

Harvest Maturity Indices

Root size is the principal measurement of harvest maturity for cassava. Cassava roots may be ready for harvest beginning 6 to 7 months after planting. Several randomly selected plants, typical of the entire field, should be harvested every several weeks, beginning about 6 months after planting, to determine the average root size and the correct time for harvest.

The age of the leaves and lower leaf yellowing can be a sign of harvest maturity. When the lower leaves are distinctly yellow and some have dried, it is likely the plants are mature enough for the roots to be harvested.

Harvest Methods

Harvesting cassava roots is usually done by hand and is easier when the soil is moist. The main stem of the plant should be cut back to a height of 30 cm to 50 cm (12 in to 20 in) and used as a handle to lift the roots out of the ground. In heavier soils or during the dry season, harvesting usually requires digging around the roots to free them prior to lifting the plant. While lifting, care should be taken not to break the roots or split the skin. Wounds and scratches are an entry point for decay. During the dry season, the upper parts of the cassava plant should be removed several weeks prior to harvest to allow for root curing and skin thickening while still in the ground.

After the roots have been pulled out of the ground, they are removed from the base of the plant by hand. Care must be taken during harvest to minimize damage to the roots. Harvesting the roots with a short section of the stem still attached may help prevent the spread of decay. Cassava should be graded in the field and any unmarketable, damaged, or diseased roots should be discarded. Loose soil should be removed from the root surface with cotton gloves at the time of harvest.



The cassava should be gently placed in strong well-ventilated field containers for transport from the field. Wooden crates or strong plastic containers are much better field containers than sacks or reed baskets, which provide minimal protection to the roots.

Curing

Roots intended for storage should be properly cured immediately after harvest. Curing improves potential market life by reducing water loss and lowering the incidence of decay during storage. Cassava that is not cured will deteriorate faster and lose more weight than properly cured roots. Curing is a process in which the skin thickens and new tissue forms beneath the surface in injured areas of the root. The injured tissue must heal quickly to avoid disease from entering the root. The curing process should begin as soon as possible after harvest. However, curing will not be effective on roots with a lot of damage. Cassava should never be washed prior to curing, as this will likely result in severe decay.



The optimal conditions for cassava curing are 26.5°C to 29.3°C (80°F to 85°F) and 90% to 95% relative humidity (RH) for 4 days immediately following harvest. The temperature should not exceed 35°C (95°F) nor should the RH be so high (i.e. 100%) that moisture occurs on surface of the roots.

Cassava can be cured outdoors if piled in a partially shaded area. Cut grasses or straw can be used as insulating materials and the pile should be covered with canvas, burlap or woven grass mats.

Cassava can also be cured inside a protected structure at ambient temperatures, provided the RH is high.

Temperature Control

Fresh cassava roots are highly perishable at normal air temperatures, often becoming unmarketable after several days to a week. However, with proper temperature control, cured roots can be stored for several months. The recommended temperature for maximizing cassava storage life is 2°C (36°F). Sound roots can be stored for up to 4 to 5 months at this temperature. Cassava is vulnerable to chilling injury (CI), and should not be stored below 2°C (36°F). Refrigerated storage may not be an affordable method for extending the postharvest life of domestically marketed cassava, but is typically necessary for roots intended for high-value export markets.

In the absence of temperature control, cassava market life can still be extended by using appropriate low-input storage structures. Above-ground clamp silos are low-cost structures that generally work well for cassava storage. Roots are piled up on a layer of straw in conical heaps weighing between 300 to 500 kg. The pile is covered with straw and soil and openings should be left for ventilation. It is possible to store cassava for up to 4 weeks without significant weight loss or decay.

Cassava should be stored at a high RH in order to minimize weight loss and root shriveling. Ideally, the storage atmosphere should be maintained between 90% to 95% RH.

Preparation for Market

Cleaning/Washing

The surface of the cassava should be cleaned to meet market expectations. For the domestic Guyanese market, excess soil should be removed from the cassava surface with a soft brush or cotton gloves. Cassava destined for export should be cleaned by carefully submerging the roots in a tank of clean water sanitized with 150 ppm hypochlorous acid (household bleach) and 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. The water in the tank should be replaced frequently as dirt and debris will quickly accumulate.

Grading/Sorting

Following cleaning, the roots should be graded according to size, shape, and amount of faults. Remove all cut, cracked, diseased and unattractive roots to make the package as attractive as possible. Good quality cassava should be smooth, firm, fairly straight, and even in shape and size. In addition, the roots should be free from damage, decay, and streaking. The pulp should be an even white or light yellow, depending on cultivar. Grades are based on freedom from defects, size, shape and uniformity. The National Bureau of Standards has established three different grade classes for domestically marketed cassava (Extra, Class 1, and Class 2) based on various root quality characteristics. Domestic marketed roots are also categorized according to size, based on weight per root: A (large) = 2.5 kg to 3.0 kg; B (medium) = 1.5 kg to 2.4 kg; C (small) = 0.5 kg to 1.4 kg. Export markets typically prefer large sized roots, between 15 cm to 25 cm in length (6 in to 10 in). Root lengths in excess of 30 cm (12 in) are undesirable in most export markets.

Waxing

Dipping the roots in melted paraffin wax at 51.5°C to 52.5°C (125°F to 127°F) for one second adds a smooth thick surface coating to the root. This coating helps reduce root moisture loss and extends market life for up to 2 months. It also improves the external appearance of the root and reduces discolouration of the vascular tissue. A wax treatment is highly recommended for export market destined cassava roots. It is essential that the root surface be completely dry prior to the paraffin wax application. The roots are packed for export immediately after waxing. Waxing and holding at 0°C to 5°C (32°F to 41°F) can extend shipping time to over several months with minimal amounts of streaking.

Packaging

After waxing, the cassava roots should be placed in a clean, strong, well-ventilated carton. If the cassava is not waxed, the surface of the root should be thoroughly dry prior to packing. Wet or damp roots will develop surface mould. Cassava is typically packed loose inside the carton. Wrapping alternate roots with soft paper can provide additional protection. Net carton weights are typically 18.2 kg or 20.5 kg (40 lb or 45 lb) depending on the market and importer requirements.

Principal Postharvest Diseases

Cassava is vulnerable to a number of postharvest diseases. Decay can be kept to a minimum by using careful harvesting and handling practices to reduce root injury, prompt curing, and storage at 2°C (36°F) and 90% to 95% RH. The roots should be washed in properly sanitized water and applied with an appropriate postharvest fungicide prior to packing.

Botryodiplodia Rot

Infected roots may at first appear healthy on the outside, although the skin is usually slightly wrinkled. The internal flesh tissue becomes discoloured and a



fine white mould often develops on the wounded surface. Infected roots stored for some weeks shrivel and dry up.

Rhizopus Soft Rot

Symptoms of *Rhizopus* soft rot include a soft, watery decay that rapidly progresses at ambient temperatures. Infected areas give off an off-coloured liquid when broken and produce a characteristic odour.

A grayish-black whiskery fungal growth develops and covers the root surface.

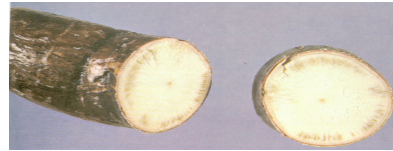
Bacterial Soft Rot

Bacterial soft rot typically enters the root through surface wounds, producing a soft wet, foul-smelling decay. Eventually the entire root collapses into a viscous leaky mass of tissue. Sanitation of the wash water is essential to minimize the spread of bacterial soft rot during root cleaning.

Postharvest Disorders

Vascular Discolouration

Vascular discolouration or streaking is a common postharvest disorder of cassava, thought to be caused by damage and tissue injury during harvesting and handling. Vascular discolouration begins near the region of initial damage and continues to spread down the root. Symptoms typically appear as blue-black or brownish discolouration of the vascular tissue, referred to as vascular streaking or blue vein. These first signs are followed by a more general discolouration of the starch bearing tissue. The rate of development and the intensity, pattern, and distribution of the discolouration varies between cultivars and roots. Some cultivars discolour so fast they cannot be eaten 24 hours after harvest while others do not exhibit any sign of discolouration after 10 days at room temperature. The main way to reduce vascular discolouration is to minimize wounding and physical injuries to the roots.



Technical bulletins are also available on waxing fruits and vegetables, curing and hot bath treatment.

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CASSAVA

Postharvest Handling 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 cassava. A more technical and detailed bulletin is available from the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI).