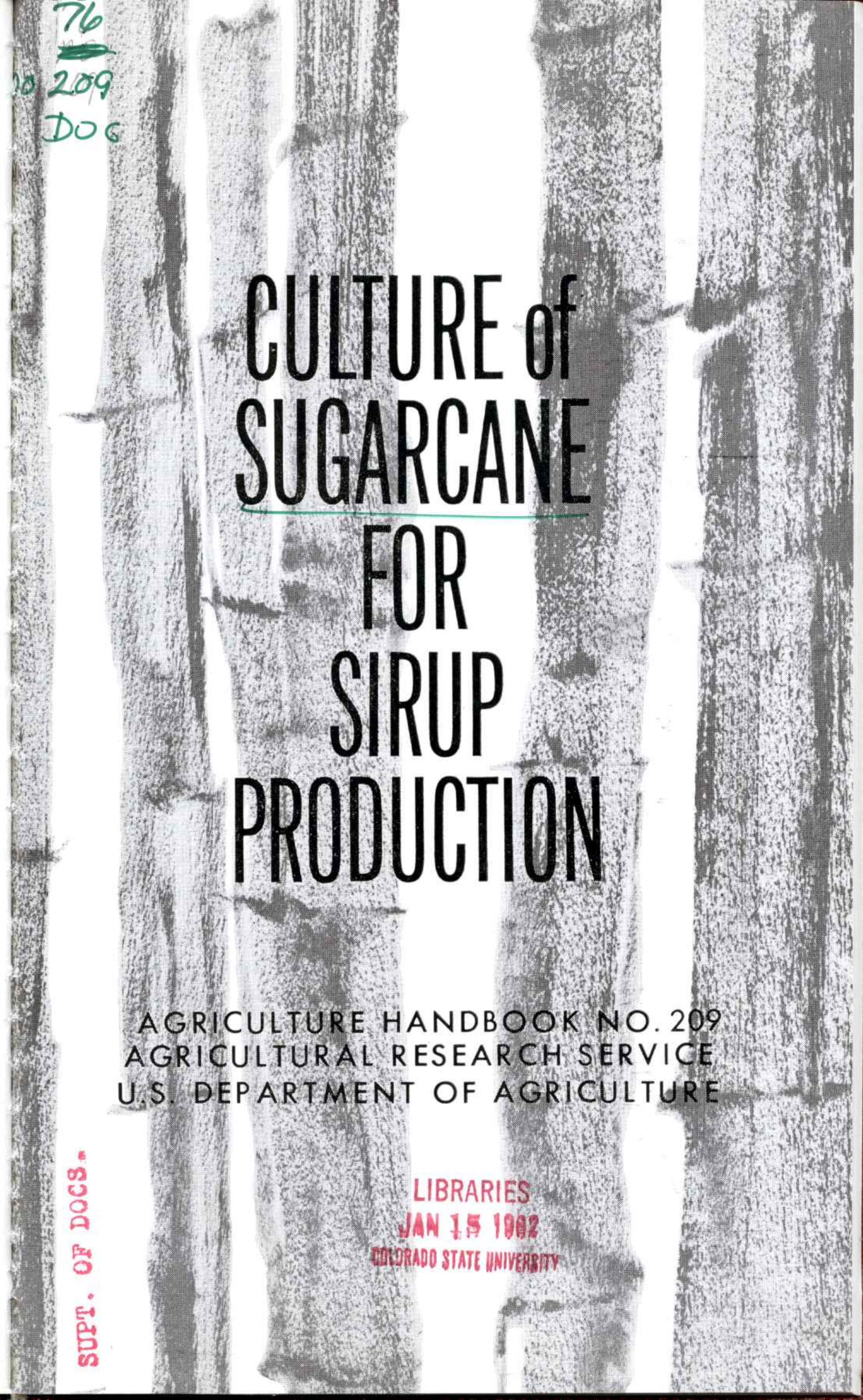

CULTURE of SUGARCANE FOR SIRUP PRODUCTION

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Contents

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CULTURE OF SUGARCANE FOR SIRUP PRODUCTION

By I. E. STOKES, O. H. COLEMAN, K. C. FREEMAN, and D. M. BROADHEAD, *research agronomists*, and J. L. DEAN, *pathologist, Crops Research Division, Agricultural Research Service*

The production of sugarcane sirup varied considerably from year to year during 1938–60. It ranged from 28,251,000 gallons in 1945 to 3,225,000 gallons in 1957. Prices per gallon ranged from 42.9 cents in 1936 to $1.53 in 1946. Peak annual income from sugarcane sirup was $35,806,000 in 1946, when 23,335,000 gallons were produced.

In general, the sugarcane grown for sirup production on individual farms ranges from a fraction of an acre to 10 or 20 acres; a few farmers have larger acreages. Sirup is usually manufactured on a small scale; however, there are a few large factories. It is sometimes made in the neighborhood for home use only; otherwise it is produced primarily for the market. In many communities a group of farmers has the sirup manufactured at a privately or cooperatively owned plant.

Sugarcane sirup is usually light colored and mild and it has a good flavor. It is a wholesome food and is favored as a table sirup.

Sugarcane is grown most extensively for sirup in Georgia, Alabama, Mississippi, and Louisiana. These States, sometimes called the sugarcane-sirup belt, produce about 90 percent of the sugarcane sirup. Louisiana and Georgia have been the largest producers for many years. Some sugarcane is also grown for sirup in Florida and Texas. The northern limit for growing sugarcane commercially for sirup (fig. 1) is where the crop remains immature, imparting objectionable qualities to the sirup, gives a prohibitively small yield due to the short season, or fails to produce a stubble crop (*9*).[1]

Sugarcane is propagated by means of "seedcane," or sections of the stalk. True seed, occasionally produced in southern Florida (fig. 2), is not suitable for growing an ordinary crop of sugarcane. It is exceedingly small, germinates very poorly, and requires much longer to develop into full-grown plants than do the shoots from "eyes," or buds, on the seedcane. Plants raised from true seed are not true to type and are usually inferior to the parent varieties. However, the production of true seed is useful to the plant breeder in developing sugarcane varieties that are resistant to diseases and that produce high yields of a good-quality sirup.

Sugarcane varieties propagated vegetatively, that is from seedcane, do not tend to degenerate when planted over long periods of time. However, the old vari-

[1] Italic numbers in parentheses refer to Literature Cited, p. 30.

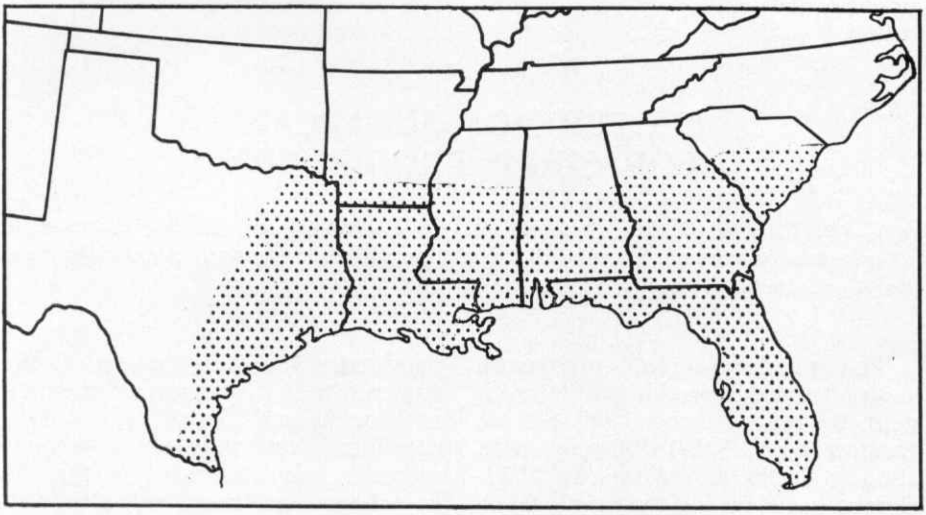

FIGURE 1.—Successful sugarcane culture for sirup production is restricted to the shaded area on the map.

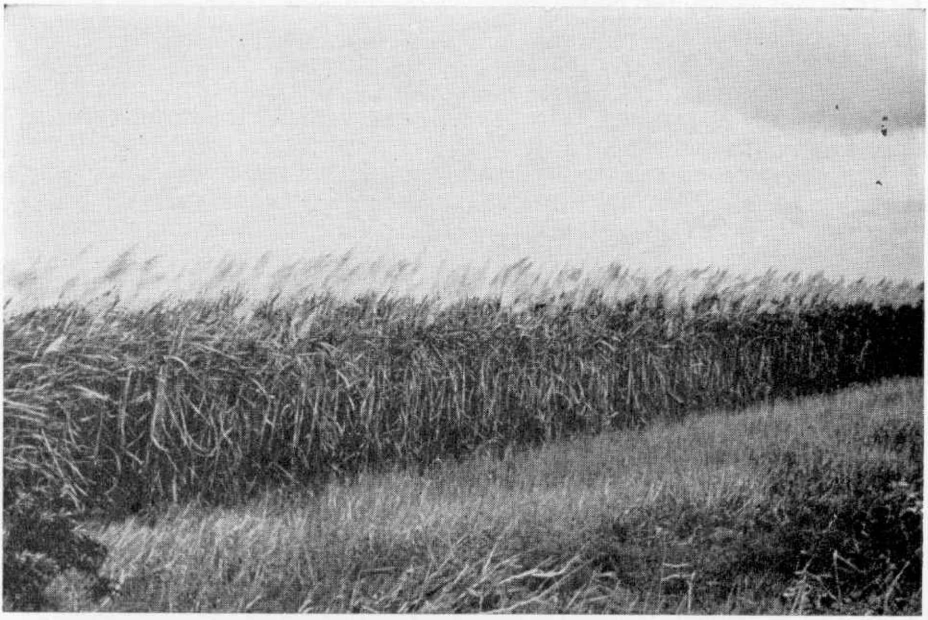

FIGURE 2.—Sugarcane C.P. 50–28 flowering at Fellsmere, Fla.

eties have gradually disappeared because of diseases, particularly mosaic to which these varieties were especially susceptible. Disease-resistant, high-yielding varieties are now used almost exclusively throughout the sugarcane-sirup belt.

The primary objective in growing sugarcane for sirup is to obtain the largest possible yield of good-quality sirup. Yield and quality of sirup are affected by the variety, diseases, insects, fertilizer and cultural practices, harvesting, and manufacturing processes.

DESCRIPTION OF THE PLANT

Sugarcane is a member of the grass family, belonging to the genus *Saccharum*. It is best adapted to tropical conditions. Little or no growth is made during the winter in most areas of the Southern United States. However, a new crop normally will be produced from stubble of the previous crop under favorable conditions.

Early growth above the surface appears to consist mainly of leaves. However, the stalk is developing during this period—at first mainly by the formation of nodes very close together. The internodes from this time grow more rapidly and become much longer. Tillers develop from buds below the surface (fig. 3) (*2*).

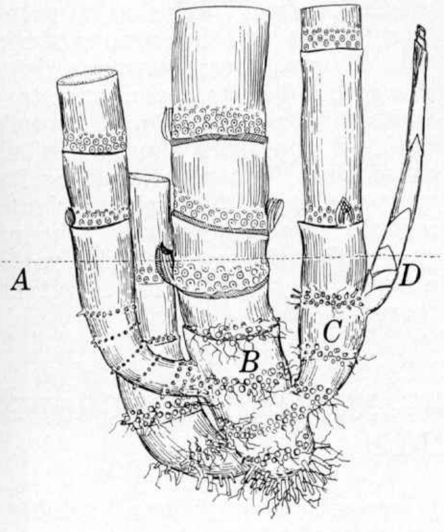

FIGURE 3.—Diagram of part of a sugarcane stool: *A*, Ground level; *B*, primary, *C*, secondary, and *D*, tertiary stems.

A mature plant usually has several stalks growing together in a large cluster, or stool (fig. 4).

FIGURE 4.—Sugarcane C.P. 36–111, consisting of several stalks, at Newton, Miss.

The stalks, which are made up of fully expanded nodes and internodes, vary in height from 6 to 10 feet. Stalks of most varieties taper from the base to the top. They range from light green or yellow to red or purple.

The node is tough, fibrous tissue between the internodes. Four essential structures are on the node—the root band, the growth ring, the bud, and the leaf-sheath attachment (fig. 5) (*3*).

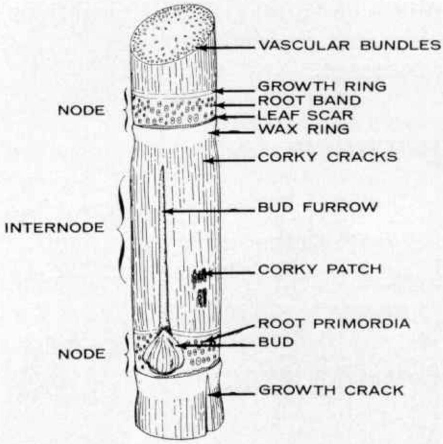

FIGURE 5.—Diagram of node and internode of sugarcane.

The root band is a small section of the node just above the leaf scar. It usually differs in color from the internode and has many small dots. Under favorable moisture conditions a root may develop at each dot.

Just above the root band and usually not clearly distinct from it is a transition area known as the growth ring. Elongation and growth of the internodes takes place in this area.

The bud is on the root band. Buds are arranged in two rows, usually alternately on opposite sides of the stalk. When a bud is exposed to favorable moisture and temperature conditions and with proper stimulus, it can develop into a new shoot.

A slightly protruding, encircling shoulder is visible at the node. It is the point of attachment of the leaf sheath.

The exterior of the mature internode is usually covered with a thin film of waxy bloom. This outer region, or rind, of the internode is hard and contains numerous fibers that strengthen the stalk, whereas the interior of the stalk is mainly soft pith that contains sweet juice.

A leaf of the sugarcane plant consists of the sheath and the blade. The sheath is so situated on the node that it completely encircles the stalk, forming a close-fitting cover for the bud. It usually extends the full length of the internode. The blade varies in width from 1 to 3 inches at the point of attachment to the sheath, but it tapers to a sharp point. Leaf blades are usually 4 to 5 feet long.

The primary feeding roots originate from nodes at a point slightly beneath the surface of the soil. They grow downward into the soil, whereas secondary, tertiary, and smaller roots branch out and penetrate the soil in all directions. The plant obtains its moisture and mineral nutrients largely from the upper foot of soil, although some of the roots extend downward 3 to 4 feet or more.

CHARACTERISTICS OF SUGARCANE VARIETIES GROWN FOR SIRUP

The desirable characteristics of sugarcane varieties grown for sirup production are (1) ability to produce a high yield of medium to large stalks; (2) a high percentage of extractable juice; (3) juice with a high total soluble-solids content, mostly sugar, and expressed as degrees Brix; (4) ability to mature in a comparatively short growing season; (5) resistance to diseases; (6) ability to produce a high-quality sirup; (7) good germination and stooling; (8) good stubbling; (9) strong, erect plant growth that resists lodging; and (10) resistance to cold injury. Varieties differ greatly in these characteristics and in their adaptation to soil and climatic conditions. The grower should carefully consider all these qualities in his choice of a variety.

A high yield per acre of medium to large stalks is essential to the economical production of sugarcane sirup. Large-stalk varieties are cheaper to harvest and easier to handle in the small mills normally used throughout the sirup-producing areas of the United States. Yields of cane per acre are affected by cultural and fertility practices.

A good variety should yield a high percentage of extractable juice. Stalks should not be pithy. They should be soft and easily milled in the small mills used in the sirup areas. An efficient mill should extract approximately 60 pounds of juice from each 100 pounds of stalk.

Sirup yield per ton of cane is determined by the degrees Brix of the juice and the amount of juice extracted. A good variety should produce juice with a high Brix reading. To avoid excessive crystallization, or formation of sugar, in the finished sirup, the soluble-solids content should not contain more than 50-percent sucrose.

Since most of the sugarcane for sirup production is grown on the northern fringe of the area adapted to the culture of sugarcane in the United States (fig. 1), it is essential that the variety mature as early as possible. Maturity is determined by the Brix reading of the juice. A good variety should be mature for harvest in October to avoid cold injury later in the season.

All commercial varieties are susceptible to one or more of the sugarcane diseases. A satisfactory variety must have some resistance to the most economically important diseases. Losses from diseases may range from a slight reduction in yield and quality of sirup to a total loss of the crop. Sugarcane diseases have been economically important in all sugarcane areas of this country and in most sugarcane-producing countries of the world.

A good variety should produce a high-quality sirup with the following characteristics: (1) Light amber color; (2) mild, sweet flavor typical of sugarcane sirup; (3) no colloidal sedimentation or sediment confined to a trace of small particles near the top of the container; and (4) no crystallization or, if present, limited to a few small crystals. Sound cultural and manufacturing practices are also essential in producing sirup of good quality.

The yield of cane and sirup per acre and the quality of the juice for sirup production at harvest are affected by the ability of the variety to germinate and to develop an adequate number of tillers per stool early in the spring. Tillers produced late in the season often die before harvest. They sap the growth of primary stalks and tend to delay the maturity of the crop. Delayed maturity causes a low-quality juice for sirup production. A good variety should germinate early in the spring and produce an adequate number of tillers by harvest.

Three crops of sugarcane are usually produced from one planting in the sirup area. Early harvesting of a crop usually reduces the stand of cane produced from the stubble the following year. A good variety should produce a satisfactory stand from stubble even when the previous crop was harvested as early as October 15.

Sugarcane stalks that are lodged and entangled prior to harvest increase greatly the harvesting costs and reduce the profit from the crop. In severe cases of lodged cane the quality of the juice is inferior for sirup production. A good variety should not lodge readily even under severe conditions of rain and high winds.

Since sugarcane is normally a tropical plant, it has very little resistance to cold injury. Cold injury reduces the quantity and quality of sirup produced. A good variety should withstand light frost injury, without being greatly damaged for sirup production.

VARIETIES

The variety grown is one of the most important factors in the production of sugarcane sirup. Most of the older varieties have been eliminated from commercial production because of susceptibility to diseases. As a result of plant explorations, valuable breeding material has been brought to the United States for use in variety-improvement work conducted at the U.S. Sugarcane Field Station, Canal Point, Fla. Here the best varieties of the world are being assembled. They are crossed and studied so that better varieties for sirup, adapted to the specific requirements of each locality, can be developed and made available to farmers (fig. 6).

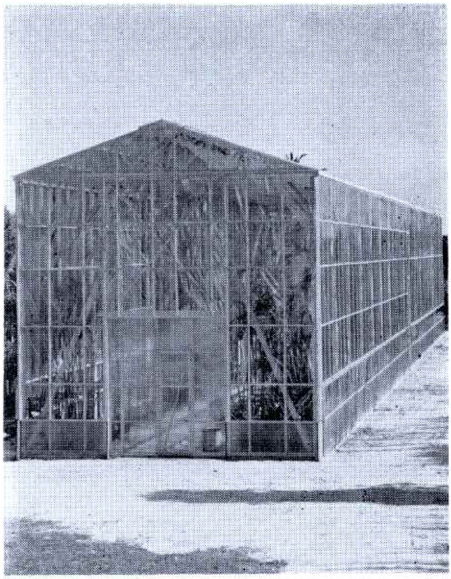

FIGURE 6.—Plastic-covered crossing house at Canal Point, Fla. It is 26 feet wide, 26 feet high, and 204 feet long.

Co. 290, C.P. 29–116, and C.P. 36–111 are the principal varieties grown in the sugarcane-sirup belt (pl. I). The last two are recommended for sirup production. Yield data are given in table 1.

TABLE 1.—*Yields of three varieties of sugarcane at Brewton, Ala., Cairo, Ga., and Meridian and Poplarville, Miss., 1944–55*

Crop and variety	Brewton, Ala.			Cairo, Ga.		
	Cane per acre	Sirup per ton of cane	Sirup per acre	Cane per acre	Sirup per ton of cane	Sirup per acre
	Tons	*Gallons*	*Gallons*	*Tons*	*Gallons*	*Gallons*
Plant cane:						
Co. 290	29.8	16.9	504	33.4	21.0	701
C.P. 29–116	28.4	18.3	520	33.4	21.2	708
C.P. 36–111	27.5	18.7	514	28.1	21.9	615
First-year stubble:						
Co. 290	22.4	18.4	412	22.1	20.4	451
C.P. 29–116	30.7	18.4	565	34.6	21.3	737
C.P. 36–111	34.4	18.9	650	27.7	21.8	604
Second-year stubble:						
Co. 290	14.9	19.3	288	14.0	19.2	269
C.P. 29–116	30.4	19.7	599	35.1	20.2	709
C.P. 36–111	31.6	19.9	629	26.3	20.2	531
Average:						
Co. 290	22.4	18.2	408	23.1	20.2	467
C.P. 29–116	29.8	18.8	560	34.3	20.9	717
C.P. 36–111	31.1	19.1	594	27.3	21.3	581
	Meridian, Miss.			Poplarville, Miss.		
Plant cane:						
Co. 290	24.3	15.2	369	41.5	18.7	776
C.P. 29–116	28.9	16.6	480	35.8	18.5	662
C.P. 36–111	27.7	16.8	465	36.5	19.4	708
First-year stubble:						
Co. 290	24.0	17.5	420	35.4	18.4	651
C.P. 29–116	28.2	17.9	505	34.4	20.1	691
C.P. 36–111	27.9	18.6	519	40.9	20.4	834
Second-year stubble:						
Co. 290	19.4	18.7	363	22.2	16.9	375
C.P. 29–116	22.6	19.1	432	26.4	19.8	523
C.P. 36–111	27.3	19.9	543	35.4	20.2	715
Average:						
Co. 290	22.5	17.1	385	33.0	18.0	594
C.P. 29–116	26.5	17.8	472	32.2	22.3	718
C.P. 36–111	27.6	18.4	508	37.6	20.0	752

Co. 290 was imported from India by the U.S. Department of Agriculture. It is a selection from a cross between Co. 221 and D. 74. This variety is not grown extensively because of its susceptibility to mosaic, red rot, and other sugarcane diseases (*5*).

The stalks are green with a blush of reddish purple. From a distance they appear blue because of the wax layer. This variety grows erect, usually with straight stalks, which are approximately the same diameter as those of C.P. 29–116, though somewhat shorter. The leaves strip readily. It is relatively late in maturing and somewhat susceptible to drought and cold injury. Lower parts of the stalks have a relatively high concentration of sugar. The fiber content is low. Stubbling qualities are inferior to those of C.P. 29–116. Yields of sirup per ton of cane and per acre are usually lower than from C.P. 29–116 and C.P. 36–111, especially in stubble crops (table 1).

C.P. 29–116, a variety bred by the U.S. Department of Agriculture in 1929, has consistently given good yields of sirup in the Southeastern United States (*5*). It is a selection from a cross between P.O.J. 2725 and C.P. 1165.

C.P. 29–116 grows erect, generally with straight stalks in most sirup-producing areas. Stalks are usually longer and about as large in diameter as those of Co. 290. They are green to greenish yellow, becoming darker yellow where exposed to the sun. This variety has a relatively low fiber content. It has much better stubbling qualities than Co. 290. The leaves strip readily. C.P. 29–116 is highly resistant to mosaic in the Southeastern United States. It is susceptible to red rot injury under some conditions, especially when banked in the fall for planting the following spring. It produces a sirup of good quality.

C.P. 36–111, another variety bred by the U.S. Department of Agriculture in 1936, has consistently given good yields of sirup, though somewhat less than C.P. 29–116 in some tests at Cairo, Ga. (table 1) (*17*). It has the same parentage as C.P. 29–116.

Stalks of C.P. 36–111 are pale green to greenish yellow, with faint reddish-purple markings developing lengthwise as the internodes mature. A purplish color develops when leaves and sheaths are removed and the stalk is exposed to the sun. Under favorable growing conditions the internodes are long and the stalks straight and about the same in diameter and weight as those of C.P. 29–116. C.P. 36–111 has given excellent stands as first- and second-year stubble in most areas. The leaves are fairly easily stripped from the stalks at harvest. Milling operations are greatly facilitated by the straight stalks. The percentage of juice obtained in milling is approximately the same as from C.P. 29–116. Although this variety has not been damaged severely by mosaic or other diseases, it is not immune to them.

C.P. 52–48 was released for commercial culture in southwest Georgia in August 1960. This variety, bred by the U.S. Department of Agriculture, has consistently given higher yields of cane and sirup per acre than C.P. 29–116 (table 2). It is a selection from a cross between C.P. 36–105 and C.P. 38–34 (*11*). Like Co. 290, the long leaves of C.P. 52–48 tend to droop. Its early coverage of the land makes the variety highly competitive with weeds.

TABLE 2.—*Yields of two varieties of sugarcane at Cairo, Ga., 1955–59*

Crop and variety	Cane per acre	Sirup per ton of cane	Sirup per acre
	Tons	*Gallons*	*Gallons*
Plant cane:			
C.P. 29–116	28.3	19.5	552
C.P. 52–48	36.3	19.4	704
First-year stubble:			
C.P. 29–116	23.3	17.4	405
C.P. 52–48	33.9	19.1	647
Second-year stubble:			
C.P. 29–116	16.3	20.2	329
C.P. 52–48	33.6	19.6	659
Average:			
C.P. 29–116	22.6	19.0	429
C.P. 52–48	34.6	19.3	668

Stalks of C.P. 52–48 are pale green when the grayish to pinkish wax is removed. The variety is highly resistant to lodging. It has a stiff stalk and an extensive root system. Under favorable growing conditions the internodes are long. The stalks are straight and of about the same diameter and weight as those of C.P. 29–116. They are hard and more difficult to cut by hand than those of C.P. 29–116, but they are well adapted for machine harvest because of their erectness. This variety does not strip so clean and so easily as C.P. 29–116, but stripping is not particularly difficult.

C.P. 52–48 germinates early in the spring and develops a satisfactory stand 2 to 3 weeks earlier than C.P. 29–116 or C.P. 36–111. It is superior to them in tillering and in producing a good stand in first- and second-year stubble crops in southern Georgia.

Milling operations are also greatly facilitated by the straight stalks of C.P. 52–48. The percentage of juice extracted and the Brix reading are approximately the same as for C.P. 29–116. The juice clarifies well, and the sirup is equal in quality to that of C.P. 29–116.

Mosaic has not been observed in C.P. 52–48 in Georgia. Also, there has been no extensive damage from red rot. Based on limited observations, banked seedcane of C.P. 52–48 is more resistant to damage from red rot and other diseases than that of C.P. 29–116.

SUGARCANE DISEASES

Only those diseases that are frequently found on sugarcane in the sirup areas of the Southeastern United States are discussed here (*10*).

Damage to a sugarcane crop from any particular disease varies from year to year, depending on the locality, weather conditions, and the variety. Primary disease-control measures include planting resistant varieties if available, planting healthy seedcane, and using crop rotation and clean cultivation.

Mosaic

Mosaic is caused by a virus that is transmitted from diseased to healthy plants by aphids, principally the corn leaf aphid (*Rhopalosiphum maidis* (Fitch)), the greenbug (*Toxoptera graminum* (Rond.)), and the rusty plum aphid (*Hysteroneura setariae* (Thos.)). Leaves of diseased plants are pale green because of irregular, longitudinal streaks of light-green chlorophyll-deficient tissue (pl. II). In severe cases the light-green streaks may coalesce to cover most of the leaf, and the normal green is restricted to isolated areas (*18*).

Mosaic causes reduced germination of seedcane and stunting of infected plants. Most plants from mosaic-infected seedcane will be diseased (*6*). In susceptible varieties, losses in sirup yields range from 10 to 35 percent, depending on the percentage of infected plants.

Control measures include using resistant varieties (*7*) and roguing infected plants from fields of seedcane during the growing season and at harvest. Roguing may be effective for retarding excessive spread of mosaic when the infection is limited to a small percentage of the crop, but it is rarely adequate to eliminate the disease.

Red Rot

Red rot is caused by the fungus *Physalospora tucumanensis* Speg., referred to in older literature as *Colletotrichum falcatum* Went. It is primarily a disease of seedcane. However, it may damage the crop before it is harvested for sirup. This disease is best observed by splitting the stalks longitudinally (pl. III). The extent of symptoms depends on the susceptibility of the variety and on environmental conditions. In general, the disease can be recognized by the reddened interior of the stalks interrupted by occasional white patches extending crosswise on the stalks (*1*).

Losses from red rot are usually greatest in banked seedcane or in the plant-cane crop. The fungus invades the buds of the seedcane and reduces germination and stands. Severe infection prior to harvest reduces the sugar content and lowers the yield and quality of the sirup. Losses from red rot have been negligible in varieties currently recommended for sirup production, except where seedcane is banked for winter or spring planting.

Control measures include using resistant varieties and fall planting to avoid the practice of banking seedcane.

Ratoon Stunting Disease

Ratoon stunting disease is caused by a virus that is transmitted from diseased to healthy plants by knives used in harvesting the crop. External symptoms are retarded growth, less tillering, and smaller stalks (fig. 7). These symptoms are most pronounced under drought or other stress conditions. Internal symptoms are limited to orange vascular bundles that are most evident in the nodal regions (pl. IV).

Losses from ratoon stunting disease are usually greatest in stubble crops. In severe cases 35 percent of the crop may be destroyed, depending on the susceptibility of the variety and on growing conditions.

FIGURE 7.—Stunting of sugarcane due to ratoon stunting disease. *A*, Diseased; *B*, healthy.

Ratoon stunting disease is controlled by treating the seedcane with hot air or hot water. In Louisiana the hot-air treatment of 54° C. (129.2° F.) for 8 hours with an inlet temperature of the heating chamber of 57°–58° is used almost exclusively to control the disease. The hot-water treatment of 50° for 2 hours is used in most areas of the world. However, for maximum control, 51° for 2 hours or 50° for 3 hours is recommended to insure healthy seedcane for successive plantings.

Other Diseases

Several minor diseases of sugarcane occur in sirup areas, but they rarely cause serious damage. Pokkah boeng is caused by *Gibberella fujikuroi* (Saw.) Wr. It produces distorted chlorotic areas and often red discoloration of leaves usually near the top of the plant. Infected plants may be stunted for a while; however, they usually recover and resume normal growth.

Red stripe is caused by *Xanthomonas rubrilineans* (Lee et al.) Starr & Burkh. It produces long, narrow, dark-red stripes lengthwise on the leaves and sometimes on the sheaths. In severe cases the bacteria invade the growing point.

INSECT PESTS OF SUGARCANE [2]

The major pests of sugarcane in the United States are not present in all sugarcane-growing areas. The establishing of a pest in new areas is often due to shipment of exchange seedcane by planters and others to introduce new varieties for trial. This practice has been largely responsible for extending pest-infested areas. Such exchange of seedcane should be reduced to a minimum. Precautions should be taken to reduce the hazard of transporting insects with the seedcane.

Hot-water treatment (*8, 19*) of the seedcane or cuttings will kill all stages, including eggs, of the common pests that may lodge on or in the cane. The buds will not be killed if the treatment is carefully controlled. The temperature of the water should be 122° to 126° F., and the duration of the treatment 30 minutes. This is an easy, practicable procedure for small lots of a dozen cuttings or less, the usual package for shipment, and it requires no special equipment.

[2] Prepared by the Entomology Research Division.

Sugarcane Borer

The most serious insect pest of sugarcane in the United States is the sugarcane borer (*Diatraea saccharalis* (F.)). It causes extensive damage to sugarcane in Louisiana and is present also in southwestern Mississippi, southern Florida, and the Gulf area of Texas. This insect has not been found in Georgia, Alabama, or northern Florida.

Injury to sugarcane by borers takes many forms. It is not specially noticeable in old cane unless closely examined. If the leaves are pulled away, small holes may be observed in the rind, and the frass or sawdustlike material may be seen clinging to the stalk near the holes. When the stalk is split lengthwise, tunnels are visible, through which the larvae of the insect have eaten their way, sometimes for several feet. The tunnels are about an eighth of an inch wide and meander lengthwise and crosswise through the interior of the stalk, often joining the main axis of the stalk but generally running parallel with it. The stalk is so weakened that sometimes it is broken or blown down by the wind. Almost invariably the disease known as red rot becomes established in these injuries and finishes the work of destruction.

In the field, injury to young cane is more apparent than to older cane. It takes the form of "dead heart," or death of the growing point, and shriveling of the whorl of youngest leaves. Such affected stalks are conspicuous early in the season when the plants are 1 to 3 feet high.

To control the sugarcane borer, follow these practices, which have proved of value:

1. Harvest the heaviest infested fields first. Destroy overwintering borers by thoroughly cleaning up large pieces of cane at harvesttime. After harvest burn over the fields, as this practice destroys approximately three-fourths of the borers overwintering in the trash. However, burning has not reduced borer egg parasitism by the tiny wasp *Trichogramma minutum* Riley.

2. Cut cane stubble close to the ground to decrease the number of overwintering borers.

3. Early in the winter plow fields to be taken out of sugarcane.

4. Plant resistant sugarcane varieties. Co. 290 is less damaged by the borer than other varieties. Since C.P. 36–111 and C.P. 29–116 are susceptible to borer injury, do not plant them where borer damage is usually serious.

5. Soak seedcane for 72 hours in water at room temperature. This practice has killed, on an average, 69 percent of the borers in the seed pieces.

6. Apply 2-percent endrin granules at the rate of 12 pounds per acre. Make four applications at 14-day intervals and schedule them so that the last application is made at least 45 days before harvest. Do not feed bagasse or field trimmings from endrin-treated cane to livestock. A dust containing 40-percent ryania can also be used. Apply it in four weekly applications at 12 to 15 pounds per acre when the air is still and the plants are moist with dew. There are no feeding restrictions on sugarcane treated with ryania. Insecticide treatments are recommended to control only the second- and third-generation borers.

Gray Sugarcane Mealybug

The gray sugarcane mealybug (*Pseudococcus boninsis* Kuw.) is found throughout southern Florida and Louisiana and on some farms in the northern part of these States, as well as in Georgia, Alabama, and Texas. It is not known to occur in Mississippi.

The female mealybug, which is more commonly seen than the male, is soft bodied, flat-oval, grayish, and about one-eighth inch long when full grown. It surrounds its body with a white webby, mealy substance, in which the eggs are deposited. Mealybugs most often feed on sugarcane between the sheath and the stalk and suck the juice. Although usually considered a minor pest, the mealybug does cause some direct loss through its feeding. Its presence also makes sirup manufacture more difficult and generally lowers the quality of the sirup.

The mealybug parasite *Pseudaphycus mundus* Gahan is now well distributed over the areas infested by the mealybug in the continental United States and helps to keep it under control.

To control the mealybug or to prevent its spread to uninfested fields where sugarcane is grown for sirup, follow these practices:

1. Plant only clean, or uninfested, seedcane.
2. Plant it some distance from mealybug-infested fields.
3. Cut cane close to the ground so that mealybugs will have less food.
4. Destroy all scraps of cane left on the fields and around the mills after grinding.
5. Avoid carrying mealybugs from place to place. Brush out trucks or wagons after they have been used to haul infested cane to the mill. Do not carry about live specimens for exhibition or other purposes.

Soaking seedcane for 30 minutes in water held at 122° to 126° F. has been successful in eradicating the mealybug from infested areas. Soaking seedcane in water at ordinary temperatures for 7 days also has been satisfactory. Heattreatment of sugarcane to control ratoon stunting disease should also destroy most of the mealybugs.

Corn Leaf Aphid

Direct injury to cane by the corn leaf aphid (*Rhopalosiphum maidis* (Fitch)) is insignificant, but this insect is the principal agent in transmitting mosaic to healthy plants during epidemics of this disease. Therefore it must be regarded as an economically important pest. The corn leaf aphid is universally present in or near sugarcane fields, where it infests certain wild grasses and cultivated grass crops like corn and sorgo. Its abundance depends mainly on the availability of food plants at the proper stage of succulent development, which in turn depends on seasonal and weather conditions.

Where mosaic-susceptible sugarcane varieties are planted, it is worthwhile to supplement seedcane-selection practices with measures to reduce infestation by the corn leaf aphid. These measures include eliminating near seedcane plots any corn and sorgo, which are favored food plants of the aphid and on which it breeds in enormous numbers. Sugarcane itself is not especially attractive to the aphid. When the corn or sorgo becomes mature and less desirable as a source of food, this insect migrates to sugarcane. If any mosaic is present, the aphid then serves as a source of the virus, which is rapidly spread to other cane by the successive feeding of the insect.

Sugarcane Beetle

Injury by the sugarcane beetle (*Euetheola rugiceps* (Lec.)) is serious in some localities. The newly emerged adult is black and shiny, about one-half to five-eighths inch long. Ragged holes gnawed in the shoots just below the surface of the ground cause noticeable injury to sugarcane. The inner leaves turn yellow, and the shoots usually die.

Damage to the field is apparent early in the season and is in proportion to the number of beetles present. Losses are ordinarily greater in plant than in stubble cane. The beetles breed heavily on sod lands and slightly or not at all in woodland. To reduce beetle populations, sugarcane fields, where possible, should not be near sod and grass pastures. In some sugarcane areas there is a gradual shift to early-fall or summer planting. Because of the large number of shoots the following spring from such plantings, there is proportionately less beetle injury and better stands result.

Planting more vigorous varieties of sugarcane gives a better original stand and greater recovery from injury. Spraying endrin at ½ pound or heptachlor at 2 pounds per acre on the seed-cane pieces in the open planting furrow gives fair beetle control.

Wireworms

Several species of wireworms of the family Elateridae seriously deplete the stand of sugarcane in some areas. Injury is greatest in the winter, when the plant is growing very little, if any. Wireworms are the young of click beetles. They are yellowish, slender, smooth, and wiry. They are one-half to an inch or more long. They bore into buds of plant cane and stubble and into young plants below the surface of the ground. Wireworms may be controlled by applying 2 pounds of chlordane per acre as a spray, dust, or granules on cane in the planting furrow. The dosage should be doubled in muck soils.

Lesser Cornstalk Borer

The lesser cornstalk borer (*Elasmopalpus lignosellus* (Zell.)) is found throughout the sugarcane-growing area of the continental United States. The larva is slender and greenish, with dark-brown longitudinal bands. It is about an inch long when full grown. It makes a rapid jerking motion when disturbed. The larva bores into the young cane at or below the surface of the ground and then usually upward, killing the shoot. Its injury resembles that of the sugarcane borer, except that the hole made by the lesser cornstalk borer is close to the soil surface and has a tubular burrow extending outward from it. The burrow consists of soil particles, which the borer webs together with silk. The larva pupates in this burrow and changes into a small moth.

Injury from the lesser cornstalk borer is found from March to June. Since the infested plants usually put out suckers from below the injury, there is little loss of stand but only delayed growth with slightly lower sucrose content at harvesttime. Greatest injury from this insect has been observed in southern Florida, where as many as 30 percent of the plants were infested in some fields. Infestations were lighter in fields where the trash had not been burned. Nonburning of trash may therefore be of value in areas where there is heavy damage from the lesser cornstalk borer.

FERTILIZER PRACTICES [3]

Most of the land used for growing sugarcane requires fertilizer. The amount for optimum growth depends largely on soil type, rainfall, crop history, and previous applications of manure and fertilizer (*12, 15*).

Heavy soil may produce a good sugarcane crop with little or no fertilizer. Sandy soil is less fertile and usually requires fertilizer for a good growth of sugarcane. Some upland soils of intermediate types, such as sandy loam, produce low yields without fertilizer, as shown in table 3.

When legume cover crops are used for green manure, the need for fertilizer, especially nitrogen, is less. This is also true for land that has been well manured in the past or for land just plowed out of improved pasture.

Fertilizer may be applied in the "off-bar" [4] furrow on each side of the row in late March or early April with the first spring cultivation. The fertilizer is covered with 4 to 6 inches of soil. Subsequent applications of fertilizer, usually nitrogen, should be made during June. Later applications may retard maturity of the cane and lower the yield and the quality of sirup.

In a fairly fertile soil a small application of fertilizer in the off-bar furrows to help the early growth may be all that is necessary the entire season. However, on most soils the quantity applied should be greater than that needed for a starting effect only. Also, more fertilizer may be added later.

[3] Prepared by E. S. Lyons, formerly research agronomist, Crops Research Division.

[4] "Bar-off" is commonly used in Georgia.

Each grower should study his soil and fertilizer practices and get current fertilizer recommendations from the nearest experiment station or the county extension agent.

Most of the fertilizer used for sugarcane is a mixture of nitrogen, phosphorus, and potassium. The ratio varies in different localities, depending on local requirements or practices. Nitrogen is particularly needed in most soils and is generally considered first. Most soils are usually not deficient in phosphorus. Potassium is needed in some soils (table 3).

It is not possible to recommend a single fertilizer practice to fit all farm conditions. In the absence of specific information about the needs of a particular farm, the grower should use a standard fertilizer formula that is recommended for his area, such as 5–10–5, 6–8–4, 6–8–8, or 10–10–10 (N, P_2O_5, K_2O, respectively), at a rate of 500 to 700 pounds per acre. Where fertility is low, it may be advisable to make a second application, or side dressing, of 20 to 30 pounds of nitrogen; the total amount is 50 to 80 pounds of nitrogen and 30 to 60 pounds each of phosphorus and potassium.

It was formerly believed that nitrogen used in an organic fertilizer, such as cottonseed meal or tung meal, gave superior sirup. Current information indicates that a sirup of good quality can also be produced by using organic nitrogen in ammonium sulfate, sodium nitrate, ammonium nitrate, or anhydrous ammonia (*4*). It should be applied during early

TABLE 3.—*Effect of fertilizer on sirup yield at Cairo, Ga., and Poplarville, Miss.*

CAIRO, GA. [1]

Fertilizer per acre (pounds)			Sirup yield per acre from—			Average yield	Increase in yield from fertilizer
N	P_2O_5	K_2O	Plant cane	First-year stubble	Second-year stubble		
			Gallons	*Gallons*	*Gallons*	*Gallons*	*Gallons*
0	0	0	333	328	236	299	-----
0	72	0	361	346	251	319	20
0	0	72	415	413	315	381	82
0	72	72	422	442	339	401	102
36	0	0	390	367	241	333	34
36	72	0	404	394	251	350	51
36	0	72	502	513	367	461	162
36	72	72	518	535	420	491	192
72	0	0	396	369	232	332	33
72	72	0	428	406	241	358	59
72	0	72	537	568	438	514	215
72	72	72	528	597	467	531	232

POPLARVILLE, MISS. [2]

N	P_2O_5	K_2O	Plant cane	First-year stubble	Second-year stubble	Average yield	Increase in yield from fertilizer
0	0	0	393	423	305	374	-----
20	0	0	537	498	479	505	131
40	0	0	571	572	530	558	184
60	0	0	561	621	595	592	218
80	0	0	480	608	571	553	179
20	20	0	454	508	447	470	96
40	20	0	532	692	572	599	225
60	20	0	661	605	584	617	243
80	20	0	530	538	622	563	189
20	40	0	516	516	426	486	112
40	40	0	585	610	513	569	195
60	40	0	609	642	686	646	272
80	40	0	596	572	627	598	224
80	40	20	534	658	674	622	248

[1] Tifton fine sandy loam.
[2] Ruston sandy loam.

growth, not later than June, in amounts not exceeding the requirements of the crop.

Under some conditions inorganic sources of nitrogen, as ammonium sulfate, sodium nitrate, and ammonium nitrate, produce slightly higher yields of sirup per acre than organic sources, as cottonseed meal and

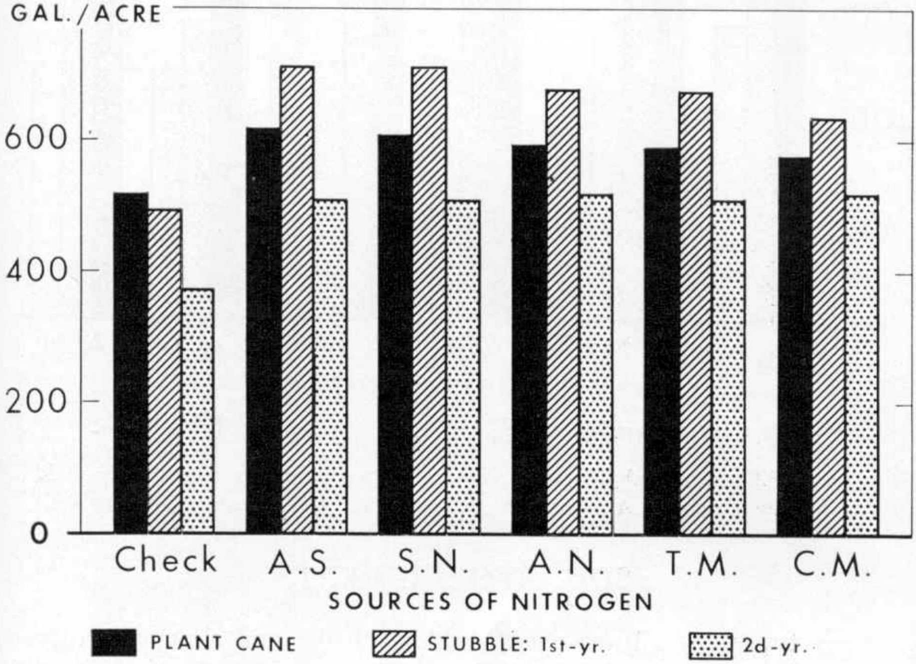

FIGURE 8.—Effect of five sources of nitrogen on yield of sugarcane sirup when applied in March in a 6–8–4 mixed fertilizer at 1,000 pounds per acre. A.S.=ammonium sulfate, S.N.=sodium nitrate, A.N.=ammonium nitrate, T.M.=tung meal, C.M.=cottonseed meal.

tung meal (fig. 8). The cost per unit of nitrogen is usually lower in inorganic sources. Anhydrous ammonia is equal to ammonium nitrate in its effect on yield of sugarcane sirup (fig. 9).

Avoid applying a high nitrogen fertilizer after June as a side dressing. Use an organic fertilizer in March or early April. If manure is used, apply it to the previous crop instead of directly to the sugarcane crop. When heavy applications of manure are applied to the sugarcane crop or directly preceding it, a sirup of poor quality may be produced.

Tractor-propelled distributors are generally used to apply fertilizer in the off-bar furrows. Distributors can be adjusted to apply the quantity needed at the depth desired. Later, during cultivation of the crop, the same equipment can be used to apply a side dressing along the row.

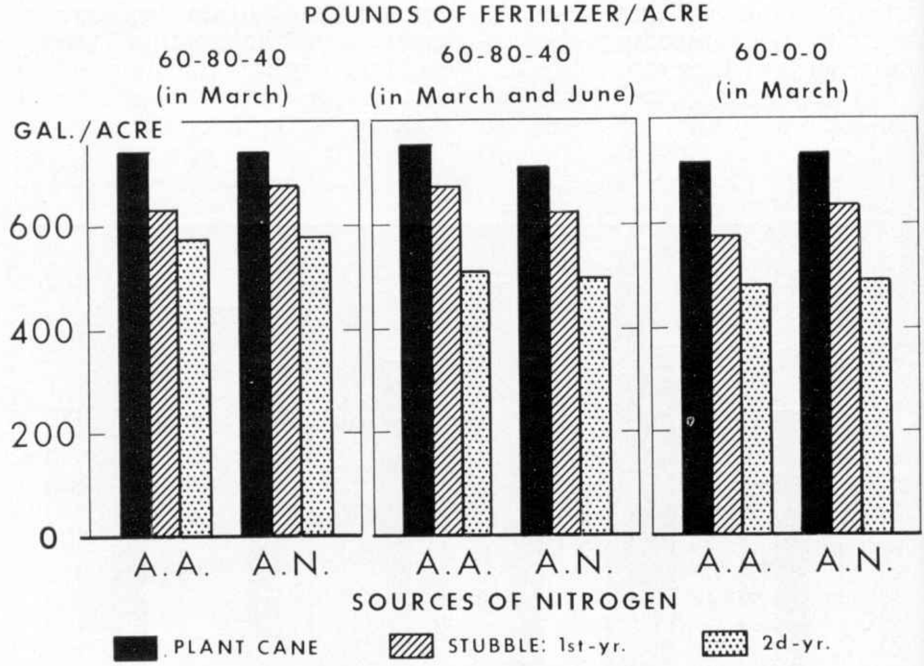

FIGURE 9.—Effect of anhydrous ammonia and ammonium nitrate on yield of sugarcane sirup. A.A.=anhydrous ammonia, A.N.=ammonium nitrate.

SOIL REQUIREMENTS

Many types of soil are used to grow sugarcane, ranging from the heavy silt loam of Louisiana to the light sandy soil of Mississippi and Alabama. However, a soil with good physical characteristics and high fertility produces the best results. In general, loam and sandy loam are best for growing sugarcane for sirup production. Poorly drained, heavy soils usually result in sparse stands, low yields, and a poor quality of sirup.

Soils rich in organic matter may have a detrimental effect on the quality of sirup. However, if cultural practices are satisfactory, sirup of good quality is frequently made from sugarcane grown on soils rich in organic matter supplied by green manure crops.

CULTURAL PRACTICES

Yield and quality of sugarcane sirup and the economy of handling the crop are affected chiefly by the soil type, fertilizer practices, growth, uniformity in maturity, erectness of stalks, and ability to withstand deterioration after harvest. The cultural practices that affect these factors are discussed.

Crop Rotation

Sugarcane usually is grown on the same land for 3 years. The rotation should provide for one or more interim crops, such as corn, cotton, or soybeans. Clean cultivation of the interim crop is desirable to reduce the weeds in sugarcane. Addition of the residue from all crops to the soil will help maintain adequate organic matter and water-retention capacity.

A winter cover crop may be grown in cotton rows or after corn or soybeans to add organic matter preceding the sugarcane crop. However, during many seasons a cover crop cannot be planted early enough in the fall after sugarcane or the interim crop to produce a satisfactory growth before cold weather. Since the cover crop must be turned under early in the spring to avoid damage to the succeeding interim crop, it does not usually have time to produce a satisfactory yield of green manure.

The residue from corn, cotton, or soybeans must be thoroughly chopped into the soil several weeks before planting sugarcane to avoid damaging the stand.

Planting soybeans in May on land to be used for sugarcane in October is usually a very good practice. The growth is turned under in late August or early September and allowed to deteriorate partially before planting sugarcane. After this treatment the land usually has enough organic matter to remain in good condition during one plant-cane and two stubble crops of sugarcane.

Other leguminous plants, particularly blue lupin where it does well, have been used with equal success.

Land Preparation

Since plant-cane and succeeding stubble crops occupy the same land for 3 to 4 years, it is necessary to have a well-prepared seedbed. The land should be "flat-broken" to a depth of 6 to 8 inches at least a month before planting. Tractor-propelled disk or moldboard plows are used to prepare the seedbed. The land should be plowed so as to drain properly.

Just before planting, disk the land and bed it into rows. Furrows between the beds may be used for seedcane. However, the practice of opening the beds to provide a furrow for seedcane is best done during wet weather or on land with slow drainage.

Row Spacing

Most sugarcane in the sirup-producing areas is planted in rows spaced 4 to 5 feet apart. However, the spacing may be varied slightly to suit available tractor equipment.

Table 4 shows average yields from different row spacings of plant-cane and first-year stubble crops. Rows spaced 3 to 4 feet apart are generally satisfactory for the plant-cane crop, but they may cause crowding in successive stubble crops.

Planting

In order to protect the eyes, or buds, during planting, do not strip seedcane. However, to facilitate handling, remove the tops. Before the eyes germinate, leaves and sheaths will deteriorate without hindering the stand.

The practice of planting sugarcane in late September or October is recommended. However, planting can be done under favorable conditions until March 15. Plantings in February or March usually yield as much as those in the fall, as shown in table 5. Results for C.P. 29–116 were similar to those obtained for C.P. 36–111. Seedcane for spring plantings must be stored in banks at the time of harvest in October (*13*). Fall planting requires less labor,

TABLE 4.—*Effect on sugarcane yield of various row spacings of plant cane and first-year stubble on Ruston sandy loam at Poplarville, Miss.*

Row spacings (feet apart)	Cane per acre	Sirup per ton of cane	Sirup per acre
	Tons	*Gallons*	*Gallons*
3	42.2	21.2	895
4	36.8	20.7	762
5	31.9	21.0	670
6	25.4	20.2	513

TABLE 5.—*Effect on sugarcane yield of date of planting of C.P. 36–111 second-year stubble on Kalmia sandy loam at Brewton, Ala.*

Date of planting	Cane per acre	Sirup per ton of cane	Sirup per acre
	Tons	*Gallons*	*Gallons*
Oct. 6	34.8	19.7	686
Feb. 17	33.7	19.9	671

and the seedcane usually remains in good condition while dormant.

A satisfactory stand is usually obtained by planting 1½ to 2 lines of seedcane in a furrow. The practice of overlapping seedcane about 12 inches helps eliminate gaps in the stand (fig. 10). Crooked stalks should be cut to straighten the lines in the furrows. Approximately 2,400 six-foot stalks are required to plant an acre at the rate of 1½ lines in rows spaced 4½ feet apart.

Seedcane may be planted 1½ to 4½ inches below the surface of the soil without affecting yields. Typical yield data from depth-of-planting experiments in Mississippi are shown in table 6. Results for C.P. 29–116 were similar to those obtained for C.P. 36–111. Cover fall-planted seedcane with 7 to 9 inches of soil to protect it from cold injury during the winter. Remove the soil in the spring to within 2 to 3 inches of the seedcane. Cover spring-planted seedcane with 2 to 3 inches of soil. Provide good drainage after planting by plowing out the middle area between beds to a depth of 2 to 4 inches below the seedcane (figs. 11 and 12).

Cultivation

Cultivation should begin in the spring when the eyes start to germinate. A "finger-weeder" (fig. 13) is useful for breaking the surface of the soil and removing small weeds that develop during the winter. When the soil is firmly packed or when weeds are intermingled with stubble, a rotary hoe (fig. 14) is more

FIGURE 10.—Two lines of seedcane in furrows before stalks are cut into short pieces.

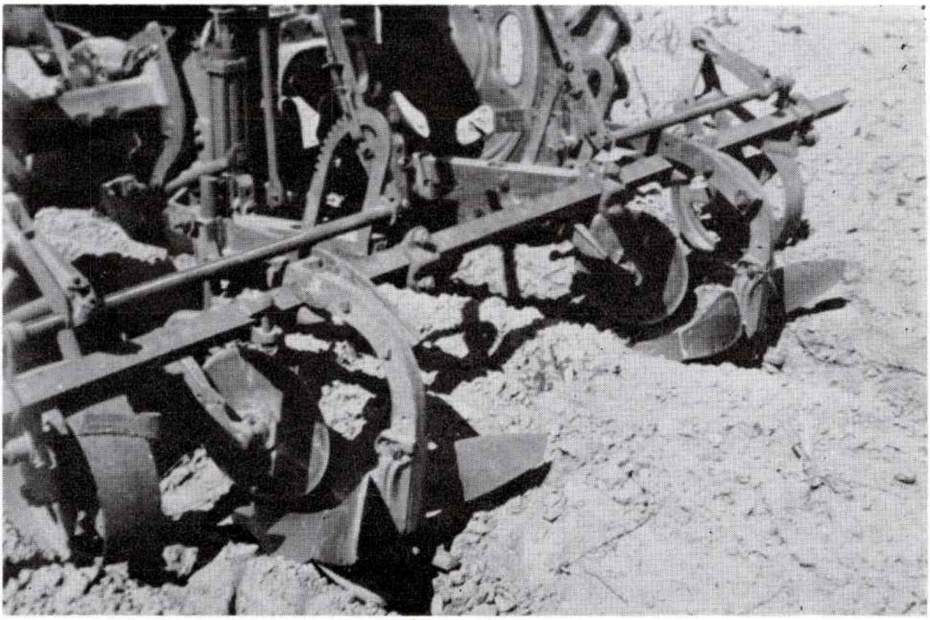

FIGURE 11.—Two-row lister used for plowing out middle area between beds after sugarcane is planted.

FIGURE 12.—Field of sugarcane showing middle area between beds plowed out to provide drainage.

TABLE 6.—*Effect on sugarcane yield of various planting depths of C.P. 36–111 plant cane on Ruston sandy loam at Poplarville, Miss.*

Planting depths (inches)	Cane per acre	Sirup per ton of cane	Sirup per acre
	Tons	*Gallons*	*Gallons*
1.5	34.2	19.5	667
3.0	34.0	20.5	697
4.5	36.8	20.7	762

efficient than the finger-weeder for the first cultivation. A section harrow can be used on some soils to remove the top layer.

After the soil is removed to within 2 to 4 inches of the seedcane, a disk cultivator (fig. 15) or moldboard plow can be used to off-bar plant or stubble cane. Off-barring favors germination and early growth during the cool part of the spring. When the cane is 8 to 12 inches high, apply fertilizer in the off-bar furrows and follow by shallow cultivation. Frequent shallow cultivations are needed throughout the season to control weeds and to provide optimum growing conditions.

Weed Control

The practice of hoeing sugarcane to control weeds is decreasing because of economic factors

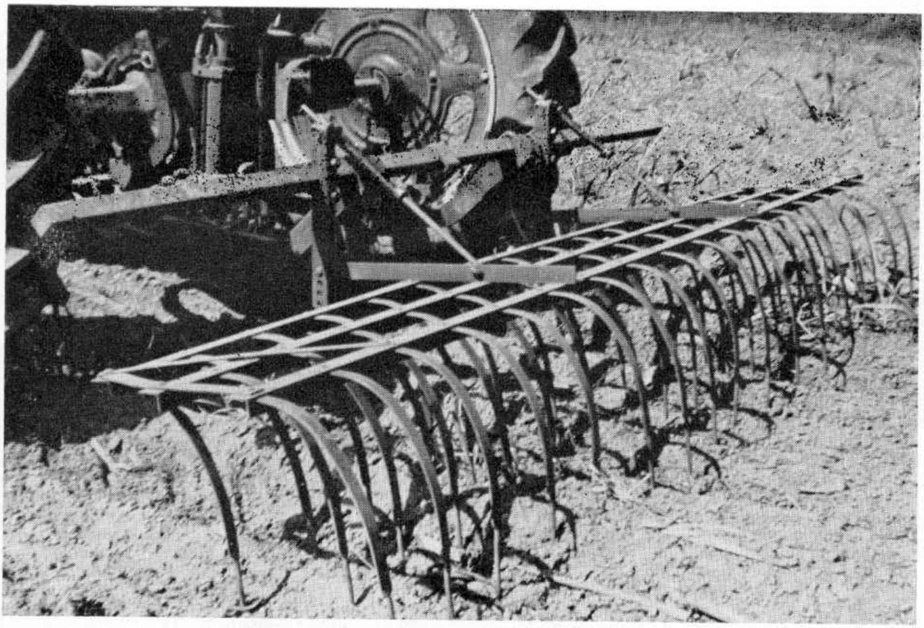

FIGURE 13.—"Finger-weeder" used for removing winter growth of weeds from sugarcane.

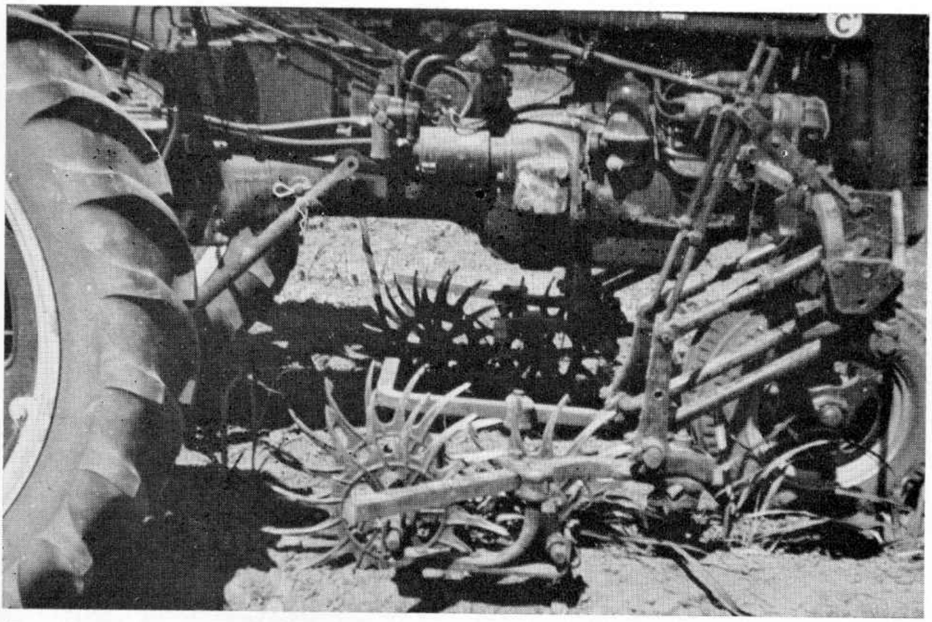

FIGURE 14.—Rotary hoe used for breaking the soil and removing weeds from sugarcane.

FIGURE 15.—Off-barring sugarcane with a disk cultivator.

and improved mechanical and chemical weeding.

"Flame cultivation" is generally satisfactory for destroying young weeds in early stages without damaging sugarcane. Some hardy weeds, such as johnsongrass, cannot be killed by flaming without damaging the sugarcane crop.

Chemical weed control in sugarcane grown for sirup production shows promise.[5] In areas where broad-leaved weeds are a problem in the fall, a postemergence application of 2,4–D (amine–2,4–dichlorophenoxy-acetic acid) at 1½ pounds per acre will give excellent results. This treatment should be followed in the spring by a preemergence spray of monuron (3 (p–chlorophenyl)–1, 1–dimethylurea) or diuron (3 (3,4–dichlorophenyl)–1, 1–dimethylurea) at 3 pounds of active ingredient per acre on heavy soils and 2 pounds on sandy soils. Cultivation may be done 2 months after preemergence treatments if necessary.

HARVESTING

Changes in the composition of the juice as the cane matures affect the quality and quantity of the sirup. In general, harvest-

[5] Information on chemical weed control is furnished by R. D. Palmer, assistant plant physiologist, Mississippi Agricultural Experiment Station.

ing should be delayed as late in the year as possible to allow for the maximum accumulation of soluble solids. However, sugarcane should be harvested before it is subjected to severe damage from cold.

Early-harvested cane produces less sirup per acre than cane harvested late in the season (fig. 16). Also, the stand and corresponding yield are usually less in succeeding stubble crops following early-harvested cane (fig. 17). The effect of early harvesting on yield depends on the variety and whether the crop is plant or stubble cane (*16*).

When suitable facilities are available, the most accurate way to determine the maturity of the crop and the time for harvesting is to run adequate mill and laboratory tests to evaluate the yield and quality of sirup.

Late-maturing varieties may produce low yields early in the season. Varieties particularly susceptible to diseases may decrease in sirup yield late in the season.

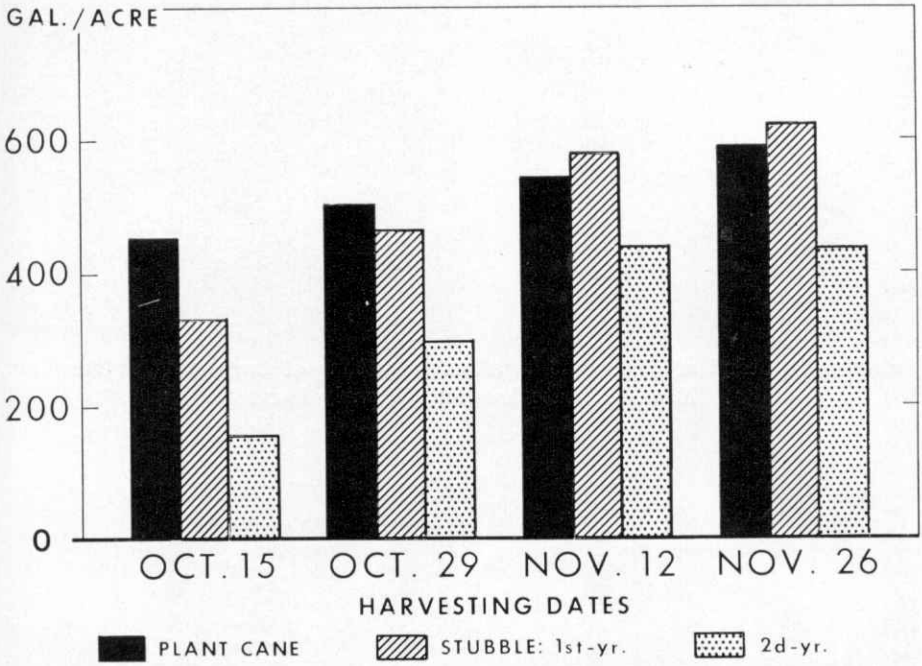

FIGURE 16.—Sirup yields based on nine date-of-harvesting tests of sugarcane at Poplarville, Miss.

Harvesting practices vary considerably throughout the sugarcane-sirup belt, depending largely on the acreage and on local practices. Stripping the leaves from the stalks is usually done first. Leaves may be struck off with a paddle, a cane stripper, or the knife used to cut the stalks, or they may be pulled off by hand. Stripping and topping should be done while the stalks are standing.

Sugarcane for sirup production may be cut with a corn knife (fig.

FIGURE 17.—Stand of sugarcane as affected by time of harvesting at Meridian, Miss. *A*, Late harvest; *B*, early harvest.

FIGURE 18.—Cutting sugarcane with a corn knife at Meridian, Miss.

18), cane knife, hoe, or with a mechanical harvester, of which there are several types. Small tractor-mounted harvesters are used in the sugarcane-sirup belt.

Generally the cane is cut near the surface of the soil. If cut higher, losses in tonnage and total production of sirup result. Juice from the lower internodes contains more sugar than that from internodes in the middle and top of the cane.

Since most sugarcane for sirup is manufactured on small-scale equipment, stripped cane must sometimes remain in the field or at the mill several days before it is milled. This practice does not cause a loss of sirup, provided the cane is in good condition at the time of harvest, it is stored no longer than 25 to 30 days, and it is not subjected to freezing temperatures. The sirup quality is often improved when stored for 15 to 20 days (*14*). Table 7 shows the effect of length of storage on yield of sugarcane sirup.

TABLE 7.—*Effect of length of storage on sirup yield of C.P. 29–116, based on 10 observations in two tests, at Meridian, Miss.*

Days of storage	Relative weight per stalk [1]	Laboratory-mill juice analysis		Sirup per ton of cane
		Extraction	Brix	
	Percent	*Percent*	*Degrees*	*Gallons*
0	100.0	58.5	14.98	18.4
2	100.6	60.1	15.21	19.1
4	99.5	58.6	15.56	19.2
7	98.0	59.2	15.84	19.0
14	93.2	53.5	16.63	19.9
21	91.6	53.1	16.98	19.7
28	90.0	51.1	16.95	19.1

[1] Based on 0 storage as 100 percent.

MANUFACTURE OF SUGARCANE SIRUP

The yield and quality of sugarcane sirup are affected by the manufacturing equipment and process and by the skill of the sirup maker.

Several sizes and types of mills are used. The size of the mill depends on the volume of sugarcane to be milled. In general, mills with three horizontal rollers propelled by motor power are used for crushing the cane. Larger mills with more rollers subjected to hydraulic pressure are used for large volumes of sugarcane. The extraction of juice should be between 50 and 60 percent; that is, 100 pounds of stripped cane should furnish 50 to 60 pounds of juice. Extracting less juice results in less sirup and a lower return from the crop, as shown in table 8. More juice may be extracted if the procedure does not lower the quality of the sirup.

TABLE 8.—*Effect on sirup yield of various extractions of sugarcane juice, based on an assumed Brix reading of 15°*

Extraction of juice (percent)	Juice per ton of cane	Sirup per ton of cane	Increase in yield
	Pounds	*Gallons*	*Percent*
40	800	12.1	----
45	900	13.7	13.2
50	1,000	15.2	25.6
55	1,100	16.7	38.0
60	1,200	18.2	50.4

Most farmers make sugarcane sirup on open-type, continuous-flow evaporators of galvanized iron or copper. These evaporators are shallow and have crosswise baffles to slow down the flow of juice. Cold juice enters the lower end of the evaporator and then flows slowly to the opposite end, where it is drawn off as finished sirup.

Fuels to heat the evaporator include wood, kerosene or fuel oil, liquid-petroleum or natural gas, and coal.

In small-scale operations the fire heats the bottom of the evaporator. In most large-scale operations the juice is heated by steam coils placed in the evaporator.

The Stubbs pan is another open-type, continuous-flow evaporator of galvanized iron (fig. 19). It is not used so widely, but somewhat less skill is required for efficient operation. It is 12 feet long, 3½ feet wide, and 10 inches deep. The side where the juice enters is 1¼ feet and the other side 2¼ feet wide. Heat is supplied through four copper coils, each of which is fitted with a steam-inlet valve and an automatic steam trap.

Juice enters the evaporator at the side (*A*) through an adjustable valve (*E*) and travels lengthwise along the high longitudinal partition, around the end of this partition, and back to the finishing-off compartment (*F*). When the cold juice is heated, certain proteins and nonsugar substances are coagulated. They rise to the surface and are removed as skimmings. The juice is clarified in this manner and evaporated to semisirup before it reaches the finishing-off compartment (*F*).

After clarification, the juice is evaporated to sirup density as rapidly as possible (fig. 20). The desired sirup density can be determined by a sirup hydrometer or a thermometer. A suitable thermometer (fig. 20) is preferred, because it indicates accurately and continuously the sirup density. When sirup is tested near boiling, the reading for a desirable density should be 35° to 36° Baumé with a sirup hydrometer or 226° to 228° F. (108° to 109° C.) with an accurate thermometer.

The finished sirup should be filtered as effectively as possible

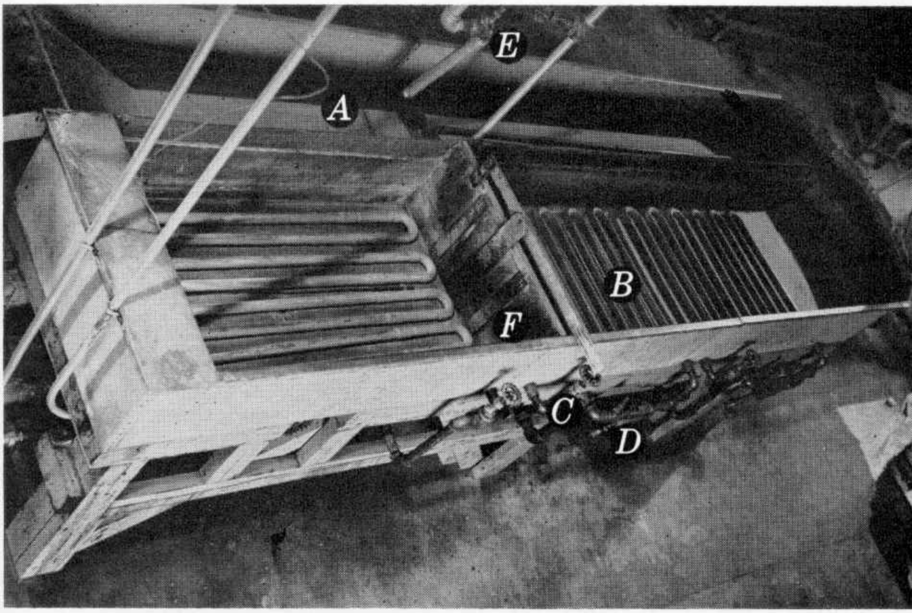

FIGURE 19.—Stubbs-type evaporator: *A*, Side where juice enters; *B*, copper heat coils; *C*, steam-inlet valve for coil; *D*, automatic steam trap; *E*, adjustable valve; *F*, finishing-off compartment.

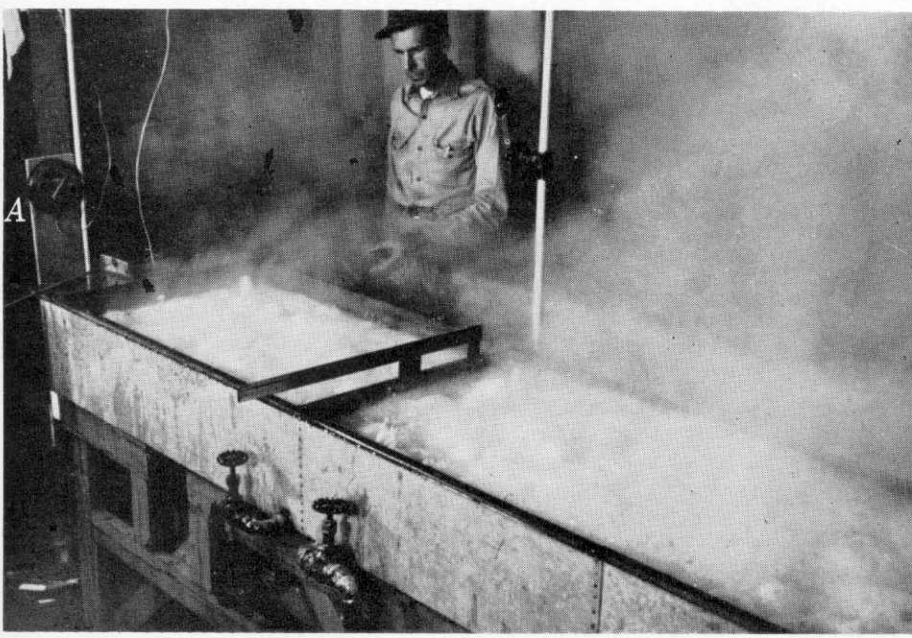

FIGURE 20.—Stubbs-type evaporator in operation. Thermometer (*A*) used to determine sirup density.

and cooled to the proper temperature before being stored in containers. It should be 190° F. when half-gallon and smaller containers are filled, 180° for gallon containers, and 120° for barrels.

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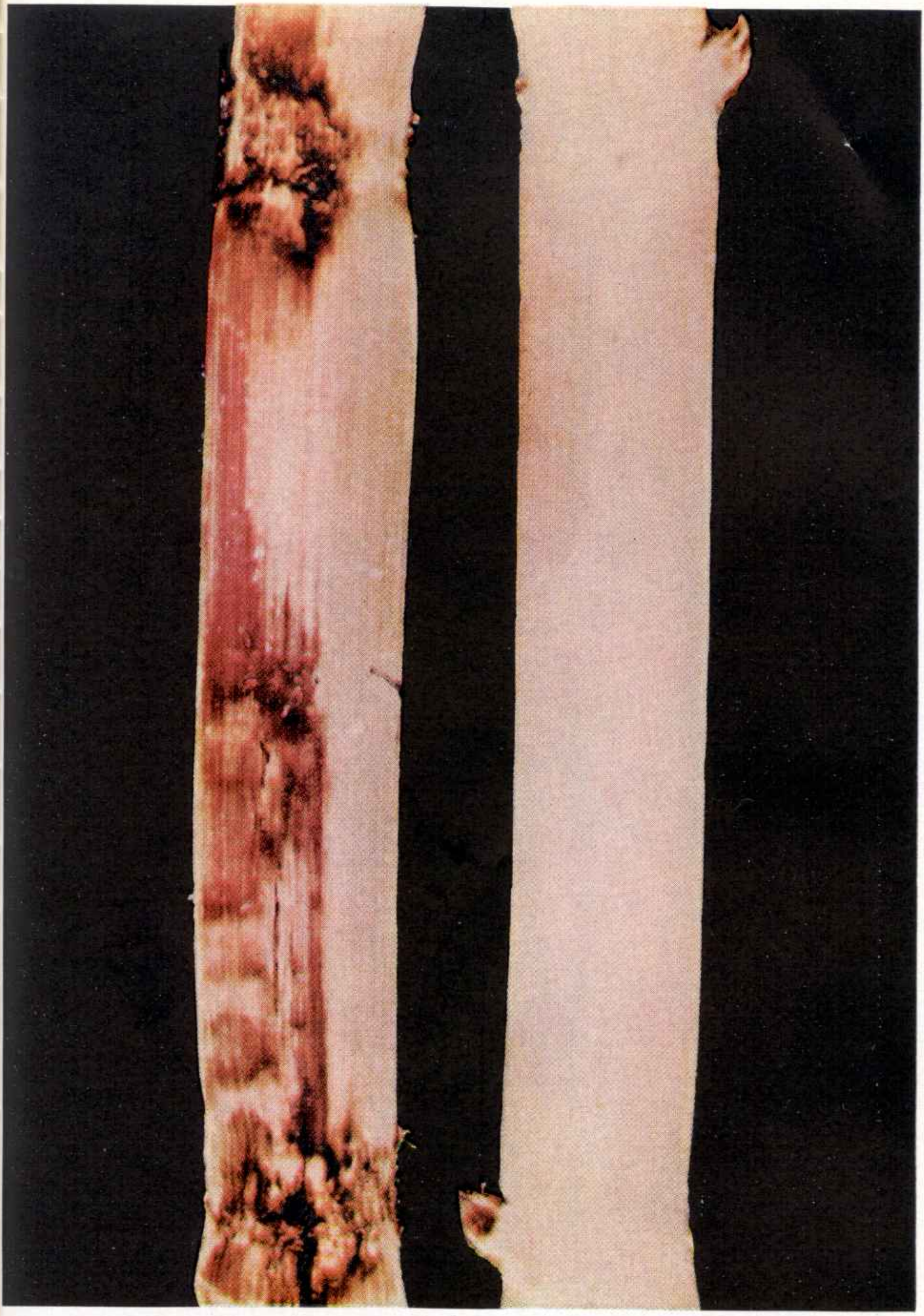
Stalk characters of three varieties of sugarcane: *A*, C.P. 29–116; *B*, Co. 290; *C*, C.P. 36–111.

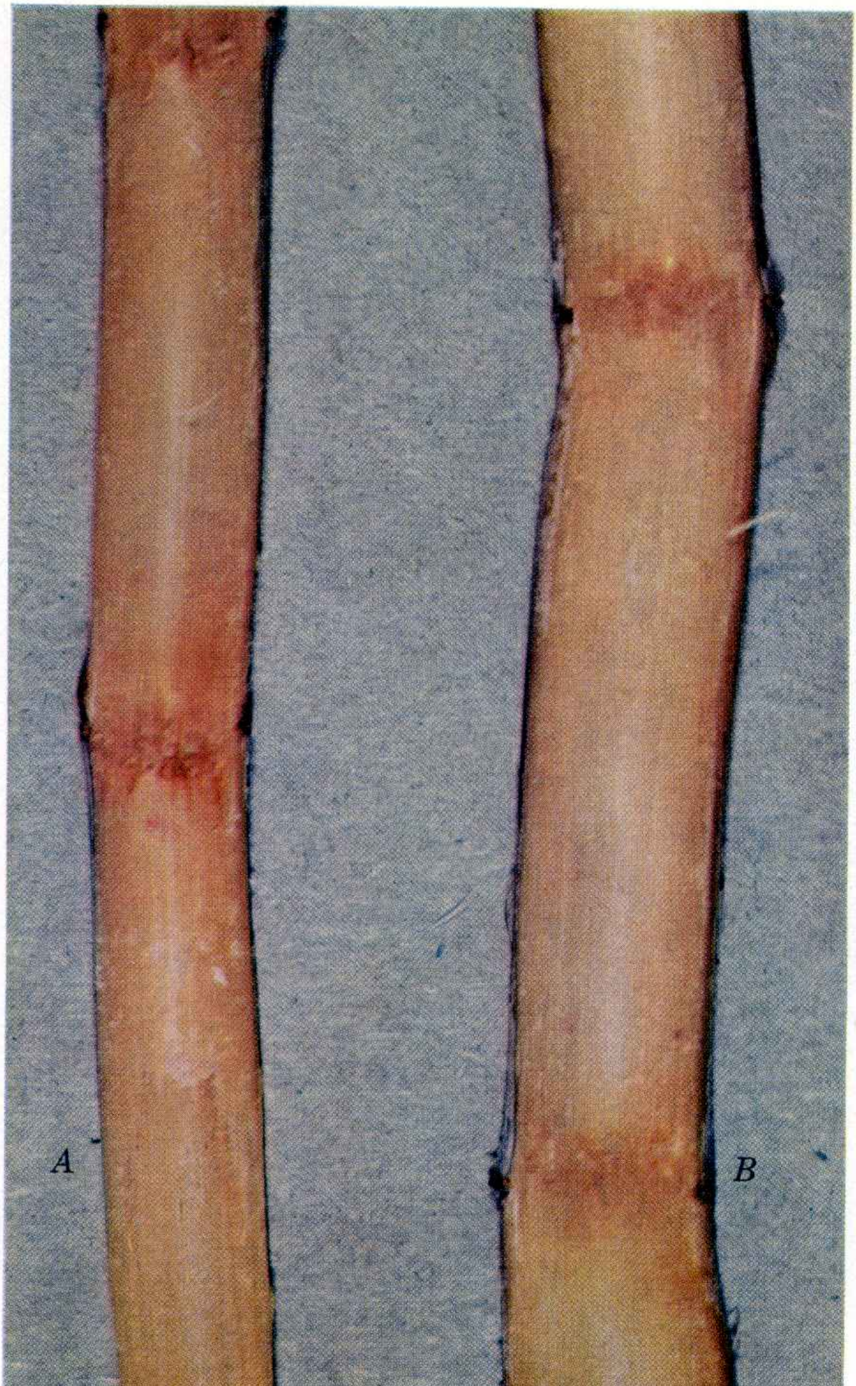
A *B*

Leaves of sugarcane showing mosaic. *A*, Diseased; *B*, healthy.



A *B*

Split sections of sugarcane showing red rot. *A*, Diseased; *B*, healthy.



Split stalks of sugarcane showing internal symptoms of ratoon stunting disease. *A*, Diseased; note orange discoloration in nodes. *B*, Healthy.

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