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STUDIES ON SWEET POTATO PRODUCTION IN TEXAS

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Successful sweet potato production is largely the result of care in following methods known to give good results. These include the selection of roots to secure potentially productive seed of high quality, measures to control diseases, early planting, the use of adequate fertilizers, clean early culture, care in handling the roots and so on. Such things have been discussed simply and briefly so that East Texas growers will have a ready source of information in regard to practices now recommended. More complete reports of the experimental work will be made available later.

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STUDIES ON SWEET POTATO PRODUCTON METHODS IN TEXAS

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Acreage and Production

The sweet potato is one of the best liked and most valuable vegetable crops produced in Texas. Its high nutritive value is widely recognized. The crop is easily grown, and can be used as a fresh vegetable throughout the late summer months as well as in cured form with nearly equal value for five or six months in storage. For these reasons sweet potatoes are planted on the majority of the farms in the sandy soil areas of Texas. The monetary value of the sweet potato crop in Texas for 1943 was placed at $12,074,000 by the United States Crop Reporting Board. The Texas acreage for 1943 was estimated at 72,000 as compared with 64,000 for 1944. Acreage of this crop could be greatly expanded if economic conditions justified the increase.

Due to its high vitamin and food content and the ease with which it can be processed the sweet potato has acquired added prominence during the war emergency. The various government agencies have purchased millions of pounds of fresh, canned, and dehydrated sweet potatoes for our armed forces and our allies. A shortage of carbohydrate feeds in Texas has stimulated interest in converting culls into livestock feed by sun drying and artificial means. The sweet potato as a source of commercial alcohol should not be overlooked.

In most cases it is not practical for the average farmer to increase his sweet potato acreage. Therefore, if increased production is to be secured the most economical procedure would be to increase the average yield on the acreage normally grown. A study of the problems affecting yields has been underway at the Sweet Potato Investigations Laboratory in Upshur County, since 1938.

Varieties and Strains

The Porto Rico as represented by its various strains is the most popular variety grown in the State. This variety is popularly known as a "Yam" because of its moist flesh. Typically, the Porto Rico is characterized by its copper-red skin and salmon-pink flesh. It is a good eating potato when first harvested as well as after curing, which makes it suited to both early and late markets.

During the seven year period, 1938 through 1944, more than 400 varieties, seedlings, or selections have been grown from seed stock secured from various sources. In addition to these lots, several thousand new seedlings were grown from true seed.

Representative data on yields from ten varieties are presented in Table 1. It is interesting to note from this table that several varieties outyield the Porto Rico, but they are suitable only for feed or industrial purposes. Of all the varities tested to date only the Porto Rico can be recommended for the table stock market.

Table 1. Sweet Potato Variety Test—Three-year Average, 1940-1942

(Fertilizer—600 lbs. 4-8-10 per acre.)

Variety	Yield in bushels per acre				
	Jumbo	U.S. No. 1	U.S. No. 2	Culls	Total
Big Stem Jersey	0	31.8	43.6	74.4	149.8
Nancy Hall	7.0	45.1	141.2	58.3	251.6
Triumph	9.9	65.9	134.0	82.8	292.6
Unit 1 Porto Rico*	20.6	55.0	166.6	40.5	282.7
Texas Porto Rico*	14.6	51.9	154.7	59.2	280.4
B-196	88.2	44.7	174.1	85.2	392.2
B-219	10.8	97.0	161.5	95.2	364.5
L-4-5	17.1	30.5	157.0	80.2	284.8
Maryland Golden*	0	27.8	50.6	43.2	121.6
Wenholz 1	11.6	45.9	173.4	85.7	316.6

*Two-year average.

Experiments have shown that as much variation in yield can be expected between various strains of Porto Rico as between the Porto Rico and other varieties of sweet potatoes.

Table 2 shows that some strains outyield others by 40 percent. These figures for only one season, supported by the additional data available, are very strong evidence that yields can be increased significantly by following rigid seed selection practices.

Table 2. Comparison of Yields of Strains of Porto Rico Sweet Potatoes, 1942

Strain	Yield in bushels per acre				
	Jumbo	U.S. No. 1	U.S. No. 2	Culls	Total
Hill 10, 1938	5.0	174.4	170.8	117.3	367.5
S. Jordan	13.0	110.9	109.4	86.8	320.1
Texas Porto Rico	18.5	89.6	169.1	73.1	350.3
Red Velvet	3.6	75.4	176.4	65.0	320.4
Arnold	0.0	72.8	158.9	101.0	352.7
La. Unit 1	5.3	68.5	211.5	47.4	332.7
Porto Orado	0.0	66.3	180.7	53.6	300.6
Y-37, 1938	0.0	65.0	106.6	38.3	209.9
Texas, 1938	9.9	50.0	188.4	79.7	328.0

Selection of Seed Stock

There are a number of factors essential to the successful production of sweet potatoes. Seed selection is among the most important of these. The common practice of selecting small potatoes from the storage house in the spring without regard to the behavior of the parent plant has a tendency to reduce yields and results in "running out" of the strain. How-

ever, most growers must produce plants from sweet potatoes which they have on hand. To comply with State Certification requirements, all seed potatoes must be smooth, free from breaks, cracks, crooks, bruises, decay or disease signs, and insect pest damage. They must be at least one and one-half inches in diameter and at least three inches in length.

Seed potatoes meeting these requirements can be further improved by selecting for uniform salmon-pink flesh color. Flesh color can be readily determined by cutting out a small chip not over 1/4 inch deep from the shoulder of the potato near the end by which it was attached to the plant. This process is referred to as "nicking". Only those potatoes having the desired interior flesh color should be used for bedding. Immediately after selecting and "nicking" the seed stock should be disinfected and bedded. This process should be continued each year as sweet potatoes tend to mutate to a white color.

The size of roots used for seed purposes has some effect on yield and grade as shown in table 3.

Table 3. Size of Seed—Three-year Average (1938-1940)

Size of root used for slips	Yield in bushels per acre				
	Jumbo	U.S. No. 1	U.S. No. 2	Culls	Total
Jumbo	2.2	62.9	30.5	45.1	140.7
U. S. No. 1	0.9	52.9	27.5	51.2	132.5
U. S. No. 2	0.4	49.8	23.4	48.9	122.4
Turnip shape	2.5	50.8	23.7	46.0	123.0
Strings (under 1½-in.)	0.9	43.1	25.9	45.6	115.4

Increases in yield obtained from the use of good seed stock would more than offset the increased cost. Good seed stock can be checked for interior color more satisfactorily than can the small roots.

The size or shape of seed stock has little effect on the shape of roots produced in the subsequent crop, as indicated by the data in table 4.

Table 4. Comparison of Shape From Different Size of Seed

Size of roots used for slips	Average, inches		
	Length	Diameter	L/D Ratio
Jumbo	6.33	2.31	2.74
U. S. No. 1	6.14	2.27	2.70
U. S. No. 2	5.95	2.26	2.63
Turnip Shape	6.10	2.33	2.62
Strings	6.65	2.31	2.88

Growers should make a special effort to grow and select good seed stock for large scale plantings. To avoid disease vine cuttings from selected seed stock should be planted on land not previously used for sweet potatoes, and selection should be done at harvest. Hills having the largest

number of uniform roots should be examined for disease, skin and flesh color. Flesh color can be determined at harvest by clipping off the stem-end of the sweet potatoes thus eliminating the necessity of "nicking" at bedding time. This procedure does not materially damage roots for market purposes if they do not meet seed stock standards.

Seed plots should be harvested earlier than commercial plantings. Unpublished results indicate that early harvested sweet potatoes will produce the earliest slips as well as the highest number of slips per bushel.

Selected seed stock should be stored in new crates, or old crates which have been disinfected immediately before storing. A storage compartment separate from the main storage house is desirable, and the temperature should be maintained between 50 and 55 degrees F with high relative humidity.

Seed Treatment

Seed disinfection is essential for successful sweet potato growing. Even though no disease is evident, the spores causing soft rot and black rot may be present on the skin, since both diseases are common where sweet potatoes are stored. Disinfection can be accomplished satisfactorily with corrosive sublimate or Semesan Bel, both materials being approved by the State Department of Agriculture for certification purposes.

If corrosive sublimate is used, seed potatoes should be soaked 8 to 10 minutes in a solution made by dissolving four ounces of corrosive sublimate in 30 gallons of water. A stock solution can be conveniently made by placing 4 ounces of the corrosive sublimate in a one-half gallon glass jar, adding just enough hot water to make a paste, then filling the jar with hot water while stirring with a wooden paddle. This half gallon of stock solution is then stirred into 30 gallons of water in a *non-metal* container. After each 10 bushels of potatoes treated add one-half ounce of corrosive sublimate, or one-half pint of the stock solution and enough water to restore the solution to its original volume. The solution should be discarded after treating about 50 bushels. In the case of larger tanks, the proportions should be the same. *CAUTION*: All containers must be of *wood, glass,* or *stone ware.* Corrosive sublimate is a deadly poison and should be handled accordingly.

The Semesan Bel treatment is faster and easier to use, and apparently is just as effective as corrosive sublimate for controlling diseases. A drum or tub, equipped with a drain board to prevent loss of the solution is satisfactory equipment for average operations. The sweet potatoes are transferred to a wire basket, dipped into the solution for one minute, and then allowed to drain before bedding. One pound of Semesan Bel in 7½ gallons of water is sufficient for treating 75 bushels of seed potatoes. The solution should then be discarded, the dipping containers cleaned, and a new solution prepared.

Plant Growing

From 8,000 to 12,000 plants are required to set an acre, depending upon the width of the rows and spacing in the drill. A bushel of No. 1 potatoes will require about 15 square feet of bed, and will produce from 1500 to 2000 slips during the entire season. When early plantings are desired, eight bushels should be bedded for each acre. However, if plantings are to be made until late in the season, from four to six bushels will be sufficient. Sweet potatoes should be placed close together in the bed, but should *not* touch. This is important since several diseases attack the seed potatoes and slips in the plant bed.

Many different types of beds are used for plant growing in this State. Seed potatoes bedded in the open usually produce slips around May 15, depending upon the season. For early plant production, some form of hotbed should be used. Flue heated, steam or electric beds are all satisfactory. Small beds may be heated with shredded or chopped corn stalks, or any other organic material which will generate heat as it decomposes. The temperature of the bed should be held between 75 and 85 degrees F. Manure heated beds should be avoided if certification is desired, because they encourage diseases.

The seed bed should be located in a well-drained, protected place, preferably with a southern exposure. If the soil is likely to pack after heavy rains, old sawdust or sand can be used satisfactorily in the beds in place of soil. Commercial fertilizer or manure is not needed to produce healthy slips where good potatoes are bedded in a properly constructed plant bed.

For early slip production, both electric and corn-stalk heated beds have been used. The corn-stalk method would be most practical and economical for the average grower.

Table 5. Average Number of Slips Per Bushel of Seed Stock

Year	Source of Heat		
	Electricity	Corn-stalk	No heat
1940	1776	2230	.....
1941	1366	1890	746
1942	929	1673	547
1943	1599	1449	788
1944	1020	1787	573
Average	1338	1806	664*

*Four year average.

Note: The average current consumption on the electric bed was 27 K.W.H. per thousand plants.

Preparation of Soil and Cultivation

Thorough preparation is essential for sweet potatoes, inasmuch as compact or unbroken soil retards down growth of the roots. The land should be selected as early as possible and organic matter plowed under suf-

ficiently early to allow time for decaying prior to planting. This operation can be accomplished by flatbreaking, bedding or disking.

Sweet potatoes grow off rapidly after setting in the field, requiring relatively few cultivations. Experiments at Gilmer have shown that the crop should be thoroughly cleaned and "laid by" as soon as the vines begin to run freely. Cultivation after this time has not increased yields, and operations which resulted in covering or breaking the vines reduced yields.

Tests with different ridge heights were conducted for five years. Results from these studies indicate that the height of the bed, or row does not materially affect the yield or grade of sweet potatoes, if the land has been thoroughly prepared. The type of implements used on the farm should be the determining factor as to the height of beds used. These results are being published elsewhere.

Rotation

The sweet potato plant is generally recognized as being a heavy feeder, and should not be grown continuously on the same land. In many cases sweet potato fields are pastured during the fall and winter when the soil is wet resulting in injury to the soil which is reflected in future crops. Yields can be increased by rotation and soil building practices, but such cover crops as vetch should follow sweet potatoes instead of being plowed under just preceding the crop. Damage from disease can be reduced to a minimum when sweet potatoes are grown on the land only once in four or five years.

Fertilization

Fertilizer tests have been conducted at the Laboratory at Gilmer, for a seven year period. Rates of application ranging from 400 to 600 pounds per acre have proven most profitable, but increased yields were secured from rates up to 1000 pounds per acre even during dry seasons. On sandy soils, 4-8-8 will probably give the best results, but 4-12-8 and 6-10-7 are also satisfactory.

Time of application studies on Bowie fine sand show that the entire amount can be profitably applied before planting, if the fertilizer is thoroughly mixed in the drill before bedding. This procedure lessens the possibility of the roots of the slips being injured by coming in direct contact with the fertilizer. Plants set immediately following bedding will begin growth within a few days, and can be cultivated before grass and weeds become troublesome. Thus fewer cultivations will be required due to rapid vine growth.

Time of Planting and Spacing

Date of planting studies show that highest yields may be expected when plants are set in the field as soon as danger of frost has passed. Plantings made more than four weeks after average date of the last killing frost

show a significant reduction in yield. Early planting tends to produce chunky potatoes, making them less attractive for market purposes, but the increased yield usually more than offsets this difference in grade. No difference in shape or grade was evident when slips and vine cuttings were planted on the same date under similar fertilizer and soil conditions. Table 6 shows the effect of dates of planting on the yield of Porto Rico and Triumph sweet potatoes dug at the same time.

Table 6. Effect of Time of Planting on Yield of Sweet Potatoes, 1940-1942

Planting*	Acre yield in bushels	
	Unit 1 Porto Rico	Triumph
1st—April 15-25	315.7	311.7
2nd—April 30-May 13	294.5	316.9
3rd—May 15-19	257.2	287.6
4th—May 30-June 5	207.2	200.1
5th—June 15-17	160.9	173.8
Average	247.1	258.0

*The interval between plantings was about 15 days.

Spacing studies carried on in connection with date of planting tests indicate that close spacings produce the highest yield of sweet potatoes. Spacing from 12 to 18 inches in three and one-half foot rows are most economical as indicated by results presented in table 7.

Table 7. Effect of Spacing on Yield of Sweet Potatoes, 1940-1942

Spacing, inches	Acre yield in bushels	
	Unit 1 Porto Rico	Triumph
9	268.1	299.4
12	266.7	284.6
15	256.9	273.8
18	262.6	262.8
24	236.7	246.2
32	224.2	226.6
42	214.3	212.7

Proper setting is just as essential as proper spacing. Extreme care should be exercised in setting to pack the soil firmly around the slips, thus eliminating airpockets. Poor stands and irregular growth is due more often to poor setting than to dry weather. Mechanical transplanters, whether home-made or commercial, provide more uniformity in setting and makes subsequent cultivation easier.

Harvesting

Sweet potatoes should be handled like eggs or apples, and should not be thrown together in heap rows. If the sun is not too hot, the potatoes should be allowed to dry before they are handled. Persons handling sweet

potatoes should use cotton gloves to reduce further injury due to handling. Grading should be done in the field and the sweet potatoes should be placed carefully in crates before hauling to the storage house. Bruised or cut roots do not keep well in storage, and such material should be fed to livestock as soon as possible, or sliced and dried for future use.

A test designed to determine the effect of time of harvest (and other factors) on the yield of sweet potatoes was conducted for five years. During the three-year period beginning with 1940, sweet potatoes were planted during the first half of May and harvested at approximately three-week intervals from the first week in September, with the final harvest being delayed until after the first killing frost. Table 8 indicates that yields increased approximately 20 percent during both the first and second intervals but no significant increase was recorded for the last interval.

Table 8. Effect of Time of Harvest on Yield of Porto Rico Sweet Potatoes

Time of harvest	Acre yield, in bushels			
	1940	1941	1942	Average
1	230.6	221.8	171.2	207.9
2	268.0	252.9	232.6	251.2
3	322.4	301.0	283.8	302.4
4	324.4	309.1	275.5	303.0
Average	286.4	271.2	240.8	.....

If growth of vines is heavy, it may be necessary to cut them before plowing out the crop. In most cases a rolling coulter attached to the beam of a 12 inch turning plow will be found satisfactory for cutting and plowing in one operation. A digger which cut the vines and lifted the entire row was built for operation on the tractor at the Laboratory during the 1944 season. See Texas Extension Service blueprint, Serial No. 308. This equipment eliminated most of the hand scratching, inasmuch as approximately 90 percent of the sweet potatoes adhered to the vine when the plants were lifted from the soil by the main stem.

Storage

One of the most essential factors in successful sweet potato storage is sanitation in the storage house. Storage disease organisms live over from season to season on decayed sweet potatoes, as well as the floor, walls, and crates within the house. Prior to harvesting, the house should be thoroughly cleaned, and the interior walls, floor and crates disinfected with a formaldehyde solution (one pint formaldehyde to 30 gallons of water).

The use of artificial heat for curing is normally unnecessary under East Texas conditions if the crop is harvested during October. Due to the length of time required for harvesting and filling a house, satisfactory

results will be obtained by opening the house during the day and closing it at night. Sweet potatoes are generally considered as being cured when they show indication of sprouting. If artificial heat is used, this condition can be brought about in a period of 7 to 10 days by maintaining a temperature of 85 degrees with high humidity.

Curing is not necessary for the removal of excess moisture from stored sweet potatoes. Tests have shown that a part of the starch is converted to sugars, and the percentage of moisture in the sweet potatoes actually varies very little during the storage period. Harvesting causes some wounds to all sweet potatoes which must heal to resist organisms causing decay in storage. Conditions favorable for rapid curing are also ideal for the healing of wounds on sweet potatoes.

Data presented in table 9 show that artificial heat for curing at Gilmer was uneconomical for the three-year period the storage tests were conducted. All lots of sweet potatoes were stored in the same house. The difference in shrinkage, which is in favor of the curing, is insufficient to pay for the expense incurred.

Table 9. Effect of Curing on Shrinkage of Porto Rico Sweet Potatoes in Storage*

Treatment	Percent shrinkage based on harvest weight			
	1940	1941	1942	Average
Cured 5 days at 85 degrees, before storage....	14.6	9.8	10.2	11.5
Check—harvested and placed directly in storage.....	13.9	10.4	12.4	12.2

*Average length of storage 140 days.

Sweet potatoes should be stored after curing at 50 to 55 degrees F with a relatively high humidity. Rapid temperature changes will cause the condensation of moisture on the walls and on the sweet potatoes, and should be avoided. A more uniform temperature can be maintained, even in warm weather, by keeping ventilators closed, especially during the day time.

Utilization of Culls and Vines

Sweet potatoes in their natural state are a satisfactory succulent feed for dairy cattle, beef cattle, horses and hogs. They have a feed value of 32% when compared with corn, thus requiring approximately three bushels to equal one bushel of corn. In the commercial market area of East Texas only the unmarketable roots can be used for commercial feeding. However, with an average corn yield of 10 bushels per acre, more carbohydrate feed per acre is usually available from cull sweet potatoes. In most cases storage loss and costs make it uneconomical to store culls for use at a time when they are most needed.

Sweet potatoes can be sun dried for feed and stored in a dry place indefinitely without loss from decay or freezing. The dried material makes a carbohydrate concentrate which is practically equivalent to yellow corn chops in feed value, and can be safely fed to all farm livestock in place of corn.

In preparing sweet potatoes for sun drying it is essential that they be cut instead of being ground in a hammer mill. A machine designed and constructed for use at the Laboratory cuts the cull roots in slices averaging 3/16 inch in thickness (Blueprint, Serial No. 273, Texas Extension Service). This equipment, built at a cost below twenty-five dollars, will cut two bushels of sweet potatoes per minute when powered with a 1 H. P. electric motor.

The cut potatoes are spread on mulch paper, sheet iron roofs on low sheds, or specially prepared asphalt or oiled drying areas, at the rate of one pound per square foot of surface. With favorable weather conditions the sweet potatoes will dry in 48 hours. The pieces break when dry, or rattle when dropped on paper, and are then ready for storage. Approximately two-thirds of the weight is lost in drying, requiring 300 pounds of sweet potatoes to produce 100 pounds of feed. The dried slices can be ground for feeding if desired.

By using the digger referred to previously, sweet potato vines with cull roots attached were converted into feed by the same method. This dry feed has the following analysis, per cent by weight: protein—5.86, fat—2.06, crude fiber—8.27, nitrogen-free extract—60.79, water 11.44 and ash—11.58. Utilization of this material for feed should increase the returns per acre considerably, and offers a source of badly needed feed.

ACKNOWLEDGMENT

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