

- **GLOBAL INVASIONS OF OPUNTCIOIDEAE: ARE THERE SOLUTIONS FOR THEIR CONTROL WITHOUT A CONFLICT OF INTEREST?**

- HELMUTH ZIMMERMANN



- Opuntioideae: Countries where serious invasions have been recorded

Genus	Countries of introduction and where invasive
Austrocylindropuntia	Australia, South Africa, Namibia, Kenya, Spain
Cylindropuntia	Australia, South Africa, Namibia, Zimbabwe, Israel, Spain, Kenya, Zimbabwe, Botswana, Namibia
Opuntia	Australia, South Africa, Namibia, Zimbabwe, Kenya, Ethiopia, Yemen, Ghana, Tanzania, Angola, India, Sri Lanka, Madagascar, Mauritius, Hawaii, Canary Islands, Saudi Arabia, Reunion, Spain, Angola
Tephrocactus	South Africa, Australia?
Cumulopuntia	Australia

- Examples of invasions: *Austrocylindropuntia*

*A. subulata*

South Africa



*Austrocylindropuntia cylindrica*



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Cumulopuntia	Australia

*Cylindropuntia. C. fulgida var. fulgida*



• *Cylindropuntia. C. fulgida var. fulgida*



Zimbabwe

• *Cylindropuntia. C. fulgida var. mamillata*



Australia

• *Cylindropuntia: C. pallida (Australia)*



*Cylindropuntia: C. pallida : South Africa*



• *Cylindropuntia: C. spinosior (Australia)*



• Total number of Opuntioideae that have been listed as invasive at a global level.

Genera in the Opuntioideae	Number of species	Number of invasive species
Austrocylindropuntia	11	2
Cylindropuntia	33	8
Opuntia	181	25
Tephrocactus	6	1
Cumulopuntia	20	1



- **Opuntia: *O. stricta* var. *stricta***

Ethiopia



Ghana



- **Opuntia: *O. humifusa***
- **(South Africa)**



- **Opuntia: *O. aurantiaca* (South Africa/Australia)**



- **Opuntia: *O. salmiana* (South Africa)**



- **Opuntia: *O. engelmannii* (South Africa)**



- **Opuntia: *O. elatior* (Kenya)**



*O. elatior*

►

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- Opuntioideae: *Tephrocactus auriculatus*



Solutions?

►

Genus	Utilization	Chemical/ mechanical control	Biological control
Austrocylindropuntia	X	✓	X
Cylindropuntia	X	✓X	✓
Opuntia	✓		✓
Tephrocactus	X	✓	X

- Cylindropuntia: chemical control



Solutions?

►

Genus	Utilization	Chemical/ mechanical control	Biological control
Austrocylindropuntia	X	✓	X
Cylindropuntia	X	✓X	✓
Opuntia	✓	✓	✓
Tephrocactus	X	✓	X

- *Cylindropuntia fulgida* var. *mamillata*  
Biological control



- *Cylindropuntia fulgida* var. *fulgida*
- Biological control





- *Cylindropuntia: C. pallida* in Namibia
- No solution yet!




- Solutions?

Genus	Utilization	Chemical/ mechanical control	Biological control
Austrocylindropuntia	X	✓	X
Cylindropuntia	X	X	✓
Opuntia	✓	✓	✓
Tephrocactus		✓	X



- Opuntia: utilization
- *Opuntia ficus-indica*





- Opuntia: utilization
- Opuntia ficus-indica*






- But how much of utilization is really contributing to the control of large invasions??? We don't know.

**Utilization (cont.)**  
***Opuntia robusta* (South Africa, Australia)**

• Solutions?

Genus	Utilization	Chemical/ mechanical control	Biological control
Austrocylindropuntia	X	✓	X
Cylindropuntia	X	X	✓
Opuntia	✓	✓	✓
Tephrocactus	X	✓	X

**Mechanical/chemical control**  
***Opuntia*:**

• Solutions?

Genus	Utilization	Chemical/ mechanical control	Biological control
Austrocylindropuntia	X	✓	X
Cylindropuntia	X	X	✓
Opuntia	✓	✓	✓
Tephrocactus	X	✓	X

**Biological control: Most of the research was on *O. stricta* & *O. ficus-indica***

1. 65 Cactophagous species of insects and mites were introduced and released for the BC of Cactaceae worldwide and only 21 successfully established;
2. The cochineals and Cactoblastis have contributed by far the most to the biocontrol (BC) of Cactaceae worldwide. The successes are unlikely to be repeated;
3. The contribution of Hemiptera, other Lepidoptera, Coleoptera, Diptera and mites has been minimal;

→ Biotypes and host-specific "strains" of mainly *Dactylopius* spp. have been identified which provided good control of several cactus invaders that could not yet be controlled.

"stricta" biotype

2 Agents on *O. stricta*

South Africa 1999      Australia 1933

- *Opuntia ficus indica*.
- "prickly pear"

+

**Opuntia ficus-indica: South Africa**

1. More than 80% of the original infestations had been controlled and much of the grazing value was restored.
2. The remaining infestations are actively utilized and have acquired considerable value.

- *O. ficus-indica*: What to do with Ethiopia, Saudi Arabia, Yemen, Madagascar????

**Biological control: Opuntia: *O. humifusa***

*Dactylopius opuntiae*  
biotype "stricta"

**Biological control**  
*Opuntia aurantiaca*

• ....and what to do with new emerging cactus invaders???

?

?

- Except maybe for new host-adapted biotypes of *Dactylopius* cochineals, most of the new natural enemies on *Opuntiae* will also feed (not necessarily develop) on *Opuntia ficus-indica* and the spineless *Opuntia robusta* and this precludes the release of these biocontrol agents in South Africa but not necessarily in other countries.
- Therefore the chances of biological control of new *Opuntia* invaders in South Africa are slim.

The research on host-specific biotypes of cochineal has potential.



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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

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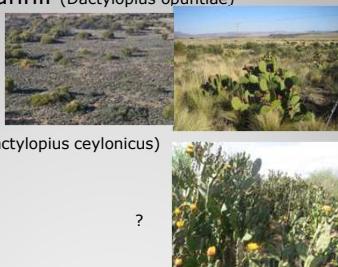
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39: 980–989

#### Biological control of cactus weeds: implications of hybridization between control agent biotypes

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- We may find new host-adapted biotypes of cochineal spp.. For example:
- *O. engelmannii* (*Dactylopius opuntiae*)  
?
- *O. elata* (*Dactylopius ceylonicus*)  
?



But for this we need the co-operation and assistance of Mexico, the USA, Brazil and Argentina.



Thank you

