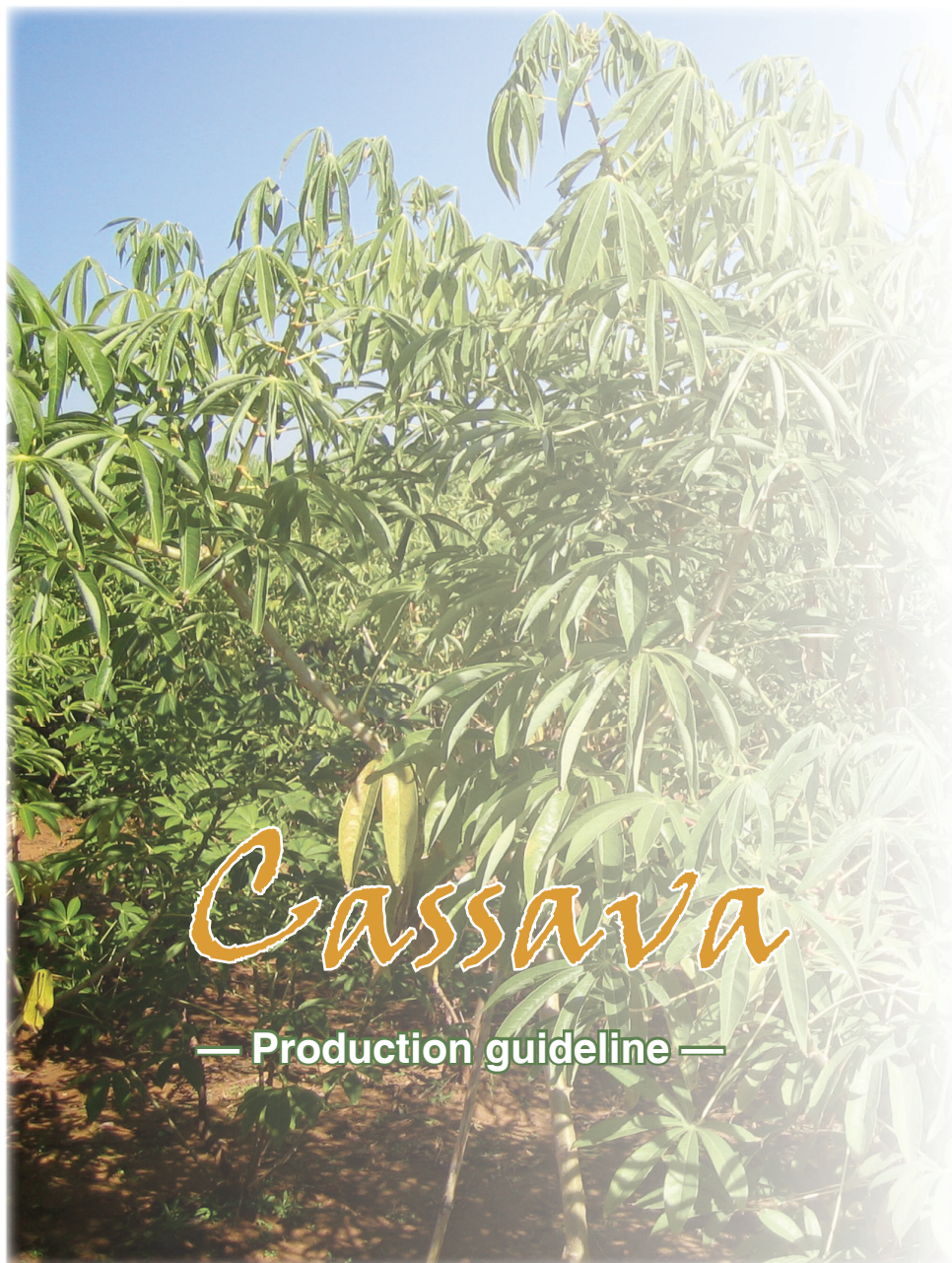




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Cassava

— Production guideline —

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GENERAL

Classification

Scientific name: *Manihot esculenta*
Family: Euphorbiaceae
Common name: Cassava (English), Mutumbula (Tshivenda), Muthupula (Xitsonga), Unjumbula (isiZulu)

Origin and distribution

The cassava plant has its origin in South America. The Amazonian Indians used cassava instead of or in addition to rice, potato or maize. Portuguese explorers introduced cassava to Africa during the 16th and 17th centuries through their trade with the African coasts and nearby islands. Africans then spread cassava further, and it is now found in almost all parts of tropical Africa.

Today Nigeria and Congo-Kinshasa are the biggest producers of cassava after Brazil and Thailand.

Production levels

South Africa

Cassava is grown as a secondary crop in South Africa by smallholders and is utilised for the production of starch (commercial and food grade starch). Currently, 20 000 tons of its starch are produced commercially.

Internationally

The north-eastern region of Thailand is the world's biggest exporter of dried cassava. About 60% of the total planted area is in this region. The major production provinces are: Nakhon Ratchasima (main producing area, accounting for 22% of the total), followed by Chiyabhum,



Chachoengsao, Prachin Buri and Udon Thani. The world cassava production at present stands at 200 million tons a year.

Major production areas

In South Africa, the crop is cultivated in Limpopo, Mpumalanga and northern KwaZulu-Natal. It is produced on a large scale in Limpopo, mainly for industrial purposes.

Cultivars

“Bitter” and “sweet” are the two general types of cassava. The sweet type is more commonly grown because of its greater yields. The colour and texture of the root peel are often the only factors used in separating clones in the market.

Description of the plant

Mature plant

The cassava plant is a perennial that, under cultivation, grows to a height of about 2,4 m.

Roots: Cassava roots are tuberous, long and tapered, with firm, homogeneous flesh encased in a detachable rind, about 1 mm thick, which is rough and brown on the outside. Commercial varieties can be 5 cm to 10 cm in diameter at the top, and around 15 cm to 30 cm long. A woody cordon runs along the root's axis. The flesh can be chalk-white or yellowish. Cassava tubers are very rich in starch, and contain significant quantities of calcium (50 mg/100 g), phosphorus (40 mg/100 g) and vitamin C (25 mg/100 g).

However, they are low in protein and other nutrients.



Stems: The stem erects and radiates from the tuber and has milky latex. As the plant grows, the main stem usually divides into three branches, each of which then divides in the same way.

Leaves: The leaves are large and palmate and

have five to seven lobes borne on a long, slender petiole. The leaves grow only towards the end of the branches. They are dark green above and light green below.

Flowers and fruit: Male and female flowers are arranged in loose plumes and are found on the same plant. The fruit is a globose capsule, 1,2 cm in diameter, with six winged ribs. Each capsule contains three seeds.

Essential parts

The tubers and leaves are the essential parts of cassava.

Climatic requirements

Temperature

Cassava is a typical tropical plant. For this reason, it is most productive between 15 degrees North and 15 degrees South latitudes. In general, the crop requires a warm, humid climate. Temperature is important, as all growth stops at about 10 °C. The crop is typically grown in areas that are frost-free all year round. The highest tuber production can be expected in the tropical lowlands, below an altitude of 150 m, where temperatures average 25 °C and 29 °C, but some varieties grow at altitudes of up to 1 500 m.

As a tropical crop, it is a short-day plant. More than 12 hours of daylight can cause delays in tubering (starch storage) and eventually low yields, while short light periods enhance flowering.

Water

The plant produces best when rainfall is fairly abundant, but it can be grown where the annual rainfall is as low as 500 mm but well-distributed and where it is as high as 5 000 mm. The plant can stand prolonged periods of drought in which most other food crops would perish. This makes it valuable in regions where the annual rainfall is low or where seasonal distribution is irregular. In tropical climates the dry season has about the same effect on cassava that a low temperature has on deciduous perennials in other parts of the world. The period of dormancy lasts two to three months and growth resumes when the rains begin again. It is a valuable crop where rainfall is uncertain. If moisture availability becomes low, the plant will cease to grow and shed some older leaves, reducing the transpiration surface. When moisture is available again, growth is resumed and the plant produces new leaves

Soil requirements

Cassava grows best on light, sandy loams or on loamy sands which are moist, fertile and deep, but it also does well on soils ranging in texture from sands to clays and on soils of relatively low fertility. In practice, it is grown on a wide range of soils, provided the soil texture is friable enough to allow the development of the tubers.

Cassava can produce an economic crop on soils depleted by repeated cultivation to the extent that they have become unsuitable for other crops. On very rich soils the plant may produce stems and leaves at the expense of tubers. In some parts of Africa, freshly cleared forest soils are regarded as highly suitable after they have produced a cereal crop.

CULTIVATION PRACTICES

Propagation

Cassava is propagated exclusively from cuttings.

Soil preparation

When cassava is grown as the first crop in forest land, no further preparation is required other than the clearing of the forest growth. When cassava is grown after other crops, it can often be planted without further preparation of the soil (e.g. once the preceding crop has been harvested or the soil has been ploughed two or three times until it is free from grass and other plants).

Clearing of forest land is done to let in more sunlight to the ground and to remove weeds and undergrowth which might otherwise compete with economic plants. The practice is to clear the forest soil completely. All the roots and other obstructions beneath the soil must also be removed by slashing and burning of the forest cover. After this has been done, the land must be deeply ploughed. Burning is important as it also destroys soil parasites, and the layer of ashes increases the quantity of potassium salts available to the growing plants. However, it could lead to soil deterioration due to the leaching out of nutrients.

Field layout and design

The field layout should not have slopes of more than 8% and the field should not be in low-lying and flood-prone areas. The field may need to be



graded to ensure good drainage. If cassava is planted on slopes, then it would be advisable to make the field across the slope, or slightly inclined to the contours so as to minimise soil erosion on the field. Spacing between the rows is about 80 cm to 100 cm, while spacing along the rows is usually 80 cm to 100 cm. However, this is mainly determined by local conditions. The number of plants per hectare varies in different regions—between 10 000 and 15 000.

Planting

Cassava culture varies according to the purposes for which it is grown. The cassava is either planted as a single crop or intercropped with maize, legumes, vegetables, rubber, oil palms or other plants. Mixed planting reduces the danger of crop loss due to unfavourable weather conditions and pests as the risks are spread among plants with different susceptibilities.

For selection purposes, cassava is raised from seed only. Seeds produce plants with fewer and smaller tubers than those of the parent plants and up to 50% of the seeds may fail to germinate. On the other hand, taking cuttings from the stalks of the plant is a better method as the cuttings rapidly and easily take root, producing plants that have identical characteristics to those of the parent plants.

Fertilisation

If cassava yields drop, no fertilisation is required when the land is freshly cleared or when there is enough land to enable the cultivator to substitute new land for old land. Like all rapidly growing plants yielding carbohydrates, cassava has high nutrient requirements and soil depletion very quickly occurs. When the crop is grown on the land for a number of years in succession or in rotation, the store of certain nutrients in the soil will be reduced and must therefore be replenished by means of fertilisation. This depletion of nutrients is aggravated by the introduction of high-yielding cassava varieties and the promotion of production for both food security and export.

The application of fertilisers causes significant increases in yield of roots as well as starch content. Potassium salts favour the formation of starch while nitrogen and phosphorus are essential for growth. However, if the soil contains large quantities of assimilated nitrogen, the result will be a big increase in vegetal growth without a corresponding rise in tuber production.

Small-scale farmers use different kinds of organic manures such as cattle or chicken manure. The kinds and quantities of fertilisers required by a cassava crop depend on the nature of the soil. Soil analysis is therefore important to determine the quantity of fertiliser that has to be applied. Cassava removes large quantities of N, P, K and Mg; a crop of 25 kg/ha of cassava removes about 60 kg/ha of N, 40 kg/ha of P_2O_5 and 136 kg/ha of K_2O . Thus the aim in using soil analysis results should be to replace the removed nutrients.

Irrigation

Cassava is quite drought tolerant and is rarely irrigated, but it does produce better yields when it is regularly watered and the soil is not allowed to dry out completely.

Weed control

Weeding is recommended when the cassava plants are 20 to 25 cm tall, that is, three or four weeks after planting. Weed a second time one or two months after the first weeding. Earth up the plants at the same time; this greatly promotes the formation of tubers, and prevents the wind from blowing the plants down. After this step the plants are big enough to prevent weeds from growing. When rain spoils the mounds, they must be remade. When the soil of the mounds gets too hard, it should be broken up with a hoe to allow water and air to get in to nourish the roots.

Pest control

In many regions, the cassava plant is not normally affected by diseases or pests. However, in other regions it may be attacked by the following pests:

Insects: Some insects affect the plant directly (locusts, beetles and ants), while others affect it indirectly through the transfer of viruses (aphids).

Animals: Rats, goats and wild pigs are probably the most troublesome because they feed on the tubers, especially in areas adjacent to forests.

Disease control

The main diseases affecting cassava are mosaic disease, bacterial blight, anthracnose and root rot. The means of controlling mosaic disease are not yet known. The disease can be avoided by using cuttings from uninfested plants only. Choose varieties that have been bred for disease resistance. The spreading of mosaic disease in a region can be prevented if the farmer burns all the plants attacked by the disease. Avoid rot by not planting cassava in a place that is often flooded.

Other cultivation practices

Cassava is commonly intercropped with maize, melon, okra, groundnut or cowpea. Planting takes place when the intercrop is almost ready for harvesting, so cassava starts its field life as an intercrop and in its second stage is a pure stand.

In rotational plantings, cassava should occupy the field for one-and-a-half seasons. It is usually the last crop in rotation before the land is returned to bush fallow in traditional agriculture because it still provides a yield in areas of depleted fertility, and it is suited to the dry spell that follows the growing season. Cassava should not be planted after a legume crop as high nitrogen levels produce large quantities of glucosides.

Harvesting

Harvest maturity

In regions with seasonal rains, cassava can be harvested throughout the year when the tubers reach maturity. Harvesting usually takes place in the dry season, during the dormant period of the plant. In areas where rain prevails all year round, the crop can be harvested throughout the year. Maturity differs from one variety to the next. The tubers can be harvested between six months and three years after planting, but for food purposes

harvesting can take place at almost any age below 12 months. Harvesting may be delayed until market, processing, or other conditions become favourable. With regard to starch production, cassava should be considered ripe when the yield of starch per hectare is at its highest. In experiments with certain strains of the variety, an optimum age of 18 to 20 months was found. It is seen that both tuber and starch production rapidly increase to reach a maximum value, after which tuber production decreases slowly and starch production much more rapidly on account of the declining starch content of the tubers. If the tubers are left in the ground, the starch content increases with age until, at a certain point, lignification takes place, causing the tubers to become tough and woody and making it more difficult to prepare them for consumption and other uses.

Harvesting methods

Harvesting is still generally a manual operation, although equipment to facilitate this operation is being considered. The day before harvesting, the plants are topped—the stalks are cut off manually 40 to 60 cm above ground or by using a machete or machine and piled at the side of the field. The 40 to 60 cm length of stalk is left as a handle for pulling the tubers from the soil. Material required for the next planting is selected and the rest is burned. In light soils the tubers are slowly drawn from the soil by the stems or with the help of a kind of crowbar, and the tubers are cut off the stock. In heavier soils a hoe may be required to dig up the tubers before the plants are pulled out. It must be noted that once the plants have been topped, the roots must be lifted without delay or they will sprout and the starch content will fall drastically.



Because of the way the tubers grow, cassava is not a crop that readily lends itself to mechanical harvesting. The tubers may spread over 1 m and penetrate the soil 50 to 60 cm deep. If care is not taken when machinery is used during harvesting, the tubers may be damaged and may

darken as a result of oxidation. This will lower the value of the flour produced. Mouldboard ploughs can be used to make hand-harvesting less tedious. Stalks can be successfully cut by means of a mid-mounted mower or a topping machine, and the tubers must be mechanically lifted with a mid-mounted disk tracer. A modified beet or potato harvester has been suggested for use behind the tractor, with a pulling mechanism instead of the digging shares to raise the tubers by the cut stems left after the topping process.

POST-HARVEST HANDLING

In the processing of cassava starch it is vital to complete the whole process within the shortest time possible, because as soon as the tubers have been dug up, and also during each of the subsequent stages of manufacture, enzymatic processes tend to have a deteriorating effect on the quality of the end-product. This will require a well-organised supply of tubers within a relatively short distance of the processing plant, and the stages of processing will have to be scheduled so as to minimise delays in manufacturing. Thus, while basic in principle, the production of good-quality cassava flour still requires great care.

The tubers are normally received from the field as soon as possible after harvest and cannot be stored for more than two days. Since the presence of woody matter or stones may seriously interfere with the rasping process by causing stoppages or by breaking the blades, the woody ends of the tubers are chopped off with sharp knives before the processing operations begin.

Peeling and washing

In small and medium-sized mills the general practice is to remove the peel (skin and cortex) and to process only the central part of the tuber, which has a much softer texture. With the relatively primitive apparatus available and limited power, the processing of the whole tuber would entail difficulties in rasping and in removing dirt, crude fibre and cork particles, while comparatively little extra starch would be gained.

The roots are longitudinally and transversely cut to a depth corresponding to the thickness of the peel, which can then be easily removed. Any dirt remaining on the smooth surface of the core of the tuber can be washed off without any trouble and the peeled tubers can be deposited in cement basins where they will remain immersed in river water until taken out for rasping. In the larger factories, whole tubers are generally processed. The



washing here serves to remove the outer skin of the tubers as well as the adhering dirt. Provided the tubers are sufficiently ripe, the skin may be removed without the use of brushes. Only the outer skin or corky layer is removed, as it is profitable to recover the starch from the cortex. The inner part of the peel represents about 8% to 15% of the weight of the tuber.

Rasping and pulping

One has to rupture all the cell walls in order to release the starch granules. This can be done by biochemical or mechanical action. The biochemical method, an old one, allows the tubers to ferment to a certain stage. Then the roots are pounded to a pulp from which the starch is washed with water. This method does not give complete yields and the quality of the resulting starch is inferior. Mechanical action requires the roots to be and then rasped, grated or crushed, which tears the flesh into a fine pulp.

By pressing the tuber against a swiftly moving surface provided with sharp protrusions, the cell walls are torn up and the whole of the tuber is turned into a mass into which the greater part, but not all, of the starch granules is released. The percentage of starch set free is called the rasping effect. Its value after one rasping may vary between 70% and 90%. The efficiency

of the rasping operation therefore to a large extent determines the overall yield of starch in the processing. It is difficult to remove all the starch in a single operation, even with efficient rasping devices. Therefore, the pulp is sometimes subjected to a second rasping process after screening. The rasping is carried out in different ways and with varying degrees of efficiency.

Hand and mechanical rasping

On tiny smallholdings in some cassava-growing regions, the tubers are still rasped by hand on bamboo mats. Where daily production amounts to several hundred kilograms of flour, basic mechanical implements are used.

Grading

Cassava is graded into three classes or sizes, namely large, medium and small. The tubers are also separated according to quality. Those of good quality are free from any bruises and cuts and those of poor quality are usually not saleable and are normally given away or used as feeds. The perception of good-quality cassava among buyers is that it is bigger in size, fresh and free from rotting.

Packing

In Africa there are also a number of traditional systems involving cassava storage in pits or clamps. Fresh tubers are generally processed on the day that they arrive at the factory and it is rare to find industries that have storage facilities. Cassava processing industries that use dried raw material such as gaplek (sliced dry tubers) for chip or pellet production do not depend on rapid processing of the tubers since the dried raw material can be stored for several months. Seasonal supply shortages of cassava can be avoided by drying peeled pieces of the tubers immediately after harvest and storing them on-farm or at the site of the processing industry until required.

Transport

To avoid losses from root deterioration, cassava has to be processed very close to the production areas and processors have to ensure a daily supply of raw material. Decentralised, small-scale processing has been an important strategy to resolve the problems of how to minimise transport costs and how to avoid post-harvest deterioration of bulky, low-value raw material.

Starch extraction process

- Harvested tubers must be delivered to the processing plant within 48 hours to prevent deterioration.
- After washing and peeling, the tubers are grated to release the starch granules and then separated from the pulp and water by sedimentation or by means of a centrifuge.
- Solar or artificial drying can also be used to remove the moisture before milling, sieving and packing take place.
- The tuber peelings can be recycled as fertiliser and animal feed.
- Once dried, the discarded fibre can be sold as flocculent to the mining industry, while low-density starch lost during sedimentation is used as pig feed.

Marketing

Cassava spoils easily and is costly to transport in its raw form as it consists mainly of water. Therefore, a lot of processing takes place on-farm. Processing results in products such as gari (a type of pickled vegetable), lafun (a fibrous, powdery form of cassava) and fufu (a thick paste made by boiling) which all have a longer shelf life than cassava tubers do. These products are consumed in the household or sold in the local market. They are sold within South Africa or to traders from Swaziland and Mozambique.

PRODUCTION SCHEDULES

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Planting												
Fertilisation												
Harvesting												

UTILISATION

The tubers are used as a substitute for rice or maize meal and the leaves and tender shoots are cooked as a vegetable or used in sauces. They can

also be chopped, dried and fed to animals. The main use of cassava in South Africa is for the production of starch, which makes a good natural adhesive. Fresh tubers contain about 30% starch and very little protein. The starch has many industrial applications, including food processing and in the paper, wood, textile, pharmaceutical, chemical and feed industries. The tubers are prepared much like potato and can be peeled and boiled, baked, or fried. Eating uncooked cassava is not recommended because of the potentially toxic concentrations of cyanogenic glucosides. However, these concentrations are reduced to innocuous levels through cooking.



In the traditional areas of North and South America, the tubers are grated and the sap is extracted through squeezing or pressing. The cassava is further dried over a fire to make a meal, or it is fermented and cooked. The meal can then be rehydrated with water or added to soups or stews. In Africa, the tubers are processed in several different ways. They may first be fermented in water, and then either sun-dried for storage or grated and made into dough that is cooked. Alcoholic beverages can be made from the roots.

Cassava has a high content of fermentable substances. This makes it appropriate for the production of alcohol. The fresh tubers contain about 30% starch and 5% sugars, and the dried tubers contain approximately 80% fermentable substances (which are equivalent to rice as a source of alcohol).

REFERENCES

- REY CHRISSIE. 2006. *Improvement of cassava for social and economic benefits*. Southern African Society for Plant Pathology.
- FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1988. *Traditional Food Plants*. FAO, Food and Nutrition, Paper 42.

FOX, F.W. & NORWOOD YOUNG, M.E. 1988. *Food from the veld*. Johannesburg. South African Institute for Medical Research, 1982.

FOX, F.W. & NORWOOD YOUNG, M.E. 1982. *Food from the veld*. Edible wild plants of Southern Africa. Delta books.

SPOTLIGHT: CASSAVA STARCH, 2006. Food and Agriculture Organization of the United Nations, *Agriculture and Consumer Protection Department*.

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