

**Cultivation, processing and use of cassava
Practical instructions**

*Empresa Brasileira de Pesquisa Agropecuária
Embrapa Mandioca e Fruticultura
Ministry of Agriculture, Livestock and Food Supply*

Cultivation, processing and use of cassava – Practical instructions

Authors

José Raimundo Ferreira Filho

Agronomist, M.Sc.

Researcher at *Empresa Baiana de Desenvolvimento Agrícola*

Jose.ferreira@colaborador.embrapa.br

Helton Fleck de Silveira

Agronomist

Analyst at *Embrapa Mandioca e Fruticultura*

Helton.fleck@embrapa.br

José Jario Gama Macedo

Agronomist

Extensionist at *Empresa Baiana de Desenvolvimento Agrícola*

jriomacedo@hotmail.com

Marcelo Bezerra Lima

Agronomist, M.Sc.

Researcher at *Embrapa Mandioca e Fruticultura*

Marcelo.lima@embrapa.br

Carlos Estavao Leite Cardoso

Agronomist, D.Sc.

Researcher at *Embrapa Mandioca e Fruticultura*

Carlos.estevao@embrapa.br

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PRESENTATION

This booklet was elaborated with the purpose of guiding the farmers of the II Northeastern Semi-Arid Territory, in detail, on the use of all necessary operations for the cultivation, processing and use of cassava. It contains information for the necessary procedures, such as choosing and preparing the cultivation area, choosing varieties, obtaining the branches, conserving the branches, defining the spacing, preparing for planting, undertaking the planting, cultivating practices, controlling pests and diseases, and harvesting.

It is expected that the adoption and/or adjustment of this knowledge will result in an increase in productivity, improved quality and greater use of products and, consequently, increased family income and improved living conditions of farmers.

INTRODUCTION

The cultivation of cassava takes place in the entire Brazilian territory, therefore representing one of the most socioeconomically important cultivations in Brazil. It occupies a prominent position in the State of Bahia, where it is mainly undertaken by family farmers, as their main source of income. Cultivation of cassava in the Northeastern Semi-Arid Territory presents low average productivity, due to the lack of an adequate production system and soil and climatic conditions. The low availability and adoption of available technologies, mainly fertilizers, correctives and adapted varieties, together with inadequate planting and harvesting times, and a narrow genetic base, result in low yields of the crop. As an example of the narrow genetic base, there is a predominance in the use of only two varieties: *Alagoana* and *Cria Menino*.

The areas planted with cassava have been gradually reduced. In addition to inadequate processing structures, which exist in reduced numbers, causing the raw material to travel large distances to be processed; the main product – roasted cassava flour, or “farinha” – suffers a loss of quality, in turn losing its space with consumers and therefore culminating in low aggregation of value. Without the gains provided by industrialization, cassava cultivation can become a low-profit activity.

I. Choosing the planting area

Roots are the main product of cassava cultivation. Therefore, when choosing the planting area, one should prefer deep, flat or slightly sloping terrain. Sandy or sandy-clayey (mixed) soils are the most appropriate, as they ease the passage of water, favour the thickening of roots and allow less time to be spent on harvesting, as the roots become easier to tear out.

Avoid planting under the following conditions:

- Downhill;
- In very muddy (clay) soil;

- In areas subject to waterlogging (poorly drained);
- In soil that is weak or depleted by other crops.

Preparation of planting area

The cleaning of the area consists of the elimination of the vegetable coverage. If deforestation and the removal of existing crops are necessary, care must be taken when done so mechanically to avoid too much movement of the topsoil. When done so manually, the removal of existing crops can be carried out gradually, year by year, as a cost-reduction measure, by initially planting within the “stump”.

The preparation of the soil can be done manually, with animal traction, or mechanically, with the use of a tractor. Soil preparation operations should be as minimal as possible, just enough to allow for the planting of the crop and for the proper development of the root system.

Generally speaking, soil preparation aims to improve the physical conditions of the soil to allow for the sprouting of the cutting and the growth of the roots, by increasing aeration, water infiltration and reducing the soil’s resistance to root penetration.

Good soil preparation allows for a more efficient use of correctives, fertilizers and other agricultural practices.

Photo caption: Preparation of the planting area. Photo: Helton Fleck

Care during soil preparation

- Alternate the types of implements used and the depth of work;
- Stir the soil as little as possible;
- Work the soil with adequate moisture;
- Leave the maximum amount of vegetable residue on the soil surface

Soil conservation in cassava planting

Two important aspects should be considered in cassava planting, with respect to soil conservation.

- 1- It is a crop that favours erosion. In sloping terrains, soil conservation practices should always be used:
 - Levelled planting or cutting across the flow of water;
 - Build terraces;
 - Plant contouring strings;
 - Remove weeds in alternating rows of cassava.
- 2- It is a soil-draining crop, and therefore it is recommended to:

- Sow legumes for incorporation into the soil;
- Rotate cassava with other crops;
- Fertilize the soil for new crops, according to chemical analysis recommendation.

II. Fertilizing and correcting the soil

Undertaking the liming

The cassava plant is tolerant to the acidity of soils. The recommended doses of limestone depend on the results of the soil's chemical analysis and should not exceed one ton of limestone per hectare. The application of limestone should be broadcasted, at any time of the year, preferably 30 to 60 days previous to the planting. Fertilize according to the soil's chemical analysis, at least two months before planting. Correct fertilization increases production. Investing in fertilization without knowing the fertility of the soil is an economic mistake.

Using of organic fertilizer

Cassava is a plant that responds to organic fertilization. The use of organic fertilizers, around 8.0 tons per hectare, is important to increase the production of roots due to the supply of nitrogen and other nutrients and, mainly, to improve the physical, chemical and biological characteristics of the soil. Various sources of organic materials are used to fertilize cassava, such as manure, droppings, organic compost, legumes and crop residue, and can be broadcast throughout the planting area, in the pit or in the furrow, at the time of planting.

Photo caption: Mulch and intercropping with beans. Photos: Claudio Luiz Leone Azevedo (1) and Zara Fernandes (2)

Fertilizing with minerals

Cassava does not require much fertilizer, and, generally, 300 kg of simple superphosphate per hectare can increase production from 4 to 6 tons of roots. Mineral fertilizers, mainly phosphates, have been indispensable for most of the soils cultivated with cassava, as they produce the most remarkable effects when in the presence of nitrogen and potassium.

Among the commercially available sources, the most common are: urea and ammonium sulphate (nitrogenous); simple superphosphate and triple superphosphate (phosphates); and potassium chloride and potassium sulphate (potassium).

Fertilizing with top-dressing

Nitrogen fertilizers should be applied as top-dressing, 45 to 60 days after the sprouting of plants, as long as the soil shows sufficient humidity.

Potassium fertilizers may be applied in a mixture with the phosphates at the time of planting. In the case of extremely sandy soils, they should be applied as top-dressing, along with the nitrogen.

Observe well! Areas that have been cultivated for a long time (tired) require fallowing (rest), crop rotation and fertility correction.

III. Selecting the planting material

When selecting the planting material, agronomic aspects should be observed (variety, age of mother-plant, adequate section of the plant, relationship between the manioc and the marrow, viability of the buds), as well as sanitary aspects, as it must be free of pests and diseases. Stems with symptoms of plagues and/or diseases should be removed.

Use mature stems (from plants 10 to 14 months old) and remove the ends (base and tips), as the middle section of the plant sprouts better and produces more. Before cutting it into pieces of 15 to 20 cm in length, check if the material is healthy. To find out if the cuttings have adequate levels of moisture, prick them a few times with a cutting tool (knife or machete) and observe if the milky substance (“latex”) comes out quickly and if the core (marrow) is moist.

To remove the plant stems for new planting processes, reserve part of the best crop area.

Conserving the stems

The storage of the branches, when necessary, should be done in an airy place, in the field or under trees. In case of a shortage of planting material, conserve the stems for a period of up to 60 days before planting. Look for a spot next to the new planting area, turn over the soil, keep the material vertical (standing up) with the tips up, and bury the base (5 to 10 cm). The area should be cool and protected from cold and hot winds and also from the sun.

It is best to reserve a small part (20% of the crop) of the cassava planting area or to harvest at the time of the new planting process.

Photo caption: Material selection and spacing. Photos: Helton Fleck (1) and Lea Cunha (2 and 3)

IV. Spacing

Avoid planting in without structure. Plant in rows and place the stems with the buds or tops facing the same direction.

In order to define adequate spacing in the planting of cassava, a few factors should be taken into consideration, such as the fertility of the soil, cultivation practices, the variety used, and the purpose of the crop, all of which are explained as follows:

Soil fertility

In fertile or well-fertilized soils, a larger spacing is recommended, varying between 1.00 m between rows and 0.80 to 1.00 m between plants, as they are more developed and require a larger area of exploitation. In weak soils (low fertility), use spacing of 0.80 to 1.00 m between rows and 0.60 to 0.80 m between plants, providing a more densely populated area and compensating for the lower production per plant in the area by having a larger number of plants.

Cultivation practices

Spacing can have many variations according to the type of cultivation practice used, and allows for the free movement of equipment without damaging the plants. In large plantations, weeding is mechanized, and in small plantations, weeding is done with the help of a hoe. These smaller plantations can therefore use smaller spacing.

Variety utilized

The type of growth (tall or short, unbranched or branched) of the variety utilized can alter the spacing. Tall varieties and those with a lot of branching require larger spacing.

Purpose of the crop

The purpose of the crop can interfere in the distance between the plants. Crops intended for human consumption (table varieties) require a smaller spacing, as the roots have a more uniform development; whilst the crops intended for the production of roots for the processing industries require larger spacing for more developed roots. When the main objective is the production of stems and foliage for fodder use, spacing must be reduced to up to 0.50 m between rows.

Photo caption: Planting and table variety. Photos: Mauricio Coelho Filho (2) and Zara Fernandes (1 and 3)

V. Planting season

Plant the cassava cuttings at the beginning of the rainy season (April), at the same time as planting beans and maize. It is especially fruitful when rainfall occurs at least in the four months after planting.

VI. Varieties

What is the best type of cassava to plant?

In Brazil there are many types of cassava – over 3,000 varieties. In the region of the Northeastern Semi-Arid Territory very few varieties are used, the most common being ‘Alagoana’ and ‘Cria Menino’.

Embrapa Mandioca e Fruticultura, the Agricultural Development Company of the State of Bahia (*Empresa Baiana de Desenvolvimento Agrícola*), the Regional Development and Integration Secretariat (*Secretaria de Desenvolvimento e Integração Regional – SEDIR*), community groups, associations and rural unions have all been introducing new varieties of cassava in the region and carrying out tests to verify their behaviour in relation to the production of roots, flour and gum, cycle length and resistance to drought. These tests are being carried out in order to have the option of new varieties that can be introduced in the production systems of the territory.

The demand for new cassava varieties has been growing as new alternatives to the use of the product arise, as well as the expansion of new agricultural frontiers, where other soils are used, the amount of rainfall changes and the altitude changes, among others.

Do not plant a single variety or type of cassava. Choose the best three or four and plant each one in separate stands (without mixing).

VII. Planting

The forms of planting cassava vary according to the type of soil, the size of the crop, the purpose of cultivation, the availability of machinery and equipment, labour and financial resources.

The most recommended system consists of planting in grooves approximately 10 cm deep, in ploughed and barred soil with the stem cuttings placed horizontally (lying down, with the ‘eye’ on the same side). In small plantations, the planting is done in ‘shallow pits’ (holes made with a hoe), or in *covetas* (small mounds of loosened soil with a hoe). In soils that are very humid or subject to waterlogging, it is recommended to plant in high pits, ridges and narrow mounds.

VII. Cultivating practices

Cultivating practices, when well used and at the right time of the year, create the conditions for the crop to establish itself as quickly as possible, providing greater productivity and better quality products.

Control of invasive plants

One of the factors that contribute the most to the decrease in cassava root yields is the presence of invasive plants that compete for light, water and the soil’s nutrients. Undergrowth can interfere with the crop and, depending on the time of coexistence, yields can be reduced by up to 90%.

Under normal conditions, cassava is sensitive to competition from invasive plants, especially in the first four to five months after planting. Therefore, in the first 100 days of the life cycle, the crop should be free of weed competition.

The mechanical method consists of the elimination of the weeds through manual tillage, hoe weeding and mowing.

Chemical control is done using chemicals known as herbicides. During this control, technicians' recommendations and the instructions of the agrochemicals must be strictly followed. This method should only be used when strictly necessary.

Integrated control consists of the combining available methods to maximize results. In this system, cover crops such as legumes can be used, especially in intercropped areas.

Undertake the ridging

Ridging consists of bringing the soil closer to the plants during weeding, with the aid of the hoe. This operation can also be performed while the cultivator is going over the weeding with the hoe. It is important to do so in this manner, so as not to hamper productivity and to maintain root quality.

Photo caption: Manual weeding. Photo: Zara Fernandes

Fertilize with top-dressing

When the chemical analysis of the soil indicates the need for the use of nitrogenous and/or potassium fertilizers, apply these somewhere between 45 to 60 days after the sprouting of the plants, when the soil presents adequate moisture.

IX. Pests associated with cassava cultivation and their control

There are a large number of mites and insects that attack the cassava crop, reducing the production and quality of the roots, as well as the propagation material that comes from attacked plants.

The mites and insects that attack cassava are classified by being found:

- on the surface of stems and leaves;
- inside the stem;
- in the soil

The pests that occur most commonly in cassava planted areas are: hornworms, mites, lace bugs, whiteflies, sprout flies, stalk-borers, termites and ants.

The control of insects and mites that attack cassava crops can be done through the use of natural enemies, light traps, resistant or tolerant varieties, biological or crop control, destruction of host plants and crop residues, periodic inspections and selection of planting material. It is not advisable to use chemicals, to avoid the elimination of natural enemies, in addition to the expenses and risk to human health and the environment that their continued use poses. Insecticides should only be used when the pest reaches very high numbers.

X. Diseases associated with cassava cultivation and their control

Cassava can also be attacked by several pathogens (systemic, localized and of the soil), which induce internal or external rot and/or cortical or epidermal cancers. Others invade the woody tissues of the stem without, however, provoking visible symptoms.

Among the diseases present in the cassava crop, the most important are: root rot, bacterial disease, anthracnose, super elongation, super sprouting and viruses, which are responsible for enormous economic losses.

Disease control can be done by taking preventive measures, such as avoiding the introduction of planting material obtained from affected areas, using tolerant varieties associated to cultivation practices such as crop rotation, physical and chemical soil management, crop systems, and the adaptation of the planting season and strict selection of the propagation material.

Photo caption: Cassava pests. Photos: Alba Rejane Nunes Farias

XI. Harvest

The cassava harvest is primarily manual and/or with the aid of tools, although mechanized implements already exist. It is one of the costliest operations of the cassava production system.

The harvesting includes the following stages: pruning of aerial parts (dispensable in some cases) to a height of 20 cm above ground level, followed by the uprooting and collapse of the roots and, finally, the transport of the roots to the processing units.

In the region of the Northeastern Semi-Arid Territory, harvesting typically occurs when the plants have completed the cycle, between 18 to 24 months after planting. After the uprooting or harvesting, the roots are heaped at specific points in the area, in order to streamline the collection. However, these should not remain in the heaps for over 24 hours between harvesting and processing, to avoid spoiling.

The harvest should be planned according to the size of the planted area and the destination of the production, in order to avoid accumulation and root losses.

At the time of harvest, it is important to leave part of the crop (20%) to be harvested or pruned at the time of the new planting cycle.

Photo caption: Harvest. Photo: Zara Fernandes

XII. Post-harvest and processing

Root harvesting is an important part of processing. The roots should be cut close to the peduncle, should not be injured and, most importantly, should be transported for processing as quickly as possible, avoiding direct incidence of sun and wind.

The vast majority of processing units in use in the region of the Northeastern Semi-Arid Territory do not have the capacity to compete with more technologically apt units, due to their inadequacy and reduced number of units, which makes cassava cultivation a low-profit activity. Processing is almost entirely directed to the production of table cassava flour (*farinha*), which is the product most typically consumed. The extraction of starch occurs on a smaller scale, using a rustic process. The production of *beijus*, biscuits and other similar products is almost non-existent.

XIII. Cassava in human nutrition

Cassava varieties can be classified as: 1) Sweet, subtle or 'table' varieties, also known as *aipim* or *macaxeiras*, with low levels of hydrocyanic acid. These are usually used for human consumption, after cooking, and for animal consumption, when *in natura* or processed; and 2) bitter or strong, with higher levels of hydrocyanic acid, which are used indirectly in human nutrition, after processing in the flour and starch industries.

There are several products that can be made from cassava roots and its varieties, such as flours, starch, bakery products (biscuits, bread and cakes), dough, *beiju*, *carimã*, among others.

Photo caption: Cassava processing. Photos: Lea Cunha

Dry flour

"*Farinha de mesa*", also known as table flour or roasted flour, is the product obtained by processing the edible parts of the cassava roots. Produced in all regions of Brazil, mainly the North and Northeast regions, it is the most consumed cassava product in the country, being one of the main sources of energy for low-income populations. The level of moisture needed for the packing of dry flour for storage should not be higher than 14%.

The main issues of the cassava flour currently being produced are the lack of uniformity and the wide variation of its composition, influenced by the variety, plant age and time interval between harvest and processing.

The processing of cassava for the production of “farinha” follows the following steps:

- Cassava roots
- Washing and peeling
- Grating
- Crumbling
- Sieving (optional)
- Roasting
- Sieving
- Packaging
- Storage

Starch or gum

The production of starch or gum is carried out at an artisanal scale, with variations only in the type of equipment used. From the starch, various other products can be manufactured, such as sour starch, tapioca, sago, creams, puddings, baby food, sauces, broths, etc.

In Brazil, starch production is also carried out on an industrial scale. For the industry, the starch content of the root directly influences the industrial yield and production cost.

The processing of cassava roots for the production of starch or gum follows the following steps:

- Washing and peeling
- Grating
- Addition of water
- Extraction of starch
- Decanting
- Drying
- Milling
- Packaging
- Storage

Sour starch

Obtained through the fermentation of the starch or gum, which modifies its properties, allowing for the production of *cheese bread*.

The fermentation occurs naturally, undertaken in open or closed tanks, preferably of coated masonry or stainless steel. A layer of starch covered with 10 to 20 cm of water is placed inside and, after a few days, there should be a cloudiness to the water and bubbles on the surface of the liquid, as well as an increasingly acidic smell, which identifies the end of the fermentation. The supernatant liquid is drained and the surface should be scraped to remove impurities. The material is crumbled, set to dry to 14% moisture, packaged and stored.

Cooked and fried cassava

'Sweet' cassava, *aipim* or *macaxeira* should be washed, peeled, cut and cooked or fried. They can be pre-cooked, packed and kept refrigerated for some time. From cooked *aipim*, one can make soups, porridges, broths and many other products. For fried consumption, the cassava is first pre-cooked, then very finely sliced and fried.

The natural *aipim* roots are increasingly less frequent in large cities and supermarkets, as not only do they spoil quickly after harvesting, but they also need to be peeled.

***Carimã* or *puba* dough**

This is the product obtained by the spontaneous fermentation of fresh whole or split cassava roots. The roots are placed in water, where they remain for approximately five days, until they soften and begin to release the bark. Then they are crushed in sieves and washed, until only the fibres remain. The separated dough must be washed several times, after which it should be dried in the sun or in dryers to a humidity of 50% for the wet *puba*, and 13% for the dry *puba*. It is used in the preparation of cakes, porridge, cassava couscous and other dishes.

Beijus

Beijus are delicacies obtained through the drying, in ovens, of the grated dough of cassava roots, after they have been pressed and crumbled, either with or without the addition of moist starch, or cassava starch, also known as gum or sour starch.

A recent breakthrough in the production of *beijus* has been to replace the water for fruit and vegetable juices. This has allowed the *beijus* to gain new colours, smells, flavours and nutrients, making them more attractive to consumers.

Photo caption: Beijus. Photo: Lea Cunha and Joselito Motta

XIV. Cassava in animal nutrition

Both the roots and shoots of the varieties of 'table' cassava (*macaxeira* or *aipim*) and industrial ('strong') cassava can be used in animal feed. Among the products and by-products of cassava used in animal feed, special mention should be made of the shoots and roots of fresh cassava; hay made from the shoots (crushed and sun-dried shoots); whole shavings (pieces of sun-dried roots); table flour meal (by-product of the production of table flour); and the silage of the shoots, roots or whole plant.

Precautions when using cassava roots and shoots for animal feed

The roots and shoots of the industrial varieties of cassava ('strong') present high concentrations of cyanogenic glucosides, which can produce cyanide, a toxic substance. Therefore, before they are given to animals, they should be chopped and placed to dry in the shade, in a cemented place, over beaten ground or on canvas, for one or two days. This material, after drying, is called cassava root shavings or cassava shoot hay.

In the case of roots from table varieties of cassava, or if the manufacturer already knows the different types of varieties (which ones are not highly toxic), the roots and/or shoots can be cut and fed directly to the animals, or dried and stored.

Photo caption: Animal feed. Photos: Lea Cunha

Nutritional value of cassava roots and shoots

The cassava root is rich in energy, which is, quantitatively, the most important component in animal diets; whilst the shoot has high protein concentration, rich in vitamins A, C and B complex, as well as a good concentration of minerals. The roots, on the other hand, have some limitations, such as low amounts of proteins, fibres and some vitamins and minerals.

Cassava is considered an almost complete food for most animal species, seeing as its leaves are rich in proteins and its roots have a high energy value.

How to prepare cassava root pellets

In the making of cassava root pellets, both industrial and table varieties can be used. The cassava roots are initially washed (to remove excess soil, foreign bodies and damaged roots) and then chopped and set to dry in the shade until reaching 12% moisture, which in practice can be verified when the pieces can make scratchings similar to a piece of chalk. From there, it should be bagged and stored.

Cassava pellets can replace maize with good results in diets for cattle, goats and sheep.

How to prepare hay from cassava shoots

Cassava shoots are to be chopped manually or in an electric chopper, and placed to dry in the shade. After drying, the hay should be bagged. The entire shoot can be used to make hay, however the upper third should be given preference, as it has the highest number of fresh, green leaves and, therefore, higher nutritional value.

Hay made from cassava shoots is very well accepted by animals, and can be used as the only source of bulk feeding in the diet of ruminant animals.

How to prepare silage from cassava shoots

After being chopped, the cassava shoots should be stored in a silo. When the material has been properly compressed and the silo well sealed, the conservation process and the quality of the silage will be better. The silo should be opened preferably 30 days after the sealing.

Precautions in the storage of cassava pellets and cassava shoot hay

Cassava root pellets and shoot hay should be bagged and stored in a cool, ventilated place and, preferably, on a wooden pallet to avoid losses due to contamination and deterioration. This way, the feed can be stored for longer periods, without losing palatability and nutritional value.

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