

RESEARCH ON ROOT CROPS BY IRAT IN AFRICA AND MADAGASCAR

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Root crops play an important part in feeding some African and Malagasy populations. In several areas root crops are still used as a basic foodstuff; manioc in the forest areas of West Africa and of Equatorial Africa, yam in the areas of wet tropical climate along the edge of the dense forests of West Africa, and taros in West Cameroon. Nevertheless, these crops are also grown on areas lying beyond these narrow limits particularly those species which are adaptable to a wide range of environments. Being nowhere a staple food, sweet potato is cultivated almost throughout the African continent and in Madagascar. Taro crops are found in the wettest zones of West Africa, in most countries of Equatorial Africa and in Madagascar except in the cold areas of high altitude. Yam cultivation is widespread in Equatorial Africa. Lastly, manioc is an important industrial crop in Madagascar and in Togo. It also has general use as a supplementary food and is particularly valuable as a security against disastrous cereal harvests. In this context, cassava cultivation is spreading even in the relatively dry areas of Africa.

Investigations on root crops are being carried out by IRAT in Madagascar, Senegal, Dahomey, Niger, Gabon and Central African Republic; their importance varies according to the species and the countries. The main objectives and results of these studies will be described below.

MADAGASCAR

The country has a wide range of ecological zones. This diversity is due to the different degree of fertility of soils depending on their pedological origin and on differences in climate : for instance, a wet tropical climate on the Eastern Coast, a dry tropical climate on the Western Coast with arid areas in the South and a high elevation tropical climate in the interior of the country.

Here IRAT is carrying out intensive investigations on manioc and less important studies on the sweet potato. The first studies were initiated about 30 years ago, with a special aim to improve the industrial crops devoted to starch and tapioca production.

At the beginning they were primarily concerned with mosaic control. This virus disease had recently spread in the Island and had reduced yield considerably. Control was attempted by breeding for resistance. The criteria for selection were :

— the resistance to mosaic which was evaluated by visual symptoms forming five classes of susceptibility.

— yield capacity according to the useful starch production in relation to the total weight of dry matter in the plant.

— the resistance to some rots, particularly to physiological rots occurring in soils which were periodically water logged.

The method used was the artificial hybridization between clones having some required characters. The parents originally used were selected from a world collection, the most interesting introductions originating from Reunion, Java and Malaya. The use of the factors of vigour and of resistance to mosaic of closely-related species, particularly *M. glosivii*, by inter-specific cross was also attempted.

Subsequently the parents of the new hybrids were selected among the old hybrids with more desirable characters. About fifteen clones either resistant or tolerant to mosaic, highly productive and adapted to various soil types were thus developed. Observations on mosaic have shown that a clone resistance is not always final, perhaps because of some evolution of the physiological strains of virus.

The accumulation of the cyanogenetic glucoside content of roots was studied. This revealed higher contents in the roots during the first year than during the second year with a maximum in the dry season and minima in the wet season for both years.

Studies on mineral nutrition and fertilization have also been performed. The high nitrogen and potash requirements of plants were established and a test to estimate potash requirements by analysing the phelloderm was developed. There is a positive correlation between the potash content of phelloderm and root and starch yield. Organic matter plays an important part in high yields. When farmyard manure was lacking, *Mucuna*, a green manure proved to be very efficient.

Lastly, technological studies particularly on the improvements required by the various manioc mills in Madagascar have been performed. With respect to industrial manioc great progress has been achieved. Since 1960, research work has been particularly directed towards the improvement of variety and of the cropping systems used in the small farms. In the country this product is principally used as feed supply but also as a supplementary food in human diet particularly in the Southern part of the Island where the main food crops are still subjected to acridien attacks.

In this way, the work on genetic improvement carried out according to the same methods are still aimed to obtain high yields, mosaic resistance but also a low cyanhydric acid content of roots.

Very interesting varieties are now available and among them H41, H46, H49, H44, for starch production; H53, H45, H52, H47 for direct consumption, H53, H52 for drying and H54 a very interesting multipurpose variety which is in addition extremely plastic. The present yields from the trials are of about 40 tons/ha or more.

A study of the different drying methods which could be used in family farms for tubers cut up into pieces (cossettes) showed that complete drying can be obtained with 70 hours of sun exposure on reed racks provided that elementary precautions were taken.

Several trials largely decentralized throughout the island are being con-

ducted on variety improvement, on the adaptation of cultural practices to family farming and on fertilizer use.

Sweet potato

Work on this species is very limited. The behaviour of local varieties and of some improved varieties introduced from the United States has been studied. Some local varieties show a very high potential production often superior to that of the introduced varieties. Trials on fertilizer use have generally indicated a favourable effect of nitrogen.

SENEGAL

The ecological conditions of Senegal, unlike those of Madagascar, are relatively homogenous; most soils are light and rather poor, and the variable element is climate which progressively changes from South, where rainfall rises to 1200 mm, to North where rainfall is of about 350 mm, but in any case rainfall is concentrated over one relatively short season.

The majority of the population is concentrated in the central-west area characterised by a rainfall ranging from 800 to 500 mm. The production of this area is essentially groundnut and cereals (millet and sorghum) the latter being in inadequate amounts to meet the food requirements of people.

In this country IRAT is carrying out very extensive research work aimed at replacing the present primitive cropping system with a system of family farming which is intensive, and carried on at an increased level of soil fertility, with diversified production, and the use of a rational rotation incorporating mixed farming (draft animal and beef cattle).

Here, manioc is studied with regard to crop diversification; without doubt it will keep on being used as a supplementary food. Some increased use is also expected as a supply of animal feed, as well as for some local industrial markets (bread, biscuit).

The work consists of clone selection on populations from seeds. Since climatic conditions are unfavourable for the mosaic vector in Senegal the character of resistance to this virus disease is not taken into account. Some highly productive clones have been selected; a relationship between the regrowth ability of cuttings and the productivity of clones has also been noted.

As regards fertilizer use the interest of nitrogen-potash fertilizers and the ineffectiveness of phosphorus despite of the serious phosphorus deficiency of soils has been pointed out.

As for cultural practices it has been determined that the best plant rate was between 8,000 and 10,000 cuttings per hectare planted in rows 1, 5, to 2 m apart.

Studies on the best harvest time according to plant age and of the most suitable dates of planting are now in progress. Simple methods of drying tuber roots cut up into small pieces (cossettes) which can be used within the framework of a family farm are also studied.

DAHOMY

The country is characterized by an equatorial climate with two rainy seasons in South and a Tropical climate with one rainy season in North. Everywhere total rainfall ranges from 1000–1200 mm a year.

Manioc plays an important part in feeding the population particularly in the South and yam plays an almost equal part in the Central and Northern areas of the country.

Work on root crops has not yet been very much developed because precedence has been given to studies on cereals, particularly maize, and to the studies related to the improvement of cropping systems : the position of crops in the rotation, the improvement of fertility by fertilizer use and the study of fallows, green manures and fodder crops.

Manioc

The work concerning manioc mainly consists of developing very sweet varieties being also highly productive and resistant to mosaic. These objectives are tried to be obtained by clone selection on progenies from seeds and from a polyclonal field in which individual plants have been selected among the local manioc plants the least injured by mosaic. A method which consists of introducing into a valuable and highly productive variety the genes of mosaic resistance present another local variety by hybridization and back-cross has run against the difficulty of obtaining synchronous flowering for the two parents.

Yam

Concerning this species local varieties belonging particularly to *D. cayenensis*, *D. rotundata* and *D. alata* species have been collected. This collection gives rise to observations particularly about productivity. Each variety, indeed, is adapted to particular uses; early or late harvest, good storage qualities, or use on the occasion of some traditional ceremonies. Any improvement programme should essentially take these various factors into account.

Independently of the variety problem which has been hardly tackled it has been shown that plantations with 8000 mounds/ha were the most favourable under the conditions of traditional cultivation on mounds. Till now the results from fertilization trials are contradictory. Lastly, experiments aimed to define yam position in rotation are being carried out.

OTHER AFRICAN COUNTRIES

In Niger where conditions are almost similar to those of Senegal, the manioc clones having been developed in this country are tested under various ecological conditions.

In Gabon, a wet and forest country, manioc and sweet potato varieties have been introduced. Manioc introductions come essentially from Madagascar because of the mosaic disease present in the country and of the interest of possessing already resistant clones. Sweet potato introductions come from the United States.

In Central African Republic works are limited at present to the study of a manioc collection of local varieties and to trials on harvest time in which the most favourable vegetative period of the best clones is tried to be determined.