TEXAS AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 195 AUGUST, 1916

DIVISION OF AGRONOMY

JAPANESE SUGAR CANE AS A FORAGE CROP

POSTOFFICE:
COLLEGE STATION, BRAZOS COUNTY, TEXAS

AUSTIN, TEXAS
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BY

A. H. LEIDIGH, B. S.,
Agronomist,

IN CONSULTATION WITH

G. T. McNESS,
Superintendent, Substation No. 11, Nacogdoches, and

H. H. LAUDE, B. S.,
Superintendent, Substation No. 4, Beaumont

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*As of September 1, 1916.
**In cooperation with the United States Department of Agriculture.

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Japanese Sugar Cane as a Forage Crop.

BY

A. H. LEIDIGH,

Agronomist, Texas Agricultural Experiment Station, College Station, Texas,

IN CONSULTATION WITH

GEO. T. MCNESS, Superintendent, Substation No. 11, Nacogdoches, and H. H. LAUDE, Superintendent, Substation No. 4, Beaumont.

The Texas Agricultural Experiment Station has systematically undertaken to find good forage and hay crops for the State. The lack of these crops has been especially felt in the Gulf coast region.

This bulletin relates to Japanese sugar cane, an excellent forage plant. This crop has made yields of 25,000 to 50,000 pounds of green forage to the acre and is well adapted to both the climate and the soils of the Gulf coast region.

Japanese sugar cane was introduced into the United States about 1878 and was tested as a sugar and syrup crop by the Louisiana Experiment Station for a number of years. It is very leafy and somewhat difficult to crush, unless a heavy mill is used. It has not been as well liked for its sugar and syrup producing qualities as are the larger stalker sugar canes. From the Louisiana Experiment Station it has slowly gotten into the farmers' hands. The crop has been successfully grown for forage in Florida for some years, and has been grown in a small way at a few points in Texas, but public attention has never been centered on it.

This Station began testing Japanese sugar cane on the substations in 1912.* It proved to be a success on the Gulf coast. To test the

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*In November, 1911, the Texas Agricultural Experiment Station obtained a small quantity of seed canes of the Japanese sugar cane from Professor S. M. Tracy, Special Agent, Bureau of Plant Industry, United States Department of Agriculture, Biloxi, Mississippi. This seed cane was sent to the substations.

The original planting at Substation No. 4, Beaumont, having been successful, additional seed canes were secured from the Griffing Nursery Company, Port Arthur, Texas, and one and one-half acres were planted in 1913 on that station for feed and for the production of seed cane for distribution. The yield was probably in excess of twenty-five tons to the acre. From this crop seed canes were distributed to nearby farmers, and additional seed canes were sent to several of the other substations.

In 1914 the crop from the stubble of the 1913 planting was seriously retarded by reason of wet weather, there being twenty-two inches of rainfall in May alone. The entire field made a yield of 47,507 pounds to the acre, and part of this field yielded at the rate of 49,375 pounds to the acre. Definite experiments with the crop were started in the spring of 1914, and the results are mentioned elsewhere in this bulletin. From the 1913 and 1914 crops seed canes

Figure 1. A Dense Stand of Japanese Sugar Cane.
Substation No. 4, Beaumont, Texas.

crop in other regions and places, plantings were made throughout the State, about seventy-five lots of seed canes being sent out from Substation No. 4, Beaumont, Texas. Of these, one-half have been reported as successful. Nearly all failures have been due to dry weather. The crop was not successful without irrigation in Southwest Texas, and it was not satisfactory in the north central part of the State.

PARTS OF TEXAS WHERE THE CROP WILL PROVE OF VALUE.

As a result of the tests made thus far, the accompanying map is presented, which will show where the crop is a success at this time. (Figure 2.)

The map shows the State divided into three districts.

District No. 1 includes all of the central and eastern Gulf coast region north and east of Aransas Pass and Victoria. In this district Japanese sugar cane has been a very successful crop. It has given satisfaction both as a drouth resistant crop and because it is very little injured by floods. In this part of Texas it is urged that every farmer grow a Japanese sugar cane field, even if it is only one acre. One acre of Japanese sugar cane should provide more cane than two mules, one cow and a hog could eat during the winter months, if a little cottonseed meal or peanut or peavine hay is also fed. There is no other crop of which we can say the same.

District No. 2 includes that part of the State between a line drawn through Texarkana, San Antonio and Kingsville, for the western boundary, and District No. 1, previously described. In this district Japanese sugar cane has made satisfactory yields in our experiments, but there have been a number of failures. It is thought that it will be a very profitable crop to grow on rich bottom land and on low, wet lands.

District No. 3 includes all of the western and northwestern parts of Texas. In this district Japanese sugar cane has not given satisfactory yields in our experiments, but it may yet be found to be adapted to irrigation in the southern part of this district.

Japanese sugar cane has been tested on eight of the substation farms. These tests were made by planting one or two rows the first year, and thereafter increasing the area as rapidly as possible. The crop has been so successful that now it is being grown on Substations Nos. 1, 2, 3, 4, 5, 6, 10, 11 and the Main Station.

That there is a great difference in the producing power of the crop in the three districts outlined in the map, is shown by the yields made in 1915 at the different substations. These are as follows for the new

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were sent to some of the other substations, and several tons were placed with farmers throughout Southern Texas.

The 1915 crop, both with farmers and at the substations, was very satisfactory in all locations near the Gulf coast. It was not successful in some other parts of the State.

Seed canes of Japanese sugar cane have been distributed for two years among farmers in Jefferson and Orange counties. In nearly every case this crop has been successful.

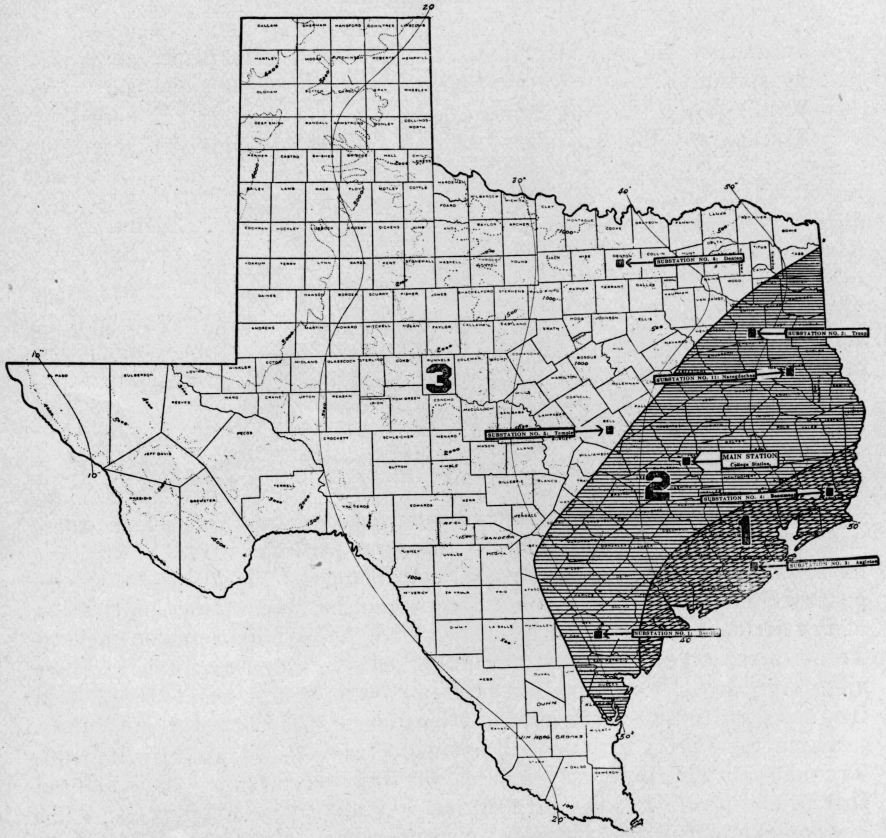

Figure 2. Map of Texas showing districts wherein Japanese Sugar Cane has been grown, and the location of seven of the twelve sub-experiment stations.

District No. 1. Where the crop is very successful.
District No. 2. Where the crop has made some satisfactory yields and some failures.
District No. 3. Where the crop has not given satisfactory yields. It may probably give satisfaction in the southern part of this district when irrigated.

planting of 1915, giving the one best yield of green forage at each place for the one year:

District No. 1—

Substation No. 3, Angleton	25,080	pounds per acre.
Substation No. 4, Beaumont	37,220	pounds per acre.
Average for the district	31,150	pounds per acre.

District No. 2—

*Substation No. 1, Beeville	6,600	pounds per acre.
Substation No. 2, Troup	13,300	pounds per acre.
Substation No. 11, Nacogdoches	12,450	pounds per acre.
Main Station, College Station	25,814	pounds per acre.
Average for the district	12,041	pounds per acre.

District No. 3—

Substation No. 5, Temple	Failure.
Substation No. 6, Denton	Failure.
Average for the district	———

The data from the plantings made with farmers are not so reliable as are those shown above. The area to which the crop is adapted is well shown by the yields quoted, and the various yields have been the basis on which the map, Figure 2, is drawn.

DESCRIPTION.

Japanese sugar cane (*Saccharum officinarum*) is a true sugar cane; it does not make seed except in a very warm country, where it may live for fourteen or fifteen minths without being set back by frost. As pointed out previously, Japanese sugar cane has been under cultivation in this country for over thirty years. Seed of various well known varieties of sorghum is sometimes offered as seed of "Japanese Cane." These are simply sweet sorghums or sorgos and are not to be confused with the true Japanese sugar cane. Attention is called to the misnamed sorghum varieties, and it is to be remembered that these seed producing sorghums are not Japanese sugar cane. Japanese sugar cane is planted only in the form of canes, or cuttings, like any other sugar cane.

The Japanese sugar cane is a perennial, coarse, grass-like plant, which grows to a height of from seven to twelve feet, and resembles the green, red and ribbon types of sugar cane, except that the stalks are smaller in diameter and the leaves are more plentiful. The stalk is from one-fourth inch to one inch in diameter, bears at each node, on alternate sides, a pointed bud or eye, and is very shallowly grooved above the bud. The stalk is green in color, which appears dark in splotches where dirt and dust are held because of its resinous nature. The leaves are abun-

*Japanese sugar cane was first planted at Beeville in 1912. The 1915 yield of only 6,600 pounds was from a new field of 6-11 of an acre, planted in 1915. This low yield is due to excessively dry weather, there being only 8.38 inches of rainfall at that place during the entire growing season.

dant, long, narrow, tightly held and droop at the tips. Each internode contains on its surface a number of almost transparent dots, which mark the dormant rudiments of adventitious roots. The joints are rather short. It stools or suckers much more freely than do the other varieties of sugar cane, single plants having as many as seventy-five stalks. In Texas, if the crop is not harvested, the above-ground growth is killed by freezes. The part of the stalk which is in the ground, if protected from frost and disease, will remain alive over winter and start growth again next year and may even be moved to a new location. This growth from the stubble comes from the buds or seed eyes at the base of the

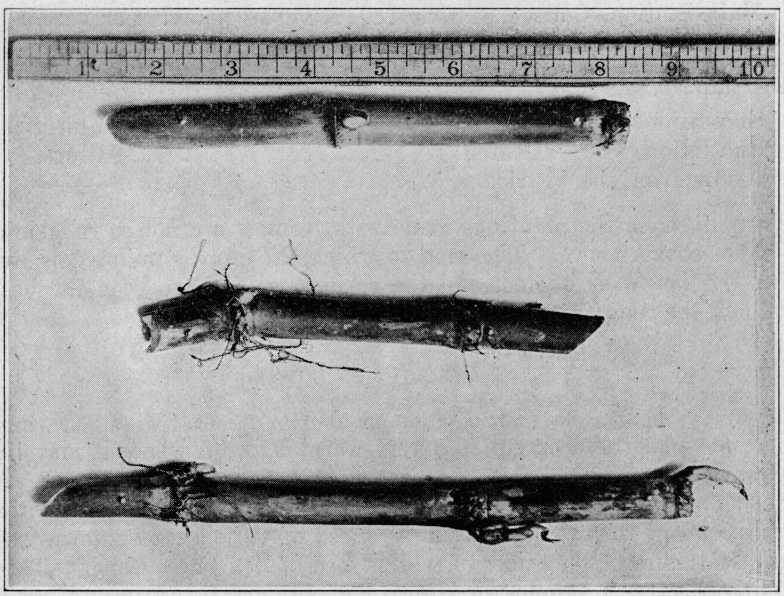

Figure 3. Parts of the Stalk of Japanese Sugar Cane Showing Buds and New Roots.

old stalks, which are very similar to the eyes of Irish potatoes but shaped differently. (Figure 3.) By exercising a little care the stubble may be kept alive in Southern and Central Texas from year to year, and this means is depended upon by farmers for the maintenance of a field after it is planted. Usually the stubble is not used for new plantings of this cane. The common method is to plant all or part of the stalk itself. When so used the stalk is called a seed cane. Growth from the seed cane starts from the buds. Soon after the buds begin to grow, roots are sent out from the joints and each joint having a growing bud then forms a new plant.

HARDINESS.

Japanese sugar cane is very hardy. It is not greatly injured by floods or poor soil drainage. On the Gulf coast one of the serious

features about the growing of common field crops, such as cotton and corn, is that there necessarily are periods of wet weather, during which the fields become water-logged and the crops suffer severely.

In 1915 the Japanese sugar cane on Substation No. 3, Angleton, was under flood water at two periods. The first flood was from May 5 to May 11, a total of five days. This flood necessitated the replanting of all ordinary crops. Japanese sugar cane did not have to be replanted. The newly planted cane was just coming up and the sprouts that had not emerged from the ground were killed but those already up were uninjured. The stubble crop of the 1914 planting was well up and none of it was killed by the flood.

Substation No. 3 was again flooded for five days in August as it was in almost the very center of the Gulf storm of August 16, 1915. The Japanese sugar cane was four to five feet high at the time, cotton was fruiting well, and corn was nearly mature. All crops except the cane were destroyed by the storm and the flood which followed. This Japanese sugar cane on the farm, where there had been two five-day floods in the one season, yielded green succulent forage as follows:

Stubble crop, second year	28,456	pounds to the acre.
Five-inch plowing, first year	12,980	pounds to the acre.
Twelve-inch plowing, first year	25,080	pounds to the acre.
Thin seeding, first year	8,260	pounds to the acre.
Medium thick seeding, first year	12,980	pounds to the acre.
Thick seeding, first year	17,160	pounds to the acre.

These results show an unquestioned ability to yield well under adverse conditions. Japanese sugar cane will grow on damp, undrained soils, and resists floods and poor drainage better than almost any other crop now known.

Another type of hardiness possessed by Japanese sugar cane is its resistance to frost. The plant when growing, and also the stubble and the ripe canes, will resist cold better than the other varieties of sugar cane. This adds to its value, as it is thus suitable for planting somewhat farther north than the other varieties, and is an important characteristic for either the syrup maker or the stock farmer.

USES.

Japanese sugar cane is most valuable at this time because of its succulent forage, heavy yields, and ease of storage. It may be used as a fresh green feed, as a dry forage crop, or for ensilage or pasture. It may also be used for syrup.

The chief advantage of Japanese sugar cane is that it is a succulent feed. Like fresh pasture grass or silage, most of the plant is soft and contains a large proportion of water. When a well chosen ration, which contains a fair amount of succulent roughage, is fed, the animals will thrive better than when an equal amount of food value is used in a hard, dry state. Green succulent foods lessen the amount of feed needed and thereby cheapen the ration, but they also result in more

rapid growth or fattening and promote a healthy condition of the animals. Succulent feed is most needed in the winter, since pasture furnishes our summer succulence. To these advantages of a succulent food are the added facts that Japanese sugar cane may be harvested with little risk of weather damage, wetting, molding and shattering, which cause great loss to the dry roughage raised in the area to which Japanese sugar cane is adapted. It is a fact that ensilage crops also have all of these advantages, but on the Gulf coast Japanese sugar cane may be produced at a less cost per ton than are such ensilage crops as sorghum and corn. This is because of its being a perennial, its resistance to poor drainage and drouth, and its heavy yields.

Japanese sugar cane may be fed directly from the field during the fall and from the shock or stack during the winter. The expense of maintaining a silo and the labor and expense of filling and emptying the silo may be thus avoided. The crop may be put into the silo, but as it retains its succulence when stacked, the production of silage is not altogether necessary. But as the silo will hold the crop almost indefinitely without loss of leaves, its use is urged. The small farmer who desires to use Japanese sugar cane for feed for work stock can keep the feed even for summer use without a silo. But when stacked out of doors for several months, very little value is secured from the leaves. On Substation No. 4, Beaumont, cane was kept in the field in piles through the spring and summer of 1914, being regularly fed to work stock with very satisfactory results, and only a little of the cane spoiled.

Feeding Value.—Japanese sugar cane is similar to green fodder from corn or from sorghum in its feeding value. Anyone feeding the crop will find it an excellent substitute for hay, ensilage, pasture, and so forth, and also a partial substitute for molasses and such grain as corn or the grain sorghums.

The chemical analyses of several samples of the crop are as follows:

JAPANESE SUGAR CANE ANALYSES.*

No.	Material from Substation No. 3, Angleton.	Protein per cent	Fat per cent	Crude Fiber per cent	N.-Free Extract per cent	Water per cent	Ash per cent
9522	Whole plant, except roots....	.91	.49	8.12	17.01	72.01	1.46
9526	Leaves and sheaths.....	2.53	.97	15.34	20.17	57.16	3.83
9525	Stalks only.....	.50	.20	6.01	13.89	78.62	.78
	From Substation No. 4, Beaumont.						
9474	Whole plant, except roots....	.73	.39	8.30	16.13	73.27	1.18
9473	Leaves only.....	2.29	1.22	20.18	25.10	46.37	4.83
9472	Stalks only.....	.67	.25	6.14	14.13	78.07	.74

The above table shows that the green Japanese sugar cane plant contains approximately as much water as does silage or green fodder. It is rich in starches and sugars and is lacking in protein. For con-

*Unpublished data, Division of Chemistry, Texas Agricultural Experiment Station.

venience in comparing it with other well known crops the following table has been prepared:

CHEMICAL ANALYSES OF JAPANESE SUGAR CANE AND OTHER CROPS. WATER-FREE BASIS.

Crop.	Protein per cent	Fat per cent	Crude Fiber per cent	N.-Free Extract per cent	Ash per cent
Green Japanese Sugar Cane. No. 9474.....	2.73	1.46	31.05	60.34	4.41
Green Japanese Sugar Cane from Angleton. No. 9522.....	3.25	1.75	29.01	60.78	5.21
Green Sorghum. Texas Exp. Sta. Bul. 13...	6.18	3.85	29.13	54.12	6.72
Sorghum Hay. Texas Exp. Sta. Bul. 172...	9.95	3.73	26.68	50.00	9.64
Johnson Grass Hay. Texas Exp. Sta. Bul. 172	7.99	2.10	33.22	48.79	7.90
Sudan Grass Hay. Texas Exp. Sta. Bul. 172..	12.42	1.93	29.93	45.56	10.16

The latter table makes it very evident that the percentage composition of Japanese sugar cane causes it to appear very low in feeding value. But the crop is rich in sugars, is cheaply produced, and is succulent. These features are so strongly in its favor that its lack of protein is of little consequence and can be easily made up. It may be balanced by feeding with cottonseed meal, peanut hay, or some other feed rich in protein.

These peculiarities in the chemical make-up of the plant would be of great importance in any expensively raised or low-yielding forage, but since the crop is cheaply and easily raised, and is a very heavy producer, its yields and suitability to the region must outweigh its lack of protein. And, as already pointed out, the ration may be balanced with readily available feeds.

This Station has not carried out a feeding experiment with Japanese sugar cane. The Florida Agricultural Experiment Station has conducted such tests, and has found that Japanese sugar cane as silage, as a green forage, or as cured fodder, may be fed in about the same manner as we feed sorghum or corn silage.* Fattening steers may receive a cane and cottonseed meal ration, but it probably would be best to include some grain. A ration for fattening steers may contain twenty or more pounds of Japanese sugar cane; four to six pounds of cottonseed meal and twelve to sixteen pounds of corn, or twelve to twenty pounds of milo or feterita. A dairy cow may receive twenty to thirty-five pounds of cane a day. Work horses or mules on medium work may receive ten to twenty pounds of cane per head per day.

The stalks of Japanese sugar cane are easily eaten by live stock; however, any feed of this kind is used best if it is chopped. To prepare Japanese sugar cane for feeding the cattle or work stock it may be run through a cutter which cuts it into small pieces, or chopped into four to six-inch lengths with a knife. A cheap cutter operated by hand and having a capacity of 250 to 400 pounds an hour may be used if desired; however, it is not very difficult to cut up by hand

*Florida Agricultural Experiment Station Bulletins No. 105, 129; Press Bulletin No. 242.

enough cane to feed a few head of stock. For large farms a power cutter is suggested.

Syrup.—As a syrup crop the Japanese sugar cane has some possibilities. Where the heavier stalked and better known varieties of sugar cane will grow well they should be given preference. Japanese sugar cane, however, is more hardy than the other varieties, and, as previously pointed out, will grow better in the central part of the State. It gives very satisfactory yields of syrup. The stalks are smaller and somewhat tougher than are those of the other varieties. In every other respect it resembles the other varieties, and the syrup is made by the ordinary process.

At Substation No. 11, Nacogdoches, a syrup test was made in 1914. Owing to late planting and the effects of drouth, the acre yield of canes was very light that year, and that used for syrup yielded only 7.75 tons to the acre on poor upland. This crop, however, produced a very rich juice, nine gallons of juice making one gallon of syrup; whereas, eleven gallons of ribbon cane juice were required for one gallon of syrup.

GROWING THE CROP.

Soil.—The Japanese sugar cane plant is as well suited to our coastal plains soils as is almost any other crop we may grow. Well drained loamy clays and sandy loams will doubtless produce the largest crops of cane. It seems probable that both drouth and lack of drainage will be as important for consideration in raising this crop as is lack of fertility. The plant requires a great deal of moisture and must have a fair amount of soil above the water-table of the field so that its roots may develop properly.

In South and Southeast Texas any good agricultural soil that is well drained is suitable for Japanese sugar cane, if the crop is reasonably well attended. Our experiments indicate that this crop can stand a greater lack of drainage than most crops. Even where drainage is so poor as to seriously retard cotton or corn this crop grows comparatively well.

Soil Preparation.—The production of Japanese sugar cane does not differ materially from that of the other sugar canes. Deep fall plowing, crop rotation, and fertilizing will all be needed to supply to the plant enough food to equal the full value of the climate and allow the production of the large crops one may properly expect.

The field, when being prepared for planting to Japanese sugar cane, should be plowed as soon as the previous crop can be removed. If at all practicable, the field should be thus prepared by November 1. Plowing for this crop should be as deep as possible. This is important. As the crop will probably be left on the field for three or more years, the expense of excellent and thorough advance preparation will be justified.

In South and Southwestern Texas the plowing, harrowing, and planting had best be followed immediately by more harrowing, and at once

putting the field into shape to retain its moisture. As soon as spring approaches, the surface soil should be well worked to a depth of three to five inches, and from then on every attention should be paid to the conservation of moisture, the killing of weeds, and the aeration of the soil.

In Southeast Texas harrowing, disking and other kinds of surface tillage are not so necessary in the fall, as the rough field will absorb moisture well and the soils in that region are usually such that fall plowing causes them to settle together closely.

Surface tillage, before as well as after the crop starts into growth, is an important step in the preparation of soluble plant food for the crop. In fact, the maintenance of a soil mulch is as important as a means of preparing food as it is from a moisture-conservation standpoint. Tillage, therefore, is very necessary, whether weeds are present or not.

The above described methods of plowing for the crop are well brought out by experiments at Angleton and Beaumont. At Substation No. 3, Angleton, a seedbed preparation experiment with Japanese sugar cane was started in 1915. This consisted of plowing five inches and twelve inches deep as a preparation for plainting. The data for the season are as follows:

DEPTH OF PLOWING EXPERIMENT SUBSTATION NO. 3.

Depth of Plowing. Inches.	Yield in Pounds to the Acre.	Gain in Favor of Deep Plowing. Pounds to the Acre.
5	12,980	
12	25,080	12,100

At Substation No. 4, Beaumont, a seedbed preparation experiment with Japanese sugar cane was started in 1915. This consisted of plowing six inches and fourteen inches deep as a preparation for planting. Although the land was plowed late in the spring, a gain resulted from the deeper plowing. The data for the season are as follows:

DEPTH OF PLOWING EXPERIMENT.

Depth of Plowing. Inches.	Yield in Pounds to the Acre.	Gain in Favor of Deep Plowing. Pounds to the Acre.
6	32,597	
14	37,237	4,620

The following figures are secured by averaging the results from the above two experiments:

DEPTH OF PLOWING EXPERIMENT

Description.	Depth of plowing. Inches.	Yield in Pounds to the Acre.		
		Angleton 1915	Beaumont 1915	Average of of two stations.
Medium	5	12,980	.....	.....
Medium	6	.....	32,597	.....
Medium	5 to 6	.....	.....	22,788
Deep	12	25,080	.....	.....
Deep	14	.....	37,237	.....
Deep	12 to 14	.....	.....	31,158
Gain in favor of deep plowing	.....	12,100	4,620	8,370

These plantings will be retained for stubble crops. As the figures given above are from the first year's planting, it is expected that further results will be available as the experiment is continued.

Planting and How to Plant.—In Southern Texas the seed canes of Japanese sugar cane may be cut in November and planted at once. In other parts of the State better stands may be obtained from spring planting. Whether the seed canes are planted in the fall or in the spring, the selection and care of the seed, and the field work of planting, are practically the same. (See Selection and Storage of Seed Canes, page 26.)

To get the best results, 3000 to 3500 seed canes should be planted to the acre, although only 500 or 600 seed canes may be planted. These 3000 to 3500 canes will weigh approximately from one and one-half to two tons. Good, sound seed canes are worth about ten dollars a ton at this time.

The seed canes should be sorted carefully before being taken to the field where they are to be planted; this sorting should not be done at the new field, and all canes which are thrown out should be burned, as they frequently contain insects or disease.

Low, heavy, poorly drained fields must be bedded up for this crop. High, well drained locations may be farmed flat. The rows are laid off five to eight feet apart and furrowed out six inches deep; the bed should be split where single row beds are used, and the seed canes planted in this furrow. It is important to plant thick, and thereby secure a good, heavy stand. The seed canes may be cut into lengths of two or three feet each, and should be made to lap one-half one on another, so as to make a double line of canes in the row. Cutting into short lengths is done to check rot and similar troubles. When the seed canes are cut into short lengths they will lie in the row better and are easier to cover. The canes are covered with about five or six inches of soil. The plow is usually used for covering, but a disk cultivator is probably a more satisfactory tool. If covered too deeply in a cold, damp soil, the plants may be slow in starting and the resulting stand may be poor. After covering the seed canes, the field will be almost level, with possibly a slight depression between the rows on bedded fields. In February or March two or three inches of the soil

over the row should be dragged off when harrowing before the crop comes up.

Experiments showing the influence of rate of planting on yield are as follows:

At Substation No. 4, Beaumont, a rate of planting experiment was conducted in 1914 and 1915. The same rates were also used in 1915 at Substation No. 3, Angleton, and Substation No. 11, Nacogdoches. Three rates of planting were used, all the rows being of the same width. The rates of planting are designated as thin, medium thick, and thick. These different rates were secured as follows:

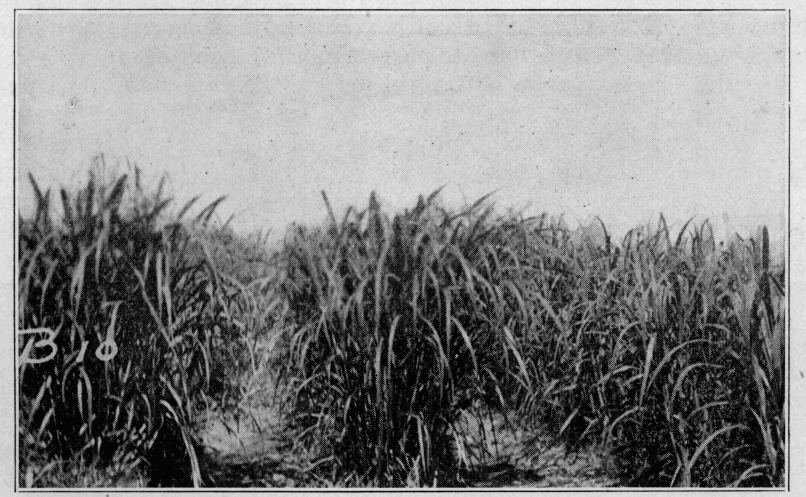

Figure 4. Japanese Sugar Cane, Six Feet High, August, 1914. Planted in 1913. Substation No. 4, Beaumont, Texas. This Cane Yielded 23.75 Tons of Green Forage to the Acre in 1914.

Thin: Canes were cut into pieces, each piece containing two good buds. One piece was planted every two feet; 500 to 800 pounds of seed canes being used to the acre.

Medium thick: The canes were laid in a single continuous line in the row. Where the buds were not good the ends of the canes were overlapped so that the live buds were four to six inches apart; 1500 to 2000 pounds of seed canes were planted to the acre.

Thick: The canes were laid in a double line in the row, the canes in each line overlapping as in medium thick planting. These canes were arranged so the ends of the canes in one line were not opposite the ends of the other line; 3000 to 4000 pounds of seed canes were planted to the acre.

The results from the three experiments are as follows:

RATE OF PLANTING EXPERIMENTS. SUBSTATIONS NO. 3, 4 AND 11.

Rate of Planting.	Yield in Pounds to the Acre.					Average for 1915 from three stations.
	Beaumont Planting of 1914.			Angleton, Nacogdoches Planting of 1915		
	1914	1915	Average for two years.	1915	1915	
Thin	19,226	14,476	16,851	8,260	5,375	9,370
Medium thick	27,689	19,641	23,664	12,980	12,450	15,023
Thick	36,524	21,619	29,071	17,160	11,805	19,345

While the final average shown above is from unlike fields, since the Beaumont field was in its second year, it seems more reasonable not to use the 1914 figures from that substation for comparison.

It will be noted that at both Angleton and Beaumont the thick rate of planting in the first season practically doubled the yield of the thin rate. This was also true at Nacogdoches, where, however, the medium thick rate of planting made a larger yield than either of the others.

The grower who, from a small supply of seed canes, desires to raise his own seed for a large acreage should plant his seed canes wide apart the first year. He may, by planting two jointts with good buds, every two feet in the row, probably secure a fairly uniform but thin stand that will give a very large return for the small amount of seed used. When so planted the yield to the acre will be one-third to one-half that of thickly planted cane, but the yield from a given amount of seed cane will be about four times as great from thin planting as from thick planting.

Cultivation.—As soon as growth starts, cultivation is needed. The harrow for the early cultivation may be used on the beds or between the rows, if care is exercised. The field should be cultivated in about the same manner as for cotton or corn. A good, clean, rather deep soil mulch should be kept on the field until the crop thoroughly shades the ground. As the season progresses, the row may be ridged up a few inches in cultivating. This will aid in preventing lodging of the crop during fall storms. Early in the season the young plants live mostly on the food in the seed cane, therefore rather close cultivation will not harm them greatly. Later in the season cultivation should not be deeper than that given earlier. The plant makes a strong growth of fine roots near the surface, and it is therefore necessary that root pruning be carefully avoided. This is best done by starting cultivation at a good depth early in the season as the roots will then grow below the mulch. A long wet spell, during which cultivation is impossible, will bring the roots to the surface. When cultivation is resumed after a wet spell it is important that it be shallow.

The Japanese sugar cane crop is a heavy yielder and uses a great deal of plant food. This Station has not made definite fertilizer experiments with Japanese sugar cane. It seems evident, however, that rather heavy applications of fertilizer would be a paying practice.

Fertilizers suitable for the crop are any of the following: Cottonseed meal, nitrate of soda, acid phosphate, and mixed fertilizers containing nitrogen and phosphorus. As the crop grows very slowly in the spring, not all the fertilizer should be applied at planting time. The remainder may be drilled with a distributor at any time previous to midsummer.

In Southwest Texas, Japanese sugar cane under irrigation has great possibilities as a forage crop. When irrigated a very moderate amount of water will be needed in the spring, but more liberal applications will be required late in the summer and fall.

As a drouth resistant this plant ranks high. It cannot make large yields, however, without water at the later stages of its growth. At College Station, Texas, in 1915, it successfully withstood a long midsummer drouth. At Substation No. 1, Beeville, the 1915 crop of 6600 pounds to the acre, with only 8.38 inches of rainfall, was an excellent

Figure 5. Japanese Sugar Cane as a Dry-Land Crop. Nine Feet High, September, 1914. Planted in 1912. Substation No. 1, Beeville, Texas.

yield, considering the severity of the local drouth, and shows the value of the crop in the Southwestern part of the district to which it is adapted.

Harvesting.—As a green crop to be fed fresh from the field Japanese sugar cane is ready to use as soon as it begins to sweeten, which is usually in August. For storage, however, the crop must not be harvested early. The completion of the growing season is late in the fall. The most valuable food in the plant is sugar, and the plant does not cease to make sugar at the time it stops rapid growth; therefore the harvest of the main crop must wait for maturity, which is usually in November instead of for mere completion of growth. Harvesting, however, must not be delayed until danger of heavy frost or bad winter weather approaches. The crop is harvested with hand knives, machetes, or heavy hoes. (Figures 6 and 7.) When Japanese sugar cane is

Figure 6. Cutting Japanese Sugar Cane with a Cane Knife. Substation No. 4, Beaumont, Texas.

Figure 7. Cutting Japanese Sugar Cane with a Hoe. Substation No. 11, Nacogdoches, Texas.

to be grown on the land the following year it is necessary in harvesting to cut the canes off near the ground, as fermentation and disease are easily started in long stubble; but care should be taken not to chop into the ground, as splitting the canes below the ground may kill the stubble or injure the buds.

As a succulent rough forage the Japanese sugar cane crop is most valuable. It keeps best when slightly damp. The common method of storage is either to pile the cane on the ground, or else to place it in shocks. As soon as the leaves are well wilted the crop may be stacked in long, flat ricks, the width being nearly equal to twice the length of the stalk. When stacked in ricks the stack should be rounded up with old hay, cane leaves, or straw. A good method of storage for a damp climate is to place the crop in the barn, hay shed, or under some sort of cover. Warm spring weather has caused Japanese sugar cane to sprout in the barn loft on Substation No. 4, Beaumont. When this sprouting took place the canes stacked in the field were keeping well.

When Japanese sugar cane is desired for winter feed, it is not necessary to keep the crop damp. If it is desired for feed after warm weather comes on, small, low, flat-topped stacks or ricks will be found to keep the crop best. On Substation No. 4 cane was thus kept at no expense throughout all of the spring and summer of 1914. It will be seen that protection from frost and not allowing the crop to dry out are the principal points that should receive attention in storing the crop.

The Japanese sugar cane crop may be used for ensilage. The stalk is so full of juices that some difficulty may be experienced in certain types of blowers, because the leaves may stick in the blower. Silage made from the cane keeps well, and is relished by stock. Because of its large yields the expense of production of ensilage is very small.

Japanese sugar cane may be pastured with considerable success when the winters are dry and warm. Light freezing will kill the leaves and buds, but the stalk itself will not be injured unless the temperature goes down to about 26 degrees Fahrenheit. Pasturing may begin when the crop is practically mature and is probably possible from October to December. When velvet beans are planted with the cane, the expense of harvesting the mixed crop will be large, unless it is pastured off.

Care of Old Cane Fields and Rotation.—As Japanese sugar cane is perennial, it is advisable to leave the crop in the same field for three or more seasons. The fact that the stubs of the plant usually will remain alive over winter should not lead the farmer to neglect the field. After harvest, three methods of handling the field may be followed: (1) It may be left to care for itself; (2) a light furrow may be thrown from each side of the row upon the plants; (3) a furrow may be plowed alongside the row and the stubs turned upside down into this furrow and then covered with earth. If a furrow is turned upon the row, the dirt may be removed before growth starts in the spring. Whatever method is used, care should be taken not to cause winter killing. When spring growth starts in the stubble, cultivation is needed and should commence.

There has not yet been sufficient opportunity for ascertaining definitely whether the yields of Japanese sugar cane will be maintained from year to year on the same field. The following data, however, are derived from experiments covering two years:

COMPARISON OF FIRST AND SECOND YEAR CROPS OF JAPANESE SUGAR CANE. SUBSTATIONS NO. 3, 4 AND 11.

	Yield in Pounds to the Acre.		Decrease.
	1914	1915	
Angleton	38,016	28,456	9,560
Beaumont	36,524	21,619	14,903
Nacogdoches	15,504	11,190	3,314

The figures above confirm those of the Florida Experiment Station* in showing that the yields from a field of Japanese sugar cane are usually greatest the first or second season. Thereafter the yields may decrease and may ultimately amount to only 20 per cent. of former crops. Plowing the middles in the winter, good cultivation, manuring, and the use of commercial fertilizers, will aid in keeping up the producing power of the field, but even the best of care does not seem to prevent a falling off in yields. The stand will be found to become irregular; in places it will be thin and in other places there will be entirely too heavy a stand. Where the stand is too heavy the row may be narrowed by plowing out part of it. Replanting to thicken up a stand does not seem to be a success. In general, the decreasing yield of old fields of cane is probably a manifestation of the same thing which we find when other crops are grown continuously on the same field. The field needs more intensive culture, a change of crops, or the benefit of a systematic rotation. At the Florida Experiment Station an old, low yielding field of this cane was plowed up and then planted again in the same crop with the result that the yields were increased.*

Planting a field back to the same crop that has been grown there for several years is poor farm management. A change to some other crop is better farm practice. If a change of crops is planned, a leguminous crop, such as cowpeas, clover or velvet beans, will benefit the soil and do much to get the field into good condition for the production of large yields of any of the farm crops, such as cotton, corn, and rice. Then after a few years cane might be again planted on it.

As Japanese sugar cane yields have decreased from year to year, it will be seen that a little new land must be planted in cane each season, if the farmer is to have a uniform supply of this feed. Likewise, a little of the oldest stubble may be plowed up each year and the land devoted to other crops. It is advised that about one-fifth of the field be plowed up each year, and an equal amount of new planting made.

Velvet beans make a very good crop in parts of Southeastern Texas.

*Florida Experiment Station Bulletin No. 129.

Japanese sugar cane and velvet beans will grow on the same land at the same time. The velvet bean crop will contain nutriment lacking in the cane, and, therefore, the combination crop will more nearly approach a balanced ration for livestock. It will be possible to plant velvet beans on old Japanese sugar cane stubble and secure a mixed crop, which may be pastured off.

Our experiments at Substation No. 4, Beaumont, with this mixed crop have not been very encouraging. The cane shaded the velvet beans and they were not able to keep ahead of the cane. Likewise, where the velvet beans made an extremely rapid growth, they smothered the cane.

Wherever the cane grew well the velvet beans made very little growth, and where the stand of cane was thin the velvet beans grew up and over it, keeping it from stooling, and dwarfing it. The first light frost killed the velvet beans, but did not hurt the Japanese sugar cane.

In the rice districts very little use is made of much of the abandoned rice land. This is especially true in the southeastern section of the State. Such fields may be plowed in the winter and made to produce excellent crops of Japanese sugar cane. If the rice land is exceptionally poorly drained, it will be necessary to plow it in narrow lands, each of the lands being the width of a cane row. After a few years in Japanese sugar cane, such a field may be made ready for other crops or again used for rice. Since the usual practice makes it difficult to grow ordinary farm crops following rice, it will be seen that this crop is of great value for such localities.

To test the value of Japanese sugar cane as a crop to follow rice, at Substation No. 4, Beaumont, in 1915, one-half acre of cane was planted on land which had been cropped in rice in 1914. This land was disked March 20 and plowed three inches deep on March 26, deeper plowing being impossible because of the wet condition of the soil. Planting was made on April 19 and 20. In many ways the experiment was planned so that it would represent what a rice farmer would do in making a late spring planting on poorly conditioned rice stubble. The field was irrigated August 10, but heavy rains set in six days later; so it is doubtful if this irrigation is of great moment. The crop was harvested on November 16. The yield was at the rate of 25,837 pounds of green crop to the acre whereas much better prepared land on the same farm yielded 29 bushels of corn.

The results show the wonderful suitability of the crop for such conditions, and, as the crop is a perennial, fair yields are expected for some years to come.

An important point for the farmer to consider is that Japanese sugar cane as a crop will scarcely interfere with the work of producing other crops. Most of the work it demands will be needed late in the fall and early in the spring. Only in the matter of cultivating will its production interfere with other farm operations. The way in which the cane works into the general cropping system of the region will make it a very welcome addition to the list of crops we may grow.

COST OF PRODUCTION.

On Substation No. 4, Beaumont, sufficiently large fields of Japanese sugar cane have been grown to afford reliable figures as to the cost of production. Omitting charges incident to experiment operations, such as those concerned in collecting weights, and so forth, the figures are as follows:

Newly planted cane yielding at the rate of fourteen tons to the acre was produced and harvested at a cost of $3.10 a ton for man and team work.

Stubble cane yielding at the rate of twenty-three tons to the acre was produced and harvested at a cost of $1.25 a ton for man and team work. When put on a comparative basis of twenty-three tons to the acre for each of these crops this gives us a cost of $2.22 per ton for first year cane and $1.25 per ton for second year cane.

These figures do not include cost of seed, land rental, or interest on the investment, or charges for use of plows, cultivators, hoes, or cane knives, and they do not include taxes. It is evident, however, that the crop may be produced very cheaply once one has a supply of seed of his own.

SELECTION AND STORAGE OF SEED CANES.

There is some variation in the maturity, vigor, vitality, and production capacity of different Japanese sugar cane plants, and there is also danger of disease and insects being in the seed canes. For these reasons the seed canes should be carefully selected in the fall and either planted or stored where no damage will result. While the feeding value of the cane is not injured by light freezing, the buds are easily injured by frost. For this reason the seed canes should be cut earlier than the feed crop. A seed cane should be selected for a good height, well developed and mature buds, and for joints of medium length. Size, leafiness, healthfulness and development of plant should also be borne in mind in cutting the seed canes. The leaves and the tip of the stalk should not be removed when selecting seed.

As previously stated, 3000 to 3500 seed canes will be needed for each acre to be planted. This number is not sufficient to allow for loss over winter. The loss from various causes is from 10 to 50 per cent.

In that part of the State where the crop is of most value much of the planting may be done in the fall. One of the chief dangers from planting in the fall is that there may be a dry winter and many canes will die because of drying out. Fall planting should be done whenever possible. Some cane, however, will doubtless always be spring planted.

In keeping seed over winter, the most important points to be provided for are: Protection from frost, drainage so as to prevent the collection of water about the canes, and keeping the canes moist. The storing of canes for preservation over winter is known as banking, or bedding. A cane bank should not be large; several medium sized banks are better than one large one. The bottom of the bank is smoothed off several inches below the surface of the ground and is six feet wide. The butts are set at a slight angle so as to touch the ground

and keep moist. The canes are placed in overlapping layers, the butts of each layer being several inches ahead of those in the layer below it. In this way about four or five layers only are at any one place on the bank. The center of the layers is kept high so as to give a slope to the earth roof. The canes are covered with earth to a depth of two or more inches. The covering of earth is left open, or nearly so, along a line down the middle so as to allow ventilation. More canes than will be needed for seed should be stored.

INSECTS.

In Texas Japanese sugar cane has not been seriously damaged by insects. There are, however, several insects which feed upon it, and which may keep it from growing rapidly.

The cane borer moth (*Diatrea saccharalis*) is the principal insect enemy of sugar cane in the Southern States. This insect also attacks Japanese sugar cane. The damage resulting from it is caused by the larva, or worm, which bores into the stalks of the cane. Its attack reduces the amount and quality of the plant juices and injures the eyes of the cane. The damage to Japanese sugar cane in Texas from this source will doubtless increase as more of the cane is grown. At present the borer is not extensively distributed in this State, but has been found in several places. Preventive measures will assist in keeping it in check. Old cane stalks and leaves from infested fields should either be plowed under or burned. The thorough plowing under of infested material is preferable to burning, since it is very effective in combating the insect, and is better farm practice. Johnson grass and old corn stalks should be plowed under or burned when near cane fields, some writers maintaining that this insect attacks these crops as well as sugar cane.

During the past two years the common chinch bug has been very prevalent in Central Texas. This insect is destructive to corn, sorghum, and small grain. It has been found in large numbers feeding on Japanese sugar cane, its most important damage being done in very dry, hot weather. Whenever rains were plentiful this insect damaged sugar cane very little. The fact that the sugar cane has a hard outer rind makes it much less susceptible to chinch bug injury than are the other crops it attacks.

SUMMARY.

(1) Japanese sugar cane is essentially a forage rather than a sugar crop. It resembles the cane used for sugar production.

(2) It was introduced into the United States about thirty years ago.

(3) Certain varieties of common sorghums or sorgos are sometimes erroneously called "Japanese Cane." They are not Japanese sugar cane.

(4) Japanese sugar cane has given very large yields in Southeastern Texas, and as a forage crop it is of great value, being well suited to the soils, climate, and methods of farming of that part of the State.

(5) It is very hardy, making large yields even when other crops are injured or destroyed by lack of drainage or floods.

(6) When planted on abandoned rice fields it has made exceptionally good yields.

(7) Its water content and succulence add to its value as a forage crop.

(8) In feeding value it is somewhat comparable to green sorghum or corn, but is low in protein content, and must be fed in connection with feeds containing sufficient protein to balance the ration.

(9) To feed it to best advantage the entire plant should be run through a feed cutter, or chopped into pieces.

(10) Fields to be planted to Japanese sugar cane should be plowed very deeply in the fall.

(11) As the plant does not make seed in Texas, the stalks are planted in the field just as is done with the other kinds of sugar cane.

(12) When seed canes are plentiful, 3000 to 3500 pounds should be planted to the acre, but thinner planting may be practiced if necessary.

(13) Fall planting is preferable, but spring planting may be done.

(14) For green feed the crop is available for use when it begins to taste sweet, which will probably be in August. The main crop should be harvested in November.

(15) The crop may be harvested with very little danger of weather damage and may be stored in almost any convenient manner.

(16) While the yields are thought to decrease after the first season, the crop may be grown several years without replanting.

(17) After a field of Japanese sugar cane is plowed up, other crops, preferably legumes, such as cowpeas and velvet beans, should be planted.

(18) The stalks are bedded and stored over winter for spring planting.

(19) Insect enemies are not numerous.