http://dx.doi.org/10.1590/1519-6984.08313 Original Article

Distribution, management and diversity of the endangered Amerindian yam (*Dioscorea trifida* L.)

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Received: May 22, 2013 – Accepted: August 26, 2013 – Distributed: March 31, 2015
(With figures 3)

Abstract

The objective of this study was to verify the occurrence of *Dioscorea trifida* in Brazil and to obtain information concerning its distribution, management and diversity. Farmers from 21 communities were interviewed in the states of São Paulo, Santa Catarina and Mato Grosso. During the visits, semi-structured interviews were conducted to collect socio-economic, management and diversity data for this crop. Fifty-one collected accessions, plus two accessions obtained at local markets of Amazonas, were characterized using 12 morphological traits. Most the interviewed farmers were men (75%) with a mean age of 59.5 years. Just a few young people and labor force were available for agricultural activities, with an average of only three individuals per farm. Most farmers (56%) grew only one variety of *D. trifida*, although 44% had more than one variety in their fields, which aims to provide greater assurance at harvest. Many popular names were observed for *D. trifida*, and *cará roxo* (purple yam) was the name most used by farmers (43.4%). Characters referring to the tuber, such as skin and flesh color, were most relevant for the distinction of the accessions. The results of this study may collaborate to develop strategies for conservation, both *ex situ* and *in situ*, within the view of *on farm* conservation.

Keywords: genetic variation, *in situ*/*on farm* conservation, tuber, morphological traits.

Distribuição, manejo e diversidade da espécie ameaçada de inhame ameríndio (*Dioscorea trifida* L.)

Resumo

O objetivo deste trabalho foi verificar a ocorrência de *Dioscorea trifida* no Brasil e obter informações a respeito da sua distribuição, manejo e diversidade. Para tanto, foram visitados e entrevistados agricultores de 21 comunidades, nos Estados de São Paulo, Santa Catarina, Mato Grosso. Durante as visitas, foram realizadas entrevistas semi-estruturadas visando obter dados sócioeconômicos, de manejo e diversidade da cultura. Cinquenta e um acessos, além de dois acessos adquiridos em feiras no Estado do Amazonas, foram caracterizados por meio de 12 descritores morfológicos. A maioria dos entrevistados era homem (75%) com média de idade de 59,5 anos. Observou-se um número reduzido de jovens e mão de obra disponível para as atividades agrícolas, cerca de três indivíduos por roça. A maior parte dos agricultores (56%) cultiva apenas uma variedade de *D. trifida,* embora 44% tenham declarado o cultivo de mais de uma variedade, procedimento que visa dar maior garantia de colheita. Vários nomes populares foram observados para *D. trifida*, sendo *cará roxo*, a denominação mais utilizada pelos agricultores (43,4%). Os caracteres referentes às túberas, como cor da casca e da polpa, foram os mais relevantes para a distinção dos acessos. Os resultados obtidos poderão colaborar para elaborar estratégias de conservação, tanto *ex situ* como *in situ*, dentro da visão de conservação *on farm*.

Palavras-chave: variabilidade genética, conservação *in situ/on farm*, túberas, descritores morfológicos.

1. Introduction

Dioscorea is the largest and most important genus of the family Dioscoreaceae, with 644 species approximately (Govaerts et al., 2007). Among these, only 10 are considered important in human nutrition (Lebot, 2009), and in Brazil only *D. alata* L., *D. cayenensis* Lam, *D. rotundata* Poir., *D. bulbifera* L. and *D. trifida* L. are grown and consumed (Pedralli, 1988; Bressan et al., 2005; Veasey et al., 2010; Siqueira et al., 2014).

Domesticated by pre-Columbian peoples and of Neotropical distribution, *Dioscorea trifida* was probably the first yam species cultivated by indigenous peoples and immigrants from Europe and Africa in the Amazon (Lebot, 2009; Bousalem et al., 2010). Although there is still controversy regarding the origin and domestication of this species and its evolutionary history is poorly documented, studies show that among the economically important yam species in Brazil, *D. trifida* originated in South America, specifically in areas located on the border between Brazil, Suriname, Guyana and French Guiana (Pedralli, 1992).

In Brazil, *D. trifida* occurs in areas of rain forests, savannas of the Planalto Central, rocky fields of the Cadeia do Espinhaço and seasonal forests adjacent to these fields (Pedralli, 2002), and has been maintained and propagated by traditional farmers in the Vale do Ribeira, São Paulo (Bressan et al., 2005), in the Baixada Cuiabana, Mato Grosso (Ferreira et al., 2010), in Manaus and its surroundings, in the channel of Rio Negro and in Belém (Lin Chau Ming, personal communication). Despite the problems related to agricultural production and lack of consumption diversification, this crop is an important food source, because its tubers have a high nutritional quality, and astringent, antimicrobial, diuretic and energizing properties, allowing its use in fighting malnutrition and for several diseases treatment such as diabetes, reducing cholesterol and convalescence (Ramos-Escudero et al., 2010).

Although the tubers are of high nutritive quality and are highly appreciated in the cuisine of several Brazilian communities, little has been observed on the cultivation of *D. trifida* on a commercial basis, with the crop being underutilized and most of the cultivation performed by traditional farmers for their own subsistence (Carmo, 2002). However, in some Brazilian states, such as Amazonas and Santa Catarina, the commercialization of this species seems to occur in an intensive way (Veasey et al., 2010).

Over the past decades traditional farmers have suffered strong socioeconomic pressures that have been leading towards a decrease of agricultural activities, with farmers abandoning the fields, and thus leading to a loss of genetic diversity of yam species and other crops such as cassava and sweet potato (Siqueira and Veasey, 2009; Siqueira, 2011). In this context, there is a need for studies to verify the damage caused by these pressures to the yam crop, to estimate the genetic diversity that is managed by these farmers and to develop strategies for conservation and maintenance of traditional varieties, which are an important source of genes for various desirable agronomic characteristics such as resistance to pests, pathogens and abiotic factors.

Studies related to the morphological characterization of *D. trifida* accessions are scarce, such as the study conducted by Bressan (2005), assessing 25 local varieties of *D. trifida* from the Vale do Ribeira, São Paulo. Therefore, any information on the morphology of the species is important to aid to their conservation and maintenance. Based on morphological characters, Melo Filho et al. (2000) classified 11 accessions of the yam germplasm collection of the Universidade Federal Rural de Pernambuco (UFRPE), Brazil, while Mignouna et al. (2002) characterized 45 yam accessions of *D. cayenensis/D. rotundata* collected in Cameroon, Africa, and Hasan et al. (2008) evaluated the morphological variation among 70 accessions of *D. alata* from Malaysia.

This study aimed to obtain information regarding the distribution, management and the morphological and nomenclature diversity of *D. trifida* local varieties held by small farmers in Brazil in order to assist in the development of more effective conservation strategies for the species.

2. Material and Methods

Between 2009 and 2010, 21 communities in nine municipalities were visited, distributed in the States of Santa Catarina, São Paulo and Mato Grosso, located between latitudes 14°43'S and 26°15'S and longitudes 44°05'W and 57°59'W (Table 1; Figure 1). During the visits interviews and previously standardized semi-structured questionnaires were made regarding the socioeconomic characteristics of the farmers, and the management and use of *D. trifida* varieties. Simultaneously, with the consent of the owners, yam tubers were collected, so that all the varieties grown and consumed in these locations could be sampled and maintained *ex situ*. Two accessions obtained in local markets of Manaus and Barcelos, in the State of Amazonas, were also used in this study for the morphological analysis.

The collected materials were planted in pots in the greenhouse, to allow a first step of multiplication and plant quarantine. Two months after planting, the plants were transplanted to the field with two replications. The spacing between rows and between plants was 2.5 m and 1.5 m, respectively.

We used 11 qualitative and one quantitative (number of leaf lobes) morphological traits to characterize the accessions (Table 2). These traits were selected from a list developed by the International Plant Genetic Resources Institute (IPGRI) and the International Institute of Tropical Agriculture (IITA), located in Ibadan, Nigeria, which includes morphological descriptors for various economically important species of the genus *Dioscorea*, except *D. trifida* (IPGRI and IITA, 1997). The characterization was performed in two plants representing each accession. Information concerning the morphological and socioeconomic data as well as those related to the handling and consumption of *D. trifida* were evaluated by descriptive analysis and then compared between the different study sites.

Table 1. *Dioscorea trifida* accessions collected in Brazil.

Nº	ID	Municipallity	Community	Folk name	Stem color[1]	Number of lobes	Tuber skin color	Tuber flesh color
01	180	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Br	5	Brown	Pur white
02	181	Ubatuba-SP	Sertão de Ubatumirim	Cará branco	Green Br	5	Brown	Pur white
03	182	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Br	5	Brown	Pur white
04	183	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Pur	5	Brown	Pur white
05	184	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Pur	5	Brown	Pur white
06	185	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Pur	5	Brown	Pur white
07	187	Ubatuba-SP	Sertão de Ubatumirim	Cará branco	Green Br	5	Brown	White
08	191	Ubatuba-SP	Sertão das Cutias	Cará roxo	Green Pur	5	Brown	Purple
09	193	Ubatuba-SP	Rio Escuro	Cará branco	Green Br	5	Brown	White
10	195	Ubatuba-SP	Sertão do Ingá	Cará cobrinha	Green Br	5	Brown	White
11	196	Ubatuba-SP	Sertão do Ingá	Cará branco	Green Pur	5	Yellow	White
12	197	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Pur	5	Brown	Pur white
13	198	Ubatuba-SP	Sertão do Ingá	Cará roxo	Green Pur	5	Brown	Pur white
14	201	Ubatuba-SP	Sertão do Ingá	Cará roxo	Green Br	5	Brown	Pur white
15	203	Ubatuba-SP	Sertão do Ingá	Cará roxo	Green Pur	5	Brown	Pur white
16	204	Ubatuba-SP	Rio Escuro	Cará roxo	Green Pur	5	Brown	Pur white
17	208	Ubatuba-SP	Araribá	Cará roxo	Green Pur	5	Yellow	Pur white
18	210	Ubatuba-SP	Sertão de Ubatumirim	Cará roxo	Green Pur	5	Brown	White
19	216	Ubatuba-SP	Fazenda da Caixa	Cará roxo	Green Pur	5	Brown	Purple
20	217	Ubatuba-SP	Feira de Ubatuba	Cará roxo	Green Pur	5	Yellow	Pur white
21	236	Manaus-AM	Feira em Manaus	Cara roxo	Green Pur	5	Brown	Purple
22	237	Barcelos-AM	Feira em Barcelos	Cará	Green Pur	5	Yellow	Purple
23	281	Joinville-SC	Pirabeiraba	Cará	Green Pur	5	Brown	White
24	282	Joinville-SC	Pirabeiraba	Cará mimoso	Green Pur	5	Yellow	White
25	283	Joinville-SC	Pirabeiraba	Cará	Green Pur	5	Brown	White
26	285	S. F. do Sul-SC	Acaraí	Cará pão	Green Pur	5	Brown	White
27	286	Joinville-SC	Pirabeiraba	Cará mimoso	Green Pur	5	Yellow	White
28	287	Joinville-SC	Pirabeiraba	Carcanhá de nego	Green Pur	5	Brown	White
29	290	Joinville-SC	Pirabeiraba	Cará mimoso	Green Pur	5	Yellow	White
30	292	Joinville-SC	Pirabeiraba	Cará	Green Pur	5	Yellow	White
31	297	Joinville-SC	Pirabeiraba	Cará	Green Pur	5	Yellow	White
32	298	Joinville-SC	Rio da Prata	Cará	Green Pur	5	Brown	White

[1] Green brown (Green Br), Green purple (Green Pur).

Table 1. Continued...

Nº	ID	Municipallity	Community	Folk name	Stem color[1]	Number of lobes	Tuber skin color	Tuber flesh color
33	301	Joinville-SC	Rio da Prata	Cará mimoso	Green Pur	5	Yellow	White
34	302	Joinville-SC	Pirabeiraba	Cará	Green Pur	5	Yellow	White
35	312	Iguape-SP	Pontalzinho – Icapara	Cará S João branco	Green Pur	5	Yellow	Pur white
36	313	Iguape-SP	Cavalcanti	Cará-pipa	Green Pur	5	Brown	Purple
37	323	Iguape-SP	Pontalzinho – Icapara	Cará S João roxo	Green Pur	5	Brown	Pur white
38	328	Iguape-SP	Momuna	Cará São João roxo	Green Pur	5	Brown	White
39	329	Iguape-SP	Momuna	Cará S João branco	Green Pur	5	Yellow	White
40	335	Acorizal-MT	Carumbé	Cará roxo	Green Pur	3	Yellow	Purple
41	336	Acorizal-MT	Carumbé	Cará roxo	Green Pur	3	Yellow	Purple
42	340	Cuiabá-MT	Rio dos Couros	Cará pé de anta	Green Pur	5	Brown	Purple
43	343	Acorizal, MT	Carumbé	Cará branco	Green Pur	5	Yellow	White
44	344	Nobres-MT	Sela Dourada	Cará do Joaquim	Green Pur	5	Yellow	White
45	345	Jangada-MT	Sto. Antônio do Barreiro	Cará roxo	Green Pur	5	Brown	Pur white
46	350	Nobres-MT	Sela Dourada	Cará branco	Green Pur	5	Brown	Pur white
47	351	Nobres-MT	Sela Dourada	Cará mão de anta	Green Pur	5	Brown	White
48	352	Rosário Oeste-MT	Timbozal	Cará mão de anta	Green Br	5	Brown	Purple
49	355	Acorizal-MT	Chapada Vacaria	Cará roxo	Green Pur	5	Brown	Purple
50	361	Nobres-MT	Sela Dourada	Cará roxo	Green Br	5	Brown	Purple
51	364	Rosário Oeste-MT	Barranco Alto	Pombinho branco	Green Pur	5	Brown	Purple
52	366	Nobres-MT	Sela Dourada	Cará roxo cumprido	Green Pur	5	Brown	Purple
53	368	Rosário Oeste-MT	Barranco Alto	Cará roxo	Green Pur	5	Brown	Pur white

[1] Green brown (Green Br), Green purple (Green Pur).

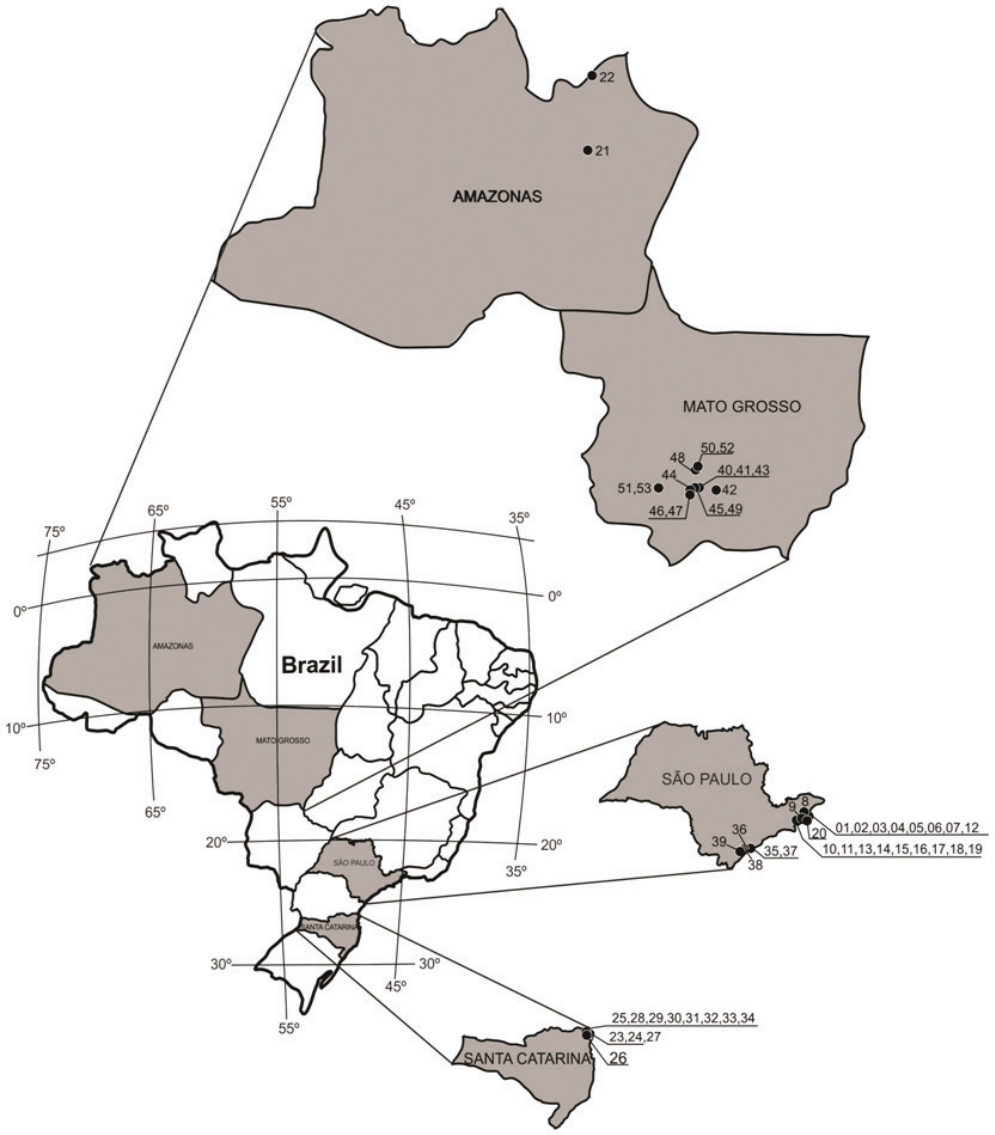

Figure 1. Collection sites of *Dioscorea trifida* in Brazil. Accession numbers are identified in Table 1.

Table 2. Morphological traits used for characterization of the *Dioscorea trifida* accessions collected in Brazil.

Descriptors	
1. Petiole color	7. Position of leaves
2. Stem color	8. Leaf shape
3. Absence/presence of wings in the stem	9. Number of lobes
4. Absence/presence of spines in the stem	10. Absence/presence of underground tubers
5. Twining direction	11. Tuber skin color
6. Stem shape	12. Tuber flesh color

3. Results and Discussion

3.1. Distribution and socioeconomic aspects

A total of 53 accessions of *D. trifida* was collected, with 25 accessions from São Paulo State, 14 from Mato Grosso, 12 from Santa Catarina and two accessions collected in markets of Amazonas State (Table 1).

D. trifida is considered an underutilized species and is maintained mainly by small and medium size farmers. Thus, a socioeconomic characterization was necessary at the time of collection in order to acquire data to assist in the profile of these farmers. Of the interviewed farmers, responsible for the maintenance of agricultural activities related to the yam cultivation, 75% were men and 25%

women. The mean age was 59.5 years old ($40 \leq n \leq 79$), with 62 years for the women, on average, and 59 years for the men, on average.

Unlike the early days of agriculture, where men were responsible for hunting and fishing, and women for planting and harvesting, currently it is observed that most of those responsible for agricultural activities are male, although all family members are involved. This is because activities related to agriculture are very laborious, with a low financial return, and therefore, the cultivation of yam is characterized by low involvement of women in field activities (Tamiru et al., 2008).

Similarly, there is a reduced number of young people and labor available for agricultural activities, with only an average of three individuals per farm the amount of people involved in activities related to the cultivation of yams. As yam is a subsistence agriculture crop maintained by the family, only family members, usually over the age of 50 years, are involved in these activities. According to Carneiro (2001), this condition becomes a problem because the maintenance of family farming occurs in an endogenously way, subsided by the community, with the successor of a productive unit traditionally being a family member. Therefore, the reduction in the number of young people and scarcity of labor may result in reducing this type of agriculture over the next generations.

The productive units, where *D. trifida* cultivation was observed, showed swidden fields with less than two hectares (92%), with its plantation intercropped with other species, especially vegetables, in most cases. According to Miller and Nair (2006), swidden fields are of fundamental importance for the conservation of yam varieties, as well as various other crops, since a high biodiversity, with multiple purposes for the farmers, is maintained at these sites (Smith, 1996).

In relation to the varieties grown by the visited farmers, 44% said they had acquired from predecessor family members living in the collection site, the planting being carried out with tubers derived from materials obtained some decades ago and which were passed down the generations; 40% stated they grow varieties provided by neighbors and 16% did not know the origin of the material. As there is no formal system for the supply of seed tubers, varieties of *D. trifida* grown in these areas are kept for decades and these are exchanged between local farmers, with a low incidence of introduction of new varieties from other areas. These data corroborate the studies reported by Tamiru et al. (2008), which also noted that in Ethiopia there was no formal system for the supply of yam tubers, as well as farmers specialized in producing materials for planting.

During the collection and subsequent identification of the material in the greenhouse, we observed that sprouted tubers sometimes belonged to other species of *Dioscorea*, particularly *D. alata* (Siqueira et al., 2014). It was also observed that 56% of the farmers cultivate only one variety of *D. trifida*, unlike other species of vegetative propagation, such as cassava (*Manihot esculenta*), potato (*Solanum tuberosum*), sweet potato (*Ipomoea batatas*) (Brush et al., 1981; Salick et al., 1997; Sambatti et al., 2001; Emperaire and Peroni, 2007; Amorozo, 2008; Veasey et al., 2008), where it is customary to keep two or more varieties in the same farm. This decrease in the number of yam varieties maintained by farmers is worrisome because it is directly related to the loss of genetic resources and the process of genetic erosion. However, in general, we found several varieties of *D. trifida* maintained by farmers located in the study areas, which characterizes the type of agriculture practiced in the tropics, where several crop species or varieties of the same species are kept in rural farms by small and medium farmers (Clawson, 1985; Brush, 1995), in response to economic, social, cultural and natural factors (Cox and Wood, 1999).

Moreover, it was also observed that 44% of farmers plant more than one variety of *D. trifida*. This procedure aims to give greater assurance of harvest, because if some biotic and abiotic stress may interfere with planting, all varieties are hardly affected in the same intensity, thus increasing the probability of obtaining a production that guarantees at least the family sustainability during adverse conditions.

The loss of genetic resources was also observed when 96% of the farmers claimed to have planted yam varieties that are no longer planted in the property. The main reasons listed by the farmers were abandoning the fields in order to obtain employment in urban areas, thus ensuring a source of income to support their family; changes in the physicochemical conditions of the soil, leading to the emergence of diseases in the crop, and consequently the total loss of the crop; preference of a variety over others; reduction of manpower available to carry out the activities of preparation, planting and harvesting; poor land distribution, heavily reducing the area available for agricultural activities; lack of information regarding the proper management of the crop such as diseases and pests management, allowing large losses of tubers at harvest time; as well as increased production costs, low returns and lack of financial incentive to encourage the practice of family agriculture.

When farmers continue their activities in the field and keep the varieties of *D. trifida* in successive cycles of planting and harvesting, they perform several agricultural practices in order to increase the production of tubers. Among these practices, we observed the use of herbicides and organic or chemical fertilizers. However, significant differences in the mode and frequency of application of these inputs among the visited areas were found, where only farmers in Santa Catarina reported using some type of agricultural implement. This fact is relevant because we noticed that farmers in Santa Catarina are better prepared in terms of management given to the yam cultivation, which justifies the production of up to 2,500 kg of yam obtained in some properties with an area above 2 ha, the highest production found among the areas visited. This production is also related to the fact that the tubers of *D. trifida* are greatly appreciated by producers and consumers in the

region, rather than tubers of *D. alata* and *D. cayenensis*, species of greatest economic impact in Brazil. Also, tubers of *D. trifida* were found being sold in a local supermarket, as well as being served in a typical restaurant of the region (Veasey et al., 2010). This species also has a commercial interest in the Amazon, being the main species of the genus *Dioscorea* sold in local markets (Lin Chau Ming, personal communication), such as the two accessions of the Amazon evaluated in this study.

As yam is considered an underutilized and subsistence crop, it is quite remarkable the lack of information related to its management and potential use, as emphasized by the farmers themselves, as well as the delay in the processing of yams in Brazil. These factors are reflections of a malfunction of the activities related to agricultural production and also lack of consumption diversification (Chu and Figueiredo-Ribeiro, 1991).

In other parts of the world, such as Africa and Asia, although substantial consumption diversification occurs, especially through the use of significant industrial or homemade yams products, the technological level is low and the products produced do not exceed the boundaries due to poor quality, being used only for local consumption or at a regional level. Santos (1996) stated that for the yam cultivation to reach high yields, it requires favorable climate conditions during the vegetative and reproductive cycle, especially adequate availability of light and water. However, the most limiting factors for yam cultivation are associated with low natural fertility of the soil used and improper management directly related to the small family and traditional agriculture (Chu and Figueiredo-Ribeiro, 1991). Thus, the availability of yam for industrialization in Brazil is not very significant because there is no definition of the types of products most recommended to then select varieties appropriate for each situation or market requirement. Therefore, the local interest of the farmers themselves is the main factor of selection and the driving force for the maintenance of yam varieties, especially *D. trifida*, whose cultivation and maintenance are performed exclusively by Brazilian farmers and some other Latin American countries such as Suriname and French Guiana (Bousalem et al., 2010).

3.2. Folk names and morphological characterization

The yam varieties found under cultivation are given different names by the local communities, which consider a combination of morphological, sensory and ecological adaptation to classify them, and perhaps these are the main criteria used to select varieties that are maintained over time (Tamiru et al., 2008). Contrary to what Stephens (2009) claims, where *cará doce* (sweet yam) is the only name given to *D. trifida* in Brazil, in this study we found that, among the folk names attributed to the species, the most mentioned was *cará roxo* (purple yam) (43.4% of the sampled units), followed by *cará* (yam) (13.2%), *cará branco* (white yam) (9.4%), and *cará mimoso* (delicate yam) (7.6%). There was also a regionalization of these names, where *cará roxo* was assigned to the species by the farmers in São Paulo, Mato Grosso and Amazonas, *cará* in Santa Catarina and Amazonas, *cará branco* in São Paulo and Mato Grosso, and *cará mimoso* only in Santa Catarina. Besides these, several other names for the species were found, but in low frequencies (Table 3).

From the morphological characterization, we found that all accessions of *D. trifida* showed green petioles with brown pigment; polygonal winged stem, a specific feature of climbing plants, because the presence of membranous wings on the stem facilitates their attachment during growth; absence of spines, unlike *D. cayenensis* and *D. rotundata*, widely cultivated species, especially in the northeastern and southeastern Brazil (Veasey et al., 2010); counterclockwise twining direction, exclusive of the *Dioscorea* species of Macrogynodium section, in which *D. trifida* is the only economically important species (Lebot, 2009); and underground tubers, like most species of the genus *Dioscorea*.

All accessions showed lobed leaves and most accessions presented alternate leaves with five lobes, except for accessions 40 and 41 collected in Acorizal, Mato Grosso, who showed only three lobes (Figure 2a and 2b). These could belong to another *Dioscorea* species, however due to its high morphological similarity to the other accessions, most probably these two accessions are products of gene mutation related to number of lobes.

Most accessions showed green stems with purple pigments, except for accessions 01, 02, 03, 07, 09, 10 and 14, collected in Ubatuba, São Paulo, and accessions 48 and 50, collected in Rosário do Oeste, Mato Grosso, which showed green stems with a brown pigmentation. Bressan (2005) concluded that the cultural unit, which is the community, have a great influence over the morphological characters, since farmers grow varieties with similar morphological aspects.

Table 3. Folk names for *Dioscorea trifida* given by farmers in the States of Mato Grosso, Santa Catarina, São Paulo and Amazonas, Brazil.

Folk name	(%)	Number of citations by State			
		MT	SC	SP	AM
Cará roxo	43.40	7	-	15	1
Cará	13.20	-	6	-	1
Cará branco	9.43	1	-	4	-
Cará mimoso	7.55	-	4	-	-
Cará São João branco	3.77	-	-	2	-
Cará São João roxo	3.77	-	-	2	-
Cará mão de anta	3.77	2	-	-	-
Cará pão	1.89	-	1	-	-
Calcanhar de negro	1.89	-	1	-	-
Cará pipa	1.89	-	-	1	-
Cará pé de anta	1.89	1	-	-	-
Cará do Joaquim	1.89	1	-	-	-
Pombinho branco	1.89	1	-	-	-
Cará cobrinha	1.89	-	-	1	-

The most important traits for the accessions differentiation were those related to the tuber, especially the skin and flesh colors (Figures 2c, 2d, 2e and 3). We found that 68% of the accessions had brown skin and 32% yellow skin. As to the flesh color, 42% of the accessions showed white flesh, 24% purple flesh and 34% showed flesh color of a mixture of several tonalities of white and purple, especially the accessions collected in Ubatuba, SP (Figure 2d). Characteristics related to the tubers are usually responsible for the names given to the different yam varieties by farmers, such as *cará roxo* (purple yam), *cará branco* (white yam), among others.

Because it is a vegetative propagation species and maintained primarily by family farms, some degree of homogeneity is expected among these varieties, as indicated by morphological characterization, although variations between them have been observed. However, the exchange of tubers among farmers is common practice in traditional communities. In many cases, there is an intense exchange of tubers from neighboring communities in an open and dynamic system, where local networks promote the planting of varieties in larger and more heterogeneous environments, often resulting in long-distance travelling, even among municipalities (Tesfaye and Lüdders, 2003).

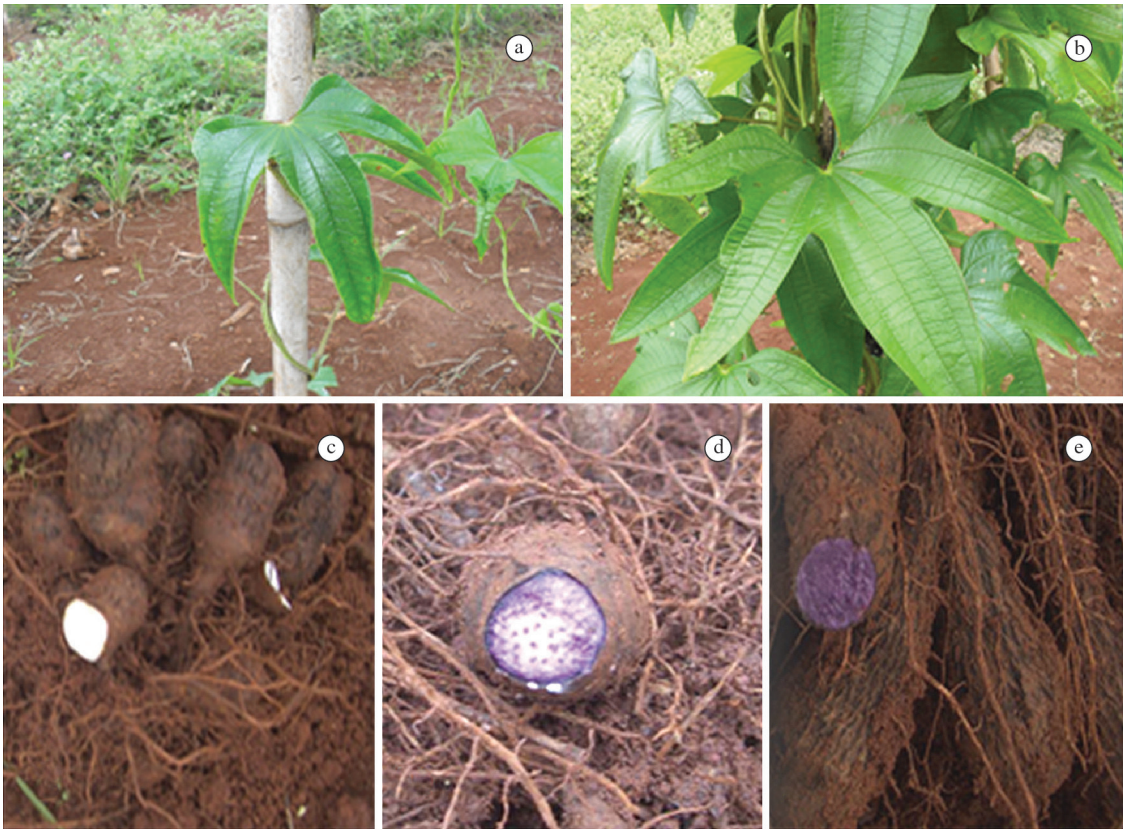

Figure 2. Morphological aspects of leaves and tubers of *Dioscorea trifida* collected in Brazil. a) leaves with three lobes; b) leaves with five lobes; c) tubers with white flesh; d) tubers with white and purple flesh; e) tuber with purple flesh.

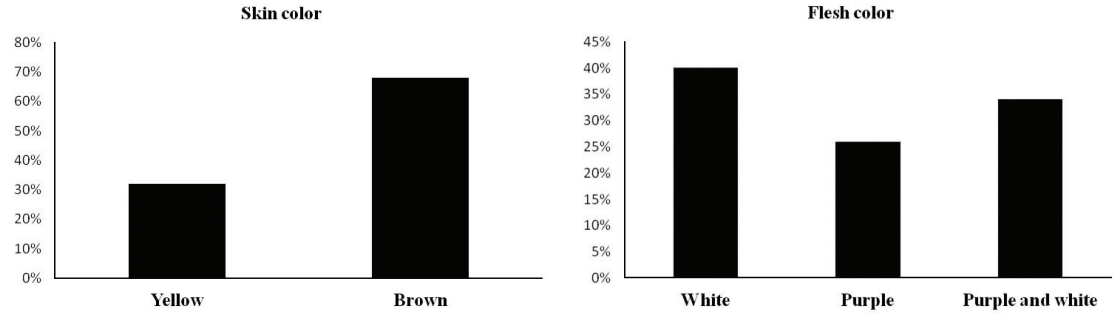

Figure 3. Frequencies for skin and flesh color of *Dioscorea trifida* tubers collected in Brazil.

We conclude from this study that *D. trifida* is grown and consumed by traditional communities in the States of São Paulo, Santa Catarina and Mato Grosso, and is commercialized in the States of Amazonas. In most of these communities there is no formal system for the supply of seed tubers, with tubers exchange occurring among local farmers, and, consequently, a low rate of introduction of new varieties from other areas is observed.

Deficiency and lack of information related to management, potential uses and yam industrialization in Brazil are a reflection of inadequate functioning of the activities related to agricultural production and lack of consumption diversification, both caused by the lack of political and financial support for the maintenance of a production system, processing and marketing of tubers.

Given the importance of this crop and the socioeconomic context in which *D. trifida* cultivation is inserted, there is an urgent need to detect the genetic diversity of the species held by Brazilian farmers, to facilitate their preservation, as well as their use in breeding programs. Studies that relate the problems faced by the yam crop may enhance the role that this crop plays in food security and ensure the ongoing maintenance of yam diversity through an increased use of varieties available.

Acknowledgements

The authors would like to thank the researchers José Carlos Feltran from Instituto Agronômico and Antonio Henrique dos Santos from Epagri, Santa Catarina, as well as Danielle Muniz da Silva and Caroline Groppo Blumer, for their assistance in this research and the agriculturists for their contributions in the field collecting and interviews. The authors also wish to thank FAPESP (process no. 2007/04805-2) and CNPq for the financial support given to this study.

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