Genebank network of tropical and subtropical fruits in Brazil

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ABSTRACT

Fruit crops are an important industry in Brazil, which is one of the biggest fruit producers in the world. Brazil is also one of the most important centers of genetic diversity of several important tropical fruits. The Brazilian plant genetic resources conservation model is composed by Embrapa Genetic Resources and Biotechnology (National Genetic Resources and Biotechnology Research Center - CENARGEN), in Brasilia-DF, and by a network of genebanks spread all over the country in Research Units, Universities and State Institutions. CENARGEN is one of the 39 Research Units of the Brazilian Agriculture Research Corporation (EMBRAPA). At EMBRAPA the conservation of tropical and subtropical fruit genetic resources is formed by 24 genebanks. Along with several other germplasm collections, this system has about 300 species and more than 10,000 accessions under conservation, including duplications. All material is kept the field, except for a small collection of banana and pineapple germplasm which is maintained "in vitro". In this paper, the number of accessions per species, and the location where the collections are kept is presented. Brazil has a strong collecting program for native species including pineapples, cashews and passion fruits. For exotic species, such as bananas, mangoes and citrus, there is a good exchange program. Morphological and molecular characterization, and evaluation of the most important tropical and subtropical fruit germplasm is in progress in the active genebanks and at EMBRAPA Genetic Resources and Biotechnology. The germplasm documentation uses the updated national information system SIBRARGEN. Tropical and subtropical fruit genetic resources, such as pineapples, bananas, citrus, mangoes, and cashews are actively being used in breeding programs and correlated research.

KEY WORDS: Genetic resources, germplasm, fruit crops.

INTRODUCTION

Fruit culture is an important industry in Brazil, one of the largest countries in fruit production, as showed in Table 1 (FAO, 2002). Brazil, due to its continental geographic dimensions, is also one of the most important centers of genetic diversity for several important tropical and subtropical fruits.

Brazil has a very rich and diversified range of native fruit species, mainly in the North region and in the savanna area, such as cashews, pineapples, passion fruits and others. Besides these important crops, there are other minor fruit species, which are still not very known or totally unknown by the local and international population (Table 2).

Plant domestication

Plant domestication depends mainly on man's intelligence about how directing the evolution process so that it can be better adapted to the changes of the environment by anthropic action (Ford-Lloyd and Jackson, 1986). The domestication process of the cultivated plants differs from its natural system, because it depends on a reproductive system developed by man.

In the remote past, genetic variability was exploited by simple intuition about the phenotypic aspects, and the selection was made according to the needs of the human being (Wet and Harlan, 1975). Two types of ancestral genetic variability were presented by Giacometti and Ferreira (1987) related to bananas in Asia and grapes in Asia and America, as described

Table 1. Tropical and subtropical fruit production in the world and in Brazil, and the percentage and ranking in Brazil. Brasilia, 2002.

Fruit	World	Brazil		
	(1000 T)	(1000 T)	%	Ranking
Avocado	2455	85	3.5	7°
Banana	66511	5744	8.6	3°
Cashew apple	1568	1500	95.7	1°
Cashew nuts	1418	180	12.7	3°
Citrus	98536	18280	18.5	1°
Coconut	49798	1999	4.0	4°
Mango	23233	500	2.2	9°
Papaya	5470	1403	25.6	1°
Pineapple	13889	1442	10.4	3°

Source: FAO (2002).

Table 2. List of some important native Brazilian tropical and subtropical fruit species. Brasilia, 2002.

FAMILY	SPECIES
Anonaceae	*Annona cacans, A. crassiflora, Rollinia emarginata, R. exalbida, R. silvatica*
Myrtaceae	*Psidium guajava, P. araça, P. acutangulo, P. catleyanum, P. grandifolium, P. giganteum, Eugenia uniflora, E. pyriformis, E. stipitata, E. dysenterica, E. klostzichiana, E. lutescens, E. calycina, E. brasiliensis, E. myrtifoloia, E. uvalha, E. involucrata, Campomanesia cambesseana, C. aurea, C. fluminensis, C. pubescens, C. discolor, C. littoralis, Myrciaria cauliflora, M. jaboticaba, M. dubia, M. peruviana, M. grandifolia,*
Solanaceae	*Solanum topiro*
Passifloraceae	*Passiflora edulis, P. alata, P. nitida, P. macrocarpa, P. quadrangularis, P. incarnata*
Caricaceae	*Carica quercifolia, C. glandulosa, C. microcarpa, Jaracatia spinosa, J. heptaphylla*
Arecaceae	*Mauritia vinifera, M. flexuosa, Euterpe oleracea, Bactris gasyapes, Orbygnia phalerata, Syagrus flexuosa, Acrocomia aculeata, A. totai, Oenocarpus bataua, Astrocaryum vulgare*
Bromeliacea	*Ananas comosus, A. ananassoides, A. bracteatus, A. parguazensis, Bromelia antiacanta, B. balansae, Pseudananas sagenarius*
Anacardiaceae	*Anacardium occidentale, A. humile, A. nanum, A. othonianum, Spondias lutea, S. tuberosa*
Sterculiaceae	*Theobroma grandiflorum, T. cacau*
Leguminosae	*Inga edulis, Dypteris alata, Hymenaea Stignocarpa, H. stilbocarpa, H. courbaril*
Rubiaceae	*Genipa americana, Alibertia edulis, Borojo sorbilis*
Apocynaceae	*Hancornia speciosa, Couma utilis*
Cariocaceae	*Caryocar Brasilliense, C. villosum*
Sapindaceae	*Paullinia cupana, Talisia sculenta*
Lecythidaceae	*Bertholletia excelsa*
Guttiferae	*Platonia insignis*
Moraceae	*Pourouma cecropiaefolia*

by Ferreira and Pinto (1998).

For instance, the Brazilian domestication and genetic breeding of cashew nut plants have a good use of genetic variability, as presented in the work of Paiva et al. (1997), following five steps. The first step was developed by the Brazilian Indians, who used to eat fresh cashew peduncles or use them to make beverages. The second period, from 1940 to 1950, coincides with the extraction of the nut shell oil and the industrial processing of the cashew peduncle. In the third period, from 1960 to 1970, big areas were planted with material from seeds and showed a large genetic variability in the orchards. In the fourth period, the material was selected and vegetatively propagated from the pre-established orchard via clonal and seedling plants, significantly increasing the yield. The last period, the clonal selection, was based on plant yield, fruit weight, disease and pest resistance and other important traits.

Fruit genetic variability

In Brazil there are several wild fruit species, mainly the ones from the Myrtaceae family, from the far southern - in the state of Rio Grande do Sul - up to the far northern in the state of Amazonas. Many wild fruit species grown naturally in the whole country and belong to the Myrtaceae, Annonaceae, Anacardiaceae, Bromeliaceae, Passifloraceae, Arecaceae, Caricaceae and Leguminosae families (Table 2).

The importance of conservation and improvement of the wild species was emphasized by several researchers, who were involved for many years in the study and classification of native fruit species. Some of them are Giacometti and Ferreira (1987), Giacometti (1993), Coppens et al. (1998), Ferreira (1999) and others. These authors proved that through the breeding and management processes, these species could be commercially cultivated. They also showed the importance of the wild fruit species not only for human consumption but also for feeding birds and fish, as well as for timber production.

Fruit genebanks

Brazil has a model for the conservation of plant genetic resources comprising the National Center for Genetic Resources and Biotechnology Research - CENARGEN, located in Brasilia, Federal District, as well as a network of genebanks distributed all over the country in research units, universities and state research institutions. CENARGEN is one of the 39 research units of the Brazilian Agriculture Research Corporation (EMBRAPA). Cenargen coordinates Program 2, the Conservation and Use of Genetic Resources, of the Embrapa Planning System - SEP. The program has approximately 160 Active Germplasm Banks (BAGs), and 24 out of them are

Table 3. Genetic resources of tropical and subtropical fruit crops in Brazil. Brasilia, 2002.

FRUIT CROPS	SPECIES	NUMBER OF COLLECTIONS	NUMBER OF ACCESSIONS[1/]
Avocado	*Persea americana*	6	216
Pineapple	*Ananas comosus* and others species	3	823
Acerola	*Malpighia glabra*	9	309
Anonacea	*Annona spp* and *Rollinia*	9	223
Banana	*Musa spp*	6	554
Cashew	*Anacardium occidentale* and others species	4	505
Citrus	*Citrus* spp and others genus	4	3023
Guava	*Psidium guajava* and others species	6	428
Papaya	*Carica papaya* and others species	5	382
Mango	*Mangifera indica* and others species	7	458
Passion Fruit	*Passiflora edulis* and others species	8	305
Cupuassu	*Theobroma grandiflorum*	4	508
Assai	*Euterpe oleraceae*	1	130
Camu-camu	*Myrciaria dubia*	2	140
Guarana	*Paullinia cupana*	1	270
Others Fruit Crops	Several (± 200 species)	17	2300
TOTAL	± 300 species	92	10574

[1/] Include duplicates in the several collections.

of tropical and subtropical fruit tree species. Besides the BAGs, there are other germplasm collections, comprising a system of about 300 species and 10,574 accessions under conservation, including duplications (Table 3). All the materials are maintained in the field, except for a small collection of banana and pineapple germplasm which are kept "in vitro".

Brazil has a strong program for the collection of native species, such as pineapples, cashews and passion fruits. Concerning exotic species, such as bananas, mangoes and citrus there is a good exchange program. The wild and exotic species were first introduced and put in an "ex situ" field collection. Morphological and molecular characterization, and evaluation of the most important tropical and subtropical fruit germplasm are being conducted in the active genebanks, and also at CENARGEN.

All the documentation of the material under conservation is regularly updated via a computerized system as part of the new Brazilian Genetic Resources Information System (SIBRARGEN), which is presently under development and soon will be accessed via Internet.

Both the research data and the pollen and vegetative material of the germplasm collection are freely used in the country breeding programs, and are also exchanged with other national and international research institutions. They are used for studies aiming at identifying traits associated with productivity and disease resistance. Tropical and subtropical fruits genetic resources are being used in breeding programs and correlated research.

REFERENCES

Coppens d'Eeckenbrugge, G.; Ferla, D.L. and Ferreira, F.R. 1998. Diversidade e potencial das fruteiras neotropicais. p.19-47. In: Congresso Brasileiro De Fruticultura, 15th , Poços de Caldas, 1998. SBF, Poços de Caldas.

FAO. 2002. Tropical and subtropical fruit production in the world and in Brazil. Disponível on-line: http://apps.fao.org/page/form. Consultado em: 15.07.2002.

Ferreira, F. R. 1999. Recursos genéticos de fruteiras tropicais e subtropicais no Brasil. p.9-27. In: Ferreira (Ed.). Recursos genéticos de espécies frutíferas no Brasil. Embrapa Recursos Genéticos e Biotecnologia, Brasília.

Ferreira, F. R. and Pinto, A. C. Q. 1998. Tropical and subtropical fruits genetic resources in Brazil. p.39-62. *In*: Galan Sauco, V. (Ed.). Proceedings of the Second Mesfin Meeting on Plant Genetic Resources and First Mesfin Meeting in Fruit Production., Funchal, 1997. FAO/Gobierno de Canarias, Madeira.

Ford-Lloyd, B. and Jackson, M. 1986. Plant genetic resources: an introduction on their conservation and use. Edward Arnold, Baltimore.

Giacometti, D. C. 1993. Recursos genéticos de

fruteiras nativas do Brasil. p.13-27. In: Anais do Simpósio Nacional De Recursos Genéticos De Fruteiras Nativas, Cruz das Almas-BA, 1992. Embrapa/Cnpmf, Cruz das Almas.

Giacometti, D. C. and Ferreira, F. R. 1987. Organização e uso de bancos de germoplasma de frutíferas. p. 11-17. *In:* Anais do Congresso Brasileiro De Fruticultura, 9., Campinas, 1987.

Paiva, J. R.; Crisostomo, J. R.; Barros, L. M. and Paiva, W. O. 1997. Domesticação e melhoramento genético do cajueiro (*Anacardium occidentale* L.) no Brasil. Informativo SBF, Sociedade Brasileira de Fruticultura. 16:19-20.

Wet, J. M. J. and Harlan, J. R. 1975. Weeds and domesticates: evolution in the man made habitat. Economy Botanic. 29:99-107.

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