

Production Technology of Cassava (*Manihot esculenta*)

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Introduction

Cassava (*Manihot esculenta* Crantz.) is a dicotyledonous perennial plant originated in North-East Brazil, with an additional centre of origin in Central America (Rogers, 1963; Hillock *et al.*, 2002). From its places of origin, the plant has spread to various parts of the world, and it is today cultivated in all tropical regions of the world. There are 98 species of *Manihot* recognized (Rogers and Appan, 1973), including popular cultivating varieties under *M. esculenta* (eg: Malayan clone-M4 of India) and wild varieties like *M. anomala*, *M. caerulescence*, etc. It is assumed that cassava originated by hybridization between two wild *Manihot* species followed by vegetative reproduction of the hybrid (Nassar, 2000). Cassava is very important staple food crop for many people in Uganda especially for West Nile, Northern and Eastern Uganda. It is also widely grown in other parts of the country as a famine reserve crop. It has high yielding capability, easy to grow and performs well even in marginal areas. Cassava provides a good source of alcohol and industrial starch.

Contains a Few Key Nutrients

A 3.5 ounces (100-grams) serving of boiled cassava root contains 112 calories. 98% of these are from Carbohydrates and the rest are from a small amount of protein and fat. This serving also provides fiber, as well as a few vitamins and minerals. The following nutrients are found in 3.5 ounces (100 grams) of boiled cassava.

Calories	: 112
Carbohydrates	: 27 grams
Fiber	: 1 gram
Thiamine	: 20% of the RDI
Phosphorus	: 5% of the RDI
Calcium	: 2% of the RDI
Riboflavin	: 2% of the RDI

Boiled cassava root also contains small amounts of iron, vitamin C and Niacin.

Overall, the nutrition profile of cassava is unremarkable. While it does provide some vitamins and minerals, the amounts are minimal. There are many other root vegetables you can eat that will provide significantly more nutrients — beets and sweet potatoes, to name two.

Summary : Cassava is a significant source of Carbohydrates and also provides a small amount of fiber, vitamins and minerals.

Ecological requirements

i) Soil: Cassava can be grown on a wide range of soil but best on deep, free draining soils with reasonable fertility levels. Shallow soils which may restrict tuber expansion should be avoided.

ii) Rainfall : Cassava is highly drought resistant and grown in many parts where rainfall is low and unreliable.

iii) Altitude: Cassava grows at all altitudes but best on low to medium altitudes. It is low yielding at altitudes above 1500 Mea Sea Level (MSL)

Varities

Inter-varietal hybridization between superior varieties and/or selection among recombinants resulted in the isolation and release of the first three hybrids in the world viz., H-97, H-165 and H-226 in cassava from CTCRI in 1971. Even though these hybrids are high yielders, culinary quality was not as good as that of the popular local variety M4. However, they are the most preferred varieties in the neighbouring states as an industrial crop due to high extractable starch content and easy peeling of tubers. Later, two high yielding hybrids with improved culinary quality were released under the names Sree Sahya and Sree Visakham during 1977 and the latter has higher amounts of beta carotene (466IU/100 grams). Important characteristic features of the three hybrids are as follows.

1. H-97 is a hybrid between a local variety 'Manjavella' and a Brazilian seedling selection. The plants are medium tall, branched with light brown emerging leaves. The tubers are conical shaped and stout, yielding 25-35 t ha⁻¹. The tuber flesh is white with 27-29% starch content and matures in 10 months.

2. H-165 is a hybrid between two indigenous cultivars viz., 'Chadayamangalam Vella' and a clone similar to Kalikalan. The plants are predominantly unbranched with the mature leaves showing a drooping nature.

The tubers are relatively short and conical, yielding 33-38 t ha⁻¹. The variety is comparatively early maturing in 8-9 months.

3. H-226 is a hybrid between a local cultivar "Etthakka Karuppan" and the Malayan introduction M4. Plants are tall, occasionally branching and leaves with a characteristic green colour. The tuber yield is 30-35 t ha⁻¹ and the crop duration is ten months. Both H-165 and H-226 are the predominant varieties cultivated in Tamil Nadu and Andhra Pradesh for their industrial potential.

4. Sree Visakham (H 1687) is a hybrid between an indigenous accession and a Madagascar variety S-2312. The female parent is unbranched with light yellow tuber flesh, while the male parent is a heavy yielder with good culinary qualities. Sree Visakham is predominantly a non-branching type and tall having compact tubers with yellow flesh due to high carotene content (466 IU/100 g). Tuber skin is brown and rind is cream in colour. The crop duration is ten months and the tuber yield is 35-38 t ha⁻¹ with 25-27% starch.

5. Sree Sahya (H 2304) is a hybrid involving five parents of which two are exotic and three indigenous. Plants are tall, generally non-branching with dark brown and a predominant spiny, stipular mark. The tubers are long necked with light brown skin, cream coloured rind and white flesh. Tuber yield is 35-40 t ha⁻¹. Both Sree Visakham and Sree Sahya are improved varieties for table purpose having better palatability than the former three hybrids and are popular in southern Thiruvananthapuram and western Kanyakumari districts.

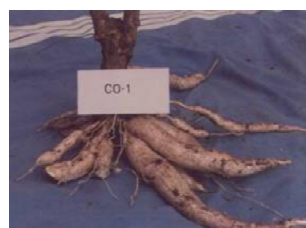
6. Sree Rekha (TCH 1): Top cross hybrid of cassava viz., TCH 1 was released for general cultivation in Kerala under the name 'Sree Rekha'. The average yield and starch content are 48.0 t ha⁻¹ and 28 % respectively. Tubers cook well and give good yields both under upland and lowland conditions.

7. Sree Prabha (TCH 2): Top cross hybrid of cassava viz., TCH 2 was released for general cultivation in Kerala under the name 'Sree Prabha'. The average yield and starch content are 42.0 t ha⁻¹ and 26% respectively. Tubers cook well and give good yields both under upland and lowland conditions.

Early maturing varieties

Majority of cultivated cassava varieties take about ten months for maturity and thus occupy the land for a long period. Systematic screening of the germplasm collections has

resulted in the identification of three early maturing varieties in cassava which can be harvested at 6-8 months. The early maturing selection 'Sree Prakash' released from CTCRI during 1987 was quickly adopted in paddy based cropping systems in low lands of Kerala state for eg: in Alappuzha district. Later, two more short duration varieties viz. Sree Jaya and Sree Vijaya were also released for this purpose in 1998 and are popular in Kollam and Pathanamthitta district.



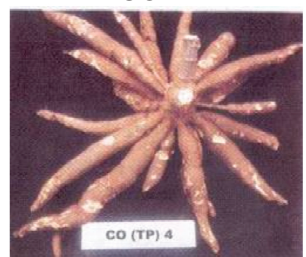
CO 1



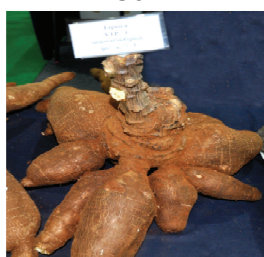
Co 2



Co 3



CO (TP) 4



YTP1



MVD-1

1. Sree Prakash is a relatively short statured plant, generally non-branching with high leaf retention. The tubers are medium sized, necked and the tuber yield is 35-40 t ha⁻¹. The duration is 7-8 months. Tubers possess good culinary quality and give a starch content of 29-31%.

2. Sree Jaya is a medium tall variety and produces conical tubers and have white flesh. Its duration is 6 months and tuber yield is 26-30 t ha⁻¹. The cooking quality of the tuber is very good and on par with the popular local variety M4.

3. Sree Vijaya is also medium tall and has conical tubers but yellow flesh. The tuber yield is 25-28 t ha⁻¹ and duration is 6 months. It has average cooking quality.

Breeding work outside CTCRI

Cassava breeding research is in progress at the State Agricultural Universities of Kerala and Tamil Nadu as well as the Department of Horticulture and Plantation Crops of the Government of Tamil Nadu. The Kerala

Agricultural University has released two short duration varieties viz. Nidhi in 1993 and KMC-1 (Vellayani Hraswa) in 1998. Four varieties viz. CO-1, CO-2, CO-3 and CO-4 were also released for general cultivation from Tamil Nadu Agricultural University. The Horticulture Department of Tamil Nadu released two varieties, MVD-1 and MVD-2 in 1993. These varieties are yet to make a dent into the cultivator's fields except to a limited extent by CO-2 and MVD-1.

Propagation

Cassava is propagated vegetatively using stem cuttings.



Agronomic practices

Land preparation

Good cassava production requires a good land preparation. The land should be well prepared with tillage the land in order to remove the weeds, loosen up the soil, improve soil drainage and make it easy for root development. For tillage system, the soil is ploughed and exposed to the sun for 2 weeks to a month. This helps to kill deeply embedded weed seeds. Second plowing is then done in preparation for planting associated with seedbed pattern. Land preparation can be done by manual, animal drawn and machine land. Cassava and soil productivity can be sustained with proper land preparation and applying an appropriate integrated nutrient management techniques in local context.

Propagation

These are parts of the stem which should be from a mature plant, especially the middle part. They should be 30 – 45 cm long and 2 – 4 mm thick with buds above the leaf scar.

Virus elimination through tissue culture in cassava

The protocol for virus elimination through tissue culture has been standardized for the varieties MVD 1 and H 226 by using meristem culture. The Murashige and Skoog (MS) medium supplemented with BAP at 0.1 mg/l for meristem establishment and shoot growth and MS medium without growth regulators for rooting have to be followed.

The in vitro plantlets are to be hardened in sterile pot mixture (sand : soil : FYM in 1 : 1: 1) under mist chamber for 10-15 days and later kept under shade net for 10 days before transferring them to the open field.

Planting method and spacing

Cuttings may be buried in a horizontal position 71/2 – 10 cm deep or buried half way into the soil. In pure stands (without

intercropping), a spacing of 1.5 m x 0.9 m is recommended.

When intercropped, interplant with a cover crop of beans or groundnuts at a spacing of 50cm x 20cm. This combination gives maximum yields of both cassava and bean or groundnuts.

Weeding

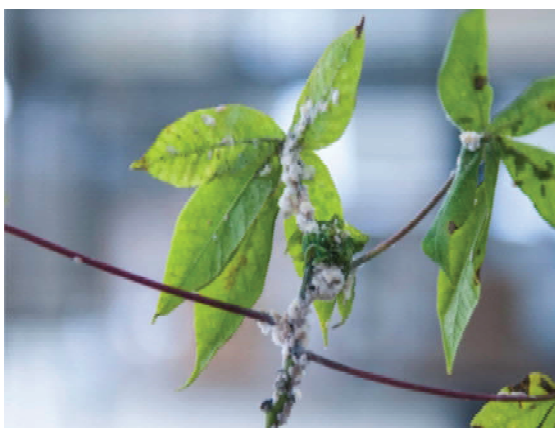
Keep the crop weeded in the early first 3 months. Intercropping also helps to suppress weeds.

Pests and Diseases and Their Management

(i) Pests

Most times insect pests are not a threat to cassava production but still need attention. The most notable ones include;

Cassava mealy bug : Attacks mainly the growing points of the plant causing stunting, leaf and shoot deformation. Severe damage leads to tuber quality deterioration.



Control: Use clean and resistant varieties like Nase 1. Biological control is also being tried in some districts.

Cassava green mite: It is a sucking pest which leads to reduces growth, scorching of leaves, tiny leaf production, leaf fall and eventually a plant without leaves. This causes great yield reduction or loss.

Control may be through;

- Use of resistant varieties
- Biological control using predator mites
- Crop rotation
- Planting early at the onset of rains
- Other pests include wild pigs and termites.



(ii) Diseases

- The cassava Mosaic Disease (CMD) is the most feared virus disease at the moment. It causes reduced leaf size, malformed and twisted leaves with yellow areas separated by areas of normal green color. Severely affected plants are stunted. Yield loss due to CMD depends on the stage at which the plant is infected and severity of symptoms. The disease is transmitted by the white fly.

Control

- Roughing infected plants
- Use of resistant varieties
- Use of clean planting materials

Cassava Brown Streak

This is another virus disease but is less damaging than mosaic causing brown streaks

on green stems. The marks remain and appear as sunken areas on mature stems. The disease is controlled in the same way as CMD.

Harvesting, yields and post harvest handling

1. Cassava takes 8 – 36 months to mature depending on the variety.
2. Yields also vary depending on variety and soil type. Average yields are 10 – 30 tons/ha.
3. Cassava harvesting may be done piecemeal (one by one) or by uprooting whole plants. A stick or hoe may be used to remove the tubers.
4. Cassava cannot be stored fresh for a long time. It is therefore sliced and dried in the sun. In this dry form, it can be kept for long periods of time in a dry bag in a place such as granary or other food stores. The dry cassava may also be pounded into flour which can be stored for a long period of time in a dry place.

Yield

Yield of 25 t/ha and above can be obtained with good agronomic practices and management.

Cost of production

To reduce cost of production and attain high yields, it is recommended that land preparation be fully mechanized. A power tiller can be used if the total land area under cultivation is not more than 250ha

Production cost for one hectare of cassava to ensure yield of 25 t/ha and above.

Sl. No.	Particulars	Production cost in Rupees
1	Land preparation	10,000.00
2	Cassava cuttings (60 bundles @ N300/bundle)	18,000.00
3	Planting (10 pd* at N700/pd)	7,000.00

4	Pre-emergence herbicides (5 liters at N1000/l)	5,000.00
5	Fertilizer (20:10:10, 9 bags at N2500/bag)	22,500.00
6	Insecticides (2 liters at N1000/l)	3,000.00
7	Application of herbicide	3,000.00
8	Application of insecticide	3,000.00
9	Application of fertilizer (8 pd at N700/pd)	5,000.00
10	One weeding (20 pd at N700/pd)	14,000.00
11	Harvesting (35 pd at N700/pd)	24,500.00
Total		115,000.00

* pd = person days. Farm labor wage rates vary by location

Note: Fixed capital investments are not included. Such capital investments include knapsack or boom sprayers, tractors or power tillers, stem cutters, planters, and harvesters. With planters and harvesters, manual labor use can be minimized.

Conclusion

Cassava is grown under many complex and diversified production systems where technology preferences are multifarious to suit different socio-economic production systems and objectives. It is necessary to have technology assessments under a wide range of agro-climatic situations through farmer participatory research. However, with better management practices good crop can be harvested.

