HARVESTING, CURING AND STORAGE OF SWEET POTATOES

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INTRODUCTION

Sweet potatoes may be harvested whenever they reach a marketable size. Under good growing conditions, harvesting may begin 90 to 100 days after planting of some varieties and continue until well after frost has killed the vines and leaves. Injuries to the roots detract from their value and cause losses. Injury to sweet potatoes can be incurred several ways that will impair their keeping quality.

COLD SOIL

Sweet potatoes freeze at about 30 degrees Fahrenheit and are ruined. They are injured at temperatures below 55 degrees Fahrenheit, especially below 45 degrees Fahrenheit. Many small acreage growers delay digging until the first light frost occurs, some because of large acreages, can not harvest all their crops before frost occurs. In general, no damage will result unless frost injures the top exposed roots or the air temperature drops low enough to freeze the top inch of the soil and the roots in this layer. If roots are dug promptly after a light frost, they will keep as well as before the frost. The soil temperature at the time of the first frost usually will be near 60 degrees Fahrenheit in the vicinity of most of the roots.

Probably the best time to harvest for storage is after the leaves show a slight yellowing, indicating that growth is slowing up, and before or very soon after the first light frost. The earliest planted fields generally should be harvested first. The digging should be done if possible when the soil is dry and the temperature is fairly high. Less heat is required in curing if sweet potatoes are harvested and cured when the weather is still fairly warm.

HARVESTING AND HANDLING

The sweet potatoes root is covered by a thin, delicate skin that is very easily broken. Striking the roots with harvesting equipment or dropping them into containers injures their skin. Bruises and abrasions must be kept at a minimum. The sweet potato may be cut or bruised if they are placed in containers having sharp edges or roughly hauled or handled.

If a sweet potato is cut or bruised during harvesting or handling, a heavy, sticky, milky juice is released from the injured cells. This juice dries in a few hours and may appear to have closed the wound but actually several days are required for the growth of new cells that protect the interior cells from infection, the dried juice on the surface of a wound on a sweet potato is in itself no appreciable protection against rotting; such a root is not safe from storage diseases.

Various methods can be used to harvest sweet potatoes. Growers with a few acres may use a mold board plow (with the tip of the wing cut off, Figure 1.) or middle buster with a notched coulter adjusted just left of the point to cut the vines. After the sweet potatoes are plowed out, they are removed from the vines and excess root length is broken off. A field worker picks up one row (scratching out) and placing roots on the adjacent row. Going back on the adjacent row, the worker picks up the potatoes, grades them either as No. 1’s or No. 2's and places each grade into a separate container, plows will not expose all the roots nor will the workers of today scratch out partially buried potatoes. Research has showed that 20% of the marketable potatoes are left in the ground when dug with plows.

FIGURE 1. A mold board plow or middle buster used for digging sweet potatoes.

Some mechanical harvesters require that the vines be removed prior to digging. (Figure 2.) The rotary mower can be used, but it does not cut the vines between the rows of some varieties.

FIGURE 2. Sweet potato vines removed prior to digging.

Another vine removal machine that works very well is a modified flail chopper. (Figure 3.) Flails are contoured to fit the rows.

FIGURE 3. A modified flail chopper for vine removal.

Several types of mechanical diggers have been and are still being used to lift sweet potatoes out of the ground. The simplest machines patterned after a low flat-bed type potato digger. (Figure 4.) These machines are for one row which incorporates a short separating chain behind a wide blade which elevates both soil and potatoes onto the chain. Soil is taken off and

potatoes move by chain rotation to the rear of the diggers where they drop back to the ground for hand pick-up. This type of machine does well in a heavy or wet soil.

FIGURE 4. A low, flatbed potato digger used to dig sweet potatoes.

The second type of harvester incorporates two rod link chain conveyors. (Figure 5.) One conveyor is useful to elevate the sweet potatoes from the digging blade to the other conveyor from which sweet potatoes are graded and packed by 4 to 6 people, who are riding the machine. Another name brand machine (Figure 6.) uses one continuous rod link chain conveyor from the digging blade to the rear *of* the machine. While the sweet potatoes are being elevated the chain conveyor is agitated to separate most of the soil from the potatoes. Then the conveyor forms a grading table where grader-packers select potatoes and place them in bins. This machine conveyor has longer life because of less contact with the soil.

FIGURE 5. A sweet potato harvester using two, rod link, chain conveyors.

FIGURE 6. A continuous, rod link chain conveyor sweet potato harvester.

A third type of machine is a combine. (Figure 7.) Usually two rows are required for two to five people to operate. They are normally powered by PTO and tractors with hydraulic system. Normally vines do not have to be removed since the machine separates vines from roots. Also, they are conveyed to large boxes to be sent to a packing shed for grading or to be cured.

FIGURE 7. A two-row sweet potato combine that does not require vine removal.

FILLING THE STORAGE HOUSE

Storage in crates or boxes or bins is recommended. Unless the storage house has a fan or blower for circulating the air, stacking containers higher than 8 to 10 feet is not recommended. If the temperature of the bottom layer of higher stacks is right, then the temperature of the top will be too high; excessive sprouting and consequent pithiness of the sweet potatoes will result. Stacking too high may also result in buckling or breakage of the lower crates or bins especially under high-humidity conditions; however, it is sometimes necessary to store higher than 10 feet because of a shortage of space. In such cases it is best to dispose of the upper layers first.

When there are several rooms in a storage house, one should be filled before another is started. Each room should be filled as rapidly as possible within 2 to 3 days if it can be arranged. In this way the curing will be uniform.

If filling a storage room takes a week or more, the first sweet potatoes may be cured longer than desirable and the last ones only partly cured. It is therefore suggested that large storage houses be divided into several rooms each of which can be filled in two or three days. As the sweet potatoes are sold, the rooms can be emptied one at a time and the heat cut off as they are emptied. It is easier to maintain proper temperature and humidity in a room which is full of sweet potatoes than in one which is relatively empty. If the house is not divided into several rooms and it cannot readily be divided, it is preferable to place the lower layers of crates first throughout the house and then the upper layers, because the latter will be at a higher temperature during curing.

CURING

Sweet potatoes should be cured immediately after harvest, preferable at 85 degrees Fahrenheit and a relative humidity of 85 to 90 percent for 4 to 7 days. Sufficient exchange of air in the curing room should be allowed to prevent the accumulation of carbon dioxide

produced by the roots or depletion of oxygen consumed by them. If condensation is excessive, it is removed by ventilation.

The primary purpose of curing is to heal injuries so that the sweet potatoes remain in good condition for marketing during the winter and to preserve "seed" roots for the next crop. Healing takes place rapidly at 85 degrees Fahrenheit and 85 to 90 percent relative humidity. Curing should start as soon after harvest as possible to heal injuries before disease-producing organisms gain entrance. Healing involves production of cells that are very much like the skin in their ability to prevent infection. These new cells form in a layer just below the surface of the injuries. Because this layer is corky, it is commonly called wound cork. Healing is more rapid under clean cuts and skinned areas than in deep wounds where tissue is crushed. The rate of healing differs a little among varieties.

At 85 to 90 degrees Fahrenheit wound cork begins to form in 2 days and is well developed in 5 or 6 days. At lower or higher temperatures than this, wound cork forms less rapidly. Above 95 degrees very little, if any, wound cork develops and such temperatures should be avoided. Satisfactory wound-cork formation takes about 4 to 7 days at 85 degrees, 8 to 10 days at 80 degrees, 15 to 20 days at 75 degrees, and 25 to 30 days at 70 degrees. At 55 degrees or below, wound cork does not form. Slow formation of wound cork increases the opportunity for decay-producing organisms to gain entrance to the root before the layer is sufficiently well formed.

Because the layer of wound cork forms near the surface of wounds, desiccation of the wounds retards such formation by making the cork form several cells deeper, or, if the wound dries rapidly, prevents the formation of wound cork by desiccating the cells that form the cork layer. Usually, a relative humidity below 70 percent retards healing, causes high weight losses, and makes injuries dark, sunken, and unsightly. Relative humidity near saturation (95 to 100 percent) often allows considerable condensation on storage walls and ceiling, and may cause discoloration of the surface of the roots. The relative humidity around the roots in a storage container is usually slightly higher than that in the air around the containers or in the rest of the room.

CARE DURING STORAGE

After sweet potatoes are cured, the temperature in the storage house should be brought down below 60 degrees, but not lower than 55 degrees, as rapidly as possible-preferably during the week or two after curing is completed, because continued high temperatures result in excessive sprouting.

For best results during the storage period, the relative humidity of the air should be maintained at about 85 to 90 percent. If it becomes too damp in the storage house, the ventilators and possibly the doors should be opened, but care should be taken to prevent the temperature in the storage house from becoming too low. The desired temperature during storage generally can be obtained in warm weather by manipulating the ventilators. It is generally possible to cool a house by opening them during the night or during cool spells and by closing them during the day or in warm weather. Some operators leave the top ventilators open during mild weather and open the bottom ones only at night to cool the room. Special care should be taken to prevent the temperature of any part of the storage from dropping below 55 degrees Fahrenheit. During cold weather both the top and the bottom ventilators should be closed and if necessary the storage should be heated. Sweet potatoes must be kept at 55 degrees to 60 degrees if satisfactory results are to be obtained.

A temperature of 40 degrees Fahrenheit, although more than 10 degrees above the freezing point of the sweet potato is definitely harmful. When sweet potatoes are chilled, even though not frozen there is a very marked increase in their susceptibility to infection by certain rot-producing organisms. If the temperature stays as low as 40 degrees for 3 weeks or more, 40 to 90 percent of the sweet potatoes may rot. One of the difficulties in connection with rotting as a result of chilling is that the damage does not appear at once but several weeks after the proper storage temperature of 55 to 60 degrees has been restored.

A second effect of chilling is an internal discoloration and breakdown of the root that may occur even though it is not attacked by rots. This trouble also may not develop for several weeks after chilling unless the sweet potatoes have been held at a temperature near the freezing point. An exposure of only 4 days at 40 degrees Fahrenheit has resulted in the development of this discoloration.

A third effect of chilling is reduction of the "seed" value of the roots; if the chilling is severe the sweet potatoes may fail to produce any sprouts when bedded.

PREPARATION FOR MARKET

One reason why farmers often receive low prices for sweet potatoes is that they have used improper methods of growing, handling, and marketing. Careful grading, cleaning, and packing the product and putting it on the market when there is a good demand means better prices. When sweet potatoes are to be marketed they must be carefully graded. The market demands uniform medium-sized sweet potatoes, free from bruises or decayed spots. In grading those that are too large or too small, as well as those that are misshapen, cut, or bruised, should be used for making stock feed or for canning.

After being carefully graded, the sweet potatoes should be put into clean, attractive packages. An attractive pack of well-graded sweet potatoes will usually bring a better price than an ungraded one.

The general practice is to wash (Figure 8.) both the newly harvested and the cured sweet potatoes before they are packaged for market. When black rot is present, washing seriously spreads the disease particularly in the freshly harvested crop; however, the sweet potatoes are still washed because of market demands for an attractive product.

If black rot has not been eliminated in the field, the sweet potatoes showing symptoms of black rot when dug should be disposed of promptly. Sweet potatoes from lots that show no signs of black rot at harvest often develop serious amounts during storage or marketing.

Washing should not be more extensive than necessary to remove the soil. Care should be taken not to make fresh wounds such as broken ends because of the danger that soft rot organisms may infect them. A washing and grading line of common type consists of the following equipment:

1. An overhead spray washer with underneath rollers.
2. A roller-conveyor type of sorting table to permit removal of unsound sweet potatoes.
3. An underneath brush and overhead spray washer.
4. A 10 or 12 foot section of a roller-belt conveyor for draining.
5. A roller or flat belt conveyor for grading.

In some storage houses the marketable sweet potatoes are picked from this conveyor and placed in shipping containers and the unmarketable one are dropped off at the end of the belt;

in other houses the unmarketable grades are picked off and the marketable roots drop into containers at the end. Keep the number of places where the sweet potatoes drop from one piece of equipment to another to a minimum and the drop as short as possible. All places where they drop should be cushioned with sponge rubber or similar material.

Many operators prefer to have their sweet potatoes stored in the packing house for several hours to a day to permit them to dry off.

All cull sweet potatoes should be removed to a safe distance, dehydrated for stock feed, or buried to help prevent spread of disease. They should not be left near packing sheds or plant beds.

Sweet potatoes shipped during the winter must be protected against cold. In no case should their temperature drop below 55 degrees Fahrenheit.

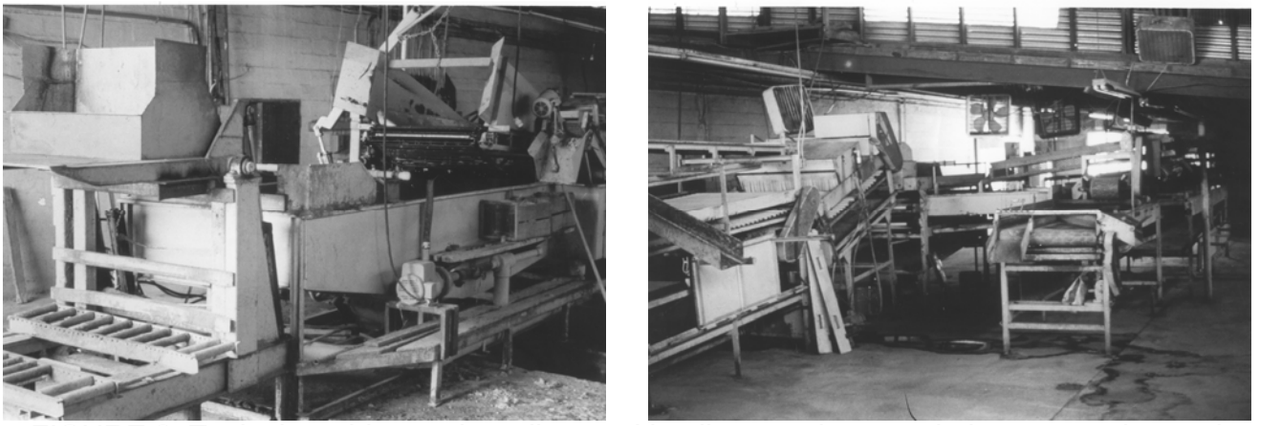

FIGURE 8. Typical washing and grading packing line top-dump tank, bottom-sorting and grading.

CONSTRUCTION OF STORAGE HOUSES

The storage house should be designed to provide the temperature, humidity, and ventilation recommended for proper curing and storing of sweet potatoes throughout the season in the location selected.

Heat is usually necessary in the fall during curing, in the late winter or early spring for pre-sprouting, and often in the winter during the coldest weather. The storage should be designed to provide the amount of heat needed as well as its proper distribution to maintain reasonably uniform temperatures. To do this, heat is usually added beneath the stored sweet potatoes, since the lower levels of the storage are usually cooler and harder than the top.

Excess heat is removed from the storage house in two ways. Warm air may be exhausted from the top of the storage and cool air introduced through doors and special vents near floor level. Or cool air is introduced into the top of the storage with ventilation equipment.

High humidity is usually rather easily maintained in most of the sweet potato-producing areas because the roots give off some moisture and the relative humidity is often fairly high in the outside air. But when large amounts of heat are added to the storage, or in dry climates, some provision for humidifying the air in the storage is needed. Conversely, because outside air

temperatures often are considerably lower than the temperature inside the storage room, some provision for removing condensation is desirable. This is usually provided in the system of ventilating that is used both for cooling and for exchange of air.

Locating the storage near the point of production will minimize hauling costs. Size of the storage influences the relative cost per unit stored. Usually large storages are more advantageous than small ones large storages often benefit by complementing storage with marketing and processing facilities.

Since all circumstances of weather, construction, or management cannot be anticipated, the following sections will provide some guidelines to consider in constructing and managing storage houses to obtain the objectives. The storage house should be located on a well-drained site with a foundation or footing appropriate to the site and construction.

For large storages, or small ones which may be expanded, it is desirable to plan for the following five steps which usually make up the complete operation.

1. Unloading of field trucks directly into the curing room or to the grading equipment (if this is present or to be added in the future).
2. Curing with forklift handling of palletized boxes or provision for it in the future.
3. Storage, either in the curing room or in separate rooms provided for it, also with provision for handling by forklift.
4. Grading, preferably with equipment that includes washing and treating to prevent decay during marketing.
5. Loading trucks for shipment to market.

In storage houses, office space and restrooms are included, too.

The storage should be located where an adequate supply of electricity and water are available or can be made available. Depending upon the facilities included in the plans, electricity will} be needed for lights, conveyors, humidifiers, grading, heating or ventilating. Water is used for humidifying and cleaning the storage, and, usually in large amounts, for washing the roots during preparation for market when this is performed at the storage house.

The exact requirements for operating a storage house will be determined by the size and facilities included.

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