THE JOURNAL OF AGRICULTURE
OF THE UNIVERSITY OF PUERTO RICO

Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, for the publication of articles by members of its personnel, or others, dealing with any of the more technical aspects of scientific agriculture in Puerto Rico or the Caribbean Area.

Vol. XLIV January 1960 No. 1

The Influence of Time of Harvest and Age of Sixteen Sugarcane Varieties on their Sucrose Content

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INTRODUCTION

It is customary in Puerto Rico to harvest sugarcane during a 6-month period extending from January to June. The sugarcane harvested falls into two age groups—1, a fall-plant cane (gran cultura) aged from 14 to 18 months; and 2, spring-plant cane (primavera) and ratoons aged 12 months. The grinding season is normally begun with the older fall-plant canes in January and February. During the major portion of the grinding season from March to June ratoon and spring-planted cane is used.

From experience both the grower and the sugarcane mill are aware of the influence of the time of the year the cane is ground on its sucrose content. The records of the sugarcane factories regularly show that the highest average sucrose for the grinding season occurs in the latter part of March and during April.

Variations are encountered from one year to the next in the sucrose content of sugarcane. The effects of weather and climate on the sucrose content of sugarcane for Puerto Rico have been investigated and discussed by Lugo-López and Capó (*2*)[2]. However, very little published information is available on the variation of the sucrose content of sugarcane throughout the year in Puerto Rico. Fernández-García (*1*) reported in 1928 on experiments carried out in Río Piedras at the Experiment Station on the influence of fertilizers on the quality of sugarcane. The work revealed little influence of the fertilizers used on cane-juice quality. However, the variation of sucrose in the monthly cane samplings from November to June revealed that the highest sucrose values occurred March 14–18, and only slightly lower values April 18–22.

Lugo-López, Samuels, and Méndez (*3*) investigated the influence of varieties on the sucrose content of sugarcane. However, they did not report

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[2] Italic numbers in parentheses refer to Literature Cited, p. 10.

the variation in sucrose content for different varieties throughout the harvest season.

The grower and the factory are both faced with a problem of trying to maintain the sucrose content of the sugarcane harvested at the highest levels possible. Knowing from experience that, in the beginning and the end of the grinding season sucrose values in general are lower, they seek to raise these values by using sugarcane varieties to grind in those months the sucrose values of which are high. The classification of such sugarcane varieties suitable for early or late harvesting is normally determined from experience.

It is the purpose of this paper to report the influence of the time of harvest and age of cane at harvest on the sucrose content of 16 sugarcane varieties, and to show differences in varietal performance attributable to these factors which can be used to rank these varieties as early-, intermediate-, or late-maturing canes.

PROCEDURE

The experiment concerned 16 sugarcane varieties planted at the same time and harvested from an age of 6 months after planting and, thereafter, every 15 days until an age of 23 months. The experiment was planted at the Solís Farm of the Agricultural Experiment Station, University of Puerto Rico, Río Piedras. The soil used was a Vega Alta clay, a highly leached soil. It has a friable brown heavy-clay surface soil about 8 inches thick, underlain by a reddish-brown, heavy, slightly plastic clay about 10 or 12 inches thick.

The 16 cane varieties used were: P.R. 902, P.R. 903, P.R. 905, P.R. 968, P.R. 969, P.R. 975, P.R. 980, P.R. 999, P.R. 1000, M. 336, B. 37161, B. 41227, B. 37172, C.A. 38102, C.A. 3874, and H. 328560. The P.R. varieties were developed at the Agricultural Experiment Station, University of Puerto Rico, Río Piedras; the M. 336 at the Federal Experiment Station of the United States Department of Agriculture at Mayagüez, P. R.; the B. varieties in Barbados, B.W.I.; the C.A. varieties at Central Aguirre, Aguirre; and the H. 328560 at the Hawaiian Sugar Planters' Association Experiment Station, Hawaii.

The varieties were planted on plots consisting of 22 rows 4½ feet apart, or an area of 2,376 square feet or one-eighteenth of an acre. Twenty-five three-eyed sugarcane seed pieces were placed in the bottom of each furrow and covered with soil. This gives a planting rate of about 10,000 sugarcane seed pieces per acre.

The planting took place on June 22, 1954, and was fertilized on June 29 with a 14-4-10 fertilizer at the rate of 1,500 pounds per acre. The first cutting for each variety was made on December 22, 1954, when the varieties were 6 months old. Cuttings were then made every 15 days thereafter.

Although the 16 sugarcane varieties were planted without replication,

each variety had 22 rows in its plot. One row from each variety plot was cut at each harvesting date. Each variety plot was fully randomized for the choice of row within each plot to be harvested. The production from each row was weighed at time of harvest. Ten whole canes were selected at random from each harvested row for sucrose determination. The samples were ground and analyzed for sucrose-percent-cane as described in a previous publication (*4*).

RESULTS

The results of all 16 varieties grouped together are given in table 1 and in figure 1. The sucrose-percent-cane had two maximum peaks, both in April: one at 10.2 months of age, April 27, 1955 and the other at 21.6 months of age, April 12, 1956. Low sucrose values were obtained with the first cuttings at 6 to 7 months and, in the August-September period, at an age of 14 months.

The tons of cane produced per acre increased with increasing age of the cane until about 18 months when it began to drop off. From a maximum of 51 tons per acre at 17.5 months, the mean of the 16 sugarcane varieties began to decrease as the cane grew older to a minimum of 37 tons at 23 months. This decrease of 14 tons was due mainly to dead canes and some minor rat damage.

As shown in table 1, maximum yields of 96° available sugar per acre for the mean of the 16 varieties were achieved at 18.5 months of age.

The individual varieties displayed quite a variation in yields of sucrose and cane tonnage. As shown in table 2, the average sucrose-percent-cane was highest for M. 336 and lowest for P.R. 999. For average tons of cane per acre, B. 41227 was first with P.R. 980 and C.A. 38102 tied for second place, and B. 37161 and P.R. 903 last. In terms of 96° available sugar per acre C.A. 38102 was first, P.R. 980 second, and P.R. 903 last.

The individual varieties displayed marked differences in the time of the year they had their peaks and lows of sucrose-percent-cane. Although the average high for 6- to 12-month cane was on April 27 with 12.08 sucrose-percent-cane, some varieties reached their peak weeks before or after this date. The variations in highest sucrose-percent-cane for the 16 varieties are given in table 3. Here we see that P.R. 902 hit its peak on February 8 with 13.96 and M. 336 on February 23 with 15.90. M. 336 has long been favored by the growers and mills to begin the harvest season in January because of its high sucrose content at this early date. For the 18- to 23-month cane, M. 336 was first with a high of 15.69 sucrose-percent-cane when the average for all 16 varieties for this age group was 12.18 percent on April 12. C.A. 3874, C.A. 38102, and P.R. 999 all had their highest sucrose contents in January for 18- to 23-month cane.

Some sugarcane varieties have their highest sucrose content after the

TABLE 1.—*The influence of time of cutting and age of cane on the mean yields of 16 sugarcane varieties*

Cutting No.	Date of cutting	Age of cane when cut	Mean yields per acre for—		
			Sucrose in cane	Cane	96° available sugar
		Months	*Percent*	*Tons*	*Cwt.*
1	Dec. 22, 1954	6.0	8.27	12	19.4
2	Jan. 7, 1955	6.5	7.64	15	22.6
3	Jan. 22, 1955	7.0	8.45	14	23.3
4	Feb. 8, 1955	7.6	10.20	14	30.0
5	Feb. 23, 1955	8.0	10.48	18	39.4
6	Mar. 14, 1955	8.7	11.07	15	34.6
7	Mar. 28, 1955	9.3	11.21	20	45.6
8	Apr. 12, 1955	9.5	11.89	21	50.6
9	Apr. 27, 1955	10.2	12.08	23	55.8
10	May 12, 1955	10.7	11.42	24	55.7
11	May 27, 1955	11.2	11.05	28	61.9
12	June 10, 1955	11.6	10.62	29	60.2
13	June 24, 1955	12.0	10.05	30	59.8
14	July 11, 1955	12.1	9.63	34	65.9
15	July 28, 1955	13.2	9.96	36	70.4
16	Aug. 12, 1955	13.7	10.38	37	73.3
17	Aug. 27, 1955	14.2	9.30	35	65.2
18	Sept. 12, 1955	14.7	9.34	39	70.3
19	Sept. 27, 1955	15.2	9.49	40	74.5
20	Oct. 11, 1955	15.6	9.57	40	77.7
21	Oct. 25, 1955	16.1	9.66	45	86.8
22	Nov. 8, 1955	16.5	10.02	49	97.2
23	Nov. 22, 1955	17.0	9.57	41	79.6
24	Dec. 6, 1955	17.5	10.16	51	101.6
25	Dec. 20, 1955	18.0	10.60	42	90.7
26	Jan. 4, 1956	18.5	11.38	49	112.3
27	Jan. 17, 1956	18.9	11.33	44	98.8
28	Jan. 31, 1956	19.4	10.93	47	103.5
29	Feb. 14, 1956	19.9	11.38	38	86.0
30	Feb. 28, 1956	20.3	11.17	44	101.6
31	Mar. 13, 1956	20.6	12.01	38	91.6
32	Mar. 28, 1956	21.1	11.62	42	98.3
33	Apr. 12, 1956	21.6	12.18	37	91.8
34	Apr. 26, 1956	22.1	11.61	32	72.4
35	May 11, 1956	22.6	11.33	42	95.3
36	May 26, 1956	23.1	11.21	37	82.7

April peak. We see in table 3 that P.R. 968 reached its peak content of 12.37 sucrose-percent-cane on June 12 for cane aged 6 to 12 months. B. 37161, P.R. 905, and P.R. 980 all reached their peaks on May 12. For 18- to 23-month cane, P.R. 903 and P.R. 968 reached their high points on May 11, about 1 month later than the average high of April 12.

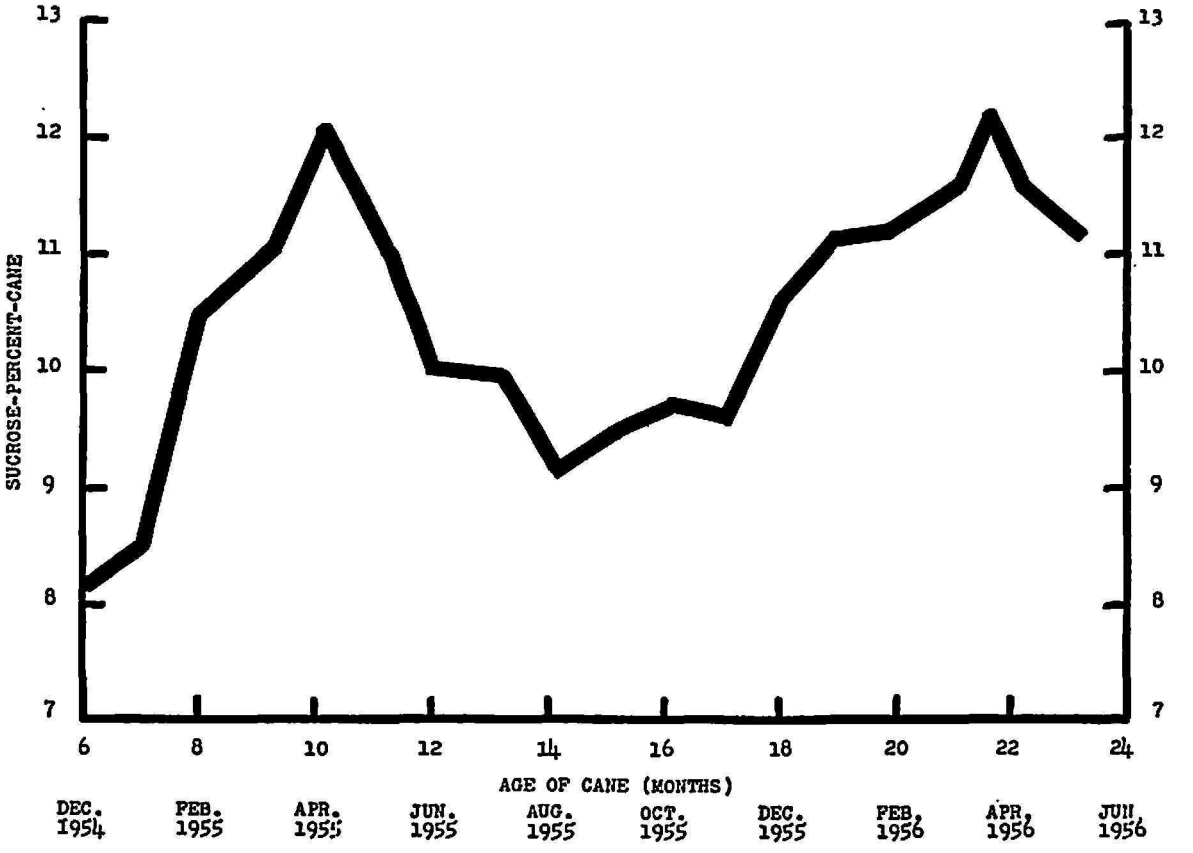

FIG. 1.—Influence of time of year cane is harvested on its sucrose-percent-cane content for the mean of 16 sugarcane varieties.

TABLE 2.—*The average yield of sucrose-percent-cane, cane per acre, and 96° available sugar per acre by 16 sugarcane varieties*

Variety	Sucrose in cane	Cane per acre	96° available sugar per acre
	Percent	*Tons*	*Cwt.*
B. 37161	10.69	24	51.3
B. 37172	10.41	39	81.2
B. 41227	9.92	44	87.3
C.A. 3874	10.99	36	79.1
C.A. 38102	11.25	42	94.5
H. 328560	10.32	28	57.8
M. 336	12.41	32	79.4
P.R. 902	11.57	30	69.4
P.R. 903	10.13	24	48.6
P.R. 905	10.78	32	69.0
P.R. 968	10.21	29	59.2
P.R. 969	10.55	32	67.5
P.R. 975	10.62	29	61.6
P.R. 980	10.63	42	89.3
P.R. 999	9.31	34	63.3
P.R. 1000	9.75	38	74.1

A ranking of the varieties as to when they reached their maximum sucrose-percent-cane content or maturity is given in table 4. We consider all varieties cited at the top of the table for January and February as suitable for early harvesting or early maturing. Those at the end of the table for May and June are regarded as late-harvesting varieties, or late-maturing.

TABLE 3.—*The highest and lowest sucrose-percent-cane values of 16 sugarcane varieties harvested from December 22, 1954 to May 26, 1956*

Variety	Highest sucrose-percent-cane content of cane 6–12 months old			Highest sucrose-percent-cane content of cane 18–23 months old			Lowest sucrose-percent-cane content of cane 12–18 months old	
	Date	Amount	Period with change less than 1 percent	Date	Amount	Period with change less than 1 percent	Date	Amount
		Percent	*Weeks*		*Percent*	*Weeks*		*Percent*
B. 37161	May 12	12.49	2	Apr. 12	12.99	16	July 11	8.50
B. 37172	Apr. 27	13.02	6	Mar. 28	13.16	2	Oct. 11	7.75
B. 41227	Apr. 27	13.11	4	Apr. 12	12.17	4	Aug. 27	7.86
C.A. 3874	Apr. 27	12.03	6	Jan. 4	12.97	4	July 28	8.90
C.A. 38102	Apr. 12	12.86	4	Jan. 17	13.38	2	Aug. 27	7.94
H. 328560	Apr. 12	12.31	10	Feb. 14	12.31	2	Oct. 25	8.85
M. 336	Feb. 23	15.90	2	Jan. 4	15.69	2	Sept. 27	9.80
P.R. 902	Feb. 8	13.96	2	Apr. 12	13.69	2	Nov. 22	8.64
P.R. 903	Apr. 27	11.64	8	May 11	12.96	4	Nov. 22	8.22
P.R. 905	May 12	13.96	10	Apr. 27	13.26	4	Nov. 22	6.99
P.R. 968	June 12	12.37	2	May 11	12.47	8	Oct. 25	8.18
P.R. 969	Apr. 12	11.40	2	Feb. 28	12.61	10	June 10	7.57
P.R. 975	Apr. 12	12.66	4	Apr. 12	13.02	4	Nov. 22	8.13
P.R. 980	May 12	13.20	2	Apr. 27	13.14	14	Aug. 12	8.79
P.R. 999	Apr. 12	12.13	6	Jan. 17	12.28	2	June 24	6.59
P.R. 1000	Apr. 27	12.16	2	Apr. 12	12.57	2	Dec. 6	7.63
Average of varieties	Apr. 27	12.08	12	Apr. 12	12.18	16	Aug. 27	9.30

Of interest to both the grower and the factory is not only when a variety reaches its peak sucrose content, but also how long this peak is maintained. Using as a criterion a loss of less than 1 percent in sucrose-percent-cane, the number of weeks each variety held its peak of sucrose is given in table 3. We see that, for a period of 10 weeks, H. 328560 and P.R. 905 did not drop more than 1 percent of sucrose from their peaks, whereas, M. 336 maintained its high of 15.90 for only 2 weeks for cane of 6 to 12 months of age before it dropped to less than 14.90. When we consider cane 18 to 23 months of age, B. 37161 did not show a loss of more than 1 percent for 16

weeks and P.R. 980 for 14 weeks. The 18- to 23-month-old canes tended to hold their high sucrose values over a longer period than did the 6- to 12-month canes. As shown at the bottom of table 3, the 18- to 23-month-old canes held their high sucrose level for an average of 16 weeks as compared with 12 weeks for the 6- to 12-month-old sugarcane.

TABLE 4.—*The ranking of 16 sugarcane varieties by date as to when they reached their highest sucrose-percent-cane content at time of harvest*

Highest sucrose-percent-cane content of cane 6–12 months old		Highest sucrose-percent-cane content of cane 18–23 months old	
Date	Variety	Date	Variety
Feb. 8	P.R. 902	Jan. 4	C.A. 3874
			M. 336
Feb. 23	M. 336	Jan. 17	C.A. 38102
			P.R. 999
Apr. 12	C.A. 38102		
	H. 328560	Feb. 14	H. 328560
	P.R. 969		
	P.R. 975	Feb. 28	P.R. 969
	P.R. 999		
		Mar. 28	B. 37172
Apr. 27[1]	B. 37172		
	B. 41227	Apr. 12[1]	B. 37161
	C.A. 3874		B. 41227
	P.R. 903		P.R. 902
	P.R. 1000		P.R. 975
			P.R. 1000
May 12	B. 37161		
	P.R. 905	Apr. 27	P.R. 905
	P.R. 980		P.R. 980
June 12	P.R. 968	May 11	P.R. 903
			P.R. 968

[1] The date when the mean of all 16 varieties tested reached its peak.

The lowest sucrose contents for the varieties between 12- to 18-month-old canes also showed variation. From the average low for 16 varieties of 9.30 sucrose-percent-cane, on August 27, P.R. 969 reached its low on June 10 but P.R. 1000 took until December 6 to reach its lowest point.

SUMMARY

Sixteen sugarcane varieties were planted at the same time at Río Piedras and harvested at 15-day intervals from ages of 6 to 23 months to study the

influence of the time of year and age of cane harvested on the sucrose content of the sugarcane varieties. The varieties used were: P.R. 902, P.R. 903, P.R. 905, P.R. 968, P.R. 969, P.R. 975, P.R. 980, P.R. 999, P.R. 1000, M. 336, B. 37161, B. 37172, B. 41227, C.A. 3874, C.A. 38102, and H. 328560. The results obtained were as follows:

1. The average sucrose-percent-cane content for the 16 varieties reached a peak on April 27, 1955, with a cane age of 10.2 months and a sucrose-percent-cane content of 12.08, and another peak on April 12, 1956, at a cane age of 21.6 months and with a sucrose-percent-cane content of 12.18.
2. The lowest sucrose values for the average of the 16 varieties were obtained with the beginning harvests at 6 to 7 months, and in the August-September period at a cane age of 14 months.
3. The tons of cane per acre for the mean of the 16 varieties increased with increasing cane age until about 18 months when it began to decline.
4. Maximum yields of 96° available sugar for the 16 varieties were reached at a cane age of 18.5 months.
5. The individual varieties displayed a wide variation in sucrose-percent-cane content with the highest values for M. 336 and the lowest for P.R. 999.
6. The individual varieties displayed marked differences in the time of the year they had their peaks and lows of sucrose. P.R. 902 and M. 336 were the earliest maturing varieties of the 6- to 12-month canes, reaching their peaks of sucrose in February, and B. 37161, P.R. 905, and P.R. 980 were late-maturing, reaching their peaks of sucrose in May, with P.R. 968 in June.
7. For canes of 18 to 23 months, C.A. 3874, C. 38102, and P.R. 999 all attained their highest peaks of sucrose in January, and P.R. 903 and P.R. 968 reached theirs in May.
8. The lowest sucrose contents were achieved in a range from June 10 for P.R. 969 to December 6 for P.R. 1000.
9. A ranking of the 16 varieties is presented showing when they reached their maximum sucrose-percent-cane contents or maturity.
10. The number of weeks that the variety changed less than 1 percent in sucrose-percent-cane from its peak value is presented for the 16 varieties. In general, canes 18 to 23 months old maintained their peak for 16 weeks as compared with 12 weeks for the 6- to 12-month-old canes.

RESUMEN

Se sembraron 16 variedades de caña de azúcar al mismo tiempo en Río Piedras, las cuales se cosecharon a intervalos de 15 días, desde la edad de 6 a 23 meses. El objetivo fué estudiar la influencia que tuviera la estación

del año sobre la edad de la caña cosechada y sobre el contenido de sacarosa de las distintas variedades. Las variedades usadas fueron: P.R. 902, P.R. 903, P.R. 905, P.R. 968, P.R. 969, P.R. 975, P.R. 980, P.R. 999, P.R. 1000, M. 336, B. 37161, B. 37172, B. 41227, C.A. 3874, C.A. 38102, y H. 328560. Los resultados obtenidos fueron los siguientes:

1. El porcentaje promedio del contenido de sacarosa en la caña, tomando en consideración las 16 variedades, llegó a su expresión máxima en abril 27 de 1955 en la caña de 10.2 meses, cuyo contenido de sacarosa fue de 12.08 por ciento. También se logró en abril 12 de 1956 en una caña de 21.6 meses, cuyo contenido de sacarosa alcanzó 12.18 por ciento.

2. Los valores más bajos de sacarosa, como promedio de las 16 variedades se obtuvieron, al empezar la cosecha, o sea, entre los 6 y 7 meses y en el período de agosto a septiembre en una caña de 14 meses.

3. Las toneladas de caña producidas por acre, promedio de las 16 variedades, aumentaron según aumentó la edad de la caña hasta llegar a los 18 meses. De ahí empezó a declinar.

4. Los rendimientos máximos de azúcar a 96° para las 16 variedades se obtuvieron cuando la caña tuvo 18.5 meses.

5. Las variedades individuales demostraron una gran variación en el porcentaje del contenido de sacarosa en la caña. Los valores más altos se le acreditaron a la variedad M. 336 y los más bajos a la P.R. 999.

6. Las variedades individuales demostraron diferencias marcadas en la estación del año que lograron su mayor y menor contenido de sacarosa. Las cañas de 6 a 12 meses de las variedades P.R. 902 y M. 336, que fueron las que maduraron más tempranamente, alcanzaron su mayor contenido de sacarosa en la caña en febrero y las de B. 37161, P.R. 905 y P.R. 980 maduraron tardiamente y obtuvieron su mayor contenido de sacarosa en la caña en mayo. La P.R. 968 lo obtuvo en junio.

7. Las cañas de 18 a 23 meses de las variedades C.A. 3874, C. 38102 y P.R. 999 todas lograron su mayor contenido de sacarosa en la caña en enero; la P.R. 903 y la P.R. 968 lo alcanzaron en mayo.

8. Los contenidos más bajos de sacarosa en la caña se obtuvieron desde junio 10 en la P.R. 969 y en diciembre 6 en la P.R. 1000.

9. Una evaluación de las 16 variedades se presentan de acuerdo al período en que éstas llegaron a su máximo porcentaje de contenido de sacarosa o a su madurez.

10. El número de semanas que la variedad se desvió de su mayor porcentaje de contenido de sacarosa, en menos de 1 por ciento, se presenta en cuanto a las 16 variedades. En general, las cañas de 18 a 23 meses mantuvieron su mayor contenido de sacarosa durante 16 semanas, comparadas con sólo 12 semanas para las cañas de 6 a 12 meses.

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