1.9 THE BRAZILIAN CORE COLLECTION OF CASSAVA

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ABSTRACT

The size of Germplasm Collections has become an important limitation for their use in plant breeding programs. To overcome this limitation the Core Collection concept has been proposed. A **Core Collection** consists of a set of accessions selected to represent the genetic diversity of the base collection with minimum repetitiveness. This insures the conservation of maximum genetic variation, allowing rapid evaluation of germplasm, and better access to the base collection. The Brazilian Germplasm Collection of Cassava is the largest national collection, and contains strategic genetic variation for the development of breeding programs worldwide. It consists of approximately 3350 accessions conserved in 7 regional Active Germplasm Banks. To develop the Core Collection a hierarchical stratification similar to that proposed by Cordeiro et al (1995) was used. Two key criteria were used for the stratification of the accessions: category and origin. According to category the accessions were classified as landraces or breeding materials. Within the landraces stratum, accessions were classified according to ecogeographical origin using the Geographic Information System. The selection of the members of the Core, was done trying to represent the genetic variability within each ecogeographic zone, incorporating the

knowledge and experience of the curators. This Core Collection will be a logical and efficient starting point for studying the Base Collection using biotechnological tools.

RESUMO

Um dos fatores que limita a utilizaçào de coleções nucleares em programas de melhoramento de plantas é seu grande tamanho. Uma coleção nuclear é uma amostra representativa da coleção de germoplasma na qual se procura manter a variabilidade genética com um mínimo de repetibilidade. Esta estratégia procura conservar a máxima variabilidade genética, permitindo uma rápida avaliaçào do germoplasma e um melhor acesso à coleção de base. A coleção brasileira de mandioca é a maior coleção nacional e contém variabilidade genética estratégica para o desenvolvimento de programas de melhoramento no mundo todo. Ela consiste de aproximadamente de 3350 acessos conservados em 7 bancos ativos de germoplasma. Para estabelecer a coleção nuclear foi usada uma estratificação hierárquica similar àquela proposta por Cordeiro et al. (1995). Dois critérios principais foram usados para a estratificação dos acessos: categoria e origem. O primeiro critério classifica os acessos como "landraces" ou material melhorado. Dentro do grupo de "landrace" os acessos foram classificados de acordo com regiões ecogeográficas de origem dos mesmos. Essas regiões ecogeográficas foram estabelecidas através do cruzamento de informações utilizando-se o programa "Geographic Information System" (GIS). A seleção dos acessos da coleção nuclear tentou representar a variabilidade genética existente dentro de cada região ecogeográfica incorporando o conhecimento e a experiência dos curadores. Esta coleção nuclear será um ponto de partida eficiente e lógico para se estudar a coleção de base de mandioca usando-se ferramentas biotecnológicas.

INTRODUCTION

One of the major limitations for the use of Germplasm Collections in Plant Breeding Programs is precisely their large size. The Core Collection concept has been proposed to overcome this limitation (Frankel and Brown, 1984). A **Core Collection** is a subset of reduced size chosen to represent the genetic diversity of the base collection with minimum redundancies. This

strategy was introduced with the intention of minimizing the cost of genetic conservation, while maintaining maximum genetic variation. It also allows a rapid evaluation of germplasm, and a better access to the base collection.

The development of a Core Collection must be based on an adequate classification of the base collection, because variability is distributed within and among populations with different levels of organization (Brown, 1989, Hintum, 1995).

Geographical origin is normally an effective and simple criterion for classifying germplasm collections of sexually propagated crops (Hodgkins, 1997; Abadie et al., 1998). While this is also true for clonally propagated crops as cassava, a more detailed ecogeographic classification is needed to insure capturing valuable genotypes adapted to specific ecological environments (Cordeiro et al., 1992; Brown, 1992).

The Brazilian Germplasm Collection of Cassava is the largest national collection, and contains strategic genetic variation for the development of breeding programs worldwide. It consists of approximately 3366 accessions conserved under field conditions in 7 regional Active Germplasm Banks. In vitro collections are also maintained at CENARGEM, and CNPMF. The objectives of this research were to update the classification of the Brazilian Cassava Collection proposed by Cordeiro et al. (1992), and to develop a Core Collection with the participation of breeders and curators.

METHODS

Two main hierarchical classification levels were established. At the first level, the accessions were classified as landraces or breeding materials. At the second level, the landraces were classified into ecogeographical regions according to the passport data using the Geographic Information System (Table 1). These ecogeographical regions were defined by combining information from "vegetation" maps of Brazil (Mapa de Unidades de Conservação Federais do Brasil, IBGE 1994; Mapa do Zoneamento Agroecológico do Nordeste, Silva et al., 1993). Within each ecogeographical region, accessions were also classified into subgroups when information for known biotic or abiotic factors relevant for differential adaptation of the crop was available (Ex. **Amazonia**: lowlands, dry lands, and fields; **Cerrados**: low fertility, wide variability in fertility; etc.). The sampling within each strata will be done in cooperation with the breeders and curators in order to represent the available genetic variability of the crop.

Table 1 - Brazilian ecogeographical regions on which the stratification of landraces is based.

Ecogeographical regions	Subgroups	Description
Amazon	Dry lands *(terra firme)*	Upland forest areas situated on higher ground with no direct influence from rivers (Rizzini et al, 1988).
	Low lands *(várzea)*	Flood plains along rivers, areas subject to flooding during the rainy season (Rizzini et al, 1988).
Caatingas, campinas and campinaranas of the Negro River		Areas of forest vegetation, growing on sandy soils, with no perceptible connection to other woody Amazonian communities (Rizzini et al, 1988).
Semi-deciduos tropical forests		Partially deciduos forests (50-80% of the foliage) during the dry months. These forests are found along the border between the Amazon region and central Brazil, throughout the cerrados and between the Atlantic forest and cerrado vegetation (Rizzini et al, 1988).
Cerrado		Savanna like vegetation. This type of vegetation includes areas of different physiognomies: dense forest like vegetation called cerradão to very open grasslands – campo limpo (Rizzini,1979).
Pantanal complex		A complex of several types of vegetation affected by periodic floods (Santos et al 1977).
Caatinga - Hyper xerophytic caatinga		Vegetation occurring in a semi arid region of the Northeast with 7-11 months without rain (Nimer, 1989).
Sertão - Hypo xerophytic caatinga		Semi arid region with 5-6 months without rain. It is an area that surrounds the driest areas called hyper xerophytic caatinga (Nimer, 1989).
Agreste		Region which occurs in the Northeast between the Caatinga and Littoral and therefore has greater humidity (4-5 months without rain). It is a type of hypo xerophytic Caatinga (Nimer, 1989)..
Mosaic vegetation areas		This is an ecological region localized mainly in the state of Maranhão and part of Piauí which includes semi deciduos forests (including *babaçual* forests –vegetation dominated by babaçu oil palm), graslands and paches of cerrado vegetation (Rizzini et al, 1988).
North littoral		Different types of vegetation situated near the coastal line, from the south of the State of Bahia. Ever green coastal rain forest of the State of Bahia, some semi perenifolious and semi deciduous forests by the coast, Restinga (relatively dense woody vegetation occurring on flat stretches of coastal plain further from the beach on sandy soils), Mangroves (Rizzini et al, 1988).
South littoral		Ever green coastal rain forests localized along the coast from the States of Espírito Santo to Santa Catarina, Restinga, Mangroves and coastal vegetation formations of the State of Rio Grande do Sul (Rizzini et al, 1988).
Subtropical		This ecological region includes areas of the States of São Paulo and Minas Gerais which present mean annual temperatures less or equal to 19° C. This temperature is the thermal limit below which there are restrictions for growing cassava (Nimer, 1989).
South		Sub deciduous subtropical forests; sub deciduous subtropical forest with *Araucaria*; grasslands (Rizzini,1979).

RESULTS

The Brazilian cassava collection has 3350 accessions, 445 are breeding material and 2905 are landraces from different ecosystems. Table 1 and figures 1 and 2 present the 13 ecogeographical regions defined to classify the landraces. Table 2 presents 17 strata which include the substrata within some of the ecogeographical regions.

The criteria of use (direct consumption vs. industry), has been mentioned as relevant in almost all the regions. This information, if available, will eventually be incorporated in the Core, although it will not be used to create a new hierarchical level in the classification.

Table 2 - Number of accessions contained in each of the 17 strata for the landraces of the Brazilian collection of cassava.

Ecogeographical Regions	Subgroups	number of accessions	%
Amazon	unknown environment	236	8.1
Amazon	terra firme	135	4.6
Amazon	varzea	91	3.1
Caatinga		288	9.9
Campina of Negro River		87	3.0
Cerrado	wide fertility variation	58	2.0
Cerrado	low fertility	238	8.2
Mosaic vegetation areas		33	1.1
North Littoral		280	9.6
Semi-decidous tropical		280	9.6
Sertao		364	12.5
South	altitude 200-600 m	59	2.0
South	altitude < 200 m	88	3.0
South	altitude > 600 m	47	1.6
South Littoral		435	14.9
Subtropical		25	0.8
Agreste		161	5.5

CONCLUSIONS

Based on the hierarchical stratification presented above (table 2), 20% of the landraces accessions of the whole collection will be sampled. The decision to include, in this case, 20% of the accessions instead of the 10% proposed by Brown (1989) is based on the fact that cassava is commonly

propagated asexually therefore the allele concept does not apply to this situation. What are considered accessions of cassava are individuals and therefore genotypes. The sampling strategy employed in our study tries to assure the recovery of two types of alleles. The ecogeographicaly based sampling and the selection done by the breeders tries to maximize the recovery of allelic blocks conferring adaptedness and good performance in specific environments (Allard, 1992). The recovery of widespread alleles, not necessarily associated with adaptive characters, and which might be dispersed among accessions of different regions, will be assured at the moment of deciding the sample size to be used.

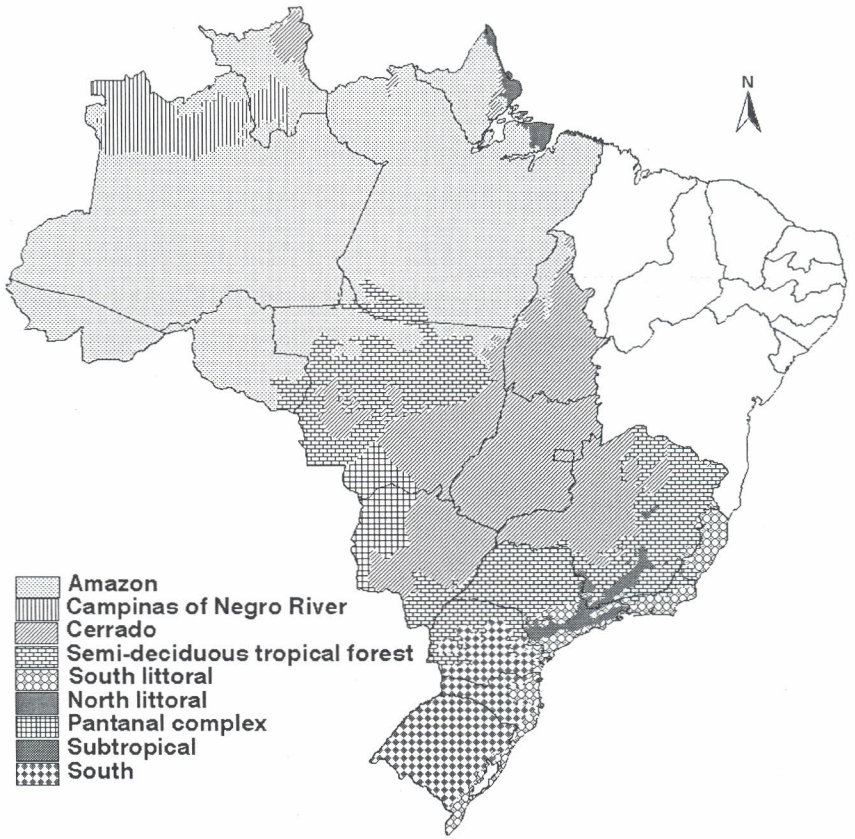

Figure 1 - Map of Brazil showing the ecogeographical regions established for landraces classification of the Cassava Core Collection. Only the ecogeographical regions for the South, Southeast, Central West and North geographic regions of Brazil are presented.

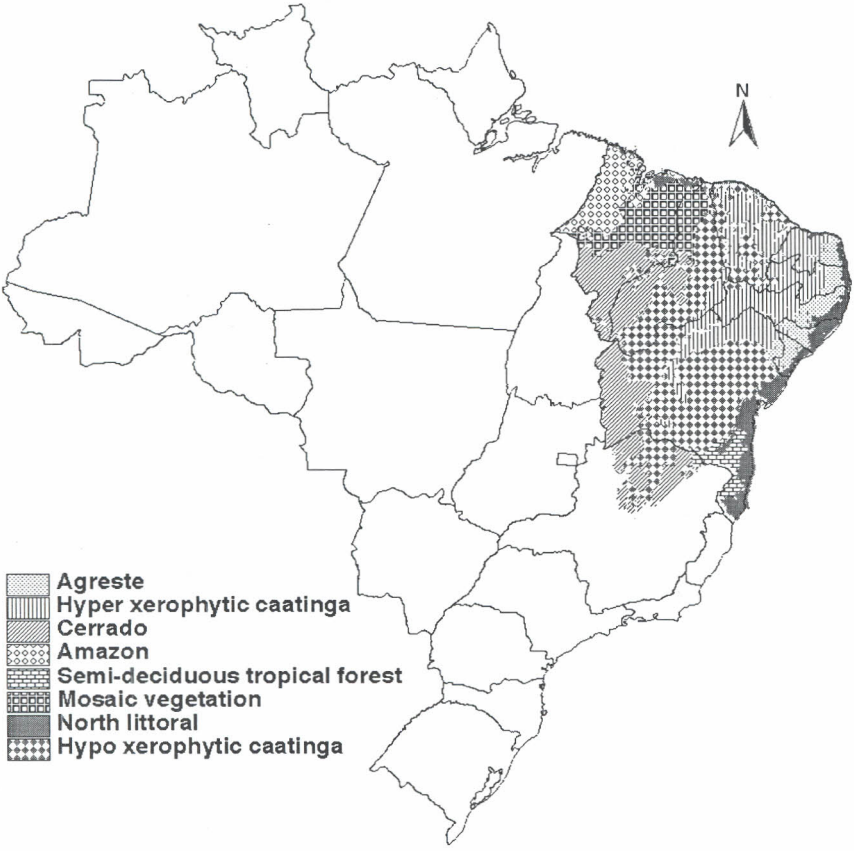

Figure 2 - Map of Brazil showing the ecogeographical regions (Northeast geographical region) established for the Cassava Core Collection landraces classification.

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