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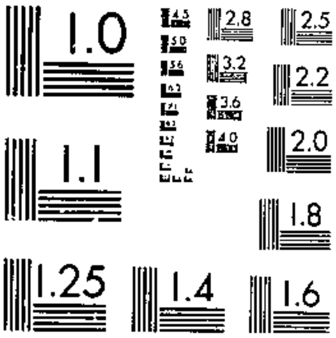

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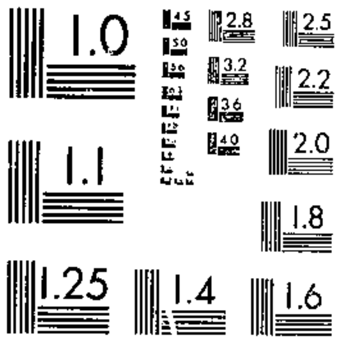

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Technical Bulletin No. 939 • July 1948

UNITED STATES
DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

Inversion of Sucrose and Other Physiological Changes in Harvested Sugarcane in Louisiana[1]

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CONTENTS

STUDIES on (1) the effect of temperature at high moisture conditions and at different levels of atmospheric humidity on rooting, sprouting, inversion of sucrose, and other physiological changes; (2) the effect of different levels of humidity at constant temperatures on the loss of moisture, inversion of sucrose, and other changes in cane of different varieties and maturity; (3) the effect of certain factors on loss of moisture in sugarcane; and (4) the influence of various storage conditions on the extraction of juice and on the milling quality of cane were the subject of research at the United States Sugar Plant Field Station, Houma, La., during the period 1932–44. The findings are summarized below.

SUMMARY

The data here presented deal with the effects of maturity of cane on inversion and with the effect of temperature, humidity, and loss of moisture on germination (rooting and sprouting), loss of solids,

[1] Submitted for publication February 17, 1948.

782227°—48——1

inversion of sucrose, and other physiological changes in hand-harvested and hand-stripped cane of different varieties (Co. 281, Co. 290, P. O. J. 36–M, C. P. 807, C. P. 28/11, and C. P. 28/19) during storage.

When moisture conditions at various temperatures (37° to 75° F.) were such as to more or less maintain the initial water content, rooting and sprouting occurred in 12 to 13 days at 65°, and rooting occurred in 5 days and sprouting in 12 days at 75°.

When the humidity of the storage rooms was reduced to approximately the same saturation deficit (0.144 inch of mercury) at each temperature—51°, 62°, 71°, and 80° F.—only slight germination occurred at 80° and none below 80°.

High moisture conditions at temperatures from 45° to 75° F. restricted inversion of sucrose at all temperatures. With the continuation of storage a gradient in the rate of inversion tended to develop, the rate decreasing with the rise in temperature from 47° to 65° and sometimes to 75°. This gradient is more evident in susceptible than in resistant varieties. When lower levels of moisture conditions were employed, the gradient became steeper by the end of about 3 weeks' storage. Sometimes this gradient is developed during the first (5 to 9 days) or second (12 to 15 days) period of storage, and always by the end of 18 to 23 days. In C. P. 28/19 and C. P. 807 the initial rate of inversion in cane stored at a low level of moisture conditions was much greater at 65° than at 47°.

In some instances this gradient results from an acceleration in rate of inversion at the lower temperatures and a deceleration and cessation at the higher temperatures.

Two patterns of inversion were evident, one in which the rate was more or less constant with the continuation of storage and the other in which inversion was retarded and became more or less stationary or reached an equilibrium with the lapse of time. The first type was common in the varieties Co. 281, Co. 290, and P. O. J. 36–M, whereas the second type occurred in certain lots of Co. 281 and Co. 290 and was characteristic of C. P. 807 and C. P. 28/19.

Both temperature and rate of moisture loss affect equilibrium levels of inversion of sucrose reached during storage in the varieties C. P. 807 and C. P. 28/19. With the rise in temperature and the decrease in loss of moisture, equilibrium tends to be reached at a lesser degree of inversion.

Normally, the drier the storage conditions, the greater is the amount of inversion of sucrose.

The loss of solids (primarily invert sugars) through respiration increased with the rise in temperature of the storage rooms. Generally, the loss of solids did not seem related to the humidity of storage, although in one instance (table 8) the loss of Brix in the varieties Co. 281, Co. 290, C. P. 807, and C. P. 28/19 was consistently greater at 96 percent relative humidity than at 74 percent at 65° F.

The respiration was less in C. P. 807 than in other varieties.

There was no significant change in ash, organic nonsugars, pH, or acidity during about 3 weeks of storage.

Increased maturity of the cane in some instances seemed to increase resistance to inversion of sucrose.

Of the varieties studied, Co. 281 on the whole showed the greatest resistance to inversion of sucrose. Co. 290 showed slightly less resistance. C. P. 28/19, C. P. 28/11, C. P. 807, and P. O. J. 36–M showed considerable susceptibility to inversion. C. P. 28/19 was the least susceptible of this group.

REVIEW OF LITERATURE

Other than for limited studies by the writers (*12, 13*)[2] on the relation between moisture loss and certain changes in the sugarcane stalk, the separate effects of controlled temperature, air humidity, and moisture loss on inversion of sucrose and other physiological changes in harvested sugarcane have not been reported in the literature.

In general, it has been assumed that within certain temperature limits the rate of inversion of sucrose increased with the rise in temperature. On the basis of the effect of temperature on chemical reactions, and enzymic hydrolysis in particular, Barnes (*5*) assumed that the rate of inversion of sucrose would decrease as the temperature at which the cane is stored falls and as long as the highest temperature is not above 52° C. (125.6° F.)—the indicated optimum for enzymic hydrolysis. Such a temperature would be disruptive of the normal changes in harvested sugarcane, and it is much higher than would be encountered in stored cane in Louisiana.

Lee (*15*), working in the Philippine Islands, reports—on the basis of observations made on the effect of temperatures prevailing during storage of sugarcane in the shade and in the field—a greater rate of inversion at the higher temperatures.

Rosenfeld (*19*) claimed a correlation between both the inversion of sucrose and maximum temperatures and the inversion of sucrose and loss in weight in cane (P. O. J.[3] 105) stored in the field, in Egypt. With reference to temperature, his conclusion was based on selected data (only after 24 hours) and it is questionable even on the basis of these data, because a gradient in loss of moisture could also account for the difference in inversion at different temperatures prevailing during that period. There was a very close correlation between inversion and loss in weight during the successive periods (daily for 8 days) of storage.

Sanyal (*20*) stored harvested sugarcane at a series of temperatures from 20° to 24° to 47° to 51° C. (68° to 75.2° to 116.6° to 123.8° F.) in one instance and from 20° to 40° C. (68° to 104° F.) in another and observed a greater loss of moisture, as well as a greater rate of inversion of sucrose, at the higher temperatures. He attributed the difference in inversion of sucrose to the effects of differences in temperature. The increase in the degree of temperature may have had the effect of increasing the rate of inversion, but the results could have been explained just as logically on the basis of the differences in moisture loss, which also increased with the increase in temperature and the increase in the rate of inversion.

[2] Italic numbers in parentheses refer to Literature Cited, p. 64.

[3] Many varieties of sugarcane bred at experiment stations are designated by letters or abbreviations, usually indicating the place or institutions where they originated. The meanings of such designations for varieties mentioned in this bulletin are as follows: C. P.=Canal Point (Fla.), where seedlings are bred by the U. S. Department of Agriculture; P. O. J.=Proefstation Oost Java seedlings; P. O. J. 36–M=Mingka; Co.=Coimbatore (India).

Insofar as published reports are concerned, information on the specific effect of temperature on inversion of sucrose in harvested sugarcane remains obscure.

The relation of moisture loss and the maintenance of water content of mill cane to inversion of sucrose has been the subject of extensive investigations. Early literature on this subject has been reviewed by Kuyper (*9*), Lauritzen and Balch (*11*), Rocha and Frota (*18*), and Rosenfeld (*19*). The later literature by Rocha and Frota (*18*) and by Lauritzen, Balch, and Fort (*12, 13, 14*) agree, in the main, with that of the earlier writers in that inversion is retarded when loss of moisture is restricted or prevented.

Haldane (*8*), in India, presented data that indicated a relation between loss of moisture in harvested cane and varietal susceptibility to inversion of sucrose; i. e., the varieties Co. 205, Barukh, and Pansahi showed greater loss of moisture and inversion of sucrose than Co. 210, Co. 213, Co. 290, and Hemza (Hemja) under the same conditions of storage. Data presented by the writers show that such a relation does not apply to every group of varieties (*13, 14*) that has been studied. In fact, varieties have been discovered that are highly resistant to inversion despite heavy loss of moisture (*13*).

Cross and Harris (*6*) observed greater loss in weight and in inversion of sucrose in the varieties P. O. J. 36, P. O. J. 139, P .O. J. 213, P. O. J. 234, Criolla, and Kavangire when stored under weather conditions of low humidity and high temperature than when stored under cool and humid conditions.

Preliminary results presented by the writers (*13*) show that when certain varieties (Co. 290, C. P. 807, and C. P. 28/19) were stored at different humidities at a given temperature the evaporation and inversion of sucrose were greater at the lower relative humidities.

An intimate association between the loss of moisture and inversion of sucrose in the different parts of the sugarcane stalk was discovered (*12*) in connection with the varieties P. O. J. 36–M and Co. 290. No information has been published on the effect of comparable humidities (comparable as measured by the evaporating power of the air) at different temperatures on the loss of moisture and inversion of sucrose.

Attention has been given to the effect of some of the physical and physiological characters of the sugarcane stalk on the loss of weight (largely loss of moisture). Sartoris (*21*), in Louisiana, placed stalks of small and large diameter of each of the varieties P. O. J. 36, P. O. J. 213, P. O. J. 234, and Louisiana Purple across two rows in the field, where they remained for 31 days. In most instances the loss in percentage of weight was greater in the smaller than in the larger stalks of the same variety.

Three-eye cuttings of about the same diameter from the middle portion of stalks of P. O. J 213 were subjected to four treatments and then stored for 28 days in the laboratory (*21*). The treatments were: (1) No treatment (controls), (2) cut ends coated with paraffin, (3) cut ends and root bands paraffined, and (4) whole cutting paraffined.

The loss in weight of controls was 32.53 percent; of cuttings with cut ends paraffined, 15.02 percent: of cuttings with cut ends and root bands paraffined, 11.19 percent; and of cuttings covered with paraffin, 1.8 percent. These results indicated that about half of the loss of moisture occurred through the cut ends, the next largest amount from the internodes, and the least from the root rings, although on the basis of a unit area the loss was greater from the root rings than from the internodes. When the cut ends of the whole stalk were paraffined, the loss in weight was about equal to that from the whole stalk, the cut ends of which had not been paraffined.

When stalks (*21*) were cut into third lengths and stored (presumably in the field), the loss in weight was greatest in the top third, less in the middle, and least in the bottom.

Lauritzen and Balch (*12*), working in Louisiana with the varieties P. O. J. 36–M and Co. 290, stored whole stalks and stalks sectioned into three equal lengths under controlled conditions of temperature and humidity, and in the shade in an open shed. In the whole stalks that were sectioned after storage there tended to be a gradient in the percentage loss of moisture, the loss being greatest in the top third, less in the middle third, and least in the bottom third. In P. O. J. 36–M this gradient was disarranged in stalks that had been sectioned into thirds before storage, so that the loss of moisture tended in most cases to be greater in the top and bottom sections than in the middle. In Co. 290 there was a corresponding shift in gradient, although the percentage of loss in weight in the bottom third remained slightly less than that of the middle third. Surprisingly, the loss in weight was much greater in the unsevered than in the severed top third. This disarrangement apparently was due to an interruption in the cut sections of a movement of moisture from the top towards the bottom of the unsectioned stalk, resulting from a higher osmotic pressure in the lower than in the upper part of the stalk.

The waxy covering of the sugarcane stalk is an effective barrier against the loss of moisture by evaporation (*10*). The degree of protection afforded by the waxy covering varies with the variety.

When samples (30-stalk) are piled one upon another, the loss of moisture is less uniform than when they are spread out (*12*).

Dymond (*7*), working with the variety Uba in South Africa, found that immature harvested cane or cane of low sucrose content deteriorated more rapidly than mature cane or cane of high sucrose content. The details regarding the source of cane and the manner of conducting the experiments are not given.

Sucrose content between varieties certainly is not necessarily a criterion of susceptibility (*18*) to inversion. Varieties of low sucrose content may be highly resistant to inversion, whereas varieties of high sucrose content may be highly susceptible. Sucrose content in itself need not be a measure of maturity except in cane of the same variety grown under similar conditions.

STORAGE CONDITIONS

The cane was stored in insulated rooms 10 feet wide, 12 feet long, and 9.5 feet high, which were equipped with refrigerating units and electric heating coils that were automatically controlled. The refrigerating units were cooled by direct expansion of ammonia from a 4-ton compressor automatically controlled to meet the refrigerating requirements of each and all the rooms. The relative humidity was controlled by water humidifiers and calcium chloride dryers. In some instances, when a high humidity was required, burlap bags were spread on the floor and kept wet. The extent of drying was controlled by the quantity of moisture supplied, the amount of calcium chloride used, and the size and number of dryers.

Because differential changes in the moisture content of harvested sugarcane stalks have a profound effect on inversion of sucrose, it is necessary, when studying the influence of temperature on inversion, either to prevent, as nearly as possible, the loss of moisture or to bring about a similar loss of moisture at each temperature. The first condition was obtained by maintaining at each temperature an atmospheric content of moisture near saturation. This high humidity was supplemented in some experiments by sprinkling the cane from one to three times daily. The second condition was attained by maintaining approximately the same saturation deficit [4] and degree of air movement at each temperature.

The tension of the moisture at the surface of the cane stalk may be expected to vary with the variety, the osmotic pressure of the sap, the water content and maturity of the cane, the size of the stalk, and other factors. It is, however, sufficiently uniform in samples of a given variety of sugarcane stored at the same time to obtain similar losses of moisture at a series of constant temperatures when approximately the same saturation deficit is maintained at each temperature.

The samples were stored in wooden racks, 8 inches above the floor, and the different lots of cane separated from one another by open partitions. In any given season in which the effects of temperature and humidity were studied, the cane used for each condition of temperature and humidity was from the same lot of samples of a given variety and experiment.

In a given experiment the desired temperature control was generally within $\pm 1.0°$ F. Temperature fluctuations within the cane stalk must have been somewhat less than that of the air (*11*). The values given in the tables in this bulletin are the average temperatures of the experiments involved. The relative humidity was generally controlled within ± 2.5 percent.

Dry and wet bulb temperature readings were taken in each room twice daily by means of a psychrometer upon which was directed the air from an 8-inch fan. Constant movement of air was provided in each room by a 20-inch fan connected with the refrigeration unit. As a check on the constancy of temperature and humidity, a hygrothermograph was installed in each room. These instruments were checked weekly with a pyschrometer.

VARIETIES

The varieties [5] used in the experiments reported in this bulletin were P. O. J. 36–M and P. O. J. 213; Co. 281 and Co. 290; and C. P. 807, C. P. 28/11, C. P. 28/19, C. P. 29/94, and C. P. 29/320. Data relative

[4] The use of saturation deficit as an ecological index to evaporation has been successfully challenged by Leighly (*16*) and Thornthwaite (*22*), except under the very special conditions under which it was originally defined by Livingston (*17*). These conditions were only partly attained in the experiments reported in this bulletin, but their partial control made it possible to obtain approximately the desired loss of moisture at different temperatures.

[5] Acknowledgment is made to Realty Operators, Inc., Houma Sugar Co., and to the estate of H. C. Minor, former owners of the above properties, for generously furnishing most of the cane used in these investigations.

to P. O. J. 213 and C. P. 29/94 are not given here but are discussed on page 41. The varieties were grown on the Hollywood and Southdown plantations near Houma, La., and at the United States Sugar Plant Field Station, Houma, La.

SAMPLING

In experiments in which the effect of maturity on inversion of sucrose was studied, a block of each variety of cane of uniform stand, sufficiently large (14 to 16 rows from 250 to 300 feet long within a cut) to provide for 3 successive experiments during a grinding season, was selected. The blocks were divided into 5 equal sections along the rows, and from 12 to 18 feet of each section was harvested for each test. The cane was hauled to the storage laboratory in plantation wagons and unloaded in the shade of a live oak tree to protect it against excessive loss of moisture during the process of setting up the experiment.

In loading the cane in the field a proportionate amount was taken from each section for each load. There were 3 or 4 loads of a given variety in each test. A few stalks at a time were taken from each load and arranged in a long pile, with the butt ends placed in one direction. By this manner of loading cane onto the wagons and of piling it the cane was thoroughly mixed previous to the selection of samples. Twenty- or thirty-stalk, and, in a few instances, 40-stalk, samples were then selected by drawing stalks at random from the pile.

For juice analysis the 30-stalk samples were used in experiments conducted from 1932 to 1937; in later experiments, the 20-stalk samples were used. In experiments dealing with analysis on a cane basis 40-stalk samples mostly were used. This method of selection provided rather uniform samples for comparable studies at different temperatures and humidities. After they were selected and all leaf and sheath trash had been removed from the stalks, the samples were tied into bundles. They were then taken at random, weighed, and placed in storage. The time consumed in harvesting, selecting, and storing the samples was usually one working day, but occasionally it was necessary to finish storing the samples the following morning.

It was possible to make two successive tests during each of the harvesting seasons from 1932 to 1939 and three tests during two of these seasons (1933 and 1934) before the cane became injured by freezing temperatures.

When the effect of degree of maturity was not being studied, only enough cane for one test was selected; otherwise, the procedure was the same as in the maturity studies.

METHODS OF ANALYSIS

Hand-Mill Juice

The methods employed in juice analyses have been previously described (*11*). The mill tests were conducted in the manner developed by Arceneaux, Krumbhaar, and Bisland (*2*). In fact, the tests were conducted under the supervision of George Arceneaux, senior agronomist, United States Sugar Plant Field Station, Houma, La.

Cane Basis

PREPARATION OF CANE FOR ANALYSIS

A Wiley laboratory mill, altered in minor details, and the following technique were used for disintegration of the cane. The regular receiving drawer of the mill was removed, and the discharge unit was fitted with a copper sleeve that closed the opening in the drawer and also provided a spout to a receiver placed at the end of the sleeve to prevent loss of material. The entire sample of cane (usually 40 stalks) was fed through the mill, 1 stalk at a time, without screening the discharge of the mill, so that the cane was merely chopped into approximately ¼-inch pieces. The receiver (5-gallon capacity) was kept covered, except for the spout opening, to reduce loss of moisture. When it became filled, the contents were transferred to a large galvanized iron tub, which was also kept covered

After the entire sample had been chopped and transferred to the tub, the cane was thoroughly mixed. A sample of about 5 pounds was obtained by picking handfuls of cane from different parts of the tub. This reduced sample was again put through the Wiley mill but with the screen (having ¼-inch openings) in place, so as to hold the material in the mill until entirely shredded. The shredded material remaining in the mill at the end of the grinding was combined with the pulp that had passed through the screen, and the total sample was then thoroughly mixed. At all times the sample material was kept protected from evaporation as much as possible by heavy oilcloth coverings. The total time required for disintegrating a sample ready for analysis was about a half hour.

ANALYSIS FOR TRUE SUCROSE ON CANE BASIS

A normal weight solution of the cane was prepared by a cold-water diffusion procedure similar to that used in the analysis of sugar beets. Five normal weights (130 gm.) of the cane pulp were weighed into a tared, 600-cc. bottle, to which was added a calculated quantity of water (by weight) to yield a liquid phase of 500 cc. Three grams of Horne's basic lead acetate was then added, the bottle stoppered, and the contents intermittently shaken during a half-hour diffusion period. The mixture was then filtered and the filtrate deleaded and used for sucrose and reducing sugar determinations.

The calculation of the quantity of water to be added to make up the normal weight diffusion involves the fiber content of the cane and the juice density. As moderate variations in fiber and juice quality, however, do not have a significant effect on the volume of water needed, it is possible to use average values as determined on the different sugarcane varieties for these water factors. For an example of the calculation, assume that the normal composition for a cane variety was 15 percent fiber and 85 percent juice of 15° Brix (sp. gr. 1.06), the 130 gm. of cane thus contain 19.5 gm. of fiber and 110.5 gm. of solution, or 110.5/1.06, which is 104 cc. juice (nearest whole number). By subtracting 104 from 500, a value of 396 cc., or grams, of water is obtained, which is the quantity needed to be added to yield a normal weight solution.

When analyzing the cane after storage, the weight of cane used was adjusted for the change in weight of the whole cane. Thus, if a cane sample lost 10 percent in weight, the weight of material used in analysis was 117 gm., and the water added was correspondingly increased to 409 gm. Thus, the determinations made were automatically on the original weight basis. The water factors, which were used for fresh cane of the three common varieties, were as follows: Co. 281, 394 gm.; Co. 290, 389 gm.; and C. P. 28/19, 396 gm. Actually, if subsequent analyses show the fiber content and/or the juice density to be abnormal, then the values obtained can be corrected to the determined basis. It was found that the limits of accuracy in polarizations or other work very rarely justify corrections.

If reducing sugars are to be determined, it is important that the quantity of dry lead used for clarification leaves the juice still acid. The 3 gm. recommended did this on the samples examined, but larger or smaller quantities might be required under other circumstances. The deleading was done with a dry, pulverized mixture composed of 7 parts disodium phosphate to 3 parts sodium oxalate, using the minimum quantity for complete deleading. A small quantity of filter-aid was used in the deleading filtration to obtain a clear filtrate.

True sucrose was determined on the clarified normal weight solution of cane by the invertase method, making the invert readings at 20° C. (*3, pp. 491–494*). Reducing sugars were determined by the Lane-Eynon titration method (*3, pp. 498–500, 683*) on a portion of the same clarified solution.

DETERMINATION OF SOLUBLE DRY SOLIDS AND TRUE PURITY

A normal weight diffusate was prepared in the same manner as that for sucrose analysis, except that no clarification agent was added. Filtration was slower and was allowed to proceed until about 300 ml. of filtrate was obtained. Twenty ml. of the diffusate was added to a dry tared sand dish and evaporated on a boiling water bath to a stiff consistency and stirred frequently while continuing the drying until the mixture was fluffy. Drying was completed in a vacuum oven at 70° C. and 27-inch vacuum for 20 hours, with a slow flow of dry air through the oven (*3, p. 485*).

The weight of juice solids was calculated on the percentage basis and used in connection with the true sucrose in calculating the true purity quotient.

Other determinations, such as ash, pH, acidity, and gums, may be made on this same type of diffusate.

EXPERIMENTAL DATA

Temperature and High Moisture Conditions

During the harvesting seasons 1932–36, a series of experiments were conducted for the purpose of studying the effect of temperatures, ranging from slightly above freezing (37°) to 75° F., on rooting, sprouting, inversion of sucrose, and other physiological changes under high moisture conditions. The experiments conducted during the harvesting season of 1932 were largely preliminary and will not be discussed here except to state that the data obtained are in agreement with those obtained in later experiments.

782227°—48——2

During the harvesting season of 1933 wet burlap bags were draped over the cut basal and top ends of the sugarcane stalks of all samples, and these bags were sprinkled three times daily. Treatment of the cane in 1934 was the same as that in 1933, except that the bags were wet only once a day. In 1935 and 1936 the burlap bags were omitted, but the cane was sprinkled once a day. The progressive decrease in the quantity of moisture applied was scheduled, because experience indicated that the addition of so much water was not required to maintain approximately the initial water content of the stalk, which was judged by the weight of the cane samples before and after storage. The loss in weight, resulting from loss of solids, was so small that it could not be determined from gross weights and, consequently, is ignored in this connection.

Rooting and Sprouting

There was a certain amount of rooting and sprouting at temperatures from 66° to 75° F., but none at any of the temperatures used below 66°. Because of the effect that rooting and sprouting had on the loss of sugars, data obtained during 1933 and 1934 relating to these phenomena are given in table 1. The shortest period in which rooting was observed at 66° was 12 days. Because in some instances rooting was absent after 12 and 13 days of storage, it would seem that such periods approximate the time required for rooting. Although sprouting occurred at 66° F. as early as the twelfth day, it was absent in two instances during the first 14 days of storage, in one instance after 16 days, and in another after 19 days. At a temperature of 75° rooting occurred as early as 5 days, although in many instances it was absent during 5 to 7 days of storage. By the end of 9 to 14 days rooting was always present. No sprouting occurred in the first period of storage (5 to 9 days), but it did occur in all instances during 12 to 16 days of storage except in the case of P. O. J. 36–M in experiment 1 conducted during 1933 (table 1) when no sprouting occurred in 12 days.

Inversion of Sucrose and Other Changes

The data recorded in tables 2, 3, 4, and 5 were obtained from three successive experiments conducted during the harvesting season of 1933–34. The values given in tables 2 and 3 are averages of juice analysis of each of five 30-stalk samples. The values in tables 4 and 5 were obtained from composite samples (in duplicate) from the juice of each of the same five cane samples. Equal quantities of juice from each cane sample were mixed and two samples of the mixture used for detailed analysis. The theoretical sugar yields (table 2) were determined by a simplified method of calculation (*1*). The sugar yields (table 2) from stored samples were corrected for change in weight during storage. The Brix values (table 3), the dry substance values (table 4), and sucrose and invert sugar in juice values (table 5) also were corrected for changes in weight. The original Brix was used in calculating apparent purities of juices of stored samples.

Little change in weight occurred in any sample (table 2) during storage. More often there was a gain in weight, indicating that water was absorbed by many of the samples.

TABLE 1.—*Rooting and sprouting in wet cane stored at high relative humidity*[1] *at 66° and 75° F. for different periods of time, 1933–34*

Variety	Experiment No.	Date of recording data	Duration of storage	Temperature and relative humidity: 66° F. and 97–98 percent — Rooting (length)	66° F. and 97–98 percent — Sprouting (length)	75° F. and 95–98 percent — Rooting (length)	75° F. and 95–98 percent — Sprouting (length)
		1933	*Days*	*Inches*	*Inches*	*Inches*	*Inches*
Co. 281	1	Nov. 3	9	0	0	0 to 1.5	0
		Nov. 10	16	1 to 2	0	1 to 3	JS[2]
		Nov. 17	23	1 to 4	JS	1 to 8	0 to 8
	2	Nov. 20	6	0	0	0	0
		Nov. 27	13	0	0	1 to 2	JS
		Dec. 4	20	1 to 3	JS	1 to 10	0 to 12
	3	Dec. 13	7	0	0	JS	0
		Dec. 20	14	1 to 4	JS	1 to 7	0 to 3
		Dec. 28	22	1 to 4	0 to 1	1 to 10	0 to 9
Co. 200	1	Nov. 6	6	0	0	0.5 to 1	0
		Nov. 13	13	1 to 2	0	1 to 6	JS
		Nov. 20	20	1 to 4	JS	1 to 8	0 to 12
	2	Nov. 27	5	0	0	JS	0
		Dec. 11	19	1 to 4	0 to 1	3 to 10	0 to 10
	3	Dec. 18	6	0	0	0 to 1	0
P. O. J 36-M	1	Oct. 30	5	0	0	0	0
		Nov. 6	12	0	0	1 to 3	0
		Nov. 13	19	1 to 2	0	1 to 3	JS
	2	Nov. 24	6	0	0	JS	0
		Dec. 1	13	0	0	1 to 4	0 to 1
		Dec. 8	20	1 to 2	JS	1 to 8	0 to 6
	3	Dec. 15	7	0	0	0 to 1.5	0
		Dec. 22	14	0 to 4	0 to 0.7	1 to 10	0 to 3
		Dec. 29	21	1 to 8.5	0 to 1.5	1 to 10	0 to 13
C. P. 807	1	Nov. 1	5	0	0	0 to 1	0
		Nov. 8	12	0	0	1 to 4	JS
		Nov. 15	19	1 to 5	JS	1 to 3	0 to 10
	2	Nov. 22	7	0	0	0	0
		Nov. 29	14	JS	0	1 to 3	0 to 0.7
		Dec. 6	21	1 to 3	JS	1 to 10	1 to 12
	3	Dec. 11	6	0	0	0	0
		Dec. 18	13	JS	0	1 to 4	0 to 1
		Dec. 26	21	1 to 4	0 to 1	1 to 10	0 to 14
		1934					
C. P. 28/19	1	Oct. 26	6	0	0	0	0
		Nov. 2	13	.5 to 2	0	2 to 4	JS
		Nov. 9	20	.5 to 4	0 to 1	6 to 10	0 to 8.5
	2	Nov. 16	7	0	0	0	0
		Nov. 23	14	0 to 1	0	2 to 3.5	0 to 1
		Nov. 30	21	1 to 3.5	JS	3 to 10	0 to 3
	3	Dec. 7	7	0	0	0	0
		Dec. 21	21			1 to 12	.5 to 6.5
Co. 281	1	Oct. 29	6	0	0	0	0
		Nov. 5	13	JS to 1	0	2 to 4	JS
		Nov. 12	20	1 to 5		6 to 9	JS to 4
	2	Nov. 19	6	0	0	0	0
		Nov. 26	13	JS	JS	2 to 4	JS to 2
		Dec. 3	20	2 to 6	JS to 1.3	6 to 8	0 to 9
	3	Dec. 10	6	0	0	JS	0
		Dec. 17	13	0 to 2	0	2 to 4	JS to 1
		Dec. 24	20	2 to 3	JS to .7	3 to 11	.5 to 5
Co. 200	1	Oct. 31	6	0	0	JS	0
		Nov. 7	13	.5 to 1.5	0	3 to 4	JS to 1.5
		Nov. 14	20	2 to 6	JS	4 to 8	JS to 8
	2	Nov. 21	6	0	0	JS	0
		Nov. 28	13	JS to 1	0	2 to 6	JS to 1.3
		Dec. 5	20	3 to 4	JS	5 to 8	JS to 4
	3	Dec. 12	7	0	0	0	0
		Dec. 19	14	1 to 2	JS		
		Dec. 26	21	3 to 7	JS to 1.3	5 to 12	0 to 1.0
C. P. 807	1	Nov. 5	6	0	0	0	0
		Nov. 12	13	JS to 4	0	1 to 6	JS to 2.5
		Nov. 19	20	3 to 9	JS	4 to 11	1 to 9
	2	Nov. 26	5	0	0	0	0
		Dec. 3	12	JS to 1	JS	2 to 3	.5 to 3
		Dec. 10	19	1 to 3.5	JS to 1.8	2 to 4	.5 to 3.8
	3	Dec. 14	7	0	0	0	0
		Dec. 21	14	1 to 3.5	JS to .8	2 to 4	JS to 6
		Dec. 26	19	1 to 5	JS to .8	2 to 5	1 to 6.5

[1] During 1933 and 1934 wet burlap bags were draped over the ends of the stalks. They were sprinkled three times a day during 1933 and once a day during 1934.

[2] Just starting.

Table 2.—*Gain or loss of 96° sugar, rise or fall in purity, and gain or loss in weight in mill cane of 4 varieties of sugarcane of different maturities stored at high humidities* [1] *(95 to 98 percent relative humidity) at different temperatures during 1933–34*

Experiment No.	Date of analysis	Duration of storage	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar at temperatures of—								Rise (+) or fall (−) in apparent purity at temperatures of—				Gain (+) or loss (−) in weight of cane at temperatures of—			
				46° F.	56° F.	66° F.	75° F.	46° F.	56° F.	66° F.	75° F.	46° F.	56° F.	66° F.	75° F.	46° F.	56° F.	66° F.	75° F.
	1933	*Days*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*					*Percent*	*Percent*	*Percent*	*Percent*
CO. 281 (FIRST-YEAR STUBBLE)																			
1	Oct. 25	0	161.7																
	Nov. 3	9		−6.4	−0.2	+0.2	+0.3	−4.0	−1.2	+0.1	+0.2	−2.5	−0.8	−0.6	−0.4	+0.9	+0.5	+0.7	+0.5
	Nov. 10	16		−8.6	−1.5	−5.9	−8.7	−5.3	−.9	−3.6	−5.4	−2.7	−.8	−2.9	−4.2	+.8	+.3	+.4	−.2
	Nov. 17	23		−16.2	−9.5	−11.1	−13.5	−10.0	−5.9	−6.9	−8.3	−5.6	−3.9	−4.7	−5.8	+.9	+.4	+.8	+.2
Difference for $P=0.05$												1.03	1.03	1.03	1.03				
Difference for $P=0.01$												1.37	1.37	1.37	1.37				
2	Nov. 14	0	200.9																
	Nov. 20	6		−6.2	−10.0	−5.2	−8.3	−3.1	−5.0	−2.6	−4.1	−1.9	−3.4	−1.9	−2.9	+.9	+.2	+.1	−.2
	Nov. 27	13		−10.9	−9.3	−10.9	−12.0	−5.4	−4.6	−5.4	−6.0	−3.7	−3.3	−4.1	−4.4	+1.0	+.2	−.2	+.3
	Dec. 4	20		−13.8	−11.7	−15.2	−20.4	−6.9	−5.8	−7.6	−10.2	−4.6	−3.9	−5.2	−7.1	+1.1	0	+.2	−.3
Difference for $P=0.05$												.839	.839	.839	.839				
Difference for $P=0.01$												1.11	1.11	1.11	1.11				
3	Dec. 6	0	214.7																
	Dec. 13	7		−.0	−4.5	−2.3	−4.8	.0	−2.1	−1.1	−2.2	−.2	−1.6	−1.3	−1.7	−.1	−.1	0	−.3
	Dec. 20	14		−.6	−3.5	−6.8	−6.2	−.3	−1.6	−3.2	−2.9	−.4	−1.3	−2.3	−2.3	+.2	−.3	−.1	−.4
	Dec. 28	22		−1.4	−2.4	−8.0	−15.9	−.7	−1.1	−3.7	−7.4	−.6	−1.0	−2.3	−5.2	−.2	−.1	+.2	−1.0
Difference for $P=0.05$												1.295	1.295	1.295	1.295				
Difference for $P=0.01$												1.719	1.719	1.719	1.719				
CO. 290 (PLANT CANE)																			
1	Oct. 31	0	139.7																
	Nov. 6	6		−0.6	+3.8	+2.4	+1.6	−0.4	+2.7	+1.7	+1.1	−0.1	+1.1	+0.3	+0.1	−0.7	−0.8	−0.5	−0.5
	Nov. 13	13		−3.7	+.6	−4.4	−5.5	−2.6	+.4	−3.1	−3.9	−1.8	0	−2.3	−3.0	−.5	−.5	+.4	+.2
	Nov. 20	20		−7.6	−3.2	−5.2	−12.5	−5.4	−2.3	−3.7	−8.9	−2.8	−1.5	−2.5	−5.7	+.3	−.1	+.6	−.1
Difference for $P=0.05$												1.67	1.67	1.67	1.67				
Difference for $P=0.01$												2.22	2.22	2.22	2.22				
2	Nov. 22	0	165.0																
	Nov. 27	5		+4.3	−2.6	+.5	−3.8	+2.6	−1.6	+.3	−2.3	+.6	−1.3	−.1	−1.9	−.5	−.9	−.6	−1.0
	Dec. 11	19		−2.1	−4.3	−5.5	−8.4	−1.3	−2.6	−3.3	−5.1	−1.0	−1.6	−2.5	−3.7	+.2	0	+.2	0
Difference for $P=0.05$												1.38	1.38	1.38	1.38				
Difference for $P=0.01$												1.84	1.84	1.84	1.84				
3	Dec. 12	0	186.7																
	Dec. 18	6		−4.6	−2.2	−10.5	−6.6	−2.5	−1.2	−5.6	−3.5	−1.2	−.6	−3.3	−2.2	+.3	0	+.1	+.2
	1934 Jan. 2	21		−11.6	−13.2	−11.1	−24.9	−6.2	−7.1	−5.9	−13.3	−3.3	−4.1	−3.5	−8.3	+.6	−.5	+.1	+.2
Difference for $P=0.05$												1.66	1.66	1.66	1.66				
Difference for $P=0.01$												2.22	2.22	2.22	2.22				

[1] Wet burlap bags draped the cut ends of all stalks. These bags were sprinkled 3 times a day during storage.

P. O. J. 36–M (FIRST-YEAR STUBBLE)

	1933																		
1	Oct. 25	0	104.3																
	Oct. 30	5		−4.9	−10.1	−1.6	−0.7	−4.7	−9.7	−1.5	−0.7	−1.8	−3.8	−0.3	0.0	+0.6	+0.1	+0.7	+0.1
	Nov. 6	12		−17.5	−13.5	−7.6	−6.9	−16.8	−12.9	−7.3	−6.6	−6.5	−5.7	−3.8	−3.5	+.2	−.5	+.1	+.3
	Nov. 13	19		−30.6	−19.2	−12.1	−16.1	−29.3	−18.4	−11.6	−15.4	−11.7	−7.9	−5.6	−7.7	+1.3	+.5	+1.4	−.3
Difference for $P=0.05$												2.98	2.98	2.98	2.98				
Difference for $P=0.01$												3.96	3.96	3.96	3.96				
2	Nov. 18	0	134.3																
	Nov. 24	6		−10.2	−11.9	−2.9	−1.4	−7.6	−8.9	−2.2	−1.0	−3.6	−4.3	−1.5	−1.1	−.2	−.3	−.3	−.4
	Dec. 1	13		−23.2	−15.5	−8.5	−10.2	−17.3	−11.5	−6.3	−7.6	−7.4	−5.7	−3.7	−4.6	+2.4	0	+.4	−.4
	Dec. 8	20		−30.2	−13.6	−6.7	+.6	−22.5	−10.1	−5.0	+.4	−10.2	−5.1	−2.7	−.6	+.9	+.1	0	−1.5
Difference for $P=0.05$												2.39	2.39	2.39	2.39				
Difference for $P=0.01$												3.18	3.18	3.18	3.18				
3	Dec. 8	0	154.9																
	Dec. 15	7		−4.7	−7.2	−1.6	−1.3	−3.0	−4.6	−1.0	−.8	−1.3	−2.6	−.5	−.5	+.4	+.1	−.2	−.1
	Dec. 22	14				−4.5	−10.8			−2.9	−7.0			−2.1	−4.4			+.2	−.1
	Dec. 29	21		−17.5	−17.1	−9.4	−12.2	−11.3	−11.0	−6.1	−7.9	−5.8	−6.4	−3.8	−4.7	+.3	−.1	+.1	−1.2
Difference for $P=0.05$												2.30	2.30	2.30	2.30				
Difference for $P=0.01$												3.08	3.08	3.08	3.08				

C. P. 807 (FIRST-YEAR STUBBLE)

1	Oct. 27	0	162.4																
	Nov. 1	5		−9.3	−10.1	−11.8	−3.1	−5.7	−6.2	−7.3	−1.9	−3.2	−3.5	−4.3	−1.0	+1.1	+0.6	+0.6	+1.0
	Nov. 8	12		−20.8	−15.5	−11.3	−16.8	−12.8	−9.5	−7.0	−10.3	−6.8	−5.3	−4.3	−6.3	+1.0	+.6	−.3	+.3
	Nov. 15	19		−22.0	−15.4	−11.8	−15.1	−13.5	−9.5	−7.3	−9.3	−7.2	−5.3	−4.2	−6.0	+1.3	+.4	+1.0	+1.0
Difference for $P=0.05$												1.67	1.67	1.67	1.67				
Difference for $P=0.01$												2.21	2.21	2.21	2.21				
2	Nov. 15	0	185.0																
	Nov. 22	7		−18.7	−16.5	−6.1	−10.0	−10.1	−8.9	−3.3	−5.4	−5.3	−5.0	−1.6	−3.1	+1.1	+.7	+.7	+.1
	Nov. 29	14		−21.8	−15.9	−14.3	−9.4	−13.4	−8.6	−7.7	−5.1	−7.3	−5.0	−4.9	−3.6	+1.1	+.5	+.2	−.6
	Dec. 6	21		−34.0	−14.1	−13.0	−16.3	−18.4	−7.6	−7.0	−8.8	−10.3	−4.5	−4.4	−5.9	+1.0	+.5	−.1	−1.1
Difference for $P=0.05$												1.35	1.35	1.35	1.35				
Difference for $P=0.01$												1.80	1.80	1.80	1.80				
3	Dec. 5	0	206.3																
	Dec. 11	6		−9.3	−7.6	−7.7	−4.3	−4.5	−3.7	−3.7	−2.1	−2.6	−2.0	−2.3	−1.2	−.1	0	−.1	−.5
	Dec. 18	13		−17.2	−15.6	−7.8	−8.2	−8.3	−7.6	−3.8	−4.0	−5.0	−4.5	−2.3	−2.6	+.6	+.2	0	+.3
	Dec. 26	21		−22.3	−15.9	−13.3	−14.0	−10.8	−7.7	−6.4	−6.8	−6.1	−4.7	−4.0	−4.5	+.7	+.2	−.3	+.2
Difference for $P=0.05$												1.05	1.05	1.05	1.05				
Difference for $P=0.01$												1.39	1.39	1.39	1.39				

TABLE 3.—*Change in Brix value in juice from 4 varieties of cane stored at high humidity at 4 temperatures for different intervals of time during 1933–34 in 3 experiments (same experiments from which data in tables 2, 4, and 5 were derived)*

Experiment No.	Co. 281 (first-year stubble): Duration of storage	Co. 281: Loss (−) or gain (+) of Brix at temperatures of— 46° F.	56° F.	66° F.	75° F.	Co. 290 (plant cane): Duration of storage	Co. 290: Loss (−) or gain (+) of Brix at temperatures of— 46° F.	56° F.	66° F.	75° F.
	Days	*Degrees*	*Degrees*	*Degrees*	*Degrees*	*Days*	*Degrees*	*Degrees*	*Degrees*	*Degrees*
	9	−0.30	−0.10	−0.34	−0.30	6	+0.04	−0.08	−0.23	−0.22
1	16	−.08	−.15	−.58	−.81	13	−.33	−.09	−.51	−.69
	23	−.33	−.53	−.59	−.86	20	−.26	−.28	−.49	−.93
	6	−.10	−.37	−.22	−.34	5	−.30	−.28	−.10	−.44
2	13	−.40	−.42	−.61	−.62	19	−.22	−.17	−.50	−.72
	20	−.42	−.38	−.56	−.85					
	7	−.16	−.24	−.43	−.27	6	+.02	−.[illegible]1	−.25	−.21
3	14	−.19	−.25	−.35	−.44	21	−.08	−.27	−.31	−.89
	22	−.12	−.22	−.10	−.54					
Average loss in Brix per day during storage in the 3 experiments:										
First period		−.025	−.032	−.045	−.041		−.041	−.071	−.034	−.051
First and second periods		−.61	−.019	−.036	−.043		−.025	−.007	−.039	−.053
All 3 periods		−.13	−.017	−.021	−.035		−.013	−.017	−.021	−.035
	P. O. J. 36-M (first-year stubble)					C. P. 807 (first-year stubble)				
	5	+0.03	0	+0.15	−0.07	5	−0.08	−0.11	−0.23	−0.01
1	12	+.03	−.28	−.41	−.42	12	−.06	−.13	−.31	−.45
	19	−.17	−.32	−.45	−.77	19	−.03	−.18	−.23	−.55
	6	−.21	−.30	−.28	−.35	7	−.09	−.09	+.11	−.14
2	13	−.03	−.44	−.54	−.70	14	−.06	−.20	−.41	−.49
	20	−.33	−.41	−.33	−.43	21	−.24	−.22	−.29	−.67
	7	+.03	−.24	−.07	−.09	6	−.04	+.03	−.11	+.01
3	14			−.38	−.58	13	−.17	−.15	−.17	−.24
	21	−.25	−.62	−.50	−.53	21	−.02	−.24	−.21	−.37
Average loss in Brix per day during storage in 3 experiments:										
First period		−.008	−.030	−.011	−.021		−.002	−.009	−.013	−.008
First and second periods		−.000	−.028	−.034	−.044		−.007	−.012	−.023	−.030
All 3 periods		−.013	−.023	−.021	−.029		−.005	−.010	−.012	−.026

TABLE 4.—*Dry substance, true purity, invert sugars, organic nonsugars, ash, pH, and acidity in juice from cane analyzed before storage and changes in these values in juice, from cane of 4 varieties stored at relative humidities ranging from 95 to 98 percent* [1] *at 4 temperatures during 1933–34*

Experiment No.	Date of analysis	Duration of storage	Initial dry substance in juice	Loss of dry substance at temperatures of—				Initial true purity (sucrose on dry substance)	Gain (+) or loss (−) of true purity (percent sucrose on dry substance) at temperatures of—				Initial invert sugars (on dry substance)	Gain (+) or loss (−) of invert sugars (on dry substance) at temperatures of—			
				46° F.	56° F.	66° F.	75° F.		46° F.	56° F.	66° F.	75° F.		46° F.	56° F.	66° F.	75° F.
		Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
CO. 281 (FIRST-YEAR STUBBLE)																	
	1933																
1	Oct. 25 to Nov. 17	23	14.60	0.50	0.56	0.64	0.98	83.90	−2.87	−0.42	−0.74	−0.68	8.21	+2.31	−0.06	−0.27	+0.14
2	Nov. 14 to Dec. 4	20	16.39	.44	.49	.65	.95	89.38	−2.88	−1.71	−1.67	−2.55	3.90	+2.14	+.79	+.43	+1.15
3	Dec. 6 to Dec. 28	22	16.79	.05	.17	.45	.75	91.36	−.66	−.67	−1.05	−1.92	1.99	+.22	+.09	+.13	+1.06
CO. 290 (PLANT CANE)																	
1	Oct. 31 to Nov. 20	20	13.48	0.12	0.18	0.34	0.80	78.93	−1.83	−0.57	+0.17	−0.84	11.21	+1.36	−0.20	−0.64	−0.01
2	Nov. 22 to Dec. 11	19	14.73	.09	.22	.38	.72	83.50	−1.77	−1.63	−1.45	−1.99	7.24	+.32	+.07	0	+.91
3	Dec. 12 to Jan. 2, 1934	21	15.63	.20	.47	.57	1.12	84.64	−.82	−.13	−.40	−1.63	5.23	+1.00	+.39	+.43	+1.34
P. O. J. 36-M (FIRST-YEAR STUBBLE)																	
1	Oct. 25 to Nov. 13	19	12.08	0.34	0.38	0.53	0.89	72.85	−7.36	−3.44	−1.30	−1.73	18.05	+7.06	+2.80	+0.86	+0.86
2	Nov. 18 to Dec. 8	20	13.97	.29	.42	.52	.43	78.17	−6.78	−2.99	−.47	+1.39	12.98	+7.09	+2.99	+.58	−1.03
3	Dec. 8 to Dec. 29	21	14.55	.17	.59	.53	.73	82.89	−4.30	−3.51	−1.38	−1.05	8.89	+3.45	+2.17	+.18	−.08
C. P. 807 (FIRST-YEAR STUBBLE)																	
1	Oct. 27 to Nov. 15	19	14.20	0.17	0.34	0.24	0.76	84.79	−4.17	−2.83	−0.93	−0.72	6.67	+4.55	+2.66	+1.22	+0.84
2	Nov. 15 to Dec. 6	21	15.81	.23	.17	.44	.73	88.43	−8.07	−3.53	−2.60	−2.66	4.68	+7.44	+2.79	+2.07	+1.87
3	Dec. 5 to Dec. 26	21	16.74	.06	.34	.38	.52	90.26	−4.27	−2.78	−1.47	−1.44	3.03	+2.76	+2.08	+.80	+.40

TABLE 4.—*Dry substance, true purity, invert sugars, organic nonsugars, ash, pH, and acidity in juice from cane analyzed before storage and changes in these values in juice, from cane of 4 varieties stored at relative humidities ranging from 95 to 98 percent*[1] *at 4 temperatures during 1933–34*—Continued

Experiment No.	Date of analysis	Duration of storage	Initial organic nonsugars (on dry substance)	Gain (+) or loss (−) of organic nonsugars (on dry substance) at temperatures of— 46° F.	56° F.	66° F.	75° F.	Initial ash (on dry substance)	Gain (+) or loss (−) in ash (on dry substance) at temperatures of— 46° F.	56° F.	66° F.	75° F.
		Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
CO. 281 (FIRST-YEAR STUBBLE)												
	1933											
1	Oct. 25 to Nov. 17	23	4.24	+0.35	+0.28	+0.82	+0.28	3.65	+0.21	+0.20	+0.19	+0.26
2	Nov. 14 to Dec. 4	20	3.56	+.46	+.66	+.96	+.93	3.16	+.28	+.26	+.28	+.47
3	Dec. 6 to Dec. 28	22	3.39	+.44	+.55	+.86	+.64	3.26	0	+.03	+.06	+.22
CO. 290 (PLANT CANE)												
1	Oct. 31 to Nov. 20	20	4.54	+0.33	+0.59	+0.39	+0.38	5.32	+0.41	+0.18	+0.08	+0.47
2	Nov. 22 to Dec. 11	19	4.05	+1.33	+1.29	+1.20	+.60	5.21	+.12	+.27	+.25	+.48
3	Dec. 12 to Jan. 2, 1934	21	4.87	−.22	−.37	−.23	−.20	5.26	+.04	+.11	+.20	+.49
P. O. J. 36-M (FIRST-YEAR STUBBLE)												
1	Oct. 25 to Nov. 13	19	5.03	+0.08	+0.43	+0.27	+0.57	4.07	+0.22	+0.21	+0.17	+0.30
2	Nov. 18 to Dec. 8	20	5.09	−.37	−.14	−.18	−.52	3.76	+.06	+.14	+.07	+.13
3	Dec. 8 to Dec. 29	21	4.42	+.75	+1.12	+1.01	+.77	3.80	+.10	+.22	+.18	+.36
C. P. 807 (FIRST-YEAR STUBBLE)												
1	Oct. 27 to Nov. 15	19	4.93	−0.37	+0.08	−0.25	−0.17	3.61	−0.01	+0.09	−0.01	+0.05
2	Nov. 15 to Dec. 6	21	3.79	+.37	+.51	+.30	+.50	3.10	+.26	+.23	+.23	+.30
3	Dec. 5 to Dec. 26	21	3.66	+.37	+.69	+.46	+.74	2.05	+.14	+.01	+.21	+.30

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CO. 281 (FIRST-YEAR STUBBLE)

Experiment No.	Date of analysis	Duration of storage	Initial pH	Increase (+) or decrease (−) in pH at temperatures of— 46° F.	56° F.	66° F.	75° F.	Initial acidity (0.1 N NaOH per 10 cc. juice)	Increase (+) or decrease (−) in acidity (0.1 N NaOH per 10 cc. juice) at temperatures of— 46° F.	56° F.	66° F.	75° F.
	1933	*Days*						*Cc.*	*Cc.*	*Cc.*	*Cc.*	*Cc.*
1	Oct. 25 to Nov. 17	23	5.21	+0.11	+0.13	+0.07	−0.01	1.60	−0.09	−0.15	−0.08	+0.05
2	Nov. 14 to Dec. 4	20	5.27	−.03	+.02	−.01	−.08	1.44	+.12	+.05	+.06	+.21
3	Dec. 6 to Dec. 28	22	5.28	+.05	+.07	+.05	−.05	1.48	−.02	−.05	−.06	+.08
CO. 290 (PLANT CANE)												
1	Oct. 31 to Nov. 20	20	5.22	+0.06	+0.08	+0.07	+0.04	2.32	−0.14	−0.16	−0.19	−0.09
2	Nov. 22 to Dec. 11	19	5.24	+.06	+.07	+.07	+.02	2.30	−.10	−.10	−.14	−.02
3	Dec. 12 to Jan. 2, 1934	21	5.20	+.11	+.10	+.06	+.03	2.41	−.15	−.09	−.10	+.01
P. O. J. 36-M (FIRST-YEAR STUBBLE)												
1	Oct. 25 to Nov. 13	19	5.20	+0.13	+0.15	+0.15	+0.11	1.20	−0.09	−0.09	−0.15	−0.10
2	Nov. 18 to Dec. 8	20	5.29	+.01	+.08	+.03	−.06	1.16	−.07	−.09	−.11	+.01
3	Dec. 8 to Dec. 29	21	5.29	+.03	+.04	−.01	−.08	1.15	+.02	0	+.01	+.12
C. P. 807 (FIRST-YEAR STUBBLE)												
1	Oct. 27 to Nov. 15	19	5.26	+0.01	+0.04	+0.05	+0.06	1.80	−0.02	−0.05	−0.14	−0.16
2	Nov. 15 to Dec. 6	21	5.33	−.04	−.01	−.05	−.11	1.74	+.04	−.03	−.02	+.02
3	Dec. 5 to Dec. 26	21	5.23	+.06	+.08	+.06	+.04	1.75	+.06	−.08	+.03	+.09

[1] Wet burlap bags draped the cut ends of all stalks. These bags were sprinkled three times daily during storage.

TABLE 5.—*Loss of true sucrose and change of invert sugars in juice of first-year stubble of 4 varieties of sugarcane stored under controlled conditions of temperature and humidity*[1] *in 3 successive experiments during the harvesting season of 1933–34*

Variety	Experiment No.	Date of analysis	Duration of storage	Loss of true sucrose in juice at—				Gain (+) or loss (−) of invert sugars in juice at—			
				46° F.	56° F.	66° F.	75° F.	46° F.	56° F.	66° F.	75° F.
		1933	*Days*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Co. 281	1	Oct. 25 to Nov. 17	23	0.83	0.53	0.61	0.92	+0.28	−0.06	−0.09	−0.07
	2	Nov. 14 to Dec. 4	20	.85	.71	.84	1.24	+.32	+.11	+.04	+.14
	3	Dec. 6 to Dec. 28	22	.16	.27	.58	.92	+.04	+.02	+.02	+.16
Average loss of true sucrose per day.				.028	.023	.032	.048				
Average increase or decrease in invert sugars per day.								+.01	+.001	−.005	+.004
Co. 290	1	Oct. 31 to Nov. 20	20	.34	.22	.25	.74	+.17	−.04	−.12	−.09
	2	Nov. 22 to Dec. 11	19	.33	.42	.53	.88	+.03	−.01	−.03	+.07
	3	Dec. 12 to Jan. 2, 1934	21	.30	.42	.54	1.19	+.15	+.04	+.03	+.13
Average loss of true sucrose per day.				.016	.018	.022	.047				
Average increase or decrease in invert sugars per day.								+.006	−.002	−.002	+.002
P. O. J. 36-M	1	Oct. 25 to Nov. 13	19	1.11	.68	.54	.84	+.77	+.26	0	−.07
	2	Nov. 18 to Dec. 8	20	1.13	.73	.47	.15	+.93	+.35	+.01	−.17
	3	Dec. 8 to Dec. 29	21	.76	.98	.63	.75	+.49	+.26	−.02	−.07
Average loss of true sucrose per day.				.050	.040	.027	.029				
Average increase or decrease in invert sugars per day.								+.037	+.015	−.002	−.005
C. P. 807	1	Oct. 27 to Nov. 15	19	.73	.68	.33	.74	+.63	+.35	+.14	+.06
	2	Nov. 15 to Dec. 6	21	1.46	.70	.79	1.05	+1.13	+.43	+.44	+.25
	3	Dec. 5 to Dec. 26	21	.77	.76	.58	.70	+.46	+.33	+.12	+.05
Average loss of true sucrose per day.				.049	.035	.028	.041				
Average increase or decrease in invert sugars per day.								+.037	+.018	+.011	+.006

[1] The relative humidity at each temperature was near the saturation point. Wet burlap bags draped the ends of the stalks. These bags were sprinkled three times daily during storage.

The cane of each variety used in the three successive experiments was of three different levels of maturity, as indicated by the dry substance values, purities, and sugar yields per ton of cane; the cane increased in total solids, sucrose content, and in purity of the juice with the advance of the season. Between varieties these values were not at the same level. The nearest approach of the values to being at the same levels were those of Co. 281 and C. P. 807. The other two varieties differed between themselves in these values and also differed greatly from those of Co. 281 and C. P. 807. Many varieties never attain the same sucrose content and purity of juice; hence, it is impracticable to compare inversion in cane of such varieties at the same levels of these values. Even in varieties that attain the same sucrose content, the time at which it is attained often differs, making comparison difficult. It is felt that it is more important to compare varieties of the same age and that other factors of maturity may play a part in regulating the amount of inversion, making difficult the comparison of varieties on any other basis than age.

In order to obtain a fairly accurate conception of the quantity of inversion of sucrose at each of several temperatures and humidities, three procedures were followed in these investigations: (1) The analysis was limited to Brix and polarization readings of hand-mill extracted juice, (2) true sucrose and soluble solids analyses were made of juice from the samples used in (1), and (3) true sucrose and soluble solids analyses were made on a cane basis of solutions of juice obtained from thoroughly disintegrated cane by cold water diffusion. Each one of these procedures has its advantages and its limitations. Because of the small amount of time required to make Brix and polarization readings (procedure 1), a large number of samples can be analyzed periodically, thus reducing to a minimum the error due to cane sampling and making it possible to follow the course of inversion more minutely than by using procedures 2 and 3. The chemical analyses are more accurate and detailed in procedures 2 and 3 than in procedure 1.

The same number of samples were used in procedure 2 as in procedure 1 and, consequently, data of the same degree of accuracy were obtained. The variability of the samples was obscured, however, by compositing the juice of the different samples of cane. Furthermore, because of the amount of work involved in chemical analyses in procedure 2, the number of separate determinations was limited, and in experiments involving four varieties and six environmental conditions it was not possible to make frequent analyses. Because of the labor involved in preparation of the cane samples for analyses in procedure 3, the number of cane samples that were analyzed at a given time was limited, thus giving rise to considerable error because of insufficient samples. The frequency of taking samples was limited for the same reason and also because of the time required for the more detailed chemical analyses.

A further error enters into this procedure because of the difficulty of obtaining a representative sample of the small piece of cane and of the disintegrated cane, which consisted of finely divided pulp of parenchymatous tissue and the macerated fiber. Procedure 3 has an advantage over procedures 1 and 2 in that it is more representative of the soluble phase of the cane itself and includes also fiber deterinations. Despite the limitations of each of the procedures, the results, insofar as they are parallel, appear to be in essential agreement.

The changes in calculated yields of 96° sugar given in the various tables are not to be regarded as representing the actual changes in the sucrose occurring during storage but merely as the effect of those changes on the recovery of 96° sugar. They do, however, give a reasonable indication of the loss of sucrose due to inversion. When the inversion of sucrose is large, the difference in calculated yields permits contrasts between varieties, temperatures, humidities, and successive periods of storage. Such data also are of considerable practical importance because they indicate the quantity of 96° sugar that can be obtained from cane stored under varied conditions.

When cane is stored at a common temperature and the production of invert sugars through inversion of sucrose is greater than their destruction through respiration, it is possible by the use of apparent and, particularly, true purity to compare rates of inversion in different lots of different varieties of cane of the same and different treatments and under conditions of storage other than temperature. When the difference in rate of inversion is large, such a comparison is greatly facilitated. When cane is stored at different temperatures, the purity values obtained are not merely affected by inversion but by a differential utilization of invert sugars through respiration (table 5). The rate of utilization increases with the rise in temperature and results in a corresponding retardation in the drop in purity. Furthermore, when sucrose is converted into invert sugars there is an increase in weight of sugars in the ratio of 95 : 100. The Brix and soluble solids are thus slightly increased in amount and, in turn, the purity is slightly lowered. When the rate of inversion differs there is a differential effect on Brix, soluble solids, and purity values.

To care for the differential utilization of soluble solids (mostly, if not entirely, invert sugars) through respiration at different temperatures (tables 3 and 5), the apparent purities were determined from the apparent sucrose (corrected for weight change) obtained after the various periods of storage and from the original Brix. Thus calculated, the apparent purities become a more direct measure of rates as affected by temperature. This procedure was followed in all experiments dealing with different temperatures.

Under storage conditions restricting inversion it is not always possible to distinguish clearly the relative susceptibility to inversion of sucrose of varieties with relatively small differences in susceptibility. Similarly, difficulty is experienced in distinguishing the effect of the degree of maturity on inversion. Another factor that makes it difficult to interpret results relating to differences in variety and in maturity of the cane is the duration of the storage periods. Because of the scope of the experiments under discussion, involving hundreds of samples, it was not possible to synchronize the dates of analysis between varieties and experiments.

The influence of the maturity of cane on inversion will be discussed in more detail in connection with data relating to the effect of loss of moisture on inversion (p. 57).

Judging by the loss of 96° sugar in pounds and percentage and the change in apparent purity (table 2), more inversion of sucrose occurred in Co. 281 than in Co. 290 in experiment 2. Because of differences in the length of storage periods in experiment 1 the relation between the two varieties is not clear, although there appears to be more inversion in Co. 281 than in Co. 290. In experiment 3 the rate of inversion was greater in Co. 290 than in Co. 281.

The data in table 2 show that at temperatures of 46° and 56° F., and sometimes at 66° and 75°, P. O. J. 36-M and C. P. 807 are more susceptible to inversion of sucrose than Co. 281 and Co. 290. At 66° and 75° inversion is greater in some instances in Co. 281 and Co. 290 than in P. O. J. 36-M and C. P. 807, especially during the later periods of storage. The difference in the amount of inversion was somewhat variable between P. O. J. 36-M and C. P. 807, depending on the duration of storage. In some instances there was a tendency for inversion to slow up in all varieties with the continuation of storage. This tendency was not marked in the varieties Co. 281, Co. 290, and P. O. J. 36-M but was rather consistent in C. P. 807. In C. P. 807 inversion seemed to have reached an equilibrium by the end of the second period at all temperatures in experiment 1, at 56° and 66° in experiment 2, and at 56° in experiment 3.

There were no consistent differences in the amount of inversion as related to the temperatures of 46°, 56°, and 66° F. in varieties Co. 281 and Co. 290. As the temperature rose from 66° to 75°, the amount of inversion in these varieties became greater by the end of the final storage period.

During the first period of storage of P. O. J. 36–M and C. P. 807 there was no consistent relation between inversion of sucrose and temperature. By the end of the second period of storage a gradient in inversion developed, the amount decreasing in C. P. 807 with the rise in temperature from 46° to 66° in all three experiments and in P. O. J. 36–M in experiments 1 and 2. In P. O. J. 36–M this gradient extended to 75° by the end of the third period of storage in experiment 2. By the end of the final storage period the amount of inversion was greater in both varieties at 75° than at 66°, except in P. O. J. 36–M in experiment 2.

During the last two periods of storage inversion was greater in C. P. 807 at 46° than at 75° in all three experiments and in P. O. J. 36–M in experiments 1 and 2. During the last period of storage in experiment 3, inversion of sucrose in P. O. J. 36–M was greater at 46° than at 75°. No data were available for the second period in this experiment. The changes in true purity, in invert sugars (tables 4 and 5), and in true sucrose content (table 5) are in essential harmony with the foregoing relation of temperature to inversion of sucrose.

It will be seen from the results recorded in table 3 that if the apparent purity values were calculated from Brix and apparent sucrose as determined, the values obtained after periods of storage would be influenced by the utilization of soluble solids, particularly invert sugars (table 5), through respiration. This loss of solids resulted in higher purity values at all conditions of storage, with the effect increasing with the rise in temperature and the continuation of storage. When inversion is slight the effect of temperature on purities may be such as to give the impression that greater inversion occurred at lower than at higher temperatures, even in cases where that is not true. This loss in Brix as related to temperature is confirmed by the loss of true solids found in the juice (table 4). Two factors probably influenced the increased loss of solids with the rise in temperature. The usual effect of increased temperature on the rate of respiration is to increase it even in dormant tissue. In this case rooting and sprouting at 66° and 75° F., and particularly at the latter temperature, would be expected to have increased respiration and the utilization of solids. Although the results are not consistent in some instances, the loss of soluble solids on the whole was proportionately greater at 75° (tables 3 and 4) than at the lower temperatures.

The loss of soluble solids other than sucrose would, in addition to increasing the purity, improve the recovery of 96° sugar more than if these solids were retained in the cell sap of the cane and, in turn, in the juice. Because the yield of 96° sugar is dependent upon the purity of the juice, however, the Brix and apparent sucrose obtained after periods of storage were used in calculating the yield values. Judging by loss of Brix and true solids and invert sugars (tables 3, 4, and 5), the respiration rate of C. P. 807 seems to be slower at all temperatures than that in the other three varieties. The loss of Brix per day indicates that the respiration rate in Co. 281 may decrease with the continuation of storage.

The increase in organic nonsugars with the continuation of storage is in harmony in most cases with previous results (*4*). As the organic nonsugars were not determined directly, however, but were computed by subtracting the sum of total sugars and ash from 100 (representing the dry substance or total soluble solids), the values obtained are subject to considerable error. Furthermore, because the values given are percentages of the total soluble solids, which show a decrease during storage, the organic nonsugars, as well as the ash values, might well be expected to increase slightly. The changes in organic nonsugars bear no relation to storage temperatures. No significant change in pH or acidity occurred during storage.

Three successive experiments with four varieties of sugarcane were conducted during the harvesting season of 1934 under practically the same conditions used in 1933-34, except that the burlap bags draping the cut ends of the stalks were sprinkled once a day instead of three times daily. C. P. 28/19 was substituted for P. O. J. 36-M. The percentage loss of sugar per ton of cane and the drop in apparent purity are graphically represented in figure 1. The initial Brix, i. e., the Brix of juice from the control samples, and the individual apparent sucrose values, obtained after periods of storage, were used in calculating the apparent purities. The samples were stored at 96 to 98 percent humidity, and cut ends of the stalks of all samples were draped with burlap bags, which were sprinkled once a day.

In certain of the experiments in which the amount of inversion was small in each variety a differential trend in inversion as related to temperature is not obvious. In experiments in which the amount of inversion is greater, an inversion gradient is noticeable, especially after the first period of storage—the amount of inversion decreasing as the temperature rises from 46° to 66° F., with a tendency for it to increase again as the temperature rises to 75°. This relationship even holds for Co. 281 and Co. 290 in experiment 1, but not for C. P. 807 in experiments 2 and 3.

During the harvesting season of 1935 two experiments with each of the varieties Co. 281, Co. 290, and C. P. 28/19 and one with each of

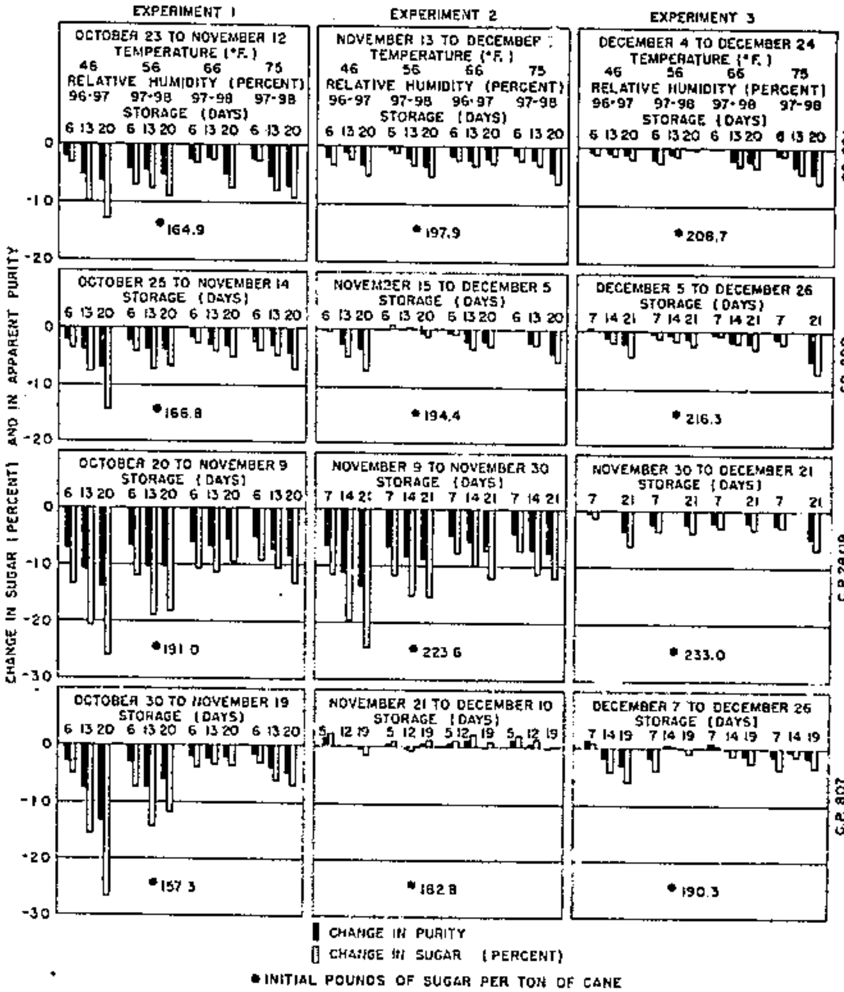

FIGURE 1.—Rise or fall of apparent purity and gain or loss of 96° sugar in four varieties of sugarcane (first-year stubble) stored at high moisture conditions at four temperatures in three successive experiments during the harvesting season of 1934.

the varieties C. P. 29/320 and C. P. 28/11 were conducted. The conditions of storage were modified slightly from those used in 1934. The use of burlap bags on the cut ends was omitted, but the cane was sprinkled once a day. Mill tests were run on some of the lots to determine whether the recovery of sugar from stored cane was different from that of freshly harvested cane. The factors that were developed are given in table 6. It will be seen that, in general, the results obtained by milling stored samples were similar to those obtained by milling freshly harvested cane.

In the main, the results are essentially in harmony with those obtained during 1933 and 1934. When inversion was limited the

TABLE 6.—*Change in weight, purity, sucrose in juice, and yield of 96° sugar in cane of 5 varieties stored at high humidity at each of 4 temperatures (relative humidity 95–98 percent)*

Experiment No.	Date of analysis	Duration of storage	Gain (+) or loss (−) in weight of cane at temperatures of—				Gain (+) or loss (−) in apparent purity at temperatures of—				Gain (+) or loss (−) of apparent sucrose in juice at temperatures of—				Gain (+) or loss (−) of 96° sugar at temperatures of—				Milling factors [1] at temperatures of—			
			47° F.	57° F.	66° F.	75° F.	47° F.	57° F.	66° F.	75° F.	47° F.	57° F.	66° F.	75° F.	47° F.	57° F.	66° F.	75° F.	47° F.	57° F.	66° F.	75° F.
CO. 281 (FIRST-YEAR STUBBLE)																						
	1935	Days	Percent	Percent	Percent	Percent					Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent				
1	Oct. 25	7	+0.2	+0.7	+0.4	+0.1	+2.1	+2.3	−1.0	+0.9	+2.9	+3.2	−1.3	−1.3	+3.5	+4.3	−1.4	+2.1	------	------	------	------
1	Oct. 31	13	+.5	+.9	+.6	+.6	+.1	+.9	+.2	−1.5	+.2	−1.3	+.3	−2.0	0	+1.4	0	−2.1	0.986	1.003	1.019	1.003
2	Nov. 14	6	+.1	+.3	+.5	+.4	−3.6	−2.9	−2.7	−2.1	−4.3	−3.4	−3.2	−2.5	−6.4	−5.0	−4.5	−4.0	------	------	------	------
2	Nov. 20	12	+.5	+.4	+.8	+.6	−4.7	−4.7	−2.7	−3.5	−5.6	−5.6	−3.2	−4.2	−8.0	−7.0	−4.0	−5.0	1.008	1.006	1.015	1.014
2	Nov. 29	21	+.5	+.3	+.9	0	−4.8	−3.3	−4.7	−7.0	−5.7	−3.9	−5.6	−8.4	−8.5	−5.5	−7.0	−10.4	1.019	1.019	1.027	1.015
C. P. 28/19 (PLANT CANE)																						
1	Oct. 28	6	+0.1	+0.2	0	−0.1	−4.1	−4.1	−2.1	−1.7	−5.6	−5.6	−2.9	−2.4	−8.2	−7.5	−3.4	−2.7	------	------	------	------
1	Nov. 4	13	+.3	+.6	+.4	0	−8.2	−6.1	−4.0	−.7	−11.2	−8.3	−5.4	−1.0	−17.8	−11.6	−6.2	0	0.985	1.007	1.029	1.000
1	Nov. 11	20	+.8	+.6	+.8	+.5	−10.7	−4.7	−4.9	−3.4	−14.7	−6.5	−5.5	−4.7	−23.3	−8.9	−6.8	−4.8	------	------	------	------
2	Nov. 18	5	+.2	+.4	−.3	−.4	−2.0	−3.6	−2.5	−2.6	−2.4	−4.3	−3.0	−3.2	−2.9	−4.8	−3.8	−3.3	------	------	------	------
2	Nov. 25	12	+.2	+.5	+.1	−.3	−3.9	−3.5	−2.0	−1.9	−4.6	−4.2	−2.4	−2.3	−5.7	−4.3	−1.9	−1.4	1.000	.999	1.013	1.009
2	Dec. 2	19	−.2	−.1	−.4	−1.2	−3.8	−2.3	−3.5	−4.1	−4.5	−2.8	−4.2	−4.9	−5.7	−2.9	−4.3	−5.3	1.017	1.028	1.026	1.010
CO. 290 (FIRST-YEAR STUBBLE)																						
1	Nov. 6	8	−0.3	−0.1	−0.1	0	−3.8	−1.1	−1.3	−1.1	−5.4	−1.5	−1.8	−1.5	−5.7	0	−1.0	0	------	------	------	------
1	Nov. 11	13	+.1	−.3	+.1	+.3	−1.5	−3.3	−2.9	−3.9	−2.2	−4.8	−4.1	−5.6	−3.3	−4.9	−4.1	−6.5	------	------	------	------
1	Nov. 18	20	−.1	+.3	+.2	+.4	−5.8	−4.2	−5.9	−5.0	−8.3	−6.0	−8.4	−7.1	−6.5	−8.1	−9.8	−8.1	------	------	------	------
2	Nov. 25	6	−.1	0	+.2	−.1	−1.9	−2.8	−3.2	−1.3	−2.6	−3.8	−4.4	−1.8	−4.0	−5.3	−6.0	−2.7	------	------	------	------
2	Dec. 2	13	+.1	−.3	−.5	−.8	−2.7	−1.4	−4.8	−4.3	−3.7	−1.9	−6.5	−5.8	−6.0	−3.3	−9.3	−8.0	1.001	1.013	1.007	1.007
C. P. 29/320 (FIRST-YEAR STUBBLE)																						
1	Nov. 8	8	−0.5	−0.4	−0.7	−0.5	+2.3	+2.1	+1.4	+0.5	+2.8	+2.6	+1.8	+0.7	+4.4	−3.9	+3.3	−1.7	------	------	------	------
1	Nov. 13	13	−.7	+.5	−.8	−.6	−1.2	−1.7	−2.8	−3.9	−1.5	−2.1	−3.4	−4.9	−2.2	−2.2	−4.4	−7.2	0.984	0.986	0.999	1.010
C. P. 28/11 (FIRST-YEAR STUBBLE)																						
1	Nov. 22	8	−0.4	−0.4	−0.4	------	+0.1	−0.9	−0.9	------	+0.1	−1.1	−1.1	------	------	−4.0	−1.0	------	------	------	------	------
1	Nov. 29	15	−.3	0	+.1	−0.7	−3.2	−2.2	−2.8	−2.5	−3.9	−2.8	−3.5	−3.0	−3.5	−3.5	−4.0	−3.5	------	------	------	------

[1] Check=1.00.

relation to temperature was not so clear. In most instances, by the end of the final storage period the amount of inversion was less at 57° than at either 47° or 66° F. In C. P. 28/19 (experiment 1) when the rate of inversion was rather large, a gradient in the drop in apparent purity, the loss of apparent sucrose in juice, and the loss of 96° sugar by the end of the last two periods of storage was apparent, the values decreasing with the rise in temperature from 47° to 75°.

Two successive experiments with each of the varieties Co. 281, Co. 290, C. P. 28/19, and C. P. 807, in which the cane was sprinkled once a day and stored at high relative humidity at temperatures of 37° to 38°, 47°, 56°, and 65° F., were conducted during the harvesting season of 1936. The data will be discussed here briefly but will not be presented in tabular form.

In general, the amount of inversion varies with the variety—from least to greatest—in the order in which the varieties are listed. Very little inversion of sucrose occurred in Co. 281 at any temperature in either experiment. There was some indication that more inversion occurred in this variety at 47° than at 37° to 38° F., although the results are not entirely consistent in this connection. The indicated loss of 96° sugar and the drop in apparent purity showed that inversion of sucrose was greater at 47° than at 37° to 38° F. in Co. 290 by the end of 7, 14, 20, or 21 days; in C. P. 28/19 by the end of 14 and 21 to 24 days; and in C. P. 807 by the end of 6 or 7, 13 or 14, and 20 or 21 days' storage. The difference was much larger in case of C. P. 807 than in the other two varieties. The relationship between inversion of sucrose and temperatures of 47°, 56°, and 65° was not clear-cut or consistent. The inversion of sucrose in Co. 281 did not show a definite differential response.

In experiment 1, Co. 290 showed a decrease in loss of 96° sugar after 14 days and a drop in apparent purity with the rise in temperature. By the end of 21 days these changes decreased with the rise in temperature from 47° to 56° F. and increased as the temperature was raised to 65°. In experiment 2 after 7 and 14 days' storage inversion of sucrose decreased with the rise in temperature from 47° to 56° and increased with a rise to 65°. After 20 days' storage inversion decreased with rise in temperature from 47° to 65°. The behavior of C. P. 28/19 was erratic, and no conclusion can be drawn from these data regarding the relation of inversion to temperatures of 47°, 56°, and 65°. In experiment 1, the loss of 96° sugar and drop in purity in C. P. 807 increased rapidly during 6 to 13 days' storage as the temperature increased from 37° to 38° to 56° and decreased rapidly as the temperature was raised to 65°. By the end of 21 days' storage the loss of 96° sugar and drop in apparent purity was greatest at 47° and decreased rapidly as the temperature was raised or lowered. In experiment 2, C. P. 807 showed the greatest loss of 96° sugar and a drop in apparent purity at 47° during 7, 14, and 21 days' storage. These changes decreased rapidly as the temperature was raised above or lowered below 47° during 14 and 21 days' storage.

Thus far the discussion has been limited to a consideration of the effect of different temperatures on inversion of sucrose in cane stored under high moisture conditions. Such conditions restrict the amount of inversion occurring at all temperatures. When lots of cane of the varieties Co. 281, Co. 290, P. O. J. 36-M, C. P. 28/19, and C. P. 807

stored under high moisture conditions at different temperatures (47° to 75° F.) showed a certain level of inversion of sucrose, there was, in most instances, an increase in amount of inversion with the rise in temperature from 47° to 66° by the end of 19 to 24 days' storage, frequently by the end of 12 to 14 days' storage, and sometimes by the end of 5 to 7 days' storage.

Temperature and High and Low Moisture Conditions

The idea that as much inversion of sucrose would take place at 47° as at 65° F. was difficult to accept. Even more difficult to accept was the idea that more inversion of sucrose would take place at 47° than at 65°. So difficult was the notion that more convincing evidence was desired. By storing sugarcane at conditions of moisture that favor inversion of sucrose and bring about similar losses of moisture at different temperatures, it was thought possible to differentiate more clearly between the effects of different temperatures than by storing cane at conditions that prevent or reduce to a minimum the loss of moisture.

Cane was stored, therefore, during the grinding season of 1936 at two levels of moisture conditions, each at temperatures of 47° and 65° F. (tables 7, 8, and 9). At the one level the relative humidity was 96 percent and the cane was sprinkled once a day; at the other level an attempt was made to obtain the same saturation deficit at each temperature. The same saturation deficit was only approximate. In the case of a given variety the greater saturation deficit at 65° resulted in most instances in slightly greater loss of moisture than at 47°. Such a difference was not undesirable because, then, any indicated greater inversion at 47° than at 65° could not be attributed to a greater loss of moisture.

Two successive experiments each with the varieties Co. 281 and Co. 290 and C. P. 28/19 and C. P. 807, in which simple juice analyses were made, were conducted during the harvesting season of 1936 (tables 7 and 8). Analyses of completely extracted juice (analyses of cane) were made of Co. 281 and Co. 290 stored at both high and low humidities and of C. P. 28/19 and C. P. 807 stored at low humidity at temperatures of 47° and 65° F. (table 9).

At a relative humidity of 96 percent the amount of inversion of sucrose in Co. 281 may have been significantly greater at 47° than at 65° F. (tables 7 and 9) during the last two periods of storage (14 and 21 days) in experiment 1. In experiment 2 the data indicate a greater loss of 96° sugar at 65° than at 47° and a greater drop in apparent purity during 15 and 21 days' storage. The consumption of soluble solids (probably invert sugars) was much greater in both experiments at 65° than at 47° F. (table 8). The loss of true sucrose was slightly greater at 65° than at 47° in both experiments after 21 and 22 days' storage (table 9).

At 96 percent relative humidity the indicated loss of 96° sugar and drop in apparent purity in Co. 290 were greater at 47° F. than at 65° during the last two periods of storage in experiment 1 and during the last period in experiment 2 (table 7). The difference in inversion of sucrose between temperatures of 47° and 65° after 14 and 21 days of storage in experiment 1 and after 21 days in experiment 2 was hardly

Table 7.—*Yield of 96° sugar, gain or loss in 96° sugar, in apparent purity, and in weight of first-year stubble cane during storage of 4 varieties of sugarcane in 2 successive experiments at 2 levels of humidity at temperatures of 47° and 65° F., 1936*

Experiment No.	Date of analysis	Duration of storage	Temperature 47° F. — Relative humidity 96 percent,[1] or saturation deficit 0.013 inch: Yield of 96° sugar per ton of cane	Gain (+) or loss (−): Of 96° sugar		In purity	In weight	Temperature 47° F. — Relative humidity 54 percent, or saturation deficit 0.148 inch: Yield of 96° sugar per ton of cane	Loss of 96° sugar		Purity drop	Weight loss	Temperature 65° F. — Relative humidity 96 percent,[1] or saturation deficit 0.025 inch: Yield of 96° sugar per ton of cane	Loss of 96° sugar		Purity drop	Gain (+) or loss (−) in weight	Temperature 65° F. — Relative humidity 74 percent, or saturation deficit 0.165 inch: Yield of 96° sugar per ton of cane	Loss of 96° sugar		Purity drop	Weight loss
		Days	*Pounds*	*Pounds*	*Percent*		*Percent*	*Pounds*	*Pounds*	*Percent*		*Percent*	*Pounds*	*Pounds*	*Percent*		*Percent*	*Pounds*	*Pounds*	*Percent*		*Percent*
CO. 281																						
1	Oct. 23	0	140.0					140.0					140.0					140.0				
	Oct. 30	7	142.6	+2.6	+1.9	+0.9	−1.0	136.1	3.9	2.8	1.8	4.4	138.8	1.2	0.9	1.2	−1.0	135.7	4.3	3.1	1.5	5.6
	Nov. 6	14	135.6	−4.4	−3.1	−1.7	−.9	128.1	11.9	8.5	4.5	8.3	138.7	1.3	.9	1.3	−.2	136.0	4.0	2.9	1.6	8.9
	Nov. 13	21	129.0	−11.0	−7.9	−4.4	−1.6	113.9	26.1	18.6	9.1	12.2	134.7	5.3	3.8	2.8	0	134.1	5.9	4.2	2.4	14.1
Difference for $P=0.05$						1.07					1.07					1.07					1.07	
Difference for $P=0.01$						1.42					1.42					1.42					1.42	
2	Nov. 18	0	180.1					180.1					180.1					180.1				
	Nov. 27	9	175.3	−4.8	−2.7	−1.4	−.4	176.8	3.3	1.8	1.0	5.0	177.2	2.9	1.6	1.1	−.2	174.0	6.1	3.4	1.9	5.8
	Dec. 3	15	175.7	−4.4	−2.4	−1.2	−.5	170.4	9.7	5.4	2.7	7.3	171.5	8.6	4.8	3.2	+.5	174.9	5.2	2.9	1.7	7.7
	Dec. 9	21	174.4	−5.7	−3.2	−1.4	+.7	154.1	26.0	14.4	8.1	12.2	169.2	10.9	6.1	4.0	−.3	169.6	10.5	5.8	3.6	13.2
Difference for $P=0.05$						1.78					1.78					1.78					1.78	
Difference for $P=0.01$						2.38					2.38					2.38					2.38	
CO. 290																						
1	Oct. 28	0	125.4					125.4					125.4					125.4				
	Nov. 4	7	117.7	−7.7	−6.1	−2.9	−0.8	113.4	12.0	9.6	4.8	3.4	119.4	6.0	4.8	2.6	−0.3	112.6	12.8	10.2	4.8	3.6
	Nov. 11	14	111.6	−13.8	−11.0	−5.4	−.5	89.2	36.2	28.9	12.8	5.6	118.6	6.8	5.4	3.2	−.4	100.4	25.0	19.9	9.2	6.3
	Nov. 18	21	110.5	−14.0	−11.9	−5.6	−1.2	67.1	58.3	46.5	20.3	8.2	116.6	8.8	7.0	4.4	−1.0	97.1	28.3	22.6	10.6	8.4
Difference for $P=0.05$						1.54					1.54					1.54					1.54	
Difference for $P=0.01$						2.05					2.05					2.05					2.05	
2	Nov. 13	0	140.3					140.3					140.3					140.3				
	Nov. 20	7	130.8	−9.5	−6.8	−3.6	−.08	127.7	12.6	9.0	4.4	3.5	134.1	6.2	4.4	2.4	−.1	128.9	11.4	8.1	3.7	3.2
	Nov. 27	14	133.7	−6.6	−4.7	−2.3	−.3	116.4	23.9	17.0	7.8	5.4	131.6	8.7	6.2	3.8	−.4	119.4	20.9	14.9	6.9	5.5
	Dec. 3	20	128.6	−11.7	−8.3	−4.2	−.3	89.7	50.6	36.1	16.2	7.0	132.8	7.5	5.3	3.0	−.2	117.0	23.3	16.6	7.6	8.7
Difference for $P=0.05$						1.57					1.57					1.57					1.57	
Difference for $P=0.01$						2.10					2.10					2.10					2.10	
C. P. 28/19																						
1	Oct. 16	0	194.8					194.8					194.8					194.8				
	Oct. 23	7	185.0	−9.8	−5.0	−2.5	−0.9	171.9	22.9	11.8	6.4	5.6	181.8	13.0	6.7	3.9	−1.2	147.3	47.5	24.4	13.5	6.7
	Oct. 30	14	182.9	−11.9	−6.1	−3.1	−.3	164.4	30.4	15.6	8.0	8.3	178.2	16.6	8.5	5.0	−.9	149.5	45.3	23.3	12.7	10.1
	Nov. 6	21	174.4	−20.4	−10.5	−5.0	−.2	123.0	71.8	36.9	20.1	12.1	177.2	17.6	9.0	5.3	−1.7	145.2	49.6	25.5	14.1	13.6
Difference for $P=0.05$						1.60					1.60					1.60					1.60	
Difference for $P=0.01$						2.13					2.13					2.13					2.13	
2	Nov. 6	0	215.6					215.6					215.6					215.6				
	Nov. 13	7	208.3	−7.3	−3.4	−1.8	−.4	200.7	14.9	6.9	3.6	5.6	210.7	4.9	2.3	1.2	−.3	195.0	20.6	9.6	5.6	4.8
	Nov. 20	14	203.9	−11.7	−5.4	−3.1	−.2	194.1	21.5	10.0	5.4	7.5	211.9	3.7	1.7	1.2	+.00	194.4	21.2	9.8	5.5	7.4
	Nov. 30	24	206.6	−9.0	−4.2	−2.2	+.5	155.8	59.8	27.7	11.7	12.5	203.1	12.5	5.8	3.8	−.2	187.2	28.4	13.2	7.3	12.7
Difference for $P=0.05$						1.49					1.49					1.49					1.49	
Difference for $P=0.01$						2.00					2.00					2.00					2.00	
C. P. 807																						
1	Oct. 22	0	164.1					164.1					164.1					164.1				
	Oct. 28	6	150.9	−13.2	−8.0	−4.4	−0.6	150.8	13.3	8.1	4.3	3.7	148.1	16.0	9.8	5.8	−0.8	105.1	59.0	36.0	19.5	4.9
	Nov. 4	13	135.9	−28.2	−17.2	−9.4	−.5	109.2	54.9	33.5	17.7	7.5	140.7	23.4	14.3	8.1	−1.3	88.1	76.0	46.3	24.9	7.8
	Nov. 11	20	110.1	−54.0	−32.9	−17.5	−.4	55.7	108.4	66.1	34.9	11.3	137.1	27.0	16.5	9.1	−2.2	86.2	77.9	47.5	25.6	11.9
Difference for $P=0.05$						2.26					2.26					2.26					2.26	
Difference for $P=0.01$						2.99					2.99					2.99					2.99	
2	Nov. 11	0	181.0					181.0					181.0					181.0				
	Nov. 18	7	167.1	−13.9	−7.7	−4.6	−.1	161.8	19.2	10.6	5.7	3.6	169.6	11.4	6.3	4.3	+.2	142.0	38.1	21.0	11.7	3.9
	Nov. 25	14	149.6	−31.4	−17.3	−9.6	+.07	135.0	46.0	25.4	13.4	6.6	173.6	7.4	4.1	2.5	−.1	128.2	52.8	29.2	15.9	6.9
	Dec. 2	21	149.7	−31.3	−17.3	−9.4	+.07	81.5	99.5	55.0	29.8	9.9	170.8	10.2	5.6	3.0	−.6	127.3	53.7	29.7	16.4	9.6
Difference for $P=0.05$						1.48					1.48					1.48					1.48	
Difference for $P=0.01$						1.97					1.97					1.97					1.97	

[1] The cane stored at 96 percent relative humidity at 47° F. and at 96 percent at 65° F. was sprinkled once a day.

TABLE 8.—*Change in Brix in first-year stubble cane of 4 varieties stored at 2 levels of humidity [1] each at temperatures of 47° and 65° F., 1936*

Variety and experiment No.	Date of analysis	Duration of storage	Initial Brix	Gain (+) or loss (−) in Brix at indicated relative humidities (percent) at— 47° F. 96	47° F. 54	65° F. 96	65° F. 74
		Days	*Degrees*	*Degree*	*Degree*	*Degree*	*Degree*
Co. 281:							
Experiment 1	Oct. 23	0	14.41				
	Oct. 30	7		−0.03	−0.25	−0.38	−0.06
	Nov. 6	14		−.14	−.31	−.42	−.16
	Nov. 13	21		−.43	−.34	−.54	−.25
Experiment 2	Nov. 18	0	15.87				
	Nov. 27	9		+.01	+.02	−.14	−.06
	Dec. 3	15		+.03	+.07	−.37	−.10
	Dec. 9	21		+.15	−.23	−.46	−.28
Co. 290:							
Experiment 1	Oct. 28	0	13.61				
	Nov. 4	7		−.09	−.32	−.25	−.20
	Nov. 11	14		−.30	−.20	−.38	−.30
	Nov. 18	21		−.19	−.20	−.67	−.41
Experiment 2	Nov. 13	0	14.53				
	Nov. 20	7		−.26	−.17	−.21	−.04
	Nov. 27	14		−.12	−.06	−.54	−.11
	Dec. 3	20		−.23	+.01	−.32	−.07
C. P. 28/19:							
Experiment 1	Oct. 16	0	16.71				
	Oct. 23	7		+.08	−.40	−.19	−.20
	Oct. 30	14		+.08	+.24	−.22	−.08
	Nov. 6	21		+.06	−.06	−.23	−.19
Experiment 2	Nov. 6	0	17.06				
	Nov. 13	7		+.13	+.19	+.09	−.12
	Nov. 20	14		−.02	+.15	−.10	+.04
	Nov. 30	24		+.12	+.13	−.33	+.08
C. P. 807:							
Experiment 1	Oct. 22	0	14.43				
	Oct. 28	6		−.04	0	−.32	−.23
	Nov. 4	13		−.17	−.01	−.25	−.18
	Nov. 11	20		−.04	−.01	−.20	−.21
Experiment 2	Nov. 11	0	15.52				
	Nov. 18	7		−.28	+.02	−.51	−.17
	Nov. 25	14		−.14	+.16	−.18	−.08
	Dec. 2	21		−.02	−.01	−.31	−.20

[1] The humidity values at 47° and 65° F. were selected to obtain similar loss of moisture at 2 levels each at temperatures of 47° and 65°. The cane stored at 96 percent relative humidity at each temperature was sprinkled once a day.

large enough to be significant. In any case, there was as much inversion at 47° as at 65°. The loss of true sucrose in both experiments after 22 and 24 days' storage was greater at 47° than 65° (table 9). This difference was small in experiment 1, but the difference in increase in invert sugars was rather large.

The results obtained with C. P. 28/19 were not consistent, and no conclusions can be drawn relative to the effect of any temperature on inversion, although in experiment 1 there was a slightly greater loss of 96° sugar and drop in apparent purity at 47° than at 65° at the end of the third period of storage. The loss of 96° sugar and drop in apparent purity were greater in C. P. 807 at 47° than at 65° after 13 and 20 days' storage in experiment 1 and after 7, 14, and 21 days' storage in experiment 2. The difference in values after 6 and 7 days' storage in the two experiments was probably too small to be significant, but it was significantly greater in both experiments after the second and third periods of storage.

TABLE 9.—*Composition and change in composition of first-year stubble sugarcane varieties Co. 281 and Co. 290 stored at 2 humidities and C. P. 28/19 and C. P. 807 at 1 humidity, at 47° and 65° F.,*[1] *1936*

Experiment No.	Date of analysis	Duration of storage	Temperature	Relative humidity	Composition of cane: True sucrose	Composition of cane: Reducing sugars	Composition of cane: Total sugars	Composition of cane: Total solids	Composition of cane: True purity	Gain (+) or loss (—) during storage in—: True sucrose	Gain (+) or loss (—) during storage in—: Reducing sugars	Gain (+) or loss (—) during storage in—: Total sugars	Gain (+) or loss (—) during storage in—: Total solids	Gain (+) or loss (—) during storage in—: True purity
		Days	*° F.*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*	*Percent*	
						CO. 281								
1	Oct. 22	0			9.27	1.09	10.36	11.76	78.83					
	Nov. 12	21	47	96-97	9.01	1.19	10.20	11.62	77.54	—0.26	+0.10	—0.16	—0.14	—1.29
	do	21	47	54	8.33	1.86	10.19	11.44	72.81	—.94	+.77	—.17	—.32	—6.02
	do	21	65	96-97	8.95	1.00	9.95	11.33	78.99	—.32	—.09	—.41	—.43	+.16
	do	21	65	74	8.87	1.26	10.13	11.50	77.13	—.40	+.17	—.23	—.26	—1.70
2	Nov. 17	0			11.09	.65	11.74	13.17	84.20					
	Dec. 9	22	47	96-97	11.06	.68	11.74	13.08	84.56	—.03	+.03	0	—.09	+.36
	do	22	47	54	10.75	1.18	11.93	13.43	80.04	—.34	+.53	+.19	+.26	—4.16
	do	22	65	96-97	11.02	.62	11.64	13.10	84.12	—.07	—.03	—.10	—.07	—.08
	do	22	65	74	10.80	.73	11.53	13.06	82.70	—.29	+.08	—.21	—.11	—1.50
						CO. 290								
1	Oct. 27	0			8.84	1.32	10.16	11.55	76.54					
	Nov. 20	24	47	96-97	8.24	1.68	9.92	11.30	72.92	—0.60	+0.36	—0.24	—0.25	—3.62
	do	24	47	54	6.56	3.32	9.88	11.38	57.64	—2.28	+2.00	—.28	—.17	—18.90
	do	24	65	96-97	8.27	1.34	9.61	10.97	75.39	—.57	+.02	—.55	—.58	—1.15
	do	24	65	74	7.82	2.02	9.84	11.36	68.84	—1.02	+.70	—.32	—.19	—7.70
2	Nov. 13	0			10.10	1.24	11.34	12.64	79.91					
	Dec. 5	22	47	96-97	9.06	1.53	10.59	12.06	75.12	—1.04	+.29	—.75	—.58	—4.79
	do	22	47	54	7.58	3.11	10.69	11.98	63.27	—2.52	+1.87	—.65	—.66	—16.64
	do	22	65	96-97	9.34	1.23	10.57	12.01	77.80	—.76	—.01	—.77	—.63	—2.14
	do	22	65	74	8.62	1.94	10.56	11.95	72.05	—1.48	+.70	—.78	—.69	—7.78

C. P. 28/19

1	Oct. 16	0			11.34	1.01	12.35	14.21	79.80					
	Nov. 7	22	47	54	9.22	3.06	12.28	13.62	67.69	−2.12	+2.05	−0.07	−0.59	−12.11
	do	22	65	74	10.67	2.01	12.68	13.97	76.38	−.67	+1.00	+.33	−.24	−3.42
2	Nov. 7	0			13.26	.67	13.93	15.40	86.10					
	Nov. 28	21	47	54	10.79	2.38	13.17	14.73	73.25	−2.47	+1.71	−.76	−.67	−12.85
	do	21	65	74	12.15	1.37	13.52	14.90	81.54	−1.11	+.70	−.41	−.50	−4.56

C. P. 807

1	Oct. 21	0			9.79	0.81	10.60	11.57	84.62					
	Nov. 10	20	47	54	7.13	3.43	10.56	11.73	60.78	−2.66	+2.62	−0.04	+0.16	−23.84
	do	20	65	74	7.68	3.19	10.87	12.01	63.95	−2.11	+2.38	+.27	+.44	−20.67
2	Nov. 10	0			10.97	.63	11.60	12.85	85.37					
	Dec. 3	23	47	54	8.02	4.01	12.03	13.28	60.39	−2.95	+3.38	+.43	+.43	−24.98
	do	23	65	74	9.25	2.39	11.64	13.00	71.15	−1.72	+1.76	+.04	+.15	−14.22

[1] The high and low humidity at 47° F. insured similar loss of moisture at high and low humidity at 65° F. For humidity and loss in weight values see table 7.

In cane of a given variety stored at low humidities at 47° and 65° F. (table 7 and fig. 2) the loss in weight was almost equal at the two temperatures, but was slightly greater in most instances at 65°. There was no consistent difference in the loss of 96° sugar and drop in apparent purity in Co. 281 and Co. 290 at 47° and 65° during the first period of storage. During the two succeeding periods, inversion

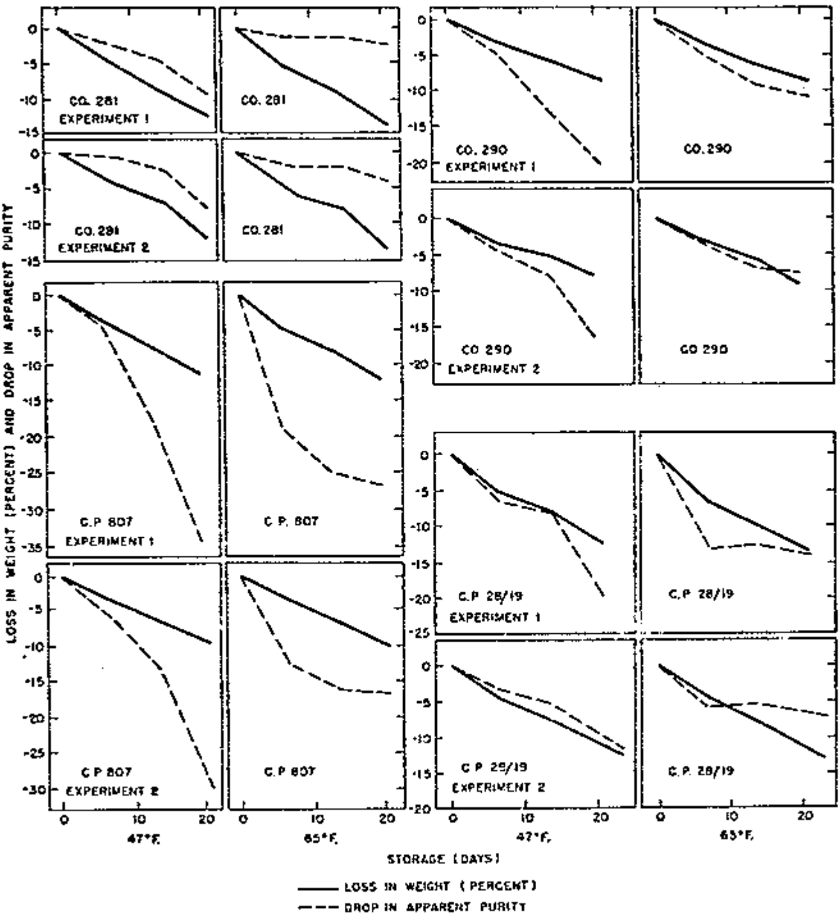

FIGURE 2.—Loss in weight of cane and drop in apparent purity of juice of four varieties of sugarcane (first-year stubble) stored at approximately the same saturation deficit at 47° and 65° F. in two successive experiments conducted during the fall of 1936 (curve drawn from data given in table 7).

of sucrose was significantly greater at 47° than at 65°, particularly during the third period of storage. C. P. 28/19 in experiment 1 and C. P. 807 in both experiments showed markedly greater inversion at 65° than at 47° during the first period. Although by the end of the second period the loss of 96° sugar and drop in apparent purity were greater at 65° than at 47°, the difference was much less than during the first period. C. P. 28/19 in experiment 2 showed greater inversion at 65° than at 47° during the first period, but the values in loss of 96° sugar and apparent purities were about equal by the end of the second period. By the end of the third period the loss of 96° sugar and drop in apparent purity were markedly greater in both C. P. 807 and C. P. 28/19 at 47° than at 65°.

A greater loss of true sucrose at 47° than at 65° F. was shown in cane of each variety and experiment by the end of 20 to 24 days' storage (table 9). Part of the difference in amount of invert sugars probably was occasioned by their greater consumption at 65°. There was a correspondingly greater increase in invert sugars at 47° than at 65°. The data relating to C. P. 807 and C. P. 28/19 indicate a shift in the rate of inversion at the two temperatures with the lapse of time. The rate of inversion of sucrose in C. P. 807 was relatively rapid at 65° during the first period of storage, then slowed up during the second period, and approached or reached an equilibrium during the third period. In C. P. 28/19 the equilibrium was reached by the end of the first period (fig. 2). An equilibrium also seems to have been approached in varieties Co. 281 and Co. 290, but it is not as definite as in the other two varieties. In all varieties the rate of inversion increases at 47° with the lapse of time. Such an increase in rate might have been expected, except that the rate approaches, and sometimes exceeds, that occurring at 65° during the first interval of storage. In an experiment conducted during the harvesting season of 1944, there was a slowing up of inversion in C. P. 807 in 28 days of storage at 45° (unpublished data).

There is little indication that rate of respiration is greater at high than at low moisture conditions at 47° (table 8). This relation of respiration to differences in moisture conditions is more clearly shown at 65°, as might have been expected because of a greater vegetative activity in wet cane at 65° than at 47°.

Temperature and Inversion at a Common Saturation Deficit at Different Temperatures

During the harvesting season of 1937, two successive experiments with Co. 281 and Co. 290 and one experiment with each of the varieties C. P. 28/19 and C. P. 28/11 were conducted, in which simple juice analyses (Brix and polarization) were made at the beginning and during the following intervals of storage at approximately the same saturation deficit at temperatures of 51°, 62°, 71°, and 80° F. (table 10). In experiment 1 dealing with Co. 281 and Co. 290 and in the experiment with C. P. 28/19, an analysis of completely extracted juice (analysis of cane) was made of three comparable samples of each variety at the beginning of the experiments and after 13 (Co. 281 and C. P. 28/19) and 14 days of storage (Co. 290) (table 11).

Rooting and sprouting occurred only at 80° F. Co. 281 showed no rooting or sprouting during 16 days' storage (experiment 1). In experiment 2, one eye began to swell in 20 days. Co. 290 showed a few sprouts after 18 days' storage (experiment 1), and roots (ranging from 0.5 to 0.75 inch) and swollen eyes after 20 days' storage (experiment 2). There was no rooting or sprouting in the varieties C. P. 28/19 and C. P. 28/11.

TABLE 10.—*Brix, apparent sucrose, apparent purity, yield of 96° sugar, and changes in these values and the loss in weight of cane of 4 varieties of first-year stubble sugarcane stored at approximately the same saturation deficit* [1] *at 4 temperatures during the harvesting season of 1937*

CO. 281

Experiment No.	Date of analysis	Duration	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar per ton of cane at temperatures of—								Initial Brix	Gain (+) or loss (−) of Brix at temperatures of—			
				51° F.	62° F.	71° F.	80° F.	51° F.	62° F.	71° F.	80° F.		51° F.	62° F.	71° F.	80° F.
		Days	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Degrees*	*Degrees*	*Degrees*	*Degrees*	*Degrees*
1	Oct. 27	0	158.1									15.02				
	Nov. 1	5		−6.9	−3.5	−5.3	−4.9	−4.4	−2.2	−3.4	−3.1		−0.01	−0.09	−0.27	−0.30
	Nov. 6	10		−10.4	−5.4	−3.8	−6.9	−6.6	−3.4	−2.4	−4.4		−.03	+.04	−.49	−.55
	Nov. 12	16		−20.2	−16.8	−9.8	−12.3	−12.8	−10.6	−6.2	−7.8		−.14	−.44	−.44	−.68
Difference for $P=0.05$																
Difference for $P=0.01$																
2	Nov. 16	0	205.4									16.78				
	Nov. 22	6		−3.0	−1.3	−2.3	−5.0	−1.5	−.6	−1.1	−2.4		−.48	−.21	−.10	−.18
	Nov. 29	13		−13.2	−14.3	−12.6	−14.4	−6.4	−6.9	−6.1	−7.0		−.14	−.49	−.54	−.65
	Dec. 6	20		−17.8	−13.8	−12.5	−20.7	−8.7	−6.7	−6.1	−10.1		−.30	−.50	−.84	−.69
Difference for $P=0.05$																
Difference for $P=0.01$																
2	Dec. 23	37		−25.0	−24.7	−62.9	−89.7	−12.2	−12.0	−30.6	−43.7		−.40	−.35	−1.55	−2.04

CO. 290

Experiment No.	Date of analysis	Duration	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar per ton of cane at temperatures of—								Initial Brix	Gain (+) or loss (−) of Brix at temperatures of—			
				51° F.	62° F.	71° F.	80° F.	51° F.	62° F.	71° F.	80° F.		51° F.	62° F.	71° F.	80° F.
1	Oct. 28	0	159.6									14.98				
	Nov. 3	6		−9.6	−14.2	−12.3	−8.6	−6.0	−8.9	−7.7	−5.4		−0.18	−0.17	−0.21	−0.40
	Nov. 8	11		−30.7	−14.8	−18.8	−18.9	−10.2	−9.3	−11.8	−11.8		−.03	−.31	−.12	−.67
	Nov. 15	18		−51.3	−25.9	−28.4	−31.4	−32.1	−16.2	−17.8	−19.7		−.12	−.33	−.64	−.89
Difference for $P=0.05$																
Difference for $P=0.01$																
2	Nov. 18	0	192.5									16.43				
	Nov. 24	6		−10.9	−8.3	−4.3	−8.7	−5.7	−4.3	−2.2	−4.5		−.36	−.22	−.36	−.36
	Dec. 1	13		−16.6	−18.8	−10.7	−22.6	−8.6	−9.8	−10.2	−11.7		−.55	−.42	−.53	−.83
	Dec. 8	20		−30.5	−25.0	−25.5	−24.6	−15.8	−13.0	−13.2	−12.8		−.41	−.62	−.86	−.80
Difference for $P=0.05$																
Difference for $P=0.01$																
2	Dec. 23	35		−44.4	−34.6	−71.3	−96.2	−23.1	−16.0	−37.0	−50.0		−.38	−.59	−1.50	−2.08

TS227*—48——5

C. P. 28/19

	Oct. 23	0	192.7									16.92				
[1]	Oct. 27	4		−23.6	−33.4	−31.0	−17.8	−12.2	−17.3	−16.1	−0.2		−0.71	−0.64	−0.66	−0.40
	Nov. 1	9		−41.5	−29.8	−25.3	−23.4	−21.5	−15.5	−13.1	−12.1		−.30	−.30	−.43	−.75
	Nov. 6	14		−44.5	−27.4	−24.1	−19.2	−23.1	−14.2	−12.5	−10.0		−.28	−.65	−.67	−1.02
Difference for $P=0.05$																
Difference for $P=0.01$																

C. P. 28/11

	Nov. 10	0	188.2									17.63				
[1]	Nov. 17	7		+2.5	−21.7	−6.8	+3.5	+1.3	−11.5	−3.6	+1.9		+0.19	−0.11	−0.09	+0.23
	Nov. 24	14		−66.8	−60.4	−27.4	−17.7	−35.5	−32.1	−14.6	−9.4		+.20	−.18	−.07	−.69
Difference for $P=0.05$																
Difference for $P=0.01$																

[1] Relative humidities and saturation deficit at temperatures of	51° F.	62° F.	71° F.	80° F.
Relative humidities — percent	63-66	73-74	81-82	85-87
Saturation deficit — inches mercury	0.134	0.147	0.140	0.143

TABLE 10.—*Brix, apparent sucrose, apparent purity, yield of 96° sugar, and changes in these values and the loss in weight of cane of 4 varieties of first-year stubble sugarcane stored at approximately the same saturation deficit*[1] *at 4 temperatures during the harvesting season of 1937*—Con.

CO. 281

Experiment No.	Date of analysis	Duration	Initial apparent sucrose in juice	Gain (+) or loss (−) of apparent sucrose in juice at temperatures of— 51° F.	62° F.	71° F.	80° F.	Initial apparent purity	Gain (+) or loss (−) of apparent purity at temperatures of— 51° F.	62° F.	71° F.	80° F.	Loss in weight at temperatures of— 51° F.	62° F.	71° F.	80° F.
		Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*						*Percent*	*Percent*	*Percent*	*Percent*
1	Oct. 27	0	11.71					78.0								
	Nov. 1	5		−0.33	−0.19	−0.32	−0.32		−2.2	−1.3	−2.2	−2.2	4.8	4.4	4.1	4.1
	Nov. 6	10		−.49	−.24	−.31	−.48		−3.3	−1.6	−2.1	−3.2	7.8	7.5	7.2	6.9
	Nov. 12	16		−.98	−.91	−.59	−.77		−6.6	−6.1	−4.0	−5.2	10.8	11.0	10.8	10.8
Difference for $P=0.05$									1.72	1.72	1.72	1.72	1.01	1.01	1.01	1.01
Difference for $P=0.01$									2.28	2.28	2.28	2.28	1.34	1.34	1.34	1.34
2	Nov. 16	0	14.42					85.9								
	Nov. 22	6		−.28	−.12	−.13	−.28		−1.6	−.7	−.7	−1.6	3.8	4.1	3.0	2.9
	Nov. 29	13		[illegible]	−.80	−.74	−.85		−3.9	−4.7	−4.4	−5.0	6.3	8.2	6.2	5.2
	Dec. 6	20		[illegible]	−.79	−.83	−1.16		−5.4	−4.7	−4.9	−6.9	9.0	11.3	9.5	4.4
Difference for $P=0.05$									1.29	1.29	1.29	1.29	.97	.97	.97	.97
Difference for $P=0.01$									1.72	1.72	1.72	1.72	1.29	1.29	1.29	1.29
2	Dec. 23	37		−1.28	−1.25	−3.37	−4.46		−7.6	−7.4	−20.0	−28.3	15.5	19.0	16.0	12.2

CO. 290

Experiment No.	Date of analysis	Duration	Initial apparent sucrose in juice	Gain (+) or loss (−) of apparent sucrose in juice at temperatures of— 51° F.	62° F.	71° F.	80° F.	Initial apparent purity	Gain (+) or loss (−) of apparent purity at temperatures of— 51° F.	62° F.	71° F.	80° F.	Loss in weight at temperatures of— 51° F.	62° F.	71° F.	80° F.
1	Oct. 28	0	11.77					78.6								
	Nov. 3	6		−0.50	−0.71	−0.64	−0.51		−3.4	−4.8	−4.3	−3.4	3.9	3.1	3.1	2.8
	Nov. 8	11		−1.44	−.78	−.91	−1.08		−9.6	−5.2	−6.1	−7.2	6.0	4.1	4.4	4.6
	Nov. 15	18		−2.42	−1.30	−1.51	−1.72		−16.2	−8.7	−10.1	−11.5	8.7	6.6	8.2	7.8
Difference for $P=0.05$									1.51	1.51	1.51	1.51	.72	.72	.72	.72
Difference for $P=0.01$									2.00	2.00	2.00	2.00	.95	.95	.95	.95
2	Nov. 18	0	13.72					83.5								
	Nov. 24	6		−.61	−.45	−.31	−.51		−3.7	−2.7	−1.9	−3.1	3.6	3.0	2.1	2.1
	Dec. 1	13		−.93	−1.00	−1.07	−1.29		−5.7	−6.1	−6.5	−7.8	5.5	6.3	5.9	3.8
	Dec. 8	20		−1.54	−1.34	−1.43	−1.38		−9.4	−8.2	−8.7	−8.4	7.8	9.2	7.7	5.7
Difference for $P=0.05$									1.25	1.25	1.25	1.25	.78	.78	.78	.78
Difference for $P=0.01$									1.66	1.66	1.66	1.66	1.03	1.03	1.03	1.03
2	Dec. 23	35		−2.17	−1.78	−3.75	−5.08		−13.2	−10.8	−22.8	−30.9	12.2	13.6	13.4	11.9

C. P. 28/19

1	Oct. 23	0	13.87					82.0								
	Oct. 27	4		−1.30	−1.74	−1.63	−0.94		−7.7	−10.3	−9.7	−5.6	4.4	3.8	3.2	2.8
	Nov. 1	9		−2.02	−1.47	−1.30	−1.31		−12.0	−8.7	−7.7	−7.8	6.0	6.5	6.0	5.1
	Nov. 6	14		−2.15	−1.46	−1.31	−1.18		−12.7	−8.7	−7.8	−7.0	7.8	7.8	7.6	7.6
Difference for $P=0.05$									2.51	2.51	2.51	2.51	1.13	1.13	1.13	1.13
Difference for $P=0.01$									3.34	3.34	3.34	3.34	1.50	1.50	1.50	1.50

C. P. 28/11

1	Nov. 10	0	13.87					78.7								
	Nov. 17	7		+0.17	−1.04	−0.35	+0.23		+0.9	−5.9	−2.0	+1.3	5.2	5.9	5.1	3.9
	Nov. 24	14		−3.05	−2.87	−1.29	−1.03		−17.3	−16.3	−7.3	−5.9	7.7	8.9	7.4	8.0
Difference for $P=0.05$									2.12	2.12	2.12	2.12	1.25	1.25	1.25	1.25
Difference for $P=0.01$									2.84	2.84	2.84	2.84	1.69	1.69	1.69	1.69

[1] Relative humidities and saturation deficit at temperatures of: 51° F., 62° F., 71° F., 80° F.
Relative humidities (percent): 63–66, 73–74, 81–82, 85–87
Saturation deficit (inches mercury): 0.134, 0.147, 0.140, 0.143

TABLE 11.—*Composition and change in composition of sugarcane of 3 varieties stored at approximately the same saturation deficit at 4 temperatures during the harvesting season of 1937 (experiment No. 1)*

Variety	Date of analysis	Duration of storage	Temperature	Relative humidity	Composition of cane: True sucrose	Composition of cane: Reducing sugars	Composition of cane: Total sugars	Composition of cane: Total soluble solids	Composition of cane: True purity	Gain (+) or loss (−) during storage in—: True sucrose	Gain (+) or loss (−) during storage in—: Reducing sugars	Gain (+) or loss (−) during storage in—: Total sugars	Gain (+) or loss (−) during storage in—: Total soluble solids	Gain (+) or loss (−) during storage in—: True purity	Acidity [1] (as percent aconitic acid) in cane
		Days	*°F.*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*	*Percent*		*Percent*
Co. 281	Oct. 28	0			9.72	1.04	10.76	12.08	80.46						0.148
	Nov. 10	13	51	63–66	9.11	1.53	10.64	12.17	74.86	−0.61	+0.49	−0.12	+0.09	−5.60	.111
	do	13	62	73–74	9.30	1.23	10.53	12.13	76.67	−.42	+.19	−.23	+.05	−3.79	.107
	do	13	71	81–82	9.15	1.10	10.25	11.81	77.48	−.57	+.06	−.51	−.27	−2.98	.107
	do	13	80	85–87	9.05	1.11	10.16	11.76	76.96	−.67	+.07	−.60	−.32	−3.50	.116
Co. 290	Oct. 30	0			10.09	1.12	11.21	12.48	80.85						.165
	Nov. 13	14	51	63–66	8.99	2.36	11.35	12.59	71.41	−1.10	+1.24	+.14	+.11	−9.44	.135
	do	14	62	73–74	9.22	1.51	10.73	12.06	76.45	−.87	+.39	−.48	−.42	−4.40	.141
	do	14	71	81–82	9.16	1.41	10.57	11.97	76.52	−.93	+.29	−.64	−.51	−4.33	.137
	do	14	80	85–87	8.99	1.47	10.46	11.78	76.32	−1.10	+.35	−.75	−.70	−4.53	.135
C. P. 28/19	Oct. 24	0			10.83	1.28	12.11	13.45	80.52						.140
	Nov. 6	13	51	63–66	9.68	2.14	11.82	13.31	72.73	−1.15	+.86	−.29	−.14	−7.79	.111
	do	13	62	73–74	9.81	1.78	11.59	13.03	75.29	−1.02	+.50	−.52	−.42	−5.23	.116
	do	13	71	81–82	10.58	1.20	11.78	13.29	79.61	−.25	−.08	−.33	−.16	−.91	.116
	do	13	80	85–87	9.91	1.40	11.31	12.81	77.36	−.92	+.12	−.80	−.64	−3.16	.125

[1] The pH of the extract of all varieties increased by 0.2 (roughly, from 5.5 to 5.7) during storage. This figure confirms the decrease in acidity obtained.

A fairly close comparable control of loss in weight at the different temperatures was attained, although the loss in weight in Co. 281 in experiment 2 by the end of the third period of storage was definitely out of line.

Considering the results of loss of sucrose in juice and drop in apparent purity, no significant difference in the amount of inversion occurred at the different temperatures during the first period of storage. As the duration of storage continued into the second and third periods, inversion became greater at 51° than at 62° F. in all varieties and all experiments. With the increase in temperature from 51° to 62° to 71°, inversion decreased in C. P. 28/19 and C. P. 28/11 by the end of the second period of storage and in Co. 281 in experiment 1 by the end of the third period. Decrease in the amount of inversion in C. P. 28/11 and C. P. 28/19 extended from 51° to 80°, as indicated by the drop in apparent purity and loss of apparent sucrose by the end of the second (C. P. 28/11) or third (C. P. 28/19) period of storage. In Co. 281 (experiment 1) and in all other varieties and experiments the amount of inversion was greater at 51° than at 80° by the end of the second or third period of storage.

In the main, the changes in yield of 96° sugar are essentially in agreement with the changes in apparent values. The fact that inversion in C. P. 28/19 becomes stationary at a less advanced stage with the rise in temperature as compared with the tendency in Co. 281, and particularly in Co. 290, to continue at about the same rate explains the difference in the results at 71° and 80° in the two cases. This explanation, however, does not hold for the difference in behavior of C. P. 28/11 and that of Co. 281 and Co. 290 at these temperatures. The rate of inversion in C. P. 28/11 did not tend to slow up at any temperature during 14 days of storage, but rather an increased acceleration in rates of inversion at each lower degree of temperature occurred (fig. 3).

Figure 3 shows the relation of temperature and time to the loss in weight and drop in apparent purity of all four varieties (table 10). A decrease in the rate of loss in weight with the continuation of storage is evident in most cases. Such a relation was to be expected because of the reduced vapor pressure at the surface of the cane caused by drying out. The pattern of inversion of sucrose, as indicated by the drop in apparent purity (fig. 3), is quite different in C. P. 28/19 from that in Co. 281, Co. 290, and C. P. 28/11. Although there may have been a tendency for inversion in Co. 281 to reach an equilibrium at temperatures of 62°, 71°, and 80° F., it was not so nearly marked as it was in C. P. 28/19 at all four temperatures. In C. P. 28/19 this equilibrium was reached at a lesser degree of inversion as the temperature rose from 51° to 80°. At 51° (fig. 3) the slope of the curve was still slightly downward at the end of 14 days of storage, whereas at the higher temperatures (62°, 71°, and 80°) the apparent purity increased either during the second or third period of storage (9 and 14 days). These results suggest the possibility that inversion of sucrose may be reversible under certain conditions of storage.

It is quite obvious from the results obtained after 37 and 35 days of storage of Co. 281 and Co. 290 (table 10) that temperatures of 71° and 80° F. combined with the humidities used are not favorable for prolonged storage of sugarcane. Not only was inversion heavy but

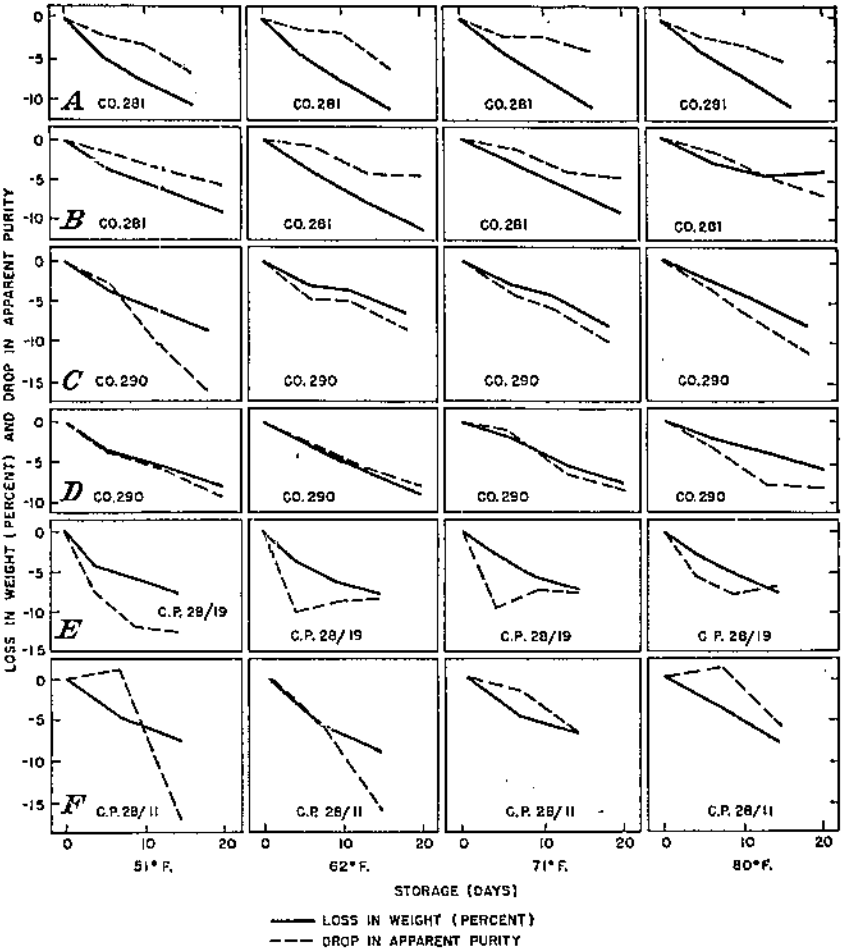

FIGURE 3.—Loss in weight of cane and drop in apparent purity of juice of four varieties of cane (first-year stubble) stored at approximately the same saturation deficit at four temperatures during the harvesting season of 1937. (Curves drawn from data in table 10: *A* and *B*, Co. 281, experiments 1 and 2; *C* and *D*, Co. 290, experiments 1 and 2; *E*, C. P. 28/19, experiment 1; and *F*, C. P. 28/11, experiment 1.)

also the loss of Brix—in Co. 281 it was 1.55° and 2.04° and in Co. 290, 1.50° and 2.08° at temperatures of 71° and 80°, respectively.

The results of analysis on cane (table 11) are in general agreement with those obtained from juice analysis. The loss of true sucrose was greater at 51° than at 62° and 71° F. in varieties Co. 281 and Co. 290, although the amount of loss at 62° was slightly less than at 71°. In C. P. 28/19 there was a decrease in loss of true sucrose with rise in temperature from 51° to 71°, but an increase as the temperature rose from 71° to 80°. The amount of drop in true purity decreased in all three varieties as the temperatures increased from 51° to 62° and from 62° to 71°. In all three varieties the amount of inversion, as indicated by the loss of true sucrose and drop in true purity, was greater at 80° F. than at 71°, and in Co. 290 it was greater at 80° than at 62° F. The discrepancies between true and apparent values may arise from the fact that the true values were obtained from fewer cane samples and that the sampling of small pieces of cane and disintegrated cane tissue involved considerable error. The completely extracted juice became slightly more alkaline, as indicated by pH and acidity readings. Evidently no deleterious changes other than inversion of sucrose and loss of soluble solids took place during these periods of storage.

These experiments were not designed to measure respiration losses, which are too small to be determined accurately by the methods employed. If experiments are conducted long enough (2 to 3 weeks), however, it is possible to obtain comparative values as related to temperatures. It will be seen from the loss in Brix (table 10) and in total solids and total sugars in cane (table 11) that these losses tended to increase with rise in temperature.

During the harvesting season of 1942, Co. 290 was stored at temperatures of 51°, 65°, 75°, and 90° F. (table 12). Some difficulty was experienced in obtaining comparable losses of moisture at each temperature. Fairly comparable losses, however, were obtained. A small amount of rooting and sprouting occurred at 90° in 19 days (experiment 2).

In three (experiments 2, 3, and 4) out of the four experiments the amount of inversion of sucrose, as indicated by the loss of sucrose in juice and apparent purity, was greater by the end of the last period of storage at 51° than at 65° F. In experiment 1 the greater loss of sucrose at 65° and 75° was associated with a greater loss of moisture, as indicated by the loss in weight. In experiments 1, 2, and 3 the loss of sucrose at 51° was greater than at 90°, and in experiments 2 and 3 it was greater than at 75° by the end of the second or third period of storage. In experiment 4 the loss of sucrose was almost as great at 51° as at 90°. These results are essentially in agreement with those previously presented.

Some Factors Affecting the Loss of Moisture

The loss of weight from cane during storage or while lying in the field during the interval between cutting and milling is caused mostly by the loss of moisture. Although there is some loss of solids through respiration, the amount is so small that it would not materially affect the loss in weight.

Whenever a stalk of cane is wholly in contact with the air, the loss of moisture is dependent upon the difference between the vapor pressure at the surface of the cane and that of the air. The vapor pressure of the air may be maintained at a fairly uniform and constant level in an insulated room in which a constant temperature is maintained. The vapor pressure of the sugarcane stalk is the resultant of a number of vapor pressures. Sartoris (*21*) found that about half the loss from three-node sections from the middle portion of stalks of P. O. J. 213 occurred through cut ends and that more loss per unit area occurred through the root rings than through internodes.

TABLE 12.—*Loss of Brix and apparent sucrose in juice, drop in apparent purity, and loss in weight in samples of mill cane of the variety Co. 290 (second-year stubble) stored in an atmosphere designed to bring about the same loss of moisture at different temperatures,*[1] *1942*

Experiment No.	Date of analysis	Duration of storage	Gain (+) or loss (−) of Brix in juice [2] at —				Gain (+) or loss (−) of apparent sucrose in juice [2] at —				Gain (+) or loss (−) in apparent purity [2] at —				Loss in weight of cane at—			
			51° F.	65° F.	75° F.	90° F.	51° F.	65° F.	75° F.	90° F.	51° F.	65° F.	75° F.	90° F.	51° F.	65° F.	75° F.	90° F.
		Days	*Degrees*	*Degrees*	*Degrees*	*Degrees*	*Percent*	*Percent*	*Percent*	*Percent*					*Percent*	*Percent*	*Percent*	*Percent*
1	Oct. 19	3	−0.41	−0.23	−0.23	−0.38	−0.54	−0.46	−0.51	−0.38	−3.8	−3.2	−3.6	−2.7	2.3	3.4	2.8	2.2
	Oct. 23	7	−.13	−.43	−.59	−.72	−.91	−1.66	−1.39	−.86	−6.4	−11.7	−9.8	−6.1	4.3	5.5	5.4	3.7
	Oct. 26	10	+.09	−.30	−.66	−.67	−1.05	−1.66	−1.39	−.86	−7.4	−11.7	−9.8	−6.1	6.3	7.1	7.0	5.0
2	Nov. 2	5	−.01	−.06	−.13	−.11	−.16	−.72	−.22	+.02	−1.1	−4.9	−1.5	+.1	2.6	3.6	2.7	2.6
	Nov. 9	12	−.10	−.30	−.37	−.54	−1.36	−1.11	−.80	−.54	−9.2	−7.6	−5.4	−3.7	5.6	6.7	6.4	6.8
	Nov. 16	19	−.24	−.56	−.68	−1.03	−2.36	−1.39	−1.55	−1.72	−16.0	−9.4	−10.5	−11.7	8.0	10.2	8.6	10.9
3	Nov. 11	5	−.02	−.43	−.30	−.35	−.03	−.64	−.40	−.19	−.2	−4.0	−2.5	−3.1	2.8	3.4	2.5	2.2
	Nov. 16	10	+.13	+.06	−.16	−.57	−.45	−.59	−.41	−.[illegible]	−2.8	−3.7	−2.6	−5.0	4.2	4.8	4.6	4.6
	Nov. 23	17	+.01	−.50	−.70	−.88	−1.55	−.98	−1.30	−1.51	−9.7	−6.1	−8.1	−9.5	7.1	8.2	8.0	9.0
4	Dec. 4	6	−.05	+.01	−.39	−.33	−.09	−.05	−.64	−.37	−.6	−.3	−4.0	−2.3	3.4	4.4	4.7	4.3
	Dec. 9	11	−.27	−.19	−.25	−.39	−.51	−.53	−.94	−.50	−3.2	−3.3	−5.9	−3.1	5.3	6.9	7.0	7.1
	Dec. 14	16	−.23	−.47	−.49	−.76	−1.02	−.96	−1.45	−1.12	−6.4	−6.0	−9.0	−7.0	7.7	9.2	8.4	10.7

[1] Moisture conditions at temperatures of

	51° F.	65° F.	75° F.	90° F.
Relative humidity . . . percent	62	78–80	82–84	89
Saturation deficit . . . inches mercury	0.142	0.136–0.123	0.156–0.139	0.155

During experiment 1 the relative humidity at 65° F. was 78 percent (saturation deficit 0.136) and at 75° F. it was 82 percent (saturation deficit 0.156). In experiments 2, 3, and 4 the relative humidity was raised to 80 percent at 65° F. and 84 percent at 75° F. (saturation deficits 0.123 and 0.139, respectively).

[2] The initial Brix, apparent sucrose, and apparent purity in the different experiments were as follows:

Experiment No.:	*Brix*	*Apparent sucrose*	*Apparent purity*
1	14.15	10.50	74.2
2	14.74	11.17	75.8
3	15.91	12.78	80.3
4	16.11	12.85	79.8

An experiment was conducted by the writers in 1933, at Houma, La., with P. O. J. 36–M, in which each stalk of one lot of five 30-stalk samples was coated with paraffin; the cut ends of the second lot and the cut ends and root rings of the third lot were paraffined; and two lots of five 30-stalk samples were left untreated. The ends were cut as nearly as possible at right angles to the length of the stalks. One lot of samples of stalks of untreated cane was stored at a temperature of 65° F. and a relative humidity of 98 percent; the remaining lots were stored at a temperature of 65° and a relative humidity ranging from 66 to 71 percent. The loss in weight of the untreated lot of cane during 7 days' storage at a relative humidity of 98 percent was 1.2 percent; in cane stored at a relative humidity of 66 to 71 percent the untreated lot lost 7.05 percent; the lot with the cut ends paraffined, 6.41; the lot with the cut ends and root rings paraffined, 3.66; and the lot with the entire stalk paraffined, 2.7.

The foregoing results thus confirm those of Sartoris (*21*) and show that there is much greater loss of moisture per unit area from root rings than from the surface of the internodes and that some loss occurs from cane coated with paraffin. Contrary to Sartoris' results with P. O. J. 213 (*21*), the results with P. O. J. 36–M show a greater loss in weight from whole untreated stalks than from stalks with cut ends coated with paraffin.

The results obtained by Sartoris and the writers indicate that the vapor pressure at the surface of a cut cross section of a sugarcane stalk and at the root bands is higher than at the internodes. This difference is facilitated by the difference in the character of the tissues involved and the difference in the freedom of the moisture to move to the surface.

In contrast to the results obtained by Sartoris (*21*), showing greater loss of moisture from the bundles of cane (70 to 100 pounds) than from single stalks, the writers obtained a higher percentage loss from stalks spread out—so that each stalk was fully exposed to the air—than from stalks tied in bundles. Twenty 30-stalk samples of P. O. J. 36–M were selected by drawing stalks at random from a pile of thoroughly mixed, straight cane. Ten of these samples were tied into bundles, with wire, and 10 left loose. The samples were stored across two 2- by 4-inch timbers, the 2-inch side resting on a concrete floor in an empty building 30 by 60 feet in horizontal dimensions. Weighings were made after 2, 4, and 6 days. The loose samples showed the greater loss.

It was noted that samples varied in weight, and the weights of the 10 loose samples were slightly less than that of the tied samples. In order to ascertain whether or not this difference in size was a factor affecting the results, 5 loose samples were paired with 5 tied samples. Three of the pairs were identical in weight and the other 2 pairs were almost the same size at the beginning of the experiment. The results in the 2 cases were similar. The percentage loss in weight after 2, 4, and 6 days of storage was as follows: 10 loose samples, 2.7, 4.9, and 7.3; 5 loose samples, 2.6, 4.9, and 7.3; 10 tied samples, 2.3, 4.5, and 6.5; and 5 tied samples, 2.2, 4.5, and 6.4. The results were confirmed by the results of another experiment with the variety Co. 281.

In the other experiments reported in this bulletin on inversion of sucrose, only part of the stalk was completely exposed to the air. The cane was tied into samples of from 20 to 30 stalks each. Furthermore, these samples were piled together in racks in the storage rooms. It will be seen, therefore, that the degree of exposure to the air varied among the stalks and samples. It was impracticable to provide the necessary space for full exposure to the air of all stalks or even for the samples required for these experiments. Satisfactory results were obtained, however, as has been indicated by the comparable losses obtained at different temperatures (tables 7, 10, and 12, and figs. 2 and 3).

In many instances there was a slight slowing up of the rate of loss in weight (see tables 13, 15, and 16, and figs. 3, 4, and 5), especially after the first period of storage, although in many other instances there appeared to be an increase in rate. It might be expected that there would be a decrease in rate as a result of the concentrating effect of the loss of moisture on soluble solids (*12*). In no case is the change in rate of loss of moisture marked. Among the varieties, Co. 290 showed in most cases the least loss of moisture and C. P. 28/19 and P. O. J. 36–M the greatest. In a given variety stored at a given temperature the amount of moisture loss is governed largely by the relative humidity at the storage room.

Relation of Humidity and Moisture Loss to Inversion of Sucrose

The results recorded in tables 7 and 9 show that the loss of moisture from mill cane was an important factor in bringing about inversion of sucrose—more important in susceptible than in resistant varieties. These relations are clearly shown by the data in tables 13, 14, 15, 16, and 17, and in figures 4, 5, and 6. Certain lots of cane of varieties Badila (*10*),[6] C. P. 29/94 (*13*), Co. 281 (unpublished data), and P. O. J. 213 (unpublished data) in particular experiments failed to show any inversion, or else showed but little inversion as a result of heavy loss of moisture. With the exceptions mentioned all varieties tested have shown at some time or another increased inversion in response to increased loss of moisture. There appears to be a physiological condition that develops in certain varieties under certain field conditions that practically prevents inversion of sucrose under a rather wide range of conditions that are normally favorable to inversion. Neither the conditions nor the physiological state responsible for this behavior is known or understood. In P. O. J. 213 resistance to inversion was associated with cane of high maturity. In the case of C. P. 29/94 difference of maturity of the cane may have been a factor in its varied behavior.

The degree of response of inversion of sucrose to loss of moisture increases with the increased susceptibility of the variety. This relation will be seen readily in figures 4, 5, and 6 by examining the change in apparent purity relative to the loss in weight.

[6] In an experiment conducted in Florida during the harvesting season of 1946 Badila showed considerable inversion when stored at high temperatures and low humidities; otherwise, it has shown very little inversion under any of the conditions under which it was stored. In this case it is not clear to what extent the high temperature or the heavy loss of moisture or a combination of both of them or even of some other factor was responsible for the inversion that occurred.

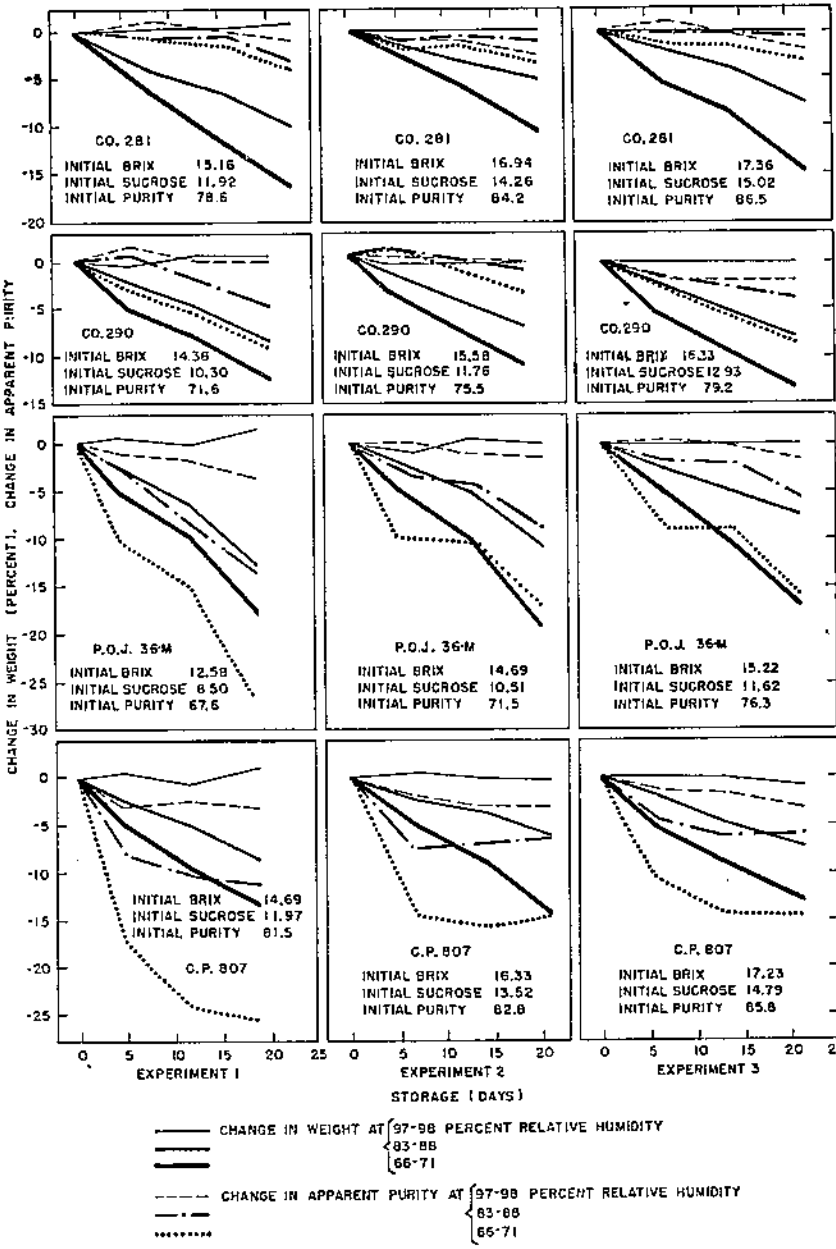

FIGURE 4.—Change in weight of cane and in apparent purity of juice of four varieties of sugarcane—first-year stubble of Co. 281, P. O. J. 36–M, and C. P. 807, and plant cane of Co. 290—stored at three relative humidities at a temperature of 66° F. in three successive experiments conducted during the harvesting season of 1933. (Curves were drawn from data in table 13.)

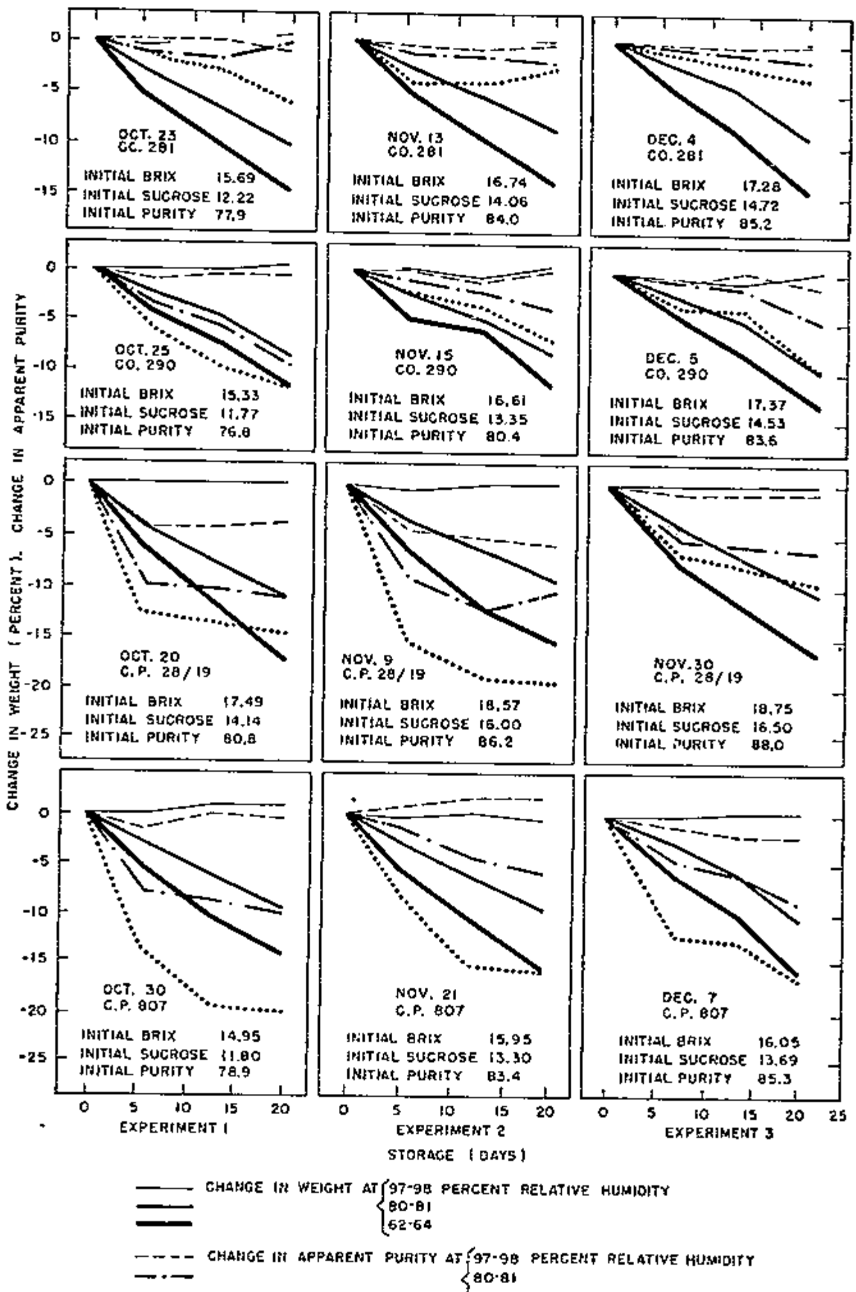

FIGURE 5.—Change in weight of cane and in apparent purity of juice of four varieties of sugarcane—first-year stubble—stored on the dates shown at three relative humidities at a temperature of 66° F. in three successive experiments conducted during the harvesting season of 1934.

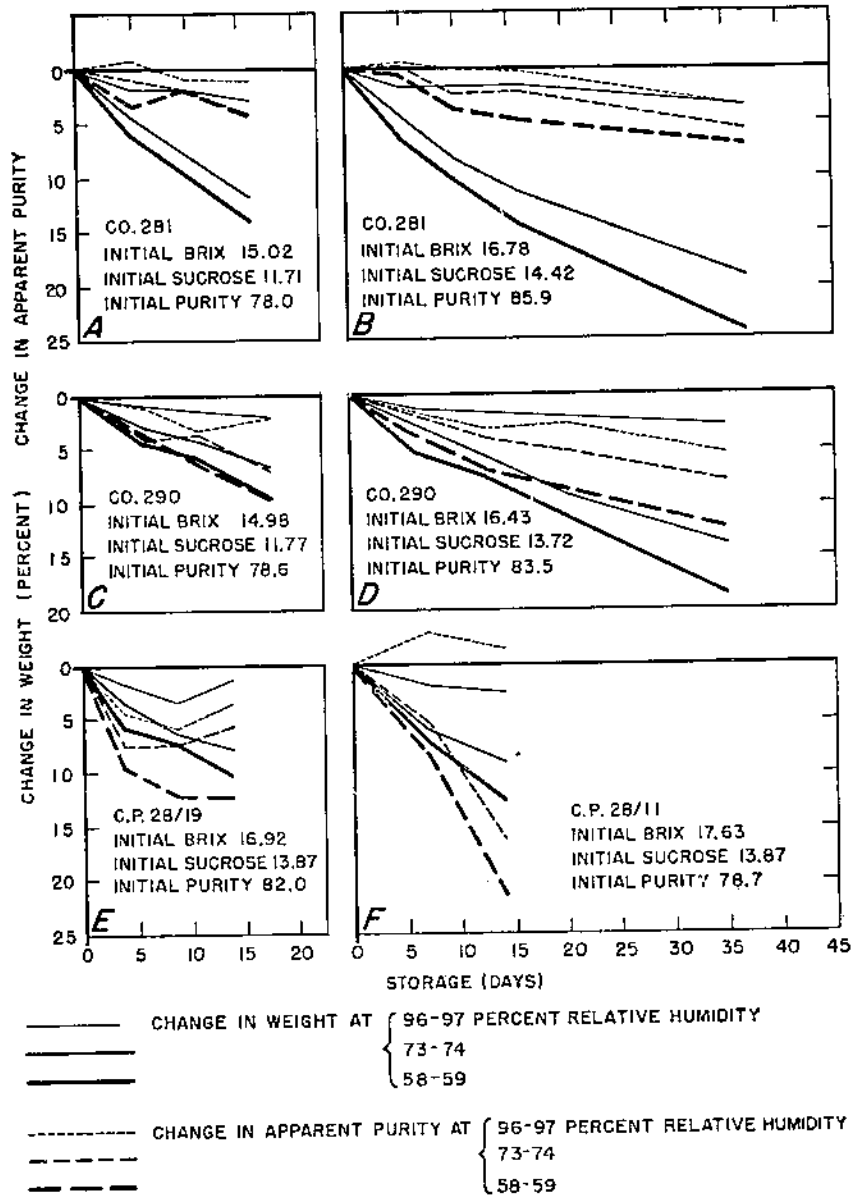

FIGURE 6.—Changes in weight of cane and apparent purity of juice of four varieties of sugarcane of first-year stubble stored at three relative humidities at 62° F. during the harvesting season of 1937. Dates at which cane was stored: *A*, Oct. 27; *B*, Nov. 16; *C*, Oct. 28; *D*, Nov. 18; *E*, Oct. 23 and *F*, Nov. 10.

Although the amount of inversion of sucrose occurring in a variety may vary from experiment to experiment, and in some varieties considerably so under the same conditions of storage, it will be observed that in most of the experiments at most conditions of storage (temperature and humidity) the relative resistance of the varieties is uniformly exhibited. There are occasional exceptions, however, such as the small amount of inversion at high humidities in C. P. 807 as compared with that in C. P. 28/19 in experiment 2, figure 1. At low humidities in this same experiment (fig. 5) the relation between these two varieties was more nearly normal, although inversion was still less than normal in C. P. 807 as compared with that in C. P. 28/19. Co. 281 is the most resistant among the varieties studied in this investigation. Co. 290 is slightly less resistant, although at high humidity it showed in some instances less inversion than Co. 281 (table 2). C. P. 28/11, C. P. 28/19, C. P. 807, C. P. 29/320, and P. O. J. 36–M are susceptible to considerable inversion. C. P. 28/19 is usually the most resistant of this group (*13*, *14*).

At least two types of behavior are exhibited by varieties C. P. 807, C. P. 28/19, Co. 281, Co. 290, C. P. 28/11, and P. O. J. 36–M when stored at different levels of humidity at a constant temperature: (1) Inversion of sucrose is greatly retarded with the continuation of storage and ultimately becomes more or less stationary; and (2) inversion continues at about the same rate with the lapse of time and continued loss of moisture. With exception of C. P. 28/19 in one experiment (expt. 2 in 1935, table 15), C. P. 807 and C. P. 28/19 conform to the first type of behavior, and Co. 281, Co. 290, C. P. 28/11, and P. O. J. 36–M more or less to the second type (tables 13–15, and figs. 2–6). It is possible that a third type of behavior may be found in C. P. 28/11 in which the rate of inversion of sucrose at the two lower humidities tends to increase with the lapse of time (fig. 3). Since the data relating to this variety, however, are limited to one experiment, final conclusions regarding its behavior are reserved.

The behavior of C. P. 807 and C. P. 28/19 presents a striking phenomenon, particularly at the lower levels of humidity. During the first period of storage (5 to 9 days) the rate of inversion of sucrose is very rapid. Following this period, and, perhaps, in some cases before the end of this period, the rate of inversion is retarded, sometimes greatly so, and often becomes stationary; in other words, the reaction tends to reach an equilibrium. Strangely, there is a different equilibrium level of inversion for each relative humidity employed. The initial rate of inversion is slower at the higher than at the lower humidities. Inversion is retarded and tends to stop at the higher humidities when less sucrose has been inverted than at the lower humidities. In fact, these equilibrium stages are widely separated. The initial rate of inversion and stage of equilibrium are determined by the rate of loss of moisture, which is only slightly retarded with lapse of time. It would seem that the rate of loss of moisture had an influence on inversion of sucrose independent of the actual loss of moisture.

TABLE 13.—*Gain or loss of 96° sugar, rise or fall of apparent purity, and gain or loss in weight in mill cane of 4 varieties of sugarcane stored at 3 relative humidities at 66° F., in 3 successive experiments during the harvesting season of 1938*

CO. 281 (FIRST-YEAR STUBBLE)

Experiment No.	Date of analysis	Duration of storage	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar at relative humidities (percent) of—						Rise (+) or fall (−) of apparent purity at relative humidities (percent) of—			Gain (+) or loss (−) of weight of cane at relative humidities (percent) of—		
				97-98	83-88	66-71	97-98	83-88	66-71	97-98	83-88	66-71	97-98	83-88	66-71
		Days	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*				*Percent*	*Percent*	*Percent*
1	Oct. 25	0	161.7												
	Nov. 3	9		+0.2	−4.7	−10.5	+0.1	−2.9	−6.5	+1.2	−0.4	−0.6	+0.7	−4.7	−7.2
	Nov. 10	16		−5.9	−5.3	−14.1	−3.6	−3.3	−8.7	+.1	−.7	−1.4	+.4	−6.5	−11.3
	Nov. 17	23		−11.1	−15.9	−21.6	−6.9	−9.8	−13.4	−1.2	−2.8	−3.4	+.8	−9.8	−16.5
Difference for $P=0.05$.										1.03	1.03	1.03			
Difference for $P=0.01$.										1.37	1.37	1.37			
2	Nov. 14	0	200.9												
	Nov. 20	6		−5.2	−4.7	−7.6	−2.6	−2.3	−3.8	−.8	−1.0	−1.8	+.1	−1.7	−3.2
	Nov. 27	13		−10.9	−9.0	−9.9	−5.4	−4.5	−4.9	−1.1	−.6	−1.3	−.2	−3.6	−6.0
	Dec. 4	20		−15.2	−3.4	−18.4	−6.7	−1.7	−9.2	−2.5	−1.0	−3.3	+.2	−5.0	−10.7
Difference for $P=0.05$.										.839	.839	.839			
Difference for $P=0.01$.										1.11	1.11	1.11			
3	Dec. 6	0	214.7												
	Dec. 13	7		−2.3	−2.5	−7.1	−1.1	−1.2	−3.3	+.9	0	−1.3	0	−1.8	−5.4
	Dec. 20	14		−6.8	−3.6	−10.4	−3.2	−1.7	−4.8	−.6	+.1	−1.4	−.1	−3.8	−8.6
	Dec. 28	22		−8.0	−8.2	−20.0	−3.7	−3.8	−9.3	−1.8	−.4	−3.2	+.2	−7.4	−15.2
Difference for $P=0.05$.										1.205	1.205	1.205			
Difference for $P=0.01$.										1.719	1.719	1.719			

CO. 290 (PLANT CANE)

1	Oct. 31	0	139.7												
	Nov. 6	6		+2.4	−1.4	−11.8	+1.7	−1.0	−8.4	+1.5	+0.3	−3.2	−0.5	−2.5	−5.6
	Nov. 13	13		−4.4	−10.5	−20.6	−3.1	−7.5	−14.7	+.2	−1.8	−5.4	+.4	−5.1	−7.8
	Nov. 20	20		−5.2	−18.9	−32.7	−3.7	−13.5	−23.4	−.1	−4.4	−8.5	+.6	−8.4	−12.0
Difference for P=0.05.										1.07	1.07	1.67			
Difference for P=0.01.										2.22	2.22	2.22			
2	Nov. 22	0	165.0												
	Nov. 27	5		+.5	+4.0	+.8	+.3	+2.4	+.5	+.4	+1.0	+.9	−.6	−1.5	−3.5
	Dec. 11	19		−5.5	−7.5	−16.1	−3.3	−4.5	−9.8	−.1	−.8	−3.1	+.2	−6.9	−10.8
Difference for P=0.05.										1.38	1.38	1.38			
Difference for P=0.01.										1.84	1.84	1.84			
3	Dec. 12	0	186.7												
	Dec. 18	6		−10.5	−8.2	−11.8	−5.6	−4.4	−6.3	−2.1	−1.7	−2.3	+.1	−2.0	−5.1
	Jan. 2[1]	21		−11.1	−16.1	−34.3	−5.9	−8.6	−18.4	−2.1	−3.7	−8.5	+.1	−7.8	−13.6
Difference for P=0.05.										1.66	1.66	1.66			
Difference for P=0.01.										2.22	2.22	2.22			

[1] In 1934

TABLE 13.—*Gain or loss of 96° sugar, rise or fall of apparent purity, and gain or loss in weight in mill cane of 4 varieties of sugarcane stored at 3 relative humidities at 66° F., in 3 successive experiments during the harvesting season of 1933*—Continued

P. O. J. 36-M (FIRST-YEAR STUBBLE)

Experiment No.	Date of analysis	Duration of storage	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar at relative humidities (percent) of—						Rise (+) or fall (−) of apparent purity at relative humidities (percent) of—			Gain (+) or loss (−) of weight of cane at relative humidities (percent) of—		
				97–98	83–88	66–71	97–98	83–88	66–71	97–98	83–88	66–71	97–98	83–88	66–71
		Days	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*				*Percent*	*Percent*	*Percent*
1	Oct. 25	0	104.3												
	Oct. 30	5		−1.6	−14.2	−26.9	−1.5	−13.6	−25.8	−1.1	−5.1	−10.3	+0.7	−2.6	−5.0
	Nov. 6	12		−7.6	−23.8	−42.0	−7.3	−22.8	−40.3	−1.6	−7.8	−15.1	+.1	−5.9	−9.5
	Nov. 13	19		−12.1	−39.9	−73.3	−11.6	−38.3	−70.3	−3.3	−13.4	−26.6	+1.4	−12.4	−17.6
Difference for P=0.05.										2.98	2.98	2.98			
Difference for P=0.01.										3.96	3.96	3.96			
2	Nov. 18	0	134.3												
	Nov. 24	6		−2.9	−11.2	−33.1	−2.2	−8.3	−24.6	−.2	−2.9	−9.0	−.3	−2.7	−5.1
	Dec. 1	13		−8.5	−16.8	−36.6	−6.3	−12.5	−27.3	−1.2	−4.3	−10.4	+.4	−5.2	−10.5
	Dec. 8	20		−6.7	−33.3	−62.4	−5.0	−24.8	−46.5	−1.3	−8.4	−17.5	0	−10.5	−18.8
Difference for P=0.05.										2.39	2.39	2.39			
Difference for P=0.01.										3.18	3.18	3.18			
3	Dec. 8	0	154.0												
	Dec. 15	7		−1.6	−9.2	−31.0	−1.0	−5.9	−20.0	−.3	−2.0	−9.0	0	−2.4	−5.7
	Dec. 22	14		−4.5	−9.8	−32.6	−2.9	−6.3	−21.0	−.2	−2.0	−8.9	+.2	−4.9	−10.7
	Dec. 29	21		−9.4	−21.8	−53.9	−6.1	−14.1	−34.8	−1.4	−5.5	−15.7	+.1	−6.9	−16.9
Difference for P=0.05.										2.30	2.30	2.30			
Difference for P=0.01.										3.08	3.08	3.08			

C. P. 807 (FIRST-YEAR STUBBLE)

1	Oct. 27	0	162.4												
	Nov. 1	5		−11.8	−24.6	−52.1	−7.3	−15.1	−32.1	−3.1	−8.0	−16.8	+0.6	−2.5	−4.8
	Nov. 8	12		−11.3	−32.5	−75.5	−7.0	−20.0	−46.5	−2.6	−10.5	−23.9	−.3	−5.1	−9.9
	Nov. 15	19		−11.8	−37.1	−80.3	−7.3	−22.8	−49.4	−3.0	−11.4	−25.7	+1.0	−8.3	−12.9
Difference for P=0.05.										1.67	1.67	1.67			
Difference for P=0.01.										2.21	2.21	2.21			
2	Nov. 15	0	185.0												
	Nov. 22	7		−6.1	−27.0	−50.4	−3.3	14.6	−27.2	−2.1	−7.6	−14.5	+.7	−2.1	−4.8
	Nov. 29	14		−14.3	−25.7	−56.0	−7.7	13.9	−30.3	−2.9	−7.6	−15.3	+.2	−3.6	−8.4
	Dec. 6	21		−13.0	−23.9	−52.3	−7.0	12.9	−28.2	−2.9	−6.4	−14.5	−.1	−6.0	−14.3
Difference for P=0.05.										1.35	1.35	1.35			
Difference for P=0.01.										1.80	1.80	1.80			
3	Dec. 5	0	206.3												
	Dec. 11	6		−7.7	−16.2	−37.5	−3.7	7.9	−18.2	−1.7	−4.5	−10.4	−.1	−1.3	−4.8
	Dec. 18	13		−7.8	−24.1	−51.5	−3.8	11.7	−25.0	−1.5	−6.2	−13.9	0	−4.4	−8.4
	Dec. 26	21		−13.3	−22.6	−53.7	−6.4	11.0	−20.0	−3.0	−5.8	−14.5	−.3	−7.0	−12.7
Difference for P=0.05.										1.05	1.05	1.05			
Difference for P=0.01.										1.30	1.30	1.30			

TABLE 14.—*Detailed analysis of juice of 4 varieties of cane and maturity of each before and after storage at 3 relative humidities at a temperature of 66° F. in 3 successive experiments during 1933*

Experiment No.	Date of analysis	Duration of storage	Initial dry substance in juice	Loss of dry substance at relative humidities (percent) of—			Initial true purity (sucrose on dry substance)	Rise (+) or fall (—) in purity (sucrose on dry substance) at relative humidities (percent) of—			Initial invert sugars (on dry substance)	Gain (+) or loss (—) of invert sugar at relative humidities (percent) of—		
				97–98	83–88	66–71		97–98	83–88	66–71		97–98	83–88	66–71
		Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
CO. 281 (FIRST-YEAR STUBBLE)														
1	Oct. 25 to Nov. 17	23	14.60	0.64	0.73	0.41	83.90	—0.74	—1.91	—4.32	8.21	—0.27	+1.20	+3.50
2	Nov. 14 to Dec. 4	20	16.39	.65	.95	.49	89.38	—1.67	—1.57	—3.08	3.90	+.43	+.88	+2.15
3	Dec. 6 to Dec. 28	22	16.79	.45	.36	.57	91.36	—1.05	—1.62	—3.70	1.99	+.13	+.75	+2.78
CO. 290 (PLANT CANE)														
1	Oct. 31 to Nov. 6	6	13.48	0.09	0.15	0.08	78.93	+0.12	—0.58	—3.45	11.21	—0.02	+0.79	+3.96
	Oct. 31 to Nov. 20	20	13.48	.34	.37	.43	78.93	+.17	—3.81	—7.39	11.21	—.64	+3.00	+6.95
2	Nov. 22 to Dec. 11	19	14.73	.38	.26	.28	83.50	—1.45	—2.35	—4.30	7.24	0	+.88	+3.21
3	Dec. 12 to Jan. 2, 1934	21	15.63	.57	.44	.23	84.64	—.40	—2.06	—6.86	5.23	+.43	+1.72	+7.17
P. O. J. 36-M (FIRST-YEAR STUBBLE)														
1	Oct. 25 to Oct 30	5	12.08	0.20	0.26	0.24	72.85	—0.05	—3.57	—7.52	18.05	+0.77	+4.51	+8.74
	Oct. 25 to Nov. 13	19	12.08	.53	.60	.53	72.85	—1.30	—9.46	—19.60	18.05	+.86	+8.76	+18.71
2	Nov. 18 to Dec. 8	20	13.07	.52	.78	1.03	78.17	—.47	—6.53	—14.14	12.98	+.58	+6.06	+13.67
3	Dec. 8 to Dec. 29	21	14.55	.53	.33	.12	82.80	—1.38	—5.35	—13.59	8.89	+.18	+3.65	+11.92
C. P. 807 (FIRST-YEAR STUBBLE)														
1	Oct. 27 to Nov. 8	12	14.20	0.42	------	0.25	84.79	—1.58	------	—18.45	6.67	+1.41	------	+18.58
	Oct. 27 to Nov. 15	19	14.20	.24	0.17	.19	84.79	—.93	—7.99	—19.84	6.67	+1.22	+8.18	+19.84
2	Nov. 15 to Dec. 6	21	15.81	.44	.07	.22	88.43	—2.60	—6.20	—13.22	4.68	+2.07	+5.65	+12.36
3	Dec. 5 to Dec. 26	21	16.74	.38	.05	.08	90.26	—1.47	—5.01	—12.74	3.03	+.80	+4.05	+11.57

Experiment No.	Date of analysis	Duration of storage	Initial organic nonsugars in juice	Gain (+) or loss (−) in organic nonsugars at relative humidities (percent) of—			Initial ash (on dry substance) in juice	Gain (+) or loss (−) of ash at relative humidities (percent) of—			Initial pH in juice	Increase (+) or decrease (−) in pH at relative humidities (percent) of—			Initial acidity (0.1 N NaOH per 10 cc.) in juice	Increase (+) or decrease (−) in acidity at relative humidities (percent) of—		
				97–98	83–88	66–71		97–98	83–88	66–71		97–98	83–88	66–71		97–98	83–88	66–71
		Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*					*Cc.*	*Cc.*	*Cc.*	*Cc.*
CO. 281 (FIRST-YEAR STUBBLE)																		
1	Oct. 25 to Nov. 17	23	4.24	+0.82	+0.54	+0.87	3.65	+0.19	+0.17	−0.05	5.21	+0.07	−0.03	−0.05	1.60	−0.08	+0.21	+0.27
2	Nov. 14 to Dec. 4	20	3.56	+.96	+.71	+.80	3.16	+.28	−.02	+.13	5.27	−.01	−.01	−.01	1.44	+.06	+.08	+.21
3	Dec. 6 to Dec. 28	22	3.39	+.86	+.82	+.80	3.26	+.06	+.03	+.13	5.28	+.05	0	−.01	1.48	−.06	+.09	+.28
CO. 290 (PLANT CANE)																		
1	Oct. 31 to Nov. 6	6	4.54	−0.23	−0.23	−0.60	5.32	+0.13	+0.02	+0.11	5.22	+0.09	+0.11	+0.06	2.32	−0.13	−0.05	+0.07
	Oct. 31 to Nov. 20	20	4.54	+.39	+.58	+.27	5.32	+.08	+.23	+.17	5.22	+.07	+.07	+.06	2.32	−.19	+.04	+.02
2	Nov. 22 to Dec. 11	19	4.05	+1.20	+.36	+.88	5.21	+.25	+.11	+.21	5.24	+.07	+.04	+.03	2.30	−.14	+.10	+.19
3	Dec. 12 to Jan. 2, 1934	21	4.87	−.23	+.20	+.29	5.26	+.20	+.14	−.02	5.20	+.06	+.06	+.03	2.41	−.10	+.14	+.32
P. O. J. 36–M (FIRST-YEAR STUBBLE)																		
1	Oct. 25 to Oct. 30	5	5.03	−0.54	−0.95	−1.33	4.07	+0.14	+0.01	0	5.20	+0.10	−0.02	−0.03	1.20	−0.09	−0.04	+0.12
	Oct. 25 to Nov. 13	19	5.03	+.27	+.52	+.31	4.07	+.17	+.18	+.08	5.20	+.15	+.15	+.12	1.20	−.15	+.02	+.12
2	Nov. 18 to Dec. 8	20	5.09	−.18	+.28	+.18	3.76	+.07	+.19	+.29	5.29	+.03	+.04	−.01	1.16	−.11	+.05	+.23
3	Dec. 8 to Dec. 29	21	4.42	+1.01	+1.37	+1.38	3.80	+.18	+.33	+.29	5.29	−.01	+.01	−.04	1.15	+.01	+.18	+.41
C. P. 807 (FIRST-YEAR STUBBLE)																		
1	Oct. 27 to Nov. 8	12	4.93	+0.21	--------	−0.09	3.61	−0.04	--------	−0.04	5.26	+0.02	--------	−0.02	1.80	−0.08	--------	+0.13
	Oct. 27 to Nov. 15	19	4.93	−.25	−0.08	−.08	3.61	−.04	−0.11	−.11	5.26	+.05	+0.03	0	1.80	−.14	0	+.21
2	Nov. 15 to Dec. 6	21	3.79	+.30	+.52	+.74	3.10	+.23	+.12	+.11	5.33	−.05	−.05	−.12	1.74	−.02	+.02	+.34
3	Dec. 5 to Dec. 26	21	3.66	+.46	+.89	+.95	3.05	+.21	+.07	+.22	5.23	+.06	+.05	+.04	1.75	+.03	+.14	+.49

TABLE 15.—*Changes in weight, apparent purity, sucrose in juice, and 96° sugar in 5 varieties of sugarcane stored at 3 relative humidities at 66° F., 1935*

Experiment No.	Date of analysis	Duration of storage	Gain (+) or loss (−) in weight at different relative humidities (percent) of—			Gain (+) or loss (−) in purity at different relative humidities (percent) of—			Gain (+) or loss (−) in sucrose in juice at different relative humidities (percent) of—			Gain (+) or loss (−) of 96° sugar at different relative humidities (percent) of—			Milling factors (checks=1.00) at different relative humidities (percent) of—		
			97–98	80–83	61–64	97–98	80–83	61–64	97–98	80–83	61–64	97–98	80–83	61–64	97–98	80–83	61–64
CO. 281 (FIRST-YEAR STUBBLE)																	
	1935	*Days*	*Percent*	*Percent*	*Percent*				*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*			
1	Oct. 25	7	+0.4	−3.9	−6.3	−0.3	+0.6	−2.6	−1.3	+0.7	−1.5	−1.4	+1.4	−3.5	1.019	0.980	0.955
	Oct. 31	13	+.6	−6.7	−9.2	−.4	−1.5	−1.8	+.3	−2.4	−2.0	0	−3.5	−3.5	------	------	------
2	Nov. 14	6	+.5	−3.1	−4.9	−1.9	−4.4	−4.8	−3.2	−6.5	−6.8	−4.5	−9.5	−10.0	------	------	------
	Nov. 20	12	+.8	−4.9	−7.6	−1.1	−4.2	−6.1	−3.2	−6.9	−8.1	−4.0	−9.5	−11.9	1.015	1.008	1.001
	Nov. 29	21	+.9	−8.5	−10.3	−2.2	−4.7	−5.8	−5.6	−8.4	−6.4	−7.0	−11.4	−10.0	1.027	------	------
C. P. 28/19 (PLANT CANE)																	
1	Oct. 28	6	0	−3.9	−5.7	−0.6	−5.6	−10.1	−2.9	−8.0	−14.4	−3.4	−13.0	−23.3	------	------	------
	Nov. 4	13	+.4	−6.6	−9.6	−1.3	−6.9	−12.5	−5.4	−11.0	−18.5	−6.2	−17.1	−29.5	1.029	0.995	0.986
	Nov. 11	20	+.8	−11.1	−14.4	−2.5	−7.3	−12.0	−5.5	−11.6	−17.4	−6.8	−17.8	−28.1	------	------	------
2	Nov. 18	5	−.3	−1.6	−4.5	−.9	−1.3	−4.8	−3.0	−3.3	−8.2	−3.8	−4.3	−11.5	------	------	------
	Nov. 25	12	+.1	−5.1	−8.0	+1.2	−2.3	−5.3	−2.4	−6.0	−9.7	−1.9	−7.7	−12.9	1.013	1.001	.983
	Dec. 2	19	−.4	−10.9	−15.0	−.1	−4.5	−9.6	−4.2	−9.3	−14.0	−4.3	−12.0	−20.1	1.026	.990	.974
CO. 290 (FIRST-YEAR STUBBLE)																	
1	Nov. 6	8	−0.1	−3.2	−5.4	+0.9	−1.6	−7.7	−1.8	−14.6	−13.5	−1.0	−5.7	−21.1	------	------	------
	Nov. 11	13	+.1	−4.4	−7.1	−.1	−2.4	−10.6	−4.1	−6.3	−18.8	−4.1	−8.9	−29.3	------	------	------
	Nov. 18	20	+.2	−7.5	−10.8	−1.5	−5.2	−9.3	−8.4	−11.4	−16.3	−9.8	−16.3	−25.2	------	------	------
2	Nov. 25	6	+.2	−1.6	−3.5	−1.7	−1.4	−2.8	−4.4	−2.8	−4.4	−6.0	−4.0	−7.3	------	------	------
	Dec. 2	13	−.5	−5.0	−6.9	−3.3	−4.2	−6.4	−6.5	−6.7	−7.2	−9.3	−10.0	−12.7	1.007	------	0.987
C. P. 29/320 (FIRST-YEAR STUBBLE)																	
1	Nov. 8	8	−0.7	−6.3	−9.8	+2.2	−7.6	−15.1	+1.8	−9.6	−17.9	+3.3	−15.0	−28.9	0.999	0.962	0.938
	Nov. 13	13	−.8	−9.4	−14.5	−1.6	−13.4	−22.0	−3.4	−17.6	−27.5	−4.4	−27.2	−42.8			
C. P. 28/11 (FIRST-YEAR STUBBLE)																	
1	Nov. 22	8	−0.4	−3.4	−6.8	0	+0.2	−9.8	−1.1	−3.5	−12.6	−1.0	−3.5	−19.3	------	------	------
	Nov. 29	15	+.1	−6.5	−11.7	−.8	−7.1	−19.0	−3.5	−10.1	−24.1	−4.0	−14.9	−27.1	------	------	------

TABLE 16.—*Brix, apparent sucrose, apparent purity, and yield of 96° sugar per ton of first-year stubble cane, and changes in these values, and the loss in weight in cane of 4 varieties during storage at 3 relative humidities at a temperature of 62° F. during the harvesting season of 1937*

Experiment No.	Date of analysis	Duration of storage	Initial Brix	Gain (+) or loss (—) per day in Brix at relative humidities (percent) of—			Initial apparent sucrose	Gain (+) or loss (—) per day of apparent sucrose at relative humidities (percent) of—			Initial apparent purity	Apparent purity				
												Gain (+) or loss (—) per day at relative humidities (percent) of—			Difference for $P=0.05$	Difference for $P=0.01$
				96-97	73-74	58-59		96-97	73-74	58-59		96-97	73-74	58-59		
CO. 281																
		Days	*Degrees*	*Degrees*	*Degrees*	*Degrees*	*Percent*	*Percent*	*Percent*	*Percent*						
1	Oct. 27	0	15.02				11.71				78.0					
	Nov. 1	5		−0.022	−0.018	−0.020		+0.004	−0.038	−0.120		+0.14	−0.16	−0.70	0.344	0.456
	Nov. 6	10		−.019	+.004	−.040		−.024	−.024	−.058		−.07	−.18	−.19	.172	.228
	Nov. 12	16		−.019	−.028	−.014		−.023	−.057	−.047		−.06	−.24	−.24	.108	.143
2	Nov. 16	0	16.78				14.42				85.9					
	Nov. 22	6		−.022	−.035	−.062		−.003	−.020	−.58		+.10	+.07	−.03	.215	.287
	Nov. 29	13		−.046	−.038	−.041		−.039	−.062	−.082		+.01	−.18	−.28	.099	.132
	Dec. 6	20		−.011	−.025	−.020		−.012	−.040	−.056		−.02	−.11	−.24	.065	.086
CO. 290																
1	Oct. 28	0	14.98				11.77				78.6					
	Nov. 3	6		+0.010	−0.028	−0.010		−0.017	−0.118	−0.097		−0.17	−0.65	−0.60	0.252	0.333
	Nov. 8	11		−.034	−.028	−.029		−.065	−.071	−.100		−.27	−.34	−.53	.137	.182
	Nov. 15	18		−.022	−.018	−.019		−.036	−.072	−.093		−.13	−.39	−.54	.084	.111
2	Nov. 18	0	16.43				13.73				83.5					
	Nov. 24	6		−.010	−.037	−.040		−.057	−.075	−.128		−.30	−.27	−.58	.208	.277
	Dec. 1	13		−.041	−.032	−.046		−.072	−.077	−.124		−.24	−.31	−.54	.096	.128
	Dec. 8	20		−.037	−.031	−.020		−.052	−.067	−.089		−.14	−.26	−.45	.063	.083
C. P. 28/19																
1	Oct. 23	0	16.92				13.87				82.0					
	Oct. 27	4		−0.125	−0.160	−0.195		−0.283	−0.435	−0.555		−1.10	−1.88	−2.45	0.628	0.835
	Nov. 1	9		−.064	−.033	−.057		−.157	−.163	−.268		−.63	−.82	−1.36	.279	.371
	Nov. 6	14		−.027	−.046	−.031		−.066	−.104	−.174		−.27	−.41	−.90	.179	.239
C. P. 28/11																
1	Nov. 10	0	17.63				13.87				78.7					
	Nov. 17	7		+0.031	−0.016	−0.029		+0.096	−0.149	−0.210		+0.40	−0.79	−1.09	0.303	0.406
	Nov. 24	14		−.003	−.013	+.004		+.017	−.205	−.267		+.11	−1.12	−1.53	.151	.203

TABLE 16.—*Brix, apparent sucrose, apparent purity, and yield of 96° sugar per ton of first-year stubble cane, and changes in these values, and the loss in weight in cane of 4 varieties during storage at 3 relative humidities at a temperature of 62° F. during the harvesting season of 1937*—Continued

Experiment No.	Date of analysis	Duration of storage	Initial yield of 96° sugar per ton of cane	Gain (+) or loss (−) of 96° sugar per day at relative humidities (percent) of—						Weight: Loss (−) per day at relative humidities (percent) of—			Weight: Difference for $P=0.05$	Weight: Difference for $P=0.01$
				96–97	73–74	58–59	96–97	73–74	58–59	96–97	73–74	58–59		
		Days	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		
CO. 281														
1	Oct. 27	0	158.1											
	Nov. 1	5		+0.20	−0.70	−2.48	−0.13	−0.44	−1.57	−0.35	−0.89	−1.15	0.202	0.268
	Nov. 6	10		−.40	−.54	−.99	−.25	−.34	−.63	−.22	−.75	−.94	.101	.134
	Nov. 12	16		−.38	−1.05	−.93	−.24	−.66	−.59	−.18	−.69	−.89	.063	.084
2	Nov. 16	0	205.4											
	Nov. 22	6		+.05	−.22	−.90	+.002	−.10	−.44	−.24	−.69	−1.02	.162	.215
	Nov. 29	13		−.55	−1.08	−1.50	−.27	−.53	−.73	−.12	−.63	−.78	.075	.099
	Dec. 6	20		−.18	−.69	−1.09	−.09	−.34	−.53	−.07	−.57	−.71	.049	.064
CO. 290														
1	Oct. 28	0	159.6											
	Nov. 3	6		−0.43	−2.37	−2.00	−0.27	−1.48	−1.25	−0.13	−0.52	−0.69	0.119	0.158
	Nov. 8	11		−1.18	−1.35	−1.96	−.74	−.85	−1.23	−.12	−.37	−.53	.065	.086
	Nov. 15	18		−.63	−1.44	−1.89	−.39	−.90	−1.18	−.12	−.37	−.53	.040	.053
2	Nov. 18	0	192.5											
	Nov. 24	6		−1.17	−1.38	−2.50	−.61	−.72	−1.30	−.20	−.50	−.87	.129	.172
	Dec. 1	13		−1.28	−1.45	−2.38	−.66	−.75	−1.24	−.14	−.49	−.61	.060	.079
	Dec. 8	20		−.88	−1.25	−1.79	−.46	−.65	−.93	−.09	−.46	−.56	.039	.053
C. P. 28/19														
1	Oct. 23	0	192.7											
	Oct. 27	4		−5.30	−8.35	−10.73	−2.75	−4.33	−5.57	−0.40	−0.95	−1.40	0.282	0.375
	Nov. 1	9		−2.97	−3.31	−5.41	−1.54	−1.72	−2.81	−.36	−.73	−.85	.125	.166
	Nov. 6	14		−1.26	−1.96	−3.56	−.65	−1.02	−1.85	−.10	−.55	−.73	.081	.107
C. P. 28/11														
1	Nov. 10	0	188.2											
	Nov. 17	7		+1.89	−3.10	−4.31	+1.0	−1.65	−2.29	−0.31	−0.85	−0.98	0.179	0.241
	Nov. 24	14		−.39	−4.31	−5.77	+.21	−2.29	−3.07	−.17	−.64	−.89	.089	.121

TABLE 17.—*Composition and change in composition of 3 varieties of first-year stubble cane stored at 3 relative humidities at a temperature of 62° F. during the harvesting season of 1937*

Experiment No.	Variety	Date of analysis	Duration of storage	Relative humidity	Composition of cane: True sucrose	Reducing sugars	Total sugars	Total soluble solids	True purity	Organic nonsugars	Acidity (as percent aconitic acid in cane)[1]	Gain (+) or loss (−) in composition during storage: True sucrose	Reducing sugars	Total sugars	Total soluble solids	True purity	Organic nonsugars
			Days	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*
1	Co. 281	Oct. 28	0	----	9.72	1.04	10.76	12.08	80.46	0.92	0.149						
		Nov. 10	13	96-97	9.47	1.05	10.52	12.05	78.50	.99	.107	−0.25	+0.01	−0.24	−0.03	−1.87	+0.07
		..do	13	73-74	9.30	1.23	10.53	12.13	76.67	1.06	.107	−.42	+.19	−.23	+.05	−3.79	+.14
		..do	13	58-59	9.25	1.32	10.57	12.10	76.45	.99	.116	−.47	+.28	−.19	+.02	−4.01	+.07
	Co. 290	Oct. 30	0	----	10.09	1.12	11.21	12.48	80.85	.77	.165						
		Nov. 13	14	96-97	9.67	1.16	10.83	12.11	79.85	.78	.143	−.42	+.04	−.38	−.37	−1.00	+.01
		..do	14	73-74	9.22	1.51	10.73	12.06	76.45	.83	.141	−.87	+.39	−.48	−.42	−4.40	+.06
		..do	14	58-59	9.33	1.82	11.15	12.40	75.24	.75	.135	−.76	+.70	−.06	−.08	−5.61	−.02
	C. P. 28/19	Oct. 24	0	----	10.83	1.28	12.11	13.45	80.52	.92	.140						
		Nov. 6	13	96-97	10.88	1.05	11.93	13.46	80.83	1.11	.102	+.05	−.23	−.18	+.01	+.31	+.19
		..do	13	73-74	9.81	1.78	11.59	13.03	75.20	1.02	.116	−1.02	+.50	−.52	−.42	−5.23	+.10
		..do	13	58-59	9.68	2.22	11.90	13.36	72.46	1.04	.111	−1.15	+.94	−.21	−.09	−8.06	+.12

[1] The pH of the extract increased by about 0.2, roughly from 5.5 to 5.7, in all varieties during storage, confirming the decrease in acidity obtained.

In some instances there was a tendency for inversion of sucrose in Co. 281 to slow down and even reach an equilibrium (table 15, figs. 2, 3, and 5). This tendency was shown to a less extent in Co. 290 (table 15, figs. 2 and 3). Normally, inversion in these varieties continues at about the same rate with the continuation of storage. As the period of storage was extended to 35 or 37 days, there was a very slight retardation in rate in Co. 281 at the lowest humidity and in Co. 290 at the two lowest humidities (fig. 6).

P. O. J. 36–M showed a decrease in rate of inversion of sucrose at the lowest humidity during the second period of storage in experiment 1 and at the two lowest humidities in experiments 2 and 3 (table 13, fig. 4). In each case, however, an increased rate was resumed during the third period of storage.

C. P. 28/11 was included in only one experiment (fig. 6) and then only for two periods of storage (7 and 14 days). At the highest humidity there was an apparent increase in apparent purity. This may have resulted from a low initial purity. At the two lower humidities the rate of inversion increased with the continuation of storage.

The loss of total solids (dry substance) and of Brix that occurred at the two to three levels of humidity at 62° to 66° F. are given in tables 8, 14, 16, and 17. The data are not consistent in showing a definite relation between the loss of solids or Brix and the moisture conditions of storage. During the harvesting season of 1936 (table 8), the loss of Brix in the varieties Co. 281, Co. 290, C. P. 28/19, and C. P. 807 was rather consistently greater at 96 percent relative humidity than at 74 at a temperature of 65°. C. P. 807 showed a greater loss of dry substance at the highest humidity than at the two lower humidities in all three experiments conducted during the harvesting season of 1933–34 (table 14). Otherwise, the data relative to loss in Brix and soluble solids at different relative humidities at 65° to 66° are contradictory (tables 14, 16, 17); also data on Brix obtained during 1933–35, which are not included in the data presented, were not consistent. Because of the effect of high moisture on the vegetative condition of the cane, one would expect the respiration rate and hence the consumption of soluble solids to be greater at high than at low moisture conditions. This assumption may have been found to be true if one could have reduced the error due to sampling.

There was an increase in organic nonsugars in more instances than a loss (tables 14 and 17). It is not believed that these changes are significant. The values obtained may have been influenced by the loss of total solids.

There was a slight gain in ash in juice in most instances (table 14), and it is believed that the values obtained were influenced by the loss of solids.

There was no significant change in pH, or acidity, other than that which might have been caused by the change in concentration of the juice.

That the change in apparent purity and the calculated yields of 96° sugar are fairly satisfactory criteria for comparing the amount of inversion of sucrose between varieties under different humidities at a constant temperature is shown by the data given in tables 13 to 17. The data in table 14 were obtained from juice (each value given being obtained from a composite sample of juice from five 30-stalk samples of cane) of samples of cane from which the data of simple juice analyses given in table 13 were also obtained. The results given in table 17 were from samples of cane from the same lot from which the data in table 16 were obtained. The change in true purity corresponds closely to the change in apparent purity, and concomitant with this change in true purity was a corresponding increase in invert sugars, indicating that inversion of sucrose was the principal change taking place in cane of the different varieties stored at different conditions of temperature and relative humidity.

The difference in pattern of inversion in varieties Co. 281, Co. 290, and P. O. J. 36–M as compared with that of C. P. 807 and C. P. 28/19 is shown by the apparent sucrose and apparent purity data in table 13 and figure 4 and is also shown by the difference in true sucrose and true purity data (table 14) for Co. 290 and P. O. J. 36–M as compared with C. P. 807. Analyses of Co. 281 were made only at the beginning and end of the experiments.

The mill tests on samples of cane stored at three relative humidities at 66° F. during the harvesting season of 1935 (table 15) show that the recovery of sugar at the two lowest humidities is slightly different from that at the highest humidity. Judging by the milling factors obtained, calculated yields from the first juice analysis would be too high in some instances at the lower humidities. In other words, the losses from cane stored under dry conditions were generally larger than indicated by the simple juice analysis.

Effect of Maturity on Inversion of Sucrose

Judging by the sucrose content of the juice, the cane of each variety used in the three successive experiments (expts. 1, 2, and 3) conducted during each of the harvesting seasons of 1933 and 1934 increased in maturity in the successive experiments or with the advance of the season. The data relating to the effect of temperature on inversion are given in tables 2 to 5 and figure 1; those relating to the effect of humidity are given in tables 13 and 14 and figures 4 and 5.

The effect of maturity on inversion of sucrose is more obvious in canes susceptible to inversion than in resistant varieties and at conditions favoring inversion than at those unfavorable to it. Although the data are not always consistent, it is believed that they indicate, in general, a tendency in most instances for the cane to acquire an increased resistance to inversion at some stage in its development during the harvesting season. The results will be discussed on the basis of general effects rather than on the basis of individual temperatures and humidities.

During 1933 Co. 281 exhibited slightly greater susceptibility to inversion of sucrose in experiments 1 and 2 than in experiment 3 at different temperatures and high humidity (tables 2, 4, and 5). During 1934 Co. 281 showed an increase in resistance to inversion with advance of the season at different temperatures at high humidity (fig. 1) and a greater susceptibility in experiments 1 and 2 than in experiment 3 at different humidities at 66° F. (fig. 5).

The results in connection with Co. 290 were contradictory. During 1933 no relation was found between maturity and inversion of sucrose in cane stored at different temperatures at high humidity (tables 2, 4, and 5). More inversion occurred in experiments 1 and 3 than in experiment 2 at the lowest humidity at 66° F. (tables 13 and 14, fig. 4). During 1934 inversion was greater in experiment 1 than in experiments 2 and 3 (figs. 1 and 5).

P. O. J. 36–M showed decreased inversion with the advance of the harvesting season at a temperature of 46° F. at high humidity (tables 2, 4, and 5) and at the lower humidities at a common temperature of 66° (table 13, fig. 4).

C. P. 28/19 showed greater inversion in experiments 1 and 2 than in experiment 3 in both types of experiments (figs. 1 and 5).

During 1933 the effect of maturity on inversion of sucrose in C. P. 807 is not clearly indicated in the data on the influence of different temperatures at high humidities (tables 2, 4, and 5). During 1934 more inversion, however, occurred in experiment 1 than in experiments 2 and 3 and more in experiment 3 than in experiment 2 (fig. 1). In experiments on the influence of different humidities on inversion more inversion occurred at the two lower humidities in experiment 1 than in experiments 2 and 3 during both 1933 and 1934 (figs. 4 and 5).

DISCUSSION AND CONCLUSIONS

Conclusions relative to the effects of temperature on moisture loss, duration of storage on inversion of sucrose, and other changes in harvested sugarcane are limited to temperature, moisture conditions, and duration of storage employed in the experiments reported. They do not extend to heavier losses of moisture than those obtained in these experiments at temperatures of 71°, 75°, 80°, and 90° F., nor to still higher temperature or to heavy loss of moisture at these higher temperatures. Likewise, the conclusions regarding the restriction of inversion by restricting loss of moisture are limited to the temperatures employed and to weather conditions usually present in Louisiana during the harvesting season.

The effect of temperature and the concentration of sucrose and of invertase on inversion of sucrose outside the plant are well known. The behavior of inversion of sucrose in the harvested sugarcane stalk might well be expected to bear the same relation to sucrose and invertase content and to temperatures as that outside the plant. Previous results and results recorded in this bulletin indicate that the relation of inversion of sucrose to temperature and the concentration of sucrose and invertase are different on the inside of the sugarcane stalk from that on the outside. In the limited studies that have been made, no relation was found between the invertase content of the whole, or millable, stalk and resistance to inversion of sucrose. In fact, C. P. 29/99, which normally shows a higher resistance to inversion than the other varieties tested (Co. 281, C. P. 29/94, and C. P. 29/136), showed the highest invertase content (*13*). C. P. 29/136 is one of the most susceptible varieties to inversion ever tested, but it has a much lower invertase content than C. P. 29/99. If concentration of invertase is a factor influencing the rate of inversion in the sugarcane stalk, it would seem to be caused by a localization of concentration within the cells in which inversion occurs, rather than to a total invertase content of the stalk as a whole. Of course, it is possible that the technique used for determining invertase activity was faulty.

Between varieties there was no relation between sucrose content of the stalk and rate of inversion of sucrose. Co. 290, which has a relatively low sucrose content, is more resistant to inversion than C. P. 28/19, which has a high sucrose content. Within a variety sucrose content is sometimes correlated with higher resistance to inversion. Such relation, however, is not universal, and previous cases (*13*) have been observed in which greater resistance has been associated in cane with lower rather than higher sucrose content in the same variety, which was harvested about the same time and stored under similar conditions.

In cane stored at high moisture conditions, rooting and sprouting occurred in 12 to 13 days at 66° F., and rooting occurred in 5 days and sprouting in 12 days at 75° (table 1). These vegetative activities had a noticeable effect on the loss of sugars, including sucrose, at 75°, and probably occasioned some loss at 66°, during the later periods of storage (tables 2, 4, 5, and 6). As the humidity was lowered at 65° to 66° and 71°, neither rooting nor sprouting occurred. A small amount of rooting and sprouting occurred at a relative humidity of 85 to 87 percent at 80° in 18 to 20 days and at a relative humidity of 89 percent at 90° in 19 days, indicating that drier storage conditions restricted both processes.

The loss of Brix and soluble solids increased with the continuation of storage and the rise in temperature. This loss is believed to be a rough measure of respiration losses. This effect of temperature on the loss of Brix and soluble solids corresponds to its effect on the evolution of carbon dioxide in other plants. The respiration rate is not only affected by temperature on the dormant tissue but also by rooting and sprouting at the higher temperatures. At temperatures of 46°, 56°, 66°, and 75° F., C. P. 807 seems to have a slower respiration rate than P. O. J. 36-M, Co. 281, and Co. 290 (table 3).

The effect of different temperatures on inversion of sucrose is often indistinguishable in such resistant varieties as Co. 281 and Co. 290 when stored at high moisture conditions. When inversion is restricted this effect extends to more susceptible varieties—C. P. 807 and C. P. 28/19—(fig. 1 and table 6). In certain lots of resistant varieties, and particularly of more susceptible ones, a unique relation develops. With the continuation of storage to the second period (12 to 15 days) and to the third (18 to 24 days) a gradient develops, the rate sometimes decreasing in the varieties Co. 281 and Co. 290 with the rise in temperature from 45° to 56° F., sometimes to 66°, and occasionally to 75°. In the varieties P. O. J. 36-M, C. P. 807, C. P. 28/11, and C. P. 28/19 the gradient usually extends to 66°, where inversion often increases as the temperature is raised to 75°. The inversion of sucrose was slightly less in Co. 281, and considerably less in Co. 290, C. P. 807, and C. P. 28/19, at 37° to 38° than at 47°, indicating that temperatures between these two become critical in their effects.

With an increase in the loss of moisture there is an increase in the amount of inversion in all varieties, except Badila.[7] The loss of moisture in certain varieties (Co. 281, P. O. J. 213, and C. P. 29/94) had little effect on inversion in only a few instances. Normally in-

[7] See footnote 6, p. 41.

creased inversion occurs in Co. 281 and P. O. J. 213 in response to an increase in loss of moisture. P. O. J. 213 is more susceptible to inversion than Co. 281 (*11*). As a result of loss of moisture, C. P. 29/94 (*14*) has been less responsive to inversion than any other variety thus far tested, except Badila (*10*). C. P. 29/94, however, has shown an increase in inversion in response to an increase in loss of moisture (*10*). In many varieties the increase in the amount of inversion in response to the loss of moisture is pronounced.

The loss in weight tended in most instances to slow up slightly with the continuation of storage. In some instances, however, there was no change in the rate of loss during approximately 3 weeks' storage; in others there apparently was an increase in rate. Because of the increase in concentration of soluble solids resulting from the loss of moisture with the lapse of time, it would be expected that there would be a decrease in the vapor pressure of the sugarcane stalk and hence a decrease in the rate of loss of moisture. The change in rate of loss of moisture has no varietal significance.

The data indicate that there is a varietal difference in rate of loss of moisture when cane is stored under the same conditions. On the basis of the percentage loss of moisture in these experiments the varieties are here roughly listed from least to greatest in accordance with their susceptibility to loss of moisture: Co. 290, C. P. 807, C. P. 28/11, C. P. 28/19, Co. 281, P. O. J. 36–M, and C. P. 29/320. The losses in the varieties Co. 281, C. P. 28/19, and C. P. 28/11 were similar, as were also those of P. O. J. 36–M and C. P. 29/320. The data relating to C. P. 28/11 and C. P. 29/320 were not sufficient to warrant definite conclusions.

The interplay of temperature, loss of moisture, variety, and maturity of cane on the inversion of sucrose presents interesting relations and problems. The restriction of inversion of sucrose by high moisture conditions at temperatures ranging from 46° and 47° to 75° F. is interesting in view of the fact that inversion is a hydrolytic process. In lots of all varieties stored at temperatures from 46° to 66° and at high moisture conditions, a tendency for a gradient in rate of inversion of sucrose developed, the rate decreasing with the rise in temperature. This gradient was associated with lots of cane that showed appreciable amounts of inversion. When cane was stored under lower conditions of moisture that favored about equal loss of moisture at temperatures of 47° to 65°, the gradient was accentuated (table 7, fig. 2). This gradient was sometimes present during the first period of storage (6 to 7 days), more often during the second period (13 to 15 days), and always by the end of 20 to 24 days.

The initial rates of inversion at a temperature of 65° to 66° F. as compared with that at temperatures below 65° and 66° were variable in the varieties Co. 281 and Co. 290. Sometimes the rates were practically the same at 65° and 66° and sometimes greater, and vice versa. Generally, by the end of the second period of storage (13 to 15 days) a gradient was developed, with the greatest amount of inversion taking place at the lower temperature. There was a tendency for the difference in rate to become greater with the continuation of storage. In C. P. 807 and C. P. 28/19, the initial rate of inversion was greater, and generally very much greater, at 65° and 66° than at 47° (table 7, fig. 2).

The total amount of inversion in C. P. 28/19 (experiment 1) was much greater at 65° and 66° F. than at 47° by the end of the second period of storage and about equal at these two temperatures in experiment 2. In C. P. 807 the total amount of inversion was much greater at 65° than at 47° by the end of the second period of storage. In both varieties and both experiments the total amount of inversion was much greater at 47° than at 65° by the end of the third period of storage. In C. P. 28/19, stored at temperatures of 51°, 62°, 71°, and 80° (table 10, fig. 3), the initial rate of inversion was greater at 62° and 71° but less at 80° than at 51°. By the end of 14 days' storage the amount of inversion decreased with the rise in temperature from 51° to 80°.

From these data and from figures 2 and 3 it will be seen that there was a shift in the rate of inversion at 47° and 65° F. In Co. 290 there was not much difference in rate during the initial period of storage, but with the continuation of storage there was an acceleration in rate at 47° and a deceleration at 65° (table 7).

In some instances inversion became almost stationary at 65° F. In C. P. 807 and C. P. 28/19 this tendency to become stationary at 65° to 66° was much more marked and definite. and in C. P. 28/19 stored at 51°, 62°, 71°, and 80°, this characteristic was exhibited at each temperature. With the continuation of storage this tendency for inversion to become stationary was also exhibited to a marked degree by C. P. 807 and C. P. 28/19 stored at three different humidity levels at the same temperature, 66° (figs. 4 and 5).

The higher the level of humidity, the less was the degree of inversion when it became more or less stationary. These stationary levels of inversion were widely separated, particularly in lots showing marked inversion. This tendency for inversion to become stationary at different levels of humidity was either not present at all or only to a minor degree in Co. 290 and P. O. J. 36–M. It was exhibited a number of times by Co. 281, but to a much less degree than in C. P. 807 and C. P. 28/19.

Taking into consideration the effects of temperature and loss of moisture in the course of inversion in C. P. 807 and C. P. 28/19, it would seem that a substance is formed (or a condition is developed) during the early part of the storage period that retards and finally arrests inversion. The rate of formation increases with the rise in temperature and with the increase in humidity levels or the decrease in water loss. This substance is apparently sometimes formed in Co. 281 and Co. 290. The formation of this substance seems to inhibit invertase activity. The formation of such a substance certainly does not, in most instances, account for the inherent difference in resistance or susceptibility between varieties. Some other factor affecting the rate of inversion must be responsible for the relatively high resistance of Co. 281 and Co. 290 as compared with the relatively high susceptibility of C. P. 28/19 and C. P. 807. The difference in the amount of inversion that normally occurs in these pairs of varieties is attributed to the difference in rate before an equilibrium is indicated.

The formation of the equilibrium substance may account for the behavior of lots of canes of different varieties and of varieties that show little inversion response to a great variety of storage conditions. Its normal presence in Badila could account for the behavior of this variety, which has generally shown little or no inversion even when the loss of moisture was enormous (*10*). Inversion might also be limited by the factor affecting the rate of inversion before the equilibrium stage is initiated.

Temperature affects the normal rate of inversion, i. e., the rate that operates before, and apparently independent of, the equilibrium phase, by reducing it as the temperature is raised from 47° to 65° F., as indicated by the results with P. O. J. 36–M, Co. 281, C. P. 28/11, and Co. 290 when the equilibrium factor was not operating. When this factor was operating it accentuated the gradient in these varieties. In varieties C. P. 807 and C. P. 28/19 the equilibrium factor not only accentuated the gradient but there was evidence that it would, in some instances, also extend the gradient to higher temperatures. In C. P. 28/19, stored at 51°, 62°, 71°, and 80°, the gradient extended from 51° to 80° (fig. 3).

The loss of moisture affects both factors. That it affects the normal rate is indicated by the fact that it influenced inversion in all varieties tested. That it affects the equilibrium factor is indicated by a change in equilibrium level with the change in moisture level. By maintaining a high moisture content in cane, it has been possible to obscure in some varieties the effects of temperature on inversion (figs. 1 and 5).

The data presented in this bulletin indicate that there was a tendency for cane of a particular variety to acquire in most instances an increased resistance to inversion at some stage of development during the harvesting season, and in some instances an increased resistance in each successive experiment. This increase in resistance was more evident in susceptible than in resistant varieties, although resistance may be no more real in the susceptible than in the resistant varieties. The increase in resistance in a particular variety was correlated with an increased sucrose content of the stalk. Between varieties no such correlation exists.

Increased maturity or the factors that reduce inversion in cane as it becomes older either hasten the formation of the equilibrium substance during storage or there is more of this substance present in mature than in immature cane, because the equilibrium phase is reached at a reduced stage of inversion with the increase in maturity (see data relating to C. P. 807 and C. P. 28/19, figs. 1, 2, 4, and 5). Maturity may also affect the normal rate of inversion, because reduced inversion with increased maturity is also associated with varieties (P. O. J. 36–M, Co. 281, and Co. 290) in which there is less tendency for inversion to reach an equilibrium (table 2, figs. 1, 4, and 5).

Relative to their resistance to inversion of sucrose, the varieties studied in these experiments may be divided into three groups: (1) Co. 281; (2) Co. 290; and (3) C. P. 28/11, C. P. 28/19, C. P. 807, and P. O. J. 36–M.

On the whole, the relative position of these varieties to one another with respect to resistance or susceptibility seems to be independent of the storage conditions, although differences in susceptibility are less manifest at high moisture conditions. This observation is of great practical importance to sugarcane planters and to mill men in connection with the harvesting and transportation of cane and mill operations. If heavy losses are to be avoided, the susceptible varieties must be milled expeditiously after cutting or greater care must be exercised to keep the cane moist during the interval between cutting and milling.

Consistency in the behavior of varieties under all conditions of storage is of immense importance in breeding for resistance to inversion and in testing for such resistance. If satisfactory samples of cane of different varieties are stored under conditions favoring loss of moisture and inversion of sucrose, results that will indicate relative resistance to inversion under the conditions prevailing in Louisiana during the harvesting season, especially if the degree of resistance is somewhat dissimilar, can be confidently expected.

The most important practical consideration in connection with results on the effect of temperature on inversion of sucrose is that instead of a rapid increase in rate with the rise in temperature between 37° and 75° F. the differences in rate are relatively small at high moisture conditions. This range of average temperature includes most temperatures that are likely to prevail in storage piles during the harvesting season in Louisiana when the mean is usually less than 75° and the periods during which 45° prevails are relatively short. Although the effects of temperature on inversion are more marked as the storage conditions become drier, it is possible to avoid drying by sprinkling the cane.

The mean air temperatures for October (*23*) at the various Weather Bureau stations in southeastern and southwestern Louisiana from 1924 to 1943, inclusive, ranged from 62° to 79.8° F. Some stations have rather consistently higher means than others. Burwood, which is located on an island at the lower end of the South West Pass to the Mississippi River, showed a higher mean in 16 out of 20 years than all other stations. Excluding the records for the Burwood station, the mean was below 75° at all stations in 12 out of 20 years. These means are normally high for the period of grinding cane in Louisiana, because grinding usually does not begin until October 10 to 20.

Records (*11*) of air temperatures and at the center of storage piles ranging from a few hundred pounds to 800 tons show that the temperatures at the center of the piles were usually lower than the mean between night and day temperatures. The larger the pile the truer was this relationship. Samples of cane at the center of a dry pile showed less inversion of sucrose than those on the top of the pile.

It has been the practice for certain mills in Louisiana to store cane in piles as large as 2,000 tons or more for week-end grinding. This cane was sprinkled once or twice daily. There has been no indication of accumulated respiration heat. This statement applies to hand-cut and hand-stripped cane and not to burned or frozen cane.

The range of mean temperatures for November and December from 1924 to 1943, inclusive, at the weather stations mentioned above were 50.2° to 71.2° F., and 44.7° to 66.9°, respectively. October, November, and December cover the usual period of grinding cane in Louisiana, although cane is frequently harvested in January, which, however, has lower temperatures than the other 3 months.

Within the range of temperatures prevailing in Louisiana during the harvesting season the loss of moisture is a far more important factor than temperature in affecting inversion of sucrose. This is particularly true during the early part of the season when the relative humidity is low and the vapor pressure of the stalk is high because of the prevailing high temperatures. Then, too, there is generally less precipitation during the early part of the season. Furthermore, cane is normally less mature during the early part of the harvesting season and is often much more susceptible to the inversion of sucrose. Consequently, during the first 3 or 4 weeks of the harvesting season heavy losses of sucrose may result from delay in milling and drying out of the cane.

A very important result obtained from these studies on the relation of moisture loss to inversion of sucrose is the fact that irrespective of the variety and the temperature (up to 75° F.) cane that is kept wet shows relatively little inversion, although there is a tendency for it to be greater in susceptible than in resistant varieties. In previously reported results (*11*) it was shown that inversion was kept at a minimum for a week to 10 days by sprinkling cane in piles of various sizes and when stored under weather conditions prevailing in Louisiana during harvesting.

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U. S. GOVERNMENT PRINTING OFFICE: 1945

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