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Food and Agriculture  
Organization of the  
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CACTUSNET



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FAO-ICARDA International Technical Cooperation Network on Cactus

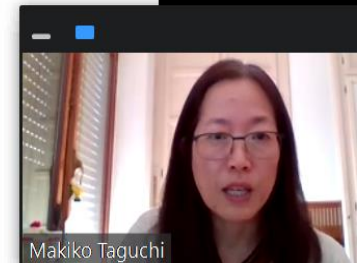


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Launching the  
2<sup>nd</sup> edition of cactus book

MORE INFORMATION



Makiko Taguchi

[www.cactusnetwork.org](http://www.cactusnetwork.org)


Welcome

<https://dgroups.org/fao/cactusnet/>

FAO-ICARDA CactusNet

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Welcome to CactusNet! (Español abajo / Français suivant)

CactusNet is an international technical cooperation network on cactus created in 1993 by FAO and ICARDA.

The FAO-ICARDA CACTUSNET is established on voluntary basis, and aims to :

- Collect and disseminate information on cactus production
- Facilitate the collection and utilization of germplasm
- Promote the ecological and social benefits of cactus pear
- Develop new food and cosmetic acid uses
- Work with national partners to improve technical capability

This is an open platform, with moderated inscription. There is no restriction in regards to the kind of ideas expressed, as long as the participants "respect the principles of the netiquette" and stays relevant to the topic. As such, we encourage our members to express and argument their opinions in a respectful way.

Recent discussions

Discussions -->

- FW: TECHNICAL WEBINAR, FAO-ICARDA CactusNet webinar series - Cactus: a staple fodder to enhance food security in semi-arid regions  
Makiko Taguchi on October 8
- Cactus app  
YAD ALZAEEM on October 3
- Registration organization of prickly pear varieties  
haiquan peng on September 22
- Blog - CACTUS PEAR - THE 'GREEN GOLD' OF JORDAN  
NAHDI OUMAIMA on September 19
- FW: SURVEY on DRYLANDS dry and sub-humid  
Makiko Taguchi on September 1
- X International Congress on Cactus Pear and Cochineal in an online format  
suryendalcar@gmail.com on August 16

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# CACTUS PEAR AND COCHINEAL A RECURRING INTERPLAY

Liberato Portillo





Food and Agriculture  
Organization of the  
United Nations

## Global Programme on Sustainable Dryland Agriculture

*Applies integrated, participatory and evidence-based approach to nurture agricultural systems*

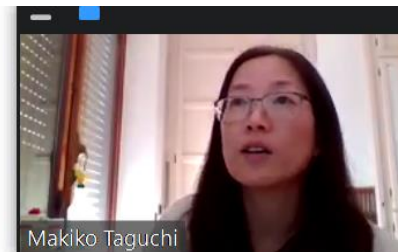
**Objective:** Improve food and nutritional security, livelihoods and environment sustainability in drylands by strengthening capacities of stakeholders and provide business opportunities

**Target:** Low and mid-income, low-capacity countries located in the drylands for 5 years with medium and long-term impact.

### **Thematic pillars:**

1. Data platform and Toolbox for assessments and integrated decision-making
2. Enabling environment for policies, strategies, investments and partnerships
3. Capacity development, strengthening institutions, infrastructure and services
4. Knowledge sharing and information exchange for awareness and advocacy

**Funding:** Multiple resource partners, financial institutions, private sectors, Government and partnership programmes, FAO Regular and Technical Cooperation





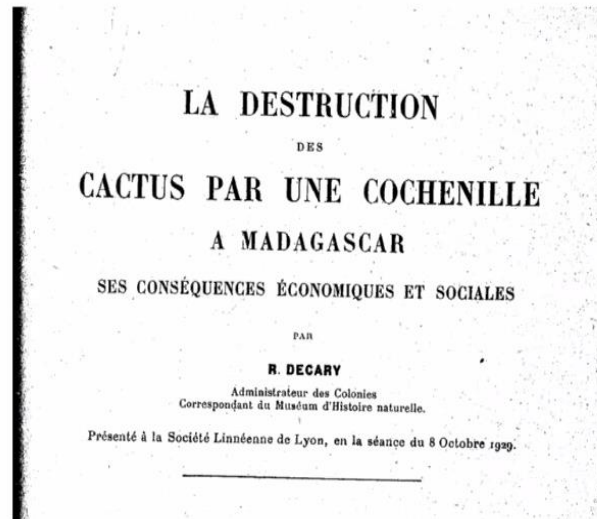


Liberato Portillo



Recording

## Cochineals have led dramatic events between cactus pear and humans...



Malagasy cactus (Middleton, 1999)

*Opuntia monacantha* Haw

The introduction of *Dactylopius ceylonicus* devastated **naturalized populations** of cactus pear, leading to a great economic losses and having consequences as severe as famine (Decary, 1929; Allorge and Matile-Ferrero, 2011).



*Dactylopius ceylonicus*  
Madagascar

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11/30/2020





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## Cochineals have led dramatic events between cactus pear and humans...

...which repeats itself in regions where these organisms are non-native

Dissemination of wild cochineal started in the state of Pernambuco, Brazil (2001), destroying more than 100,000 ha by 2009 (Santos et al., 2006; Batista Lopes et al., 2009)



***D. opuntiae***  
**Brazil**







Liberato Portillo

Cochineals have led dramatic events between cactus pear and humans, which repeats itself in regions where these organisms are non-native...



***D. coccus***  
***Ethiopia***

More than 16,000 ha of cactus pear  
land was infested with carmine  
cochineal (Tesfay Belay, 2015)



Liberato Portillo

Cochineals have led dramatic events between cactus pear and humans, which repeats itself in regions where these organisms are non-native...



Spain



Morocco

***D. opuntiae***

**Mediterranean Basin**

Dissemination of wild cochineal to other countries





Liberato Portillo

Cochineals have led dramatic events between cactus pear and humans, which repeats itself in regions where these organisms are non-native...



Spain



Morocco

India

Lebanon

USA

North of  
Mexico

*D. opuntiae*

Mediterranean Basin

Dissemination of wild cochineal to other countries

...

Regularly, when cochineals reached an *Opuntia* sp population in a non-native area, they start a biological control process

This biological control tends to succeed



Lack of native enemies of cochineal



Cochineal may become a biocontrol agent as it happens in the new association approach

## The Canadian Entomologist

Vol. 121

Ottawa, Canada, October 1989

No. 10

### NEW ASSOCIATIONS IN BIOLOGICAL CONTROL: THEORY AND PRACTICE

HEIKKI M.T. HOKKANEN

Agricultural Research Centre, Institute of Plant Protection, SF-31600 Jokioinen, Finland

and DAVID PIMENTEL

Department of Entomology, Cornell University, Ithaca, New York, USA 14853

#### Abstract

*Can. Ent.* 121: 829–840 (1989)

The new association approach for selecting biological control agents has been re-analyzed in the light of recent data. The results support the conclusion that the new association approach is ecologically and statistically sound. One of the major advantages of this approach is its capacity to control native pests, which make up 60–80% of all pests. The specificity of biocontrol agents newly associated with the target hosts is similar to other biocontrol agents. In addition, the new association approach is as safe as the old association approach in terms of environmental risks. Recent trials in the use of new associations have been most encouraging, and suggest that this approach should contribute to the future success of biological pest control worldwide.





Liberato Portillo

Regularly, when cochineals reached an *Opuntia* sp population in a non-native area, they start a biological control process

This biological control tends to succeed



Lack of native enemies of cochineal



Cochineal may become a biocontrol agent as it happens in the new association approach

Absence of crop management

## The Canadian Entomologist

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Recording

**Cochineals dissemination to new areas seems to be just of matter of time...**

**Border plant quarantine must be reinforced, also GOOD AGRICULTURAL PRACTICES must be fulfilled to limit the flow of cochineals.**

**Cactus pear is an official crop?**  
**Invasive alien species?: Spain**



**Other countries**

**Conflict of interests**

**Within and among countries**

**Good Agricultural Practices  
In Cactus Pear Crop**

Editor  
María Judith Ochoa

Authors  
María Judith Ochoa  
Giorgia Uguori  
Enrique Lobos  
Salvatore D. Aquino  
Innocenza Chessa  
Liberato Portillo  
Ana Lilia Viguera  
Alexandre De Mello

2016

**Guidelines  
"Good Agricultural Practices  
for Family Agriculture"**



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Liberato Portillo

# Cochineals dissemination to new areas seems to be just of matter of time...

Bi-lateral Mexico-Ethiopia Workshop  
Control of cochineal in Tigray, Ethiopia  
July 2<sup>nd</sup>, 2015  
Mekelle, Ethiopia



SECRETARIA DE RELACIONES EXTERIORES, EMBASSY OF MEXICO IN ETHIOPIA  
UNIVERSIDAD DE GUADALAJARA  
UNIVERSITY OF ADIGRAT  
BUREAU OF AGRICULTURE MEKELLE, ETHIOPIA

Biol Invasions (2017) 19:2427–2441  
DOI 10.1007/s10530-017-1453-x

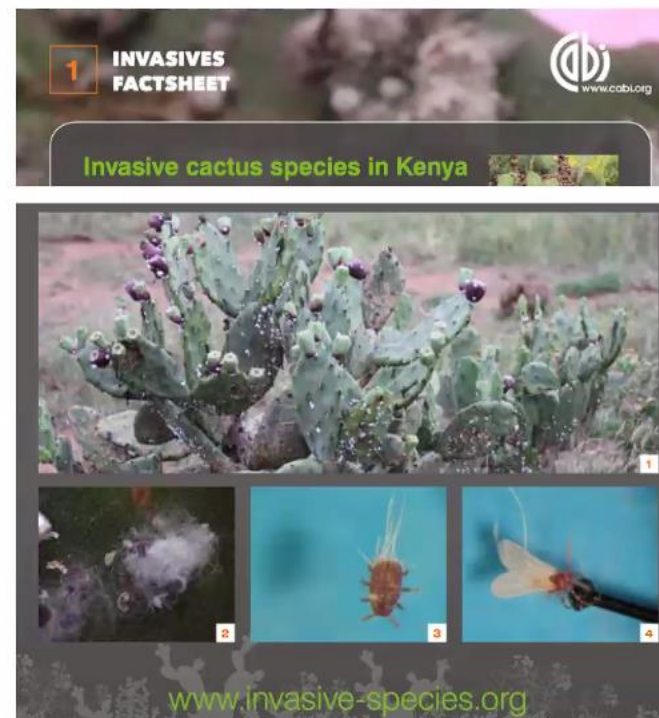


ORIGINAL PAPER

## Distribution and socio-ecological impacts of the invasive alien cactus *Opuntia stricta* in eastern Africa

Ross T. Shackleton · Arne B. R. Witt · Francis M. Piroris · Brian W. van Wilgen

Conflict  
of  
interests





## NATURAL ENEMIES (no parasitoids) PREDATORS:

Predators in Mesoamerica control cochineals, but nevertheless is necessary to implement some studies to know their efficiency in non-native areas (attending also controversies).



Species	Order and family
<i>Laetilia coccidivora</i> Comstock	(Lepidoptera: Pyralidae)
<i>Eosalpingogaster cochenillivora</i> Guerin-Meneville	Diptera: Syrphidae
<i>Sympherobius amicus</i> Fitch	Neuroptera: Hemerobidae
<i>Hyperaspis trifurcata</i> Schaeffer	Coleoptera: Coccinellidae
<i>Chilocorus cacti</i> Lineo	Coleoptera: Coccinellidae
<i>Leucopis bellula</i>	Diptera: Syrphidae





Liberato Portillo

# Cochineals dissemination to new areas seems to be just of matter of time...

## *D. opuntiae*



EPPO Reporting Service no. 04 - 2017 Num. article: 2017/082

### First report of *Dactylopius opuntiae* in Cyprus

*Dactylopius opuntiae* (Hemiptera: Dactylopiidae) feeds on *Opuntia* species. This scale has been used as a biocontrol agent against *Opuntia* spp. where these plants are considered as weeds. However, in areas where *Opuntia* spp. are grown as crops, the presence of this scale can cause severe damage. The NPPO of Cyprus recently informed the EPPO Secretariat of the first record of *D. opuntiae* on its territory. In September 2016, its occurrence was confirmed in the Famagusta district on *Opuntia ficus-indica* plants growing in public gardens and fields. The identity of the pest was confirmed by the laboratory of Fera (GB) in collaboration with the Department of Agriculture in Cyprus. Observations made after this initial finding have showed that the pest is widespread in the Famagusta district, causing quality problems to *Opuntia*. Official control measures will be taken, including insecticide treatments in the infested areas, surveys across the whole island, and an information campaign for *Opuntia* growers and owners.

The pest status of *Dactylopius opuntiae* in Cyprus is officially declared as: **Present, subject to official control.**

#### Sources

NPPO of Cyprus (2017-03).



Chat



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Q&A

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## Cochineals dissemination to new areas seems to be just of matter of time...

### Abstract

**Bufaur, M. and R. Bohamdan. 2020. First report of the Opuntia cochineal scale *Dactylopius opuntiae* (Cockerell, 1896) in Syria. Arab Journal of Plant Protection, 38(1): 59-63.**

The *Opuntia* cochineal scale insect *Dactylopius opuntiae* (Cockerell) (Dactylopiidae: Hemiptera) was reported for the first time as a new species in Syria. Classification and identification was made in the plant protection laboratory of Sweida Research Center. Field survey was conducted on cactus plants in the western area of Sweida governorate during the summer of 2018, when considerable damage was noted as yellowing and death of plant parts following the attack with this insect species. Field survey of the insect and its density were carried out in different areas in the region. Morphological and taxonomical features of the adult female were used for classification.

**Keywords:** *Dactylopius opuntiae*, cactus, morphological features, First record, Syria.

**Corresponding author:** Mazen Bufaur, Sweida Research Center, General Commission for Scientific Agricultural Research, Damascus, Syria, Email: [mazenaudy@yahoo.com](mailto:mazenaudy@yahoo.com)

*D. opuntiae*





## Cochineals dissemination to new areas seems to be just of matter of time...

.....  
**Management of the *Opuntia* cochineal scale insect, *Dactylopius opuntiae* (Cockerell) in Israel**

Alex Protasov, Zvi Mendel / Dept. of Entomology, ARO, Volcani Center, Bet Dagan, Israel

Malkie Spodek / The Steinhardt Museum of Natural History, Tel Aviv University, Israel

Carlos Jorge Carvalho / Tsemach Nisyonot, Jordan Valley, Israel

The *Opuntia* cochineal scale, *Dactylopius opuntiae* (Hemiptera: Coccoomorpha: Dactylopiidae), an aggressive scale insect, was first reported in Israel in the Upper Galilee in 2013. It infests and kills the Indian-fig prickly pear, *Opuntia ficus-indica* (L.) Miller (Cactaceae), a prominent plant in Israeli landscape. The management of the early outbreak with inundated releases of 100,000 adult predatory beetles, *Cryptolaemus montrouzieri* Mulsant, was unsuccessful. A collaboration with Mexican researchers from the Posgrado en Fitosanidad Colegio de Postgraduados, and KKL forest department, facilitate the introduction of two natural enemies from Mexico for the control of the scale in Israel: a predatory beetle, *Hyperaspis trifurcata* (Coleoptera: Coccinellidae) and a predatory fly, *Leucopis bellula* (Diptera: Chamaemyiidae). Recently, individuals of *H. trifurcata* have been released in the cochineal infested sites in the Galilee. ■

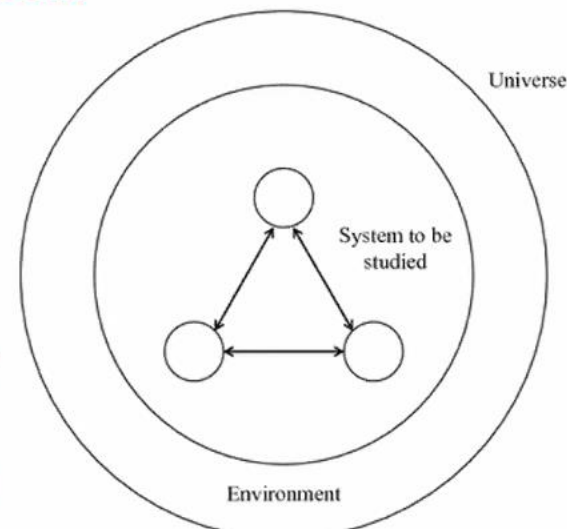
**Biotic - abiotic factors, and the use of cactus pear in a given region are particular.**

**Then the management of the pest should be also specific in every case...**

**Nevertheless, global action must be considered.**

## General Systems Theory

All processes are linked





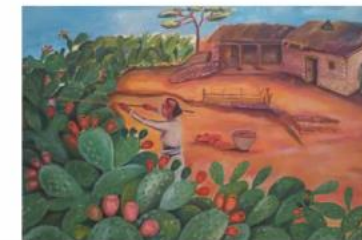


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## Control of cochineals depends on many factors...

➡ where does the cactus pear and cochineal interplay occur?

- ☐ native or non-native region
- ☐ invasive species (management)
- ☐ local weather
- ☐ communal worldview
- ☐ others



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## Control of cochineals depends on many factors...

→ where does the cactus pear and cochineal interplay occur?

- ☐ native or non-native region
- ☐ invasive species (management)
- ☐ local weather
- ☐ communal worldview
- ☐ others

- Pesticides (chemical and botanical)
- Detergents, oil
- Pressurized water
- Silicon powder
- Natural enemies
- *Opuntia* spp
- Others (*Wolbachia*)





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## Control of cochineals depends on many factors...

→ where does the cactus pear and cochineal interplay occur?

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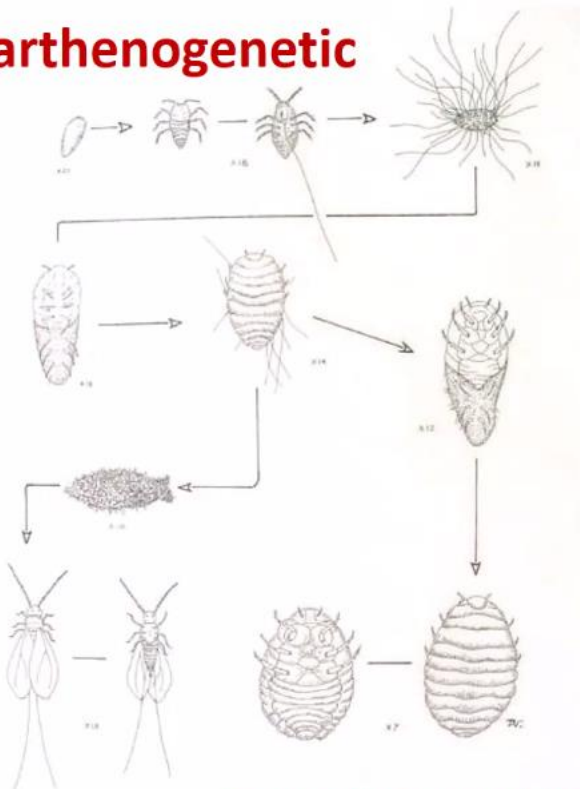
Cactus pear plantations or  
naturalized populations

- Pesticides  
(chemical and botanical)
- Detergents, oil
- Pressurized water
- Silicon powder
- Natural enemies
- *Opuntia* spp
- Others (*Wolbachia*)



## Control of cochineals depends on many factors...

### Parthenogenetic



**Female: sessile**

Environmental Entomology Advance Access published April 7, 2016

*Environmental Entomology*, 2016, 1–7

doi: 10.1093/ee/nvw023

Research

### Biological Control—Parasitoids and Predators

## Autonomous Biological Control of *Dactylopius opuntiae* (Hemiptera: Dactylopiidae) in a Prickly Pear Plantation With Ecological Management

J. A. Cruz-Rodríguez,<sup>1,2</sup> E. González-Machorro,<sup>1</sup> A. A. Villegas González,<sup>1</sup> M. L. Rodríguez Ramírez,<sup>3</sup> and F. Mejía Lara<sup>4</sup>

<sup>1</sup>Departamento de Agroecología, Universidad Autónoma Chapingo. Km 38.5 de la carretera México- Texcoco, Estado de México, México (jacr66@hotmail.com; EmiliaGonzaM@hotmail.com; apolo\_vlac\_avg@hotmail.com), <sup>2</sup>Corresponding author, e-mail: jacr66@hotmail.com, <sup>3</sup>Área de Biología, Universidad Autónoma Chapingo. Km 38.5 de la carretera México- Texcoco, Estado de México, México (malur85@hotmail.com), and <sup>4</sup>Farmer of organic prickly pear. Axapusco, Estado de México, México (tunaeco@yahoo.com.mx)

Received 16 October 2015; Accepted 4 March 2016

**In Mexico**





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## Control of cochineals depends on many factors...

### Always integrating new concepts

---

**Autonomous Control (AC)** of cochineals on *Opuntia* plantations with **Good Agricultural Practices (GAP)**, currently allows in Mesoamerica to have this biointeraction below the economic threshold...

The main request to fulfill this concept is having the plants as a **formal cultivation**, since in **neglected plantations** or **naturalized** plant populations it seems useless.

## AC & GAP

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## Control of cochineals depends on many factors...



- Border plant quarantine
- Prospecting
- Control
- Prevent spread
- Prospecting

## PROSPECTION



**México**

**The management of the cochineal as pest should be local...  
...global action must be considered**



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**Control of cochineals depends on many factors...**

**The support from leaders of domestic agricultural institutions**

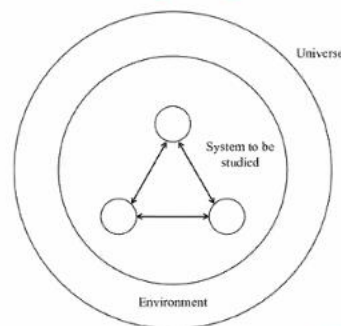
**Decision makers from social, cultural, and political spheres**

**Training of cactus pear growers will be fundamental to face this situation**

**All efforts will lead to a proper management of cactus pear**

**...and may keep cochineal populations at acceptable thresholds**

**Integral  
IPM**



**Holistic  
HPM**



**Model**



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## IPM & HPM

---

Holistic Pest Management (HPM) goes beyond Integral Pest Management (IPM) by integrating ideas, concepts, philosophies, and experiences; **placing growers in central focus**, instead the plagues (as occurs with IPM), allowing producers surpass their significative problems, and then they will have resources and interest to attend the causes and control of a given plague, getting competitive levels of profitability.

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## Control of cochineals depends on many factors...

**Selection pressure helps to find tolerant opuntias to cochineals**

Selecting opuntias and biocontrol agents in base to the **Theory of New Association** in combination with **Good Agricultural Practices**: Morocco and Ethiopia

**TNA, GAP, & AC**

**Autonomous Control in Brazil**

**Coccinelid in Paraiba**



**TNA  
&  
GAP**

**Specific  
Management**





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## Control of cochineals depends on many factors...



***Opuntia stricta* (subsp. *esparzae* Scheinvar)**

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## Control of cochineals depends on many factors...

### Multiplication of selected plants

**Material de propagación para el cultivo de xoconostle**

Penca	Brazo	Fracción de penca
-Útil para nuevas plantaciones. -Fácil manipulación y transporte. -La primera cosecha se obtiene 2 años después.	-Compuesta por 2 o 3 pencas. -Difícil manipulación y transporte. -La primera cosecha se obtiene al ciclo siguiente.	-Fracción en 2 o 4 partes. -Menor inversión. -La primera cosecha se obtiene 3 años después.

**Nota:**

Para realizar el corte del material se requiere de una navaja o machete previamente desinfectados en una solución de 30 mililitros de hipoclorito de sodio.

INIFAP [www.inifap.gob.mx](http://www.inifap.gob.mx) Tel.: 01 800 088 2222



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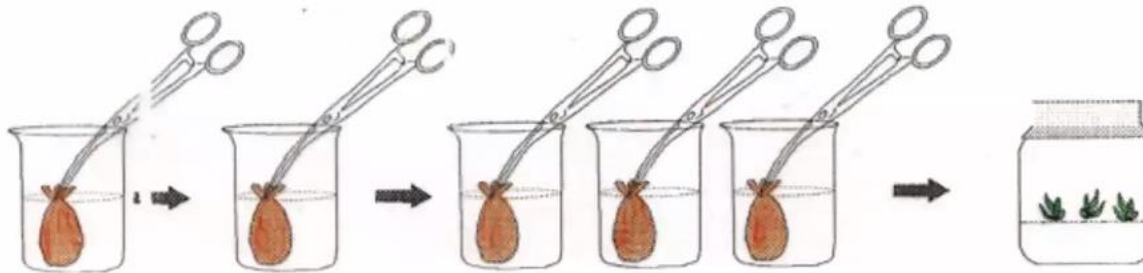
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## Control of cochineals depends on many factors...



**Aseptic multiplication  
of selected plants**



**bio-101**

[www.bio-protocol.org/e2923](http://www.bio-protocol.org/e2923)

DOI:10.21769/BioProtoc.2923

### Micropropagation of Prickly Pear by Axillary Shoot Proliferation

Luisa Gutiérrez-Quintana, Carlos Zúñiga-Rizo, Asdrúbal Burgos\* and Liberato Portillo

Laboratorio de Biotecnología, Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Zapopan, Jalisco, MÉXICO



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## Control of cochineals depends on many factors...

*Journal of  
Applied Ecology*  
1999, 36,  
85–91

### Host-plant affinities of two biotypes of *Dactylopius opuntiae* (Homoptera: Dactylopiidae): enhanced prospects for biological control of *Opuntia stricta* (Cactaceae) in South Africa

C.R. VOLCHANSKY\*, J.H. HOFFMANN\* and H.G. ZIMMERMANN†

**Insect  
science**

*Insect Science* (2015) 22, 360–374, DOI 10.1111/1744-7917.12120

ORIGINAL ARTICLE

Genetic variation amongst biotypes of *Dactylopius tomentosus*

Catherine W. Mathenge<sup>1</sup>, Markus Riegler<sup>2</sup>, G. Andrew C. Beattie<sup>1</sup>, Robert N. Spooner-Hart<sup>1</sup> and Paul Holford<sup>1</sup>

**Selection pressure  
helps to find tolerant  
opuntias to cochineals**

**Adaptation:  
*O. brasiliensis*  
*O. schickendantzii***

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## Cochineals have been disseminated along with cactus pear... **Opuntias** have been disseminated along with **cochineals**

Viguera & Portillo: Uses of *Opuntia* in Mexico

493

### USES OF *OPUNTIA* SPECIES AND THE POTENTIAL IMPACT OF *CACTOBLASTIS CACTORUM* (LEPIDOPTERA: PYRALIDAE) IN MEXICO

A. L. VIGUERAS G. AND L. PORTILLO  
Departamento de Botánica y Zoología, Universidad de Guadalajara,  
Apdo. Postal 1-139, Zapopan, Jalisco 45101 México

#### ABSTRACT

In Mexico, cactus pears (*Opuntia* spp.) are regarded as very important plants, especially in semi-arid and arid regions where few crops can be cultivated. Historically, Mexicans have used cactus pears for food, as fodder for cattle, for medicinal purposes, in cosmetics, to produce dyes, and as natural fences. Cactus pears are also an important component of native ecosystems. Central Mexico is considered to be one of the main centers of cactus diversity. Approximately 200 species of *Opuntia* are recognized worldwide, 114 of which occur in Mexico. Because most *Opuntia* species are thought to be susceptible to attack by the cactus moth, *Cactoblastis cactorum* (Berg), spread of this moth into Mexico would likely have significant economic and social impacts. A number of the most widely used and/or distributed species, including *O. compressa* Macbride, *O. ficus-indica* (L.) Miller, *O. megacantha* Salm-Dyck, *O. stricta* (Haw.) Haworth and *O. tomentosa* Salm-Dyck, are known hosts of the cactus moth.

Key Words: prickly pear, cactus moth, invasive species



...and more





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Cochineals have been disseminated along with cactus pear...

**Opuntias** have been disseminated along with **cochineals**

Viguera & Portillo: Uses of *Opuntia* in Mexico

493

USES OF *OPUNTIA* SPECIES AND THE POTENTIAL IMPACT OF  
*CACTOBLASTIS CACTORUM* (LEPIDOPTERA: PYRALIDAE) IN MEXICO



...and more

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Recording

Cochineals have been disseminated along with cactus pear...  
**Opuntias** have been disseminated along with **cochineals** ...and more



**Black spot in Mexico**  
(*Pseudocercospora opuntiae*)

Argentina  
Bolivia  
Peru  
Others



**Cylindrocopturus biradiatus**  
spine weevil

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NAKARI

SOCIEDAD JALISCIENSE  
DE CACTOLOGIA[www.cactusnetwork.org](http://www.cactusnetwork.org)<https://sites.google.com/view/nakari/home><http://expoimagina.cucba.udg.mx/>

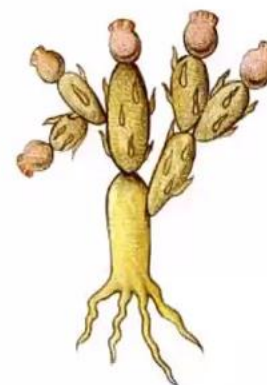
Miradas al futuro

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Liberato Portillo

NAKARI

SOCIEDAD JALISCIENSE  
DE CACTOLOGIA[www.cactusnetwork.org](http://www.cactusnetwork.org)<https://sites.google.com/view/nakari/home><http://expoimagina.cucba.udg.mx/>

Miradas al futuro

EXPO  
IMAGINA

2020 - 2021

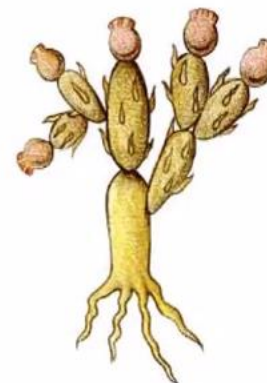


THANKS

-let's share-



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Codex Azcatitlan