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# Sugar making on a small scale with results at the North Louisiana Experiment Station, Calhoun, La.

T S. Adams

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—OF THE—

LOUISIANA STATE UNIVERSITY & A. & M. COLLEGE

BATON ROUGE, LA.

Wm. C. STUBBS, PH. D., Director and Official State Chemist.

## SUGAR MAKING ON A SMALL SCALE

—WITH RELULTS AT THE—

NORTH LOUISIANA EXPERIMENT STATION,

CALHOUN, LA.

ISSUED BY THE BUREAU OF AGRICULTURE.

T. S. ADAMS, Commissioner.

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LOUISIANA STATE UNIVERSITY & A. & M. COLLEGE,
OFFICE OF EXPERIMENT STATION, BATON ROUGE, LA.

Dear Sir: I hand you herewith a Bulletin on "Sugar Making on a Small Scale," together with results obtained at the North Louisiana Experiment Station, Calhoun, La. This bulletin is issued to meet the heavy demands made upon this Station for information in the rudiments of sugar making, by farmers throughout the Gulf States. It is hoped that the information contained therein will aid in giving an inteligent direction to sugar-making and thereby largely increase the profits of the farmer. I respectfully ask that this Bulletin be published as No. 5 of Second Series.

Respectfully submitted,

WM. C. STUBBS, DIRECTOR.

# SUGAR MAKING ON A SMALL SCALE.

This article is intended to give the simplest rudiments of sugar making for the guidance of small farmers who grow only patches of sugar cane, and make sugar, syrup and molasses for home cosumption or local use.

To make a refined sugar upon an extensive profitable basis, there are required many hundred acres of cane and a most costly sugar house, consisting of ponderous mills or a diffusion plant clarifiers, tanks, filter presses, multiple effects, vacuum pan, mixer, centrifugals, sugar wagons, powerful engines, and enormous boilers. To make sugar on the small scale about to be described, there are required only a horse mill, evaporator and a few boxes c.pable of holding cane juice—an outfit varying in cost from $50 to $300.

There is also given herein the results of the experiments made at the North Louisiana Experiment Station, Calhoun, La., in growing cane and making sugar. These results were so satisfactory as to justify the prediction heretofore made by the author, that sugar cane could be grown successfully everywhere in Louisiana, and in the southern parts of the gulf states. To aid in the development of this prophecy, a minute and detailed description of the processes of cane and sorghum growing and manufacture is hereby given.

The first step towards sugar making is the growing of sugar cane or sorghum. The latter is planted from seed, and up to date, of the large number of varieties used, none have surpassed the Link's Hybrid, a variety originated by Mr. Ephraim Link of Greenville, Tenn. This is planted either in the drill (and thinned when up to one stalk every four inches) or dropped at intervals of eight to ten inches, and two stalks left to each hill. Its after cultivation is like that given to corn. Sorghum should be cut just as soon as the seed is ripe. In making sugar or syrup

from sorghum it should be treated as sugar cane, but it should be borne in mind that the juices of the former are much more impure and therefore much more difficult to granulate and purge than those from the sugar cane.

PRESERVING CANE FOR SEED,

The question of greatest importance to a sugar planter. is the preservation of cane for seed during the winter.

Cane must be planted in the fall—or must be preserved carefully in windrows or "mats" through the winter for spring planting. Upon high, well-drained soils, fall planting may be practised with success. It should be borne in mind, however, that fall planted cane should be covered from three or four inches deep with well pulverized earth. It is customary in the sugar dictrict to run a heavy roller over it, after planting, to firmly press the soil against the cane. Cane may be lost from either wet or dry rot. The former will occur when too much moisture, exists in the soil and the latter when too little. In open, cloddy land, especially during a dry fall and winter, dry rot sometimes occurs despite precau ions against it. It is never safe to plant cane in the fall upon low and undrained soils, nor in cloddy, dry lands (unless seasonable rains prevail). When fall planting is not done the seed must be preserved for the spring. In south Louisiana this is now almost universally done, in windrows. The cane, with all its adherent leaves and trash is cut at the ground and thrown into the open furrow between the rows, the tops covering the butts in such a manner that when the windrow is completed nothing but the leaves of the cane are visible. Two four-horse turn plows, one right-handed the other left-handed, throw furrows over this windrow, completely covering it. Hoes follow, filling in the inequalities of the soil. The quarter drains are carefully opened and the windrow is completed. When planting begins in the spring the same plows now remove the dirt, and by the aid of mattocks or picks the cane is withdrawn from the row. Vertical mats are found in low, wet grounds, but upon high lands horizontal ones are best. These are made by digging out the soil to the depth of one or two feet and in this pit the cane is placed so that the tops will every-where cover

and protect the stalks; after filling to the proper height dirt is thrown over the entire pile. In the spring the pile is broken down and cane planted.

### PLANTING CANE.

In planting the sugar cane one continous stalk (and two, if the land be very fertile), should be deposited in an open furrow and securely covered. In the fall this covering should be several inches thick and the land should be well drained. Early in the spring the extra soil used in covering should be removed in order to secure early germination, for the sooner the cane starts in the spring the greater the maturity in the fall, and therefore the richer in sugar. After the germination of cane there is a period of apparent rest, when the young sprout undergoes a multiplication several times by "tillers" or "succors." This process of "tillering" being over, the cane, the season being favorable, grows with great rapidity. During tillering the harrow or plow should be used only to stir the soil and with great care. When growth ensues the work of cultivation should be rapid and thorough, to be completed by a "lay by," when the cane has reached a size which will effectually shade the ground and prevent the growth of weeds or grass.

### VARIETIES.

There are two varieties of cane generally planted throughout the south, viz: Purple or violet cane, and the red ribbon or striped cane. Both are superior canes. The green cane, sometimes found in the hills, is unworthy of extensive cultivation. Of the seventy-six foreign varieties now introduced at the Sugar Experiment Station, one seems pre-eminently adapted to higher latitudes on account of its extreme hardiness. It grows and thrives without much attention, ratoons and stools well, and withstands considerable cold. It is now on trial in Kansas and North Louisiana. It is, however, a hard cane, and has not so high a sugar conent as the purple or ribbon cane. It is also difficult to clean it for the mill. But its merits recommend it to all those who live outside of the true sugar cane belt. This cane is called the Japan-

ese or Zwinga, and is white cane of good length, but small in diameter.

### CULTIVATION AND FERTILIZATION.

That cultitation found best for corn will generally suit sugar cane and sorghum. Both crops require thorough drainage. The conditions necessary for growing successfully these crops may be summarized as follows: Thorough and deep preparation of the soil, cultivation rapid and as shallow as the soil will permit, and a "lay by" when the growth shades the ground. Rows varying from five to seven feet are now usually adopted. The fertilizer for cane should contain enough nitrogenous matter to insure a large growth by September. An excess should be avoided as detrimental to large sugar content. Phosphoric acid in a soluble form is everywhere beneficial to cane, while potash may be demanded upon light sandy soils.

Experiments have shown that the limits of profit in the use of fertilizers are between 24 and 48 pounds of nitrogen and 40 to 80 pounds of phosphoric acid.

These ingredients are cheaply furnished in the forms of cotton seed or cotton seed meal and acid phosphate.

The following mixture per acre has been found very efficient under cane, viz: Six hundred pounds of cotton seed meal, 300 pounds of acid phoshate.

Instead of this meal, cotton seed may be used at the rate of three to one of the meal (circa).

The above may seem excessive to many, but may be reduced at will—but with favorable seasons on soils in good tilth, all of the above will be utilized. Crops of 30 to 35 tons of cane per acre are frequently obtained in South Louisiana, and may be secured elsewhere.

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### HARVESTING THE CANE.

When the cane is ready to be harvested the cane knife should be used. The fodder is stripped from the cane by a projection on the back of the knife. After removing the fodder the cane is topped—up into the white joints if only syrup is desired,

but in the upper red joint if sugar is to be made. After topping the cane is seized with the left hand and severed at the ground with a strong blow, and thrown upon the heap row (every third row), from which all the trash has been removed. The carts now drive between the heap rows and load from both sides. Sugar wagons and carts specailly designed to empty their loads are used by sugar planters. Dump carts, or tumbrels with sideboards, will be found useful in handling cane on a small scale. Reaching the sugar house the operation of sugar making begins. It is worthy of remark here, that all leaves and sheaths should, as far as practicable, be removed from the cane before entering the mill.

MANUFACTURE.

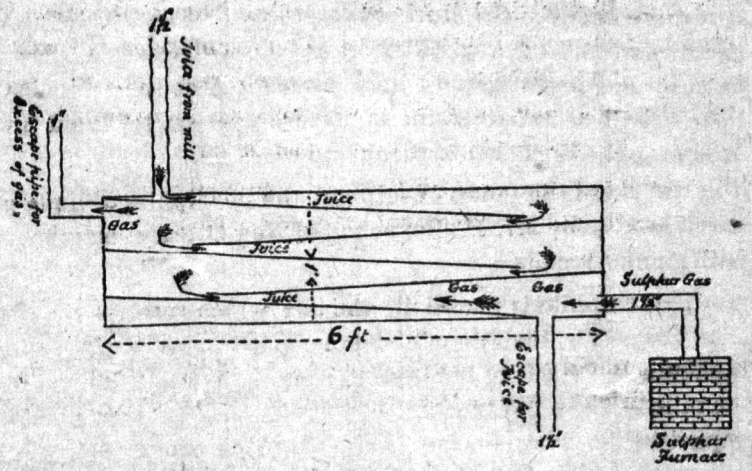
The outfit for sugar or syrup making on a small scale consists of a horse mill and evaporator, with boxes and barrels to be used as juice tanks, sulphur machine, coolers, etc. These will be described in detail.

The horse mill must be erected in a substantial manner. The feed roller should be left slightly open to receive the cane, while the bagasse roller should be made to touch everywhere the main roller in order to secure good extraction. The rollers should be tighted every morning, and only when the bagasse comes out in short, dry pieces should the operation of squeezing be considered satisfactory. It pulls the team heavier, but a much larger percentage of juice is obtained. In this way as much as 70 per cent. of the weight of the cane will be procured as juice—while the bagasse, coming from the mill, simply pressed, not broken, means often not over 50 per cent. extraction. It is useless to grow the sugar and throw it away in the bagasse. Underneath the mill should be placed a tight box of a capacity of not less than fifteen to twenty gallons. Over this box and directly under the spout of the mill should be a metallic strainer to intercept all broken fragments of cane, since the latter are very objectionable in sugar making.

On the side of this box and about three or four inches from the bottom, an inch pipe should be inserted, which leads to the top of the sulphur box. In the latter the juice is sulphured. This box may be made in many forms.

## SULPHUR MACHINE.

A cheap and effective machine is herewith given, which may be made by any carpenter.




It is made of thoroughly dried lumber and water-tight. The size of the box will largely depend upon the amount of juice to be sulphured. For a one-horse mill, 1x2x6 feet, with four or five shelves, will be ample size. A very small brick furnace, three brick high and two wide each way, with an opening sufficiently large in front to receive a small iron cup, in which the sulphur is burned, is connected with the sulphur machine by a 1½ inch pipe on the side of the box, near the bottom. The fumes of sulphur arise in the box and ascend in the opposite direction of the fall of the juice and finally any excess escapes the chimney on the upper part of the machine. The shelves down which the juice flows may be much narrower than the box. In this case they must be supported and must have narrow strips on each side to restrain the juice on the shelf. The juice entering at the top of the box, meets with the fumes of sulphur all along its passage, and before escaping becomes charged with this gas.

The object is to retard the flow of the juice through the box,

and during its passage to cause it to absorb as much of the fumes of sulphur (sulphur dioxide) as possible.

### OBJECTS OF SULPHUR.

The objects of sulphuring is three-fold: First, it disinfects; second, it bleaches, and third, it assists in defecation. By sulphuring, the juice, already acid, becomes more so, and must be treated with lime (neutrallized) before heating, to avoid inversion, i. e., a conversion of sugar into molasses.

Instead of the fumes of sulphur, the bi-sulphite of lime, prepared largely by Mr. H. Bonnabel, of New Orleans, may be used with similar results.

This sulphite is placed in the box which receives the juice from the mill at the rate of about one quart to every fifty gallons. It should be added to the juice as soon as it begins to run from the mill, so as to have as much time as possible to act upon the impurities.

After the juice is sulphured it is conducted to the tank resting directly over the evaporating pan, where it is limed. Freshly made lime should be used. It is slaked to a powder and mixed with a small quantity of the juice until a thick milk of lime is obtained. This should now be poured into the juice, stirring the latter all the time until enough has been added, which can easily be told by the use of "blue litmus paper." The natural juice of the cane is acid, and this is destroyed by the addition of lime. If blue litmus paper be dipped into acid it will turn red. If the acid be neutrallized, no change of color takes place. Lime should be added until the litmus paper shows only a faint violet color. Should too much lime be added it will be indicated by the use of "yellow turmeric paper," which will then turn brown, but will remain unchanged if lime be not in excess. The proper point of liming is found when the juice gives no change to either litmus or turmeric paper.

After liming the juice should be permitted to settle, so as to remove all the precipitate produced by the lime and sulphur. Through a valve placed just above the bottom of the settling

tank, the clear juice is drawn into the pan and the process of cooking begins.

Every evaporating pan should consist of three or more separate compartments. In an open kettle sugar house, there are four large kettles, known respectively as "The Grand," "The Flambeau," "The Sirop," and "The Batterie." The juice is emptied into the grand, where the scums are removed, then into the flambeau, where it is brushed or cleaned; then into the sirop, where it is thoroughly cleaned, and then into the batterie, where it is cooked to sugar. In the small evaporators the flambeau is discarded and we have three compartments representing the grand, the sirop and the batterie.

The juice is taken into the grand, where the heat coagulates the scums. The latter are removed by means of a strainer on a long handle. After removing all the scums this juice is transferred to the sirop, where, on account of the increased heat of the furnace and the density of the juice, an ebullition is obtained, which permits of brushing off any floating particles of dust or scums (with a small wooden paddle) back into the grand. Here the juice is thoroughly cleaned and concentrated. When it has reached the density of thin syrup—say 20 or 25 deg. Baume—the latter is transferred to the batterie, where it is cooked to a density of 40 to 42 degs. Baume, or until the thermometer shows a boiling point of 238 to 242 degs. Fahrenheit. When this point is reached it is emptied into a cooler, which may be a watertight, square box, or even the half of a molasses barrel. When the cooler is full it is generally stirred to induce graining. Usually in twenty-four hours the masse cuite (for such this is called in French) is hard and solid, due to the granulation of the sugar. It is then cut out of the cooler with a sharp spade, all lumps mashed and "potted."

On a large scale the potting is done in hogsheads. It can as easily be done in barrels or kegs. The process of potting consists in taking a barrel or keg and boring three holes equi-distant from each other in the bottom with an inch augur. Into these holes are inserted stalks of cane with their ends beveled so as to form an outlet for the molasses. They are often peeled on oppo-

site sides so as to furnish channels for the escape of the molasses. Having adjusted the canes in the barrel, it is placed over a large water-tight box or over half a molasses barrel and filled with the "masse-cuite" from the cooler. The molasses escapes down the cane and out of the barrel into a box or tub below. In a week or so there will be a barrel of sugar and considerable quantity of molasses (not syrup). Instead of a barrel a strong osnaburg sack suspended over a tub may be used to advantage. The molasses will keep for a long time and is more valuable than syrup, which can never be relied on if made from rich cane.

INSTRUMENTS AND APPARATUS.

The Baume hydrometer mentioned above can be obtained in New Orleans, at Claudel & Co., I. L. Lyons & Co., and elsewhere and costs 75 cents. This hydrometer is graduated from 0 deg. to 50 deg., and may be used for either juice, syrup or "masse cuite." In making syrup this hydrometer should show 34 deg. to 36 deg.

The rude sorghum pans now so extensively used are so constructed that the juice is kept flowing continuously in the pan and syrup out of it—without any gates or partitions to seperate into compartments. Such pans could be easily remedied by a tinsmith or even by a farmer himself. It is always best to have at least three compartments, without communication with each other, necessitating the dipping of the juice from one to the other. Even in those pans where gates are provided these should be securely fastened before beginning to cook. A small leak will invariable interfere with successful work.

The small mills are made by the Chattanooga Plow Co., Chattanooga, Tenn., and several houses in Atlanta, Ga. The Blymer Co. of Cincinnati, the Geo. L. Squire Manufacturing Co. of Buffalo, N. Y. and other places. The same houses also make evaporators. Mr. W. J. Sharp, of Baton Rouge, La., makes an evaporating pan which is very highly recommended. It has been successfully used by scores of small sugar planters in Louisiana. It can be obtained of any size and capacity.

There are no safe or reliable preventives of syrups turning

to sugar. Cutting the cane up in the green joints, the addition of sour oranges or even acids during boiling are the methods adopted to accomplish this purpose. If the cane be rich in sugar the first two will not prevent granulation. If the latter be used the resulting compound could hardly be called syrup. In re-boiling syrups, milk of lime should first be added, so as to remove all *the acidity* and then boiled to the proper density.

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RESULTS OF EXPERIMENTS AT NORTH LOUISIANA EXPERIMENT STATION, CALHOUN, LA.

In the fall of 1888 a few hundred stalks of purple cane were purchased and planted. Only a partial stand was obtained and a light tonnage made. This cane was used to plant the crop of 1890. A portion was planted in the fall, and the rest, after being successfully matted, was planted in the spring. The stubble left in 1889 was covered first with trash and then with two furrows of a two-horse plow. In the spring it was uncovered. An excellent stand was secured. The fall plant came up early, and a part of it gave a large tonnage. The spring plant came up late, and on account of a prolonged drought in July and August never attained a large size. The ground upon which his cane was grown is perhaps the poorest in North Louisiana, and has been in cultivation for over seventy-five years. It was well prepared and laid off in five foot rows, and planted a single running stalk. It was fertilized with a mixture of cotton seed meal and acid phosphate.

The small sugar house contained a Victor mill (one horse), a Cook's evaporator, a sulphur machine (like the one already described), two juice tanks, six or eight coolers and several sugar and molasses barrels. With this outfit the results given below were obtained. The following results are the chemical :

ANALYSES OF JUICES.

| Date. | Kind of cane. | Degrees Baume. | Degrees Brix. | Sucrose. | Glucose. | Glucose ratio. | Purity coefficient. |
|---|---|---|---|---|---|---|---|
| Oct. 27 .... | Stubble ..... | 9.5 | 16.9 | 13.8 | 1.26 | 9.13 | 81·06 |
| Oct. 28 .... | Stubble ..... | 9.8 | 17.3 | 13.9 | 1.19 | 8.56 | 80.34 |
| Oct. 29 .... | Stubble ..... | 9.7 | 17.2 | 14.0 | 1.16 | 8.28 | 81.38 |
| Oct. 30..... | Fall plant..... | 8.8 | 15.5 | 12.6 | 1.94 | 15.38 | 81.35 |
| Oct. 31..... | Fall plant..... | 8.9 | 15.7 | 12.7 | 1.96 | 15.43 | 80.89 |
| Nov. 1 ..... | Fall plant..... | 8.9 | 15.7 | 12.7 | 1.95 | 15.35 | 80.89 |
| Nov. 2 ..... | Japanese..... | 7.6 | 13.4 | 9.9 | 3.20 | 32.32 | 73.88 |
| Nov. 4 ..... | Spring plant ..... | 8.4 | 14.9 | 11.9 | 1.80 | 15.12 | 79.86 |
| Nov. 5 .... | Spring plant ..... | 8.5 | 15.0 | 12.3 | 1.74 | 14.14 | 82.00 |

Stubble cane gave an extraction of .....69.36 per cent
Fall plant cane gave an extraction of .....75.24 per cent
Japanese cane gave an extraction of..... .....66.74 per cent
Spring plant cane gave an extraction of.....60.19 per cent

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The above differences in extraction were accomplished by experiments in tightening the rollers.

When the bagasse roller was jammed against the large roller and cane carefully fed, over 75 per cent. of the weight of the cane was obtained in juice.

Again, the fall plant cane consisted of large stalks and were thus better squeezed. The smaller stalks of the spring plant, with the rollers slightly opened, gave as low as 60 per cent. extraction.

The stubble cane yielded 15.6 tons per acre.

The fall plant cane yielded 16.6 tons per acre, though much of it went over twenty tons.

The spring plant cane gave only about eight tons per acre.

The Japanese cane gave about ten tons per acre.

There were ground of stubble cane, lbs .....11,155
There were ground of fall plant, lbs .....15,678
There were ground of Japanese, lbs ..... 1,010
There were ground of spring plant, lbs ..... 8,526

Total cane.....36,369
Or tons ..... 18.19

The sugar and molasses from each run could not be separated, so only the aggregate of each can be given.

| | |
|---|---|
| Total sugar made, lbs | 2,400. |
| Total molasses made, lbs | 1,920 |
| Total molasses made, gals | 160 |
| Sugar per ton of cane, lbs | 132.08 |
| Molasses per ton of cane, lbs | 105.50 |
| Molasses per ton of cane, gals | 8.79 |
| Sugar per acre, lbs | 1,600 |
| Molasses per acre, lbs | 1,280 |
| Molasses per acre, gals | 106.6 |

The molasses has been sold for 35 cents per gallon. The sugar is worth on the sugar exchange in New Orleans, 3½ cents per lb. at this date—at retail in the city 5 cents per lb.

No special effort was made to grow the cane, or to manufacture it. It was grown upon the poorest land and manufactured with inexpensive machinery. What has been done by the station can be accomplised by any farmer in the State. Upon good land, well fertilized and with inexpensive machinery, sugar, molasses and syrup may be made in abundant quantities for local use and with a surplus for market.