERIALS AND METHODS**

Seventy-two 38-L pots (top diameter = 37 cm, bottom diameter = 32 cm, and height = 38 cm) were filled with equal volumes of organic soil, wash-construction sand, and pine bark mulch at Canal Point, FL. The organic soil was typical of the EAA (Euic, hyperthermic Lithic Haplosaprist). The sand and mulch were added to the pots because previous experience at Canal Point has shown that pots filled only with organic soils of the EAA do not drain well when used with this drip irrigation system.

Thirty-six sprouted plants from single-bud cuttings of cultivar CP 72-2086 (Miller et al., 1984) and 36 sprouted plants of cultivar CP 80-1827 (Glaz et al., 1990) were transplanted into pots on 17 April, 2001. Each of the 72 pots was placed down a row of constructed bars to which the growing plants were later tied for support. A drip irrigation system provided water to each pot for 5 minutes, three times daily. This water regimen is necessary to avoid water deficits of sugarcane growing through the summer and autumn months in 38-L pots at Canal Point.

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CP 72-2086 and CP 80-1827 were selected for this experiment for several reasons. They both comprised a substantial portion of Florida's commercial production for several years (Glaz, 2002). In a previous field experiment, both cultivars had similarly high values of TRS, cane yields, and sugar production in plant-cane through second-ratoon crops exposed to moderate (38-cm depth) and high (15-cm depth) summer water tables (Glaz et al., 2002). Also, Gilbert et al. (2004) reported that CP 72-2086 and CP 80-1827 maintained similarly high values of TRS throughout the harvest season.

Based on bulk soil tests of the organic soils (Sanchez, 1990), nutrients were applied at planting, and 3 weeks later on 1 May, 2001, near the sprouted plants, at rates of 25 and 139 kg ha<sup>-1</sup> of P and K, respectively, and at rates of 0.9, 0.9, 0.9, 2.3, 0.9, and 0.9 kg ha<sup>-1</sup> of B, Cu, Fe, Mn, Mo, and Zn, respectively. On 29 May, 2001, 728, 312, and 624 kg ha<sup>-1</sup> of N, P, and K, respectively, was applied as slow release fertilizer (Scotts Osmocote<sup>1</sup>, Sierra Hort. Products, Co., Marysville, OH) to the soil surface of each pot. In the first-ratoon crop, similar slow-release fertilizer rates were applied on 4 April, 2002, and later on 20 May, 2002. These fertilizer practices are used at Canal Point to grow mature healthy plants in similarly irrigated 38-L pots. The high nutrients replenish nutrients continuously washed out by the frequent drip irrigation.

Experimental units (pots) were arranged as randomized complete blocks in a 2 x 2 x 6 factorial. In addition to the two cultivars, CP 72-2086 and CP 80-1827, the factorial included two water treatments and six monthly flood applications. The two water treatments were continuous drain and 21-day flood applied 46 days prior to harvest. Three unique pots (three replications) were assigned to each monthly water treatment. Thus, the monthly water treatments were not repeated measures, but each cultivar x water treatment x month was a unique treatment in each replication. The six monthly water treatments were applied approximately at the beginning of September, October, November, December, January, and February (Table 1). These factorial treatments were repeated over the plant-cane and first-ratoon crops. Following each flood, all treatments were sampled twice (Table 1). Sample Day 1 was the first day of drainage and was 21 days after floods were applied. Theoretical recoverable sucrose was measured, as described by Legendre (1992), from two to six stalks on Sample Day 1 to identify immediate effects of the 21-day floods on TRS. Sample Day 2 occurred 46 days after floods were applied and 25 days after drainage. The rationale for waiting until 25 days after drainage was that in commercial fields, this duration would allow sufficient soil drying so that heavy equipment could harvest the fields. On Sample Day 2, stalk weights were recorded, and TRS was estimated from all remaining mature stalks (2-12 stalks). Stalk number was the total of stalks harvested in Sample Day 1 and Sample Day 2. All mature stalks were cut as near to the soil surface as possible. Immature stalks, or suckers, were discarded. Dates of Sample Day 1 and Sample Day 2 of each monthly flood for the plant-cane and first-ratoon crops ranged from 28 September, 2001 to 14 March, 2003 (Table 1).

Factorial treatments were replicated three times arranged in a randomized complete block design. Analyses of variance were conducted using Proc Mixed of SAS (SAS, 1999). Cultivar, water treatment, month, sample day, and crop cycle were treated as fixed effects. Replication was

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<sup>1</sup> Mention of trade names or commercial products is solely for the purpose of providing specific information and does not imply recommendation or endorsement by USDA over others not mentioned.

treated as a random effect. When month or an interaction involving month was identified as significant by analysis of variance, the dependent variable was further analyzed by regressing it on month. Differences were identified as significant at  $P \leq 0.05$  and as highly significant at  $P \leq 0.01$ . Regression equations and their probabilities were calculated using procedures described by Steel and Torrie (1980).

Analyses combining the plant-cane and first-ratoon crops were conducted as randomized complete blocks with crop cycle as repeated measures, and analyses of separate crop cycles for TRS were conducted with sample days as repeated measures. Based on procedures described by Tao et al. (2002), for analyses with crops cycles as repeated measures, Toeplitz with heterogeneous variance (TOEPH), Banded Main Diagonal [UN(1)], and compound symmetry (CS) were the covariance structures selected to describe repeated measures covariance for TRS, stalk weight, and stalk number, respectively. Compound symmetry described repeated measures covariance for analyses of TRS in separate crop cycles with sample days as repeated measures. Because analyses with repeated measures identified significant interactions involving crop cycle and sample day, separate analyses for each crop cycle and sample day were conducted.

## RESULTS AND DISCUSSION

### Theoretical recoverable sucrose, Sample Day 1

On Sample Day 1, there were no significant differences in TRS between the continuously drained and flooded treatments in either the plant-cane or first-ratoon crop cycle (Tables 2 and 3). Also, there were no significant interactions involving water-management in either crop cycle (Table 2). Thus, TRS on the day of drainage was not affected by a flood of 21 days.

The TRS of CP 80-1827 was significantly higher than that of CP 72-2086 in the plant-cane crop and for the mean of the plant-cane and first-ratoon crops (Table 3). However, there were highly significant Month x Cultivar interactions for TRS in both crop cycles (Table 2). In the plant-cane crop, the TRS values of CP 72-2086 were lower than those of CP 80-1827 on the day that September and October floods were drained (Fig. 1). On drainage days from November through February, TRS values were similar for both cultivars. Similarly, on the drainage days of the October and November floods of the first-ratoon crop, the TRS values of CP 80-1827 were higher than those of CP 72-2086. Otherwise, except that CP 72-2086 unexpectedly had higher TRS after the September flood, both cultivars had similar TRS values on other drain days in the first-ratoon crop. These differences in TRS between cultivars and among months on drainage days during both crop cycles were not affected by water treatments. Gilbert et al. (2004) reported that CP 72-2086 and CP 80-1827 had similar TRS values. Results in this study agree with those of Gilbert et al. (2004) except that it was found here that CP 80-1827 had higher TRS than CP 72-2086 early in the harvest season.

### Sample Day 2

For TRS on Sample Day 2 in the plant-cane crop, the main effect of water treatment and interactions involving water treatment were not significant, except that the Month x Water x

Cultivar interaction was highly significant (Table 2). Highly significant and significant quadratic responses of TRS on month predicted the Cultivar x Water treatment combinations in the plant-cane crop (Fig. 2). These quadratic responses show that the two cultivars reacted differently to flooding in September and October. The TRS of CP 80-1827 was significantly increased by the September and October floods. In September, TRS of CP 72-2086 was not affected by flooding, but contrary to CP 80-1827, flooding in October significantly reduced the TRS of CP 72-2086. After the January flood, TRS of CP 80-1827 was significantly reduced by flooding. These differing reactions suggest that growers would need to identify separate cultivar seasonal reactions to these floods. Further research is warranted to determine if extended floods such as these can function as ripeners for some cultivars early in the harvest season, but cause reductions in TRS later in the harvest season.

In the first-ratoon crop, the only effect that significantly affected TRS was month of water treatment (Table 2). Linear or quadratic regression was not helpful in explaining TRS response on month. Mean separation identified low TRS values for both cultivars in November as the cause of the highly significant TRS response to month (Table 4).

The flood and drain treatments affected the TRS of each of the two cultivars differently in the plant-cane crop when early harvest-season flooding served as a ripener for CP 80-1827 and reduced TRS of CP 72-2086. Flooding in January of the plant-cane crop reduced the TRS of CP 80-1827. The flood and drain treatments did not affect TRS of either cultivar throughout the first-ratoon harvest season.

The varied TRS responses reflect the complex factors that affect TRS increases in sugarcane (often referred to as ripening). Factors that improve ripening are reduced moisture availability (Clements, 1962), reduced rates of nitrogen nutrition (Alexander, 1973), and reduced temperatures (Yates, 1996). In addition, it is widely recognized that different cultivars are genetically predisposed to certain TRS limits during different portions of the harvest season.

At first it may appear that if reduced moisture availability enhances ripening, then it would be expected that preharvest flooding would decrease rather than increase TRS. However, reduced moisture often does not truly ripen sugarcane; rather, it dehydrates sugarcane resulting in what appear to be higher TRS values (Yates, 1996). Additionally, reduction of TRS attributed to excessive moisture is usually due to delaying mill delivery after burns and to increased extraneous matter in the delivered sugarcane. The TRS has not actually declined due to the increased moisture.

There are several possible explanations for the positive effects of preharvest flooding on TRS identified in this study. The positive effects of decreased temperature on ripening are thought to be primarily due to reduced growth rates that allow for translocation and storage of sugars as opposed to use of sugars for new tissue production (Yates, 1996). Flooding may similarly reduce growth rates and allow for translocation and storage of sugar. In addition, flooding may reduce temperatures, particularly in the root zone. Finally, in Florida, flooding may reduce nitrogen nutrition by slowing down microbial oxidation of the organic soils. Thus, the positive and negative effects of flooding on TRS reported here are explainable by difference in cultivar,

differences in air and soil temperature at time of flooding, and possible cultivar interactions with temperature differences. These results and theoretical considerations emphasize that effects of these 21-day floods on TRS will be variable across cultivars, month of harvest season, and crop cycles.

There were no significant differences in stalk weight between the continuously drained and flooded treatments in either the plant-cane or first-ratoon crop cycle (Tables 2 and 3). Also, there were no significant interactions for stalk weight involving water-management in either crop cycle (Table 2). Thus, stalk weight was not affected by a flood of 21 days.

In the plant-cane crop, the stalk weight of CP 80-1827 was significantly higher than that of CP 72-2086, and cultivar did not interact significantly with water treatment or month (Tables 2 and 3). In the first-ratoon crop, cultivar was not significant for stalk weight, but the Month x Cultivar interaction was significant (Table 2). In both crop cycles, the effect of month of water treatment on stalk weight was highly significant. As indicated by the non-significant F value for the Month x Cultivar interaction in the plant-cane cycle (Table 2), the shapes of the stalk-weight responses over months were similar for CP 72-2086 and CP 80-1827, with both cultivars reaching maximum stalk weights after the November floods (Fig. 3).

In the first-ratoon crop, a quadratic response for CP 72-2086 predicted maximum stalk weight after the flood applied in November (Fig. 3). However, the best fitting response for stalk weight of CP 80-1827 was a non-significant negative linear regression ( $P = 0.06$ ). Thus, the significant Month x Cultivar interaction for stalk weight in the first-ratoon crop was due to the significant quadratic response of CP 72-2086 and the lack of a significant regression response for CP 80-1827 rather than due to differences in their stalk weights. The quadratic responses in stalk weights, with maximum stalk weights following the November floods in both crop cycles, were probably related to the lower temperatures from December through February (Fig. 4) and the tendency for sugarcane stalks to lose moisture during this period.

Stalk number was significantly higher in the continuously drained than in the 21-day flood treatment in the plant-cane and first-ratoon crop cycles and for the mean of both crop cycles (Tables 2 and 3). In the plant-cane crop, water treatment did not interact significantly with other treatments on stalk number. However, in the first-ratoon crop, the Month x Water interaction was significant, although its significance was not explained by regression models. The cause of this significant interaction was that only the November, December, or January flood caused reduced stalk number if each flood was compared with the continuously drained treatment of the same month (Table 5). These responses indicate that flooding during the cooler months of the plant-cane crop resulted in reduced stalk numbers in the first-ratoon crop. These results for stalk numbers suggest that cane yields of a ratoon crop may be reduced due to residual effects of the flood applied during the cooler months of the prior crop cycle.

In both the plant-cane and first-ratoon crops, and the mean of both crop cycles, CP 72-2086 had significantly greater stalk numbers than CP 80-1827 (Tables 2 and 3). However, in the plant-cane crop, cultivar interacted significantly with month (Table 2). This significance was not explained by regression models. Rather, the cause of the significance was that CP 72-2086 had

low stalk numbers due to the September water treatments and CP 80-1827 had similar stalk numbers across months (Table 4).

A concern with pot studies is that the results may not be repeatable in commercial fields. However, the results from this study compare well with previous field research using CP 72-2086 and CP 80-1827. As mentioned earlier, the relative TRS results of Gilbert et al. (2004) and the TRS results from the present study for CP 72-2086 and CP 80-1827 are similar. The results of a field study reported by Glaz et al. (2002) collected, but did not report, stalk weights and stalk numbers of CP 72-2086 and CP 80-1827. The mean stalk weights from the plant-cane and first-ratoon crops of CP 72-2086 and CP 80-1827 from that study were 1.71 and 1.82 kg, respectively (Unpublished data). Thus, the stalk weight of CP 72-2086 in that study was 94.0 % that of CP 80-1827, and in the present study, the stalk weight of CP 72-2086 was 94.3 % that of CP 80-1827 (Table 3).

In the plant-cane crop of the study reported by Glaz et al. (2002), the stalk number of CP 72-2086 was 108 % that of CP 80-1827, and in the first-ratoon crop, the stalk number of CP 72-2086 was 91 % that of CP 80-1827 (Unpublished data). The stalk number relationships of CP 72-2086 with CP 80-1827 in the plant-cane and first-ratoon crops of the present study were 159 and 120 %, respectively. The field and pot stalk numbers do not agree as well as the stalk weights and TRS. However, they have a similar relationship, that is, the stalk number of CP 72-2086 in the plant-cane crop is relatively higher than that of CP 80-1827 compared with their relationship in the first-ratoon crop. Based on the strong similarities in the TRS and stalk-weight relationships between CP 72-2086 and CP 80-1827 from this pot study with previous field relationships, and the similar tendencies in stalk number, the results from this pot study should be useful for designing future lysimeter and field experiments to further understand the reactions of sugarcane to preharvest flooding for extended durations.

## CONCLUSIONS

Theoretical recoverable sucrose values, stalk weights, and stalk numbers of CP 72-2086 and CP 80-1827, exposed to continuous drainage or 21-day floods applied 46 days prior to harvest, were compared monthly throughout the harvest seasons of plant-cane and first-ratoon crops. Only month affected TRS in the first-ratoon crop, whereas effects varied by water treatment, month, and cultivar in the plant-cane crop. Stalk weight was not affected by floods in the plant-cane or first-ratoon crops. Stalk numbers were reduced by the preharvest floods in both crop cycles, but the most substantial reductions were in the first-ratoon crop and related to the November through January floods. These reductions in stalk number may have been due to residual effects of floods during the plant-cane crop. This suggests that these floods may be more damaging to cane yields of subsequent ratoon harvests if applied during relatively cooler periods of the prior crop cycle.

Economic benefits from these floods are: reduced need to extinguish fires on organic soils that ignite after preharvest burning, possible improved emergence of sugarcane planted successively after the final-ratoon harvest, and possible ripening of some cultivars following September through November floods. Savings from these benefits would probably be less than the economic losses from reduced ratoon crop yields resulting from these long-duration November

through January floods. Analyses are needed to determine if other potential benefits would make these preharvest floods economically worthwhile. One additional benefit is that by maintaining fields flooded throughout the harvest season, growers would have water readily available to apply to other fields to protect their crops against winter freezes. A second potential benefit would be that this water storage may alleviate some ecological concerns by moving some winter-water storage from Lake Okeechobee to the EAA. Cost-benefit analyses are necessary to determine if using public funds to pay growers for the ecological benefits of storing water in the EAA would be a cost-effective use of public funds, and if the compensation would be sufficient to encourage growers to apply these preharvest floods. Further research with reduced flood durations is warranted to quantify flood durations with positive or neutral effects on TRS and stalk number, and field research is needed to substantiate results of this pot study.

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**Table 1.** Dates that 21-day floods were initiated and drained, and first date (Sample 1) and second date (Sample 2) after flood that theoretical recoverable sucrose (TRS) was sampled in the plant-cane and first-ratoon crops of an experiment transplanted into pots on 17 April, 2001.

Crop cycle	Flood	Drain	Sample 1	Sample 2
Plant cane	07 Sept. 01	28 Sept. 01	28 Sept. 01	23 Oct. 01
Plant cane	01 Oct. 01	22 Oct. 01	22 Oct. 01	16 Nov. 01
Plant cane	02 Nov. 01	23 Nov. 01	23 Nov. 01	18 Dec. 01
Plant cane	07 Dec. 01	28 Dec. 01	28 Dec. 01	22 Jan. 02
Plant cane	02 Jan. 02	24 Jan. 02	24 Jan. 02	18 Feb. 02
Plant cane	07 Feb. 02	28 Feb. 02	28 Feb. 02	25 Mar. 02
First ratoon	09 Sept. 02	30 Sept. 02	30 Sept. 02	25 Oct. 02
First ratoon	30 Sept. 02	21 Oct. 02	21 Oct. 02	15 Nov. 02
First ratoon	28 Oct. 02	18 Nov. 02	18 Nov. 02	13 Dec. 03
First ratoon	25 Nov. 02	16 Dec. 02	16 Dec. 02	10 Jan. 02
First ratoon	23 Dec. 02	13 Jan. 03	13 Jan. 03	07 Feb. 03
First ratoon	27 Jan. 03	18 Feb. 03	18 Feb. 03	14 Mar. 03

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**Table 2.** Probabilities of F values of fixed effects for theoretical recoverable sucrose (TRS), stalk weight, and stalk number of two sugarcane cultivars exposed to two water-table treatments applied at monthly intervals, in the plant-cane and first-ratoon crops.

Fixed effect <sup>†</sup>	TRS <sup>‡</sup>		Stalk weight <sup>‡</sup>	Stalk number <sup>‡</sup>
	Sample 1	Sample 2		
<i>Plant cane crop</i>				
Water (W)	0.76	0.65	0.81	0.05
Cultivar (C)	<0.01	0.02	<0.01	<0.01
W x C	0.30	0.20	0.81	0.19
Month (M)	<0.01	<0.01	<0.01	<0.01
M x W	0.17	0.49	0.89	0.55
M x C	<0.01	0.99	0.94	0.01
M x W x C	0.82	<0.01	0.72	0.14
<i>First ratoon crop</i>				
Water (W)	0.10	0.83	0.97	<0.01
Cultivar (C)	0.13	0.73	0.10	<0.01
W x C	0.78	0.69	0.24	0.08
Month (M)	<0.01	<0.01	<0.01	0.03
M x W	0.22	0.17	0.07	0.02
M x C	<0.01	0.11	0.03	0.86
M x W x C	0.59	0.53	0.66	0.47

<sup>†</sup>Water treatments were continuous drain and 21-day flood initiated 46 days prior to harvest; cultivars were CP 72-2086 and CP 80-1827; and floods were initiated in September, October, November, December, January, and February of each crop cycle.

<sup>‡</sup>Sample Day 1 was day of drainage and Sample Day 2 was 25 days after drainage. Stalk weight was calculated using data from Sample Day 2, and stalk number was the total stalks of Sample Days 1 and 2.

**Table 3.** Least square means from the plant-cane and first-ratoon crops of water and cultivar treatments, averaged over five monthly samples, for theoretical recoverable sucrose (TRS), stalk weight, and stalk number.

Treatment	Crop	TRS		Stalk weight <sup>†</sup>	Stalk number <sup>†</sup>
		Sample 1 <sup>†</sup>	Sample 2 <sup>†</sup>		
		-----kg Mg <sup>-1</sup> -----		kg	# pot <sup>-1</sup>
Drain	Plant cane	111.3 a <sup>‡</sup>	119.4 a	2.00 a	7.4 a
Flood	Plant cane	110.8 a	120.5 a	1.98 a	6.9 b
Drain	First ratoon	127.1 a	127.0 a	1.36 a	10.6 a
Flood	First ratoon	130.6 a	127.5 a	1.36 a	9.6 b
Drain	Mean	119.2 a	123.2 a	1.68 a	9.0 a
Flood	Mean	120.7 a	124.0 a	1.67 a	8.3 b
CP 72-2086	Plant cane	105.7 b	117.2 b	1.83 b	8.5 a
CP 80-1827	Plant cane	116.4 a	122.7 a	2.14 a	5.9 b
CP 72-2086	First ratoon	127.2 a	127.7 a	1.41 a	11.1 a
CP 80-1827	First ratoon	130.5 a	126.8 a	1.31 a	9.2 b
CP 72-2086	Mean	116.5 b	122.5 a	1.62 b	9.8 a
CP 80-1827	Mean	123.4 a	124.8 a	1.73 a	7.5 b

<sup>†</sup>Sample Day 1 was day of drainage, and Sample Day 2 was 25 days after drainage. Stalk weight was calculated using data from Sample Day 2, and stalk number was the total stalks of Sample Days 1 and 2.

<sup>‡</sup>Within each group and column, least square means not followed by the same letter are significantly different according to *t* tests (P = 0.05).

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**Table 4.** Monthly theoretical recoverable sucrose (TRS) content and stalk weight in the first-ratoon crop and monthly stalk number in the plant-cane crop for continuously drained and flooded treatments of cultivars CP 72-2086 and CP 80-1827.

Month <sup>†</sup>	Cultivar	TRS <sup>‡</sup>	Stalk weight <sup>‡</sup>	Stalk number <sup>‡</sup>
		kg Mg <sup>-1</sup>	kg	# pot <sup>-1</sup>
September	CP 72-2086	122.8 cde <sup>'</sup>	1.37 abcd	6.0 b
October	CP 72-2086	124.0 bcde	1.48 ab	8.8 a
November	CP 72-2086	120.1 de	1.55 ab	8.5 a
December	CP 72-2086	132.5 abc	1.44 ab	8.8 a
January	CP 72-2086	134.3 abc	1.47 ab	9.7 a
February	CP 72-2086	135.5 ab	1.13 cde	8.8 a
September	CP 80-1827	125.5 bcde	1.41 abc	5.5 b
October	CP 80-1827	131.3 abcd	1.63 a	5.8 b
November	CP 80-1827	118.1 e	1.52 ab	5.8 b
December	CP 80-1827	138.2 a	1.31 bcd	6.0 b
January	CP 80-1827	129.2 abcde	0.91 e	6.0 b
February	CP 80-1827	118.8 e	1.07 de	6.0 b
LSD (0.05)		11.5	0.30	1.2

<sup>†</sup>Months during which 21-day floods were initiated.

<sup>‡</sup>Sample Day 1 was day of drainage and Sample Day 2 was 25 days after drainage. Stalk weight was calculated using data from Sample Day 2 and stalk number was the total stalks of Sample Days 1 and 2.

<sup>'</sup>Within columns, least square means followed by the same letter are not significantly different according to LSD (P = 0.05).

**Table 5.** Monthly theoretical recoverable sucrose (TRS), stalk weight, and stalk number of continuously drained and flooded treatments in the first-ratoon crop, averaged across cultivars CP 72-2086 and CP 80-1827.

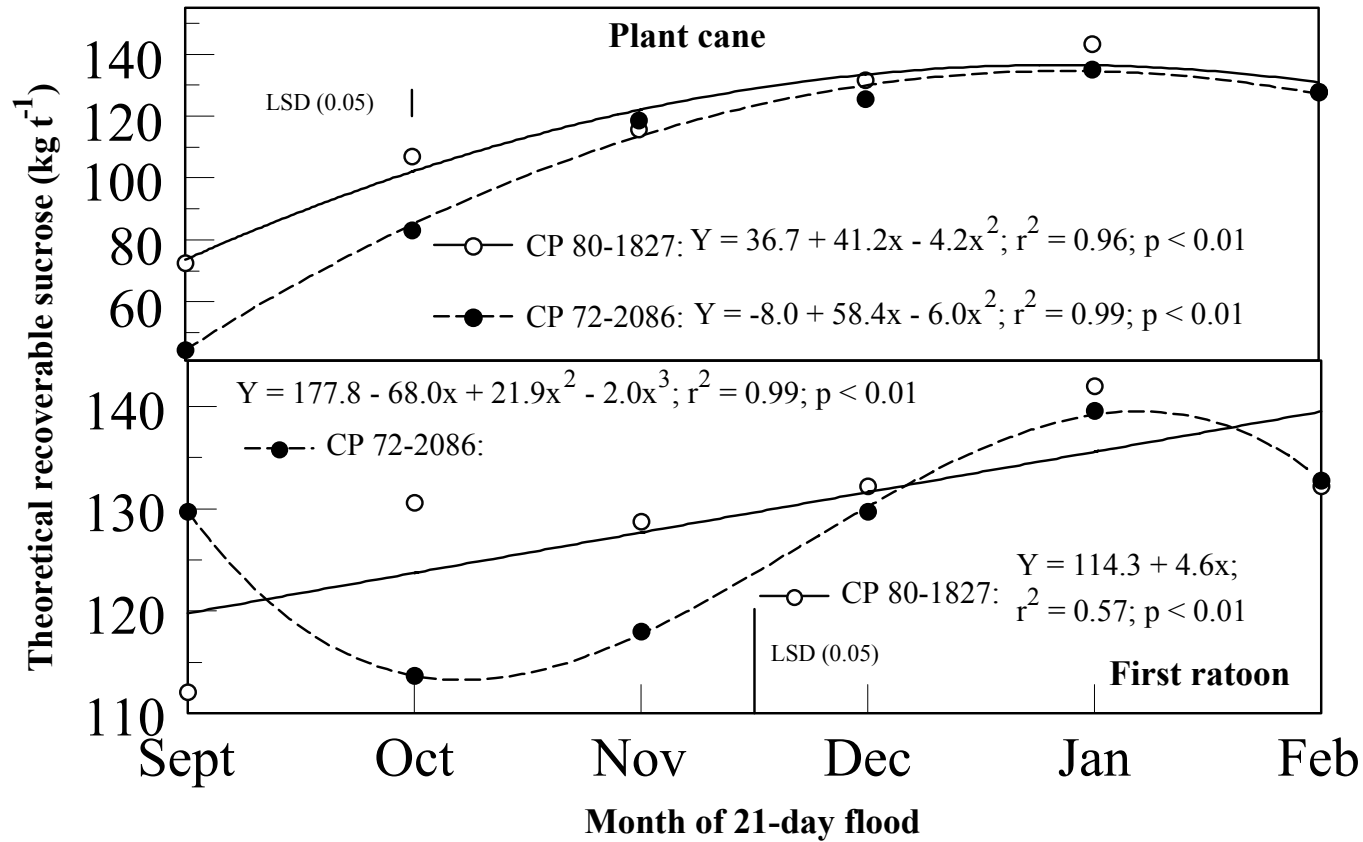
Month <sup>†</sup>	Water treatment	TRS <sup>‡</sup>	Stalk weight <sup>‡</sup>	Stalk number <sup>‡</sup>
		kg Mg <sup>-1</sup>	kg	# pot <sup>-1</sup>
September	Drain	120.6 d'	1.33 bcd	11.2 a
October	Drain	124.2 d	1.75 a	10.3 ab
November	Drain	121.3 d	1.47 abc	11.3 a
December	Drain	128.7 abcd	1.37 bcd	10.3 ab
January	Drain	135.8 abc	1.24 cd	11.1 a
February	Drain	131.5 abcd	1.15 d	9.3 bc
September	Flood	124.4 cd	1.55 ab	10.3 ab
October	Flood	125.6 bcd	1.52 abc	11.0 a
November	Flood	121.2 d	1.49 abc	9.3 bc
December	Flood	137.5 a	1.40 bcd	8.8 c
January	Flood	136.7 ab	1.26 bcd	8.7 c
February	Flood	129.0 abcd	1.29 bcd	9.5 bc
LSD (0.05)		11.5	0.30	1.4

<sup>†</sup>Months during which 21-day floods were initiated.

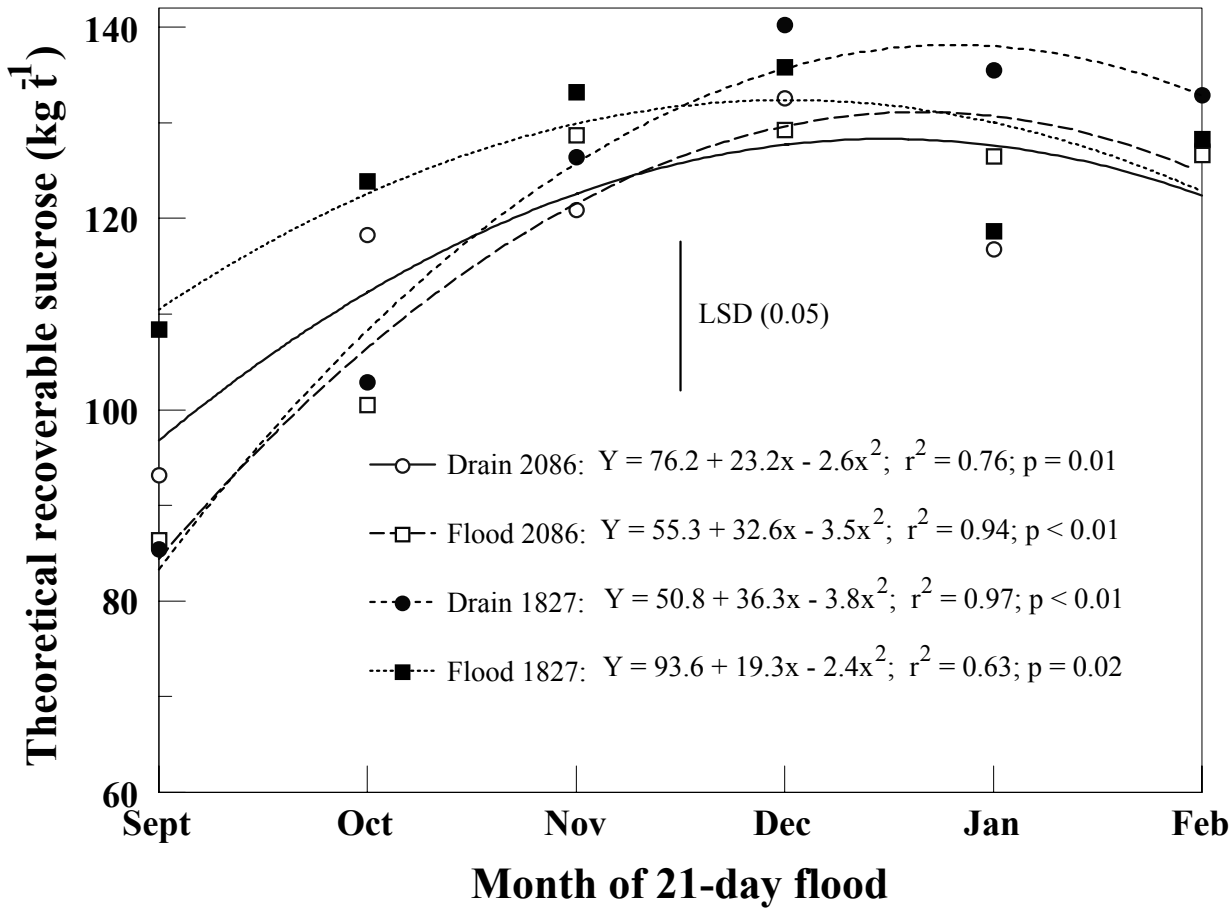
<sup>‡</sup>There were two sampling days. Sample Day 1 was on the day of drainage, and Sample Day 2 was 25 days after drainage. Stalk weight and TRS were calculated using data from Sample Day 2, and stalk number was the total stalk number of Sample Days 1 and 2.

'Within columns, least square means followed by the same letter are not significantly different according to LSD (P = 0.05).

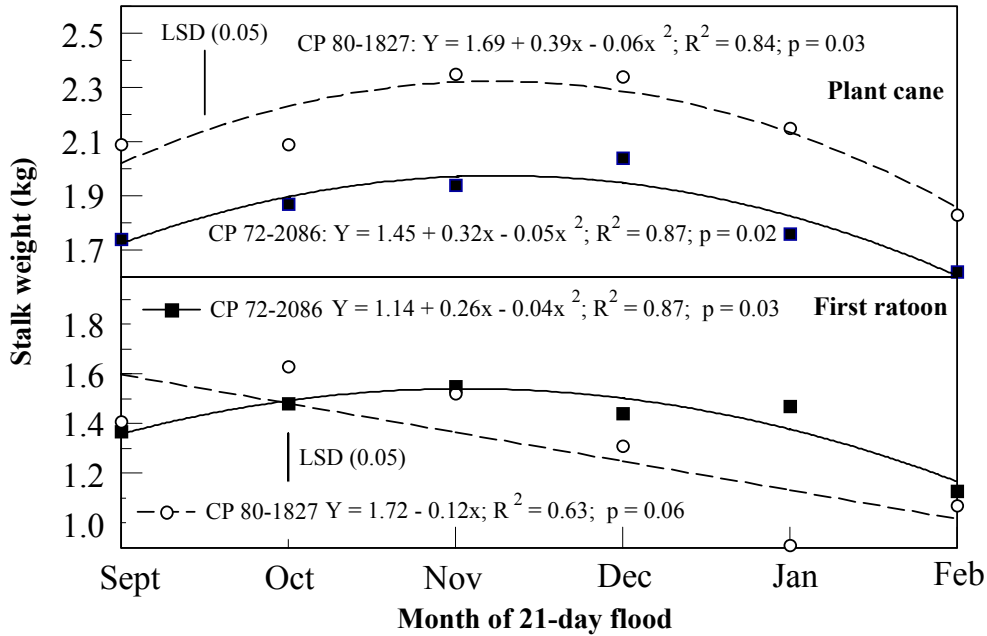
Glaz: Sugarcane Response to 21-day Floods Applied Prior to Harvest



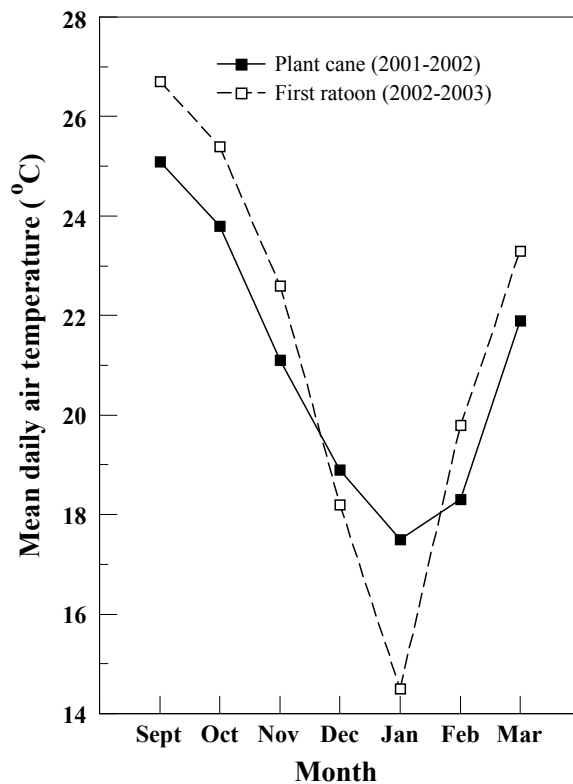
**Figure 1.** Continuously drained and flooded theoretical recoverable sucrose of cultivars CP 72-2086 and CP 80-1827 sampled on the day of drainage (Sample Day 1) of 21-day floods that were initiated monthly from September (x = 1) through February (x = 6) in the plant-cane and first-ratoon crops.



**Figure 2.** Theoretical recoverable sucrose of cultivars CP 72-2086 and CP 80-1827 sampled in the plant-cane crop 25 days after drainage (Sample Day 2) of 21-day floods initiated monthly from September (x = 1) through February (x = 6) for treatments that were (Flood) and were not (Drain) exposed to 21-day floods beginning 46 days prior to harvest.



**Figure 3.** Mean stalk weights of 21-day floods initiated 46 days prior to harvest and continuously drained water treatments. Water treatments were applied monthly from September ( $x = 1$ ) through February ( $x = 6$ ) in the plant-cane and first-ratoon crops.



**Figure 4.** Mean daily temperatures at Canal Point, FL during flooding periods of plant-cane and first-ratoon crop cycles.