

# CONSERVATION AND EVALUATION OF TUBER CROPS GERMPLASM IN KERALA

\*A. Abraham, C.A. Ninan, S. Abraham  
P.N. Chandrasekharan Nair, P. Kuriachan and P. Gopalakrishna Pillai

## SUMMARY

Germplasm collections of *Manihot*, *Ipomoea*, *Dioscorea*, and various Aroids are maintained at Kerala University. *Manihot* species have been extensively evaluated and hybridized and polyploids produced.

Sweet potato is under improvement. Interspecific hybridization of *Dioscorea* spp. is in progress and good edible cultivars of *D. alata* are being multiplied for release. Various aroids are under evaluation.

## RESUME

Les collections de plasmé germinatif de *Manihot*, *Ipomoea*, *Dioscorea* diverses aroïdées sont entretenues à l'Université de Kerala. Les espèces du *Manihot* ont été l'objet d'une évaluation et d'une hybridation intensives, ce qui a permis la création de polyploïdes.

La patate douce est en voie d'amélioration. L'hybridation d'espèces de *Dioscorea* spp. est en cours et de bons cultivars comestibles de *D. alata* sont en train d'être multipliés en vue de leur popularisation. Diverses aroïdées sont en cours d'évaluation.

## RESUMEN

En la universidad de Kerala se mantienen *Manihot*, *Ipomoea*, *Dioscorea* y varias Aráceas. Se han evaluado extensivamente e hibridado especies de *Manihot* y se han producido poliploides.

El camote se encuentra bajo mejoramiento. Se está llevando a cabo la hibridación interespecífica de *Dioscorea* spp. y se están multiplicando, para su liberación, cultivares comestibles de *D. alata*. Varias aráceas se encuentran bajo evaluación.

## GERMPLASM COLLECTION

As a result of exploration and introduction work conducted during the past three decades, a germplasm collection of 633 accessions of root and tuber crops belonging to 22 species of the genera *Manihot*, *Ipomoea*, *Dioscorea*, *Amorphophallus*, *Coleus*, *Curcuma*, *Zingiber* and *Maranta* including their wild species has been assembled in the experiment station attached to the Department of Botany, University of Kerala, Kariyavattom, Trivandrum.

Extensive evaluation studies of these crops have revealed enormous variability among the genetic stocks which makes it possible to select directly valuable phenotypes for use in breeding programmes intended to develop hybrid clones suited to Indian conditions.

Among these tuber crops, cassava is the most important in South India while sweet potato, yams and aroids are more popular in Northern and Eastern India. It is estimated that the area of cassava is about 0.7 million acres, sweet potato and yams each 0.5 million acres.

## CASSAVA PROGRAMME

Cassava is grown in 9 states, Kerala, Tamil Nadu, Andhra Pradesh, Mysore, Assam, Meghalaya, Tripura, Orissa and Maharashtra. The first two of these are the most important. In Kerala alone 10 percent of the cultivable land is under this crop, and this accounts for 90 percent of the total production of cassava in India. Kerala, with its tropical climate and well distributed rainfall, is pre-eminently suited for the cultivation of this crop.

Cassava was introduced into India by the Portuguese during the latter half of the 17th Century. One of the Maharajas of Travancor (now known as Kerala State), Sri Visakom Thirunal Maharaja was personally responsible for popularising this crop in Travancore. Cassava can produce large amounts of food with low inputs on fertile land and has gained a reputation as a useful famine relief crop.

Three hundred and eighty three accessions of cassava are maintained in the experimental station of the Department. Our collection includes interspecific hybrids of *Manihot esculenta* Crantz, x *M. glaziovii* M.

\*Department of Botany, Kerala University, Trivandrum

Arg. made in this department and their back crosses to *M. esculenta*; intervarietal hybrids; inbred lines; artificially produced polyploids (triploids and tetraploids) and a rich germ plasm of over 172 cultivars. The genetic variability present is continuously being screened and evaluated to determine which stocks have valuable economic characters for utilization in the breeding programmes. Materials showing disease and drought resistance, high protein content, improved keeping qualities, outstanding cooking qualities, short duration, medium sized and stalked tubers and high recovery of sun-dried products are being selected for further study and propagation.

The greatest threat that the cassava industry faces today in Kerala is mosaic disease. This disease is estimated to reduce tuber yield by up to 35 percent, and most of the local cultivars under cultivation are susceptible to it. However, M<sub>4</sub>, widely cultivated in Kerala, is relatively free from the disease although it often suffers a mild attack. This cultivar is also the most popular in the State on account of its excellent cooking quality.

Most of the local cultivars contain only about 2 percent protein, but some recent introductions from Colombia have been found to contain from 2 to 6.5 percent protein, but the cooking quality of most of the high protein material is not good. However, one of these introductions, namely CMC 9 possesses good cooking quality and 6.5 percent protein. Attempts are being made to incorporate genes for high protein into the best available local strains like M<sub>4</sub>. Many new hybrids have been produced with this objective and are being evaluated.

Sixty percent of produced of cassava in Kerala is used as food, 20 percent as raw material for industrial purposes, including conversion into animal feed, and the balance is sent to neighbouring States like Madras for industrial purposes, including tapioca production. In the marketing of fresh tubers, the keeping quality of the tubers plays an important role as they tend to decay within a day or two after harvest. It is generally considered in Kerala that stalked tubers have better keeping qualities than the non-stalked ones which are found in some new high yielding cultivars. Development of high yield cultivars having stalked tubers and good cooking quality would therefore be considered an advantage. In areas where the tubers are sun-dried and marketed, cultivars having a higher conversion to dried products are important.

Intervarietal hybridization to seek for good combining ability was begun by the senior author in 1944. Many hybrids have already been produced. Preliminary evaluation showed that some hybrids between local cultivars contain about 5 percent protein, and also have good cooking quality. Yield trials are in progress to assess the yields of these.

Though triploid and tetraploid derivatives of the cultivar M<sub>4</sub> were produced and were tested on a large scale in 1950, both yield and cooking quality of the polyploids were poor. The polyploid types have been maintained. With the recent installation of a 1260 curie Co 60 gamma radiation unit in this department, mutation breeding is being attempted to rectify the defects of promising material.

## SWEET POTATO PROGRAMME

Sweet potato is used as an important subsidiary food crop in many States in India. Sweet potato ranks third in importance among tuber crops in India, next only to *Solanum* potato and cassava.

As sweet potato can be a short duration crop, it can be conveniently fitted into any multiple cropping programme and can be grown immediately after the harvest of the main crop. It is well adapted to fertile, well drained sandy loam with clayey subsoil.

One hundred and forty clones of *Ipomoea batatas* Poir. have been collected and grown in the experimental station at Kariyavattom, Trivandrum. These are being evaluated for yield and other desirable characters. There is considerable variation for starch and protein content. Both selections within the collection and hybridization are being used to achieve higher tuber yield, high starch content and high sugar content.

## YAM PROGRAMME

Over a dozen species of *Dioscorea* are available in Kerala State. The commonest is *D. alata* of which many varieties are under cultivation. Seventy six accessions of *Dioscorea* belonging to 4 cultivated species (*D. alata* L., *D. esculenta* Burkill, *D. spinosa* Boxb., and *D. sativa* Thun.) and 10 wild species (*D. bulbifera* L., *D. pentaphylla* L., *D. tomentosa* Koerig, *D. hispida* Dennst., *D. wallichii* Hook., *D. oppositifolia* L., *D. composita* Hemsl., *D. friedrichsthalii* R. Knuth., *D. spiculiflora* Hemsl. and *D. floribunda* Mar. and Gal.) are maintained in our collection. There is considerable variation for size, weight and shape of the tubers and cooking quality. Morphological characters and tuber quality have also been studied. Most plants are males, but a few are females; some have not yet flowered. Botanical data has been collected. Inter-specific hybridization is in progress. Detailed studies on edible cultivars of *D. alata* have shown that some of these possess well shaped tubers, thin skin, white flesh, uniform sized starch grains and good cooking quality. These have been selected and multiplied for distribution. The diosgenin content in different species in our collection is being studied.

## **AROID PROGRAMME**

Aroids comprise *Colocasia*, *Alocasia*, *Xanthosoma* and *Amorphophallus*. Scope for hybridization in these crops is rather limited due to high female sterility. However, in *Colocasia* it has been possible to overcome the sterility block through embryo culture. Many sexually derived plants of *Colocasia* obtained by this method are being evaluated.

Irritability factors are very important in these tubers.

*Amorphophallus campanulatus* Blume., commonly known as 'elephant foot yam' is also commonly cultivated in this area. Single corms from well cultivated plants weigh as much as 50–60 lbs. *Amorphophallus bulbifer* Blume., *A. dubius* Blume., and *A. sylvaticus* Kunth. are wild species collected from areas in South India.

*Coleus parviflorus* Benth., *Maranta arundinacea* L., (arrow root) *Zingiber officinale* and *Curcuma aromatica* are minor tuber-bearing plants collected from this area. No improvement work has so far been done on these.

## **DISCUSSION**

This vast germplasm collection of tuber and root crops from South India is a treasure store of genetic variability present in this area. The collection is a resource for current and future plant breeders. Loss of valuable genetic resources can be avoided by this kind of conservation in areas of maximum variability of these species.

Stocks of these crops can be obtained from Professor C.A. Ninan, Head, Department of Botany, Kerala University, Kariyavattom, Trivandrum, India.