KEYS TO PROFITABLE PRODUCTION

B-1274

KEYS TO PROFITABLE TEXAS SWEET POTATO PRODUCTION, STORAGE AND MARKETING

CONTENTS

Texas Agricultural Extension Service · The Texas A&M University System · Daniel C. Pfannstiel, Director · College Station, Texas

ACKNOWLEDGMENT

The authors acknowledge the contribution to this publication by Dr. Charles Cole, area Extension entomologist.

KEYS TO PROFITABLE TEXAS SWEET POTATO PRODUCTION, STORAGE AND MARKETING

Roland E. Roberts, Thomas D. Longbrake, Sam Cotner,
Terry Menges, B. Dean McCraw and Donald R. Paterson*

Texas growers and shippers produced more than 1 million hundredweight of sweet potatoes valued at over $15 million on more than 9,000 acres in 1978. The production and marketing of sweet potatoes is a highly technical enterprise requiring more hand labor and specialized mechanization than most vegetable crops. More than 80 percent of the Texas sweet potato crop is produced in northeastern counties. Crop producers with sandy soils in the Rolling Plains and South Plains regions are planting small trial acreages with encouraging results. There are many locations across northern Texas from east and west where the soil and environment are well suited for sweet potato production.

The sweet potato is a high energy food, rich in vitamins A and C. It is a good source of minerals, calcium and iron. Rising consumer interest in the nutritional value of foods will cause more people to appreciate the food value of sweet potatoes. Development of more convenient forms such as frozen, canned and flaked products is gradually increasing sweet potato consumption.

Site Selection and Soil Management

A sandy loam, fine sandy loam or loamy fine sand, at least 18 to 24 inches deep, underlaid by a clay loam or sandy clay loam is best suited for sweet potato production. Sandy soils produce smooth skinned roots of desirable shape. Clay loams and silt loams are unsuitable. Use crop rotations which allow at least 3 years before sweet potatoes are planted again on the same land. Some growers are now coming back every other year using land where winter rye was grown, followed by summer fallowing and tillage. This practice discourages nematodes, adds organic matter and kills germinating weed seeds. Presence of any soilborne disease in the sweet potato roots means that a longer rotation is needed. Grass crops such as rye, wheat and corn are valuable rotation crops. They are not hosts for the root knot nematode or other sweet potato diseases.

Varieties

Sweet potato varieties are selected on the basis of superior yield, percentage of No. 1 grade, external and internal appearance, storage quality and market acceptance.

Leading growers are planting Jewel almost exclusively. The most impressive characteristics of Jewel are superior skin color, deep orange flesh and excellent eating quality. Some growers report that Jewel is not a vigorous slip producer and requires a longer time to produce acceptable slips. Heat treatment of the mother roots helps overcome this weakness.

The Centennial variety has performed very well for many years and produces a high percentage of No. 1 grade roots. Its copper skin and orange flesh made it popular for fresh market and processing before the release of Jewel.

The Puerto Rico variety was used widely for many years. It requires a long growing season, has excellent flavor and the root keeps well in storage. It is not resistant to internal cork virus. The interior flesh color is pale yellow, not an attractive orange.

The copper skinned variety, Gold Rush, has a desirable internal color and acceptable canning and flaking characteristics. It is considered a good storage variety.

Seedstock Production

High quality seedstock is indispensable to the production of top quality roots for harvest. Plant only certified seedstock free of nematodes, scurf, black rot, soil rot and internal cork. Certified seedstock is produced in isolated plots from vine cuttings of registered foundation seedstock.

*Respectively, area Extension vegetable specialist; Extension horticulturist-vegetables; Extension horticulturist; area Extension horticulturist; Extension horticulturist-special programs; and professor of horticulture, Texas Agricultural Experiment Station, The Texas A&M University System.

A variety gradually develops undesirable features from rapid mutation which growers refer to as "running out." Successful growers carefully maintain superior seedstocks to assure profitable commercial production on a permanent, self-sufficient basis. A superior seedstock maintenance program involves reselection of the best individual roots and propagation of vine cuttings from these roots. Vine cuttings are made by cutting shoots 1 inch above the bed surface and rooting them in sand. High latex in roots means vigorous slip producer. Firm orange flesh, attractive shape, bright skin color, absence of veins, trueness to varietal type and freedom from diseases are standards to apply in reselecting superior seedstock. Strict sanitary precautions during growing, storage and handling are essential.

An effective seedstock reselection program requires careful planning. Develop a seed plot to improve your seedstock. Begin by hill selecting healthy roots from the current crop. The next spring immediately before bedding, cut out a ¼ inch chip on the stem end to expose the flesh color. Bed only roots with orange-colored flesh, thus free of internal cork lesions. Set slips from these selected roots into the seed plot. Use vine cuttings to expand the seed plot. Hill selection from the seed plot improves the quality for the next season's plot. Remaining roots are saved as seedstock for the commercial field. This process is repeated yearly.

Slip Production

Commercial growers refer to transplants produced from seedstock roots as "slip." Well-drained ground beds without supplemental heat, but covered with a suitable mulch material, produce slips in time for transplanting in Northeast, Northwest and Central Texas. Hotbeds or plastic greenhouses allow earlier slip production through precise temperature control, but lower the temperature around the slips for 4 to 6 days before they are transplanted in the field to harden them to cooler outdoor conditions.

Locate the slip bed on well-drained, light sandy soil where sweet potatoes have not been planted for at least 3 years. *At least 2 weeks before bedding the roots,* fumigate the soil with Dowfume MC-33 at the rate of 250 to 350 pounds per acre (for small beds, use 1 pound per 125 to 175 square feet). *Use MC-33 exactly as prescribed on the label.* This fumigant controls nematodes, soil diseases, soil insects and weed seeds. Fumigate only when the soil temperature is 50° to 85° F. or higher at the 8-inch depth.

From 14,300 to 19,600 slips per acre are required for field spacings of 8 to 14 inches on 40-inch centers. Sixteen to 20 bushels of seedstock usually produce enough slips to plant an acre. In the first and second slip harvest, a good sprouting variety produces up to 1,000 slips per bushel of medium-sized roots bedded. An additional 500 slips per bushel of seedstock roots are usually produced in the third and fourth slip harvests spaced at 7- to 10-day intervals.

To assure that enough slips will be ready for the earliest plantings, bed about 24 or 25 bushels of seedstock roots for each acre of the earliest planting. Also, bed rootstock at this rate for weak slip producers like Jewel. Provide 12 to 15 square feet of bed area per bushel of seedstock roots. Some growers sell slips from the second through fourth harvests to northern growers who plant later.

Treat the seedstock roots with Mertek®, Thiabendazole® or Thiram® dip before bedding them (see disease section).

Preheating roots to be used as seedstock stimulates earlier slip growth and increases the total number of slips produced per root. To preheat roots, raise the storage temperature to 85° F. (30° C.) for about 2 weeks before bedding or until short sprouts appear on the roots. Prolonged exposure of stored or bedded roots to temperatures below 55° F. (13° C.) reduces slip production and causes root breakdown.

Cover the bedded seedstock roots with a 3-inch layer of soil. Broadcast 4 to 5 pounds of 8-8-8 fertilizer per 100 square feet of bed surface and lightly rake it into the soil.

Earlier slip production is stimulated by raising the bed soil temperature. A single layer of clear plastic film, black plastic film, roofing felt or petroleum mulch such as ENCAP raises the temperature of the bed soil and stimulates earlier slip growth. Texas Agricultural Experiment Station research shows that petroleum mulch produces the earliest slip growth. When plastic film is used, do not completely seal the edges but provide ventilation by covering only 3 feet of every 4 feet of the edge of the plastic with soil. This ventilation is extremely important during the warmest part of the day to permit escape of any residual fumigant. Remove the plastic film and roofing felt when the slips start to emerge above the soil surface.

Slips from the first pulling produce the largest yields in the field.

Workers can harvest slips from beds up to 4 feet wide without stepping on the seedstock roots. A covered bed more than 4 feet wide or one located on poorly drained soil usually produces fewer slips per seedstock root because of mechanical injury or lack of oxygen.

Fertilizer Rates and Placement

The sweet potato has a moderate requirement for nitrogen, phosphorus and potassium. Excessive nitrogen in the soil causes oversized roots, crooks and elongated roots known as "rat tails." Texas Agricultural Experiment Station research conducted in East Texas shows that the highest yield and quality are produced in soils receiving 40 to 50 pounds of nitrogen (50 pounds N equivalent), 20 to 45 pounds of phosphorus

(50 to 100 pounds P_2O_5 equivalent) and 85 to 170 pounds of potassium (100 to 200 pounds K_2O equivalent). Formulate the fertilizer analysis for your soil to supply required nutrients based on the soil test. Higher rates are needed only when sweet potatoes are grown on light sandy soils with overhead irrigation.

A preplant soil test is essential to growers who wish to produce the best crop possible. Your county Extension agent can supply soil sample containers and sampling instructions. To determine the correct analysis and fertilizer rate for sweet potatoes on your farm, collect soil samples at least 4 to 6 weeks before planting time, have the samples analyzed by a laboratory which reports the nitrogen level as pounds of nitrate per acre and apply only the amount of nitrogen calculated by subtracting the soil test nitrogen level from 60.

Never apply manure to land the same year it is to be planted with sweet potatoes. Manure applied within 2 years of planting likely will result in excessively high nitrogen levels in the soil. Manure is an uncontrollable source of nutrients, especially of nitrogen.

In most Northwest Texas soils, sweet potatoes show no response to potassium fertilization. Many of these soils also contain sufficient phosphorus. Have your soil tested to avoid needless expense for fertilizer that is not needed.

For best growth, place fertilizer in bands on each side of the row, 6 to 10 inches to the side and 4 to 6 inches deep in the bed. *Never* place a band of fertilizer in the center of the row where slips will be planted.

Some East Texas growers have learned that on very light sandy soil it is beneficial to apply only phosphorus fertilizer preplant. They delay nitrogen and potassium fertilization until transplanting or sidedress nitrogen and potassium soon after transplanting. Try new and different fertilizer application methods only on a small acreage until the benefits are demonstrated conclusively.

Field Transplanting

Set plants in the field only after the soil temperature at planting depth is 65° F. or higher and danger of frost is long past. A starter solution of soluble fertilizer, high in available phosphorus, stimulates vigorous, early growth when applied as the slips are planted in the field. A high phosphorus fertilizer such as 12-24-12, 18-46-0 or 10-52-17 can be dissolved in water at the rate of 2 to 3 pounds in 50 gallons of water and applied at the rate of about 1 cup per plant during the transplanting process. Most commercial transplanters have an attachment for applying the liquid starter solution or can be modified to apply starter fertilizer solution.

Row Width and Plant Spacing

To obtain maximum yields, row widths of 38 to 42 inches are desirable with 8 to 10 inches between plants in the row. With a 40-inch row, a plant spacing of 8 inches requires 19,600 plants per acre, and a plant spacing of 10 inches requires 15,680 plants.

Weed Control

Annual grasses and weeds vigorously compete with sweet potatoes for moisture and nutrients. Early season control of grasses and weeds by mechanical cultivation or chemical herbicide application is important. Mechanical cultivation is limited to the area between rows; keep shallow to prevent root damage. Chemical herbicides control germinating weed seeds without damaging transplants when applied before or just after transplanting according to label instructions. The chemicals, suggested rates and application methods shown in table 1 are recommended for sweet potatoes.

Irrigation

Since rainfall is always unpredictable, plan supplemental irrigation to assure maximum yields and quality. In East Texas under most weather conditions, sweet potatoes require 1 to 2 inches of water per week depending on the growth stage. In Northwest Texas the water requirement is higher and may exceed 3 inches per week when the plants reach full size and day temperatures are very warm. Proper irrigation should maintain near optimum moisture in the top 10 to 18 inches of soil. Generally, apply 1 inch of water per irrigation set. Excessive irrigation rates leach fertilizer and increase the danger of disease in the crop.

Special soil moisture-sensing instruments called tensiometers help growers estimate when to begin irrigation to prevent drought stress. Install tensiometers so that the ceramic tip is 10 to 12 inches into the soil. Check the soil moisture tension early in the morning. Readings ranging from 15 to 20 centibars indicate sufficient moisture reserve to satisfy plant needs for that day. Readings of 25 to 30 centibars signal that the soil moisture reserve is too small to adequately supply the plants with water for another sunny day; start irrigation as soon as possible to avoid drought stress. Any grower who takes the few hours necessary to learn the principles and service requirements of tensiometers will be able to use them to improve irrigation timing and efficiency.

Disease Prevention and Control

Yield and market quality of sweet potatoes may be hurt by seed or soilborne fungi, nematodes and virus diseases. Of these, the scurf fungus and the root knot nematode are most likely to cause consistent damage in major production counties of Texas. Other diseases, primarily stem rot, black rot and soil pox may cause serious losses when transplants originate from infested seed or improper crop rotations are used.

Effective disease control starts with selecting a "clean" nematode-free bedding site preferably where sweet potatoes have not been grown for many years. Select only healthy seed roots free of scurf and other

Table 1. Herbicide recommendations for weed control in sweet potatoes

Product	Rate per treated acre	Time of application	Weeds controlled	Remarks
Amiben 2EC (chloramben)	4 lb a.i. (2 gal)	At planting of "slips" or draws	Most annual broadleaf and grassy weeds such as barnyardgrass, carpetweed, coffeeweed, crabgrass, foxtails, johnsongrass seedlings, lambsquarters, mustard, pigweeds, purslane, ragweed, smartweed, spurge	
Amiben 10G Granular (chloramben)	4 lb a.i. (40 lb)	At planting		Do not disturb treated bands when cultivating after treatment until last cultivation; then set sweeps closer to pull soil as high as possible over the row.
Dacthal W-75 (DCPA)	4.5-10.5 lb a.i. (6-14 lb W-75)	Preemergence to weeds at transplanting and at layby up to 6 weeks after transplanting	Crabgrass, other annual grasses, purslane, carpetweed, lambsquarters	Use on transplanted sweet potatoes. Incorporation of layby treatment not recommended.
Dymid 80W (diphenamid)	4-6 lb a.i. (5-7.5 lb 80W) depending on soil type	At transplanting	Annual grasses such as barnyardgrass, cheatgrass, crabgrass, foxtails, etc. Broadleaf weeds including carpetweed, chickweed, lambsquarters, pigweed, etc.	Can be applied directly over top of transplants. Do not plant treated areas to crops not on the label.
Enide 50W (diphenamid)	4 lb a.i. (8 lb 50W), light soil, 6 lb a.i. (12 lb 50W), heavy soil	At transplanting	Annual bluegrass, crabgrass, fall panicum, foxtails, ryegrass, lambsquarters, pigweed, smartweed, chickweed, carpetweed, etc.	May be applied over top of plants. Do not plant treated areas to crops not on label.
		At bedding		Apply to soil after covering potatoes.
Eptam 7E (EPTC)	3 lb a.i.	Preplant incorporated	Annual grasses including brachiaria, johnsongrass seedlings, deadnettle, lambsquarters, purslane, redroot pigweed, hairy nightshade, common chickweed	See label for local recommendations.
	7.5 lb a.i.	Immediately or within 2 days after planting slips or vine cuttings	Annual grasses, johnsongrass seedlings, deadnettle, lambsquarters, purslane, redroot pigweed, hairy nightshade, common chickweed	Apply to dry surface and do not mix into the soil. If sweet potatoes are irrigated, apply before irrigation. Check label for different regional recommendations.

obvious disease symptoms. Before bedding, treat seed roots with an approved fungicide dip (Mertek®, Thiabendazole® or Thiram®) to control unseen disease organisms present on root surfaces. Transplant slips to clean fields where other crops, not affected by sweet potato diseases, have been grown for at least 3 years. Where stem rot or wilt has occurred, use wilt-resistant varieties — Jewel or Centennial. The Jewel variety also is resistant to the root knot nematode.

Nematicide Application

To control parasitic nematodes, apply a nematicide in the bed 3 to 4 weeks before planting when the soil temperature is above 60° F. The nematicides giving good results in Texas are Shell DD® or Vidden-D® at 10 to 12 gallons per acre and Telone® at 8 gallons per acre.

Apply nematicides during or after any preplant fertilizer application and after forming the beds so that the soil will not be disturbed until planting. Apply the nematicide with a chisel applicator in bands 10 inches apart and sufficiently deep so that when the bed surface is flattened during transplanting, the nematicide bands will be 5 to 6 inches deep in the bed. Reshape the bed immediately after nematicide injection to seal in the gases, thereby slowing their escape.

Mocap® 10 percent granules applied broadcast at 60 to 80 pounds per acre is best incorporated 6 inches deep; wait 2 weeks to plant. Dasanit® 10 percent granules applied broadcast at 20 to 46 pounds per acre is best incorporated 6 inches deep; Dasanit® requires no waiting period.

Sweet Potato Weevil Control

Growers can prevent or greatly reduce sweet potato weevil injury where infestations occur by using the following procedures:

- Seedstock — Plant weevil-free seedstock. If possible, obtain seedstock from an uninfested area. If this is not possible, carefully examine each sweet potato chosen for seedstock; reject any that are infested. Store seedstock separately from other sweet potatoes. Store seedstock one layer at a time and cover each layer with Imidan® dust at the rate of 2 to 4 ounces of dust per 50 pounds of seedstock sweet potatoes.
- Storage — Empty and clean all storage in the spring, at least a month before the new crops are planted in the field.
- Plant beds — Locate plant beds and field plantings away from the previous season's planting and other sources of weevil infestations.
- First application — When first slips begin to show color, apply Imidan® dust on and around the base of all emerged plants.
- Second application — When all slips are up, apply Imidan® dust to cover the soil next to all plants.
- Other applications — After all slips are pulled, keep soil covered with Imidan® dust. Dust plants when vines drop to the ground and start to run.
- Field plants — Plant in fields where sweet potatoes were not grown for three previous seasons. Plant vine cuttings in preference to slips to lessen chances of infesting foundation seedstock fields with sweet potato weevils. Throw the soil up high around the base of the vines at the last cultivation, or use sweet potato varieties that develop deep beneath the soil surface.

  Good cultural and sanitary practices during storage and in the plant bed should provide weevil-free transplants. However, weevil infestations may develop from outside sources.
- Harvest — Store only weevil-free sweet potatoes and destroy those infested with weevils. Immediately after harvest, collect and destroy all crop residue — stems, roots and cull potatoes.

  Plow the field one or twice during the winter. Collect and destroy unearthed sweet potato scrap material.
- Storage — Treat sweet potatoes to be stored in quantity with 5 percent Imidan® dust at the rate of 2 to 4 ounces per 50 pounds of potatoes. Make only one storage application of Imidan® per season. Never wash harvested sweet potatoes before storing. Thoroughly cover the root surface as soon as possible before storage. Wash the sweet potatoes thoroughly before eating or marketing them.

Harvesting

Harvest the crop when the greatest number of U. S. No. 1 grade or better potatoes, 2 ½ to 2 ¾ inches in diameter and 3 to 7 inches long are found. Make sample diggings to determine this stage of growth.

Sweet potatoes continue to grow until the vines are killed by frost. Frost will not harm the sweet potatoes unless the soil temperature in the area of the potatoes falls below 55° F., whereby the sweet potatoes become chilled. Do not store chilled sweet potatoes. Ones severely chilled are unmarketable.

Before harvesting, clip or shred the vines using a flail chopper. Do not bruise the sweet potatoes. Use a large turnplow or a standard potato plow adjusted to turn out and expose the roots with the least possible injury. A 16-inch general-purpose tractor plow with an 8-inch shielded coulter for cutting the vines on one side of the row works well. Pick up one row at a time, handling roots gently to reduce bruising.

Chain-type mechanical harvesters are used widely. Some are modified with rubber-coated chains and sorting conveyors designed to carry the sweet potatoes gently. This permits digging and placement of roots in field boxes or pallet boxes in one operation.

Use new containers or old containers that have been cleaned and dipped in a solution of 2 pounds copper sulfate (bluestone) in 50 gallons of water.

Curing and Storing

Sweet potatoes are cured to stimulate the formation of a new thicker layer of skin under the thin skin present at harvest. This new skin heals over minor cuts, too. The new skin helps retain moisture in the sweet potato flesh, thereby reducing shrivelling in storage.

Stack crates or baskets in a curing room in the storage house. Place them 6 to 8 inches off the floor and 12 to 15 inches from the walls to allow ample ventilation. Circulate air during curing and storage to maintain a uniform temperature throughout the storage house. Curing is fastest at temperatures between 80° and 85° F., and relative humidities of 85 to 90 percent. Curing requires 7 to 14 days from the time the sweet potatoes are placed in storage. Skin of a properly cured root will not slough when rubbed firmly with the thumb (referred to as "thumbing"). Start a periodic check of curing on about the fifth day by using the thumbing method. After curing, move the sweet potatoes to a storage area kept at 55° to 60° F. and 85 percent humidity. Do not move or handle the potatoes until they are to be prepared for market.

Preparing for Market

Follow all practices which reduce injury during the packing operation. Less injury not only improves the appearance of the roots but also reduces entry places for the destructive organisms which cause soft rot. Avoiding all injury is impossible during handling; however, the sweet potato has a mechanism which heals the wounds after the root has been injured. The rot organism cannot enter properly healed wounds. Correct curing heals wounds.

Factors which help the healing process during handling for shipment are the same as those which help the healing during curing; however, healing proceeds at a slower rate when a sweet potato root is handled after curing. Adequate ventilation, 85° F. and 85 percent relative humidity are most conducive to rapid healing. In some operations, providing these optimum conditions before shipment may not be practical.

Botran®, a fungicide, provides additional protection against the entry of soft rot organisms during handling and shipment. Follow the manufacturer's recommendations and precautions.

During late winter, considerable changes in many packing operations may be necessary to reduce losses from soft rot and Java black rot. Roots may have to be packed into crates by hand, thereby eliminating the "drops" in the packing line. Correct parts of the packing equipment which cause excessive nicks on sweet potato roots. Caution personnel against rough treatment of filled crates. Prevent chilling of the roots while in transit.

Marketing

Sweet potatoes are sold in fiberboard cartons or in wooden crates containing 40 to 50 pounds of product. Check with your buyer and pack in the container he wants.

Sales begin in July, peak during October through January and continue at a declining rate through April.

Cooperative Extension Work in Agriculture and Home Economics, The Texas A&M University System and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
15M—12-79 HORT 4-6