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COOPERATIVE EXTENSION WORK IN
AGRICULTURE AND HOME ECONOMICS

UNIVERSITY OF FLORIDA DIVISION OF AGRICULTURAL
EXTENSION AND UNITED STATES DEPARTMENT
OF AGRICULTURE COOPERATING

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SUGAR CANE

By A. P. SPENCER

Conditions indicate that an increased acreage of sugar cane will be cultivated in Florida during 1919, and that considerable attention will be given to the crop, particularly on the muck and heavier lands.

Sugar cane in Florida is grown almost exclusively for sirup production, practically all of which comes from a small acreage on the average farm. Usually the amount grown is less

Fig. 1.—Planting Seed Canes

than five acres per farm and the sirup is made with a small equipment. Only a few farmers have as much as fifty acres, or sufficient to justify the operating of an extensive sirup manufacturing plant.

Most of the sugar cane is produced as one of the staple farm crops so that very little extra equipment over that used in general farming practices is necessary. The same cultivating machinery is used as for corn, and the only special equipment needed is an outfit for making up the sirup.

The sugar cane industry is small in comparison with other staple crops, and there are only a few sections where the amount

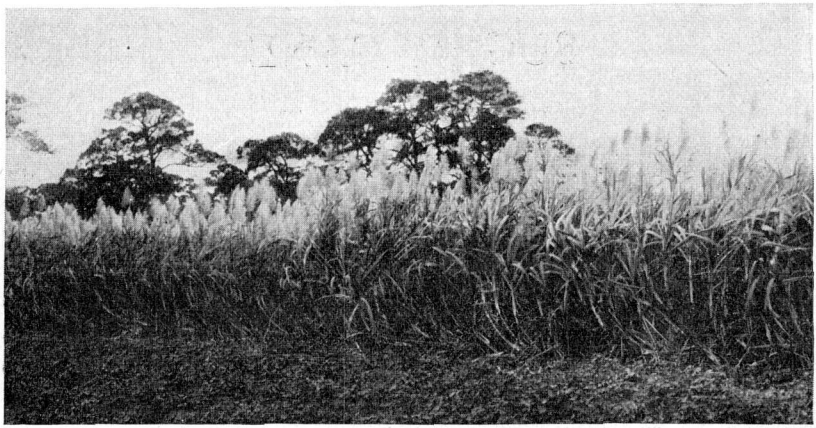

Fig. 2.—Sugar Cane in Bloom
(Photo by Fla. Photographic Concern)

of sirup produced is sufficient to justify the buyers coming to that section to purchase the crop.

Sugar cane requires a long growing season without frost. It thrives best in a climate where there is a rainfall of forty inches or more and makes its best growth during the warmest season. The abundant rainfall and semi-tropical temperatures of Florida are favorable for the crop. Florida is the only state where sugar cane matures sufficiently to produce seed-heads (figs. 2 and 3), and it is not unusual to find sugar cane in bloom in South Florida by January 15, and occasionally it blooms in Middle Florida if the canes have some protection against freezes. This condition is particularly favorable for both sugar and sirup production as the more mature the cane the higher the percentage of sucrose it contains.

Much interest has been developed in sugar cane production on the large areas of muck soils of South Florida. These lands are very rich in organic matter and produce a tremendous growth of vegetation, which makes it possible to produce a heavy tonnage of sugar cane, and with only slight danger of injury by the cold before it is well matured. Much interest has been directed toward that section with a view of establishing the commercial production of sugar.

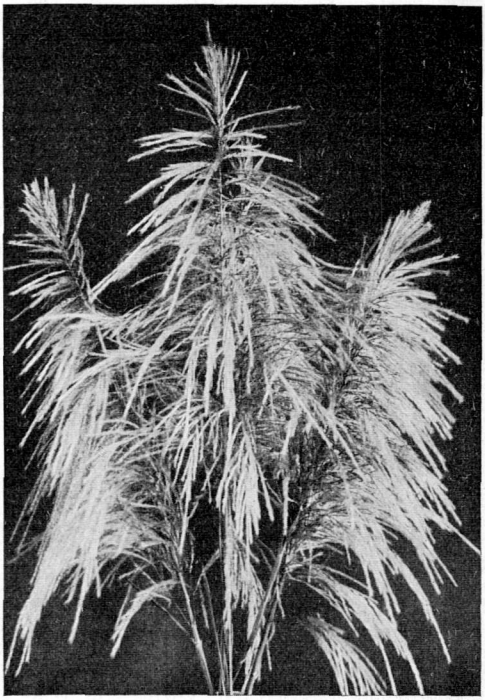

Fig. 3.—Bloom of the Sugar Cane
(Photo by Fla. Photographic Concern)

During the past ten years the greatest sugar cane production has been made on the pinelands of Gadsden and adjoining counties. The greater part of it is grown on small farms and handled with ordinary farm labor and with small equipment. The soils resemble very closely the soils near Cairo, Georgia, which is the largest cane sirup producing area in the United States. Practically all of the cane around Cairo is grown on the best grades of rolling pineland having a clay subsoil. The soil is sufficiently compact to retain moisture in dry seasons and yet porous enough for good drainage during rainy seasons. Fairly heavy crops are produced even on thin sandy lands if the soil has been improved and a sufficient amount of fertilizer used. There is nothing, however, to indicate that cane production will be profitable except on fertile lands.

Sugar cane is practically a sure crop wherever the land is suitable and proper methods of growing the crop have been observed. The future development of the industry depends more on the cost of production, distribution and marketing the products than on any natural condition of the soil or climate.

According to the latest United States general census the sugar cane acreage in the United States is as follows:

Louisiana	329,684 acres	Mississippi	24,861 acres
Georgia	37,046 acres	Florida	12,928 acres
Texas	34,315 acres	South Carolina	7,053 acres
Alabama	27,211 acres	Arkansas	3,330 acres

with a small acreage in Arizona, New Mexico, North Carolina and Oklahoma.

The production of cane sirup is as follows:

Georgia	5,533,520 gallons	Florida	2,533,096 gallons
Louisiana	4,125,083 gallons	South Carolina	881,558 gallons
Alabama	3,078,531 gallons	Arkansas	286,637 gallons
Mississippi	2,920,519 gallons		

These figures show that Florida stands sixth in acreage of sugar cane and fifth in quantity of sirup produced.

Taking these figures in consideration and the fact that the average production per farm in Florida is less than one acre, it is unnecessary to emphasize further the possibility of a greatly increased production if the products can be marketed at a profit to the grower.

SOILS

The variety of soils in Florida that produce heavy yields of sugar cane give reason to conclude that sugar cane may be made a profitable crop in many sections of the state. Under favorable conditions 25 tons of cane or more may be produced from one acre.

Hammock lands vary a great deal in fertility and only the better grades can be expected to produce good crops for more than two or three years without seriously depleting the soil fertility. Where there is a layer of vegetable matter mixed with sand two feet deep or more, and underlaid with clay or marl the soil conditions for the production of sugar cane are exceptionally favorable. But on hammocks that have only a thin surface layer of black soil or leaf mold and this underlaid with porous open sand, one cannot expect to produce average yields after the second or third year without liberal applications of fertilizer. These soils are usually less productive than good pinelands.

Of the pinelands the rolling sandy clay loam with a mixture of pebble and underlaid with clay is considered the best for cane. While they usually lack sufficient fertility and require liberal applications of fertilizer to produce good crops, they can be im-

proved by crop rotation and it is on this kind of soil that the largest acreages are grown thruout the sirup areas of Florida, Georgia, and Alabama. The cane seldom stops growing because of lack of moisture, while on the more sandy pinelands more fertilizer is required and the crop is likely to be cut short during a dry season. There is also a wide variation in quality and productiveness of such land for cane growing.

Flatwoods pinelands that have a retentive subsoil and a fair amount of humus usually produce good crops, but like high pinelands, require liberal fertilization for a heavy crop. The poorer grades of flatwoods with insufficient drainage and underlaid with sand are usually very unsatisfactory. And it is doubtful if they will grow profitable crops of cane under normal conditions.

Muck lands will produce heavy crops of cane with a minimum amount of fertilizer. They have a great abundance of ammonia, but usually lack mineral matter. Where muck has a fair amount of mineral matter it will grow heavier crops of cane without any additional fertilizer than any other type of soil in Florida. It is important particularly on muck soil that the water table comes not closer than three feet below the surface, and that the top soil be decomposed and firm, so that the cane will have anchorage to prevent lodging when mature.

On muck lands with a loose surface, a heavy cane crop is likely to lodge and become tangled, making it difficult to harvest. This can be overcome to a limited extent by planting such hard upright growing varieties as D-74. As the muck settles and the excessive amount of surplus ammonia disappears there will be less trouble from over growth and lodging.

TYPES OF SOIL AS AFFECTING THE QUALITY OF SIRUP

The type of soil on which the cane is grown has a considerable effect on the color, clearness and flavor of the sirup. It is generally considered that sugar cane grown on the light sandy lands produces a better colored sirup than when grown on the moist heavy richer soil. This is supposed to be due to a greater amount of immature cane on the rich lands at harvesting time. These lands have a tendency to continue growth late in the season, while on the lighter lands the cane matures earlier, making a better grade of sirup. Heavy applications of manure also have a tendency to produce darker colored sirup. However, the use of stable manure in cane growing is to be recommended for

increasing the yield. The humus and fertility it adds to the soil is very beneficial for increasing the yield of cane, even tho it might have a deleterious effect on the color of the sirup.

The method of making up the sirup has even a greater effect on the quality, so that the type of soil is not the only factor to be considered in the production of high grade sirup.

SUGAR CANE VARIETIES

The varieties of sugar cane most generally planted and best known thruout the sirup producing areas of Georgia, Alabama and Florida, are the Red or commonly called Purple cane, Red Ribbon cane, Green cane, Green Ribbon cane, frequently spoken of as Simpson cane, and Japanese cane. Many other varieties have been introduced from tropical sugar cane producing countries, but most of these have not proven as satisfactory, due largely to their lateness in maturing. In Florida, excepting in the extreme southern part, the crop must mature in nine to eleven months. Early maturing varieties are therefore preferable.

The Red or Purple cane is most generally grown. It succeeds fairly well under average soil and moisture conditions, and matures sufficiently for sirup production in nine months. The seed cane is also well matured before early frosts are likely to injure it.

The Red Ribbon cane is second in importance. It yields a heavier tonnage than the Red cane on rich hammock or muck land, but requires more fertilizer to make a good crop on sandy pinelands. While no careful tests have been made this variety is considered preferable to the Red for rich muck soils.

Green cane is next in importance. It is better adapted to South Florida than West Florida, but has never become an important sirup variety. It matures slower, and therefore requires the longer season. The production of sirup is usually satisfactory, especially where small horse mills are used as it is soft and is easily crushed.

Green cane also produces a light colored sirup which is desirable, and being soft it is preferred for chewing purposes. It is one of the best varieties where small patches are planted for chewing purposes only. It is considered to be more susceptible to disease than harder varieties.

The Green Ribbon cane has about the same characteristics

as the Green cane, and is not an important commercial sirup variety.

Two varieties, known as D-74 and D-95, are extensively grown in Louisiana and to some extent in Florida. These have given large yields on the rich alluvial soils of Louisiana and for similar soils are considered superior varieties. However, on the sandy soils where liberal fertilization is needed they have not proven as productive as either the Red or the Red Ribbon. They are also more sensitive to the lack of moisture and can be recommended only for richer lands that will not suffer from drought. On the muck soils of South Florida they seem to be preferable to most others as they make a more erect growth and are not so likely to lodge when mature, which is a decided advantage in harvesting. These varieties were introduced into Louisiana from Demerara, South America, in 1873 by Dr. W. C. Stubbs, Louisiana.

The D-74 variety is green, quite hard and brittle. In general appearance it resembles the Green cane. The D-95 variety is purple colored and somewhat softer than D-74.

Japanese cane produces sirup of an excellent quality, lighter in color than most other varieties. The yield of sirup per ton, however, is usually lower because the canes are hard and it requires more power to express the juice. Japanese cane requires more labor to strip the canes, as it has more leaves and these are attached very close to the stalk. There are, however, some varieties of Japanese cane now under test that promise to give better results as sirup producing canes than the ordinary varieties.

Japanese cane is very hardy. It will withstand more cold without injuring the juice, than other varieties, altho the eyes are no more hardy. It stools much more than other varieties and more crops can be grown from the stubble. Some claim it is not necessary to reset Japanese cane for several years. However, the test plots on the Experiment Station farm show a much greater yield on the newly planted plots than from stubble planted four years previous. (Fig. 4.)

Other varieties are being tested by the Office of Sugar Cane Investigation, Bureau of Plant Industry, at the Experiment Farm, Cairo, Ga., under the direction of Dr. P. A. Yoder, Sugar Cane Technologist. Inasmuch as the soil and general conditions in that section are similar in many respects to much of the pinelands of North and West Florida, the results of these tests will

Fig. 4.—Japanese Cane

be the best information obtainable for Florida cane growers.

A variety of sweet sorghum generally spoken of as Texas Seeded Ribbon cane has been highly recommended for sirup production. This has led to some confusion in that it is a variety of sorghum and not a sugar cane. Its only advantage over sugar cane is that it can be propagated from seed and requires about four months from seeding to maturity. As compared with sugar cane it is much less expensive to plant, and where sorghum sirup is desired it is a good variety of sorghum to plant. However, it is not a sugar cane and will not produce sugar cane sirup. Nor is it to be recommended over sugar cane for commercial sirup production.

SEASON FOR PLANTING

Sugar cane may be planted in Florida either in the fall or spring. The location determines the best time to plant. In the northern counties fall planting is not generally practiced, due to the uncertainty of getting a uniform stand. When the canes are planted in early November and lay in the ground until late February or March some of the buds, especially those in the upper portion of the stalk which are always less mature, are likely to germinate very slowly, if at all. When the seed cane is not planted until spring, remaining in the bank during winter, the joints with dead buds can be cut out and nothing but good seed planted. Due to the uncertainty of getting a full stand fall

planting in North and West Florida is not considered a good practice.

In Middle or South Florida, or wherever conditions are favorable, fall planting has several advantages. The labor involved in banking is omitted and the canes are planted when they are in a sappy condition, causing the growth to start very soon afterwards, usually producing a full stand. With the exception of unusual seasons, cane may remain standing in the field thruout South Florida until December without danger of frost injury. If planted at that time it will remain in the ground only a short period before growth starts.

Aside from the extra labor saved by fall planting, the usual loss of 15 to 25 percent of seed cane in the beds is avoided. When banking seed cane one should bed 25 percent more canes than is actually needed to plant in order to insure against a shortage of seed, should there be the usual loss in the beds.

Fall planting may be done as late in the season as it is safe against freezes. Spring planting should be done on or before March 15.

PLANTING

When ready to plant lay off the furrows four to five feet apart on pine land and five to seven feet apart on rich hammock or muck land, and about six inches deep. If the soil is unusually dry the furrows may be somewhat deeper so that the seed cane will be laid in moist soil. If the land is wet and needs drainage it may be necessary to put it in a small bed, but under average conditions level planting is best.

After selecting good seed the cane should be cut into lengths of about four joints each, and planted in the furrow. (Fig. 1.) If the seed is good a continuous row is sufficient for a uniform stand, but if the seed is uncertain it is advisable to use more seed, overlapping it sufficiently to insure a good stand. The seed cane should then be covered with about three inches of soil. Too shallow covering will not hold sufficient moisture to the canes, whereas, covering too deeply will delay the growth after the buds have started. If the cane is fall planted and has a deep covering of soil it may be necessary to remove some of the dirt so that the growth may begin just as soon as spring opens. This is a general practice in Louisiana. Sugar cane is a tropical plant and requires a warm soil to start growth. This must be taken into consideration when planting, and especially if the land is wet and likely to remain cold until late spring.

The buds should start to grow as soon as spring growth begins, otherwise they grow off slowly or may die, giving a poor stand. The best cane growers in the Cairo, Georgia, section plant closer than is usually practiced in Florida. Practically all cane in that section is planted in four and one-half foot rows so that the ground will be shaded in early summer. For varieties that stool considerably, such as Japanese, or where the crop is to be grown from the stubble for two or more years, it is advisable to provide more distance between the rows so that cultivation may be kept up when the cane rows have widened out due to stooling.

For forage purposes, Japanese cane does best when planted in six foot rows.

To plant an acre of cane in four and one-half foot rows requires from 2000 to 2500 canes of three to four and one-half foot lengths; in five foot rows about 2000 canes of average length are needed. This, in weight, amounts to about three tons per acre. The cost of seeding is therefore a considerable item.

The seed canes should be stripped of their leaves, mainly to avoid planting canes infected with red rot or with dead buds. If the root stocks are planted a thoro inspection should be made to see that they are not infested with root knot. This is a serious disease of cane and is readily transferred to clean fields by planting infested root stocks.

Seed canes that have been bedded should be planted immediately after they are uncovered in the banks, so that the buds will not dry out. If they are to be transported, requiring several days, every precaution should be taken to keep them moist.

STUBBLE OR RATOON PLANTING

Wherever cane stubbles or ratoons can be held over in good condition for planting it is always economical and advisable to do so. However, the heaviest crops of cane are usually produced in newly planted fields, but as planting involves a heavy expense for seed and labor it is advisable to depend on stubble for at least a part of the crop. Under favorable conditions the first crop from stubble is nearly as heavy as from newly planted fields. The second stubble crop is usually lighter than the first.

When the stubble is to be left for seed the cane should be cut quite close to the ground so that there will be very little of the stalk left above the ground to be frozen and dried out. Where the stubble is likely to be injured by freezes it should have some

covering to protect it. This covering is also beneficial to prevent dry rot. If a furrow can be opened on one side of the row and the stubble turned into this furrow and covered, then turned back with a plow when spring opens, there will be only a small loss of seed. One can also protect the stubbles by plowing a furrow on them, and without disturbing the roots. When spring opens remove enough dirt with some convenient implement to allow growth to start early. The protection usually requires more dirt than should be left on the canes. In protected places the stubble can be held in good condition over winter by covering it with the tops and leaves of the canes.

Cane growers find that they get a better stand by planting the root stocks than from the stalks alone and, therefore, utilize the roots just as far as it is practicable.

A good crop of cane can be grown from the ratoon for three or more years on the well drained muck or hammock lands of South Florida.

FERTILIZER

As sugar cane makes a heavy growth it must have liberal amounts of available plant food. On the pinelands it is usually necessary to supply liberal applications of nitrogenous fertilizer. Even on the better grades of hammock lands the ammonia becomes depleted where sugar cane is grown several years in succession. Potash and phosphoric acid should also be applied to average soil. It is probable that most of the muck soils as well as the pinelands are benefited by sufficient applications of these materials. The richer the soil in humus the less will be the need of heavy fertilization. When the cost of fertilizer is above normal it is questionable if cane growing will be profitable except on the better grades of Florida soil. Sandy lands very deficient in humus usually require more expense for production than the crop will justify.

The usual application of fertilizer on good sandy, loam lands is from 600 to 1500 pounds per acre. This should analyze four or five percent of ammonia, four percent phosphoric acid, and three to five percent of potash. As sugar cane is a long season crop with an intensive root system, almost any kind of fertilizer that supplies the fertility needed during the growing season gives good results. As far as growth is concerned it seems to make little difference as to the source of the ammonia in the mixture. However, cane growers in the largest cane producing areas prefer cottonseed meal for the ammonia, with eight tons or more of

stable manure per acre if it can be secured. A common practice is to apply about one-half of the commercial fertilizer before the seed is planted, either mixed into the planting furrows or applied broadcast. The second application is made during June or July, and if the crop seems to be making a slow growth due to insufficient ammonia, an application of 200 pounds of some readily available form of ammonia is applied as a top dressing during September. Either nitrate of soda or sulphate of ammonia is satisfactory, depending altogether on the relative cost per unit of ammonia. During the past three years cane growers have used very little potash on account of the high price. Some of the most careful growers claim the yield has been somewhat reduced because of the lack of potash, while others claim they can see little or no difference, and that the application of ammonia fertilizer is a more important consideration than either the potash or phosphorus.

Bulletin 144, Florida Experiment Station, reports the results of fertilizer tests extending over three years with Japanese cane on sandy loam soil with different forms of ammonia and phosphorus. In these experiments sulphate of ammonia produced 1.9 tons per acre more than dried blood, and nitrate of soda gave an increase of 1.8 tons per acre over sulphate of ammonia, and 3.5 tons per acre over the dried blood. These results indicate that sulphate of ammonia and nitrate of soda are economical sources of ammonia fertilizer.

On account of the present high cost of all organic forms of ammonia, particularly cottonseed meal, sulphate of ammonia should be used for the spring application with an additional application of nitrate of soda applied as a top dressing about September first.

The use of cottonseed meal as a direct fertilizer for cane is a wasteful and expensive practice, for by feeding it to cattle and applying the manure as fertilizer a double value is realized from the meal. The manure contains about eighty percent of the original fertilizer value of the meal, after the cattle have consumed it for milk or meat production.

It was also found that the plots receiving an application of thirty two-horse loads per acre of stable manure produced on the average for the three years more than fifty percent greater tonnage than any plots fertilized with commercial fertilizer, and is therefore highly recommended.

In comparing different forms of phosphorus covering the

same period the plot receiving acid phosphate yielded 11.8 tons per acre, the plot fertilized with floats yielded 12.1 tons, and the Thomas slag plot yielded 10.2 tons per acre.

The results from these tests indicate that there is very little difference in the values of acid phosphate or floats and that either one is better than Thomas slag for fertilizing Japanese cane.

It has been considered that the kind of fertilizer used would effect the quality of the sirup, but later information goes to show that the variety of cane, the stage of maturity when the sirup is made and the methods of manufacturing have more to do with the quality than the kind of fertilizer applied. Sugar cane is fairly expensive to plant, cultivate and harvest, so that it is not profitable to grow a light crop if the soil can be made to produce a good crop by proper and liberal fertilization.

BEDDING SEED CANE

Sugar cane to be used for seed should be as mature as it is possible to have it. Unless the cane has eight or nine months for growth the buds are not likely to be sufficiently mature to give a good stand. Seed cane should be selected from parts in the field that have made the earliest and best growth.

Seed cane should be bedded before it is likely to be frosted. The buds or eyes are very sensitive to a light freeze, even one that would not seriously injure the cane for sirup making. In North and West Florida seed cane should be bedded by November 10. Farther south where the frost comes later bedding any time during November is a safe practice. Killing frosts are likely to occur earlier and more frequently on dark colored flat lands than on sandy rolling lands where the circulation of air is better. One should make sure that the seed is safe against even a light freeze.

Seed cane should be bedded when sappy and moist. The more moisture in the canes when they are laid down, the better. Drying out of the canes and buds during the time it is in the beds causes the greatest losses in seed-beds. This often amounts to from fifteen to twenty-five percent of the total cane bedded. In fact, successful cane growers bed much additional cane so they will be assured of having sufficient for their planting. Seed canes should be bedded and covered just as soon as they are dug. If the seed cane lies around even for a day or more during dry weather it is likely to cause a dry condition in the seed beds, and were it not for the inconvenience in handling the seed it

would be advisable to bed the cane when wet, even during a rain. This, however, is not necessary as there is usually sufficient moisture so that if the canes are bedded immediately they will go into the beds in good condition. (Fig. 5.)

Fig. 5.—Bedding Seed Cane

The beds may be as wide as is convenient. Seed cane usually comes out of a wide bed in better condition than from a narrow one. As it requires considerable hand labor to cover the beds with dirt, eight to twelve feet in width is sufficient. Some prefer a narrower bed for the convenience in spreading the dirt over it.

If the top soil is moist the beds can be made on the surface, but if it is dry it is an advantage to plow out a bed so that the canes can be laid on moist soil. This also puts the bed a little lower than the surface and makes it somewhat easier to cover.

Cane should be laid in the beds with all the leaves. The butts are laid on the ground and the tops overlapping. This places the canes in a slanting position and the beds about thirty inches high. A covering of moist soil about three inches thick is spread over the bedded cane to hold the moisture and protect the seed against the freezes. Some cane growers consider it advisable to lay a small amount of moist earth on the roots or butts of the canes when it is placed in the beds. That is, on each layer of cane there is a layer of dirt covering the butts. It is questionable if seed canes absorb any moisture from this layer of dirt.

While the canes must be kept moist while in the beds they must not be placed where standing water is liable to surround the bed and perhaps cover it.

The best seed cane is usually bedded with the roots attached as the joints nearest the roots usually have well matured buds. So that, there is a considerable saving in seed by digging up the root stocks. It is necessary, however, to dig out the roots in order to have good seed cane as the stalks can be cut as if for grinding, and bedded in the usual way. A serious objection to bedding the root stocks is the probability of spreading disease or insect pests from infested to non-infested fields.

During the past two years the attention of county agents has been called to a general prevalence of root-knot in cane fields. This condition has caused serious loss in one of the most important cane growing sections in Florida. It is estimated that the injury this year in one region will reduce the output of sirup about one third. Should this trouble continue some change in the general method of planting must be adopted and in all probability the planting of root stocks entirely discontinued. Where cane is known to have root-knot or is grown in an area where this disease is known to exist, no roots of cane should be taken from these fields to be transplanted. Undoubtedly the root-knot has been widely scattered thruout this section because of the general practice of digging up the seed cane and planting the roots, thereby transferring the root-knot from one field to another on the seed. As the nematodes causing the root-knot cannot readily be transferred on the stalk the spread of root-knot can be materially reduced if no root stocks are planted. In the same locality referred to some newly planted fields were found to have severe infestation of root-knot which, no doubt, was transferred on the root stocks of the seed cane.

HARVESTING

The harvesting of sugar cane involves considerable labor and expense. The canes are first stripped, topped, then cut and piled for loading. This is all done by hand. The stripping is done with a light stripper, the tops cut off with a cane knife, and the canes cut with a heavy short handled hoe. (Fig. 6.) If the crop is badly lodged, the labor of harvesting is very much increased. To facilitate harvesting, the stripping may be done sometime before cutting. Some claim that it hastens maturity, but it is doubtful if it has any effect on the maturity. On account

of the very heavy growth of sugar cane no satisfactory machines have been designed to harvest it, altho several have been built for the purpose. Even the largest cane growers in Louisiana have their cane cut and stripped by hand.

Where the acreage is sufficient much labor can be saved by using the loading equipment. Most of the large planters and many small planters use hoists for lifting the cane from the wagon to the platform. After the cane is wind-rowed it may remain there for some time, two months or more if necessary. Should a freeze occur during the harvesting it is necessary to cut and wind-row the cane at once. If left standing after the canes are frozen the juice in the stalks will ferment, which injures it for making sirup. Cutting it down immediately prevents this fermentation. Should the weather remain cool this fermentation will be slow, but if warm weather follows the cane should be handled within three or four days, otherwise it is impossible to make good sirup from it.

Further covering is unnecessary as the tops will sufficiently protect the stalks from any further frost injury. If this is done promptly the loss from a moderate freeze will be very small.

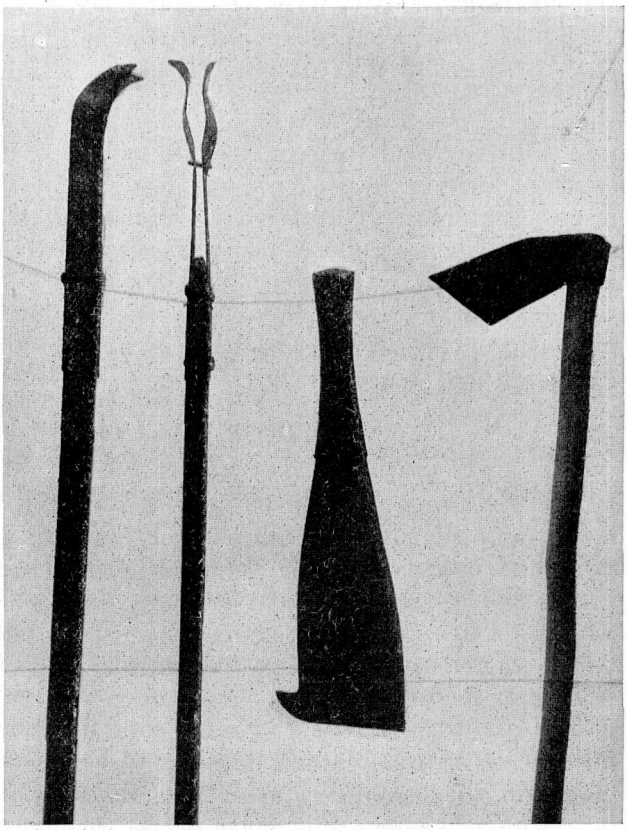

Fig. 6.—Harvesting Tools of Sugar Cane

YIELD OF CANE AND SIRUP

The yield of cane is dependent very largely on soil conditions and cultivation. On the richer lands of Florida, particularly on muck, as high as forty tons per acre have been made. This, of course, is very much higher than is produced on the average sandy lands. However, good pinelands well fertilized produce twenty tons or more per acre. On thin sandy lands with little or no fertilization the yield often runs five tons per acre or less. By using heavy mills one should extract not less than seventy-five percent of the weight of the cane in juice, while the average small mill extracts sixty percent or less, and with the one-horse mill commonly found on small plantations the yield of juice is usually less than fifty percent of the weight of the cane. The loss is considerable where light mills are used, and it is not uncommon to find 25 percent or more of the juice left in the bagasse.

Sugar cane contains about 85 percent moisture and 15 percent dry matter. The heaviest mills in use will extract 80 percent of the total weight of the cane. Estimating that the mill will extract 70 percent of the weight of the cane one can expect a yield of 20 to 25 gallons of sirup from each ton of cane milled, making a yield of sirup from a 20 ton crop about 400 gallons per acre, or 200 gallons per acre where the yield of cane is about 10 tons.

The latest census shows that the production is about 100 gallons of sirup per acre, so the yield of cane under average conditions is five to eight tons per acre.

SIRUP MAKING

MILLS

When properly adjusted the heavy sirup mills in use by large factories will extract about 80 pounds or more of juice from 100 pounds of cane. A good steam-power mill in use on the larger plantations will extract about 75 percent of the weight of the cane, while the average small one-horse mill does not extract more than 50 to 60 percent. This means that with the small inefficient outfit, from three to four hundred pounds of juice is wasted for each ton of cane hauled to the mill. The amount of sirup obtained depends to some extent on the efficiency of the machinery used.

Mills of various makes are in use thruout the sirup producing sections. These mills are similar in design but vary in

capacity according to the acreage of cane grown. The verticle horsepower mill has a capacity of 40 to 100 gallons of juice per hour. Heavier mills operated by steam or gasoline power have a capacity of 125 to 500 gallons of juice per hour, when operated to the fullest capacity. In large sirup factories the capacity of the mills used is much greater.

Where one has four acres or less to grind, the small size one-horse mill will usually handle the crop, but where there are twenty acres or more the mill should have a capacity of 15 to 25 tons of cane per twelve hour day or 200 or more gallons of juice per hour. These mills cost from $250 up. Such mills will require an engine of not less than six horsepower to operate successfully. Even small mills give better results when they are driven by an engine, as the output of juice from any mill depends on the adjustment of the rolls and speed that the mill is operated, how the canes are fed into the mill, and the kind of cane.

To save labor and for convenience, a mill should be located on a slope. This facilitates unloading and makes it easy to

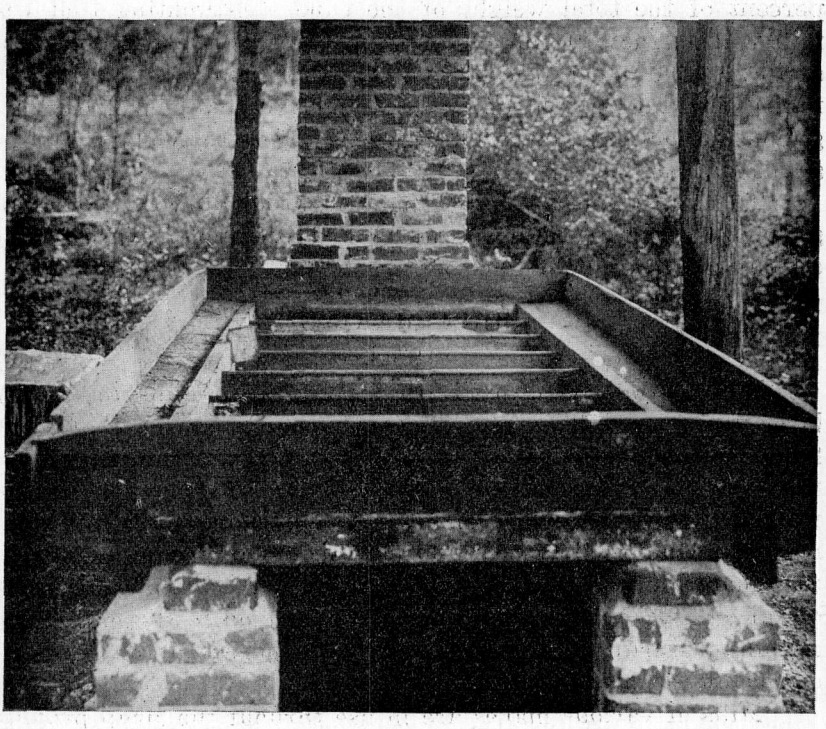

Fig. 7.—Sirup Evaporator

unload the cane from the wagon to the platform. It also gives opportunity to locate the collecting vats on the lower side of the mill so that no pumping or lifting is necessary to take the juice from the vats to the evaporating pan. There is considerable labor involved in sirup making. All necessary conveniences should be carefully planned so there will be no delay or unnecessary labor needed.

EVAPORATING OUTFITS

Most of the sirup made in Florida and Georgia is cooked in a sirup evaporator or in a sirup kettle. A few farmers use the long evaporating pan. The kettle usually accompanies the small horsepower mill. The one hundred gallon, or large size kettle is the one most generally in use. Many farmers increase the capacity of their kettles by placing a six inch band of sheet iron on the outer ring of the flange, which makes the kettle six inches deeper. This band is put on in a local blacksmith shop by shrinking it over the flange just as a wagon tire is shrunken on a wheel. A second band about three inches high is set on the inner ridge of the flange. This leaves a space of about six inches between the band. This space is used as a skimming trough. The inner band is set in loose and can be lifted out, but is heavy enough to stay in place while the sirup is cooking. With these bands the capacity of the kettle is increased 25 percent. About sixty gallons of juice is put into a 100 gallon kettle at a time. This evaporates down to about eight gallons of sirup, requiring about 7½ gallons of juice to make one gallon of sirup. In a twelve hour day about eight of these batches can be taken off, so that the capacity of a 100 gallon kettle is approximately 60 gallons, or two barrels of sirup per day.

Sirup evaporators are made of galvanized iron or copper and may be purchased direct from manufacturers. These are made 44 inches wide and vary in length from 6 to 15 feet. These evaporators are shallow and fit in a wooden frame and are divided in three compartments with openings or gates in the partitions. These divisions in the evaporator are made to hold the juice or sirup at the different stages of cooking. (Fig. 7.)

These evaporators come from the factory with and without the skimming trough on the side. Most sirup makers prefer to buy the evaporators without the skimming troughs and have them put on by a local tinner. These troughs are about six inches wide and are fastened to the side of the evaporator. The

outer edge of the trough is four inches higher than the edge of the evaporator, allowing the skimmings to boil over into the trough. These troughs are raised at the back end of the evaporator so that the skimmings will run into a barrel located under a spout at the lower end of the skimming trough. This skimming trough need not extend farther back than the second compartment, as there are practically no skimmings to come off in the finishing compartment.

These evaporators are perhaps the most satisfactory outfits where there is not more than 25 acres of cane. A twelve foot evaporator will handle from 175 to 200 gallons of sirup per day, or approximately the sirup from one acre of an average crop. The life of these evaporators is about three years, or even longer if they are properly cared for after the sirup season is over. At present the cost of the evaporator is about $2 for each foot, while formerly they were purchased for $1.50 per foot or less.

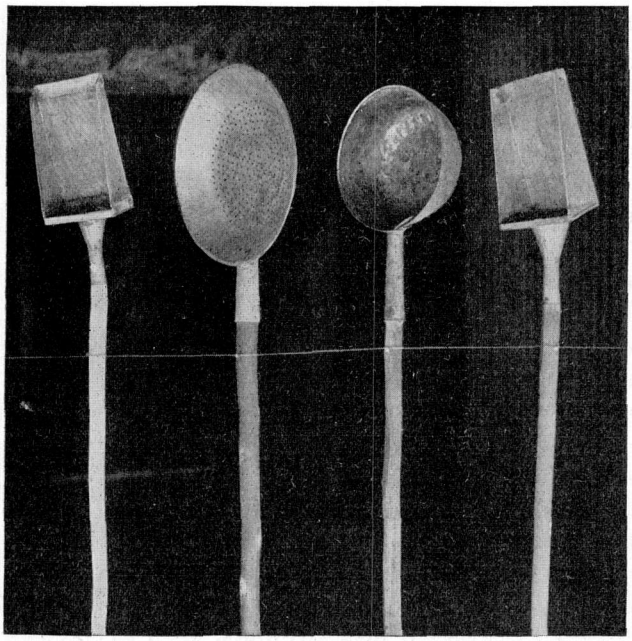

Fig. 8.—Skimming Tools

In operating these evaporators the juice is piped direct from the juice-tank into the first compartment, which is immediately over the fire. The boiling there is rapid and a heavy green scum is thrown to the surface and taken over into the skimming trough. It is at this stage that most of the sediment and foreign material is taken out of the juice, and special skimming tools are used for this purpose. (Fig. 8.) When this stage

is completed the juice is then turned into the second compartment where skimming continues and is cooked until the density of the sirup is about 25 degrees Baume. When it leaves the second compartment there should be practically no scum rising to the surface as the skimming should be completed in the first and second compartments. The sirup is then turned into the third compartment and cooked until finished. Some care must be exercised when moving the juice from one compartment to another. If the pan is almost completely drained it is very easy to scorch the thin layer left in the pan. This flavors the entire batch and injures the quality.

Water may be poured into this pan to avoid this if necessary.

As cooking continues the water is driven out of the sirup so that it becomes thicker the longer it is cooked. When it is finally finished it should have a density of 33 degrees Baume hot and 38 degrees when cold. The sirup is then drawn into barrels or put up in small containers, and this should be done immediately while it is hot.

The deep evaporating pan resembles the ordinary evaporator except that it has no partitions. The cooking process is about the same as in the kettle. These pans have a large heating surface and the only advantage over the kettle is that more sirup can be made in a day. And with careful handling a little lighter colored sirup is made, as the boiling is done more promptly.

The sirup evaporator with compartments and the evaporating pans are arranged over a furnace. This furnace is built of brick and should be about one foot longer than the pan, that is, if a twelve foot pan is to be used the furnace should be thirteen feet long. This leaves one foot of space between the chimney and the pan. The walls of the furnace are made with two layers of brick built thirty inches high. The inside measurements between the walls are 44 inches. The evaporator fits on the top of the wall with the pan exposed to the fire. The fire box runs back about three feet and the full height of the wall. Iron bars are laid below the fire box to support a fire grate. In front and below the grate there should be sufficient opening to give a good draft, as the boiling of sirup requires a very quick fire. Just behind the fire box the opening is filled in with dirt, up to within 16 inches of the pan. This leaves a throat for the passage of the smoke and throws the heat up to the sirup end of the pan. The chimney should be as high as the pan is long, in order to

give the proper draft. For the construction of the furnace and the chimney it will require about 2000 bricks.

When the evaporator is laid on the walls of the furnace it is necessary to block up with clay the inner side of the frame lying next to the fire. This clay will harden, whereas mortar will burn out. This protection is necessary to keep the frame of the evaporator from burning. On the outside of the frame it should be blocked up with mortar and if a smooth job is made it can be kept clean and sanitary. The door and grates for the furnace can be purchased or they can be made by a local blacksmith.

STEAM EVAPORATORS

With the steam evaporator the boiling is done by steam forced thru coils. A common form of this steam evaporator is a wooden box lined with galvanized iron, tin or copper. The coil is laid in the bottom of the box and can be taken out for cleaning. This coil may be either iron or copper. Copper, of course, is the most serviceable, but decidedly more expensive. In this outfit two or more evaporators are necessary—one for the juice and one for finishing the sirup. These evaporators are located so that the juice will flow from one evaporator to the other by gravity. As soon as the juice in the first tank has been sufficiently boiled the faucet can be opened and the juice will flow into the pan for final evaporation. Steam evaporators have the advantage of using less fuel and where heavy mills are used one can burn the bagasse or refuse from the cane mill. The heat, of course, can be kept uniform and well regulated. However, for general use they have not proven as satisfactory as the shallow evaporators. In large factories where greater capacity is needed the steam cookers are used entirely and it is the opinion of experienced operators that these evaporators should be as shallow as can be conveniently operated.

Excellent sirup is produced by all the methods employed. Generally a higher grade of sirup is produced on the shallow pans where the boiling is done quickly. Sirup that is made in deep pans is usually dark in color and contains more sediment.

DETERMINING WHEN SIRUP IS FINISHED

Sugar cane sirup is a standard product. It should have a density of 38 degrees Baume or over when cold and 33 degrees Baume when hot, and should weigh 11¼ pounds per gallon. Owing to the difficulty of weighing a gallon of hot sirup taken

direct from the evaporator the density is tested with a Baume hydrometer. (Fig. 9.) The Baume hydrometer used in making sirup is graduated from zero to seventy. It can usually be furnished for about $1.50 to $3 from firms handling sirup making equipment. The density of the sirup is measured by floating the hydrometer in a tall cylinder filled with sirup. The reading of the hydrometer at the top of the sirup indicates the density.

The sirup should be cooked until the hydrometer reading shows 33, then the boiling should stop. Some sirup makers determine the finishing point by dripping the sirup off of a spoon. When the sirup flakes instead of dropping off the spoon it is considered finished. Experienced sirup makers can gauge the density of the sirup fairly accurate by this method, but anyone not experienced should depend on the Baume hydrometer.

Sirup is graded according to color, sediment and fermentation. The test is made by pouring a small amount out on a sheet of white paper. It should show a light amber color, free from sediment, with no fermentation.

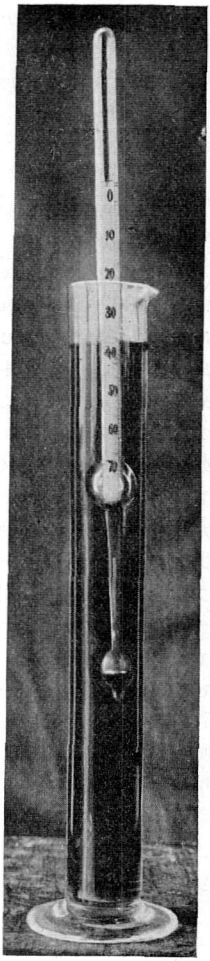

Fig. 9.—Sirup Hydrometer

CONTAINERS

Cane syrup will retail for a better price when it is put up in small packages in tin or glass. Pint and quart bottles make a readily salable package. Tin containers are used more extensively than bottles as the glass is more expensive. Quart, half gallon and gallon sizes are most generally used. These are convenient for storing and as they can be sterilized and sealed, the sirup can be kept in them for a long period without any serious deterioration.

The greatest bulk of the sirup is put up in barrels. As soon as it is cooked and when still hot it is run into barrels and these barrels promptly stoppered. If the barrels are new and clean, there is no difficulty in keeping it in good condition thruout the winter months or for four or five months after it is made. It is unsafe to hold it for a much longer period as some fermenta-

tion is likely to start when the weather becomes warm. After a barrel of sirup stands for several months the hoops are likely to become loose and it must be handled very carefully to avoid breakage. The standard sirup barrels used hold 30 gallons and cost about $1.50 each in normal times, or five cents for each gallon. Barreled sirup is usually sold by the gallon, estimating twelve pounds per gallon, including the barrel.

SKIMMINGS

Cane skimmings contain sufficient sugar content to justify working them over to get out all of the sirup possible. Usually these skimmings are wasted but with a little care the waste need be very little.

The skimmings from a full day's run may be collected and allowed to settle over night. By morning there will be a heavy sediment in the bottom, then a quantity of clear juice, and a light green scum on top. This juice can be drained off thru a hole in the barrel about three inches from the bottom. If care is used very little of the sediment or scum will be drained off with the juice. The skimmings can stand for 24 hours if the weather is cool, but in warm weather it is likely to sour slightly even in 12 hours unless it is carefully handled. The skimmings collected from a single day's run should be emptied each morning, and the vessel scalded with hot water and rinsed. An iron or galvanized vessel is much better than a barrel as it can be more thoroly cleaned. If dirty barrels are used it is almost impossible to clean them sufficiently to prevent souring of the skimmings, even tho it should stand only over night.

The cane juice drawn off can be boiled over in the evaporator or kettle either separately or mixed with the fresh juice. And if this is done before souring takes place it will not injure the quality of the sirup with which it is mixed.

When the skimmings have become too sour to use for sirup making they can be used for hog feeding. However, they are even unfit for this should they become thick and rancid. When a quantity of skimmings is collected it can be boiled until thick. This will keep for a long time, and can be made into an excellent molasses feed that is relished by livestock.

UTILIZING TOPS AND BAGASSE

The tops and leaves of the cane, which amounts to three or four tons per acre with a good crop, has considerable feeding

value if utilized when green and fresh, and if the cane is cut before it is frosted.

The bagasse also has a small feeding value, but usually too much fibre to be a satisfactory feed. Cattle will eat it with considerable relish when fresh, but it ferments so rapidly that it is difficult to use it as feed unless it could be stored in a silo. The best use for this bagasse is to compost it with litter or barnyard manure. It will require a year or more for bagasse to decay sufficiently and become fine enough to apply to the soil. The value of the bagasse converted into a compost will be much greater than the cost of handling it and plowing it into the soil, and as Florida soils are usually deficient in organic matter it should not be allowed to remain in piles to waste.

BORER, ARMY WORM AND ROOT-KNOT

The cane borer, army worm, and nematode causing root-knot are the most serious insect pests of sugar cane. At present, the cane borer and nematode are found in a few localities. It is important that the distribution of these is held in check, as they cause serious damage when once established. Prof. J. R. Watson, entomologist of the Florida Experiment Station, is an authority on these pests, and the following treatise of these enemies is credited to him.

THE CANE BORER

The most serious enemy of cane is the borer *(Diatraea saccharalis)*. In some parts of the state this is a serious pest. Luckily it is not generally distributed, and many localities are free from it. It is very important for growers in such places to keep it out.

The borer is the caterpillar of a moth. The female moth lays her eggs on the foliage. The young caterpillars, hatching out, feed on the tender leaves for a few days, but soon enter the cane thru a bud or "eye", thereby reducing the stand of cane. They spend their entire larval life in the cane, tunnelling up and down, stunting its growth, weakening it so that the wind may blow it over, and making easy the entrance of fungus diseases. Control is difficult once the borer becomes established in a field.

REMEDY

Once introduced the best the grower can do is to reduce the numbers of hybernating larvae by burning the tops and rubbish,

cutting the canes low, and destroying shoots that start from the roots where cane is cut early. Plant in the fall from sound canes only. Rotation of crops must be practiced in infested fields.

THE ARMY WORM

Sugar cane is one of the favorite food plants of this caterpillar (also known as the Southern grass worm), which in some years occurs in destructive numbers. On cane it can readily be controlled by arsenic compounds. Use a spray of three pounds of lead arsenate paste or one pound of zinc arsenite powder to 50 gallons of water, or dust the plants with zinc arsenite powder, using air-slaked lime as a filler.

ROOT-KNOT

(Heterodera radicicola)

In some of the most important cane-growing sections of the state it has recently been found that much of the cane is seriously infested with root-knot. This is a well-known disease of many crops, and is caused by a small worm which bores into the roots to feed, stunting and finally killing the plant. Their roots are swollen in places, making soft fleshy galls which give the appearance of a knotted rope, hence the name. (Fig. 10.)

There is no known remedy that could be economically used on cane.

PREVENTION

Ordinarily the worms are carried from one field to another in dirt clinging to transplanted plants, to the feet of horses or men, or to farm tools. Land that has been in cultivation for several years is more likely to be infested than is new land, particularly if cotton, truck crops or cowpeas have been grown. Dry sandy soils are more likely to be infested than heavy clay or wet muck.

In planting a new field the roots of the seed cane should never be used, for if these roots should be infested the root-knot would surely be transplanted to the new field. The canes of even badly infested cane may safely be used for seed provided no dirt is carried with them. In using such cane it would be safer to cut it and carry it out of the infested field and have it bedded on land known to be free of root-knot.

Fields which have become heavily infested with the worms can be at least partially freed by planting them to some immune crop for two or three years. Among such immune or partly immune plants are: Most of the true grasses, including crabgrass, Bermuda, etc.; most of the varieties of corn; rye; oats;

in the pith. Slight attacks or beginning infections may be represented by a few red spots scattered along the pith. In more advanced stages the pith is marked by red streaks extending from one joint to another, or the entire pith between joints may be discolored or broken down.

In more advanced cases of the disease the exterior of the stalks will appear blackened at the joints and the buds become brown or black. However, the interior of the stalk is the place to look for infection, and if the lower joints of a suspected cane are split the presence or absence of the disease is readily detected.

CONTROL

In order to avoid red rot only healthy canes should be planted. Those showing the slightest discoloration of the interior should not be used. In sections where the disease is abundant, it will be advisable to obtain seed cane from some locality where the disease is not present.

Where the seed cane is bedded healthy stalks should be selected and carefully stripped of all foliage. Where infected stalks are introduced in the bed the disease spreads very rapidly and a few stalks may infect the entire bed. As an extra precaution the seed canes may be dipped in Bordeaux mixture before bedding to kill any spores that may have lodged on the surfaces of the stalks. The 4-4-50 Bordeaux will be sufficient for this purpose. Avoid the introduction of rubbish from canes into beds since this material may harbor the fungus.

ACKNOWLEDGMENT

Acknowledgment is due Dr. P. A. Yoder, Sugar Cane Technologist, Bureau Plant Industry, who gave valuable assistance in securing much information in this bulletin, also for furnishing photos for Fig. 1 and Fig. 8.

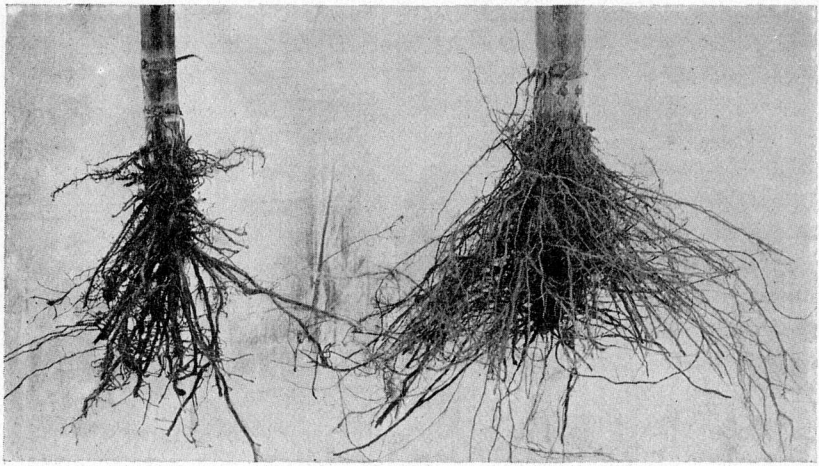

Fig. 10—Effect of Root-knot on Cane. Infested and Clean.

velvet beans; and beggar-weed. Iron and Brabham varieties of cowpeas are usually resistant. Peanuts, onions, parsnips, strawberries, and turnips are but slightly affected.

While growing a rotation of crops to free the land of nematodes, weeds that are subject to root-knot should not be allowed to grow. Some species of Amaranth or "careless weed" are especially susceptible.

SUGAR CANE DISEASE

Red rot *(colletotrichum falcatum)* is a fungus disease that causes a great deal of injury to the cane crop of Florida. It often cuts down the yield and is frequently responsible for poor stands. Prof. H. E. Stevens, plant pathologist of the Experiment Station, is credited with the following treatise of this disease.

RED ROT OF SUGAR CANE

If the seed cane is properly handled and necessary precautions are taken to prevent its introduction into new plantings, the disease can be kept in check. Little can be accomplished in the way of control after the disease appears on the growing cane. Success in controlling red rot is largely a matter of selecting and planting canes that are free from it.

APPEARANCE

The disease forms characteristic markings in the pith of the canes. If an infected cane is split, red spots or streaks appear