

FINAL REPORT**INTERNATIONAL CACTUS PEAR NETWORK****1. INTRODUCTION**

This meeting was held in the City of Guadalajara, Jalisco, Mexico from August 18-20, 1993 and was organized by the University of Guadalajara with the technical and financial support of FAO.

The Ministry of Agriculture and Water Resources through the "Sistema Producto Nopal-Tuna", National Commission of Arid Zones (CONAZA) and the University of Guadalajara provided financial support for the event.

Argentina, Bolivia, Brazil, Chile, Israel, Italy, Mexico, Peru and the United States have sent representatives to the meeting and South Africa had an observer present. The meeting was attended by 50 participants, since additional participants from Argentina, Bolivia, Mexico and the United States, which included researchers, growers and the private sector.

During the meeting in which the agreements previously formulated in Santiago de Chile (1992) were revised and ratified. The Network was established on voluntary basis.

2. CONCLUSIONS**2.1. Objectives**

2.1.1 To collect and disseminate information on production and planting, trade and markets, crop research, postharvest and processing and cochinitilla on cactus pear.

2.1.2 To cooperate in the collection, conservation, exchange, evaluation and utilization of germplasm and monitor progress and usefulness of such exchanges.

2.1.3 To promote the ecological and social benefits of cactus pear.

2.1.4 To develop new food and carminic acid uses.

2.1.5 To exchange expertise and organize training courses, workshops and meetings of experts in order to improve technical capability in the individual institutions.

2.2 **General Conclusions**

2.2.1 Cactus pear plays an important social role in the production of fruits, forage, vegetables and natural dyes in subsistence agriculture mainly in the arid and semiarid regions of the world. Cactus pear is a crop that is capable of establishing a sustainable system that will increase the efficiency and economic viability of small and medium-sized farms of low-income farmers, and women farmers benefit as they participate in the process of selection and packing of fruits and nopalitos (young cactus stems). As a result cactus pear has potential for major development projects in semi-arid areas of Latin America, Africa, and the Indian subcontinent.

2.2.2 Cactus pear shows potential for national and international markets. Two markets are possible: (1) a high priced-low volume extremely high quality product and (2) a moderate priced (competitive with other fruits and vegetables) in large volumes.

2.2.3 Cactus pear cultivation requires a low input of energy and water in order to produce satisfactory yields, so it may assume greater agronomic importance for the arid or semiarid lands.

2.2.4 Cactus pear is a useful plant for the prevention of soil degradation of the land so it will help to prevent desertification and may be advantageously cultivated over a substantial part of the earth surface especially in those semiarid regions that in a near future will be affected by the Global Environmental Changes such as the increase in atmospheric CO₂ levels.

2.3 **Particular conclusions**

The participants recognize that the CACTUS-NET may promote the following priority activities:

2.3.1 Biosystematic research on cactus pear will be useful for establishing a more coherent classification of both wild and cultivated populations.

2.3.2 The reinforcement of basic physiological studies in order to support the work of agronomists and horticulturists, in aspects related to orchard management, fruit and forage quality and postharvest.

2.3.3 Definitions of breeding strategies for cactus pear using both classical methods and biotechnology tools, oriented to overcome limitations for adaptation (e.g. drought, salinity, low and high temperature), productivity (e.g. insect pests and diseases) and fruit quality (e.g. reduce seed number and size, glochids in fruits and cladodes). The advanced genetic materials will be examined in different agroclimatic conditions.

2.3.4 Establishment of a system for genetic material exchange among participating countries to the Cactus-net.

2.3.5 Characterization and conservation (*in situ* and *ex situ*) of the genetical variability in different geographical regions.

2.3.6 Development of appropriate cultural techniques that will result in both yield increase and environmental protection according to specific problems in a given area.

2.3.7 Improvement of the efficiency of production systems of Cochinilla and carmine and their transformation in other by-products considering the potential markets for natural dyes.

2.3.8 Biomedical studies on cactus pear in order to support the medicinal uses of this plant.

2.3.9 International marketing studies may involve research on particular aspects related to quality requirements of food and non-food products and pesticides regulations, among others.

2.3.10 Promotion of research on integrated control of pests, weeds and diseases.

2.3.11 Promotion of research in biotechnology oriented to the processing of fruit and vegetative parts.

2.3.12 Creation of a diffusion system oriented to increase the consumption of cactus as a fruit, vegetable, and natural dye source giving information of their importance as a source of carbohydrates and vitamins and also their potential as a medicinal plant. This effort must involve leaders in commercial areas of the food and non-food industry.

2.3.13 Development of an integrated system of livestock fodder production.

2.3.14 Involvement in other high horticultural value and fodder cactus species.

2.4 **Functioning mechanisms.**

2.4.1 A technical subgroup coordinated by the Istituto di Coltivazioni Arboree, Università di Palermo and an economic subgroup coordinated by the Universidad Autónoma de Chapingo, dealing respectively with the improvement of production and related technologies, and economics, trade and marketing.

2.4.2 The two subgroups will operate and interact under an overall coordination mechanism, for which task the Universidad de Guadalajara, Mexico was designated by the participants.

2.4.3 The technical subgroup comprises eight working groups, dealing with:

- Germplasm/propagation
- Postharvest physiology
- Agroindustrial transformation.
- Ecophysiology.
- Productivity
- Cochinilla
- Forage

- Pests and diseases

For each working groups, specialized institutions in different countries were identified to participate, and a coordinator was nominated.

2.4.4 The network will operate with the support of three regional committees i.e. North and Central America, South America and Mediterranean Basin.

2.4.5 Terms of reference were also established for each level of coordination, together with the role of the country focal points (Annex I).

2.4.6 This structure has also been expressed through a diagram (See annex II).

2.2.7. The names of the institutions for the overall coordination, the subgroup coordination with a list of countries interested in participating in each technical working group are given in annex III.

3. TECHNICAL MATTERS

3.1 The activities to be undertaken by participating countries within the structure of the technical subgroup are:

3.1.1 Identification and dissemination of available literature on cactus pear production.

3.1.2 Periodical compilation and dissemination of information regarding progress and problems of production, postharvest handling, and processing of cactus pear fruits in various countries.

3.1.3 Preparation of a directory of cactus pear research and development work currently being carried out, including list of researches and kind of available facilities, in the individual institutions.

3.1.4 Promotion of collection, conservation (*in vitro*, *in situ* and *ex situ*) exchange and utilization of germplasm through prioritizing collection needs, undertaking collections, stimulating evaluation and exchange, and preparing germplasm catalogues.

3.1.5 Documentation and circulation of success stories on production postharvest handling and processing of cactus pear fruits.

3.1.6 Organization of short training courses and inter-institutions exchanges on selected aspects of cactus pear production research and handling.

3.1.7 Harmonization procedures for certification for production of standard planting materials; identification of sources of safe new material.

3.1.8 Simulation of the preparation of region and national project proposals on the specific topics dealt with by the network.

3.2 The subject matters to be dealt with by the different working groups belonging to the technical subgroup are summarized as follows:

3.2.1 Germplasm/plant propagation

a) Elaboration of a list of potential species and varieties as source of primary germplasm.

b) *In vitro* propagation of this germplasm for exchange, to avoid the spread of diseases and pests.

c) To prepare a manual on propagation of *Opuntia*, which describe the classical propagation methods and modern techniques (i.e. *in vitro* culture methods).

d) Report on the adaptability and results of germplasm exchange.

e) Address legal aspects for the testing and propagation of materials.

f) Conservation of species in the centres of origin and diversification.

g) Study phylogenetic relationships.

3.2.2 Postharvest Physiology

- a) Study postharvest quality of fruit and vegetable stems in relation to genotypes, stages of maturity at harvest and storage conditions; study postharvest variations due to different production conditions.
- b) Study strategies to modify the development and elimination of glochids on the fruits.
- c) Develop useful techniques to control postharvest decay on fruits and vegetable stems
- d) Study harvest and handling technique which could reduce mechanical injuries; look for packaging options for national and export markets
- e) Study the postharvest behavior of lightly processed fruits and vegetable stems (peeled, cut and packaged)

3.2.3 Agroindustrial Transformation

- a) Definition of research priorities, that will be require in the field of industrial processing in order to improve the quality of the products.
- b) Special attention must be given to the production of juices, as well as to development of appropriate rural technologies.
- c) The cultural practices that are commonly used to increase productivity, may be related with the quality of the products and processing technologies.

3.2.4 Ecophysiology.

- a) The role of the group in ecophysiology is to facilitate basic research into the responses of *Opuntias* and other cacti of commercial importance to the environment as well as to provide physiological support for applied aspects of their uses. Already considerable research has been done on water relations, gas exchange, and productivity of *Opuntia ficus-indica* under various environmental conditions.
- b) We can now predict the growth of various cacti under current field conditions as well as those associated with global climate change such as

elevated levels of atmospheric carbon dioxide. Research on root growth in particular and carbon partitioning in general are under way.

c) The laboratory at the University of California Los Angeles is available for research visits, which has already been taken advantage by scientists from Chile, Israel, Italy, and Mexico.

d) Future research emphasis will be on interactions of stresses, predicting the influences of thermoperiod and photoperiod on organ development, predicting environmental responses of fruiting, and other aspects that are physiologically important.

3.2.5 Productivity.

a) To promote research concerning the promotion of flowering.

b) To promote studies connected to fruit quality (size, seed number, and size, absence of glochids).

c) To define water requirements.

d) To define nutrient requirements.

e) To optimize planting systems

f) To optimize the shape of the plants and pruning operations.

3.2.6 Cochinilla

a) To optimize production systems oriented to increase productivity and quality carminic acid.

b) To apply moderns tools of biotechnology for the processing of carminic acid.

3.2.7 Forage

In field

a) Improved varieties for the different agroecosystem, observing the requirements of soil,

temperature, rainfall, etc.

b) To study the binomium *in situ* water harvesting versus mechanization.

c) Inter cropping with annual crops.

In laboratory

a) To study the factors that might decrease the "diarrhea".

b) To study the factors that are involved in a better use of nitrogen from the concentrates in the rumen, when chopped cactus pear stems is the main forage.

c) Improved varieties with high protein and phosphorus levels.

3.2.8 Pests and diseases

a) Collection and exchange of information of current pests and diseases which limit yields and quality of fruit, vegetable, forage and cochinitilla production. The relevant aspects include biology, incidence, severity of damage and current methods of control.

b) Publication of a poster or manual for the practical identification in the field of the principal pests and diseases.

c) Formulate a project with an integrated pest management focus for the most important diseases of *Opuntia*.

d) Participate in the newsletter of the network with short articles on phytosanitary problems of importance in different areas and control methods (e.g. cladodes thickening, "caspa").

e) Extending information through the Network on phytosanitary standards applicable to the fruit and vegetable stems for export markets.

3.3 Specific tasks to be addressed by the sub-group on Economics will be to improve the collection and dissemination of economic information regarding future development plants, current plantings,

expected supply, internal demand and world demand. This subgroup should study marketing problems and explore potential for future demand expansion.

4. RECOMMENDATIONS

4.1 An important task for each of the focal points should be to diffuse in his/her country the benefits and importance of cactus pear and motivate concerned government officials of the value of this crop.

4.2 To promote programmes of collection, conservation and characterization of the existing germplasm endangered in wild and cultivated populations.

4.3 The regional coordinators should promote the establishment of joint projects between countries that share common problems related to cactus pear.

4.4 Close relations and agreements with FAO-technical cooperation networks, national and international institutions that carry out activities in arid zones should be established.

4.5 It is highly recommended to organize a meeting of focal points in 1994, in order to review the progress of activities, discuss problems and elaborate the biennial work plan. The presence of potential donors is desirable.

TERMS OF REFERENCE**A. Working Group Coordinators**

- Prepare programmes of work in accordance with national strategies and priorities.
- Ensure communication between group members.
- Elaborate technical bulletins for dissemination of information.
- Assist in establishing agreements and procedures for exchanging information/material.
- Provide subgroup coordinators with regular information on progress, results and needs of working groups.

B. Subgroup Coordinators

- Guarantee communication among working groups and between overall coordination and working groups.
- Report on activities and progress of subgroup to overall coordination (with copy to FAO)
- Prepare newsletter or publications regularly.
- Assist in preparation of regional or subregional technical programmes of assistance for submission to funding agencies/donors.
- Stimulate collaboration among members, in close coordination with FAO, to elaborate strategies for citrus expansion, rehabilitation or reconversion, or to assist in defining diversification strategies.
- Arrange regular (2 yearly) meetings of working group coordinators to review activities, progress and priorities for ongoing and future work (combined with international workshops, congresses, etc., in order to minimize costs).

C. Overall Coordination

- Guarantee communication and feedback between the subgroups.
- Elaboration of regional project proposal to address questions of global concern for submission through FAO to potential funding agencies or donors.
- Arrange meetings every 2 years of network focal points, to review progress and priorities.
- Assist in planning and organizing training activities in relation to needs of subgroups and working groups.
- Prepare publications every 2 years integrating the information coming from the subgroups.

D. Focal Points

- To guarantee feedback to countries of information generated by the different components of the network.
- To ensure communications within each country on matters related to the cactus pear network.
- To guide overall coordination of network through regular meetings of focal points (Governing body).

E. Regional Coordinators

- Promote and encourage the establishment of joint projects on cactus pear research/development among countries that share common geographical and ecological situations in regard to arid lands.
- Ensure communication between group members, the focal points and the General Coordinator.
- Arrange regular meetings of their members to review activity progress, problems and formulate work plans.
- Assist the overall coordination in the elaboration of project proposals to be addressed to FAO for submission to donors.

- Assist the overall coordination in planning and organizing training activities, workshops and meetings of experts.

INTERNATIONAL COMMITTEE.

General Coordinator: Facultad de Ciencias, Universidad de Guadalajara. EULOGIO PIMIENTA-BARRIOS

Coordinator Technical Subgroup: Istituto di Coltivazione Arboree. Università degli Studi di Palermo. GIUSEPPE BARBERA

Coordinator Economic Subgroup: Departamento de Economía Agrícola. Universidad Autónoma de Chapingo. CLAUDIO FLORES.

Regional Coordinators:
South America - JUDITH OCHOA DE CORNELLI
North America - RAMON MARTINEZ PARRA
Mediterranean Basin - AVINOAM NERD

Working Groups and Coordinators

Germplasm and Propagation: Colegio de Postgraduados, Mexico. FACUNDO BARRIENTOS.

Postharvest and Physiology: University of California Davis, U.S.A. MARITA CANTWELL.

Agroindustrial Transformation: Comisión Nacional de Zonas Áridas, Mexico. MARCO ANTONIO PASCUAL-MONCAYO

Ecophysiology: University of California Los Angeles, USA. PARK S. NOBEL.

Productivity: Università di Reggio Calabria, Italia. PAOLO INGLESE.

Cochinilla: Universidad San Cristóbal Huamanga. VICTOR FLORES

Forage: EMBRAPA, Brazil. R. ODON PESSOA SANTANA.

Pests and Diseases: Centro de Investigaciones Forestales y Agropecuarias del Estado de Guanajuato.
CANDELARIO MONDRAGON JACOBO.

WORKING GROUP IN GERMLASM AND PROPAGATION:

Name (nombre)	Institution (Institución)
Judith Ochoa de Cornelli	Universidad de Santiago del Estero. Argentina
Candelario Mondragón Jacobo	Instituto Nacional de Investigaciones Forestales y Agropecuarias.
Ardu Wessel	University of Pretoria. South Africa. (observer)
Salomón Díaz	Universidad Nacional de Huamanga. Peru.
Avinoam Nerd	Beer Sheva University. Israel.
Severino G. de Albuquerque	EMBRAPA-CLATSA. Brazil.
Peter Felker	Texas I&A. University of Texas. USA.
Giuseppe Barbera	University of Palermo. Italy.

WORKING GROUP IN POSTHARVEST PHYSIOLOGY:

Name (nombre)	Institution (Institución)
Judith Ochoa de Cornelli	Universidad de Santiago del Estero. Argentina
Fusa Sudsuki	University of Chile. Chile.
Candelario Mondragón Jacobo	Instituto Nacional de Investigaciones Forestales y Agropecuarias.
Ardu Wessel	University of Pretoria. Sudafrica. (Observer).
Yosef Mizrahi	Beer Sheva University. Israel.

WORKING GROUP IN AGROINDUSTRIAL TRANSFORMATION:

Name (nombre)	Institution (Institución)
Carmen Saenz	Universidad de Chile. Chile
Maritta Canwell	University of California Davis. USA
Fernando Galvan Castillo	Instituto Nacional de Investigaciones Forestales y Agropecuarias. Mexico
Fusa Sudzuki	Universidad de Chile. Chile.
Victor Ortuño	Tukuypaj. Bolivia.

WORKING GROUP IN ECOPHYSIOLOGY:

Name (nombre)	Institution (Institución)
Fusa Sudzuki	University of Chile. Chile.
Candelario Mondragón Jacobo	Instituto Nacional de Investigaciones Forestales y Agropecuarias. Mexico.
Peter Felker	Texas I&A. University of Texas. USA.
Ardu Wessel	University of Pretoria. Sudafrica. (Observer).
Yosef Mizrahi	Beer Sheva University. Israel.
Eulogio Pimienta	University of Guadalajara. Mexico.
Marco Brutsch	Fort Hare. Ciskei.

WORKING GROUP IN PRODUCTIVITY:

Name (nombre)	Institution (Institución)
Judith Ochoa de Cornelli	Universidad de Santiago del Estero. Argentina.
Victor Ortuño	Tukuypak Agroexportacion. Bolivia.
Park S. Nobel	University of California los Angeles. USA.
Avinoam Nerd	Beer Sheva University. Israel.
Yosef Mizrahi	Beer Sheva University. Israel.
Ardu Wessel (Observer)	University of Pretoria. Sudafrica.
Giuseppe Barbera.	University of Palermo Italy.

WORKING GROUP IN COCHINILLA:

Name (nombre)	Institution (Institución)
Franz Scheibengraf	Ministerio de Agricultura. Argentina.
Candelario Mondragón	Instituto Nacional de Investigaciones Forestales y Agropecuarias. Mexico.
H. G. Zimmerman	Agriculture Research Council. South Africa (Observer).
Tonnie Tekelenburg	Fundacion Bolivia Exporta. Bolivia.
Salomon Díaz	Universidad de Huamanga. Peru.
Liberato Portillo.	Universidad de Guadalajara. Mexico.
Victor Ortuño	Tukuypaj. Bolivia.
Ana Lilia Vigueras	Universidad de Guadalajara. Mexico.

WORKING GROUP IN FORAGE:

Name (nombre)	Institution (Institución)
G.C. De Kock	Grootfontein College of Agriculture. South Africa (observer).
Fusa Sudsuki	University of Chile. Chile.
Victor Ortuño	Tukuypak Agroexportacion. Bolivia
Peter Felker	Texas I&A. University of Texas. USA.

WORKING GROUP IN PEST AND DISEASES:

Name (nombre)	Institution (Institución)
Giuseppe Barbera	University of Palermo. Italy
Judith Ochoa de Cornelli	Universidad de Santiago del Estero. Argentina.
Victor Ortuño	Tukuypak Agroexportacion. Bolivia.
Adolfo Jimenez	Ministerio de Agricultura. Argentina.

WORK PLAN

(1993-1994)

1. Publication of a periodical newsletter with information provided by members of the Cactus-Net.
2. To initiate the organization a basic information system on Cactus Pear
3. Printing and distribution of FAO Handbook on Cactus Pear.
4. Organize regional meetings of specific technical groups.
5. Define sites and institutions for the establishment of regional germplasm.
6. Elaboration of regional-intercountry project-proposals by technical groups.
7. Explore potential national and international donors.
8. Promote intercountry agreements.