

**ESTABLISHMENT AND MAINTENANCE OF A MEXICAN
NATIONAL COTTON GERMPLASM RESOURCE NURSERY**

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Abstract

Mexico as the center of origin and genetic diversity of cotton (*Gossypium hirsutum* L.) has a great diversity of wild diploid species. However, there is no National Cotton Germplasm Resource Nursery in Mexico to guarantee the preservation and investigation of this natural resource, which was used and conserved by the nature inhabitants since prehispanic times. Several expeditions were done for collection and conservation of the genetic cotton resource of Mexico by Mexican explorers as well as explorers from other countries. Unfortunately, none of the collected samples from these expeditions have been used fully for conservation and/or crop improvement. Since it is considered that the success of the genetics, cytogenetics and taxonomical studies, as well as the success of the programs of genetic improvement, depend in a large part on the readiness of the germplasm variability, it is important that a permanent genetic nursery be established. The objectives of this project are to collect, conserve, and document endemic species and races of *Gossypium* found in Mexico as well as introduce species and races of the genus *Gossypium* that can be found in other countries, and establish a field Cotton Germplasm Resource Nursery, which will be unique in the world. This nursery will be located at Iguala, Guerrero, Experimental Station. The cotton nursery will be established on approximately one hectare where all genetic material from collections carried out in several States of the Mexican Republic will be planted. The necessary information for the characterization of all the established genotypes is going to be collected for use by cotton researchers and institutions that carry out investigation of these species. Scientists from the USA (USDA-ARS and Univ. of Arkansas) have been and still are collaborating and supporting this new cotton nursery, and we would like to invite any other interested parties to this effort.

Introduction

Mexico's natural heritage with respect to cotton equals that of maize, yet no national resources are dedicated to the preservation of this natural resource. Both the center of origin and the center of genetic diversity of *Gossypium hirsutum* L. are within the boundaries of Mexico. The race type known as "yucatanense" occurs among the littoral vegetation along the north coast of the Yucatan peninsula. It is the only truly wild *G. hirsutum* and probably is the ancestral type from which upland cotton was domesticated. Following domestication regional landraces emerged over centuries of cultivation, particularly to the south and west of its origin. The center of genetic diversity of *G. hirsutum* is southern Mexico and neighboring Guatemala. The landraces of *G. hirsutum* are the primary germplasm pool from which genes for future improvement of cotton can come. However, the landraces are no longer cultivated for cotton production. The diversity that remains *in situ* is limited to feral plants that occur opportunistically in waste areas and as occasional home garden plants maintained as a novelty by rural peoples. Feral or dooryard plants are often destroyed in areas of commercial cotton production because of the misguided belief that they serve as a reservoir for insects.

The genetic diversity that is essential for continued improvement and development of elite cotton genotypes must come from the primary, secondary, and tertiary germplasm pools of *Gossypium*. The most accessible genetic resource for cotton breeders comes from the primary germplasm pool, and this resource is composed mostly of the landraces of Mexico. It is highly unlikely that any individual landrace accession will have sufficient yield and fiber quality to compete with modern cultivars. However, taken as a whole, the landraces possess extensive genetic diversity that can be utilized through breeding and selection. With continued urbanization and its associated convenience, and with adoption of "elite" cotton genotypes for production, the genetic diversity that resides with the landraces continues to be eroded through abandonment or deliberate destruction.

In addition to being the country of origin of *G. hirsutum*, 11 of the 13 known wild diploid species from the D genome of *Gossypium* in the western hemisphere are endemic to Mexico. These species fall into the secondary germplasm pool of cotton. Four of the known species (*G. aridum*, *G. schwendimanii*, *G. lobatum* and *G. laxum*) are arborescent in growth habit and their taxonomic treatment may be incomplete because of limited collection effort. It is Possible that additional species occur in Mexico that belong to this group. Little is known about them or what they might contribute to cotton improvement. Other species are adapted to desert environments (*G. armourianum*, *G. harknesii* and *G. turneri*) or to sclerophyllus habitats with seasonal water (*G. thurberi*, *G. trilobum*, *G. davidsonii* and *G. gossypoides*). A few traits have been transferred from these

species into modern cultivars, but for the most part this genetic resource has been underused for cotton improvement. Because cotton and its related species are a part of the natural heritage of Mexico, we should assume some stewardship of the genetic resource to assure that it is preserved for posterity.

The objectives of this project are to collect, conserve, and document endemic species and races of *Gossypium* found in Mexico as well as introduce species and races of the genus *Gossypium* that can be found in other countries, and establish a field Cotton Germplasm Resource Nursery, which will be unique in the world. This nursery will be located at Iguala, Guerrero, Experimental Station.

Antecedents

In the old world the botanical relationships and the geographical patterns of the old commercial routes suggest that the first domestic use of cotton took place in the south of Arabia (Hutchinson, 1959), using the diploids ($2n=2x=26$) species of cotton *G. arboreum* and *G. herbaceum*. The main use of cotton was to cover wounds and filling of linings. In the new world a textile technology of cotton without any relationship with that of the old world was developed. In America, allotetraploids ($2n=4x=52$) cotton species, *G. hirsutum* and *G. barbadense*, were domesticated and used.

Lemeshev (1978) reported that historically, the first formal expedition (1975) to collect cotton germplasm native of Mexico was initiated by cotton researchers N. Lemeshev, V. Usakov, A. Abdumaulayer, R. Prado and Q. Obispo. However, since 1905, the United States had introduced Mexican species in their country. The second expedition was conducted by a group of investigators of the Instituto Nacional de Investigaciones Agrícolas today Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias with the participation of cotton breeders from Mexico Ricardo Prado and Quintín Obispo in coordination with Russian investigators (Prado *et al.*, 1978). They traveled through 11 states of the Mexican Republic and an island: Yucatan, Chiapas, Guerrero, Oaxaca, Michoacan, Colima, Sonora, Sinaloa, Baja California Sur, Coahuila, Tamaulipas and Cozumel, respectively. The above mentioned explorers collected seed of four races of *G. hirsutum*, *yucatanense*, *punctatum*, *palmeri* and *morrilli* and seed of five diploids species *G. laxum*, *G. trilobum*, *G. aridum*, *G. lobatum* and *G. harknessii*.

In 1977-1978, N. Lemeshev and Q. Obispo carried out several expeditions covering 16 states of the Mexican Republic. These states were Veracruz, Tabasco, Campeche, Yucatan, Quintana Roo, Chiapas, Oaxaca, Guerrero, Oaxaca, Michoacán, Jalisco, Colima, Nayarit, Sinaloa and peninsula of Baja California. In total seed of seven *Gossypium* species was obtained *G. armourianum*, *G. harknessii*, *G. trilobum*, *G. aridum*, *G. lobatum*, *G. laxum* and *G. gossypoides*. Three collections carried out in Tlaxi-coyan and San Andres in the state of Veracruz and in La Frontera in the state of Tabasco were identified as a race (*braziliense*) of *G. Barbadense*. The discovery of plants of this species is very important since there were not reports of their existence.

In 1984, Zhong Frang Chen, Shao An Ho, C. Arroyo, A. Palomo and A. Hernandez, carried out a new expedition in search of wild cotton species. The last three cotton researchers were from INIFAP, in collaboration with two cotton breeders from the Peoples Republic of China. They explored four states, Yucatan, Campeche, Oaxaca and Guerrero. Seventy-two entries of five landraces of *G. hirsutum* (*palmeri*, *morrilli*, *punctatum*, *yucatanense* and *richmondi*), two entries of *G. aridum* and one of *G. barbadense* (race *braziliense*) were collected. This last genotype possessed a very large cotton fiber (39.2 mm) and was found in a garden in a coffee production zone of Oaxaca.

In 1984, A. E. Percival (USDA-ARS), J.M. Stewart (Univ. of Arkansas), A. Hernandez and F. de Leon (INIFAP), carried out an expedition. The states of Tamaulipas, Veracruz Tabasco, Yucatán, Quintana Roo, Chiapas and Oaxaca were surveyed. Several wild races of *G. hirsutum*, one line of *G. barbadense* and one of *G. aridum* were collected.

Percival *et al.*, (1992) explored the states of Baja California Norte, Baja California Sur, Sonora and Sinaloa. Seed was collected from more than 100 samples of *G. thurberi*, *G. turneri*, *G. armourianum*, *G. harknessii* and *G. davidsonii*.

In 1989-1993, F. Talipov, C. Cataláio, F. Salgado and M. Bahena, carried out several expeditions for the Universidad Autonoma de Guerrero and the Academy of Science of Russia for the states of Veracruz, Tabasco, Campeche, Yucatán, Chiapas, Guerrero, Oaxaca, Michoacan, Morelos, Colima, Sinaloa, Sonora and Baja California Sur, they were able to collect the wild species *G. aridum*, *G. armorianum*, *G. harknessii*, *G. gossypoides*, *G. laxum*, *G. lobatum*, *G. thurberii* and *G. trilobum*, as well as the races of *G. hirsutum*, *palmeri*, *punctatum*, *morrilli*, *yucatanense* and *richmondi*.

Recently, In 2002 personal from INIFAP, USDA-ARS, and Univ. of Arkansas explored several southern states of Mexico. The accessions collected during this expedition, included a total of seven species of *Gossypium*: *G. aridum* (15), *G. barbadense* (9), *G. gossypoides* (2), *G. hirsutum* (52), *G. laxum* (5), *G. lobatum* (1) and *G. schwendimanii* (2). In addition, this expedition is the first of a total of three expeditions to suplí and support the new genetic nursery at Iguala Gerrero for endemic species of *Gossypium* in Mexico.

Materials and Methods

The location of the Mexican National Cotton Germplasm Resource Nursery will be at the Iguala, Guerrero, Experimental Station. In this location the climate and photoperiod guarantee the good development of all the species of cotton year round, independently of their place of origin.

The necessary land for the establishment of the germplasm resource nursery will be approximately one hectare. To protect the plants, the land will be fenced with cyclonal mesh, and a drip watering system (sub-superficial) will be used for their optimum growth.

The project has two stages: 1). Establishment; which will be carried out in a period of two years; and 2). Maintenance; which will be carried out indefinitely assuming funds are available.

During stage 1, the native cotton species and races of Mexico will be planted. Later on, the wild species of other countries will be obtained and planted in order to include them in the Mexican National Cotton Germplasm Resource Nursery at Iguala, Guerrero.

The wild cotton species are going to be planted in furrows 50 m long with three m in between each furrow. The native diploids races from Mexico, as well as the local Mexican tetraploids entries are going to be planted, two meters between plants, and five plants from each species will be maintained at the nursery.

The establishment of the Germplasm Resource Nursery will start with germination of the collected seeds in the greenhouse. The obtained small plants will be transplanted in their definitive place in the Experimental Field of Iguala, Guerrero, Mexico.

As a first step establishment and maintenance of a permanent nursery of living cotton accessions and species at Iguala, Guerrero is proposed. Initially one hectare should be set aside for this purpose, but allow for expansion as the number of accessions increases.

The nursery will be established with germplasm that will be collected in a series of joint Mexico-USA collection efforts along the Pacific states of Mexico over the next three years. Accessions and species from other areas of Mexico will be added through acquisition from Mexican cotton workers throughout Mexico where endemic species and dooryard accessions of cotton occur.

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Gossypium schwendimanii



Gossypium hirsutum (palmerii)



Gossypium hirsutum (palmerii)



Gossypium hirsutum (palmerii)



Gossypium gossypioides

