Roots and Tubers

1. Cassava
2. Dasheen
3. Sweet Potato
4. Tannia
5. Yam

TECHNOLOGY PACKS

SWEET POTATO

November 2015

Background

Production decisions concerning how much effort and resources to invest and which farming practices to follow, have consequences and create opportunities for the farm affecting production levels, input costs, time constraints, and the potentially size of the operation. They also may have implications for resource use and environmental quality.

Numerous information exist on the various aspects of production and handling/ marketing of crops and livestock, the majority of which are outdated, not easily understood and lacking the where with all for addressing present day challenges such as good agricultural practices (GAPs) and food safety and climate change that impact on the environment and rural livelihoods. These issues are also closely related to the importance of the role of primary producers in increasing the earnings of all actors along the value chain in supporting the development of a commercially viable and sustainable agricultural industry.

The production of high quality and easily understood information packages is critical as this forms a basis for farmers to obtain financing from lending institutions and to efficiently increase their production through the availability of modern technology. This will also result in a reduction of rural unemployment and will greatly help in alleviating poverty and other associated social ills.

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SWEET POTATO

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Introduction

This Technological Package (Tech Pack) deals with the production and postharvest aspects of sweet potato.

Also included in the Tech Pack are appendices:

- Template for cost of production
- List of recommended pesticides and application rates
- Good Agricultural Practices data record sheet.

Notwithstanding the identification of any specific pesticide for the control of pests and diseases, this decision is for the discretion of the Ministry of Agriculture Area Extension Officer and the farmer.

However, the mention of any pesticides and other products used in the Tech Pack should strictly comply with local regulations and all instructions provided by the manufacturer. Also, the use of trade names in the Tech Pack is for the purpose of citing examples and is not meant to either endorse or discredit any particular product.

Description

Sweet potato (*Ipomoea batatas* L.), is a member of the Convolvulaceae family and its origin and domestication is thought to be either Central America or South America. Depending on the variety, sweet potatoes can vary in colour, texture, moisture and size. Some are sweeter than others and flesh colours range from shades of white and orange to purple. Skin colours also vary from different shades of 'off-white' and pink to maroon. The tubers can also vary in shape and size. Some tubers are long and cylindrical, while others are short, thick and rounded at the ends.

Varieties

The characteristics of some of the sweet potato varieties available in St. Lucia are shown in Plates 1 and 2. Varieties should be selected for production based on market demand.

Plate 1 Variation in flesh colour of some sweet potato varieties in St. Lucia.

Plate 2 Variation in size and colour of some sweet potato varieties in St. Lucia.

Ecology and Environmental Requirements

Growing conditions

- The optimum temperature range for best growth is between 70 – 85°F (21 - 29 °C) with mean temperature about 75°F (25°C). However sweet potato can tolerate temperatures as low as 65°F (18°C) and as high as 95°F (35C).
- Regions/zones with an annual rainfall of 30 - 50 inches (750 - 1250 mm) and about 20 inches (500 mm) during the peak growing season are best suited for sweet potato production. Yields are reduced if a dry period occurs during the first 6 weeks after planting and no irrigation is available.

Site Selection

Fields that have not been used for sweet potatoes in the last 2 - 3 years are preferred. Well-drained sandy loam soils will give the highest yields and the best-shaped tubers. Avoid using clayey soils, as they can retard root development and produce non-uniform tubers, which do not satisfy the market requirement. Soils high in organic matter should also be avoided, as they cause excessive vine growth. Fields with high nematode populations should also be avoided.

Sweet potatoes are sensitive to alkaline or saline soil; hence, these soils should be avoided. To achieve high yields, a soil pH of 5.8 - 6.4 is required. If the pH of the soil is low, lime should be incorporated to increase the pH. The application of lime should be done a few weeks before planting, in order to allow sufficient time for the soil pH to be increased.

Land Preparation

Sweet potatoes may be grown either on hills (mounds) or beds (ridges). The height of the mounds is usually about 12 inches (30 cm). Ridges need to be spaced 3 - 4 feet (90 - 120 cm) apart, with plants spaced at 12 - 15 inches (30 - 40 cm) along the ridge. In areas where mechanization is possible, ridges are placed 3 feet (1 m) apart and are usually 12 inches (30 cm) in height. On slopes, ridges should follow the contour of the land.

Land should be prepared about 15 days before planting and a systemic herbicide applied at least 7 days before planting, in order to kill all emerging weeds.

Propagation

Sweet potatoes are generally propagated using cuttings from the previous crop. However, it is best to use fresh cuttings from newly propagated tissue culture plants every 3 years. Cuttings must be selected from healthy vines and must have at least eight nodes; that means the cutting length may range between 12 - 15 inches (30 – 40 cm). Cuttings should be treated with a fungicide/insecticide solution before planting (e.g. Banrot/Diazinon).

Planting

Sweet potatoes can be planted throughout the year, by placing approximately 6 inches (15 cm) of the cuttings below the soil surface. Planting at the onset of the heavy rains (October to December) gives the highest yields. If crops are planted in the dry season, drip or sprinkler irrigation is necessary.

Actara (Thiamethoxam) should be applied after land preparation or during planting to control the Sweet Potato Grub. A further application should be made 6 weeks after the first.

Irrigation

Either sprinkler or drip irrigation can be used.

Fertilization

In collaboration with an Extension Officer, have the soil tested before the application of any type of fertilizers or lime. If possible, leaf analysis should be done. The results of the tests will provide the guidance for fertilizer application. In the absence of soil and leaf analyses apply 2 ounces (50 g) of Triple Super Phosphate in each planting hole and another 2 ounces (50 g) of NPK 16:8:24 + 2MgO.

Weed Control

Weeds may be a problem early in crop growth and before the vines cover the beds. It is recommended that after land preparation, a broad spectrum systemic pre-emergent herbicide (as recommended by the Ministry of Agriculture Plant Protection Unit) be applied to control weeds. Allow the weeds to die and act as a mulch. Plant the cuttings at least 2 weeks after spraying the herbicide. From then on, hand weed when needed. Sometimes it is necessary that the plants be molded. This is done generally after weeding and fertilizing.

Pests and Diseases

The major pests and diseases affecting sweet potato, symptoms and control/management are indicated in Table 1.

Pest & Diseases	Symptoms	Control/ Management
Plate 3 Black Rot *Ceratocystis fimbriata* 	Dark to black sunken cankers in the lower part of the stem are the most distinctive symptom. In severe infections, yellowing, wilting, and plant death can occur. Affected storage roots develop black to gray sunken areas on which black spine-like structures of the fungus can be seen protruding from the surface of roots. A smell of alcohol resembling that of fermenting sugar is frequent.	Cuttings for transplants should come from pathogen-free planting material. In places where it is difficult to find healthy mother plants, cuttings should be taken from 1 inch (2 cm) above the soil surface to avoid infected portions of the plant. Rotate with no host plants for at least 2 years and use good sanitation practices. Cure during the 5 days following harvest at 85 - 95°F (30 - 35°C) and 85 - 90% relative humidity
Plate 8 Aphids Aphis gossypii 	The fungus penetrates healthy plants through open wounds. Yield losses may be up to 50%, and are more likely under warm weather and in dry soils. Plants normally die within a few days after visible symptoms appear in the plant. The vascular tissues of affected plants turn dark brown or black, especially close to the soil level. Leaves of susceptible plants may also turn yellow or brown.	The use of resistant or tolerant cultivars, crop rotation to lower soil disease pressure, selection of seed roots from disease-free fields, and fungicide treatments (the use of copper base fungicides e.g. Ridomil, Benlate).

Pest & Diseases	Symptoms	Control/ Management
Plate 5 Root Rot *Phytophora* spp. 	The foliage may turn yellow as the roots become unable to absorb moisture, and the plant may stop growing and start to wilt. Potatoes may be disfigured or visibly rotting.	Potatoes should not be planted where other vegetables affected by root rot were previously grown, nor in areas where tomato plants infected with root rot have been planted. Avoid waterlogged areas as these can promote the growth of the fungus. Remove infected plants immediately from the planting site so that the fungus does not spread to other plants. In addition, remove all plant debris, as fallen leaves may harbour fungal spores. Drench the soil with a fungicide
Plate 6 Leaf spots *Alternaria* sp., *Phyllosticta batatas*. 	Brown lesions with a typical bull's-eye appearance of concentric rings occur on leaves, especially older leaves. Black lesions appear on petioles and stems. Base and middle sections are more affected than the vine terminals. Death of vines can occur. The ground under affected vines is often carpeted with blackened leaf debris.	Susceptibility to the pathogen varies among varieties. Pathogen-free planting material of the more resistant varieties and good sanitation practices will help control the disease.

Pest & Diseases	Symptoms	Control/ Management
Sweet Potato Weevil *Cylas formicarius* **Pic**  **Plate 7 Larvae of sweet potato weevil Source: James Castner, University of Florida .**  **Plate 8 Adult Weevil**  **Plate 9 Grub and Weevil interactions with sweet potato**	Adult sweet Potato Weevils feed on the epidermis of vines and leaves. Adults also feed on the external surfaces of storage roots, causing round feeding punctures. The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage.	When populations are high, no single control method provides adequate protection. The integration of techniques, with emphasis on the prevention of infestation, provides sustainable protection. Cultural control. This should be the main basis of control. Cultural practices include: Use of clean planting material, especially vine tips, crop rotation, removal of weeds and other host plants and crop debris (sanitation), flooding the field for 24 hours after completing a harvest if possible, timely planting and prompt harvesting to avoid a dry period, planting away from weevil-infested fields, hilling-up of soil around the base of plants and filling in of soil cracks, applying sufficient irrigation to prevent or reduce soil cracking. Treatment of planting material. Dipping planting material in a solution of *Beauveria bassiana* or in an insecticide (such as carbofuran or diazinon) for 30 minutes prior to planting can control sweet potato weevils for the first few months of the growing season. Also pheromone traps can be used. Predators: Ants, spiders, carabids and earwigs attack weevils.

Pest & Diseases	Symptoms	Control/ Management
Plate 10 Sweet Potato Grub *Phyllophaga* spp.  **Source: Jane O'Sullivan The University of Queensland**	White grubs, the larvae of various species of scarabid beetles, live in the soil. In the larval stage, they are large and fleshy with swollen abdomens, well-developed head capsules, and large jaws and thoracic legs They usually adopt a C-shaped position. When they feed, white grubs gouge out broad, shallow depressions in sweet potato roots.  Plate 11 Grub damage	The use of soil treatments with selective insecticides can be used in combination with cultural practices. Utilizing insecticides such as imidacloprid (Admire) and thiamethoxam (Actara) during the early stages of the crop can reduce damage by white grubs. Handpicking of exposed grubs during land preparation and weeding is useful. To reduce the probability of having residues on harvested sweet potatoes, care should be taken to apply at the recommended rates and ensure proper timing of the application.

Pest & Diseases	Symptoms	Control/ Management
Plate 12 West Indian Sweet Potato Weevil *Euscepes postfasciatus* 	Adults feed on sweet potato stems and storage roots, and emerge by chewing exit holes. Larvae feed deep in the plant tissues. Internally, flesh and stem tissues are severely damaged. Affected roots are not edible by humans or animals.  **Plate 13 Damage caused by West Indian Sweet Potato Weevil *Euscepes postfasciatus***	Use Integrated Pest Management including removal of infested sweet potato vines and storage roots from the field after harvest, removal of alternate hosts, and use of uninfected planting material. Biological control with B. *bassiana* and the use of early-maturing varieties also reduces damage. Chemical applications: The use of soil treatments with selective insecticides can also be used in combination with the cultural practices. Utilizing insecticides such as imidacloprid (Admire) and thiamethoxam (Actara) during the early stages of the crop can reduce damage by white grubs. To reduce the probability of having residues on harvested sweet potatoes, care should be taken to apply at the recommended rates and ensure proper timing.

Pest & Diseases	Symptoms	Control/ Management
Sweet potato hornworm (Agrius convolvuli) Adults are large grey hawk moths with black lines on the wings and broad incomplete pink bands on the abdomen. The female lays small spherical greenish eggs singly on either surface of the leaves. Caterpillars have a conspicuous posterior horn. They are variable in color, usually greenish or brownish. Fully-grown caterpillars are large (up to 9.5 cm long and 1.4 cm broad). They pupate in the soil.  **Plate 14 Sweet Potato Hornworm** *Agrius convolvuli*  **Plate 15 Stages of development of Sweet Potato Hornworm**	Adults are large grey hawk moths with black lines on the wings and broad incomplete pink bands on the abdomen. The female lays small spherical greenish eggs singly on either surface of the leaves. Caterpillars have a conspicuous posterior horn. They are variable in colour, usually greenish or brownish. Fully-grown caterpillars are large, up to 3¾ inches (9.5 cm) long and ½ inch (1.4 cm) broad They pupate in the soil. Caterpillars feed on leaves, causing irregular holes. They may eat the entire leaf, leaving only the petiole. One large caterpillar can defoliate a plant on its own.	• Hand-pick caterpillars from leaves. This is usually feasible in small areas. • Turning the soil over between crops exposes the pupae to predators and desiccation. • Light traps can be used to monitor the population of moths
i  **Plate 16 White Fly** *Bemisisia tabac*	High White Fly populations may cause yellowing and necrosis of infested leaves. The pest is more important as a transmitter of viruses to and from other crops such as tomatoes, cucumbers and sweet peppers.	If there is a heavy infestation an application of Admire is recommended.

Good Agricultural Practice (GAP) related to the use of pesticides, requires farmers to maintain up to date records on the application of pesticides to the crop. These records should include trade names, application rates and dates of application. During the harvesting period use pesticides with a very short harvest interval.

Harvesting

The crop is ready for harvest when the leaves turn yellow and begin to drop. Maturity can also be assessed by cutting sample roots in the field and examining the colour of the latex exudation. Latex from mature storage roots remains creamy white, while in immature storage roots when cut, the latex turns black.

Maturity can vary between varieties and growers need to monitor the development of roots with regular checks of tuber/root size after 18 weeks for traditional varieties. New varieties can be harvested in as little as 13 weeks. Marketable sizes of tubers are between 0.5 – 2 lb (0.25 - 1 kg). If harvested at the correct time, around 60 - 70% of total roots should be within this grade.

Curing/Storage

Cure by storing in a warm, humid room for 5 - 10 days. Although temperatures of 80 - 85ºF (27 - 30ºC) and a relative humidity of 80 – 90% are ideal, these exact conditions may be hard to establish around the home, so select a room or building that comes close to these conditions. Do not wash sweet potatoes before curing or storage. Curing promotes the healing of cuts and bruises that occur during harvesting and handling. Curing also protects the roots from many storage diseases and excessive shrinkage while starches are being converted to sugars and other flavor components. Curing the roots increases the postharvest life of the sweet potato. Sweet potatoes are usually stored in non-refrigerated commercial or farm warehouses. This method of storing offers the primary advantage of orderly marketing several months after harvesting.

APPENDICES

APPENDIX I: TEMPLATE FOR COST OF PRODUCTION ANALYSIS: CASSAVA

	Input	Quantity	Units	Unit Cost	Total Cost
1.	**Planting material**				
	Cassava sticks (if purchased)				
	Fungicide, nutrient, insecticide, fertilizer (specify names used)				
	Shade netting				
	Polythene bags				
	Total cost for planting material				
2.	**Land preparation**				
	Pre planting herbicide, fertilizer (specify names used)				
	Other land preparation costs (e.g. equipment rental)				
	Total cost for land preparation				
3.	**Crop maintenance**				
	Water/irrigation				
	Fertilizer (specify types used)				
	Weed control (specify chemicals etc. used)				
	Pest and disease control (specify chemicals etc. used)				
	Total cost for crop maintenance				
4.	**Harvest/storage**				
	Materials (e.g. storage containers etc.)				
	Estimate any utility costs				
	Transport to market				
	Total cost for harvest/storage				
5.	**Labour**				
	Planting material				
	Land preparation				
	Crop maintenance				

	Input	Quantity	Units	Unit Cost	Total Cost
	Harvest/storage				
	Total cost for labour				
6.	**Rent/insurance**				
7.	**Miscellaneous costs**				
	Total cost of production				

APPENDIX I: TEMPLATE FOR COST OF PRODUCTION ANALYSIS: SWEET POTATO

Notes

1. It is recommended that the above data be completed on a per crop basis.
2. The cost of any fixed structures should be considered. For example if an irrigation system is solely used for sweet potato in the year and is expected to last for 10 years, then one tenth of the cost of the equipment should be added at item 7. If, however, irrigation for other crops is also provided then this also needs to be considered. If sweet potato accounts for half the irrigation in a year, then the annual cost calculated as above needs to be divided by 2.
3. The revenue obtained from sale of the crop should be compared with the cost of production to determine the profit/loss on the operation.

INSECTICIDES	APPLICATION RATE
Pronto 35 SC	3 - 5 teaspoons/gallon of water
Target	1 - 2 teaspoons/gallon of water
Pirate	½ - 1 teaspoons/gallon of water
Fastac	1 - 2 teaspoons/gallon of water
Caprid	½ - 1 teaspoon/gallon of water
Diazinon (Basudin)	¾ - 1½ pints/acre
Admiral	¼ teaspoon/gallon of water
Dipel	1½ - 2 teaspoons/gallon of water
Aza-direct	1 - 2 teaspoons/gallon of water
Cure	½ - 1 teaspoon/gallon of water
Danitol	1 - 2 teaspoons/gallon of water
Cypro	½ tablespoon/gallon of water
Dimethoate (Perfecthion, Rogor 40)	1 pint/acre
Phosvel	1¼ - 2 pints/acre
Orthene	3.2 ounces/acre
Permethrin (Ambush)	½ teaspoon/gallon of water
Padan 50 WSP	2 - 3 teaspoons/gallon of water
Lannate	1 teaspoon/gallon of water
Decis	½ teaspoon/gallon of water
Kelthane 42%	1¼ lb/acre
Orthene 75S	1 lb/acre
Malathion	½ - 1 pint/acre
Sevin	1½ lb/acre
BT(*Bacillus thruingiensis*)	Label rates
Rotenone	1 - 2 teaspoons/gallon of water
Neem X.	8 - 10 oz/gallon of water
FUNGICIDES	**APPLICATION RATE**
Bellis	2 teaspoon/gallon of water
Acrobat	2 - 4 teaspoon/gallon of water
Mancozeb (Dithane M45)	1.5 lb/acre
Cabendazim	2 teaspoon/gallon of water
Daconil	1½ - 2 pints/acre
Benomyl (Benlate)	6 oz/acre
Captan	2 - 3 teaspoons/gallon of water
Peltar	3 teaspoons/gallon of water
Manzate DF	2 - 4 teaspoons/gallon of water

Bravo	1½ - 2 pints/acre
Tri-Miltox-Forte	3 teaspoons/gallon of water
Botrilex	5 - 200 lbs/acre
Kocide 101	2 - 4 teaspoons/gallon of water
Cupravit	2½ lb/acre
WEEDICIDES	**APPLICATION RATE**
DCPA (Dacthal W-75)	10 lb/acre¬¬¬
Diphenamide	4 - 10 lb/acre
Paraquat (Gramoxone)	1 - 2 pints/acre
Dymid 80W	5 lb/acre
Atrazine 80 (Gesaprim).	1¼ - 1½ lb/acre
Linuron (Lorox)	1 pint/acre
Prometryn (Caparol)	0.8 - 1.6 lb/acre
Sethoxydim (Poast)	1¼ - 3½ lb/acre
Clethodim (Select)	0.094 - 0.25 lb/acre
Prometryn 50WP (Geagard)	2 - 3 lb/acre
Herbicidal Oil (Stoddard Solvent, Kerosene oil)	40 - 80 gallons/acre

APPENDIX III: GOOD AGRICULTURAL PRACTICES DATA RECORD SHEET

	Input	Quantity	Units	Unit Cost	Total Cost
6.	Rent/insurance				
7.	Miscellaneous costs				
	Total cost of production				