SWEETPOTATOES

BY
CHARLES MARR
NED TISSERAT

Sweetpotatoes are an important commercial vegetable crop in Kansas. They are grown primarily in the Kansas and Arkansas river valleys, but are adapted for growing in other areas of the state as well. Although per capita consumption of sweetpotatoes has declined gradually over many years, there is still a good market for the crop. Kansas is about the northernmost area where the season is long enough to produce sweetpotatoes reliably and there is nearness to market advantage over many areas of the Deep South.

NUTRITIONAL VALUE AND USE

Sweetpotatoes are an excellent source of nutrition. One average root provides over one-half of the vitamin C and twice the vitamin A of an adult's daily requirements, along with significant amounts of calcium, iron and riboflavin. Sweetpotatoes can be baked, boiled, or prepared with other ingredients—pies, cakes, breads, and puddings can be made with this versatile vegetable.

Sweetpotatoes are often referred to either as "sweetpotatoes" or "yams." At one time, the drier-textured and pale-colored types of sweetpotatoes were grown in the eastern United States, while a more moist, darker orange type was grown in the Deep South. The eastern types were known as Jersey-type sweetpotatoes while those grown in the south were known as Puerto Rican types or "yams." The darker orange fleshed, moist types are now produced throughout the United States and the two terms—sweetpotato and yam—are used interchangeably.

VARIETIES

There are several varieties that can be used for commercial production. Flesh color can be various shades of orange and skin color may vary from red to brown, depending on the variety and soil type. Jewel and Pope are probably the two most popular varieties grown in Kansas today. There are several other varieties that offer specific advantages of earliness, red skin color, improved disease resistance, and other factors. Some of the important commercial varieties are as follows:

Name	Skin Color	Earliness	Notes
Georgia Jet	Rose	Early	Turnip shaped; will become large if not harvested; good for early markets.
Jewel	Copper	Medium-early	Blocky shape, consistent yields.
Pope	Copper	Medium-early	Similar to Jewel, improved digging in wet falls.
Beaurea-guard	Copper	Medium	Recent variety, uniform-shaped roots.
Travis	Dark rose	Medium-early	Red, attractive.

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The variety should be chosen to meet your market needs, season of harvest, and personal preferences. It is usually wise to "hedge" by having several varieties for local market production to ensure a consistent supply. Larger-scale wholesale production will require a consistent product which usually means growing a single variety.

SEED SELECTION

There are several serious disease problems that can be "inherited" by choosing seed from an unknown grower. Certified seed can be purchased from southern production areas. Several local growers may have excess seed for sale in certain years. Most growers save their own seed for use in future years.

Remember that good seed is the keystone for success in a quality sweetpotato operation. You should "hill select" by saving seed from only the best hills or productive areas of the field. Be as anxious to pick up and save your quality seed as you are to get your sweetpotatoes to market. Carefully cure, handle, and store seed, keeping only the best for yourself.

GROWING LOCATION AND SOIL

Sweetpotatoes will grow in a wide variety of soil types, but produce best on sandy loam soils with good drainage. Areas where drainage is a problem may delay fall harvest and cause rots from the excessive moisture. Sweetpotatoes require l20 to l50 days from planting to harvest and sandy soils warm up earlier in the spring, allowing for earlier planting.

Heavy soils cause poorly shaped roots with duller skin color. Also, avoid high organic matter soils (or "rich" soils), since poorer quality roots and lower yields often result. Sweetpotatoes are susceptible to several soil insects so newly plowed sod, pasture, or other permanent crops such as hay crops should be avoided the first season. Plant row crops or other vegetables in these areas for several years before planting sweetpotatoes.

Rotation is important; never plant sweetpotatoes more often than every 4 to 5 years in a field to avoid several disease problems which are "soil borne." Avoid areas where sweetpotatoes may have been grown in earlier years. Soil should be plowed deeply in the fall or spring.

Sweetpotatoes are best grown on ridges for several reasons. Drainage is improved in the ridges and the soil remains loose to improve shape and size of the roots. Roots tend to concentrate in the ridge, making digging easier. Ridges should be 10 to 12 inches high and maintained at that height through the season. It may not be possible to build a tall, wide ridge and be able to get between the rows for easy cultivation at narrow row spacings used for grain crops. Usual row spacings are 40 to 42 inches. Fertilize, disc and build planting ridges 2 to 3 weeks before planting, if possible, to allow the ridges a chance to "settle." If heavy rains wash down the ridges, they may need to be rebuilt slightly before planting.

FERTILIZATION

Sweetpotatoes have a deep, extensive root system and "reach" for fertilizer in soils that may not be available to other crops. Add phosphate and potash as recommended by a soil test for your location. Nitrogen levels should be kept fairly low, 30 to 50 pounds / acre, and can be applied "sidedressed" along the row after the crop is established to avoid fertilizing weeds early in the season. Sweetpotatoes also benefit from a starter solution consisting of 3 pounds of high phosphate fertilizer such as l8–46–0 or l0–52–l7 added to 50 gallons of water used to set the plants at transplanting time. Use from ½ to l cup per plant.

PRODUCING SWEETPOTATO PLANTS

Sweetpotatoes are established by planting a transplant (a long slender plant with side roots), called a "slip." Slips are produced by planting sweetpotato roots, which are often referred to as "seed" or "seedstock," in hotbeds or a greenhouse bench, which allows them to sprout, producing the slips used in transplanting.

Uniform, solid roots should be selected. Seed should be dipped in a fungicide (Mertec 340 F using ½ pint in 8 gallons of water) to prevent seedborne disease problems. Place the roots almost touching each other (¼ to ½ inch apart) on a layer of sand in a hotbed or greenhouse bench. Cover the seedstock with 2 to 3 inches of clean sand, water the beds, and maintain the temperature of the sand at 80 to 85°F. The beds should be watched as needed and checked daily, to make sure that the temperature is being

maintained. Ventilate the beds if temperatures increase to 90°F. When the first sprouts begin to show above the sand, reduce the bed temperature to 70°F and provide more ventilation through the day. Seven to l0 days prior to transplanting, open the beds to allow the plants to acclimate to the wind and sun. If a danger of frost occurs, cover the beds and insulate with straw or other insulating material. Sweetpotatoes are intolerant of cool temperatures and severe plant injury results from cold weather.

Certain varieties of sweetpotatoes are more prolific sprout producers than others. Usually 8 to 12 bushels of seedstock are necessary to produce enough plants to set 1 acre. After the first set of slips are pulled, an additional crop of slips will develop. These can be used for later plantings to extend the use of your seed. It is desirable to use as many of the first pulling of plants as possible. Approximately 20 square feet of bed space will be necessary to plant 1 bushel of seed, but this may vary with the size of seed used. Many growers use small-sized potatoes for seed since they can be spaced closer together in the bed, resulting in greater plant production per bed area.

New growers might consider purchasing plants the first year to avoid hotbed construction and the cost of heat cables, before they decide if they want to continue to grow this crop.

PULLING PLANTS

Plants should be pulled by grasping the stem and pulling to snap off the slip at the base of the "mother" root. Pull one slip at a time. Plants should be 8 to 10 inches long, stocky, and with a well-developed main root system. It is best to pull plants needed for one day's planting; but, in adverse weather conditions, slips can be "healed in" by covering the roots with sand in a corner of the bed until they can be planted. The bed can be pulled three times approximately one week apart. Slips should be planted deeply in the ridge and watered with a starter solution immediately after transplanting. Mechanical transplanters can be used for field transplanting and most transplanters will automatically deliver a quantity of water plus starter solution to the newly planted slip. Usual plant spacing is l2 inches apart, but l5 to l8 inches apart may result in larger root sizes.

DATE OF PLANTING

Planting date is a critical factor in successful sweetpotato production. Sweetpotatoes are very sensitive to cold temperature, so all danger of frost should be past and soils should be warm before planting. In most of central and eastern Kansas, sweetpotatoes are planted in mid-May. Planting dates in June usually result in reduced yields at harvest time, although some seasonal variation can result. For most seasons, planting should occur during the last two weeks of May in most of central and eastern Kansas.

CULTIVATION AND IRRIGATION

Cultivation of sweetpotatoes is necessary even if herbicides are used. Weeds that are not controlled by the herbicide should be removed when small. Ridges may need to be reformed using rolling cultivators or disc hillers. It is wise to maintain a constant ridge height and width for optimum production. Vine growth becomes extensive usually in early to mid-July, and no more cultivation is possible after that time.

Sweetpotatoes are a fairly drought-tolerant crop, but like most plants, irrigation can be used to improve yields and ensure production in dry seasons. Irrigation should be thorough, applying 1 ½ to 2 inches of water per application and not as frequent as may be necessary for most vegetable crops, especially if a wide ridge is maintained. Critical water needs are at the time of maximum vine extension when the fleshy roots are just beginning to develop. In most areas of Kansas this usually occurs in early August. Watering late in the season may not increase yields; however, some watering may be necessary in certain years to make digging easier. Any type of irrigation can be used with sweetpotatoes. They are not susceptible to foliar diseases so overhead irrigation can be used successfully. With the deep planting ridges, furrow irrigation can be used quite effectively as well. Trickle irrigation can be adapted for use with sweetpotatoes also.

CHEMICAL WEED CONTROL

The primary need for chemical weed control is early in the season where in-row weeds are difficult to control on the planting ridges. Later in the season, sweetpotatoes produce an abundant plant canopy that competes with weeds extremely well.

Material	Rate/acre	Comments
Fluazifop–P (Fusilade 2000 1E)	.16–.19 AI (1.25–1.5 pt per acre)	Controls grasses only. Apply over top of vines to actively growing grass.
Sethoxydim (Poast 1.5 E)	.19–.20 AI (1–1.5 pt per acre)	Apply to actively growing grasses over top of vines. Use 1 qt. Crop Oil concentrate or non-ionic surfactant per acre.

It is usually advisable, if possible, to water immediately after herbicide application to incorporate the material. Some hand cultivation may be necessary between plants in certain seasons where in-row weeds cannot be controlled. It is a good idea to transplant, apply herbicide, and then irrigate to get the plants off to a good start.

HARVEST

Sweetpotatoes are ready for harvest when a maximum number of roots fall in the US #1 grade. Roots do not "mature" or ripen, so begin harvest when roots are adequate in size. Early varieties may be ready for harvest in mid- to late September, while mid-season varieties usually are ready in early October. Harvest should begin before cold weather. Complete the harvest as soon after the first frost as possible. Vines can be removed by a rotary mower or flail mower. Some growers use a rolling coulter to sever vines between the rows. Small growers may plow out the rows with a moldboard plow. Irish potato harvesting equipment may be used if rubber chains are used and the equipment is operated slowly to prevent scratching of the tender skins. Some growers use a sweetpotato harvester which lifts the potatoes and carries them along a conveyor for field sorting, snapping, and grading. "Snapping" is breaking off side roots and ends of the sweetpotato root so that they have a desirable appearance. Roots are easily bruised and should be handled with cotton gloves. Root do not separate from vines easily, so hand removal usually is necessary. Discard defective roots and carefully pack roots in baskets, boxes, or small pallet bins for transportation to the curing/storage area.

CURING AND STORAGE

Immediately after harvest, "raw" sweetpotato roots should be cured. Curing is accomplished by placing the harvested roots in a room with high relative humidity (85 to 90 percent) and warm temperatures for 7 to l0 days. Curing can be done in an unused greenhouse, cooler area, or storage room with a supplemental heat source added to maintain the temperature at 85°F. Humidity can be increased with a humidifier or by placing moist burlap in the storage area. During the curing process, starches are converted to sugars, improving the flavor of the sweetpotatoes as well as improving texture and cooking characteristics of the roots. Curing also causes a callus to form over cuts, scratches, and bruises and results in a "healing" process to improve long-term storage.

If warm temperatures can be provided, curing can be accomplished in 5 to 7 days—lower temperatures require longer time. Rub one root against another and if the skins are easily scratched, more curing is needed. The curing/storage room may need to be ventilated to remove excessive moisture. Sweetpotatoes can be damaged by rats and mice, so be alert for problems. Wire mesh screens should be used over openings or vents and rodent control measures used if they enter the storage area.

After curing, lower the temperature and maintain a 50 to 55°F storage temperature with high humidity. Usually additional humidity does not need to be added since respiration of the potatoes will maintain moisture in the air. Any temperatures below 50°F can severely and permanently injure the crop, resulting in discolored roots with poor flavor that rot excessively in storage and produce lower number of poor quality slips from seedstock.

PREPARING FOR MARKET

Sweetpotatoes should be washed or brushed, sorted, and graded for market. Handle roots carefully during the washing and packing process. Sweetpotatoes entering commercial market channels should meet U.S. #l grade standards. Specific grade standards are available from the U.S. Department of Agriculture, Agricultural Marketing Service. U.S. #l potatoes are firm, smooth, clean roots, between 1¾ and 3½ inches in diameter and from 3 to 9 inches in length, weighing not more than 20 ounces. Roots

should be free from sprouts, insect injury, cracks, or other defects.

Sweetpotatoes are usually sold in wirebound crates or baskets as a bushel volume holding 50 pounds or in paper cartons holding a bushel volume of 50 pounds. Market sources should be contacted in advance in order to meet their packaging requirements. Transport sweetpotatoes in a covered, heated truck in cold weather. Local market sweetpotatoes are usually sold by the pound. Some growers sell sweetpotatoes as "pick your own," allowing customers to pick up potatoes in the field.

A good commercial yield of sweetpotatoes should be approximately 250 bushels of U.S. #l potatoes per acre. Small potatoes can be held for seed for next years crop. Off-grade potatoes and large potatoes ('jumbos'), can be sold in local markets and priced according to demand. Price per bushel is determined by national supply and demand and varies from year to year.

INSECT PROBLEMS

Sweetpotato vines are not usually injured by insect feeding. The insect problems that influence sweetpotato production are primarily soil insects, grubs and wireworms. Avoid newly tilled pasture, sod or permanent crop areas such as hay fields. You can check for wireworms about three weeks prior to planting by digging a 4-inch hole in the soil, fill the hole with wheat or corn seeds (untreated), cover with soil and use black plastic to warm the soil over the test hole. If two or more wireworms are present in the test hole, treat with a soil insecticide as follows. Soil temperatures should be above 50°F for insect counts or treatment.

Diazinon	50WP	8 lbs / acre	Broadcast, mix into upper 4 inches of soil immediately after treatment, and form ridge for planting.
	4EC	4 qts / acre	
	14G	25 lbs / acre	
Dyfonate lOG		20 lbs / acre	
	4EC	4 qts / acre	

DISEASES

Sweetpotatoes are subject to several diseases which can seriously affect the quantity and quality of roots produced. Sweetpotatoes are vegetatively propagated; therefore, seedborne or soilborne diseases can be a major problem if certain precautions are not followed. Nevertheless, sound cultural practices and strict sanitation can eliminate many disease problems of sweetpotatoes. Fortunately in Kansas, foliar diseases are of minor importance and do not require chemical sprays for control. A brief account of some of the more important diseases of sweetpotatoes in Kansas is given below.

BLACK ROT, SCURF AND FUSARIUM SURFACE ROT

Black Rot, incited by the fungus *Ceratocystis fimbriata*, is a common and highly destructive disease of sweetpotatoes in Kansas. The fungus attacks all underground parts of the plant and causes decay of the fleshy roots in both the field and storage. Symptoms first appear as somewhat circular, metallic-black lesions or spots on the surface of affected roots. The lesions expand and may cover most of the root surface. Internal decay does not extend deeply into the root, except in cases where other decay fungi enter the lesion.

The black rot fungus also attacks new sprouts in the hotbed. Black spots which develop on the sprouts, enlarge rapidly and often girdle and kill the plant. In some cases, infected sprouts may be killed before they emerge through the hotbed soil. Aboveground symptoms are not always noticeable, although leaves of severely affected sprouts usually have a sickly, yellow appearance.

Scurf, incited by the fungus *Monilochaetes infuscans* is another common root disease of sweetpotato. The scurf fungus is only a problem on the underground portions of the plant, where it invades and kills the outermost layer of cells resulting in a brownish discoloration of the infected area. The small, individual lesions may coalesce to eventually cover large portions or the entire root. The damage to the root is mostly superficial, although secondary organisms may invade the dead tissues and cause further decay. Scurf infections are especially conspicuous after sweetpotatoes have been cleaned for marketing. Infected roots are unattractive and, therefore, sell for less. The diseased areas may increase in extent after

sweetpotatoes are placed in storage, but new infections on stored roots are rare. Affected roots shrivel during storage and become dry and leathery because the protective cork layer of the skin has been destroyed.

Fusarium surface rot, incited by the fungus *Fusarium oxysporum* is primarily a problem in storage. Surface rot lesions are generally circular, with regular margins, and the affected area is brown in color. The lesions may develop to 2 or more inches in diameter. They develop slowly, taking six weeks or more to become evident. The diseased area becomes sunken in older tissues. This disease, as its name implies, causes shallow lesions that usually do not extend deeply into the flesh. Other invading organisms, including soft rot, may follow, and cause the entire root to decay. The inner color of surface rot lesions is brown and older lesions may become dark brown. Sweetpotatoes affected with surface rot become shrunken due to loss of water and finally become hard and mummified.

Control: Sound cultural practices are very important for the control of root diseases such as black rot, scurf and Fusarium surface rot. Probably the most important thing a grower can do is to use disease-free planting stock. Original plants should be purchased from a certified source and increased under carefully controlled conditions (see discussion under Seed Selection). *Any roots showing symptoms of black rot or any other disease should not be used for propagation.* Clean roots should be bedded into pathogen-free soil. This means that the soil in the hotbed should be changed or disinfested by steaming or by chemical fumigation each year. Roots should be dipped for two minutes in a suspension of the fungicide thiabendazole (Mertect, 42% a.i. at 8 oz in 7.5 gal) to protect against black rot and other soilborne diseases.

Growers should avoid planting sweetpotatoes continuously in the same field; a three-year rotation is recommended. During the growing season, maintain good weed and insect control. Sweetpotatoes should not be harvested during cold, wet weather, as this will increase the likelihood of Fusarium surface rot. Handling during lifting should be done with care to avoid bruises and mechanical injuries. Storage facilities should be thoroughly cleaned before harvest. Follow the guidelines under the section on Curing and Storage.

SOIL ROT OR SOIL POX

Soil rot or soil pox, incited by *Streptomyces ipomoea,* can be a serious problem in alkaline soils in Kansas. The disease is also more severe in fields continuously cropped to sweetpotatoes and in fields which experience water stress during the first few months following transplanting. Infected plants develop a decay of the rootlets with malformation and pitting of the fleshy roots. The rootlets of infected plants may be injured so severely that the plants remain stunted. Fleshy roots often remain below market size and may be so malformed as to be unsalable. The symptoms of the disease are similar to that of scab on Irish potato.

Control: Soil rot is difficult to control in fields where it has become established. This organism is not dependent on sweetpotato plants for continued existence and can live from year to year on decaying organic matter in the soil. Rotating crops and keeping sweetpotatoes off infested fields tends to reduce, but does not eliminate, the organism. Be sure to select healthy roots (those free of soil rot and other diseases) for bedding. The organism can be spread from infected bedding plants to the slips and into noninfested soil. Be sure to bed in areas free of the disease. Plant slips in fields where soil rot has not occurred or in soils that have been fumigated. The disease is inhibited in soils where the pH is 5.0 to 5.2. Raising the pH by liming tends to increase the severity of the disease. Application of sulfur to alkaline soils may be helpful, but be sure to consult with a soil specialist before applying sulfur. Soil fumigation will help to control this disease, but it is very expensive.

FEATHERY MOTTLE VIRUS

Virus diseases are a major problem in sweetpotato production, largely because viruses are transmitted from infected roots to slips during propagation. The most important virus disease of sweetpotato in the United States is the feathery mottle virus. Symptoms of this disease are quite variable and cultivar dependent. Symptoms have been listed under various disease names including russet-crack, internal cork and chlorotic mottle. Initially, infected plants show a yellowing or veinclearing of the leaves. In some cases, small feathery yellow patterns develop along leaf veins.

Affected plants commonly are stunted and appear unhealthy.

Internal cork appears as dry, corky, dark-colored clumps of tissue scattered through the flesh of affected sweetpotatoes. Small cork lesions may be found in the roots at digging time. Usually extensive corking does not occur until the roots are stored for several weeks. The symptoms are more serious when storage temperatures are high (above 60°F). The corky spots may occur singly or in groups and are most readily detected by cutting the roots into thin slices. Severely diseased roots may develop so many corky lesions that they become practically useless for food.

Russet crack symptoms are most noticeable on the surface of affected sweetpotatoes and consist of areas containing numerous fine or coarser irregular cracking and browning of the surface. The lesions may cover much or only a little of the root's surface. Lesions may also develop on the stems to which the sweetpotatoes are attached or on the underground parts of sprouts in the hotbed.

Control: The virus persists in the roots of diseased plants. If these roots are used to produce slips for new plantings, then plants derived from the infected root will also be diseased. Therefore, it is extremely important to use virus-free seedstock. Purchase seed certified to be free of viruses. If seed is saved from last year's crop, use only those roots which show no symptoms of russet-crack or internal cork. Unfortunately, some infected roots remain symptomless, and there is no guarantee that these roots will be free of the virus. The virus also may be transmitted from plant to plant in the field by aphids; however, efforts to control the disease by decreasing aphid populations has had only limited success and is costly.

RETURNS

Fuel consumption is estimated at 1.5 gallons per hour of tractor time. Oil and lubrication is estimated at 15 percent of fuel cost. Repairs are estimated at $2.25 per hour of tractor time and $17 per acre for irrigation equipment. Fuel, repairs and taxes for a truck are not included as costs. Depreciation, interest on investment, and insurance for a truck are included as costs.

COST-RETURN PROJECTION FOR SWEETPOTATO PRODUCTION IN KANSAS

Variable Costs per acre	*Total*
1. Fertilizer	$ 45.00
2. Seed, Transplants	132.00
3. Herbicides	48.00
4. Insecticides	36.00
5. Fungicides	0.00
6. Nematicides	0.00
7. Labor	840.00
8. Fuel and Oil	39.59
9. Repairs	77.75
10. Water	4.00
11. Utilities	0.00
12. Custom Hire	0.00
13. Supplies	250.00
14. Marketing	0.00
15. Other	122.50
A. Total variable costs	$1,594.84
Fixed costs per acre	
16. Interest on land and building	60.00
17. Taxes on land and buildings	10.00
18. Rent for rented land	0.00
19. Depreciation on machinery	75.00
20. Interest on machinery	45.00
21. Depreciation on buildings	12.50
22. Depreciation on Irr. Equip.	165.00
23. Interest on Irr. Equip.	99.00
24. Insurance	6.63
B. Total fixed costs	$ 473.13
C. Totals costs	$2,067.96
D. Yield per acre	250.00
E. Price per unit	7.50
F. Returns per acre	1,875.00
G. Returns over variable costs	280.16
H. Returns over total costs	(192.96)
I. Variable costs per unit	6.38
J. Total costs per unit	8.27

About the authors: Charles W. Marr is Extension Specialist, Vegetable Crops; Ned Tisserat is Extension Specialist, Plant Pathology

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