

Geographical distribution and conservation of Cucurbita in Brazil

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Abstract: The collection and conservation of the Cucurbita genus in Brazil happened in so dispersed institutions, an assessment of the storage conditions and the genetic diversity is needed, making it possible to identify new priorities for the genus. This work constitutes diagnosis of geographical distribution, storage conditions *in situ* and *ex situ* and on genetic diversity of the Cucurbita genus in Brazil. Research was done in herbariums, databases, literature and *in situ* (expeditions to rural areas and markets) to map the areas of occurrence of the species. During these expeditions, questionnaires were applied to obtain information about the property and genus *Cucurbita*. Questionnaires were sent to 173 Brazilian institutions regarding the preservation conditions *ex situ*. A genetic variability of the *Cucurbita* genus was found in traditional Brazilian agriculture. Collections must be prioritized in the northern and southern regions (all states); the southeastern region, all states, except Minas Gerais; central-west, in Mato Grosso do Sul and Mato Grosso; the northeastern region, the states of Alagoas, Maranhão, Paraíba, Pernambuco, Piauí and Sergipe. Currently 5.545 entries are being conserved in the Germplasm banks, however, *C. pepo*, *C. ficifolia*, *C. argyrosperma* and wild species are poorly represented. The characterization level of conserved entries is low in the *ex situ* collections. Participative research projects must be financed as a way to stimulate the farmers to continue planting their local varieties.

Key words: Pumpkin, Genetic resources, Preservation

Distribuição geográfica e conservação de Cucurbita no Brasil

Resumo: A coleta e conservação do gênero *Cucurbita* no Brasil aconteceu de forma dispersa pelas instituições, sendo necessário um diagnóstico sobre as condições de conservação e sobre a diversidade genética, tornando possível identificar novas prioridades para o gênero. Este trabalho realizou diagnóstico sobre distribuição geográfica, condições de conservação *in situ* e *ex situ* e sobre diversidade genética do gênero *Cucurbita* no Brasil. Para mapear as áreas de ocorrência das espécies, foram realizados levantamentos de informações em herbários, banco de dados, literatura e levantamentos *in situ* (expedições para áreas rurais, feiras livres e CEASAs). Nessas expedições foram aplicados questionários, buscando informações sobre a propriedade e o gênero *Cucurbita*. Em relação as condições de conservação *ex situ*, foram enviados questionários para 173 instituições brasileiras. Foi constatado que existe variabilidade genética do gênero *Cucurbita* na agricultura tradicional brasileira. Devem ser priorizadas coletas nas regiões Norte e Sul (todos os estados); região Sudeste, todos os estados, exceto Minas Gerais; região Centro-Oeste, no Mato Grosso do Sul e Mato Grosso; região Nordeste, os estados de Alagoas, Maranhão, Paraíba, Pernambuco, Piauí e Sergipe. Atualmente estão sendo conservados nos Bancos de Germoplasma 5.545 acessos, no entanto *C. pepo*, *C. ficifolia*, *C. argyrosperma* e espécies silvestres estão pouco representadas. É baixa a taxa de caracterização dos acessos conservados nas coleções *ex situ*. Devem ser financiados projetos de pesquisa participativa como uma forma de estimular e dar condições aos agricultores de continuarem cultivado suas variedades locais.

Palavras chave: Abóbora, Recursos genéticos, Conservação

Introduction

The species of the genus *Cucurbita*, of the *Cucurbitaceae* family, are native to the Americas and were part the Olmeca civilization's food chain, later incorporated by the Aztec, Inca and Maya civilizations. Archeological data associate these species with man for, at least, 10.000 years (Saade, 1995). According to Whitaker and Bemis (1976) men introduced a selective process based on non-bitter pulp mutants, which gave origin to domesticated species, in the pre-Columbian period.

The genus *Cucurbita* is formed by 24 species of which five are cultivated (*Cucurbita argyrosperma*, *Cucurbita ficifolia*, *Cucurbita maxima*, *Cucurbita moschata* e *Cucurbita pepo*) (Ferreira, 2008). Various cultivated and wild species represent part of various aspects of human life and are fundamental in the human diet because of the culinary versatility and richness in carotene, iron, calcium, magnesium, potassium and vitamins A, B and C. The fibers also contain bioflavonoids, blockers of the cancer-stimulating hormone receptors and steroids that are transformed into vitamin D in the organism and stimulate cellular differentiation (Batra & Sharma, 2013). Furthermore, the genetic diversity is great in the Americas where these species are found in many different colors, textures, forms, sizes and

tastes. Such facts emphasize the importance of genetic resources of the genus *Cucurbita* for agriculture and food safety.

In Brazil, the species of the *Cucurbita* genus, especially *C. moschata* and *C. maxima*, were part of the nourishment of the native peoples before their discovery and colonization. Including the word pumpkin of tupi origin meaning "dark neck" is maintained until today in the traditional varieties denominated as jandaia pumpkin, caboclo pumpkin and milk pumpkin (Ramos, 2003). Therefore such species surely already are part of the Brazilian genetic patrimony having been domesticated for thousands of years and being cultivated until today in various regions. The diversity of these species in Brazil is represented by the traditional varieties cultivated by traditional farmers. Harvesting of pumpkin cultivated in traditional growing areas in the Northeast of Brazil, with previous characterization and evaluation, permits detecting a great variety with regard to morphological characteristics of the plant and the seeds (Queiroz, 1998). Specifically for *C. moschata*, the variety is not local, but dispersed in different places in the Northeastern region, as shown by Ramos (2003) from the studies with AFLP markers. This diversity has been related to the growing system and to the handling of the seeds practiced by the traditional communities (Ramos et al., 2007 & Ramos et al.,

2008).

In terms of preservation of germplasm, in Brazil there are basically five collections located at Embrapa Temperate Climate, Embrapa Vegetables, Embrapa Semi-arid, Agronomy Institute of Campinas and at the Federal University of Viçosa (Mariante et al., 2009). Besides these, there is also the Base Collection maintained at Embrapa Genetic Resources and Biotechnology, whose main objective is to make the long-term preservation of germplasm possible. However, such Germplasm Banks were established as individual routes and there has never been an opportunity for all those involved in these studies to share the available information, a way to systematize what exists, and to establish a handling strategy of the genetic resources from this point for the genus *Cucurbita* in the country.

Because of this, to make it possible to define and prioritize new collection areas and preservation strategies and use existing genetic diversity, it is necessary to have a broad panorama covering the areas of occurrence of these species, as well as existing *ex situ* collections in terms of areas where collections have already been done, the number of collected accessions, the conditions in which these collections are maintained and the existing preservation conditions in traditional agriculture in various parts of the country (*on farm* preservation), among other information.

Apart from the fact that the collection process can appear to be a simple activity with previously established rules, its execution requires previous studies, among which the definition of potential areas for the collections at the stage called prospecting or pre-harvesting (Valois et al., 2001). The objective of the present study was to establish a diagnostic about the geographical distribution, the preservation conditions *on farm* and *ex situ*, as well as the genetic diversity of the genus *Cucurbita* in Brazil.

Material and methods

Preservation conditions of herbarium specimens and distribution of species in Brazil.

Various studies of information in herbariums, databases and literature, as well as *in situ* analysis of the areas of occurrence and construction of distribution maps of the species,

were carried out to map the areas of occurrence of the species of the genus *Cucurbita*.

The major herbaria and databases of Brazilian research and educational institutes were consulted using questionnaires to evaluate the information, apart from a bibliographical revision to obtain other information. Hundred and twenty eight questionnaires were sent to Brazilian herbaria.

The distribution maps of the species and of the populations were elaborated at the Geoprocessing Laboratory of Embrapa Genetic and Biotechnological Resources, based on geographical location data of the aforementioned items (passport data of germplasm banks and expeditions to evaluate information). The geographical coordinates (latitude and longitude) were matched in Geographical Information System (SIG) with digital environmental maps of Brazil characterizing the ecogeographical regions of occurrence of the species.

Preservation conditions *on farm* and variety of fruits

To carry out the evaluation of information in the areas of occurrence of the species of the genus *Cucurbita*, as well as the preservation conditions *on farm*, expeditions were organized in rural areas and street markets of the following states: Alagoas, Bahia, Ceará, Espírito Santo, Maranhão, Mato Grosso, Minas Gerais, Pernambuco, Rio Grande do Norte, Sergipe and Tocantins. No expeditions were organized for the southern region because of the stored data were already available in the Active Germplasm Bank of Cucurbitaceae of Embrapa Temperate Climate. In the northeastern region only two states were not visited, Paraíba and Piauí, because of the information stored in the Active Bank of Cucurbitaceae of Embrapa Semi-arid. During the expeditions, questionnaires containing questions related to type and size of the property, natural occurrence of cucurbits and intercropping or cropping close to other cucurbits and/or other crops were used, besides the questions related to the genus *Cucurbita*: cultivated species, popular name, type of population, use, origin of seeds, size of the area and planting season, size of the cultivation area, format and standard color of the fruit skin, color of the pulp, type of sowing, use of irrigation and chemical fertilizer, insect and disease control, stocking methods of seeds, place of commercialization of the fruits.

Preservation conditions *ex situ*

To analyze information and previous evaluations and diagnostics of the preservation conditions *ex situ*, 173 questionnaires were sent to Brazilian institutions. These questionnaires were composed of questions related to information about the institution, about the curator for the Germplasm Bank or Collection and team, accession information (species, number of accessions/species, number of accessions with collection expeditions, number of characterized and evaluated accessions). Besides these questions, information was also requested about the collection expeditions, descriptors used in the characterization and the evaluated characteristics. In relation to the Germplasm Bank of Collection, the question was posed if any collections had been realized in Brazil; what were the maintenance conditions of the germplasm; if the same is maintained in duplicate; if it is multiplied and regenerated and how the information register is done. Furthermore, the question was asked whether the collected and maintained accessions represent the potential area of existence of *Cucurbita* of the collected region; whether the team maintains a relationship or information exchange and accession with other teams; what is the use of the germplasm (family agriculture, participative improvement, pre-improvement, conventional improvement, molecular improvement, preservation *on farm*, others); if commercial cultivars with the use of germplasm have already been released; if further qualification of the team is required; if there is a possibility to install or improve the available infrastructure; what is the future vision for preservation and use of genetic resources; what is the opinion about establishing strategic and innovative germplasm collections such as DNA and cDNA collections, of characters, etc. Specific information about each accession, such as origin, location, municipality and state of the collection, was also requested.

An inventory of the incorporation processes of *Cucurbita* germplasm was done in Collection Base Germplasm Seeds [COLBASE], together with the Brazilian System of Genetic Resources Information (ALELO), to evaluate the information

of the COLBASE at Embrapa Genetic Resources and Biotechnology. This inventory consisted of the analysis of information relating to the number of incorporated accessions/year, its origin and results of monitoring the viability of the seeds, carried out according to the Rules for Seed Analysis (Brazil, 1992).

Results and discussion

Preservation conditions of herbarium specimens and distribution of species in Brazil

Only 26 out of 128 herbaria (22,7% in total) filled out to the questionnaires that were sent out all over Brazil. Six of these were from the state of São Paulo, four from Pernambuco, three from Minas Gerais, and from Rio de Janeiro, Pará and Rio Grande do Sul two questionnaires were returned from each state, whereas from the Distrito Federal, Espírito Santo, Mato Grosso do Sul, Mato Grosso, Piauí, Paraná and Rondônia only one questionnaire from each state was received. Only 15% of the responsible curators dedicated themselves exclusively to the herbaria, while the rest fulfill other functions divided mainly between teaching, research and administrative tasks. About 42% of the curators dedicate between 20% and 50% of their time to herbarium activities, while 19% dedicate less than 20% of their time, 19% dedicate between 50% and 80% and the rest dedicate more than 80% of their time to herbarium activities. In terms of training, 81% confirmed having received specific training, but indicate the necessity for further training and qualification. In these herbariums 41 specimens of the genus are maintained, being two *C. maxima*, 11 *C. moschata*, 18 *C. pepo* and 20 other species or non-identified species. Such specimens were retrieved from all Brazilian regions, which indicates that these are distributed throughout the national territory (Figure 1). The analysis of the passport data of the maintained accessions in Germplasm Banks corroborates this fact because there also are collection registers in all Brazilian regions (Figure 2).

Figure 1 - Collection locations of *Cucurbita* specimens in Brazil.

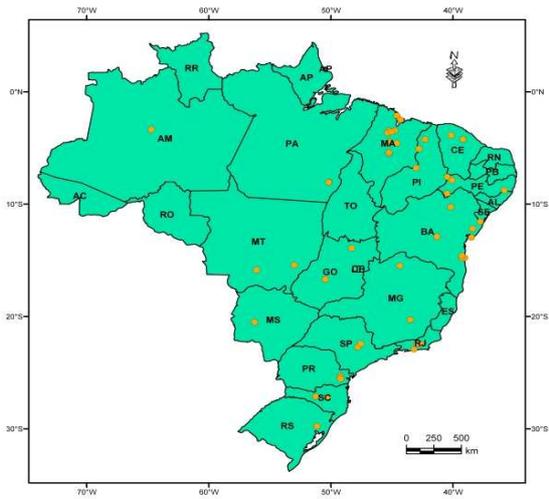
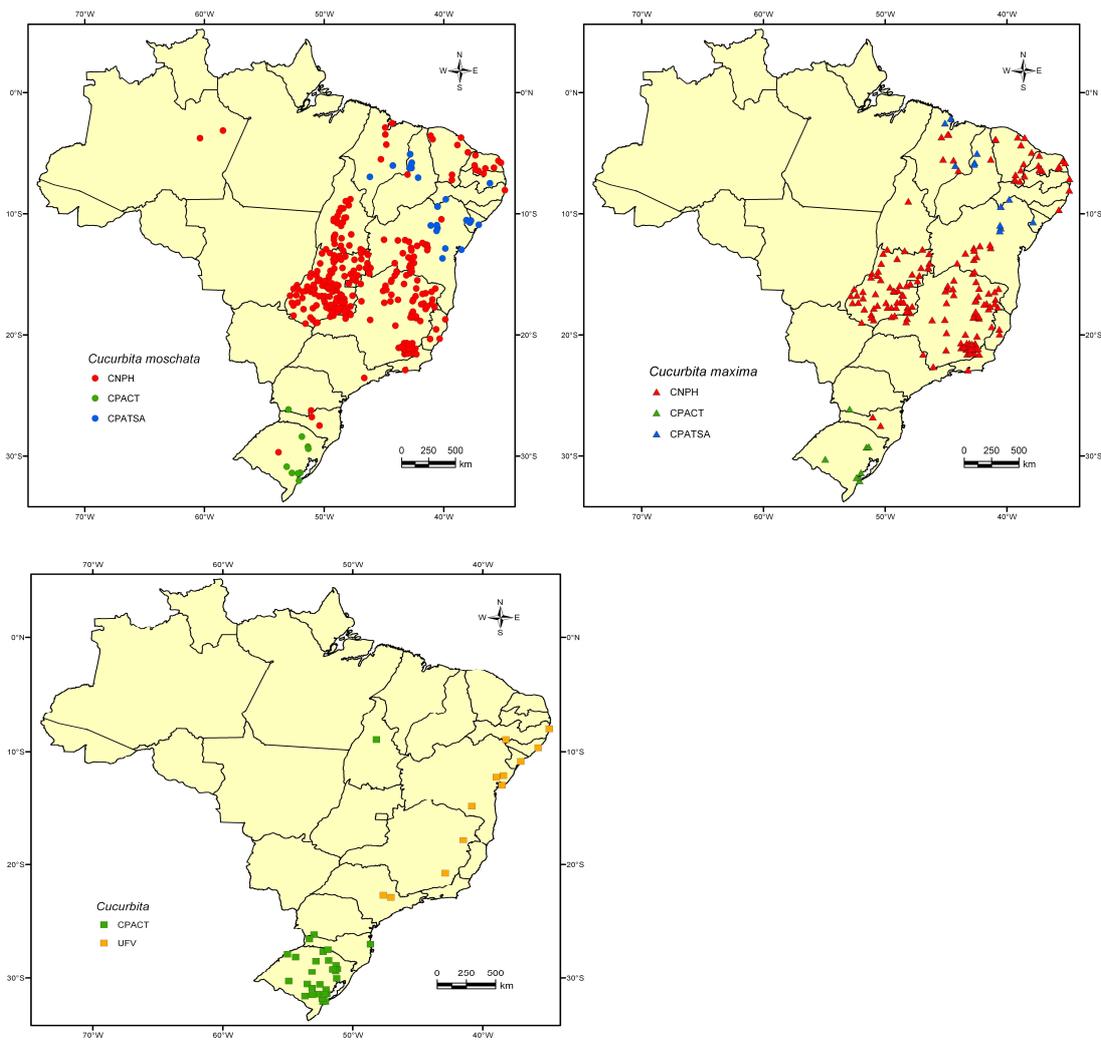


Figure 2 - Collection locations of *Cucurbita moschata*, *Cucurbita maxima* and *Cucurbita* specimens in Brazil.



Analysis of the map (Figure 1) shows that collections have been done in practically all the *Magistra, Cruz das Almas – BA, V. 27, N.3/4, p.422-432, Jul./Dez.2015.*

northeastern states with the exception of Alagoas, Paraíba and Rio Grande do Norte, while neither in Espírito Santo in the southeastern region, nor in the state of Tocantins in the central-west, is there a specimen herbarium. In the northern region there is only one register in the state of the Amazon. It suffices to say that based on the registration notebooks of collections from Embrapa Genetic Resources and Biotechnology no expeditions were organized, neither for specific collections of the genus *Cucurbita*, nor for Cucurbitaceae. The collections were realized in a sporadic manner during expeditions destined for the collection of other species. Even data from other herbaria show this fact, due to the reduced number of specimens maintained in national herbaria. Therefore this map does not represent the real situation of occurrence of species of this genus in the country, apart from the fact that the large-scale distribution of the genus *Cucurbita* is evident. In relation to the information of registration methods, 4% use notebooks, 23% computerized databases, 23% non-computerized databases and 4% use other methods (such as ledgers). However, some herbaria make combined use of data registration methods with 12% using notebooks and non-computerized data and 19% using notebooks together with computerized data, while the rest combine notebooks, computerized databases, non-computerized databases and other methods. Only 23% of the herbaria have already published catalogues of the information registers. In terms of available infrastructure for herbarium activities, the majority mentioned the limited availability of space and the bad conditions of preservation cabinets. This evaluation managed to show the existing gap in the publishing of information generated by the herbaria, the little importance that is given to maintenance of the herbarium's infrastructure, as well as the dedication of the curators who, in the majority of cases, are divided between the herbarium and other activities. The reduced quantity of herbarium specimens of the genus *Cucurbita* maintained in national herbariums is another aggravating factor.

In relation to the locations where germplasm collections of the genus *Cucurbita* were carried out by Embrapa Temperate Climate, Embrapa Vegetables, Embrapa Semi-arid and the Federal University of Viçosa, it was shown that the most collected species were *C. moschata* and *C. maxima* (Figure 2). The largest part of the

collections was carried out in the southeastern and central-western regions with the largest concentration being in the states of Minas Gerais and Goiás. However, Embrapa Temperate Climate also carried out collections in the southern region with large concentrations in Rio Grande do Sul and Embrapa Semi-arid in the northeastern region of the country. The necessity of further collection expeditions in the central-eastern (all states, except Goiás) and north (all states) is evident.

Preservation conditions on farm and fruit variability

The most cultivated species was found to be *C. moschata* because the majority of farmers plant local varieties that have been conserved for decades and that were passed on by members of family, friends and neighbors. The producers generally make a selection of their own seeds. This is what happens for example in the north of Espírito Santo and in the south of Bahia where fruit seeds called "male" and "female" are separated in the proportion of 1:9 and these seeds are stocked in different recipients (plastic bottles, glass, calabashes, etc). There is a tradition to maintain the seeds mixed, from both different landraces and other cucurbitaceae, together with ashes or sand.

The planting of pumpkins is normally done intercropped with various crops, yearly or perennial. The majority of crops are used for family consumption while selling the excess in street markets, regional markets and selling points along the roads. Planting in larger areas (5-8 ha) was also verified where commercialization is normally done through middleman at whole sale Supply Centers (CEASAs). A great variety was found in terms of the standard of the fruit: size (varying from very large to very small), format (varying from round to elongated and with and without necks), the fruit skin (various types) and the color of the pulp (very intense orange and very light orange).

It was found that species of the genus *Cucurbita*, especially *C. moschata*, show wide distribution in Brazil and that traditional varieties have been conserved for decades by small and medium producers, which characterizes the occurrence of conservation *on farm*, since these varieties are cultivated, consumed and often commercialized. However, it was also found that the local varieties are threatened with extinction because of different factors, as is happening in Maranhão where the policy is in place to

substitute these varieties by soybean and eucalyptus, and in Espírito Santo, where it is recommended to eradicate all plants of Cucurbitaceae by large-scale cultivation of papaya, keeping in mind that these host plants are carriers of the PRSV-w ringspot virus. To avoid genetic erosion of the traditional varieties it is fundamental to realize a collection of this germplasm to preserve it *ex situ* under appropriate conditions. Another strategy to favor the preservation and the sustainable use of the genetic diversity is to promote the development of participative research with the farmers to guide and educate them in the preservation of seeds, the production system and how to aggregate value to their products. It is also recommended to include activities of participative improvement by orientating the farmer on how to select the material over generations.

Preservation conditions *ex situ*

Six institutions responded the questionnaire to ascertain preservation conditions *ex situ*: Embrapa Temperate Climate, Embrapa Vegetables, Embrapa Semi-arid, the Agronomy Institute in Campinas, the Federal University of Viçosa and the Agropecuary Research and Rural Extension Company of Santa Catarina. All these institutions used the place of collection, the popular name and the characteristics of the fruit as passport data in collection expeditions of germplasm. However, the Agropecuary Research and Rural Extension Company of Santa Catarina also uses with its passport data information on the origin of the seeds and the types of property. Botanical and morphological descriptors are the most used for the characterization of the germplasm. To evaluate accessions, the most cited characteristics were format and size of the fruit, the color of the pulp and the resistance to diseases and plagues. In relation to *ex situ* preservation, all institutions maintain the germplasm conserved under mid-term conditions and only one of them (the Agronomy Institute of Campinas-IAC) maintain germplasm on the short, mid and long-term and none of them maintain specimens in duplicate. The germplasm is not multiplied and regenerated because of lack of financial and human resources. None of the institutions has been able to publish some germplasm catalogues. Only two institutions still

do not have an computerized database to register the generated information. The maintained germplasm is generally used in family agriculture, pre-improvement and conventional improvement. The IAC and Embrapa Vegetables have released commercial cultivars with the 'Exposition' squash and the 'Crown' squash (IAC) and the hybrid Jabras (Embrapa Vegetables). All believe it is necessary to install or to improve the available infrastructure for the Bank or Collection activities and the majority requires training or education in the field of plant genetic resources among their teams. Only the Agropecuary Research and Rural Extension Company of Santa Catarina did not communicate in which locations in Brazil the accessions were collected and that these do not represent the whole potential area of existence of *Cucurbita* in the region.

Embrapa Vegetables is the institution that carried out more collections of *Cucurbita* in Brazil, where 711 accessions of *C. maxima* and 1.621 accessions of *C. moschata* are preserved. Among the species, *C. moschata* (2.340) and *C. maxima* (1.237) were the most collected (Table 1). It was also found that the species *C. pepo*, *C. ficifolia* and *C. argyrosperma* are poorly represented in the collections, which is probably due to the low occurrence in the country, but not a fact that justifies having only seven conserved accessions (the case of *C. ficifolia*). Another alarming fact is the quantity of accessions (494) without identification of the species. In this case, it is necessary that an effort needs to be made to send the specimens to taxonomists specialized in Cucurbitaceae in order to have these species identified. In the same way it is preoccupying that wild species, sources of characteristics of interest, are not being preserved in the Brazilian collections, such as *C. argyrosperma*, *C. maxima* ssp. *andreaana*, *C. pepo* ssp. *fraterna*, *C. pepo* ssp. *texana*, *C. ecuadorensis*, *C. okeechobeensis*, *C. okeechobeensis* ssp. *martinezii*, *C. lundelliana*, *C. digitata*, *C. cordata*, *C. palmata*, *C. foetidissima*, *C. pedatifolia*, *C. scabridifolia* e *C. radicans*. Apart from being species that do not occur in Brazil, they are of fundamental importance to genetic pre-improvement and improvement programs as gene sources for resistance to biotic and abiotic factors.

Table 1 - Origin and number of accessions maintained per institution.

Institution	States Collect	Number of Accessions					
		<i>Cucurbita maxima</i>	<i>Cucurbita moschata</i>	<i>Cucurbita pepo</i>	<i>Cucurbita ficifolia</i>	<i>Cucurbita argyrosperm</i> a	<i>Cucurbita</i>
CNPH	AL	5	0	0	0	0	0
	AM	0	2	0	0	0	0
	BA	29	95	0	0	0	0
	CE	107	76	0	0	0	0
	DF	2	4	0	0	0	0
	ES	1	6	0	0	0	0
	GO	146	658	0	0	0	0
	MA	10	15	0	0	0	0
	MG	267	543	0	0	0	0
	MT	3	2	0	0	0	0
	PE	1	2	0	0	0	0
	PI	1	1	0	0	0	0
	RJ	1	2	0	0	0	0
	RN	101	74	0	0	0	0
	RS	1	1	0	0	0	0
	SC	29	4	0	0	0	0
	SP	1	1	0	0	0	0
	TO	6	135	0	0	0	0
	Total	711	1621	0	0	0	0
CPACT	PR	03	5	1	0	0	29
	RS	44	39	40	7	8	97
	SC	00	0	0	0	0	2
	TO	00	0	0	0	0	1
	Total	47	44	41	7	8	129
CPATSA	BA	32	105	0	0	0	0
	MA	07	13	0	0	0	0
	PB	00	1	0	0	0	0
	PE	03	27	0	0	0	0
	PI	09	43	0	0	0	0
	SE	00	9	0	0	0	0
Total	48	179	0	0	0	0	
IAC	Total	128	155	79	0	0	357
UFV	Total	295	341	1	0	0	0
EPAGRI	Total	8	0	0	0	0	8
Total		1237	2340	121	7	8	494

CNPH = Embrapa Vegetable; CPACT = Embrapa Temperate Agriculture; CPATSA = Embrapa Tropical Semiarid; IAC = Agronomic Institute of Campinas; UFV = Federal University of Viçosa; Cenargen = Embrapa Genetic Resources & Biotechnology; EPAGRI = Enterprise for Agricultural Research and Rural Extension of Santa Catarina.

The Brazilian states in which the collection of *Cucurbita* germplasm should be prioritized are shown in Table 1. In regional terms, it is evident that the priority should mainly be in the northern region since only two accessions of *C. moschata* germplasm have been collected in this region in the state of the Amazon. The second priority should be the southern region where there are only 49 accessions of *C. moschata*, 77 of *C. maxima*, 41 of *C. pepo* and 7 of *C. ficifolia*, with a total of 174 accessions. In the southeastern

region, the states of São Paulo, Rio de Janeiro and Espírito Santo should be prioritized since only nine accessions of *C. moschata* and three of *C. maxima* have been collected. In the central-western region the priority should be Mato Grosso do Sul considering that no accession has been collected in this state and Mato Grosso (only five accessions collected). In the northeastern region, the states of Alagoas, Maranhão, Paraíba, Pernambuco, Piauí and Sergipe, where few accessions have been collected, should be

prioritized. It is important to point out that in some states where no or few *Cucurbita* accessions have been collected, there is a significant presence of traditional communities, such as Indians, descendants of freed slaves and small farmers who usually consume and consequently cultivate local varieties of *Cucurbita* for their own sustenance. However, this fact should also be analyzed when the region for collecting are prioritized due to the genetic diversity maintained by these anonymous guardians.

In relation to the discursive questions, a unanimous answer was the necessity to save the local varieties still existing in the country because of the great genetic erosion that occurs over time. Another fundamental point is that the financial support for activities of genetic resources has reduced over the past few years and it is necessary to have a financial support source to maintain the germplasm banks and another one specifically to support the characterization and evaluation of the Brazilian cucurbit genetic resources to make the information truly available. In terms of use of genetic resources, the importance for pre-improvement and improvement programs, as well as *on farm* preservation, have been pointed out. The potential of the collected germplasm of Cucurbit spp. in the south of the country for ornamental use, as well as tolerance to cold in materials from the region of Ponta Grossa and Guarapuava has been reported. Another question asked for the opinion on the establishment of strategic and innovative germplasm collections such as DNA and cDNA Collection, Character Bank, etc.

Apart from having pointed out the importance of collections of such a nature, the necessity to prioritize the improvement of infrastructure of existing germplasm banks has also been shown. It is important to clarify that a Characters Bank, for example, has the objective

of ordering the germplasm accessions according to characteristics of interest, such as resistance to diseases, resistance to insect plagues, carotene levels, color of the pulp, etc. Therefore, the greatest necessity is to characterize the germplasm for the characteristics of interest that will permit using them in conventional and participative pre-improvement and improvement programs. In relation to the evaluation carried out in COLBASE, there are 1.338 *Cucurbita* accessions conserved, 60,8% being *C. moschata* and 37% being *C. maxima* (Table 2). The institutions that contribute most to the enrichment of this collection were Embrapa vegetables (50,8% of the accessions of *C. moschata* and 35,5% of *C. maxima*) and the Federal University of Viçosa (47,3% of *C. moschata* and 61,4% of *C. maxima*) (Table 3). It is important to point out that there is a possibility to increase the number of accessions maintained in COLBASE since many of the maintained accessions in the Active Banks of germplasm, under mid-term preservation conditions, still have not been incorporated. The results of the viability monitoring of the seeds of 264 pumpkin and 109 squash accessions indicate that after 10 or 14 years of storage in a cold chamber (-20 °C), the incorporated accessions showed an increase in germination power of 1,9% to 45,6% with the exception of one squash accession that showed a reduction of 1,0% for this parameter. This increase in viability is probably due to the different methodologies used in the initial and final evaluations. Many seeds may have been dormant during the initial evaluation and also fungi present on the stored seeds may have reduced their inoculum potential depending on storage time in subzero temperatures. It can therefore be concluded that these collections are maintained under adequate storage conditions

Table 2 - Accessions of *Cucurbita* conserved in COLBASE.

Species	Number of Accessions Conserved
<i>Cucurbita moschata</i> (Duch.) Duch. ex Poiret	814
<i>Cucurbita maxima</i> Duchesne	495
<i>Cucurbita ficifolia</i> Bouché	2
<i>Cucurbita pepo</i> L.	14
<i>Cucurbita pepo</i> L. var. <i>melo pepo</i> (L.) Harz	5
<i>Cucurbita moschata</i> x <i>C. máxima</i>	5
<i>Cucurbita</i> sp.	3
Total	1338

Table 3 - Accessions and origin of *C. maxima* and *C. moschata* germplasm in COLBASE.

<i>Cucurbita maxima</i>		<i>Cucurbita moschata</i>	
Origin	Accessions	Origin	Accessions
Cenargen	3	Cenargen	7
UFV	126	UFV	93
UFV	68	UFV	41
UFV	44	UFV	110
EPAGRI	5	CNPH	3
UFV	37	UFV	44
CNPH	26	CNPH	41
UFV	29	UFV	97
CNPH	76	CNPH	61
Cenargen	1	-	-
EPAGRI	2	-	-
CNPH	10	CNPH	170
CNPH	64	CNPH	139
CPACT	4	CPACT	8
Total	495		814

UFV – Federal University of Viçosa; CNPH – Embrapa Vegetable; CPACT – Embrapa Temperate Agriculture; EPAGRI – Agricultural Research and Rural Extension Organization of Santa Catarina.

Conclusions

This study shows the existence of a great genetic diversity of the genus *Cucurbita* in traditional Brazilian agriculture and this germplasm must be properly conserved, explored and used.

The priority areas for specimen collections in the northern and southern regions, all states; in the southeastern region, all states, except Minas Gerais; in the central-western region, in Mato Grosso do Sul and Mato Grosso; in the northeastern region, the states of Alagoas, Maranhão, Paraíba, Pernambuco, Piauí and Sergipe.

In terms of preservation *ex situ*, the species *C. pepo* and *C. ficifolia*, as well as wild species are poorly represented in the collections.

The level of characterization accessions of the species being conserved *ex situ* is low. A governmental effort is necessary to improve the infrastructure of the germplasm collections and to hire new staff.

To promote *on farm* preservation, participative research projects have to be stimulated and financed in order to create conditions for farmers to continue cultivating their local varieties.

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