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Postharvest Handling
Technical Bulletin

# SWEET POTATO

## Postharvest Care and Market Preparation

Technical Bulletin No. 16

January 2004

POSTHARVEST HANDLING TECHNICAL SERIES

# SWEET POTATO

## Postharvest Care and Market Preparation

Ministry of Fisheries, Crops and Livestock
New Guyana Marketing Corporation
National Agricultural Research Institute

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With the assistance of the United States Agency for International Development

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**Preface**

This publication is part of a series of technical bulletins that seek to provide specific recommendations for improvements in postharvesting and market preparation for selected non-traditional agricultural products. The intended audience for this series is primarily extension agents.

Initial market assessments in current export markets and visits with producers and exporters in Guyana have shown the quality of fresh produce currently exported is uneven and in some instances very poor. Stages all along the export chain from harvest and pre-harvest to transportation and final export are all in need of improvement. Pre-harvest practices, sanitation at the packinghouse, packaging, bacterial and fungal problems, and transportation were all identified as areas where improvement could benefit the quality and increase the shelf life of Guyana's fresh produce exports. The technical bulletins address these issues specific to each product. Harvesting techniques and crop maturity indices are provided. Preparation for market, including cleaning, sorting, packing and transportation are covered. The bulletins address and recommend specific storage conditions, covering temperature and humidity controls. Finally the bulletins address postharvest diseases and insect damage.

The undertaking of these technical bulletins is a joint effort of the Ministry of Fisheries, Crops and Livestock; the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI) to improve quality, increase production and promote exports. As a team, the three agencies are working on the problems, limitations, and constraints identified in the initial reconnaissance surveys, from production and postharvest handling problems, to packaging and transportation, to final market.

## Introduction

The sweet potato (*Ipomoea batatas)* is one of the principal ground provisions grown in Guyana. Although the roots are mostly consumed soon after harvest, a properly cured sweet potato held under optimal temperature and relative humidity conditions can be stored for many months. Various types of sweet potatoes are planted in Guyana. Skin colour, flesh colour, dry matter, sweetness, and flavour differ among cultivars. However, the postharvest care and handling recommendations are identical for all types.

Numerous pre-harvest factors influence the potential storage life of sweet potatoes. Heavy rainfall and saturated soil conditions prior to harvest may cause root fermentation and storage decay, especially if the vines have been removed before harvest. The amount of pre-harvest disease and insect pressure also influences postharvest life.

## Harvest Maturity Indices

Sweet potatoes do not mature as fruits do, but continue to grow as long as conditions allow. Harvest time is determined by market price, expected total yield, and root size. Sweet potatoes should be harvested when the majority of roots have reached the desired size for the intended market. This typically requires between 3 to 3.5 months from the time of transplanting. Average root size in a field can be estimated by removing the soil around several randomly selected plants. Sweet potatoes will continue to enlarge if left in the ground, but root diseases and insect damage typically increase with the amount of time the roots remain in the soil.

## Harvest Method

**Figure 1. Vines should be removed before digging to allow the skin to toughen.**

The sweet potato vines should be cut off at the soil level prior to the intended harvest date (Figure 1). During the dry season, the vines should be removed three to seven days before digging. During the rainy season, the vines should be left intact until just prior to harvest. Vine removal helps to toughen the skin of the root and facilitates harvesting. The vines can be removed manually with a scythe or machete, or mechanically with a rotary mower.

**Figure 2. Manual harvest of sweet potatoes with a hand-made fork.**

After vine removal, the sweet potato roots can be dug by hand or by machine. Manual harvesting of sweet potatoes typically involves the use of a metal spade, pick, or fork which is used to loosen the soil and undercut the roots (Figure 2). Care must be taken to avoid cutting or injury to the roots. The roots are then lifted out of the ground, separated from the main stem, and temporarily left on top of the soil or put directly into a field container.

The roots should be handled gently to avoid skinning and bruising. Freshly dug sweet potatoes have a very thin and delicate skin that is easily removed (Figure 3). Skinned areas of the root surface are open wounds and become entry sites for bacterial and fungal pathogens. Skinning also lowers the appearance and attractiveness of the root. Workers should be advised not to throw or step on the roots.

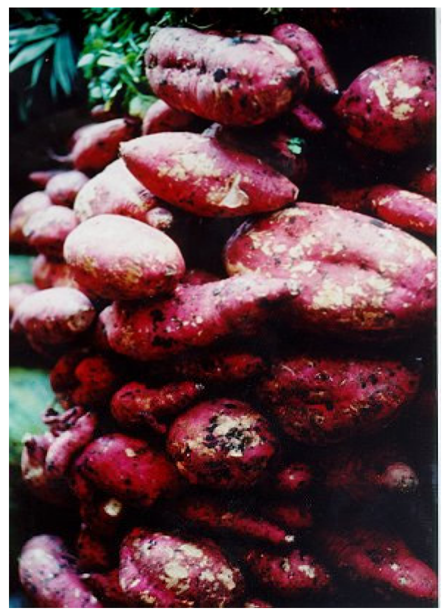


**Figure 3. Skinned roots are unattractive and susceptible to decay.**

A range of mechanical harvest devices also exists for sweet potatoes. These include mouldboard plows, middle buster plows, and single or multiple row diggers. Mechanical harvesters require the vines to be removed prior to digging.

Mouldboard plows turn the soil and roots over on top of the ground and produce the least amount of physical damage to the roots. However, they leave many roots covered by soil that makes them difficult to recover.

Middle buster plows (usually 30-35 cm size) with broad wings, may be used, although they tend to damage the roots and scatter them on both sides of the row. It is essential to operate the plow accurately on the row, at the proper depth, and at the correct speed.

Single or multiple row diggers undercut the roots and use a rod conveyor chain to separate the soil from the roots. The roots may be placed back on top of the ground, or conveyed up the chain to a sorting crew riding on the harvester in the sophisticated models (Figure 4). The sweet potatoes are detached from the main stem by hand and graded by size or quality into field containers. Mechanical diggers can cause considerable root skinning in very dry soil or at high operating speeds. The chains should be padded to reduce bruising.  A one-row chain-type digger is ideal for harvesting small plots and typically harvests 1 to 1.5 hectares per day at a harvest speed of 1.2 km/hr.

**Figure 4. One-row chain type digger capable of harvesting 1 to 1.5 hectares per day.**

Roots should be field graded by size and quality at the time of harvest. The rigorousness of grading depends on the demands of the market and the amount of variability in root size and quality. Select out sweet potatoes that are badly bruised, cut, severely mishapened, or insect damaged. Severely damaged or unmarketable roots should be put in a separate field container away from the sound and marketable roots. Roots less than 2.5 cm (1 in) in diameter (strings) are generally discarded. The marketable roots should be gathered off the top of the soil as soon as possible after harvest. Sweet potatoes are highly susceptible to sunburn damage if exposed to intense or direct sun even for periods as short as one-half hour. The damaged areas of the skin remain permanently discoloured and are very susceptible to postharvest decay. In order to avoid sunscald, the harvested roots should be put in field containers as soon as possible and covered with vegetation or stored away from direct sunlight exposure. Sweet potatoes should never be thrown or left in open piles in the field. The roots should be gently dry brushed to remove excess soil prior to curing. Cotton gloves are typically worn to facilitate field cleaning of the roots.

*Field Containers*

**Figure 5. Considerable root skinning occurs if nylon sacks are used as field containers.**

The most common field containers used in Guyana for removing sweet potatoes from the field are nylon sacks, reed baskets or wooden crates. Nylon sacks are the least durable and the least protective to the roots (Figure 5). Considerable root abrasion and skinning occurs during loading, transport, and unloading due to rubbing of the delicate skin against the inside surface of the sack and against adjacent roots.

The most desirable field containers are made of smooth wood or durable rigid plastic and are ventilated on the sides and bottom. These containers are sufficiently strong to be stackable and are easily cleaned and sanitized. Their smooth inner surfaces result in minimal root damage. Field containers should not be overfilled with roots above the upper rim, as stacking will cause injury to the top layer of roots. Rectangular crates stack better and allow more efficient use of space in a storage house than do sacks or reed baskets. When properly stacked, rectangular or square crates distribute the weight to the strong points on the crate (the corners and ends) and prevent the roots from bearing the weight load from

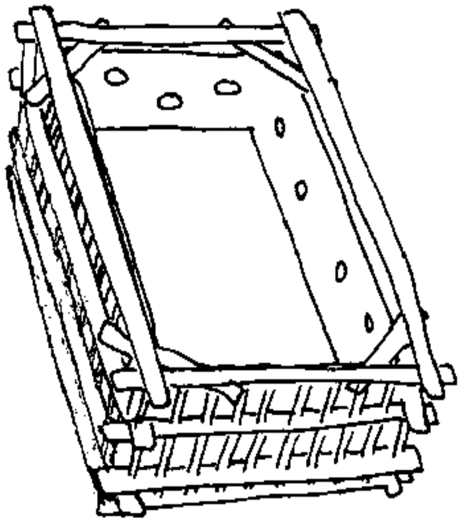


**Figure 6. Fiberboard inner liner for locally made field crate.**

the container above. When locally made containers have sharp edges or rough inner surfaces, a simple, inexpensive inner liner made from fiberboard can be used to protect the sweet potatoes from damage during handling (Figure 6).

**Curing**

Roots intended for storage should be properly cured immediately after harvest. The curing treatment should begin within 12 hours or less after digging. Curing is a process in which the skin thickens and new tissue forms beneath the surface of injured areas in the root. The purpose of curing is to heal the skin abrasions and wounds inflicted during harvest and handling, reduce moisture loss during storage, and minimize microbial decay.

Even with extreme care in harvesting and handling, a wound often occurs at each end of the root as a result of digging. These wounds and other breaks in the skin create areas where disease-producing organisms can enter the root. Therefore, these wounds must be allowed to heal over as soon as possible. Curing is an indispensable first step in a process that will allow Guyanese growers and exporters to provide a year-round supply of high quality sweet potatoes.

**Figure 7. Piling of sweetpotatoes in preparation for outdoor curing.**

Sweet potatoes can be cured outdoors if piled in a partially shaded area (Figure 7). Cut grasses or straw can be used as insulating materials and the pile should be covered with canvas, burlap or woven grass mats (Figure 8). Curing requires high temperature and high relative humidity, and this covering will trap self-generated heat and moisture. The stack should be left for about four days.

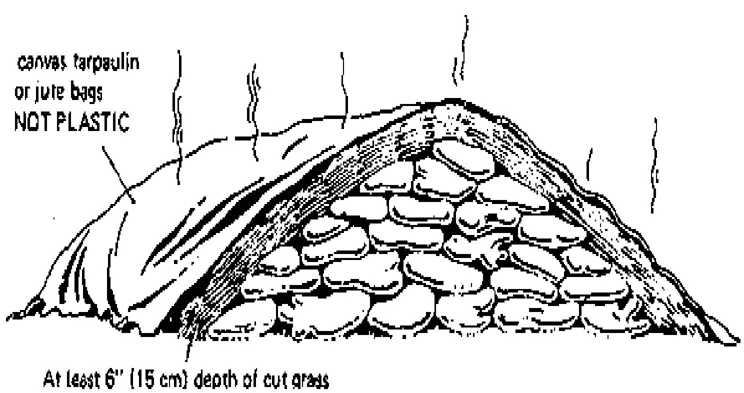



**Figure 8. Curing sweetpotatoes outdoors.**

Sweet potatoes can also be cured inside a protected structure at ambient temperature, provided the relative humidity is high in order to provide the warm humid conditions necessary for curing (Figure 9). The most uniform distribution of heat is obtained when heat is introduced near the floor level of a curing structure. Heaters can be placed on the floor near the bins of produce, or heat can be ducted in from outside the curing room. A high relative humidity can be obtained by wetting the floor or by using an evaporative cooler in the room without introducing outside air.

**Figure 9. Curing sweetpotatoes inside a temperature-humidity controlled room.**

The optimal conditions for sweet potato curing are holding the roots at 26.5°C to 32°C (80°F to 90°F) under high relative humidity (90% to 98%) for 4 to 7 days immediately following harvest. The curing process does not occur at temperatures below 23°C or RH's below 65%. On the other hand, the temperature should not exceed 35°C nor should the RH be so high (i.e. 100%) where moisture condensation occurs on the surface of the sweet potato.

Uncured roots will deteriorate faster and lose more weight than adequately cured roots. In addition, uncured sweet potatoes lack the visual appeal and eating quality of cured roots. Proper postharvest curing will increase the sweetness and moistness of the roots and enhance the aroma.

**Figure 10. Sweetpotato roots should never be washed before curing.**

Sweet potatoes can be expected to lose between 2 to 5 percent of their weight during curing. It is not unusual to see short (less than one centimeter) sprout buds develop on a few roots toward the end of curing; however, curing should be stopped before sprouting is widespread.

Roots should never be washed prior to curing and/or storage, as this would result in severe decay after several weeks. They should be stored in bins or crates, and washed only prior to packing for market (Figure 10).

An ideal curing facility is an enclosed structure with temperature and RH control equipment. Adequate ventilation is also necessary to remove the $CO_2$ and replenish the $O_2$ inside the curing facility.

## Storage Temperature

Following curing, the sweet potatoes should be moved carefully to a separate well-insulated storage room at 13°C ± 1°C and 90 to 95 percent RH. A storage life of 6-10 months can be expected under these conditions, although sprouting may begin to occur after about 6 months, depending on the cultivar. Temperatures above 15°C (59°F) lead to more rapid sprouting and weight loss. Roots can be stored up to a year without sprouting under optimal conditions (Figure 11). Ideally, sweet potatoes should be stored in well-ventilated crates stacked at least 10 cm off the floor and 15 cm from the wall. Leave 2.5 cm between stacks for air movement.


**Figure 11. Sweetpotato roots can be stored for many months under the proper temperature and relative humidity.**

*Storage Structures*

Ground storage of sweet potatoes may be used for short durations. Longer-term storage requires the use of pits, trenches, clamps or above-ground buildings. Simple storage houses can be constructed for holding small quantities (i.e. 1 to 2 tons) of sweet potatoes on the farm. One such storage house can be made from unfinished wooden planks painted white to reduce heat accumulation from the sun and covered with a large thatched roof for protection from sun and rain. It has a large door on one side for loading and unloading (Figure 12).

**Figure 12. Simple on-farm storage house made of unfinished wood and covered with palm leaves.**

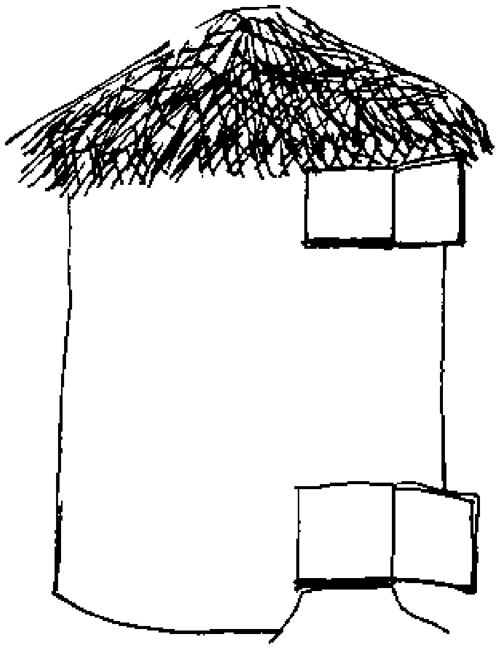


Figure 13. A cylindrical sweetpotato storage house made of lath, plaster, and mud bricks.

Another type of storage house can be made from lath, plaster, and mud bricks in a cylindrical form (Figure 13). It has two doors, one on top for loading and the other at the bottom for root removal. White-wash helps reduce heat accumulation and a thatch roof protects the potatoes from rain and sun.

A self-supporting A-frame storehouse can also be constructed for storing sweet potatoes. A pit is dug about 3 meters (10 feet) deep and wooden air ducts are placed along the earthen floor. The roof of the building is constructed of wood and covered with straw and soil (Figure 14). Note that in some areas in Guyana, particularly along the coast, the water table is very high. Under such conditions, use of pits for curing should not be used.

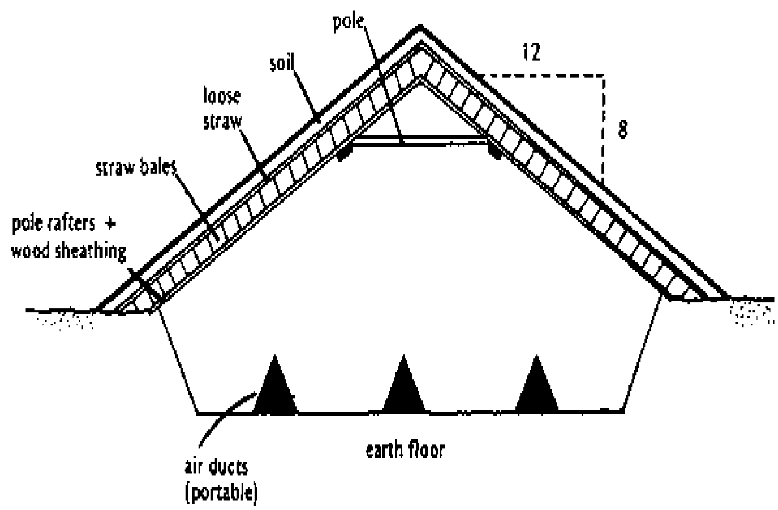



**Figure 14. A self-supporting A-frame storehouse for sweetpotatoes dug about 3 meters deep.**

## Relative Humidity

Moisture loss and root shriveling are common postharvest problems with sweet potatoes. In order to minimize these problems, the relative humidity (RH) should be maintained at 90 percent throughout the storage period. Sweet potatoes stored at 50-60 percent RH will have nearly twice the rate of weight loss compared to ones stored at 90 percent RH. Storage at a relative humidity above 95 percent is not recommended because of the possible development of surface discolouration and mould growth on the roots. Weight loss can be expected to be about 0.5 percent to 1.5 percent a month during storage, with the higher amount of weight loss incurred at the lower RH's.

## Principal Postharvest Diseases

*Fusarium Dry Rot*

Fusarium dry rot, caused by the soil-borne fungi *Fusarium oxysporum* and *Fusarium solani*, is one of the most common postharvest diseases of sweet potatoes in Guyana. The fungal spores exist in a dormant state on the root surface prior to harvest. When the skin is broken the microorganism begins to colonize the internal tissue and initiate a dry rot during storage. Care should be taken during harvesting and handling to minimize root injury, especially under wet soil conditions.

**Figure 15. Pale brown circular lesions of Fusarium dry rot.**

Symptoms consist of pale brown circular lesions (Figure 15) or a dry brown decay if the rot begins at the end of the root. Infected tissue shrivels and sometimes forms cavities filled with white mould. Postharvest decay tends to be slow and symptoms may not become apparent for several weeks.

*Java Black Rot*

Java black rot, caused by the fungus *Diplodia gossypina*, is a common dry rot disease of sweet potatoes in storage. Infection occurs via wounds sustained during harvesting and handling. Initial symptoms include a moderately firm yellow-brown surface decay, with light brown interior tissues. As the rot progresses the skin and tissue just below the surface change colour from brown to black. Eventually the entire root becomes black, hard, and mummified (Figure 16). The rot progresses slowly, taking 6 to 8 weeks to rot a sweet potato. The best control measures are careful handling to minimize wounding, prompt curing, and storage at 12.5°C immediately after curing.

**Figure 16. Severe infestation of Java black rot on sweetpotatoes.**

*Rhizopus Rot*

Soft rot, caused by the fungus *Rhizopus*, is the most rapidly developing storage rot of sweet potatoes. Symptoms include a soft, watery rot that progresses rapidly and may rot an entire sweet potato in 4 to 5 days. Newly infected areas will exude a yellowish-brown liquid when broken and will become withered, stringy and firmer as water is lost. A characteristic sweet odour is given off. Wherever the skin is broken a coarse, grayish-black whiskery growth of mycelium develops quickly and may cover the rotted section (Figure 17). An abundance of fruit flies in the storage area usually indicates the presence of the disease. Soft rot can be minimized by careful handling to avoid injury and wounding of the roots along with prompt curing at optimum temperature and humidity. Rhizopus is a wound pathogen and is not effective in colonizing healthy tissue. The postharvest fungicide 2,6-dichloro-4-nitroaniline (Botran) may be applied to reduce the risk of *Rhizopus.*

**Figure 17. Grayish-black mycelium and soft watery rot characteristic of Rhizopus rot.**

*Black Rot*

Black rot, caused by the fungus *Ceratocystis fimbriata*, is primarily a storage disease of sweet potatoes. Symptoms are circular, depressed spots of various sizes [0.6 to 5 cm diameter (0.25 to 2.0 inches)] on the root surface (Figure 18). Spots are first brown in colour and later turn greenish-black. The rot remains firm and generally shallow, but when the root is cooked the entire flesh tastes bitter. Storage losses are reduced by discarding all visibly infected roots at the time of harvest. In addition, careful handling to minimize mechanical injury will help lower the incidence of this disease. Development and spread of black rot is rapid at temperatures around 25°C (77$^{o}$F). Holding the roots at temperatures cooler than 13°C (55.5$^{o}$F) will slow the rate of deterioration from black rot.

**Figure 18. Black rot of sweet potatoes.**

*Bacterial Soft Rot*

The main postharvest bacterial disease of sweet potatoes is soft rot, caused by the pathogen *Erwinia chrysanthemi*. In warm wet production areas, bacterial soft rot can cause severe postharvest losses. The organism is soil-borne and particularly problematic in water saturated soils. Soft rot becomes established in wounded areas of the root. Infected roots show black steaks in the vascular tissue and subsequently undergo a soft moist decay. The watery decay is usually bounded by a dark margin.

Roots should be stored at 12.5°C (54.5$^{o}$F) to slow the development of this disease. In addition, maintaining 150 ppm hypochlorous acid in the wash water when preparing the roots for market can minimize the spread of bacterial soft rot.

## Principal Postharvest Insect

*Sweet  Potato Weevil*

The sweet potato weevil (*Cylas formicarius*) is the most destructive insect pest of sweet potato roots. Adult weevils resemble ants, with a narrow head and thorax, long legs and a distended body. The wing covers are metallic dark blue, the head and snout dark blue, and the thorax and legs brick red (Figure 19). The weevil is 5.5mm to 8 mm (1/4 in to 3/8 in) in length. The adult weevil prefers to feed on the storage root. Feeding punctures occur in patches on the skin of the root and are very shallow. The adult female also lays eggs under the surface of the root. The eggs hatch and after about a week develop into white larvae between 5.0 mm to 8.5 mm (3/16 in to 5/16 in) long. The larvae are wrinkled, fat and somewhat crescent-shaped (Figure 19). The head is yellowish-brown, small and narrower than the body. The larvae feed inside the root and create distinct tunnels. They also cause the flavour of the baked root to become very bitter. When they emerge through the root surface, the weevil leaves noticeable openings or holes.

**Figure 19. Sweetpotato weevil larvae (upper) and adult (lower) stages of develpoment.**

Postharvest control of sweet potato weevil is achieved by dusting the roots with the organophosphate insecticide phosmet (Imidan) immediately following harvest.

## Storage Disorders

Sweet potatoes are susceptible to several different storage disorders, including pithiness, sprouting, and chilling injury.

*Pithiness*

During storage, pithiness (hollowness) or internal breakdown of the roots develops in some cultivars (Figure 20). Pithiness results from exposure to high temperature and low RH. To avoid pithiness, cultivars should have a high dry matter content, low respiration rate, low rate of water loss, and a slow loss of internal root volume.

**Figure 20. Pithiness or internal breakdown of sweet potato.**

*Sprouting*

Sprouting of sweet potato roots will occur at temperatures above 16$^oC$ (61$^oF$). It will take a month or more for sprouts to show at 18$^oC$ (64.5$^oF$), but at 23$^oC$ (73.5$^oF$) and warmer, sprouts may develop in several weeks (Figure 21). Sprouting is always accompanied by a high amount of weight loss and adversely affects eating quality.

**Figure 21. Storage temperature above 16ºC will result in sprouting.**

*Chilling Injury*

Sweet potatoes are susceptible to chilling injury and should not be stored at temperatures below 12.5°C (54.5$^oF$). Even a few weeks of storage at chilling injury-causing temperatures will result in tissue damage. Symptoms of chilling injury include root shriveling, sunken pits on the surface (Figure 22), fungal decay, and internal tissue browning (Figure 23). The severity of chilling injury depends on the temperature and length of exposure below 12$^oC$ (53.5$^oF$). The effects of holding sweet potatoes at chilling temperatures are often not noticeable until they are returned to a higher temperature. Cultivars also differ in their susceptibility to chilling injury and uncured roots are more susceptible than cured roots.


**Figure 22. External chilling injury symptoms include surface pitting and fungal decay.**

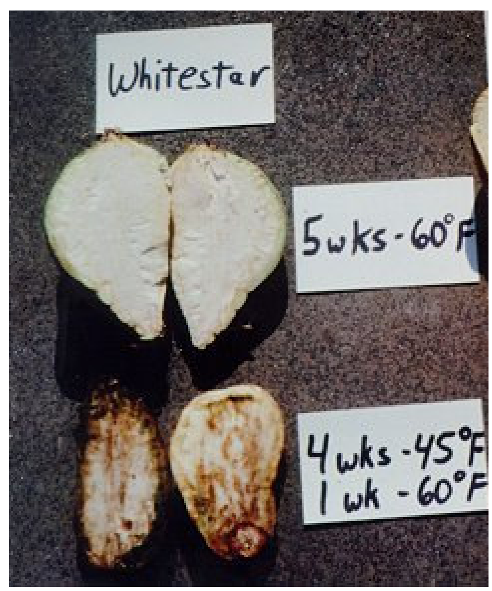



**Figure 23. Internal browning (lower roots) is a typical symptom of chilling injury in sweetpotatoes**

## Packing Operations

*Washing/Cleaning*

Immediately prior to packing for market, the dirt on the root surface should be removed by carefully dumping the roots in a water tank. Steel drums which are cut in half and fitted with drain holes can be used to make a simple washing stand (Figure 24). The metal edges of the drum should be covered with split rubber or plastic hose. The drums can be set into a sloped wooden table, with the table top is made from wooden slats which can be used as a drying rack before packing.

Large-scale operations will need to use a larger volume water tank (Figure 25). The water in the dump tank should be replaced frequently as dirt and debris will quickly accumulate.

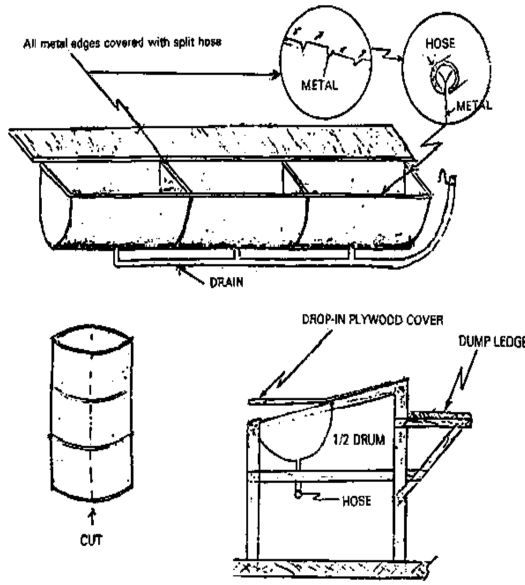
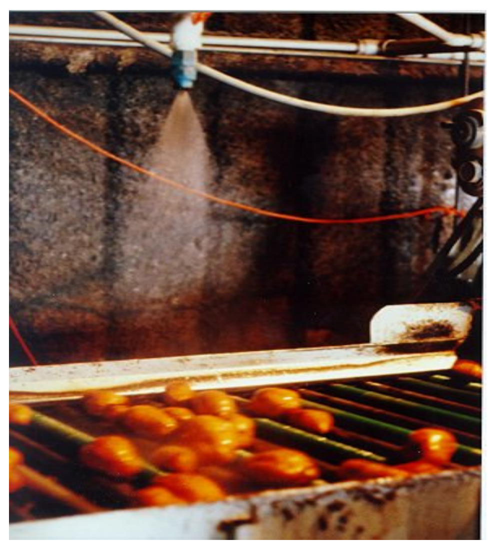



**Figure 24. Steel drums cut in half make excellent wash tanks for sweetpotatoes**

The roots can be further cleaned by passing them under a series of high-pressure spray nozzles directing chlorinated water (150 ppm hypochlorous acid) over the roots prior to grading (Fig. 26).

**Figure 25, left. Dumping roots in a tank of water will remove most of the surface dirt.**

**Figure 26, right. High pressure spray washing further cleans the roots.**



The overhead spray wash water should also contain the fungicide 2,6-dichloro-4-nitroaniline (Botran) at a concentration of 0.65 kg (1.5 lb) of 50 WP formulation per 380 liters (100 gallons) of water. For best application to the root surfaces, use 8001 T jet nozzles at 40 to 50 psi pressure.

*Grading/Sorting*

Following cleaning, the roots should be graded according to size, shape, and amount of defects. Remove all cut, cracked, diseased and unattractive roots to make the pack as attractive as possible. Good quality sweet potatoes should be smooth, firm, uniform in shape and size, free from mechanical damage, and have a uniform peel colour typical of the cultivar. Grades are based on freedom from defects, size, shape and uniformity. Canadian importers prefer large sized roots between 4.5cm to 8 cm in diameter (1¾ in to 3¼ in), 7.5 cm to 23 cm in length (3 in to 9 in), and a weight of 330 gm to 450 gm (0.75 lb to 1.0 lb). Importers in the E.U. prefer similar sized or smaller roots. Sweet potatoes exported to the E.U. must meet the Class 1 standard. Guyanese sweet potatoes cannot be exported to the U.S. because of phytosanitary restrictions.

For larger volume operations, a grading line may be made out of a series of PVC pipes on rollers. Workers stand on each side of the grading line classifying the roots (Figure 27). The roots should be air dried prior to filling the export carton.

**Figure 27. Workers classifying roots on both sides of a PVC grading line.**

*Packing*

The Caribbean market accepts different sized cartons, depending on the destination and buyer. For the European market, sweet potatoes should be packed in either 6 kg or 10 kg (13.2 lb or 22 lb) fiberboard cartons. The Canadian market package standard is the 40 lb (18 kg) fiberboard carton. Carton structural integrity and strength should be adequate to withstand long distant sea shipments without collapsing and injuring the roots. A high quality, well-ventilated, strong, attractive carton is important in export market success (Figure 28).


**Figure 28. Sweetpotatoes packed in 6-kg cartons for the UK market.**

## Transportation

Sweet potatoes have a long storage life and are typically transported by marine container to export market destinations. The container should be refrigerated and maintained at 13°C ± 2°C (55.5°F ± 35.5°F) and 90% RH during transit. Adequate ventilation is needed to prevent the internal container $O_2$ concentration from dropping below 10%. Low atmospheric $O_2$ levels result in internal root fermentation and decay.

# ANNEX I

## PUBLICATIONS IN THE POSTHARVEST HANDLING TECHNICAL BULLETIN SERIES

| | |
|---|---|
| PH Bulletin No. 1 | Pineapple: Postharvest Care and Market Preparation, November 2002. |
| PH Bulletin No. 2 | Plantain: Postharvest Care and Market Preparation, June 2003. |
| PH Bulletin No. 3 | Mango: Postharvest Care and Market Preparation, June 2003. |
| PH Bulletin No. 4 | Bunch Covers for Improving Plantain and Banana Peel Quality, June 2003. |
| PH Bulletin No. 5 | Papaya: Postharvest Care and Market Preparation, June 2003. |
| PH Bulletin No. 6 | Watermelon: Postharvest Care and Market Preparation, October 2003. |
| PH Bulletin No. 7 | Peppers: Postharvest Care and Market Preparation, October 2003. |
| PH Bulletin No. 8 | Oranges: Postharvest Care and Market Preparation, October 2003. |
| PH Bulletin No. 9 | Tomato: Postharvest Care and Market Preparation, October 2003. |
| PH Bulletin No. 10 | Okra: Postharvest Care and Market Preparation, October 2003. |
| PH Bulletin No. 11 | Pumpkin: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 12 | Lime: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 13 | Grapefruit: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 14 | Passion Fruit: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 15 | Green Onions: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 16 | Sweet Potato: Postharvest Care and Market Preparation, January 2004. |
| PH Bulletin No. 17 | Eggplant (Boulanger): Postharvest Care and Market Preparation, January 2004. |

## OTHER PLANNED PUBLICATIONS

Avocado (Pear): Postharvest Care and Market Preparation.

Bitter Melon: Postharvest Care and Market Preparation.

Bora: Postharvest Care and Market Preparation.

Cassava: Postharvest Care and Market Preparation.

Eddoes: Postharvest Care and Market Preparation.

Ginger: Postharvest Care and Market Preparation.

Breadfruit: Postharvest Care and Market Preparation.

Cabbage: Postharvest Care and Market Preparation.

Calaloo: Postharvest Care and Market Preparation.

Coconut: Postharvest Care and Market Preparation.

Cucumber: Postharvest Care and Market Preparation.

Lemon: Postharvest Care and Market Preparation.

Starfruit: Postharvest Care and Market Preparation.

Tangerine: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.

## Harvest Maturity Indices

The principal harvest maturity measurement for sweetpotato is root size. Sweetpotatoes should be harvested when most of roots have reached the correct size for the intended market. This typically requires between 3 to 3.5 months from the time of transplanting. Average root size in a field can be judged by removing the soil around several randomly selected plants in different locations.

## Harvest Method

The sweetpotato vines should be cut off near the soil before the intended harvest date. During the dry season, the vines should be removed three to seven days before digging. Removing the vines helps to toughen the skin of the root. The vines can be removed manually with a scythe or machete, or mechanically with a rotary mower. During the rainy season, the vines should be left intact until the day of harvest. Roots exposed to wet soil conditions without intact leaves and vines are most at risk to postharvest disease.

After removing the vines, the sweetpotato roots can be dug by hand or by machine. Manual harvesting of sweetpotatoes is typically done using a spade, pick, or fork which is used to loosen the soil and undercut the roots. Care must be taken to avoid cutting or injury to the roots. The roots are then lifted out of the ground, separated from the main stem, and temporarily left on top of the soil or put directly into a field container.

The roots should be handled gently to minimize skinning and bruising. Wounded areas lower the attractiveness of the root and become entrance sites for bacterial and fungal pathogens.

The harvested sweetpotatoes should be pre-graded in the field, separating the marketable roots from the unmarketable ones. Roots less than 2.5 cm (about 1 in) in diameter are generally discarded. The roots should be gently dry brushed to remove excess soil. Cotton gloves are typically worn to facilitate field cleaning of the roots.

Although large synthetic sacks are commonly used as field and market containers, they provide little protection and can cause root skinning during loading, transport, and unloading.

Wooden crates or strong plastic field boxes are much better as harvest containers. They need to be strong enough to be stackable and easily cleaned.

## Curing

Curing is a process in which the skin thickens and new tissue forms beneath the surface of injured areas in the root. The purpose of curing is to heal the skin scratches and wounds inflicted during harvest and handling, reduce water loss during storage, and minimize decay. Curing can significantly prolong the shelf life of sweetpotato. Curing should be done within 12 hours or less after harvest.

The best conditions for sweetpotato curing are 26°C to 32°C (80°F to 90°F) and 90% to 98% relative humidity (RH) for 4 to 7 days. The curing will not occur at temperatures below 23°C or RH's below 65%. On the other hand, the temperature should not exceed 35°C, (95°F) nor should the RH be so high that water condensation appears on the root surface.

Uncured roots will age faster and lose more weight than cured roots. In addition, uncured sweet potatoes lack the visual appeal and eating quality of cured roots.

Roots should never be washed prior to curing and/or storage, as this facilitates decay. They should be stored in bins or crates, and washed only prior to packing for market.

## Temperature Management

After curing, the sweetpotatoes should be moved to a separate well-insulated storage room at 12.5°C (55°F) and 90% to 95% RH. Storage life of 6 to 10 months can be expected under these conditions. Temperatures above 15°C (59°F) increase the rate of weight loss and result in sprouting.

Sweetpotatoes are vulnerable to chilling injury (CI) and should not be held below 12.5°C. Even a few weeks of storage at below 12.5°C will result in tissue damage. Symptoms of chilling injury include root shriveling, sunken pits on the surface, fungal decay, and internal tissue browning. The extent of CI depends on the temperature and length of exposure below 12.5°C. Damage increases the longer the fruit is exposed and the lower the temperature. Uncured roots are more prone to CI.

## Relative Humidity

Moisture loss and root shriveling are common postharvest problems of sweetpotatoes. In order to reduce these problems, the RH should be maintained at 90% to 95% throughout the storage period. Sweet potatoes stored at 50% to 60% RH will have nearly twice the rate of weight loss compared to ones stored at 90% RH. Storage above 95% RH is not recommended because of possible surface mold growth.

## Market Preparation

*Washing/Cleaning*
Before packing for market, sweetpotatoes should be removed from storage and carefully submerged in a tank of sanitized water. A multiple tank system may be necessary to keep the wash water clean and properly sanitized. The water should be sanitized with 150 ppm hypochlorous acid (household bleach) maintained at a pH of 6.5. This is equal to 2 oz of household bleach (such as Marvex) per 5 gallons of water, or .3 liters of bleach per 100 liters of water. Dirt and debris will collect quickly so it is important to change the water in the dump tank often.

*Grading/Sorting*
After cleaning, the roots should be graded according to size, shape, uniformity, and amount of defects. Remove all cut, cracked, insect-damaged, and decayed roots to make the pack as attractive as possible. Good quality sweetpotatoes are smooth-skinned, firm, even in shape and size, free from mechanical damage, and have a uniform colour typical of the cultivar. The National Bureau of Standards has established three different grade classes for domestic marketed sweetpotatoes (Grade 1, Grade 2, and Grade 3) based on various root characteristics. Domestic marketed roots are also classified into three sizes, based on weight per root:

- small: 112.5 g to 340.5 g (¼ lb to ¾ lb)
- medium: 340.5 g to 681 g ( ¾ lb to 1½ lb)
- large: 681g to 1362 g (1½ lb to 3 lb)

Export market sweetpotatoes should follow a similar size classification.

*Packing*
Sweetpotatoes should be packed in strong, well-ventilated containers that can be stacked without breaking or damaging the roots. Large

synthetic sacks over-stuffed with more than 40 kg (88 lb) of roots are often used in the domestic market. These sacks provide little protection to the sweetpotatoes and result in considerable root damage. Wooden crates are better and provide more protection to the sweetpotatoes. Roots of the same size and shape should be packed in the same container. The Caribbean market accepts different sized cartons, depending on the destination and buyer. For the European market, sweetpotatoes should be packed in either 6kg (13 lb) or 10 kg (33 lb) fiberboard cartons. The Canadian market package standard is the 40 lb (18 kg) fiberboard carton. The carton strength should be able to withstand long distant sea shipments without collapsing and injuring the roots. A strong, well-ventilated, attractive carton is important for success in the export market.

**Principal Postharvest Diseases**

Sweetpotatoes are vulnerable to a number of postharvest fungal and bacterial pathogens. Decay can be kept to a minimum by using careful harvesting and handling practices, by prompt curing, and storage at 12.5°C (55°F) and 90% to 95% RH. During root cleaning, the wash water should be properly sanitized and the postharvest fungicide 2, 6-dichloro-4-nitroaniline (Botran) may be applied after washing to reduce the amount of fungal decay during transport to market.

*Fusarium Dry Rot*

Fusarium dry rot appears as pale brown, dry, circular spots on the root. Infected tissue shrivels and sometimes forms cavities filled with white mold.

*Java Black Rot*

Initial signs are a moderately firm yellow-brown surface decay, with light brown interior tissues. As the rot grows, the colour of the skin and tissue just below the skin changes from brown to black. Eventually the entire root becomes black, hard, and mummified.

*Rhizopus Soft Rot*

Symptoms of Rhizopus soft rot include a soft, watery decay that rapidly grows to completely rot the entire root in 4 to 5 days. Newly infected areas will give off a yellowish-brown liquid when broken and will become withered, stringy and firmer as water is lost. A sweet odour is given off. Wherever the skin is broken, a coarse, grayish-black whiskery fungal growth develops and quickly covers the rotted portion. A lot of fruit flies in the storage area usually indicate the presence of this disease.

*Bacterial Soft Rot*

Infected roots show black streaks in the vascular tissue and later a soft moist decay. The watery decay is usually bounded by a dark margin. The decaying tissue gives off a bad odour.

**Storage Disorders**

*Pithiness*

Pithiness, or hollowness, is an internal tissue break down of sweetpotatoes that occurs after several months of storage in some cultivars. Pithiness results from storage at high temperature and low RH.

*Sprouting*

Sprouting of sweetpotato roots will occur at temperatures above 16°C (61°F). It will take a month or more for sprouts to show at 18°C (64.4°F), but at 23°C (73.4°F) and warmer, sprouts may develop in several weeks. Sprouting is always accompanied by a high weight loss and adversely affects eating quality. Sprouting can be prevented by maintaining a 12.5°C (55°F) storage temperature.

**Technical bulletins are also available on waxing fruits and vegetables and curing. Contact:**

New Guyana Marketing Corporation (NGMC) 87 Robb & Alexander Sts., Georgetown, Guyana
Tel: 226-8255, 226-2219

National Agricultural Research Institute (NARI)
Mon Repos, East Coast Demerara, Guyana
Tel: 220-2950

USAID

**With the assistance of**
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New Guyana Marketing Corporation

# SWEETPOTATO

## Postharvest Care and Market Preparation Information Sheet

*This information sheet provides growers and agriculture extension personnel with a summary of the recommended harvest and postharvest handling practices for sweetpotato. A more technical and detailed bulletin is available from the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI).*