CASSAVA IN THE MALAGASY REPUBLIC

Research and Results

— by —

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Cassava was first introduced in the Western part of the Indian Ocean by the Frenchman Mahe de la Bourdonnais who imported it in 1739 to Mauritius and Reunion. It is noted that several deaths occurred due to the high HCN content of the first introductions. Introduction to Madagascar occurred in 1790 and the crop gradually spread throughout the island. The present area under cultivation is about 300,000 hectares yielding a total of 900,000 tons, i.e. an average yield of about 3 tons per hectare.

1. *Production Methods*

There are two methods of production:—

(a) *Extensive* production practised by the small farmers throughout the island.

(b) *Intensive* production, which is usually practiced by large companies owning vast acreages of land under cassava around a factory producing cassava flour and tapioca.

(a) Extensive Production

Cassava recurs infrequently at high elevation where the temperature is low but is grown universally at low elevations, particularly close to the villages. In this system it occupies small areas and is frequently intercropped with maize, beans and other crops. Under these conditions the culture of cassava is more or less neglected. The crop serves as a "ground reserve of food" which peasants harvest as and when required. Such condition do not enable objective estimates of yield and area under cultivations to be made. This must be bourne in mind when considering the data presented above. While yields are low, certain plants may produce very large roots.

In this method of cultivation, there are no standard practices as regards planting density, method of planting, date of planting and harvesting and even less as regards fertilizer application and crop rotation. It represents nevertheless, three quarters of the area under cassava in the Malagasy Republic.

(b) Intensive Production

Farmers growing cassava alone are not common in Madagascar but several of them, especially near to the processing plants, grow cassava as their main crop.

(a) *Crop rotation and green manuring*

The practice varies but the most common method is the growing of a green manure crop before planting the cassava (green measures are either

maize or a legume like Crotolaria, Tephrosia or Vigna). Other crops in the rotation may also include groundnuts and paddy rice.

(b) *Land Preparation*

The green manure is turned in with 20-30 tons/ha of farmyard manure, the field is ploughed to a depth of 20-25 cm followed by disk harrowing, sometimes followed by banking in the humid areas. Organic manuring is often complemented by fertilizer applications of 500kg/ha of rock phosphate and of 300 kg/ha of muriate of potash; nitrogen is not added since it is contained in the green manure and it is advisable to avoid an excess of nitrogen on this crop.

(c) *Planting*

Cuttings 25 cm long with 8-15 nodes are planted either horizontal or slightly inclined. The planting distance is 80 x 80 cm. (15,600 plants per hectare) and in poor soils and 1 x 1 m (10,000 plants per hectare). The planting season is either March, i.e., at the end of the rainy season or in August-September which is more risky due to drought conditions.

(d) *Maintenance Operations*

These consist in supplying one month after planting and weeding when the cuttings start sprouting.

(e) *Harvesting*

This is done mechanically by means of heavy tractors on a large scale or by hand on smaller farms. In the latter method harvesting is more thorough as fewer roots remain in the soil. Yields reach 25-30 tons/ha and may go as high as 50 tons/ha under the best conditions. The crop cycle varies from 10 months on the coast to 24 months on the high plateaux.

II. *Losses due to pests and other factors*

Losses are caused by hail, aseptic rotting and root lignification. These vary considerably in importance according to the regions and to the years.

The main pests consist of 2 large groups of diseases: rots caused by fungi (*Gloeosporium manihotis, Phaeolus manihotis, Clitocybe tabescens, Armillariella* sp and *Diplodia* sp.) or by bacteria; and mosaic virus which is transmitted by *Bemisia manihotis*.

The selection of cassava cultivars in the Malagasy Republic is based on resistance to these two groups of disease.

III. *Research and Results*

The "Institut de Recherches Agronomiques a Madagascar" (IRAM) has for several years undertaken research with the objective of improving the cassava cultivation. Studies have been initiated on both cultural techniques and improvement of varieties.

1. Cultural Techniques

From what has been said above, it may be considered that sound techniques of cultivation are now firmly established, especially after several years of field studies, in particular on nutrient needs according to soil type.

It is a known fact that, based on a yield of 40 tons of roots and 50 tons of stems, one hectare removes approximately 285 kg N, 132 kg $P_2 O_5$, 460 kg $K_2 O$ and 225 kg CaO. From these figures a rational fertilizer guide may be arrived at, bearing in mind the fact that nutrients are made up of an organic part (green manure and pen manure and an inorganic part (mineral fertilizer).

Chemical weed control is about the only cultural technique still under study in Madagascar and it is too early to draw conclusions.

2. Plant Breeding

Improvement of varieties is being attempted at the "Station Agronomique de Lac Alaotra" where a collection of 334 clones is maintained. Part of these (170) are hybrids bred at the Station itself (both intergeneric crosses and interspecific crosses with *M. esculenta, M. glazovii* and *M. pringlei*). This collection is thus an important stock of vegetative material for further crosses.

(a) *Objectives*

There are 3 main objectives: high yields, resistance to mosaic viruses and resistance to root rots, with secondary objectives of: plant habit for uniform branching, quick ground cover with a bushy form, high starch content and quality of the starch, thin root bark, white phelloderm, good shape and distribution of roots and drought resistance for growing in the dry southern areas.

(b) *Breeding of new clones*

This is carried out by several hybridisation techniques:—

(i) by single crossing, i.e., crossing of 2 clones. Since clones are heterozygons, it is impossible to predict the results but the probability of obtaining better results from the crossing of two superior clones is made use of. Thus it is likely that crossing one clone resistant to mosaic with one resistant to rots will produce a hybrid resistant to both diseases. In fact we have observed experimentally that certain clones are always better parents than others in all crossings although these same clones are not necessarily the best in comparative trials;

(ii) by crossing a male sterile clone with promising male fertile clones;

(iii) by polyclonal crosses;

(iv) by random harvesting of seeds from the plant collection.

The results obtained have shown that the chances of obtaining a superior hybrid are equal in the first 3 methods (out of 5,000 seeds obtained, at the most only one superior hybrid is finally selected).

(c) *Selection of clones*

Seeds are sown in a sandy soil to obtain good germination and each individual is examined from the second year for the above-mentioned characteristics. In this first stage about 80% of the clones are rejected. Six cuttings from each selected plant are replanted and again examined after 2 years of growth. In this second stage about 60% of the clones are eliminated; the remaining plants are then used in 3 selection cycles on plots that gradually increase in size, up to 1-1½ after six years. This results in a selection of 2 or 3 clones for every thousand clones at the start. At the end of these 10-year selections, the selected clones are compared with local cultivars in yield trials. At the "Lac Alaotra" Agronomic Station, a total of 57,000 seedlings have been selected over a period of 25 years, i.e., an average of 2,500 clones per year from 4,000-6,000 seeds obtained from breeding.

(d) *Results*

IRAM has by now made available several very promising clones to cassava farmers. Certain clones are particularly suitable for specific conditions but others can be grown under a wide range of conditions. The list of clones available with their main characteristics is given below.

Hybrid 34 : very bitter, mosaic resistant, susceptible to rot, high starch content; adapted to high elevation and well-drained soils.

Hybrid 35 : quite sweet, moderately resistant to mosaic, quite resistant to rot; suitable for fertile soils and wet areas.

Hybrid 41 : quite sweet, quite resistant to mosaic, little resistance to rot; for well-drained and fertile soils.

Hybrid 43 : sweet, mosaic resistant, little resistance to rot; rapid growth, high yielding in dry areas.

Hybrid 45–47 and 52: very sweet, quite resistant to mosaic and rot; for fertile and well-drained alluvial soils. The sweetest clones in the collection.

Hybrid 49 : bitter, quite resistant to mosaic and rot, good sprouting characteristics; suited to dry hillsides and plateaux but susceptible to low temperatures.

Hybrid 53 : sweet, quite resistant to mosaic and rot; for fertile areas and fairly dry areas and hillsides.

Hybrid 54 : quite sweet, mosaic resistant but less so to rot; high yielding or alluvial soils and excellent response to fertilizer.

Hybrid 55 : bitter, resistant to mosaic and highly resistant to rot; suitable for low elevations and high moisture.

Hybrid 56 : quite sweet, highly resistant to mosaic and rot; excellent yields and responds very well to fertilizer; good uniform growth habit.

Hybrid 57 : quite sweet, highly resistant to mosaic and rot; high yields and responds very well to fertilizer; for low elevations and humid conditions.

In comparative yield trials, yields obtained have been as follows:—

Dry and low lying areas	:	Local varieties – 7-8 tons/ha hybrids – 12-35 tons/ha (H. 43, H. 53, H. 54).
Humid and low lying areas	:	Local strains – 9-25 tons/ha. Hybrids – 28-66 tons/ha. (H. 45, H. 53, H. 54, H. 56 and H. 57).
Areas of medium altitude	:	(300-900 metres). Local strains – 4-20 tons/ha. Hybrids 30-80 tons/ha. (H. 35, H. 49, H. 54, H. 57).
Areas of high altitude	:	(900-1300 metres). Local strains 4-12 tons/ha. Hybrids – 12-25 tons/ha. (H. 54, H. 56 and H. 57).

Conclusions

Results obtained in the Malagasy Republic with hybrids used commercially point the way to a marked improvement in production of the crop. Although it may be difficult on a larger scale to duplicate the high yields obtained in trials, it is certain that, with the high level of management described, average yields of 30 tons/ha are possible and have in fact been obtained. The hybrids available actually constitute only one stage of the continuing breeding programme whose essential aim is the development of cultivars completely resistant to mosaic and rot, with high yields and for either direct consumption (fresh or dried) or processing, i.e., with a high starch content.