Central Mexico native plant horticulture at the Cadereyta Regional Botanical Garden.

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Abstract

The Cadereyta Regional Botanical Garden has developed Central Mexican native plant horticulture as a mechanism for *in situ* and *ex situ* conservation of wild species. Reproduced species presently total more than 100 taxonomic entities; nearly 50 of these now have protocols for germination and development. 38 species are plants with survival difficulties and 6 are listed in the CITES appendix I. A propagation procedure has been developed that employs conventional and micropropagation techniques, with a production process that ensures plant quality via a series of controls. Over the last three years a project was completed to reproduce native trees and shrubs for mixed ecological and economic uses. Propagated woody species are used for forestry and restoration in vegetative communities. The benefits of this gained knowledge are shared with society by supplying plants to local government agencies in charge of environmental stewardship and also via formal training, through courses taught in local communities and at the university level.

Keywords

Central México, conservation, endangered species, key species, native plants, procedure, propagation, restoration.

Introduction

The Cadereyta Regional Botanical Garden is located in the municipality of Cadereyta de Montes, (X 416.68; Y 2, 287.80; 2074 msnm; UTM WG584) in the state of Querétaro, México. The site is on the road to the old Tovares Hacienda, no number (Camino a la antigua Hacienda de Tovares S/N). It is situated at an altitude of 2,046 metres above sea level, and occupies a surface area of approximately 15.33 hectares. The climate is temperate semiarid with summer rains; the average minimum temperature is 12º C with a maximum of 19.4º C, registering an average minimum precipitation of 309 mm, and a maximum of 798 mm. The vegetation is constituted by a xerophilic desert matorral (Sánchez & Sanaphre, 2009).

It was founded on the 25th April 1991. However, it wasn't until the year 2003 when, due to a site redesign, that the foundation for adequate functioning began to be laid.

One of the strategic lines has been the instrumentation, innovation, and strengthening of reproductive systems for native plants. Initially, efforts focused on the reproduction of endangered species. These results were presented at the 3rd Global Botanic Gardens Congress, organized in Wuhan, China, by Botanic Gardens Conservation International in 2007. During the last three years, besides ongoing propagation of threatened species, a project has been undertaken whose objectives centre on the reproduction of important woody species from various habitats, which finally, over the long term, will contribute to on-site conservation by way of rehabilitation and restoration of local vegetation, especially in the highly urbanized central part of the state of Querétaro.

This article presents a summary of the advances obtained in the past 3 years. For example, the greenhouse space has expanded to cover an area close to 1,500 square metres. Within these greenhouses we have strengthened an official Wild Plant Propagation Unit (Unidad de Propagación de Plantas Silvestres (UPPS)). This unit is capable of determining agronomic procedures, through which we have achieved the propagation of native trees and shrubs with ecological, economic, and social value, which in conjunction with the species previously in propagation, total more than 100 species of reproduced native plants. All of the above signifies an advance toward the accomplishment of national and international goals for plant conservation.

Method

A procedure has been perfected for the reproduction of native wild species of interest (Sánchez, 2008). The method consists of 2 sequences with 5 possible steps. The general procedure can be described as follows:

I. Basic Sequence: Consists of three steps in which seeds are sown without pre-germination treatment, and in the case of unsuccessful attempts, pre-germination treatment(s) are applied.

Step 1. Seeds sown without treatment,

Step 2. Seeds sown with pre-germination treatment(s),

Step 3. Seeds sown with experimental, controlled treatment(s) meant to improve the results obtained in the previous steps.

II. Alternative Sequence: This is a complementary route meant to establish reproductive protocols in species that, for reasons such as scarcity (or unavailability) of seeds or for low germination rates, require preferential management by way of asexual or vegetative reproduction. This is done in two ways:

Step 4. *In vitro* cultivation,

Step 5. Vegetative reproduction.

This procedure was applied to a group of 45 trees and shrubs from the central region of the state of Querétaro that are considered key species in the local vegetation. An objective was established in terms of reproductive efficiency, with the goal of obtaining a percentage of 60% or higher of specimens developed per lot of propagules, in 20 or more of the selected botanical species.

Results

Since the last Global Botanic Gardens Congress, as a result of the efforts of the artificial reproduction programmes of the Wild Plant Propagation Unit (UPPS), we have managed to reproduce an additional group of around 35 mostly woody species of key significance for their utility and conservation value.

The reproduced species, with respect to their obtained method of propagation, are shown in the table I.

The obtained results are exemplified in figure 1, which describes the case of two species: first, for *Acacia farnesiana* (L.) Willd., a woody pioneer of great importance in the regeneration of xerophilic matorral and the tropical deciduous forest of the Queretaran Bajío; and second, for *Cedrela dugesii* S. Watson, an endangered species which in the wild appears only in mature tropical deciduous forests. The first is reproduced by the sexual route (seed), and the second via *in vitro* regeneration (micropropagation).

The propagation procedure for native trees and shrubs of central México includes a method with standards and controls that allows us to understand what are random or

causal variations. This information will be part of the content of a book next to be published as a result of this project (figure 1).

Conclusion

The Cadereyta Regional Botanical Garden's Wild Plant Propagation Unit (UPPS) has strengthened its work with regard to wild native plant horticulture in the State of Querétaro and Central Mexico. This has been accomplished by establishing procedures permitting the reproduction of, under greenhouse conditions, more than 100 species representing 18 important botanical families in ecological, economic, and social terms (table 2). The Queretaran species under propagation include 27 species catalogued as endangered, meaning almost 46% of the presumably threatened species in this federal entity of the Mexican Republic. 11 other endangered Mexican species have also been propagated. The technical procedures have been perfected by developing explicit protocols that allow a controlled reproductive process and to obtain specimens of quality. One out of every two species reproduced in the greenhouse now possess a formal cultivation protocol that establishes appropriate germination and management techniques under the prevailing conditions in the Wild Plant Propagation Unit (UPPS).

The results obtained are continually made available to Mexican society at various levels, via different means of outreach such as publications, courses and workshops, and plant sales at subsidized prices. Of particular value is the advice given and native plants supplied to various local government posts responsible for environmental protection in their areas. The work we have undertaken provides the foundation for the protection of threatened flora in the Central and Southern regions of Querétaro state, as well as for the rehabilitation and restoration of ecosystems in this geographic zone of the world, continually subject to unrelenting pressure from the number of human beings inhabiting the area.

Acknowledgments

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Table I. Reproduced species by family and propagation method.

Method	Step	Family	Specie
Basic sequence	*Step 1*	Agavaceae	*Yucca filifera* Chabaud
		Bignoniaceae	*Tecoma stans* (L.) Juss. ex Kunth
		Bombacaceae	*Ceiba aesculifolia* (Kunth) Britten & Baker
		Burseraceae	*Bursera fagaroides* (Kunth) Engl.
		Cactaceae	*Ferocactus histrix* (DC.) G. E. Linds.
		Fabaceae	*Albizia occidentalis* Brandegee
			Lysiloma microphyllum Benth.
		Lamiaceae	*Salvia mexicana* L.
		Oleaceae	*Forestiera phillyreoides* (Benth.) Torr.
		Rubiaceae	*Randia thurberi* S. Watson
		Ruscaceae	*Dasylirion acrotrichum* (Schiede) Zucc.
		Ulmaceae	*Celtis pallida* Torr.
	Step 2	Fabaceae	*Acaciella angustissima* (Mill.) Kuntze
			Acacia farnesiana (L.) Willd.
			Acacia pennatula (Schltdl. & Cham.) Benth.
			Acacia schaffneri (S. Watson) F. J. Herm.
			Erythrina coralloides DC.
			Leucaena leucocephala (Lam.) de Wit.
			Eysenhardtia polystachya (Ortega) Sarg.
			Prosopis laevigata (Humb. & Bonpl. Ex Willd.) M. C. Johnst.
			Senna polyantha (Collad.) H. S. Irwin & Barneby
			Zapoteca formosa (Kunth) H. M. Hern.
		Cactaceae	*Mammillaria zephyranthoides* Scheidw.
			Myrtillocactus geometrizans (Mart. ex Pfeiff.) Console
		Convolvulaceae	*Ipomoea murucoides* Roem. & Schult.
		Rhamnaceae	*Colubrina greggii* S. Watson
		Sapindaceae	*Dodonaea viscosa* (L.) Jacq.
	Step 3	Ruscaceae	*Dasylirion acrotrichum* (Schiede) Zucc.
Alternative sequence	*Step 4*	Meliaceae	*Cedrela dugesii* S. Watson
		Cactaceae	*Mammillaria mathildae* Kraehenb. & Krainz
		Rhamnaceae	*Karwinskia humboldtiana* (Roem. & Schult.) Zucc.
		Rutaceae	*Ptelea trifoliata* L.
	Step 5	Cactaceae	*Opuntia elizondoana* E. Sánchez & Villaseñor
			Opuntia robusta H. L. Wendl.
			Pereskiopsis diguetii (F. A. C. Weber) Britton & Rose

Figure 1. Two examples of the data that will be shown in the book for each species.

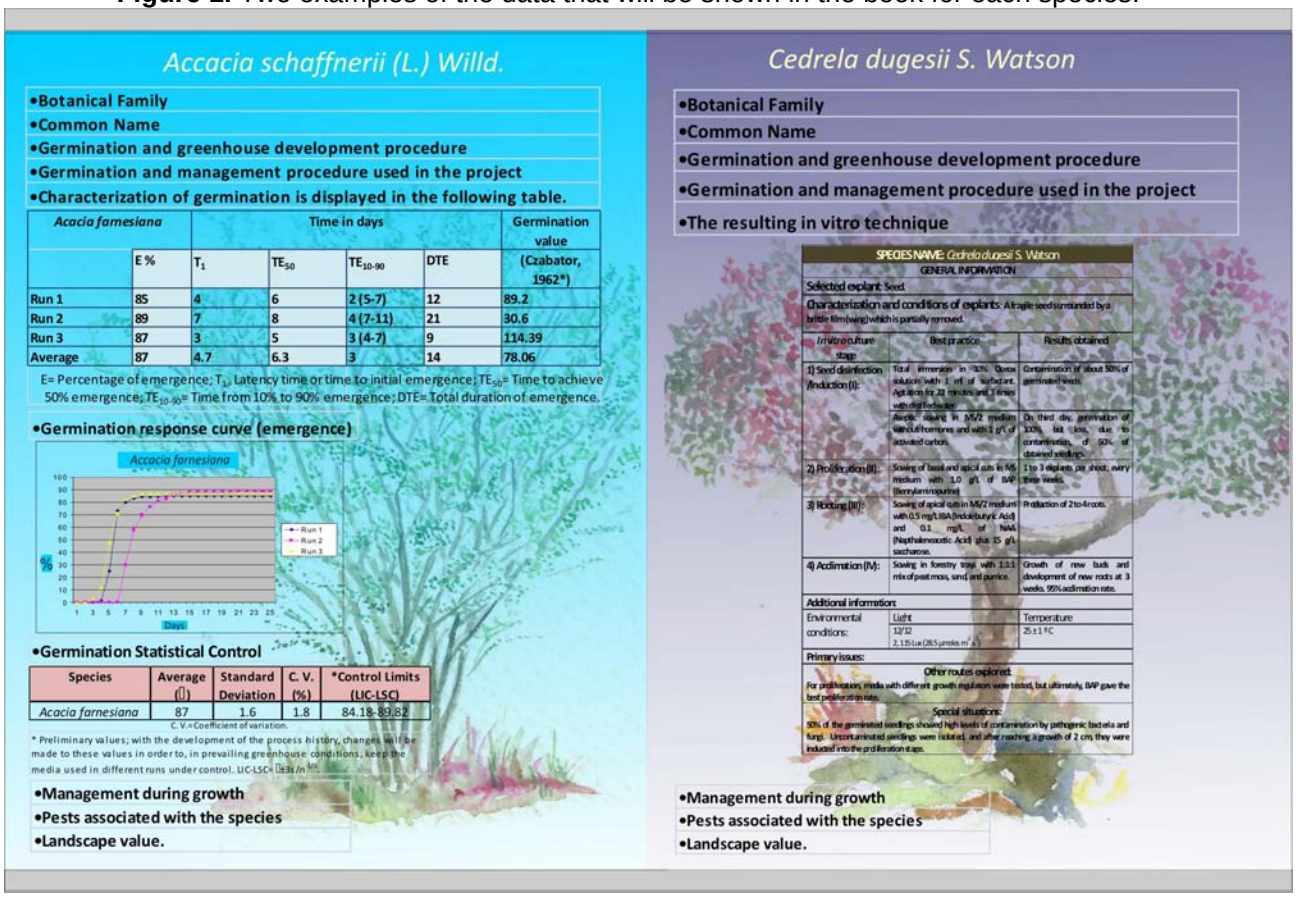

Table 2. Species that the Cadereyta Regional Botanical Garden reproduces in its Wild Plant Propagation Unit.

Family/number of species	Species in Mexican Conservation Status	Species in CITES Appendix I	Species with propagation Protocol
Agavaceae			
9	-	-	2
Apocynaceae			
1	-	-	0
Bignoniaceae			
1	-	-	1
Bombacaceae			
1	-	-	1
Burseraceae			
1	-	-	1
Cactaceae			
65	32	6	25
Convolvulaceae			
1	-	-	1
Euphorbiaceae			
1	-	-	-
Fabaceae			
12	2	-	12
Lamiaceae			
1	-	-	1
Meliaceae			
1	1	-	1
Oleaceae			
1	-	-	1
Rhamnaceae			
2	-	-	2
Rubiaceae			
1	-	-	1
Ruscaceae			
3	3	-	1
Rutaceae			
1	-	-	1
Sapindaceae			
1	-	-	1
Ulmaceae			
1	-	-	1
104 species	38	6	53