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Plant Genetic Resources in Mexico: The Perennial Crops Connection

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Cactus Pear and Stone Fruits Program

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**GRs
Breeding & Pre
Extension**

- NORGEN a three nations effort on GRs
 - Participation of Mexico to USA Genetic Resources Advisory meetings (Canada also attends) to be held in NY.
 - **Objective 5:** Encourage Reciprocal Participation of National Experts in each Country's Operational and Advisory Committees.
- CENARGEN update: A new facility to boost the Mexican effort on GR conservation and utilization.
- INIFAP- ARS proposal for collaboration: Germplasm enhancement of select temperate fruit crops, an initiative for small farmers in Central Mexico

- GRs a topic of interest since the 50s (corn & dry beans), attention peaked during this decade, covering from A to Z (amaranth to vanilla).

Native , naturalized and introduced species

Wide interest

Official, educational and NGOs

All short term < 4 yr

- Focussed on plant genetic resources, animal and microbes secondary
- A survey completed in 2006 registered:
 - 558 projects
 - 205 institutions
 - 1,484 individuals
- Concentrated in the Central Region (the most developed)
- Conducted by universities , state and federal institutions
- Commonly disconnected to future activities e.g. enhancement and utilization
- SINAREFI . A governmental effort to steer GRs projects

- SINAREFI
 - Federal funds, competitive grants
 - National initiative started 2000
 - Multi-institutional, multidisciplinary
 - Organized in crop networks, voluntary affiliation
 - Focussed on PGRs
 - Initial priority: native and naturalized PGRs
 - Exploration, documentation, protection
 - Weaknesses;
 - Short term projects <4 yr
 - Short funded for long term conservation

- Lack of space, adequate facilities and equipment to store and preserve
- Lack of continuous funding
- Insufficient attention to GRs other than plants
- Insufficient knowledge on preservation methods and protocols for many species
- Poorly staffed and equipped for renewal of strains, seedlings and other germplasm that can not maintain viability in the long term
- Lack of a National *ex-situ* preservation strategy associated to inefficient use of economic , material and human resources and to duplicities
- Absence of a common database.



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inifap

Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias



**NATIONAL CENTER
OF
GENETIC RESOURCES**
Tepatitlán, Jal. MEXICO



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Key features of the National Center for Genetic Resources Preservation of Mexico:

1. It is a joint multi institutional national effort
2. Comprises five subsystems
3. Federal Government priority, therefore federal funds
4. Focus on long-term preservation of native Mexican species
5. Linked to other national and international genebanks
6. National and International collaborator on GR research projects
7. Compatible database to share information
8. Share and exchange collections of interest

CNRG MISSION



- 1. To preserve and protect the Mexican Genetic Resources (MGR), (aquatic, agricultural, forestry, microbial and livestock).**
- 2. To contribute the appropriate, rational and sustainable use of MGR on behalf of present and future generations, according to plans and policies of the Federal Government**
- 3. To support collection, characterization, potentiation, use and preservation, driven by the National Genetic Resources System or any other entity, public or private, national or international.**
- 4. To Promote the importance of Genetic resources preservation as a foundation of our agricultural policies and environment conservation among the scientific community and the general population.**

AGRICULTURAL SUB-SYSTEM NETWORK



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In situ	Ex situ	Use	Generation of capabilities
Inventory / Participative improvement / Support in case of disaster / promotion / payment of environmental services	Collections maintenance / Regeneration / Collection / Increase preservation activities	Characterization/Improvement/biotechnology/Promote diversification/ Development of under-used species / Seed production / Emerging markets/	Promotion networks / Information, surveillance and alert systems/ Teaching and training /Public education

Type of Germoplasm



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Specímen	Méthod	Subsystems*
Seeds	Cold chamber (-20°C)	Ag, F
Tissues & plants**	Cold chamber (15 a 4°C) Nitrógen (-196°C)	Ag, F, M
Semen	Nitrógen (-196°C)	Ac, P
Óvules	Nitrógeno (-196°C)	Ac, P
Embryos	Nitrógeno (-196°C)	Ac, P
Larvae	Nitrógeno (-196°C)	Ac, P
Somátic Cells	Nitrógeno (-196°C)	Ac, P, M
Strains	Nitrógeno (-196°C) (- 80°C)	M
Nucleic Ácids	Nitrógen (-196°C) Deep freeze (- 80°C)	All

* Ac= Acuático; Ag= plants; F= trees ; M= Microbial; P= animal

Capacity first phase



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- First phase, 25% total capacity
- Two cold chambers (-18°C) total volumen 746.4 m³
- Mobile high density shelving systems
- Capacity aprox. 373,200 seed accessions (500 accessions/m³)



- 10 Líquid Nitrógen containers;
60,000 accessions c/u).
- 600,000 accessions:
semen, embryo, larvae,
óvules, microbial strains,
nucleic ácidos, etc.



- Four chambers for *in vitro* preservation (100%)
- Two for tropicals cámaras (10-20 °C) y two temperate species (5-15 °C) total volumen de 396.4 m³
- Aprox Capacity. 198,000 seedlings (500 accesions/m³)



Estimated accessions inventory 2012-2040

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SUBSYSTEM	COORDINATOR	2012	2020	2030	2040
Acuatic	INAPESCA-CICESE	10,000	100,000	212,500	325,000
Crops	SINAREFI	73,500	298,500	579,750	861,000
Trees	CONAFOR	8,000	80,000	170,000	260,000
MICROBIAL	COLPOS	350	11,150	24,650	38,150
Animal	COORDINACIÓN GENERAL DE GANADERÍA	45,000	135,000	247,500	360,000
TOTAL		136,850	624,650	1'234,400	1'844,150

Estimated figures. The storage space programmed for the 1st. phase will cover the needs of the first 15 yr of operation

- Parking space 100%
- Main building 100%
- Services main building 23.57%
- Refrigeration, Líquid Nitrógen and labs; bidding in progress
- Académic and services buildings as well as main entrance and accesory facilities in progress

Parking lots



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Main building



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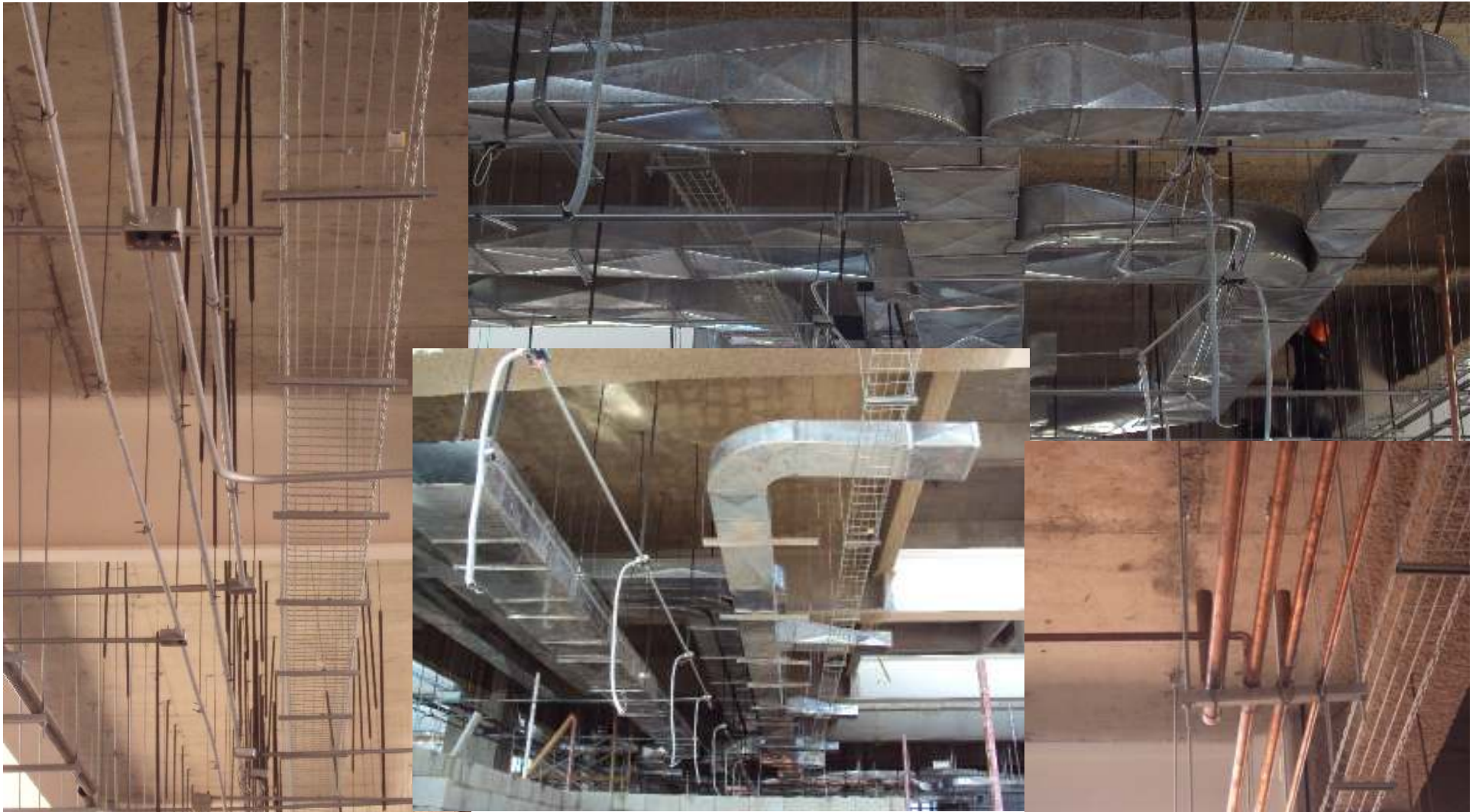


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Main building



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- SINARGEN, back up for national plant collections.
- NCGRP USA, Fort Collins, preparing 13,000 accessions of plant germplasm scheduled for repatriation to CNRG October 2010.
- CNRG will have the capacity to maintain the germoplasm obtained the next 15 years, according with the trends estimated by SINARGEN.
- GRIN Global will be the database platform, curatorial staff (2) attended basic training, on the list for future training activities, supported by Norgen- IICA , INIFAP and ARS.
- Opening due to November 2010, as a part of the celebrations of the Bicentennial of Independence.

Collaboration Inifap-ARS

“Germplasm enhancement of selected temperate fruit crops
for the benefit of small farmers of Central Mexico”

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After effects of NAFTA

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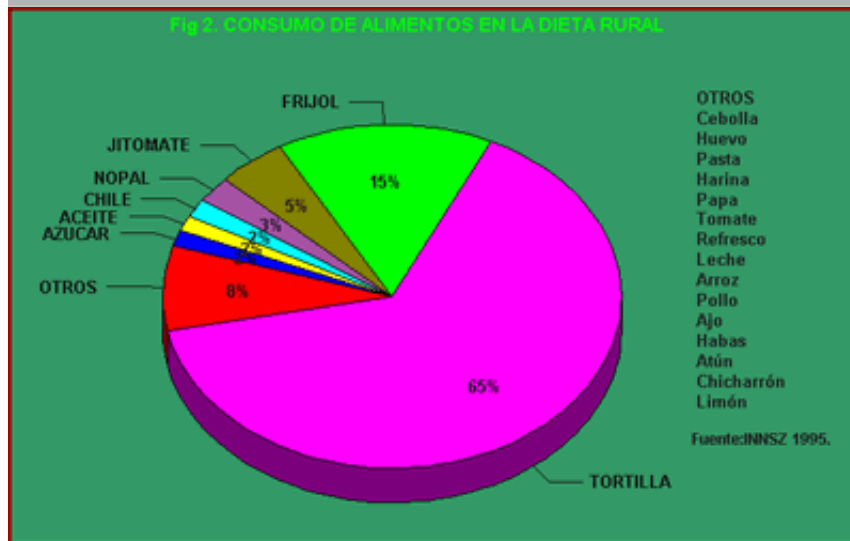
- Mexican agriculture is still based on cereal production (Maize, dry beans, wheat, sorghum etc.)
- After Nafta, profits from cereal production decreased due to cheaper imports, discouraging farmers, big and small.
- Interest for export crops in irrigated areas increased, mainly vegetables.
- Imports of temperate fruits increased
- Tropical fruits exports increased national demand well covered with cheap fruit in season: avocado, mango, citrus, etc.
- ***Peaches, apples, pears, plums, from South America in winter and spring, USA provides for late summer and fall. National production below demand.***



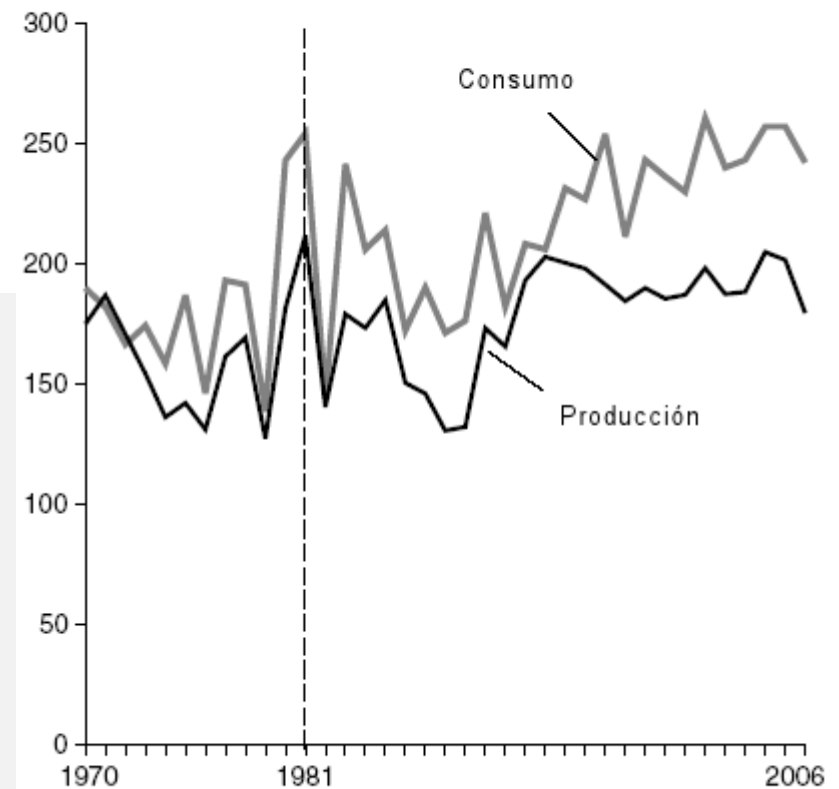
Some realities of corn production and consumption in Mexico

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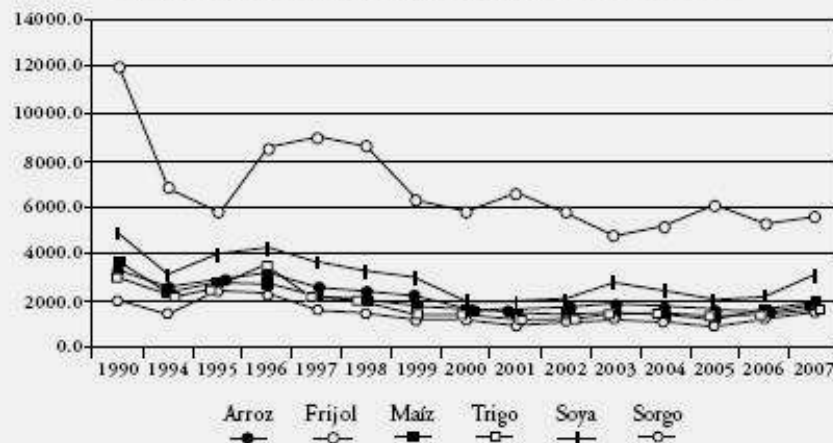
GRÁFICA 1
Producción y consumo de maíz en México
(kilogramos per cápita)



Fuente: FAO

GRÁFICA 2

Precios reales nacionales de algunos cereales. México, 1990-2007



FUENTE: Sistema de Información Agroalimentaria de Consulta. Siacon/Sagarpa, 2007. PMR - Precio Medio Rural (Ton/\$) Banxico. INP C General Base 2Q, junio de 2002.

Maize country, fruit country or both?

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- Central and southern regions abundant pockets with suitable conditions for fruit trees.
- Subtropical and temperate species
- As a result of topography, location and soils derived from volcanic activity.
- Used by small farmers for maize and beans cultivation, under not profitable farming systems.
- Abundant on native and naturalized variability of fruit species.
- See google earth...



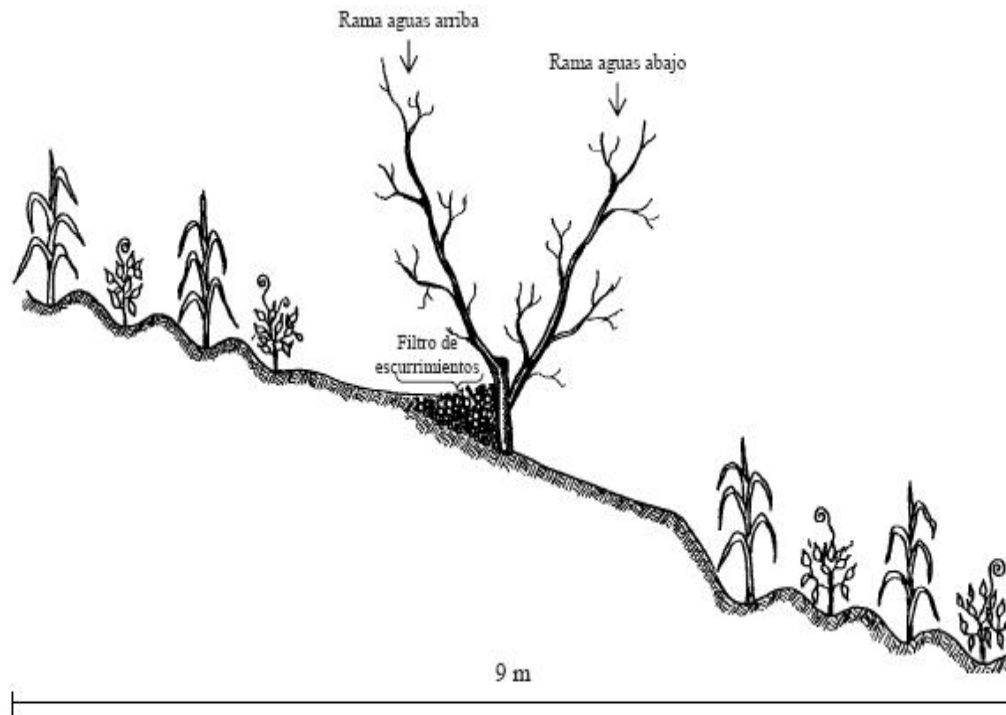


Figura 1. Diseño del sistema milpa intercalada con árboles frutales (MIAF) en laderas abruptas.

- Fruit cultivation either as specialized orchards or mixed stands maybe a better alternative than annual cultivation of corn and beans.
- Need to develop local varieties
- Fruit production can:
 - Improve family diet
 - Increase profits
 - Balance risks
 - Complete annual labor cycle thereby reducing migration
- **Effective system provided suitable cvs become available**

The example of peach

Strategy

- aggressive hybridization and selection program using the best landraces and standard foreign varieties
- Participative breeding; farmers fields multiply the number of test sites
- Direct farmer participation reduces costs and secures acceptance
- release asap intermediate products they will be always better than local original genotypes

Assumption: *the variety*

*is the axis of
any farming system*

**20 yrs effort of 1 breeder
And 1 part time collaborator**

**Salvador Perez G. and
Rafael Fernandez**

A few dozens of enthusiast
growers

Products: 12 varieties
under registration



Enough variability to obtain 2 new varieties per region per year during 4 yrs (6 regions involved).

Species and features of interest

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Species		Key features national GRs
Apple	a) old varieties asexually propagated Segregant progenies of a Sports with low chill requirements mainly GD	Low chilling requirements susceptible to powdery mildew woolly aphid and bacterial wilt low quality fruit long Fruit Development Period
Japanese Plum	a) old varieties clonally propagated Segregant progenies of a Selections with low chill requirements	Productive Low quality fruit Low to medium chill
Apricot	1 variety Canino from Spain Numerous Landraces	Well adapted Productive Low quality fruit Medium chill requirement
Pomegranate	Landraces probably derived from spanish pomegranates	Yellow skin, sweet arils, highly productive, summer production

- Specific needs
- Access to apple, plum, apricot and pomegranate live collections.
 - Attend harvest season to select potential progenitors
 - Collect pollen, perform crosses in Mexico, and if funds available conduct reciprocal crosses on US.
 - NORGEN FUNDS? Search for sources of supplementary funding.
 - Proposed starting
- What we can offer:
 - Share progenies and advanced selections for testing at developing countries without the capabilities to conduct their own breeding programs.
 - Share registration rights.

Thanks !!

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