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CASSAVA CULTURAL PRACTICES

Proceedings of a workshop held in Salvador, Bahía, Brazil, 18-21 March 1980

Editors:
Edward J. Weber, Julio Cesar Toro M., and Michael Graham

Organized by:
Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)
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Cassava Production and Planting Systems in Brazil

José Osmar Lorenzi,[1] Edgard Sant'Anna Normanha,[1] and Antonio José de Conceição[2]

Cassava is planted all over Brazil and involves multiple soil and climatic conditions as well as different socioeconomic aspects, especially at the rual level. Its roots fulfill diverse needs — a fact that enhances its cultivation. The agronomic practices in cassava cultivation differ according to the social and economic characteristics of the different regions, especially in respect to practices on plant population, fertilization, weed control, and stake size. Technology varies from primitive to highly sophisticated.

The northeastern part of the country, which accounts for 50% of the total cassava production, has the lowest yield average (6 t/ha). The national average is 14 t/ha, the southern part of the country being the region with the highest average.

Plant diseases constitute the main problem for cassava growers; in the central and southern states cassava bacterial blight is prevalent and in the north, superelongation. National cassava research is working to solve the production problems. In the short term, improved cultural practices are being developed and incorporated in technological packages for specific regions; in the long term new varieties are being created so that the phytosanitary problems can be overcome.

Cassava has been called the most typical Brazilian subsistence crop because of its relationship with Brazil's socioeconomic and historical development. At present, Brazil is interested in placing cassava among the national security crops — as a source of food, forages, industrial raw materials, and energy. Government institutions, at a commercial level, are studying cassava and are developing short-, medium-, and long-term research programs to gather scientific information to give technical assistance to cassava producers, to solve the problems in cultivation, and to develop technological processes for cassava products and subproducts. The federal government founded the Brazilian Agricultural Research Centre, EMBRAPA, linked to the Secretary of Agriculture and founded the National Research Center for Cassava and Fruit Crops (CNPMF) as a subsidiary, with headquarters in Cruz das Almas. The objective of these institutions is to carry out and coordinate research programs leading to yield increases, improvement in the quality of cassava by-products, reduced production costs, and exploitation of underdeveloped areas for cassava and horticulture production. These objectives are defined in CNPMF's commodity research programs.

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Northern Brazil

Northern Brazil contributes only 5.2% of the total national cassava production. The ecological area with the largest production in the region (about 70%) is the area of the Amazon Estuary, with an average production of 13 t/ha.

The socioeconomic aspects in this huge Brazilian region focus on the importance of cassava as a food crop. Per-capita consumption of cassava has been significant since colonial times, along with beans, sorghum, and rice. Cassava is an important crop in this area because it is easy to grow and is a well-liked, traditional food crop, often consumed as flour. At present, primitive exploitation methods and simple processing techniques are practiced in cassava flour factories.

More than 90% of the cassava is transformed into cassava meal, *pará* flour, and other typical foods such as *tucupí* and *tacacá*, etc. Although the region is not the site of large agroindustrial enterprises, it has considerable potential for increased cassava production.

Cassava Production Problems

The main problems are low soil fertility in many areas, excessive rainfall, low productivity of cultivars, pests and diseases, and primitive agricultural practices.

Northeastern Brazil

The northeast, comprising 1.52 million km^2 or one-fifth of the area of Brazil, includes nine federal states — Maranhao, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, and Bahía. As Brazil's largest cassava producer, it accounted in 1975 for 13.14 million tonnes of roots from a harvested area of 1.27 million hectares, which is almost 50% of the country's total production. Production has increased in the northeast, due greatly to an increase in the cultivated area, rather than to an increase in productivity.

Because of the high cost of fresh roots, among other factors, it is hoped that, in the long term, cassava can be used for a wider range of subproducts. For economic industrialization of cassava, the present supply of traditional products needs to be diversified through agroindustrial integration in which the industry will totally or partially produce its own raw material.

In future, production of cassava chips may assume importance in the northeastern part of Brazil because solar energy is abundant, and the technology for producing chips is simple. Furthermore, the high production potential of the region enhances the feasibility of establishing ethyl alcohol plants as a new agroindustrial activity.

The average person's consumption of cooking flour was estimated at 73.8 kg for the rural population and 32 kg for the urban population. The flour industry is limited primarily to small processors called "flour factories" that are usually located near cassava-growing areas. In some cities there are semi-industrial enterprises that use mechanical equipment for grinding the roots, hydraulic or air presses, spindles, and even mechanical ovens for toasting.

The state of Bahía, which is located in this region, has become the largest cassava producer in Brazil, contributing, in 1975, 25% of the total national production (5.109 million tonnes).

Cassava Production Problems

Serious problems plague cassava growth in this region — the main one being the amount and distribution of rainfall. It is common, after years of long summers, to see a commercial flow of baking flour from southern to northeastern states.

Primitive technical assistance and orientation have restrained the changing of traditional cutivation practices. Consequently, there is a low level of knowledge among producers, who continue to adopt obsolete production systems, including the use of low-yielding cultivars. Added to this problem are the insignificant numbers of industries, the existence of a large number of *minifundios* (small plots), and the production of other more profitable crops in areas near the coast where the *Tabuleiros Costeiros* are located. The lands bordering the coast have topographic and climatic conditions that make them particularly suitable for agricultural expansion; however, they will require fertilization. Cassava productivity is also reduced by plant pests and diseases, such as *mandarovás*, mites, ants, leaf spots, anthracnosis, and rust.

Southeastern Brazil

Southeastern Brazil is the third largest cassava producer in the country, contributing close to 15.5% of the total national production. It also has the best production systems and the greatest amount of product diversification. Flour, chip, sour starch, and baking flour industries, besides human consumption of fresh roots and the use of cassava for forages, use all the raw material that is produced.

Cassava Production Problems

Cultural problems in this region, in spite of the existence of research centres, are related to: (1) the presence of bacterial infection (which is a factor limiting production in many areas); (2) competition from more profitable crops such as sugarcane, soybeans, sorghum, wheat, and rice in most areas traditionally planted with cassava; (3) the low level of technology used by producers planting in low-fertility soils, without fertilization, mainly in Minas Gerais; (4) the planting of low-yielding cultivars; (5) the use of mountain areas, especially in the states of Rio de Janeiro and Spirito Santo; (6) bad rainfall distribution in Minas Gerais; (7) frosts in São Paulo; and (8) the high cost of land as well as the scarcity and high cost of labour in São Paulo.

Midwest Brazil

The Midwest is responsible for only 5.3% of total national production of cassava. Primarily comprising Cerrados, the area may expand cassava production because this crop can compete with other crops that demand higher fertility and water levels. Such expansion will probably depend on an increase in regional consumption of baking flour because the area is far from exporting ports and other large consumer centres.

Cassava Production Problems

In the Midwest, the problems are similar to those in other Brazilian regions, particularly the high prevalence of plant disease (bacterial blight), the use of low-yielding cultivars, low soil fertility, high levels of aluminum in the soil, and poor rainfall distribution, very often restricting the planting season to only 60 days each year.

Southern Brazil

The southern region contributes 27.9% of the total cassava production in Brazil. Starch, flour, chip, *polvillo aredo*, and pellet industries are located here, producing primarily for internal consumption and some export. Cassava is also used as a forage crop and to a limited extent for human consumption. The state of Paraná has the highest yields per hectare because of its fertile soils. However, cassava is of secondary economic importance because more profitable agricultural species are emphasized here. Nonetheless, Paraná is responsible for 7.1% of the total national production.

Cassava Production Problems

Problems in this region are practically the same as those in other Brazilian regions; the most significant are frost periods, bacterial blight, low-yielding cultivars, and poor storage of planting material. Other factors affecting productivity are the use of low-fertility soils, the lack of research, and the need for widespread use of better cultural practices.

Cassava Planting Systems in Brazil

The size of Brazil (8.511 million km^2), its complex climatic and soil conditions, the different socioeconomic levels in the rural areas, and the diverse use of products derived from cassava roots, (grown on a large and small scale) contribute to the heterogeneous nature of cassava planting and processing systems. As well, cassava is present throughout Brazil and is considered to be a permanent part of the culture.

The cassava-growing practices go from primitive — a piece of stem is planted in ground that has had no previous preparation by a farmer who has no idea of the nature, type, size, or quality of the plant — to very sophisticated, using machines and selected and treated stakes of genetically improved cultivars as recommended by research standards.

Several production systems (technological packages) were designed in 1976 with the implementation of EMBRAPA and the foundation of state research entities and were to be delivered to cassava growers throughout Brazil, who in turn could increase cassava productivity and raise their own socioeconomic level.

In the field, the main elements that determine the cassava production system start with soil preparation and include size and type of stake, stake treatment, stake's planting position, planting depth, spacing, planting season, fertilization, planting practices, and cultural treatments.

Soil Preparation

There are primarily four systems of soil preparation in Brazil:

(1) Simple cleaning of the area, whether cut or pruned with hand tools such as axes, picks, hoes, and scimitars followed by burning of residues, and planting in beds in the ground.

(2) Simple cleaning of the land, followed by hoeing, and planting in beds in the ground.

(3) Simple cleaning, with plowing and disking, using animal traction for plows and light disks.

(4) Cleaning, plowing, and disking using tractors.

The first three systems are used in small areas where cassava is grown as a subsistence crop. The third is used in areas dedicated to the production of raw materials for industries or to the production of fresh roots for human consumption. The fourth system is used in large-scale commercial plantings for industrial use or for sale as raw material.

Size and Type of Stake

(1) Stake size. For centuries, the Brazilian cassava grower has employed stakes that are no longer than 10–12 cm or have only a small number of buds. The reason may be that this

material, under favourable conditions, sprouts and produces roots that are satisfactory for the particular conditions of each farmer.

Research has shown that production per plant increases to a certain extent in relation to the size of the stakes; however when the stakes are being planted in rows, the sizes recommended are about 20 and 25 cm because a greater number of buds per stake is produced and, by implication, more stems and roots (Normanha and Pereira 1950; Conceição and Sampaio 1973b).

(2) Type and characteristics of stakes. Many farmers do not know the differences, sometimes many, that are caused by using different types and ages of stakes. Thus, the material used is very heterogeneous, as far as ripeness, diameter, number of buds, cleanliness, and cycle of the original plant that furnished the stems are concerned. In subsistence agriculture, the farmers are happy with any result.

Farmers exploiting small or large commercial areas are already aware, thanks to technology transfer, of the need to make critical selections of planting material. Thus, they usually plant ripe stakes that have been cut from the middle or lower part of healthy plants with a growth cycle of 10–12 months. In most cases, the leaves have already fallen from the middle or lower portion of the plant and because of the stem's thickness, the nutrient reserves are sufficient to provide better sprouting indices and plant survival. Some of these considerations are discussed by Mendes (1940).

(3) Stake treatment. Traditionally, the farmer rarely treats the stakes before planting. It seems that the few experiences in this regard did not give results that indicated the need for stake treatment. Current treatments are either to clean or disinfect propagating materials that have been contaminated by bacteria and fungi or to protect them against attack by these microorganisms.

In commercial plantations, immediately after the stakes have been cut, they are treated by immersion in fungicides, usually containing organic mercury, copper, or PCNB (nitrobenzene pentachloride).

Stake Planting

In general, stake planting in a horizontal position predominates when the planting is not done in beds or on ridges. The stakes are thrown into a low bed (a type of orifice produced by a hoe) or furrow, or pushed horizontally under a pile of earth.

In heavy soils, planting is done on ridges (earth piled in rows) or *matumbos* (elevation between furrows) so that the soil gets better aeration. In these cases, planting stakes are longer and are buried in a vertical or slanted position with the base down on top of the ridges or piles of earth.

Experimentally, stakes planted in a vertical or inclined position have produced better yield. However, this practice has not become widely used because planting in a horizontal position makes things easier during establishment and harvest (Normanha and Pereira 1950).

Planting Depth

Traditionally, the general trend has been to plant stakes superficially, that is covered by 5 cm of earth when planted horizontally. This practice is probably based on the fact of earlier sprouting of shoots during the rainy season, which gives the farmers the idea of a relationship with early harvesting. The farmers are anxious to see the plants. This gives them a sense of satisfaction and is a good indication of whether or not partial replanting will be required in small plots.

The farmers are correct in this procedure because planting at a depth of approximately 5 cm provides the best conditions for aeration and root formation (Brieger and Graner 1941).

Experimentation has shown, however, that horizontal planting is recommended at a slightly greater depth to improve the humidity conditions of stakes and to prevent solar burning and erosion due to heavy rains. The Economical Institute in Campinas (IAC) recommends planting at an approximate depth of 10 cm for horizontal stakes, not only to improve plant productivity but also to facilitate rooting and harvesting (Normanha and Pereira 1950).

When vertical or slanted stakes are planted on ridges, there is a tendency to plant the stakes so that their base is buried deeply.

Spacing

Distances between rows and between plants within the rows vary greatly and no pattern can be determined in subsistence cultivation. However, it is more important in plots where cassava is intercropped with common beans, climbing beans, upland rice, and sorghum. This is common in the northeast. The farmers program plantings and vary the distances between them to take into account the planting season, the harvest cycles, and the speed of growth and competition among crops.

In subsistence cassava plots, spacings vary from 1×0.50 m to 1.20×0.80 m, and often are 1.00×1.00 m, especially in the northeast. It is recommended, based on research, that spacings be 1.00 × 0.60 m for mechanized operations. For this reason, in commercial plantations, it is desirable to use 1.00 m × 0.60 m or 1.00 × 0.50 m spacings.

Planting Seasons

Planting is usually done at the beginning of the rainy season, which follows the summer season, when two essential conditions for sprouting and rooting of the planted stakes are found — humidity and heat.

Because of the size of Brazil, these conditions are not found in the same months in all regions. In the south, central, and southeast regions of the country, these conditions are found in the month of October; in the northeast, especially in the Tabuleiros coastal strips, planting takes place in April–May; and in the Amazon region, planting can practically take place year round.

Conceição (1978) published the results of planting-season trials, carried out in Cruz das Almas, Bahía, Brazil, that showed that the period between 15 April and 30 July was the best for planting. It is also possible to plant between 15 October and 15 December, taking advantage of rains from thunder storms. These results can be extrapolated to the coastal strips in the northeast, known as the best in the region for cassava production.

In southern and central Brazil, if there is delay in the planting season, plant diseases and pests increase. For instance, there is greater incidence of shoot fly (*Silba pendula*) and bacterial blight, as well as increased losses due to erosion, planting, initial cultivation difficulties, and the use of propagating material that has lost nutrients.

On the other hand, in the state of São Paulo, planting is feasible at the end of the rainy season (around May) or at the beginning of winter. This has certain advantages in that it usually means better conservation of stakes, fewer weeds, better control of shoot flies, and increased productivity (Normanha and Pereira 1948). Anticipated extension of planting may not be possible in Paraná, Santa Catalina, or Rio Grande do Sul due to the danger of frosts that kill plants during the early stages.

Fertilization

Currently, whether or not to fertilize is controversial in cassava plots because of the high costs of fertilizers and labour and the low price of the raw material that is produced. For example, in the northeast region, which contributes half of the country's total production, no fertilizer is used. In certain areas, however, fertilization with the residues from other crops (such as tobacco) is common, especially in Cruz das Almas and nearby cities.

Of the nutrients naturally available in Brazilian soils, phosphorus is the most scarce, followed by nitrogen. Although reaction to potassium is evident, no convincing response to this nutrient has been recorded in the coastal strips.

Under the edaphic conditions of São Paulo, the IAC carried out a series of surveys of mineral nutrients required by cassava and recommended fertilizers for each cassava region. In recent plantings in the Cerrado region, soils have been treated with dolomitic limestone (60 kg P_2O_5/ha), as simple superphosphate; 60 kg K_2O/ha, as KCl; and 50 kg N/ha in the form of ammonium sulfate after 40 days (applied by mulching).

Planting Practices

(1) Preparation or cutting of stakes. Preparation or cutting of stakes for planting is done manually with a variety of knives; the stem is held in one hand and cut with a light followed by a sharp strike at a point that gives the desired stake size.

The Agronomical Institute of Campinas in Brazil has for 10 years distributed a circular saw that is used mainly in large-scale plantings. This saw cuts the stakes quickly, saves labour, and produces a standard size planting material. Improvement of this simple tool started in 1964 through a private Mexican enterprise assisted by IAC's Technological Division in Campinas.

(2) Planting operation. Planting includes transportation of stakes to be planted; position of the stakes in the ground; planting depth; use of low beds, earth piles, *matumbos* (high and round beds), ridges, furrows, etc. Labourers carry stakes in bags on their backs and throw them onto beds or furrows, or bury them by the base in ridges or hills. The farmers use animals or machines to prepare furrows and ridges; however, hills and *matumbos* are prepared with a hoe. Stakes are completely covered with earth, unless they are buried vertically or slanted in which case they are usually longer, and the top portion is slightly above ground.

Planting has been done mechanically only in large areas used for industrial purposes. The first and oldest national cassava planter is Sans. Pulled by a tractor, it plows, fertilizes, plants, and covers the stakes in one single operation. It carries fertilizer and cut stakes. Two labourers put the stakes in cans placed in rotating drums, one for each of the furrows prepared by the machine.

Recently, a new planter appeared in Brazil that uses mechanical traction and eliminates manual cutting of the stakes. Like the Sans, it makes two furrows, but it takes entire stalks, automatically cuts and plants them in the furrows.

Cultural Treatments

Cultivation treatments include weeding, which is usually done with a hoe, usually 30 days after planting and subsequently when needed. A crop may be weeded three to four times during the first 12 months of the cycle. With an extension of the cycle from 15 to 18 months, one or two more weedings are needed before harvest.

An animal traction harvester has been recommended for the first two weedings in small areas, as long as the machine does not damage the aerial or underground parts of the plants. This machine is economic in areas that have been cleared of stumps or trunks and where weeding within rows is done with a hoe.

Preemergent herbicides have been used rarely, although some recently installed commercial plantations in Cerrados have been experimenting with them.

Pruning (separation of roots from plants at 9–12 months of the cycle) is traditionally practiced in certain areas; however research does not show any economic advantage to it. In fact, cassava pruning increases production costs, decreases starch formation, and increases fibre content, as the plant is forced to use up its hydrocarbons to rebuild the damaged aerial part. Pruning is only justified when planting material is needed, when the crop is infested with pests (in the case of bacterial infection, pruning increases the risk of spread of the inoculum), when the aerial portion is to be used as forage, or when the plants are threatened by frost. After pruning, a farmer should wait 4–6 months to harvest, so that the starch reserves in the roots are restored.