

# SWEET POTATO

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## ECHO TECHNICAL NOTE

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### WHY GROW SWEET POTATOES?

Sweet potatoes (*Ipomoea batatas*) are already the 6th or 7th most produced food crop in the world, surpassed only by wheat, rice, corn, potato, barley, and possibly cassava. Among the reasons that sweet potato is a great crop is that it is relatively easy to grow, relatively free of pests and diseases, has relatively high productivity, and is always good food, principally starch, some protein and vitamin C, and, in orange varieties, rich in vitamin A. In addition, the young leaves, rich in protein and most vitamins, are also good food. Furthermore, the sweet potato is an excellent animal food.

Its ability to produce in poor soils makes the sweet potato an especially good crop for poor tropical soils where fertilizer is not available. If the leaves are also used as food, sweet potato will probably produce more nutrients per acre than almost any other crop under those conditions. (The other tropical crop that produces well on poor soils and also has both edible roots and leaves is cassava. It has an advantage over sweet potato in drought tolerance, but sweet potato has the advantage in nutrients. That is because substances called polyphenols in the cassava leaf combine with protein during cooking and reduce the amount of protein that is digestible.)

Nevertheless, like all crops the sweet potato must be produced with understanding in order to obtain maximum yields. It should never be treated with neglect.

### CLIMATIC, SOIL, AND OTHER REQUIREMENTS FOR GROWING SWEET POTATO

Sweet potato is a hot weather crop. It is difficult to imagine an earthly environment that is too hot for sweet potato. In general, hot temperatures only speed up the activity and growth of sweet potato. On the other hand sweet potatoes will survive at any temperature above freezing, and are very productive at temperatures that are comfortable for humans as well. Sweet potato is often said to be a tropical vegetable. However, 1 or 2 crops per year are grown in the temperate zone during the summer where special provisions are made for conserving the storage roots during the winter (see drying and storage, later).

Sweet potatoes require a moist but well drained soil for best growth. Temperate Zone sweet potatoes are especially sensitive to flooding but many tropical varieties can tolerate short periods (a few days) of flooding. Sweet potatoes need adequate water at the time of planting and for several weeks thereafter. They can tolerate light drought in the second and third month of growth, and often fairly severe drought in the fourth or fifth month.

Depending upon variety, sweet potatoes may be ready for harvest after 10 weeks or may require up to 9 months in the field. The majority of the varieties can be harvested after 4 1/2 months in the field. Cool conditions such as found in tropical highlands can extend the needed growth period of normal varieties to 8-9 months. Early varieties (10 weeks) are in the process of development. Sweet potatoes from an individual planting may be harvested as needed over a three to four month harvest season.

Sweet potatoes bloom more freely when days are short and nights long. There is some suggestion that they form tubers more freely at this time as well. However, if temperature and water is adequate, they can produce at any season.

Sweet potatoes produce best in a well-aerated soil with medium texture. In such soils they need not be planted on ridges. They can be produced in heavy soils formed into ridges for drainage and increased aeration. Sweet potatoes are often grown in sandy soils. The requirements for soil fertility are fairly low, moderate nitrogen, low phosphorous, and high potassium. Too much nitrogen results in abundant foliage and low and /or late yields.

Sweet potatoes have two special needs, discussed in greater detail later: a reliable supply of planting materials, and protection from their chief insect pest, the sweet potato weevil (*Cylas*).

## CULTURE

### SOIL PREPARATION, PLANTING, AND FERTILIZATION

The area selected for planting should be as far from previous sweet potato plantings and its morning glory relatives as possible.

The kind of soil preparation necessary will depend on the soil itself, the rainfall expected, and the weeds to control. Plowing buries the weeds but turns up dormant weed seeds. It loosens the soil, permitting better penetration of water and air. Sweet potatoes are often planted in raised beds, ridges, or hillocks to improve drainage and aeration, or to permit furrow irrigation. In a sandy soil planting on the flat is possible, and if drought is expected, sweet potatoes can be planted at the bottom of the furrow.

Regardless of preparation, the soil should be very loose at the time of planting. Incorporation of manure or compost is useful. Distance between plants will depend upon the type of planting. One foot (30cm) between plants in a row is a minimum. Individual plants will yield more if given up to 1 square yard (meter) of space, but many roots will be excessively large. These large roots are edible but likely to be irregular in shape and unsightly. The layout of rows or beds will depend on the machinery or methods used for soil preparation.

Fertilizer can be placed in the bed or row or even broadcast on the soil before planting. Preplanting herbicide such as Amiben (chloramben) can also be sprayed on the soil before planting. The soil should be damp at planting time.

### PROPAGATION MATERIALS

Good yields of sweet potato require vigorous vegetative planting materials. If poor materials are used, growth will be delayed and yield will invariably be reduced. Poor materials will negate all other efforts to provide optimum conditions for growth.

For practical purposes in the tropics sweet potatoes are produced from cuttings of existing vines. In the Temperate Zone it is necessary to conserve storage roots during the winter and stimulate them to grow in the spring as a source of sprouts for planting. This technique requires very careful management of the stored roots, including controlled temperatures. Therefore, it cannot be recommended for the tropics. Cuttings for new plantings can be taken from existing plantings 2-3 months of age. Cuttings should not be taken from older plantings in order not to

reduce yield. Up to 5 cuttings can be taken per plant. However, at the time of harvest it may be possible to obtain some good cuttings just before the old vines are cut away for the harvest of roots. In areas where sweet potatoes are not grown year round, special plantings will have to be made as sources of cuttings. It may be possible to obtain as many as 30 cuttings per plant. The actual ratio of size of cutting bed to size of planting should be from 1:10 to 1:40.

Cuttings should be 12-18 inches long. Shorter cuttings can be used if the distance between nodes is not excessive. The vines should be vigorous but not too soft and succulent. Two, three, or more cuttings can be taken from most vines but old thickened, diseased, and leafless cuttings should be avoided. It is not useful to remove any leaves from the cuttings.

Cuttings should be gathered together in convenient sized bundles, tied, or wrapped in burlap. These bundles should be held 1-3 days in a shady protected area and maintained moist. This will stimulate root production, and even though the initial roots may be broken on transplanting the cutting will be more ready to establish itself if allowed to pre-root as described.

If weevils are a problem, cuttings can be immersed five minutes in a drum containing 0.1% carbofuran. Use gloves. Plant within 24 hours. This treatment eliminates weevils within the cuttings.

Planting can be done by hand or with an animal or machine-drawn planter. Usually best results are obtained by planting cuttings at an angle with about 2/3 of the cutting below the soil. If a pre-emergence herbicide has not been used, it can be applied after planting, followed by a light irrigation to remove it from the leaves and to carry it into the soil.

## VARIETIES

It would be useless to try to describe all the sweet potato varieties that exist or even the best varieties. There are too many and they are not freely moved from one place to another. The specific needs of each area, including human preferences, mean that local variety trials and preference tests are always desirable. Therefore, it is probably more useful to talk about some of the differences found; only the most important characteristics are included (Table 1.)

Table 1. CHARACTERISTICS OF SWEET POTATOES.			
Characteristics	Sub-characteristics	Phases	Significance or Note
Internal color	white yellow orange		no vitamin A activity little vitamin A activity high vitamin A activity
Sweetness		high intermediate low or none	common common rare
Texture		very dry intermediate moist	least preferred often preferred common in orange roots
Plant habit	running bunch		normal uncommon
Disease & Insect resistance	virus	high low	common discard the variety if virus is excessive
	Fusarium	high low	needed mostly in the temperate zone of little importance in the tropics
	Scab	high low	rare, important in SE Asia common, of little importance in most areas
	Scurf	high low	important in certain parts of the temperate zone usually not important in the tropics
	Nematodes	high intermediate low	a few excellent varieties are available common if the variety is very susceptible, discard it
	Weevil	low very low	uncommon, desirable resistance common and normal
	Soil insects	high low	a few excellent varieties in the U.S. common and normal
Sprouting ability		high low	necessary in temperate zone types common, not important in the tropics
Yield		high low	up to 60 tonnes/ha is possible yields are 4-5 tonnes/ha under inappropriate conditions or with poor varieties

## AFTER PLANTING CARE

Newly planted cuttings need watering frequently for 1-3 weeks. Once new growth begins watering can be reduced to that needed when visible wilting is seen. Very little water will be necessary the 4th and 5th month.

Depending on the previous fertilizer treatment, some fertilizers may be needed 2-3 weeks after planting. It can be applied by machine, in holes between plants, or broadcast. In any case, fertilizer application should be followed by irrigation, especially if fertilizer touches the foliage. The amount per plant can vary from 5 grams (light), 10 grams (medium) or 20 grams (high) per plant.

Weeds will normally be a problem; pre-emergence herbicide reduces the problem.

Remember, too much foliage means poor or late storage root growth. If foliage is excessive and yields are poor, usually due to too heavy fertilization, any method that destroys part of the foliage tends to decrease this problem.

The most common problems likely to be encountered are shown in Table 2.

Disease or Insect	Suggested Control
Virus	Usually of little importance, can be reduced by good culture (water and fertilizers). If persistent, destroy the variety and use another.
Leaf spots	In Southeast Asia the disease Scab requires specific chemical controls. Elsewhere, forget leaf diseases, or use more resistant varieties.
Spider mites	Usually occur during the dry season, reduced by miticides, frequent sprinkler irrigation, or soapsuds.
Leaf-eating caterpillars	Attacks are often short lived. If severe, non-toxic <i>Bacillus thuringiensis</i> (Dipel) or chemical spray application is necessary.
Weevils ( <i>Cylas</i> )	Use isolation of planting and treatment of cuttings to avoid weevil. Harvest early. Chemical controls are not reliable.
Other soil-borne insects	Many insects attack sweet potatoes. On an insects small scale controls are seldom practical. Drying and aerating the soil 1-3 months helps reduce these insects. Some U. S. varieties are resistant.

## HARVEST & STORAGE

There is no perfect time for harvests. Early harvest results in less yield, smaller roots, less insect damage, less cracking, milder flavors, and poor storability. Late harvest results in the reverse. If insects are not a problem partial or periodic harvest from 3 to 8 months may be possible, and convenient for the family.

Cut away the vines before harvest. These can be fed to animals, composted, or buried. The storage roots can be dug by hand with spades or forks, or by plow, especially a "middlebuster". As soon as possible after digging, remove the sweet potatoes from the sun, in boxes, bags, or baskets.

Sweet potatoes may have to be cleaned, depending on the soil where produced. A minimum is to brush off the soil. If the soil is not easily removed, wash with a little detergent to reduce bacteria and fungi. After washing the roots should be drained and dried, but not in the sun.

The roots should be sorted. Very small roots can be fed to animals. Damaged roots can be used immediately or processed as previously described. Sound roots can be stored at cool temperatures (minimum 55F, 13C) for 2-8 weeks.

Rot of roots in storage is reduced by curing at high (80-90%) humidity and high (90-95 degrees F) temperature for 4-5 days. Cured roots can be stored at the recommended temperature for up to 1 year.

## PRINCIPLE USES OF SWEET POTATOES

Leaves. The sweet potato plant can be harvested for leaves during the 2nd and 3rd months of production. Only the tender stem and young not fully developed leaves, which constitute the distal 2-4 inches of the growing stem, should be taken. The leaves and stems are boiled for 15-20 minutes, washed, seasoned, and served.

Boiled sweet potato. The sweet potato is washed, peeled and trimmed, cut into 1-inch thick slices or cubes, and boiled 18-20 minutes. The boiling water is then discarded. The sweet potato can then be served as is, mashed, or combined in many dishes (casseroles). The mashed pulp can be used as a partial substitute for wheat flour in baked products such as pancakes, cakes, flat breads, cookies, fritters, or even bread.

Baked sweet potato. The entire sweet potato is wrapped and then baked in a modern or primitive oven until soft (one hour at 350 degrees C). During baking of most sweet potatoes, part of the starch is converted to the reducing sugar, maltose, thus increasing sweetness.

Osmotically modified boiled sweet potato. The peeled and trimmed sweet potatoes can be cut into thin (1/8") slices, placed in water 2 hours (moved once in a while) and then boiled. The products will be clearer, less sweet, and milder than those made from untreated sweet potatoes. (What is happening chemically is that the enzymes and substrates responsible for polyphenolic oxidation are partially lost, as well as some of the sugars).

Sweet potato flour. The flour of sweet potato is much more difficult to make than that of potato because the reducing sugars readily released from the starch combine with free amino acids to produce disagreeable colors, odors, and flavors. To avoid this the peeled sweet potato can be shredded, and the shreds immersed in water 2 hours. This process works better if the water is changed 2-3 times. The shreds are drained and then dried, first in the shade (with air movement or wind) and later in the sun (in some cases, drying over the stove or in an oven will be necessary). The brittle shreds are easily crushed to flour, or this can be done rapidly in a household blender. The flour can be stored for 6 months or more in sealed containers. It can be used as a substitute for wheat flour in the following amounts: 100% in white sauces, 25-50% in cookies, cakes and flat breads, and 15-20% in breads. From the water, starch can be recovered (see below).

Starch production. The peeled sweet potato is ground in a mill or blender as finely as possible, and mixed with 5-10 times its weight in water. The starch settles out, and the water is carefully poured away (can be used as pig feed). The starch is then mixed with water 1-3 times more and the process is repeated. After the last settling the water is carefully drained and the starch is dried on a metal surface in the sun. It can be used, as is any starch, such as corn or potato starch, and can be stored in sealed containers for a year or more.

Breakfast cereal. A breakfast food similar to "cereal" can be made from any sweet potato. The sweet potato is grated (not as finely ground as for starch), suspended in water, and filtered through a cloth. The liquid is saved for starch, the residue is suspended 1-3 times more in water, and filtering is repeated. The portion of the sweet potato that does not pass through the filter is then dried and lightly toasted on a hot plate (over the fire). The toasting is very delicate. The product must be stirred and turned almost continuously, and should not become sticky and jellified. The toasted product can be stored in sealed containers and eaten with milk without further cooking, or can be used much like starch or flour, imparting its characteristic flavor.

Feed. All parts of the plant can be used as feed. The storage roots should be cooked before feeding them to pigs. Rabbits love sweet potatoes.

### **AVAILABILITY OF SWEET POTATOES**

The following companies distribute sweet potato:

- Steele Plant Co., Box 191, Gleason, TN 38229, ph. 901/648-5476
- Fred's Plant Farm, 4589 Ralston Rd., Martin, TN 38225, ph. 800/550-2575
- Gurney Seed & Nursery, 110 Capital St., Yankton, SD 57079, ph. 605/665-1930