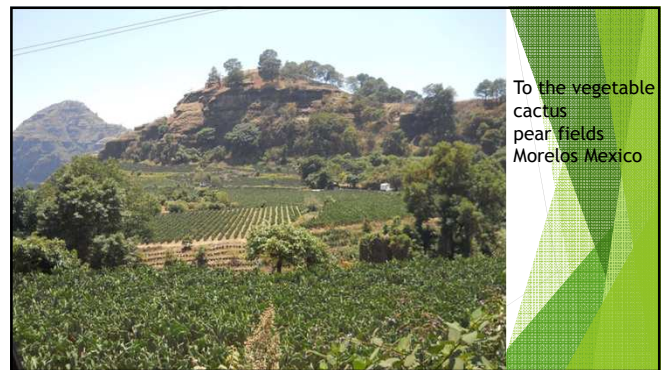
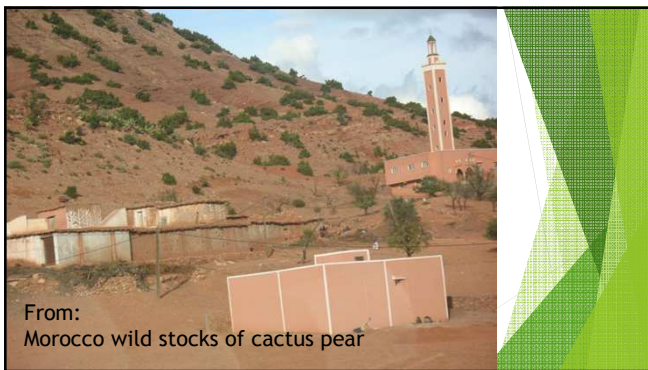


Boosting cactus pear production through genotype improvement: opportunities and challenges

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Outline

- ▶ Cactus pear a crop of contrasts
- ▶ Is the cactus pear still the exotic fruit of the 1990s? Is it necessary to find another way to improve its marketability?
- ▶ Fruit yield is not a barrier, crop management has been improved steadily
- ▶ Fruit quality and nutritional traits are the new beacons
- ▶ Fruit quality and new varieties, a must in the actual international fruit markets
- ▶ Fruit quality depends on genotype and environment plus interactions
- ▶ The role of breeding in fruit quality.
- ▶ Advances in germplasm collection and characterization
- ▶ Advances in cactus pear breeding in Mexico
- ▶ Cactus pear breeding, not attractive for private breeders?
- ▶ Does South Africa needs new cactus pear varieties? A proposal on binational collaboration
- ▶ Cactus pear breeding should be the subject of a multinational effort in the benefit of farmers



Is the cactus pear still the exotic fruit of the 1990s?

- ▶ During the 80s and 90s, the attractiveness of the cactus pear where defined by the scanty flow of fruit reaching the international markets.
- ▶ In the countries where CP is a regular crop, national demand still sustains the market,
- ▶ in Mexico the cultivated acreage, the national production and the prices of cactus pear are reaching a plateau, meanwhile the exports grew slightly.



Is the cactus pear still the marvelous exotic fruit of the 1990s?

Google search for 'cactus pear' results:

- Opuntia - Wikipedia, the free encyclopedia** (About 624,000 results (0.34 seconds))
- Barbary fig** (About 32,200,000 results (0.34 seconds))
- Mangoes** (About 8,510,000 results (0.37 seconds))

The new players on the exotic fruit corner

Modern markets are being flooded by "exotics" usually little known tropical fruits, which are presented along scanty botanical data and dubious information regarding their properties.

Most of them do not transcend beyond the ornamental effect, subjected to occasional consumption which will not generate nor sustain steady demand or potential income to the farmer.

The effects of regular consumption of cactus pear products on the other hand is backed by continuous and solid research conducted in several countries

Fruit yield is not a barrier, and crop management has improved steadily in most producing countries

ACREAGE PLANTED WITH CACTUS PEAR IN MEXICO

Productivity of cactus pear in 33 orchards of central Mexico

AVERAGE YIELD IN THE THREE MOST IMPORTANT CACTUS PEAR AREAS IN MEXICO T/HA

Fruit yield is highly dependent on the suitability (rainfall) of the areas as well as intensity of crop management

Is it necessary to find another way to improve its marketability?

Going beyond the usual nutrition table. Taking advantage of the actual trend using the consumer's interest on the composition, beneficial effects of regular consumption of fruits and vegetables, as well as the wealth of information generated by nutrition studies

Excellent presentation, new and not so new varieties and ingenious packing are the wild cards when marketing traditional fruits

Yellow Bellflower, Ralls Genet, Arkansas Black, Esopus Spitzenberg, Roxbury Russet, Winesap, Stayman

Heirloom varieties

Cactus pear breeding, not attractive for private breeders?

- The output of cactus breeding programs is low and the progress slow due to:
 - Biological complexity of Opuntia
 - Long juvenility
- There have been only two examples of private breeding in cactus pear:
 - L. Burbank, USA
 - Andy Boy, USA
- The products of both programs are in use
- There is no information on the possibility of utilization of Andy Boy's genotypes, either for commercial or scientific purposes.
- The product (varieties) should be of interest for commercial farmers but more attractive for small farmers.
- Once they are obtained and released to the growers it is difficult to control or regulate the propagation of the new varieties. (or collect royalties).

The increasing global interest on cactus pear

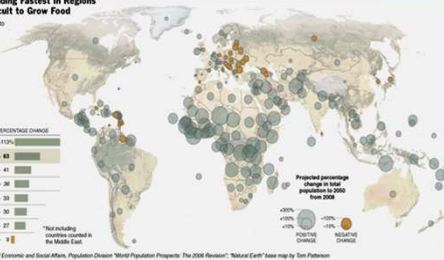
- ▶ Tolerance to drought, high productivity
- ▶ Even under stress
- ▶ Increased desertified acreage at global level
- ▶ Multipurpose plant: fruit, fodder, vegetable, valuable for human and animal consumption.
- ▶ However, its overall biological, ecological and socioeconomic value does not match with the efforts and funds available for genetic research
- ▶ Eventhough Mexico is the homeland of cactus pear the funds are inferior at 100,000 dls /yr, allocated to research in all fronts.
- ▶ There is an urgent need of more steady and sufficient funding to study cactus pear, specially on for genetics.



Cactus pear, population and food production

Populations Are Expanding Fastest in Regions Where It Is Most Difficult to Grow Food

The world's population is projected to grow to 9 billion before 2050. Proportionally, the countries in Northern Africa and the Middle East are among the fastest growing. But those are the world's most arid regions, and by 2050, fresh water there will be hard to come by.



Cactus pear is adapted and expanding in the most conflicted areas by desertification and hunger

GR conservation Ex situ conservation efforts...

Other countries involved in similar efforts: Brazil and Italy



NATIONAL OPUNTIA REPOSITORY
FIELD COLLECTION CONTAINING 410 ACCESSIONS OF DOMESTICATED CACTUS PEARS
 >To protect the national wealth Opuntia. To promote and conduct research on Opuntia germplasm. To support conservation and utilization, to provide reference material and data for legal rights

Genetic improvement in Mexico

Concentrated in the Central Region

Started in 1995

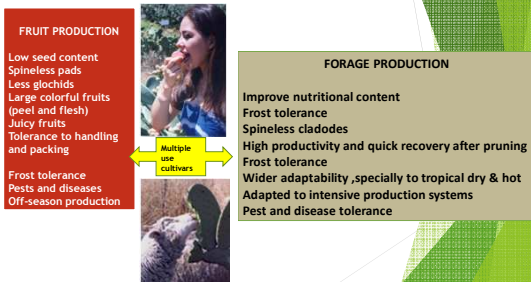
Aimed to fulfill the demands of:
 •improved fruit quality
 •extended production season
 •tolerance to pests and diseases

- Focused on Intermediate products and the development of multipurpose varieties to improve the output and benefit
- Understand the impact of biological complexity of the Opuntias



- First products presented in 2012
- Second generation expected in 2016

Breeding goals



Breeding achievements

New cultivars ...reported in 2012

New Mexican Cvs.

- "Juanita"
- "Tricolor"
- "Virreyna"

USA D Arrigo Bros.

Signature Series Cactus Pears

- Sweet Emerald
- Sweet Purple
- Sweet Crimson
- Sweet Sunset

For private use only

Plus 8-10 candidates in the pipeline

Fodder "Orelha de Elefante Mexicana" Brazil IPA

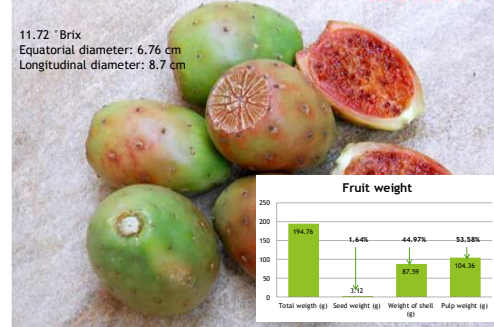
Italian selections for fruit production... reported 2012

Selection	Shape	Size	Peel colour
White peel group			
BB	ovoid	large	light yellow
M3	ovoid	large	light green
BSC	ovoid	small	light green
BSS	elliptic	medium	light yellow
Yellow peel group			
GB	elliptic	medium	orange
M1	ovoid	small	dark yellow
GS	ovoid	medium	dark yellow
GSC	ovoid	medium	orange
Red peel group			
RC	ovoid	medium	red
M2	ovoid	medium	purple
RSC	ovoid	medium	purple
RSS	ovoid	large	purple

(Chessa J. et al 2012)

Our newest addition!! **MORENA**

11.72 ° Brix
Equatorial diameter: 6.76 cm
Longitudinal diameter: 8.7 cm



Starting in 2012 A new round of hybridizations (=40) among the Best Mexican varieties, the seedlings are in the 2nd and 1st year. **inifap**



Characterization and evaluation

Molecular markers a much needed tool for GR management and to speed up breeding

- Ex situ maintenance:** Sampling, management, development of 'core' collections, utilization of genetic diversity.
- In situ and 'on farm' preservation:** Recognition of the most representative populations within the 'gene pool' Identification of the most suitable strategies for management and use.

To analyze cactus pear genetic diversity for different purposes, such as variety selection, genotypes identification and certification

Does the world needs new cactus pear varieties?

The product meets the commercial standards and competes well with other fruits?

Are actual varieties accepted by the international trade?

Productivity seems to be acceptable or even advantageous?

Are farmers happy with the actual harvest season?

Is pest tolerance acceptable ?



Towards a sustainable utilization of Cactus Pear GRs in the world. Opportunities and challenges

- ▶ The genotype is and will be the axis of any sustainable production system.
- ▶ Mexico, Italy and Brazil.
 - ▶ GR availability, expertise and suitable environment. Conduct breeding, potential collaboration with other CACTUSNET countries if funds available.
- ▶ Countries with naturalized stocks.
 - ▶ Continue selection and assessment, propagation of outstanding genotypes, keeping genetic identity and phytosanitary standards (GIPS).
- ▶ Other countries new to cactus pear cultivation.
 - ▶ Introduce the largest possible variability of improved cultivars before promote cultivation on extensive areas. Conduct medium term evaluation projects. Propagate following strict GIPS.

International collaboration a potential boost to cactus pear research, some suggestions

- ▶ Jump onto the wagon of on-going breeding programs working out agreements to obtain plant material, test on national sites and disseminate enhanced genotypes.
- ▶ Push for effective cooperation among countries who have the expertise and the research breeding programs (Mexico, Brazil and Italy)
- ▶ Pool together the efforts of demanding countries with lack of scientific manpower and genetic resources, they will also be the potential users of the products.
- ▶ Put together a bilateral or multilateral agreements to obtain funds
- ▶ *Develop multipurpose cultivars, tested on selected sites pursuing wide adaptability, include biotechnological tools, following example of cereals at CGIAR centers*

Challenges to breeding programs

- ▶ To attain effective exchange of genetic resources among breeders
- ▶ To allocate and secure long term commitment of human resources
- ▶ To secure enough funds for medium and long term funding

Acquisition , introduction and evaluation of planting material from INIFAP Mexico

- ▶ Seek and sign memorandum of understanding via SRE and INIFAP
- ▶ Controlled propagation of selected proprietary new genotypes
- ▶ Introduction of new genotypes, quarantine
- ▶ Propagation in situ of released planting material
- ▶ Short term collaborative evaluation; researchers and farmers evaluation
- ▶ Propagation of new varieties leased to authorized nurseries to ensure genetic identity and clean planting material

C. Mondragon wishes to
Thank the cactus team of the
University of Free State
for the invitation and relentless
efforts to bring me here today

And to
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And all other institutions and
Organizations who provided
the funds to organize this meetings



"Cactus pears under the sun"
by Marina Mondragon