

# What's New in Weed Biocontrol in California

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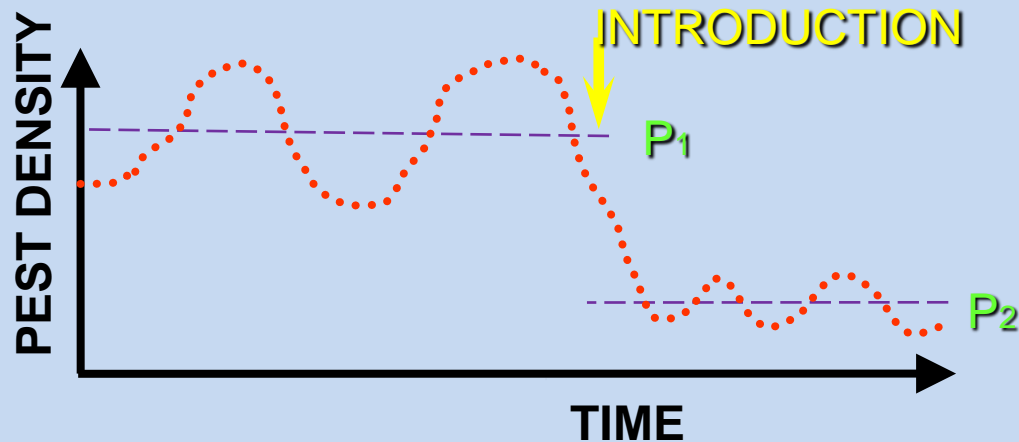
California Department of Food and Agriculture  
Sacramento

# Classical Weed Biological Control

- A method of weed control where natural enemies from a weed's native range are introduced into the exotic range where the weed has become invasive.
- The objective is for the exotic natural enemy to become self-sustaining members of the herbivore community in the new area of infestation.
- Most common biological control method used against weeds

# THEORY OF BIOLOGICAL CONTROL:

Density dependent mortality lowers the average density of the weed population



# Musk Thistle (*Carduus nutans*)

## Siskiyou County



# Musk Thistle Control Agent

## Seed Head Weevil

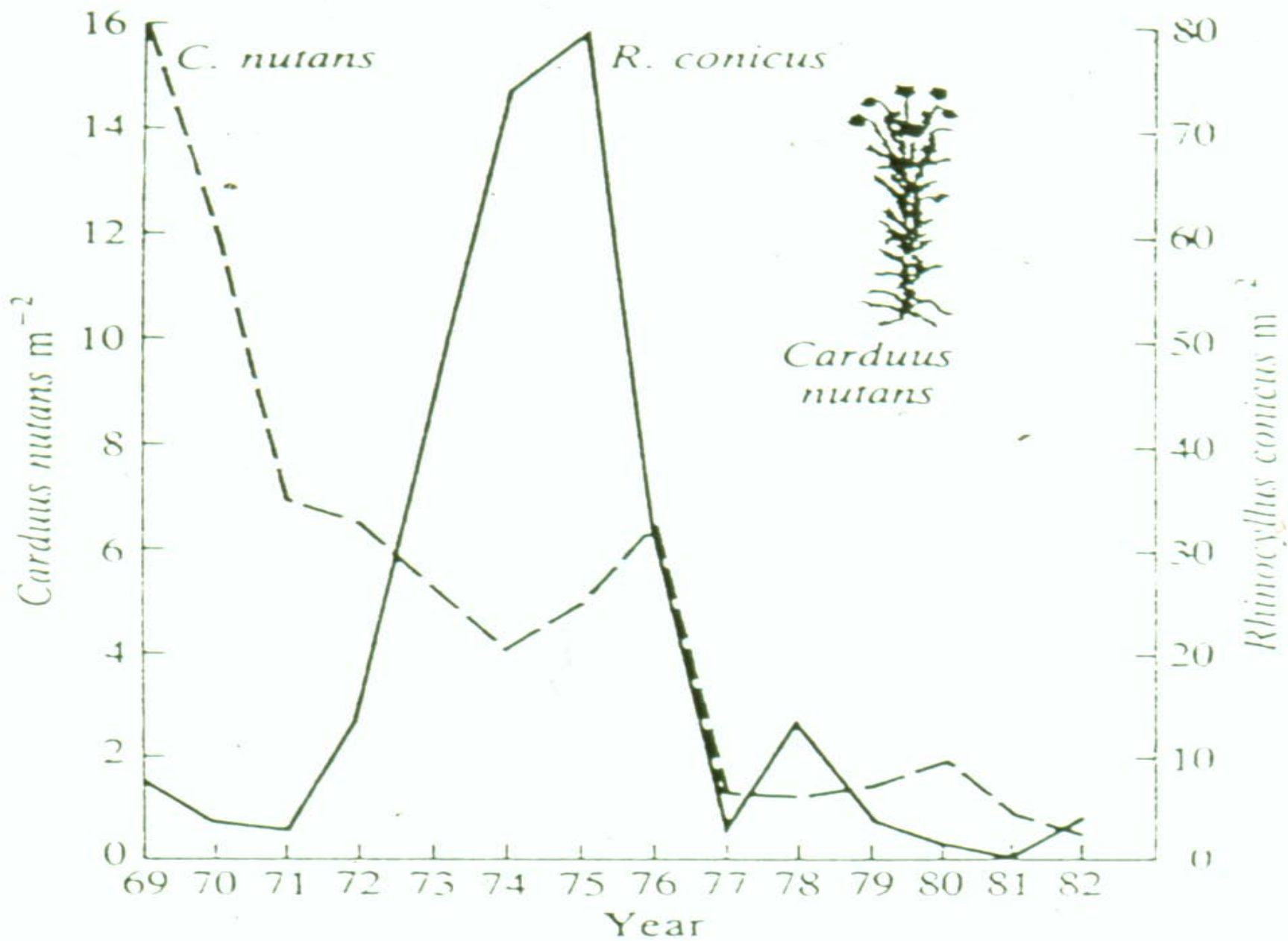
Adult



Larval Damage



Photos by CDFA



# What's New for California?

## Newly Approved BC Agents

- Giant reed, *Arundo donax*
  - *Tetramesa romana* (gall wasp)
  - *Rhizaspidiotus donacis* (scale insect)
- Russian knapweed, *Acroptilon repens*
  - *Jaapiella ivannikovi* (gall fly)
  - *Aulacidea acroptilonica* (gall wasp)
- Canada thistle, *Cirsium arvense*
  - *Ceutorhynchus litura* (root weevil)
- Rush skeletonweed, *Chondrilla juncea*
  - *Bradyrrhoa gilveolella* (root moth)
- Water Hyacinth, *Eichhornia crassipes*
  - *Megamelus scutellaris* (plant hopper)
- Klamath weed, *Hypericum perforatum*
  - *Aplocera plagiata* (leaf moth)

Patrick Moran USDA-ARS

released 2010

released 2013

Jodi Aceves (Siskiyou Co) & CDFA

released 2011

released 2013

Jodi Aceves (Siskiyou Co) & CDFA

establ. Siskiyou & Lassen Cos

CDFA

released 2013

Patrick Moran USDA-ARS

released 2011

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released 2011





**Arundo along Irrigation canal, Weslaco, TX**

Photo by John Goolsby, USDA-ARS





1539 mi

Image Landsat  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth





**Arundo along the Rio Grande River in Texas**

Photo by John Goolsby, USDA-ARS



# Biological Control Agents

**Arundo wasp**



*Tetramesa romana*  
Arundo wasp  
Hymenoptera: Eurytomidae  
larvae feed on stems & side shoots (adult stingless)  
**Released in CA in 2010**

**Arundo scale**



*Rhiaspidiotus donacis*  
Arundo scale  
Homoptera: Diaspididae  
scale insects feed on roots and side shoots  
**Released in CA in 2013**

**Arundo leafminer**



*Lasioptera donacis*  
Arundo leafminer  
Diptera: Cecidomyiidae  
Larvae are leaf sheath miners causing defoliation  
**Under evaluation**

**Arundo fly**



*Cryptonevra* spp.  
Arundo fly  
Diptera: Chloropidae  
fly larvae feed on new stem shoots  
**Testing in Europe**



# USDA-ARS Scientists working on *Arundo* biocontrol



John Goolsby

Patrick Moran

# *Tetramesa romana* (Hymenoptera: Eurytomidae)



Slide provided by John Goolsby, USDA-ARS

- Adult females live 4-5 days and reproduce via parthenogenesis-
- One female produces an avg. of 26 new adults; max of 66.
- Larvae develop inside cane in 30-35 days.
- Almost all (90%) of egg-laying and feeding occur at shoot tip.
- Growth of plant stunted by gall.
- Host specific to *Arundo donax*.

Goolsby J. A. and Moran, P. J. Host range of *Tetramesa romana* Walker (Hymenoptera: Eurytomidae), a potential biological control of giant reed, *Arundo donax* L. in North America. *Biological Control* 49:160-168. 2009.

Moran, P. J., and Goolsby, J. A. Biology of the galling wasp *Tetramesa romana*, a biological control agent of giant reed. *Biological Control* 49:169-179. 2009.



# *Arundo* wasp damage Lower Rio Grande Valley

Photos by John Goolsby, USDA-ARS





# Giant reed

*Arundo donax*



*Tetramesa romana*

Accidentally introduced –  
found in Southern California

Map of 2007 survey

Dudley et al. (2007)

Current efforts by USDA-  
ARS using known biotypes  
and releases directed at  
sites in Northern CA

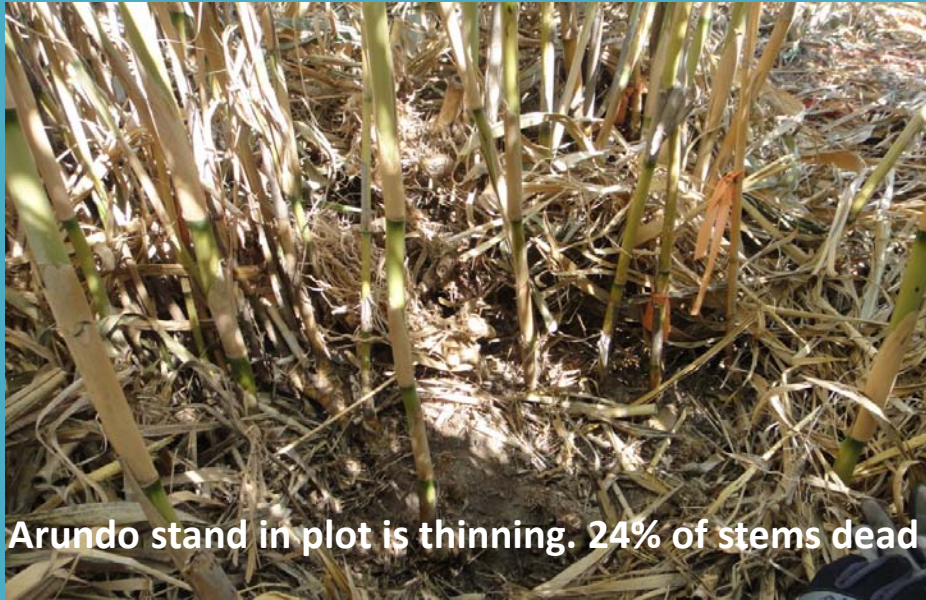
# *Rhizaspidiotus donacis*, Arundo scale



- Feeds on roots and stems, host specific to *Arundo*
- Sex ratio (Female:Male) in adults:  $0.88 \pm 0.094$  (n = 37 plants)
- Adult female survival (on plant until reproductive maturity): 203 days  
Slide provided by John Goolsby, USDA-ARS
- Average crawler production by individual female: 85 to 300, 50-80% of females are reproductive
- Highly significant impact on *A. donax* in Europe
- Goolsby, J. A., Moran, P. J., Adamczyk, J. A., Kirk, A. A., Jones, W. A., Marcos, M. A. and Cortés, E. 2009. Host range of the European, rhizome-stem feeding scale *Rhizaspidiotus donacis* (Leonardi) (Hemiptera: Diaspididae), a candidate biological control agent for giant reed, *Arundo donax* L. (Poales: Poaceae) in North America. 19: 899-918
- Moran, P. J., and Goolsby, J. A. 2010. Biology of the armored scale *Rhizaspidiotus donacis* (Hemiptera: Diaspididae), a candidate agent for biological control of giant reed. Annals of the Entomological Society of America 103: 252-263



# Arundo scale damage – Del Rio, TX





# Effects of human disturbance and climate on arundo scale impacts on *Arundo donax* in Europe



<p>A. Undisturbed No freeze Hot summer Dry soil</p>	<p>B. Disturbed (mowing) No freeze Hot summer Dry soil</p>	<p>C. Disturbed (irrigation) No freeze Hot summer Wet soil</p>	<p>D. Undisturbed Light freeze Warm summer Dry soil</p>	<p>E. Undisturbed Deep freeze Mild summer Dry soil</p>
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Goolsby, John A., Racelis, Alex E., Goolsby, Julia B., Kirk, Alan A., Cristofaro, Massimo, Grusak, M. and Perez de Leon, Adalberto. 2013. Evaluation of biogeographical factors in the native range to improve the success of biological control agents in the introduced range. *Biological Control Science and Technology*. 23:1213-1230.

# *Lasioptera donacis*, Arundo leafminer



- Larvae feed in leafsheath channels
- Causes rapid leaf death and defoliation
- Defoliator needed to open plant canopy to allow for native vegetation to compete
- Adult fly places spores of saprophytic fungi (*Arthrinium arundinis*) on leafsheath to start infection
- *A. arundinis* found worldwide, Texas accession to be used for release on Rio Grande



# Arundo leafminer

Photos by John Goolsby, USDA-ARS



Fly larva feeds on leaf sheath causing defoliation



# What's New for California?

## Accidental introductions into California

- Scotch broom, *Cytisus scoparius*
  - *Aceria genistae* (gall mite)
  - *Asphondylia pilosa* (flower bud gall fly)
- Dalmatian toadflax, *Linaria genistifolia* ssp. *dalmatica*
  - *Mecinus janthiniformis* (stem weevil)
- Canada thistle, *Cirsium arvense*
  - *Larinus planus* (seed head weevil)
- Musk thistle, *Carduus nutans*
  - *Cheilosia corydon* (root & stem fly)

# Scotch broom natural enemy

*Aceria genistae* - broom gall mite



Photos provided by Jennifer Andreas, Washington State University



# Scotch broom natural enemy

*Aceria genistae* - broom gall mite



Photos from Eric Coombs, Oregon Dept. of Agriculture



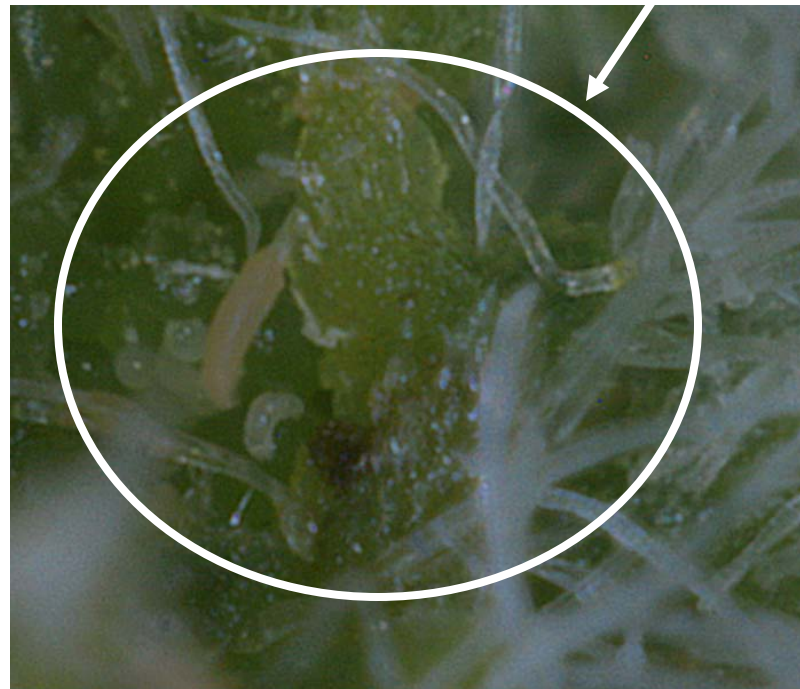
Galls stunt growth and can result in plant mortality



# Scotch broom natural enemy

*Aceria genistae* - broom gall mite

Photos from Eric Coombs, Oregon Dept. of Agriculture



# Dalmatian toadflax



- Family Scrophulariaceae (snapdragon family)
- Perennial
- Invades and dominates rangelands
- *Mecinus janthiniformis* – a stem weevil
- Accidental introduction in Northern CA





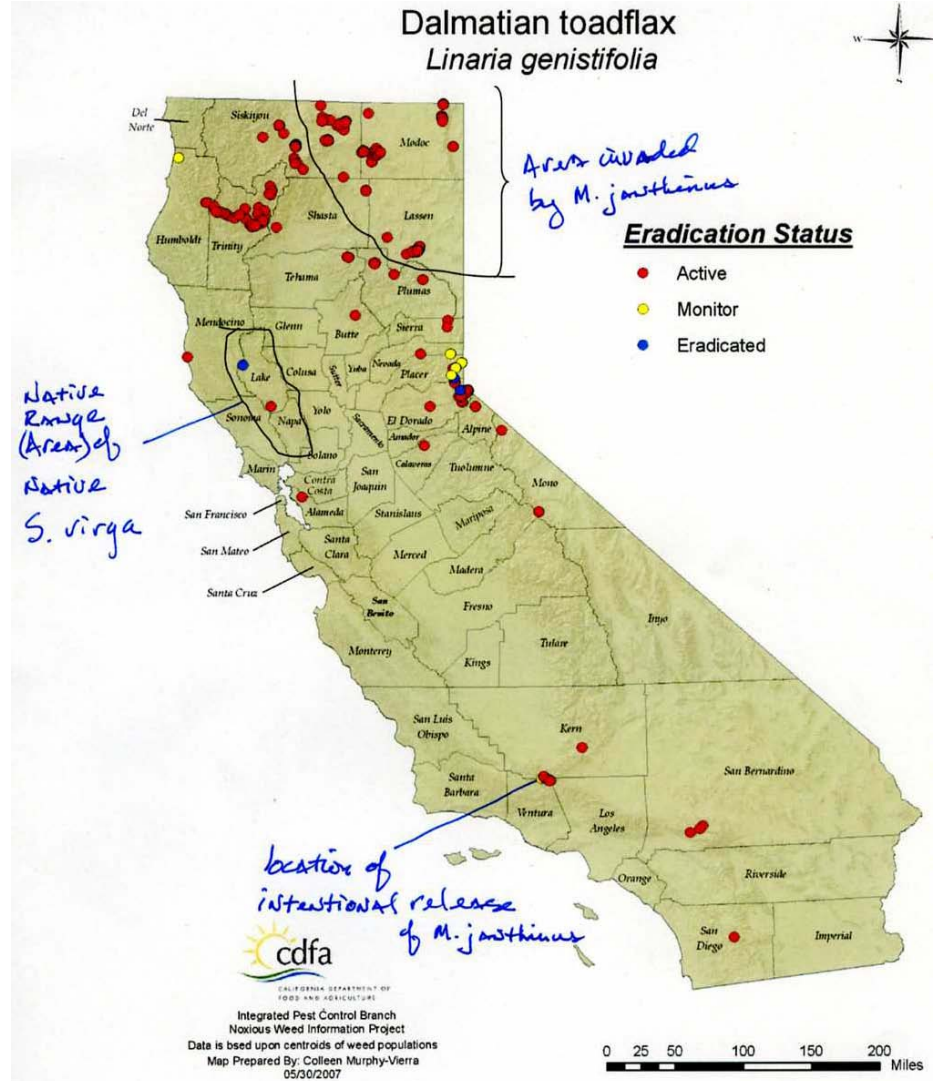
# Dalmation toadflax

*Mecinus janthiniformis* larval damage



# Dalmatian toadflax

- Issues with native Scrophulariaceae esp. *Sairocarpus* (= *Antirrhinum*) *virga*
- 13 sp. of *Antirrhinum* in CA – highest diversity in North America





# USDA-APHIS Permitting of Weed BC Agents

- Petitioner submits permit request to APHIS; this includes the host testing results
- APHIS sends document to Technical Advisory Group (TAG) for review
- If TAG recommends approval, APHIS sends document to USFWS (T & E issues) & Indian Tribes for review
- If USFWS & Indian Tribes concur, then EA written and submitted to 30 public comment period.
- If no serious negative comments, EA approved, FONSI written, and permit issued.

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# What's on the Horizon for California?

## Agents recommended for approval by TAG

### Review by USFWS & Indian Tribes pending

- Cape ivy, *Delairea odorata* (Patrick Moran, USDA-ARS)
  - *Digitivalva delaireae* (stem boring moth)
  - *Parafreutreta regalis* (stem gall fly)
- Hoary cress, *Lepidium draba* (Montana State University)
  - *Aceria drabae* (gall mite)

# Cape Ivy (*Delairea odorata*)

Patrick Moran, USDA-ARS  
(lead scientist)

*Digitivalva delaireae*  
(stem boring moth)



Photos by Joe Balciunas, USDA-ARS





# Cape Ivy (*Delairea odorata*)

Patrick Moran, USDA-ARS

(lead scientist)

*Parafreutreta regalis* (stem gall fly)



Photos by Joe Balciunas, USDA-ARS



Hoary cress (*Lepidium draba*)  
*Aceria drabae* (gall mite)



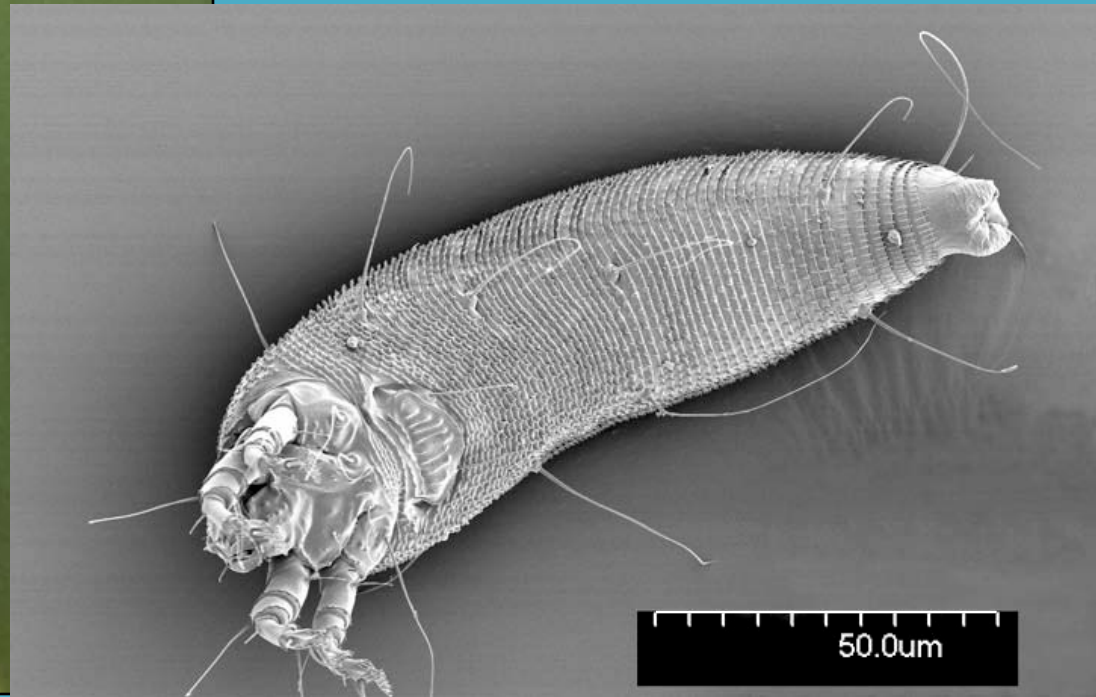


# *Aceria salsolae* (Russian thistle mite)

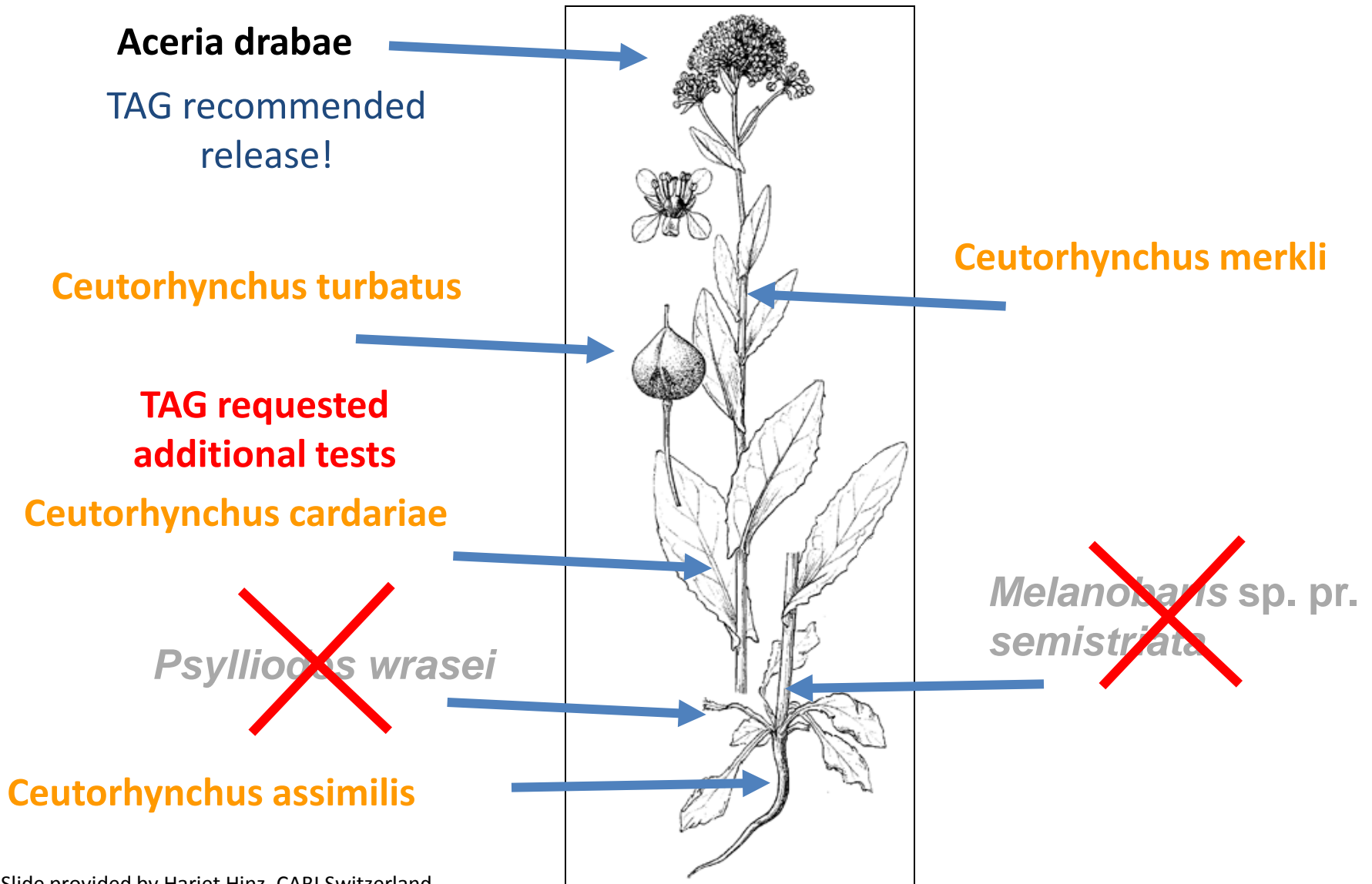
On human eyelash



**scanning electron  
micrograph**



# Potential biocontrol agents for hoary cress





# CABI in Switzerland



# What's on the Horizon?

## Agents being tested for safety – petitions to be written

Perennial pepperweed ( <i>Lepidium latifolium</i> )	CABI
Dyer's woad ( <i>Isatis tinctoria</i> )	CABI
Hoary Cress ( <i>Lepidium draba</i> )	CABI
Scotch thistle ( <i>Onopordum acanthium</i> )	USDA - ARS
Common crupina ( <i>Crupina vulgaris</i> )	USDA - ARS
Oxeye daisy ( <i>Leucanthemum vulgare</i> )	CABI
Common tansy ( <i>Tanacetum parthenium</i> )	CABI
Russian thistle ( <i>Salsola tragus</i> )	USDA - ARS
Yellow starthistle ( <i>Centaurea solstitialis</i> )	USDA - ARS