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REVIEW ARTICLE

Brazilian ornamental phytogenetic resources in Embrapa germplasm banks: obstacles and opportunities

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Abstract

Brazilian floriculture is driven by novelties, requiring the constant entry of new products into the market. This situation favors Brazil, which has, in its native flora, unique species in the world and with high potential for rational use for commercial purposes. The Brazilian flora with ornamental potential is little explored, and the use of species is restricted and, often, extractive with consequent genetic erosion. The use of native species from different ecosystems may constitute a future alternative of products for Brazilian floriculture. Despite the large amount of plant genetic resources, there are few initiatives for the conservation and domestication of species and improvement for sustainable use. For this reason, the Brazilian Agricultural Research Corporation (Embrapa) conserves collections of ornamental plants, and the research initiatives of these collections form the Genetic Resources of Ornamental Plants Project. In addition to conservation, it sought, in partnership with other institutions, the characterization and evaluation of the potential use of these species aiming at the completion of products for floriculture. In this way, the materials already characterized and documented make it possible to add value to genetic resources, already maintained. Currently, Embrapa has six ex situ collections of ornamental plants (Tropical species, Bromeliads, Cactaceae and species from the Pampa Biome, Amazonian Orchids and species from Cerrado) and also counts on the genetic variability of banks of other products (Passion fruit, Pineapple, *Paspalum*, Pepper, Pumpkin germplasm banks) that have been evaluating accessions, selecting and registering cultivars for ornamental use.
Keywords: floriculture, genetic resources, landscaping, ornamental plants.

Resumo

Recursos fitogenéticos ornamentais brasileiros em bancos de germoplasma da Embrapa: entraves e oportunidades

A floricultura brasileira é movida por novidades, necessitando da constante entrada de novos produtos no mercado. Esta situação favorece o Brasil que dispõe, em sua flora nativa, de espécies únicas no mundo, e com elevado potencial de aproveitamento racional para fins comerciais. A flora brasileira de potencial ornamental é pouco explorada, sendo restrita e muitas vezes extrativista a utilização de espécies com consequente erosão genética. A utilização de espécies nativas de diferentes ecossistemas pode constituir uma alternativa futura de produtos regionais diferenciados para a floricultura brasileira. Apesar da grande quantidade de recursos fitogenéticos são poucas as iniciativas de conservação e domesticação das espécies e melhoramento, para aproveitamento sustentável. Por esta razão, a Empresa Brasileira de Pesquisa Agropecuária (Embrapa) conserva acervos de plantas ornamentais, e as iniciativas de pesquisa dessas coleções formam o projeto de Recursos Genéticos de Plantas Ornamentais. Além da conservação, buscasse em parceria com outras instituições, a caracterização e avaliação do potencial de uso destas espécies objetivando a finalização de produtos para floricultura. Desta forma, os materiais já caracterizados e documentados, possibilitam a agregação de valor aos recursos genéticos, já conservados. Atualmente, a EMBRAPA possui seis coleções ex situ de plantas ornamentais (Espécies Tropicais, Bromélias, Cactáceas e espécies do Bioma Pampa, Orquídeas Amazônicas e Amarilidáceas do Cerrado) e conta também com a variabilidade genética de bancos com germoplasma de outros produtos (Banco de germoplasma de Maracujá, Abacaxi, *Paspalum*, Pimenta, Abóboras) que vêm avaliando acessos, selecionando e registrando cultivares para uso ornamental.
Palavras-chave: floricultura, paisagismo, plantas ornamentais, recursos genéticos.

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Introduction

Although the domestication of plants began as a function of food production, ornamental species have always been present throughout human history. Today, floriculture is a multi-billion dollar industry, modern and characterized by following fashion trends and constantly demanding new products for its various segments: cut flowers, bulbs, foliage and potted plants and for landscaping (Suprasanna and Jain, 2021).

In Brazil, this segment generates around R$ 11 billion, creating 210,000 direct jobs and 800,000 indirect jobs, involving approximately 8,000 producers in 15,600 ha of cultivated area. The activity is concentrated in the Southeast region of the country, and the state of São Paulo alone represents almost half of the national production (IBRAFLOR, 2022).

The regular offer of standardized, better quality products can supply many markets, causing influence and homogenization of consumption habits. The range of products found in Brazilian retail is limited and practically indistinguishable from North to South of the country. In addition, the "exotic species" are the most produced and marketed in the country, which has been causing a progressive dependence on imports of cultivars (Junqueira and Peetz, 2018). Even Brazilian native species such as anthuriums (*Anthurium* spp.) and bromeliads, have been bred abroad for decades and imported by our national producers.

Some cultivars may have greater adaptability in anthropic ecosystems, which reinforces the repeated use of these synanthropic plants and the consequent biotic homogenization in different urban centers. The exclusive use of exotic plants in landscaping reduces biodiversity at various trophic levels, from reptiles, birds and insects to mycorrhizal fungi (Wilde et al., 2015). The adoption of the same allochthonous repertoire in landscape projects is common in many Brazilian regions, with different soil and climate conditions. The result is often ephemeral or not viable, choosing species from temperate climates in hot and arid regions, for example, will require, at the very least, a much higher expenditure of water and maintenance costs (Junqueira and Peetz, 2018).

The Brazilian flora has several species with recognized ornamental potential for diversified uses as a product (pot plant, cut flower, landscaping, etc.), however their use is restricted and their exploitation is often predatory. In addition to unsustainable extractivism, the expansion of the agricultural frontier, infrastructure works and the occurrence of invasive alien species are among the other causes of accelerated genetic loss (Escandon, 2022).

In addition, we can point out other aggravating factors such as climate change marked by the scarcity of water for irrigation, the advance of urbanization, the emergence or worsening of factors that generate biotic stresses, such as new pests or diseases and abiotic factors such as lack of water and / or groundwater contamination (Escandon, 2022).

Reducing genetic loss can minimize the losses from an economic, social and environmental point of view. The use of native plants enriches landscape projects with the incorporation of alleles related to characteristics of interest, reinforces regional identity, promotes balance and ecological sustainability between autochthonous fauna and flora and decreases maintenance costs due to edaphoclimatic adaptation (Bastos et al., 2020; Escandon, 2022).

Thus, ex situ conservation is a safe, versatile and viable alternative for the preservation of species and their variability. Ex situ collections have a genetic basis that allows the development of more productive cultivars, resilient to climate change, in addition to providing germplasm for reintroduction into nature (Silveira et al., 2018).

Ornamental plant conservation efforts in Brazil, for most target species, are small in relation to the size of the species variability available. These are initiatives carried out, with little investment, in research and teaching institutions, botanical gardens, private collections, cooperatives for agro-industrial activities and family farmers.

Among the main problems observed in the collections, the following stand out: maintenance cost, since most of the collections are in vivo (field, greenhouse and wooden house); inputs and labor requirements and scarcity of breeding programs with ornamental plants in Brazil. The difficulty in transferring the conserved genetic base and the narrow genetic variability for some species, due to the need to work with many botanical families are also common problems.

The genetic resources of ornamental plants conservation at Embrapa is carried out in ex situ germplasm collections, that is, they are kept outside the naturally occurring environment, which aggregate groups of economic importance. There are six Collections: Collection of Bromeliads Germplasm, Cactaceae Germplasm Collection, Orchids Germplasm Collection, Temperate Climate Ornamental Germplasm Collection, Cerrado Ornamental Germplasm Collection and Tropical Ornamental Germplasm Collection, distributed in different regions of Brazil.

Germplasm Collections are sets made up of accessions with variability of current interest and potential for breeding and research, however collections do not need to meet exchange demands or have representation of the genetic diversity of the target species (Azevedo et al. 2019). Depending on the species and its particularities, the collections could be kept in the form of seeds (cold chambers), when these are orthodox or in vitro when the target species is recalcitrant. In both cases they are also kept in fields or nurseries.

In addition to the Collections, whose primary exploitation is ornamental use, Embrapa maintains more than 160 Germplasm Banks of different groups of products, such as cereals; oilseeds, fibrous and legumes; vegetables and condiments; foragers; fruit trees; medicinal, aromatic, dyes and insecticides; forestry; palm trees; roots and tubers, with potential accessions of ornamental interest.

Germplasm banks are collections of genetic resources

made up of accessions, genetically representative of the variability of a target species, family, genus or group, for use in breeding, research and exchange. The systemic activities of a bank are collecting, conservation, characterization, evaluation, documentation, regeneration and exchanging (Paiva et al., 2019). Banks, unlike collections, must meet various operating conditions, such as having passport data available in the corporate database - Alelo (Alelo, 2022).

Steps for conserve ornamental plants genetic resources

To mitigate the threats of genetic loss, expand the supply of valuable native ornamental plants to the floriculture chain and improve collections management, the strategy is focused on some activities. The main activities are: collect plants, prioritizing native species, of greater ornamental value or threatened; characterization/evaluation of species including aspects of ornamental interest; prospect long-term conservation and propagation methods; and document the accessions.

For documentation are used the Alelo Vegetal System, a software for documentation of genetic resources, data and associated information (Alelo, 2022). The corporation also gives support to the management of banks and germplasm collections of other institutions and genetic material to exchange.

Background

Activities involving genetic resources of ornamental plants at Embrapa started, in network projects (National Network of Genetic Resources, in 2003; National Platform of Genetic Resources, in 2009 and Portfolio of Genetic Resources, in 2015). The first organized collections with ornamental species were working collections, created for research purposes. Then others emerged from diagnoses of the occurrence of ornamental species, and then all the collections were aggregated in conservation activities.

The main systemic activities in all collections were enrichment, conservation, characterization and documentation of passport data. Other activities such as agronomic evaluation; selection of promising ornamental materials; elaboration of descriptors; cropping systems and propagation methodologies, were also executed.

In 2014, Embrapa's collections already had more than 800 accessions and, currently, the six germplasm collections established, aggregate groups of economic and ecological importance: Amazonian Orchids, Bromeliads, Cactus, Temperate Climate Ornamentals, Cerrado Ornamentals, Tropical Ornamentals. These collections are located in different regions of Brazil with representatives of the Caatinga, Cerrado, Amazon Forest, Atlantic Forest and Pampa biomes.

The formalization of these collections allowed small collections, maintained for research purposes by local teams, to become a network organized on a corporate platform that kept, until 2021, more than 2,900 accessions documented.

The participation of other teaching and research institutions and companies in the floriculture sector were fundamental for the characterization and agronomic evaluation of accessions, in addition to joining efforts for collection expeditions throughout Brazil.

Tropical Ornamental Flowers Germplasm Collection

This collection is located in Fortaleza-CE. The conserved plants belong to several botanical families of tropical climate, and represent exoticism, vibrant colors, contemporary design and high durability (Figure 1).

"Tropical" species, such as anthuriums and heliconias, became evident in 1998, at a time of high market demand for this niche and little technical information available. Due to its importance, Embrapa Agroindústria Tropical started a Tropical Ornamental Flowers Germplasm Collection focused in targeted valuable or vulnerable species

Currently, the collection has 155 accessions of native species of the Araceae, Heliconiaceae, Zingiberaceae and Costaceae families, and the genus *Anthurium* (70 accessions) is the best represented (Figure 1a-b and 2). Most accessions were collected (118 accessions), in different regions of the country and present a high ornamental potential for the floriculture and plants for indoor use. The plants are kept primarily in vivo, under screens with 50% and 80% and partially in vitro (minimal culture medium) for slow growth.

Morphological characterization is performed using plant descriptors of different botanical species/ families, elaborated and/ or adapted from known agronomic species. Phenological and agronomic aspects (Taniguchi et al., 2018; Campos et al., 2019; Artur et al., 2022), indication of potential use as pot plant, cut flower or landscape (Morais et al., 2017; Maia et al., 2020) are also evaluated.

Many studies of evaluation of germplasm, propagation and cultivation aspects were carried out with the collaboration of institutions such as Instituto Agronômico de Campinas and Universidade Federal Rural de Pernambuco, reinforcing the importance of the interaction with partner institutions (Castro et al., 2018; Loges et al., 2018).

Currently, the research actions are the development of methodologies for long-term conservation, characterization for aspects such as high post-production longevity and low demand for water and maintenance, and the documentation.

Figure 1. a-b) Germplasm Collection of Tropical Ornamental Flowers. c-d) Germplasm Collection of Ornamentals of Temperate Climate. e-f) Bromeliads Germplasm Collection. g-h) Germplasm Collection of Cerrado Ornamental Plants. i-j) Cactus Germplasm Collection. k-l) Amazonic Orchids Germplasm Collection.

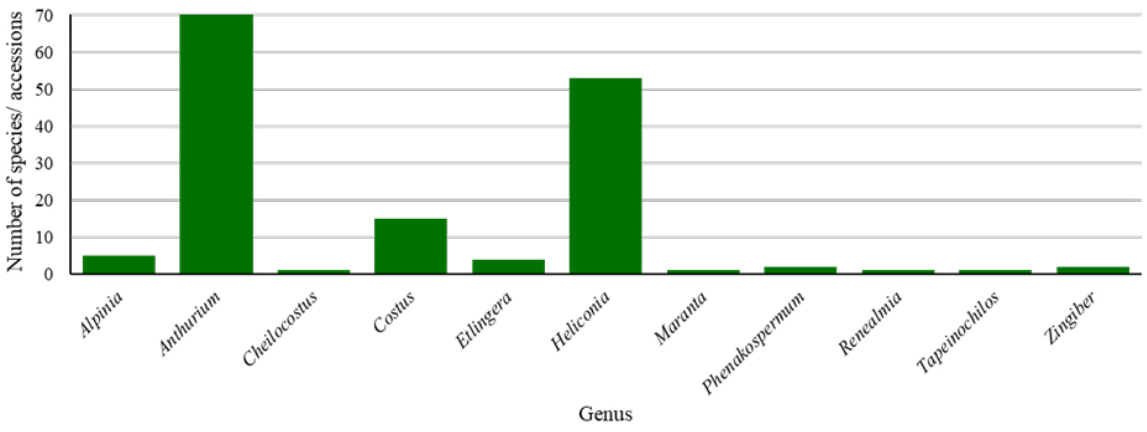

Figure 2. Accessions clustered by genus in the Germplasm Collection of Tropical Ornamental Flowers.

Temperate Climate Ornamental Plants Germplasm Collection

This collection represents part of the genetic diversity of ornamental plants from the Temperate Climate of the Southern Region of Brazil, especially native species of the Pampa Biome, a vegetation formed by species of peculiar beauty. The collection is located in the city of Pelotas-RS, at Embrapa Clima Temperado. The collection preserved in vivo until 2021, in a greenhouse, 198 accessions of native species with ornamental potential and wild relatives of cultivars already consolidated in the floriculture market (Figure 1c-d).

The accessions of the conserved species represent, in addition to beauty, the variability in terms of morphological and physiological adaptations, to the extreme climatic conditions (summer and winter), typical of temperate regions. Efforts were made to know the potential species (Stumpf et al., 2009; Marchi and Barbieri, 2015) and characterize the ornamental potential and market acceptance, a range of possibilities for landscaping and floral art.

Among the accessions, from different ecosystems, are plants for shade or full sun condition; for landscape or for small containers; annuals or perennials; with a long flowering period, variability for different market niches.

The collection actions were focused on species of ornamental value and eco-geographical importance (Figures 1 c-d and 3), such as *Butia odorata* (Barb.Rodr.) Noblick (Arecaceae), *Cattleya intermedia* Graham and *Sacoila lanceolata* (Aubl.) Garay (Orchidaceae). After the period of the Covid 19 pandemic (2020-2022), many accessions were lost, soon this collection will be discontinued and its patrimony will be hosted by other collections.

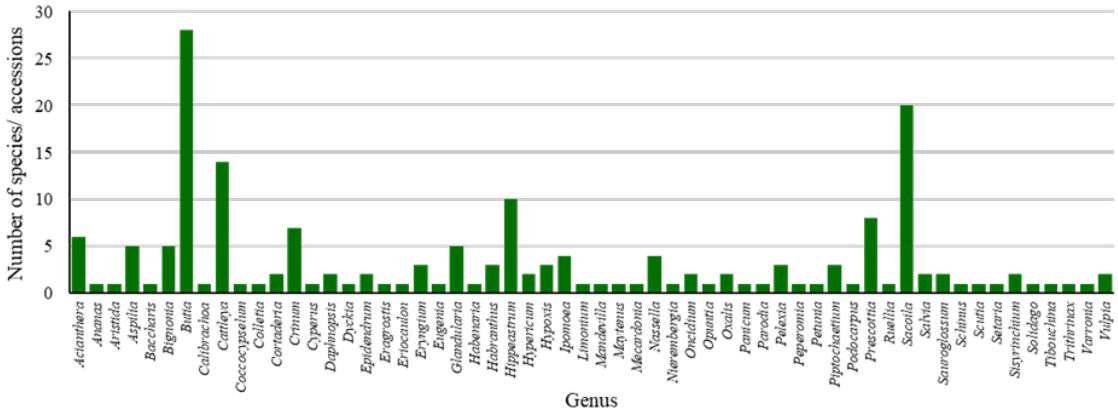

Figure 3. Accessions clustered by genus in the Germplasm Collection of Ornamentals of Temperate Climate until the year 2021.

Bromeliads Germplasm Collection

This collection installed in Cruz das Almas-BA, at Embrapa Mandioca e Fruticultura currently has 2,052 accessions maintained *in vivo* (wooden house) and 190 accessions preserved *in vitro* under minimal growth conditions. The collection represents great genetic variability of the family, including 885 different species from 60 genera and seven subfamilies (Figures 1 e-f and 4).

It is worth mentioning that 56,87% of the conserved accessions have not yet been identified at the species level, waiting for flowering to do so. The most representative genera are *Tillandsia* (165 accessions), *Vriesea* (130 accessions), *Aechmea* (120 accessions), *Neoregelia* (50 accessions), *Hohenbergia* (44 accessions) and *Cryptanthus* (73 accessions), these with great potential mainly for ornamental plants.

Among the conserved accessions, 1,987 are from Brazil and 65 from Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Uruguay, United States and Venezuela. In relation to the States of Brazil, Bahia leads with 1,050 accessions, followed by São Paulo State (320 accessions), Rio de Janeiro State (185 accessions) and Minas Gerais State (102 accessions). Many of these species are at risk of extinction, with 45 classified as "Critically Endangered", 67 "Endangered" and 21 "Vulnerable" according to the "International Union for Conservation of Nature" (IUCN) list and species protologue.

The Critically Endangered are: *Aechmea marginalis* Leme & J.A.Siqueira, *A. orlandiana* L.B.Sm., *A. winkleri* Reitz, *Alcantarea benzingii* Leme, *A. farneyi* (Martinelli & A.F.Costa) J.R.Grant, *Canistropsis elata* (E.Pereira & Leme) Leme, *Canistrum fosterianum* L.B.Sm., *Cryptanthus caracensis* Leme & E.Gross, *C. cruzalmensis* Leme & E.H. Souza, *C. flesherii* E.H. Souza & Leme, *C. glazioui* Mez, *C. lutandensis* E.H. Souza & Leme, *C. santateresinhensis* Leme, *C. santosii* Leme & E.H. Souza, *C. solidadeanus* Leme & E.H. Souza, *Dyckia delicata* Larocca & Sobral, *D. distachya* Hassl., *D. monticola* L.B.Sm. & Reitz, *D. ursina* L.B.Sm., *Fernseea bocainensis* E.Pereira & Moutinho, *Hohenbergia amargosensis* E.H.Souza & Leme, *H. correia-araujoi* E.Pereira & Moutinho, *H. nidularioides* B.P. Cavalcante, E.H. Souza, A.P. Martinelli & Versieux, *H. ymboreorum* E.H.Souza & B.P. Cavalcante, *Karawata gustavoi* (J.A. Siqueira and Leme) J.R. Maciel & G. Sousa, *Lymania involucrata* Leme & E.H. Souza, *L. spiculata* Leme & Forzza, *Neoregelia brownii* Leme, *Orthophytum arcanum* Leme, *O. zanonii* Leme, *Pitcairnia burle-marxii* R.Braga & Sucre, *Siqueiranthus cinereus* (D.M.C. Ferreira & Louzada) Leme, Zizka, E.H. Souza & Paule, *Tillandsia afonsoana* T. Strehl, *T. ertonii* E.H.Souza & Leme, *T.*

itatiensis E.H. Souza & Leodegario, *T. jonesii* T. Strehl, *T. nathanii* E.H. Souza & Leme, *T. neglecta* E.Pereira, *T. oliveirae* E.H.Souza & Leme, *T. sucrei* E.Pereira, *Vriesea altomacaensis* A.F.Costa, *V. amadoi* Leme, *V. botafogensis* Mez, *V. rubyae* E.Pereira and *V. weberi* E.Pereira & I.A.Penna.

It has already been possible to collect some extremely rare species and record new occurrences for some Brazilian states. In the last 3 years, 17 new species and 1 genus were described for Science (Leme et al., 2020; 2022; Cavalcante et al., 2021; 2022; Pontes et al., 2021; Souza et al., 2021a; 2021b; 2021c; 2022a; 2022b; Leodegário et al., 2022).

The accessions characterization is focused on morphological and anatomical aspects that support taxonomic studies, conservation activities and the development of ornamental hybrids. Studies on morphology and viability of pollen grains; morphoanatomy and stigma receptivity; conservation of pollen grains; identification of volatile compounds; reproductive and intergeneric systems and floral and reproductive biology were performed for 50 species (Souza et al., 2016; 2017a; Oliveira et al., 2021; Silva et al., 2021; Rocha et al., 2022).

Despite an ongoing breeding program, some research work in collaboration with the Centro de Energia Nuclear na Agricultura at the Universidade de São Paulo has resulted in the generation of intergeneric and interspecific hybrids (Souza et al., 2017b), which are in the phase of development and that can support a directed hybridization.

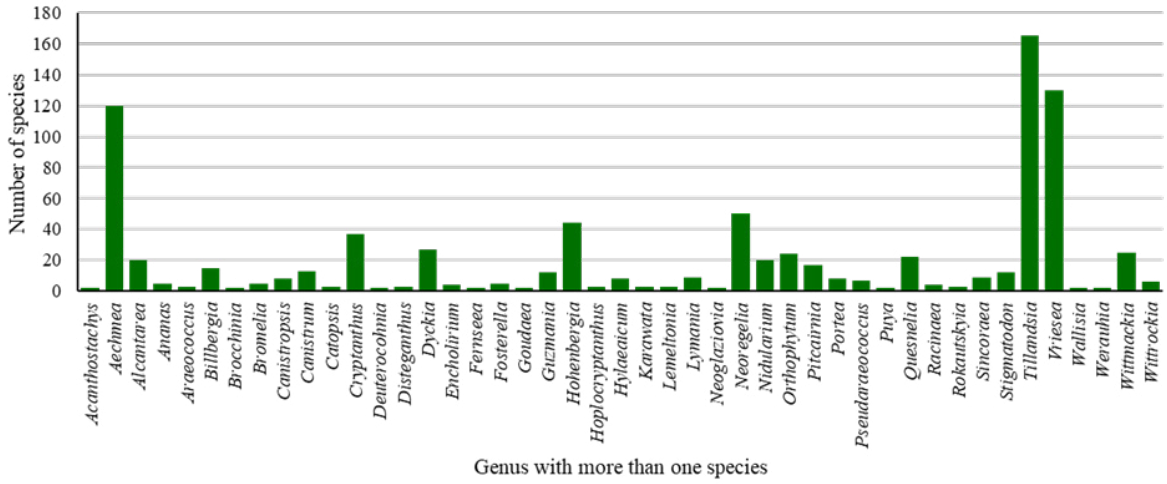

Figure 4. Accessions clustered by genus, with more than one species, in the Bromeliads Germplasm Collection.

Cerrado Ornamental Plants Germplasm Collection

Formed in 1997, this collection has 118 accessions and is located in Brasília-DF, at Embrapa Genetic Resources and Biotechnology. The collection, kept in vivo in greenhouses, is composed of representatives of the Amaryllidaceae family (Figures 1g-h and 5): *Griffinia, Habranthus, Hippeastrum, Hymenocallis and Zephyranthes*, collected in the South region (Rio Grande do Sul and Santa Catarina), Southeast (Minas Gerais, São Paulo), Midwest (Federal District, Goiás), Northeast (Ceará) and North (Maranhão, Rondônia, Tocantins).

Species with great ornamental potential not yet explored are represented in the collection, as well as species recognized by the National Center for the Conservation of Flora (CNCFlora) as "Critically Endangered" (*Griffinia nocturna* Ravenna), "Endangered" (*Griffinia liboniana* Morren, *Hippeastrum goianum* (Ravenna) Meerow) and "Vulnerable" (*Habranthus irwinianus* Ravenna).

The collection is enriched through deposits of bulbs, mostly from germplasm collection projects, focusing on areas under environmental impact, and through donation and exchange between research institutions, such as Universidade Católica de Brasília, Universidade de Campinas and Embrapa Agroindústria. Tropical. Herborized specimens associated with the accessions or population collected are continuously deposited in the herbarium of Embrapa Genetic Resources and Biotechnology (CEN Herbarium) where taxonomic and morphological characterization is performed.

The images of the witness material associated with the accessions deposited in the CEN Herbarium are available on the online data platform Specieslink (http://splink.cria.org.br/) and the Brazilian Biodiversity Information System (SiBBr). As a conservation strategy, a copy of the collection is kept at Embrapa Agroindústria Tropical, where propagation and morphological characterization research is carried out (Pereira et al., 2019).

The characterization increases the visibility and adds value to the biological material of the collection, acting in the promotion of research and scientific development in the country and abroad, in addition to stimulating the public use of scientific information. The accessions of the collection are a reference for scientific research, frequent objects of dissertations, theses, and publications, especially in the areas of chemistry, taxonomy and plant anatomy. As of 2021, this collection has expanded long-term conservation efforts and will include collection of accessions from other ornamental families typical of the Cerrado.

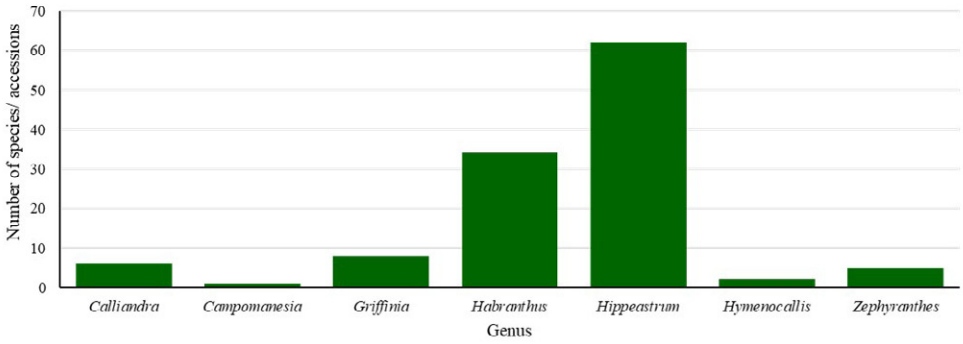

Figure 5. Accessions clustered by genus in the Germplasm Collection of Cerrado Ornamental Plants.

Cactus Germplasm Collection

Cactus are succulent plants with a striking appearance for ornamental use. The low demand for water and resilience to climate change make them indispensable in more arid regions. Eastern Brazil, a region stretching from Rio de Janeiro to Maranhão, is one of the greatest centers of biodiversity. Of the 275 native cactus species in Brazil, 188 are endemic and 87 are strictly endemic to a region (Zappi and Taylor, 2022).

Due to the great richness of native cactus species in Brazil and unsustainable exploitation, Embrapa Agroindústria Tropical created in January 2004 the Cactus Germplasm Collection, aiming at studies of conservation, characterization, propagation and use of this germplasm.

The Collection currently has 313 accessions of different species, *Pilosocereus* (117 accessions), *Melocactus* (57 accessions) and *Cereus* (47 accessions) being the most representative genera and a few succulent plants of other families (Figures 1 i-j and 6). Since then, efforts have been made to collect different species and accessions, representing different geographic and edaphoclimatic areas in northeastern Brazil, to fill the collection gaps and understand the biogeographic patterns of the family. The accessions are conserved primarily *in vivo* under greenhouses with 50% shading and partially *in vitro* under minimal culture medium.

Regarding conservation, activities aimed at multiplication, long-term conservation and cultivation are highlighted as a way of mitigating the loss of the genetic base of cacti at risk and threatened with extinction, saving this heritage for future generations in terms of economic, ecological, social, cultural or scientific.

The cactus species are differentiated plants adapted to coexist with climate change and contribute to the production chain of ornamental plants by offering alternative products to the cultivation of exotic plants, however they represent one of the most threatened taxonomic groups, mainly due to the high anthropic pressure on naturally occurring environments of arid climate, 1/3 of all species of this genus are at risk of disappearing, due to anthropic actions (Goettsch et al., 2015; Gomes et al., 2020).

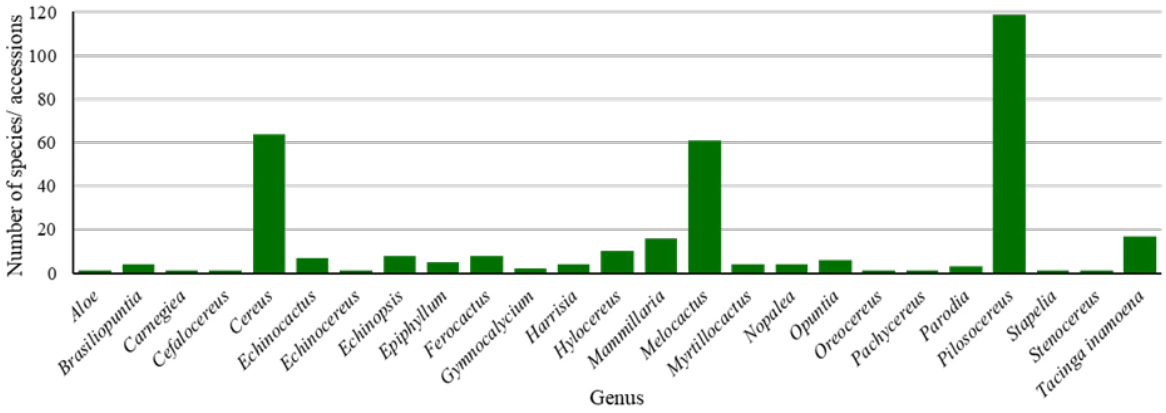

Figure 6. Accessions clustered by genus in the Cactus Germplasm Collection.

Amazonic Orchids Germplasm Collection

Among the diversity of plant species that make up the Amazon biome, the Orchidaceae family is one of the most representative. Located in this region, Roraima has a wide variety of environments and unique reliefs, climates, soils and vegetation, with emphasis on the humid and transitional tropical forests and savannas, with a high occurrence of orchids, many of which are of ornamental interest.

Activities related to ex situ conservation of orchids from the Amazon region developed by Embrapa Roraima began

in 2010, and today, the Orchid Germplasm Collection, located in the city of Boa Vista (RR), has 137 accessions, acquired by donation (71 accessions) and collection (66 accessions). The genera *Epidendrum* (17 accessions) and *Catasetum* (13 accessions) being the most representative of the orchid-loving flora of the state of Roraima (Figures 1 k-l and 7).

Currently, conservation efforts are focused on biological knowledge added to genetic resources, extensive collection and long-term conservation, in addition to the maintenance of the collection and activities of characterization and documentation of accesses and associated information in the Alelo System (Alelo, 2022).

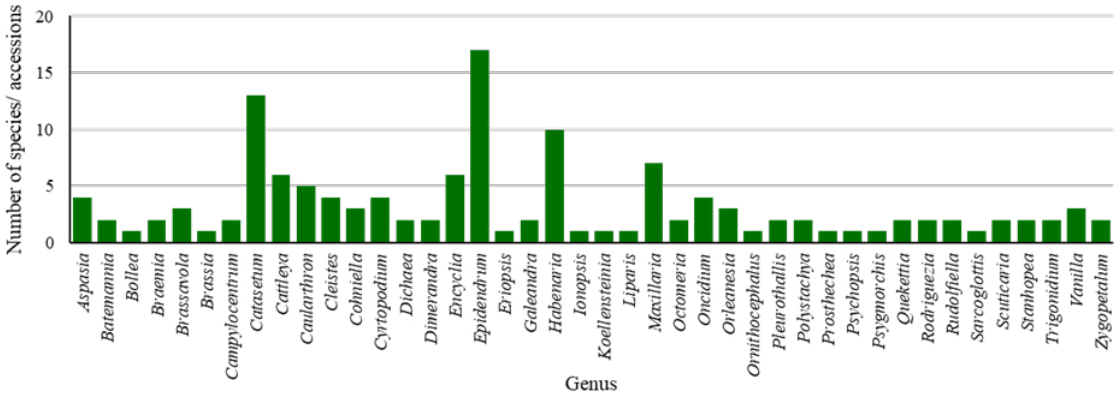

Figure 7. Accessions clustered by genus in the Amazonic Orchids Germplasm Collection.

Other germplasm banks of interest to Floriculture

Some Active Germplasm Banks (AGB) maintain accessions of interest for Floriculture, such as the Pineapple, *Passiflora*, Paspalum, Curcubitaceae and *Capsicum* Germplasm Banks, which together with the related breeding programs, prospected new uses for the preserved germplasm (Table 1).

The AGB-Pineapple conserves about 750 accessions, of the botanical varieties *Ananas comosus* (L.) Merr., *A. comosus* var. *ananassoides* (Baker) Coppens & F. Leal, *A. comosus* var. *bracteatus* (Lindl.) Coppens & F. Leal, *A. comosus* var. *parguazensis* (Camargo & L.B.Sm.) Coppens & F. Leal, *A. comosus* var. *erectifolius* (L.B.Sm.) Coppens & F. Leal and *Ananas macrodontes* E.Morre. The characterization activities perform agronomic, morphological, biochemical and molecular aspects, which support the breeding program and seek to identify promising genotypes for multiple uses such as: food, ornamental and as fibers for the textile, automotive and civil construction industries. With the contribution of AGB, four cultivars of ornamental pineapple for cut flower and potted plants were registered in the Ministério da Agricultura, Pecuária e Abastecimento of Brazil (RNC/MAPA).

The AGB-*Passiflora* (Passion fruit) conserves about 193 accessions, all characterized in terms of ecological, morphological, agronomic and molecular characteristics that facilitate the use of passifloras for diverse interests such as rootstocks, for fresh consumption, industrial processing, as functional-medicinal and also as ornamental plants. The research activities in this collection made it possible to register in the RNC/MAPA five passion fruit cultivars for landscaping and living fence.

The AGB-*Paspalum* has 488 accessions, among which many are suitable for permanent soil cover and use in lawns. The genus has many species native to Brazil and the characterization of agronomic aspects, focused on ornamental use for different soil and climatic conditions in Brazil, identified accessions with tolerance to stresses due to excess or lack of water, tolerant to pasture spittlebugs, works that allowed the registration in the RNC/MAPA of four cultivars for permanent ground cover as ornamental or functional lawns.

The AGB-Cucurbitaceae conserves about 636 accessions, from the genera *Cucurbita, Cucumis, Citrullus, Lagenaria, Luffa, Momordica and Sicana* and is focused on the conservation of the genetic diversity of the landrace varieties cultivated by farmers in southern Brazil. The efforts to characterize the collection made it possible to register 2 cultivars of decorative pumpkins in the RNC/MAPA.

The AGB-*Capsicum* has in its collection 409 accessions of peppers of the five domesticated species: *C. annuum* L., *C. baccatum* L., *C. chinense* Jacq., *C. frutescens* L. and *C. pubescens* Ruiz & Pav., in addition to a semi-domesticated species (*C. galapagoense* Hunz.) and a wild species [*C. lanceolatum* (Greenm.) C.V. Morton & Standl.]. With the characterization of the collection, three ornamental pepper plants for pots were registered in the RNC/MAPA.

Table 1. Information on Germplasm Banks of different groups of products: Pineapple, Passiflora, *Paspalum* and Curcubitaceae and *Capsicum*, cultivars released and their use of interest for Floriculture.

Germplasm Bank	Embrapa Center	Localization	Ornamental Cultivar Registered	Use
Pinneapple	CNPMF	Cruz das Almas-BA	'BRS Anauê', 'BRS Boyrá', 'BRS Porã', 'BRS Potyra'	Cut flower, Pot plant
Passiflora	CPAC	Brasília-DF	BRS Roseflora, BRS Rosea Púrpura, BRS Rubiflora, BRS Céu do Cerrado, BRS Estrela do Cerrado	Landscaping
Paspalum	CPPSE	São Carlos- SP	BRS Curica, BRS Aruaí, BRS Tuim, BRS Chauá	Lawn
Curcubitáceas	CPACT	Pelotas-RS	BRS Linda, BRS Estrela	Decorative fruit
Capsicum	CPACT	Pelotas-RS	BRS Manoela, BRS Itamira, BRS Vilma	Pot plant

CNPMF - Embrapa Mandioca e Fruticultura, CPAC - Embrapa Cerrados, CPPSE - Embrapa Pecuária Sudeste CPACT-Embrapa Clima Temperado.

Final considerations

Despite the large amount of plant genetic resources in all regions of Brazil, there are few initiatives for the conservation and domestication of species and improvement, for sustainable use. In this context, the Brazilian Agricultural Research Corporation (EMBRAPA), based on the Genetic Resources of Ornamental Plants portfolio, plays an important role in conserving collections of ornamental plants in ex situ collections. In addition to conservation, in partnership with other institutions, activities are being carried out to characterize and evaluate the potential use of these species, with the aim of adding value to genetic resources and finalizing products for floriculture.

Author Contribution

ACRC: obtained results, compiled the data and drafted and edited the manuscript; **DC**: obtained results, compiled the data; **FVDS, EHS**: obtained results, compiled the data and drafted the manuscript; **JF, TBC, DAS**: obtained results, compiled the data.

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