Utility of Field Experiments in Land of Origin to Measure Host Plant Specificity and Potential Efficacy of Prospective Arthropod Biological Control Agents of Weeds

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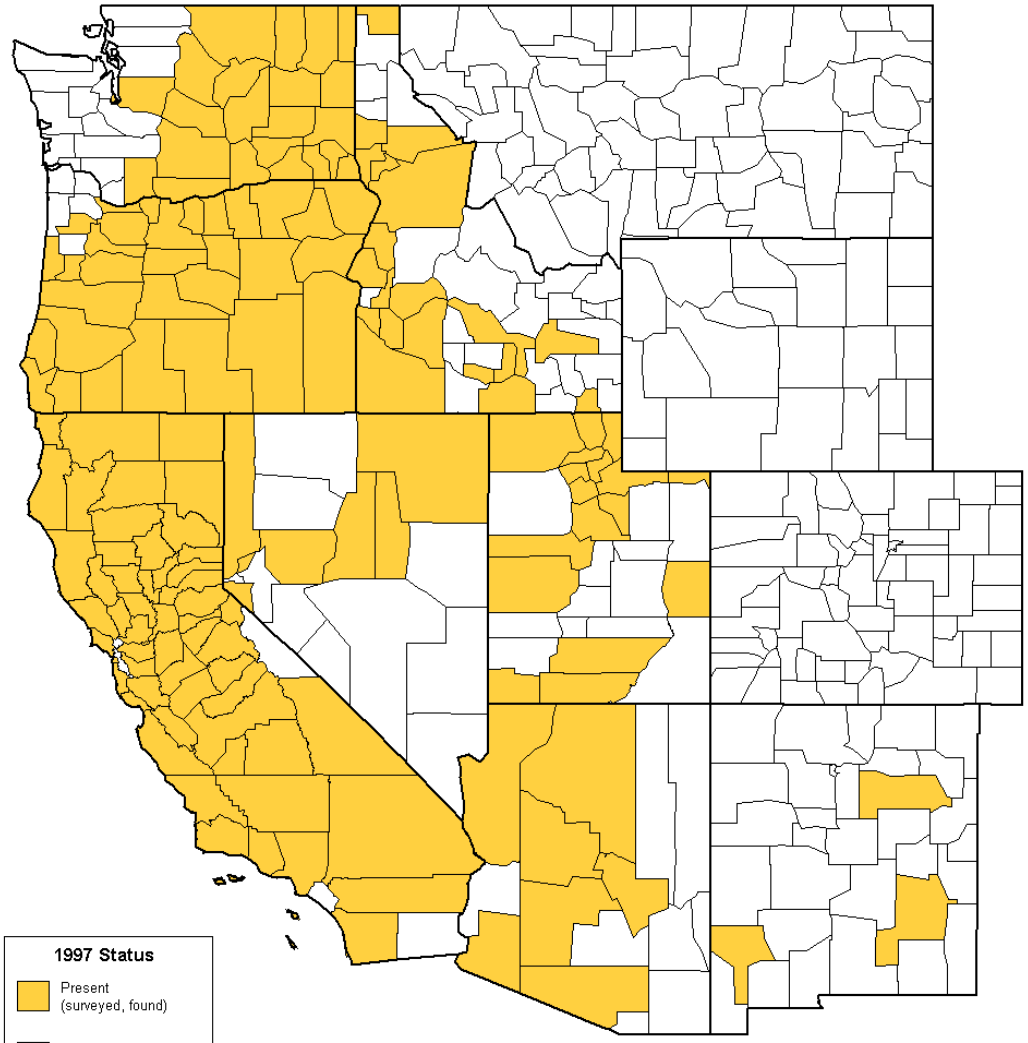
Yellow Starthistle (*Centaurea solstitialis*)

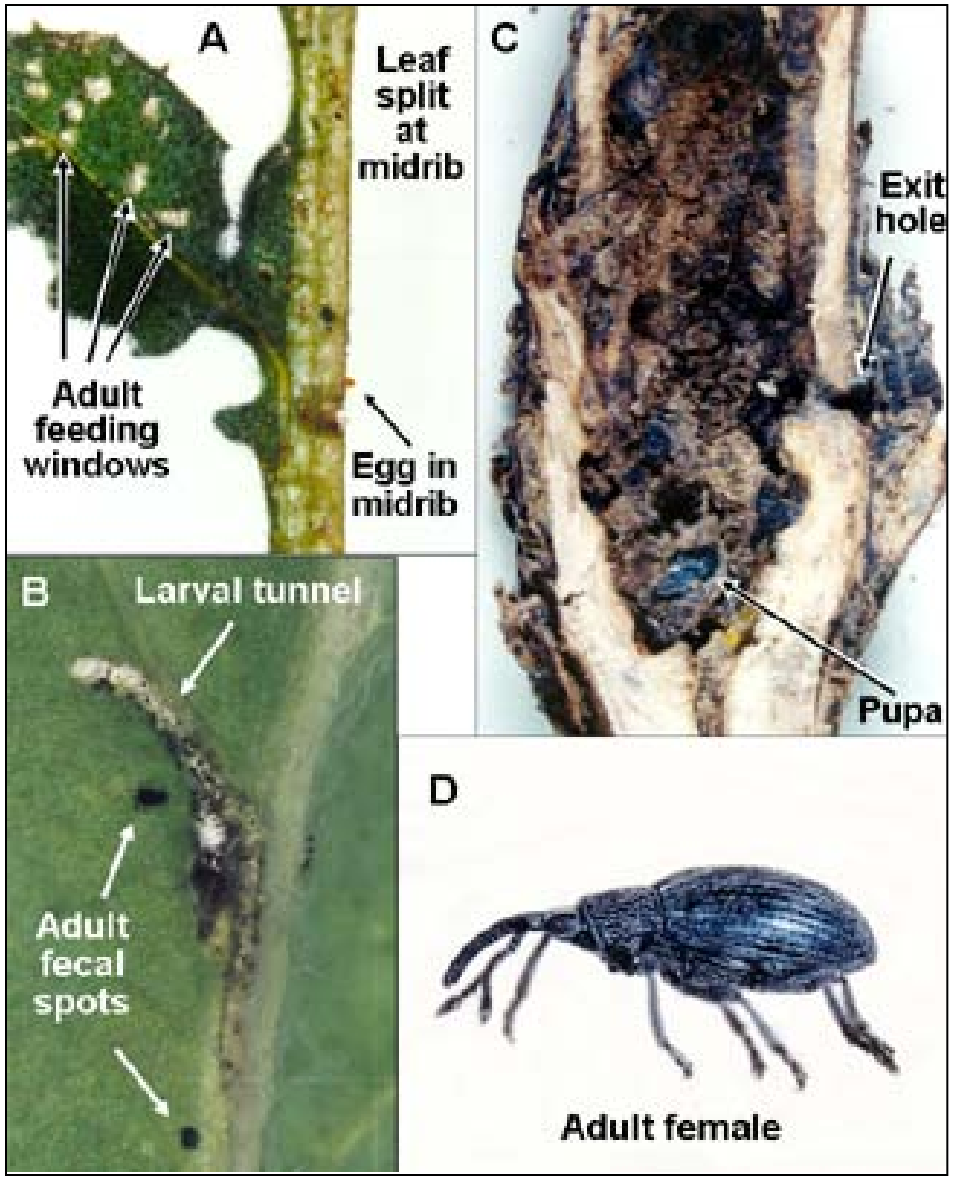
Distribution of Yellow Starthistle by County in the Western United States

Data for California from Woods, D.M. (ed.), 1998, Biological Control Annual Summary, 1997, California Department of Food and Agriculture, Plant and Health Pest Prevention Services, Sacramento, CA. p64-66; Data for the other western states are from Sheley, R.L. and J.K. Petroff (eds.), 1999, Biology and Management of Noxious Rangeland Weeds, Oregon State University Press, Corvalis, OR, p.408-416

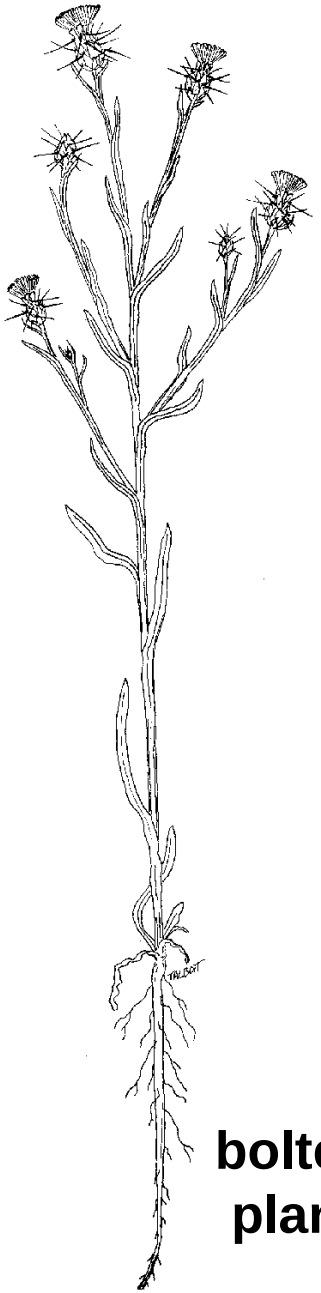


Goats Grazing Yellow Starthistle in Briones Park, California

Life Cycle of *Ceratapion basicorne* (Apionidae)

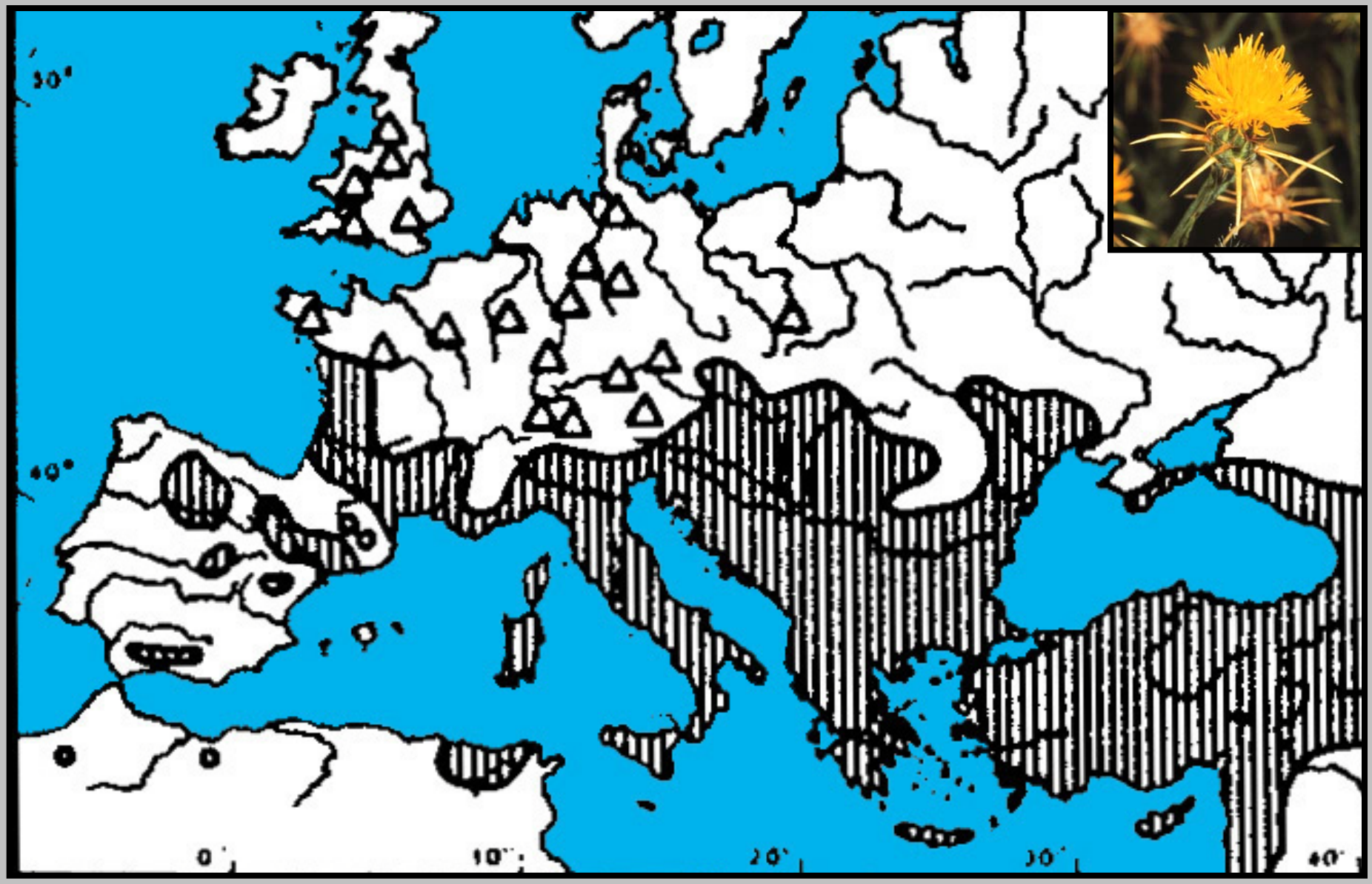


rosette



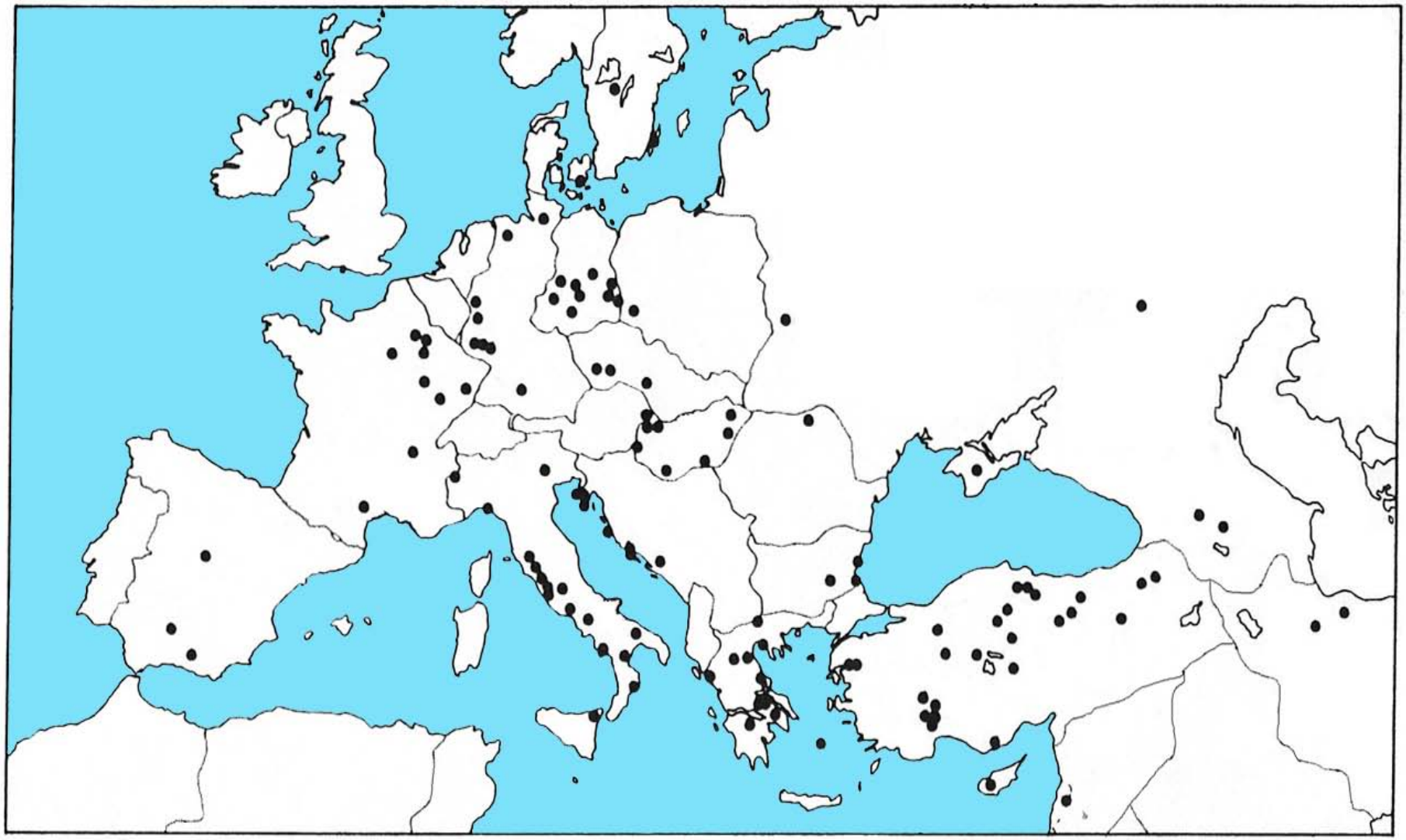
bolted plant

Distribution of Yellow Starthistle in Europe



De Bolos and Vigo. 1995. Flora dels Paisos Catalans.

Distribution of *Ceratapion basicorne*



Alonso-Zarazaga (1990) *Fragm. Entomol.*, Roma, 22(2): 514

Reported host plants of *Ceratapion basicorne* collected in the field

Adults reared from:

Centaurea solstitialis L. [1,2,3,4] ----- **YST**

Centaurea cyanus L. [2] ----- bachelor's button

Centaurea depressa M.Bieb. [4]

Cnicus benedictus L. [4] ------ (now *Centaurea*)

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1 Alonso-Zarazaga (1990a)
2 Wanat (1994)
3 Campobasso et al. (1999)
4 J. Balciunas (unpubl. data)

Tribe Cardueae

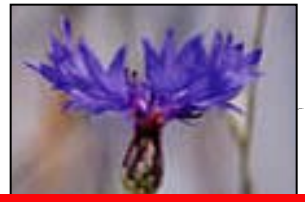
Subtribes

sawworts

native thistles

artichoke

safflower



Cyanus

bachelor's button

basket flowers

Plectocephalus

Bremer (1994)

No-choice Oviposition Experiment

1 female *Ceratapion basicorne* in tube for 5 days

American sawwort (***Saussurea americana***)

Choice Oviposition Experiment

1 female *Ceratapion basicorne* in sleevebox for ≥5 days

Host Specificity Results

No-choice oviposition

Oviposits on many Centaureinae, few Cardueae

Develops on *Ce. cyanus*, safflower,

NOT on *Ce. americana*, *Ce. rothrockii*

Choice oviposition

Trace on safflower, low on *Ce. cyanus*

None on *Ce. americana*, *Ce. rothrockii*

Field experiment in Turkey

Ceratapion Yellow Starthistle Field Tests

Ataturk University, Erzurum, Turkey

YST
- **Turkey**
- **California**

Safflower
- **oleic**
- **linoleic**

Safflower Field Tests in Turkey

Site	Proportion of plants infested (%) [a] Test plant YST(US)	YST(TR)	Oleic	Linoleic	No. Safflower plants
2002					
Horasan	83 b	100 a	0 c	0 c	45
Cat	28 b	67 a	0 c	0 c	38
Askale	59 b	87 a	19 c [b]	18 c [c]	40
2003					
Cat	37 a	45 a	0 b	0 b	57
Askale		77 a	8 b [d]		39
2004					
Horasan		98 a	0 b		250
Askale		100 a	34 b [e]		99
					390

[a] Values followed by the same letter in the same row are not significantly different (chi-square test, P < 0.01).

[b] Adults identified: 4 *C. scalptum*, 1 *C. orientale*, 2 *C. onopordi*.

[c] Adults identified: 2 *C. scalptum*.

[d] Adults identified: _* *C. scalptum*, _ *C. orientale*.

[e] Adults identified: 8 *C. scalptum*, 2 *C. orientale*.

Probability of infestation < 0.0026

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Horasan		98 a	0 b		250
Askale		100 a	34 b [e]		99
					568

[a] Values followed by the same letter in the same row are not significantly different (chi-square test, $P < 0.01$).

[b] Adults identified: 4 *C. scalptum*, 1 *C. orientale*, 2 *C. onopordi*.

[c] Adults identified: 2 *C. scalptum*.

[d] 3 unidentified adults.

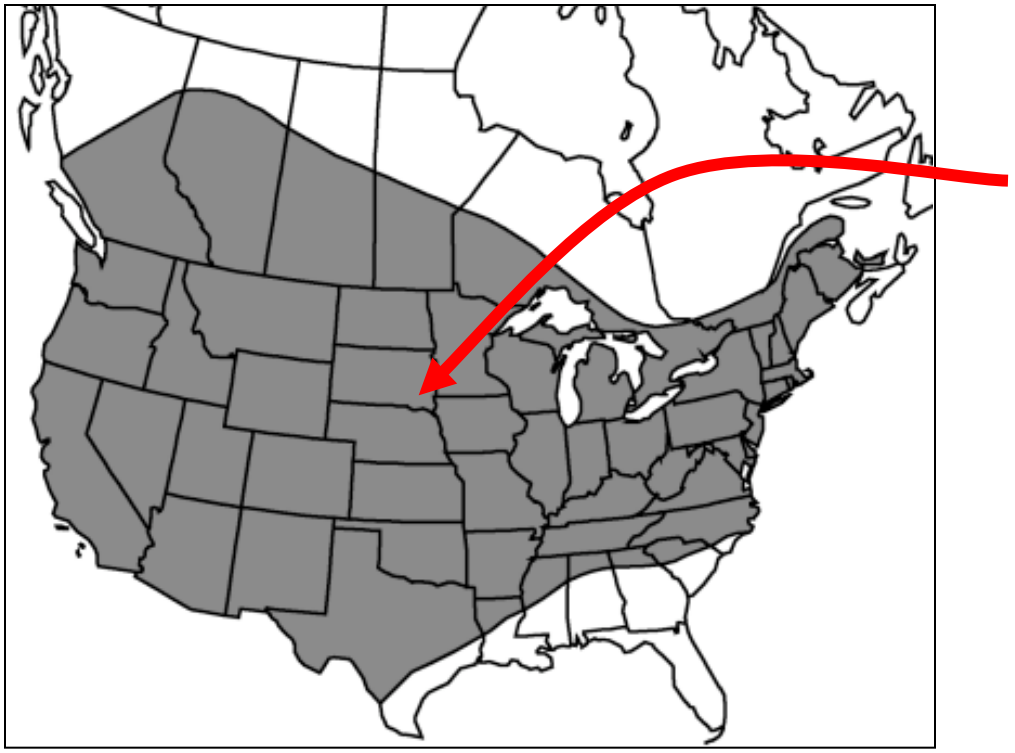
[e] Adults identified: 8 *C. scalptum*, 2 *C. orientale*.

Probability of infestation < 0.0018

Conclusions for Rosette Weevil

- **Safflower, artichoke and sunflower are not at risk.**
- **Native *Centaurea*, *Cirsium* and *Saussurea* are not at risk.**
- **Potential harm:**
  Bachelor's button (*Ce. cyanus*) is at risk for possible collateral damage. (ornamental & invasive weed)
- **Petition was "approved" by Technical Advisory Group, 2006.**
- **Release permit denied by USDA-APHIS, 2009.**

Tumbleweed (*Salsola* spp.)

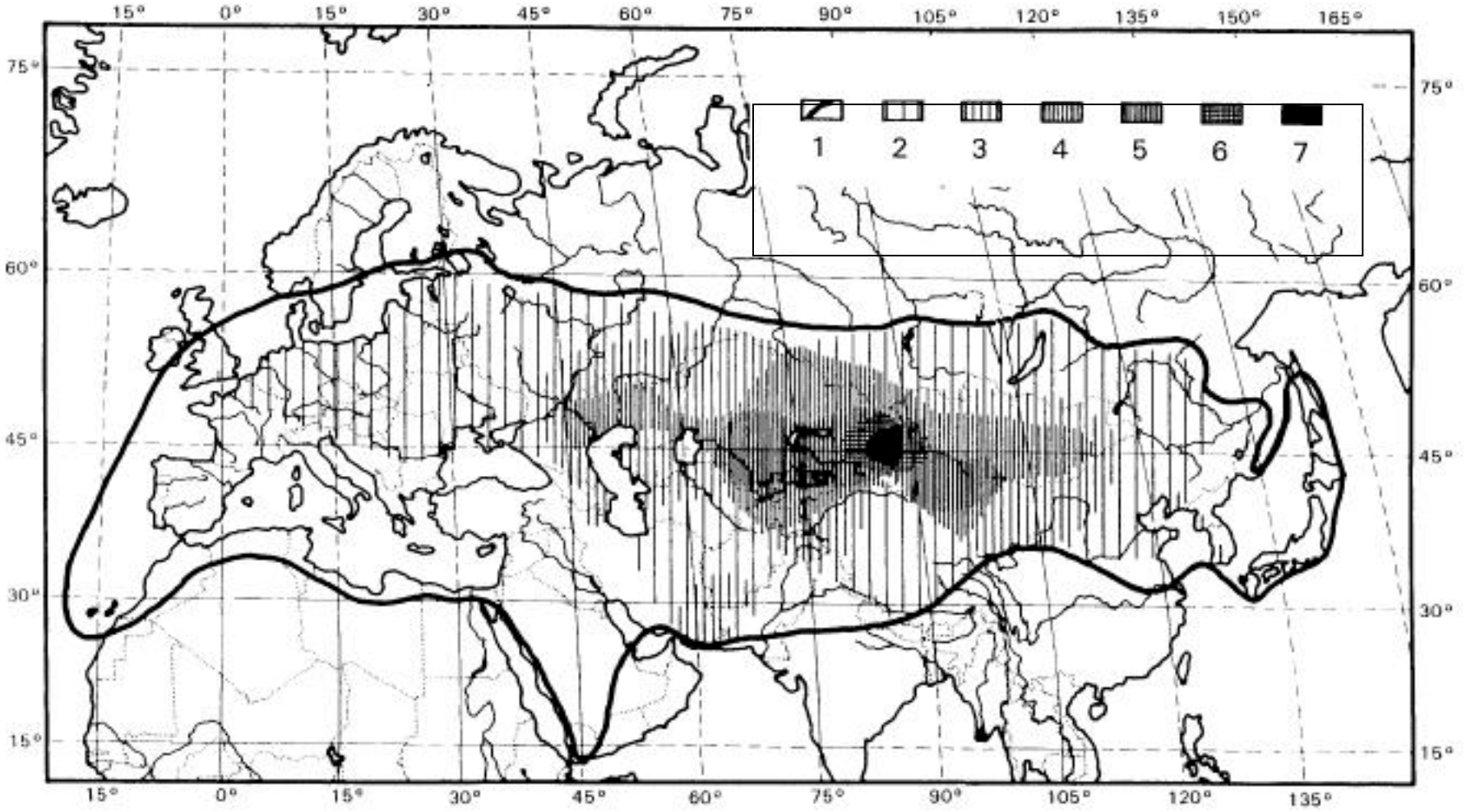


Salsola australis
Salsola collina
Salsola paulsenii
Salsola tragus
Salsola* x *gobicola
Salsola* x *ryanii

First seen in 1874 in Bonhomme County, South Dakota
(from flax seed brought from Russia)

Hrusa & Gaskin (2008) Madrono 55(2):113–131.

Distribution of species of *Salsola* sect. *Kali* in Eurasia

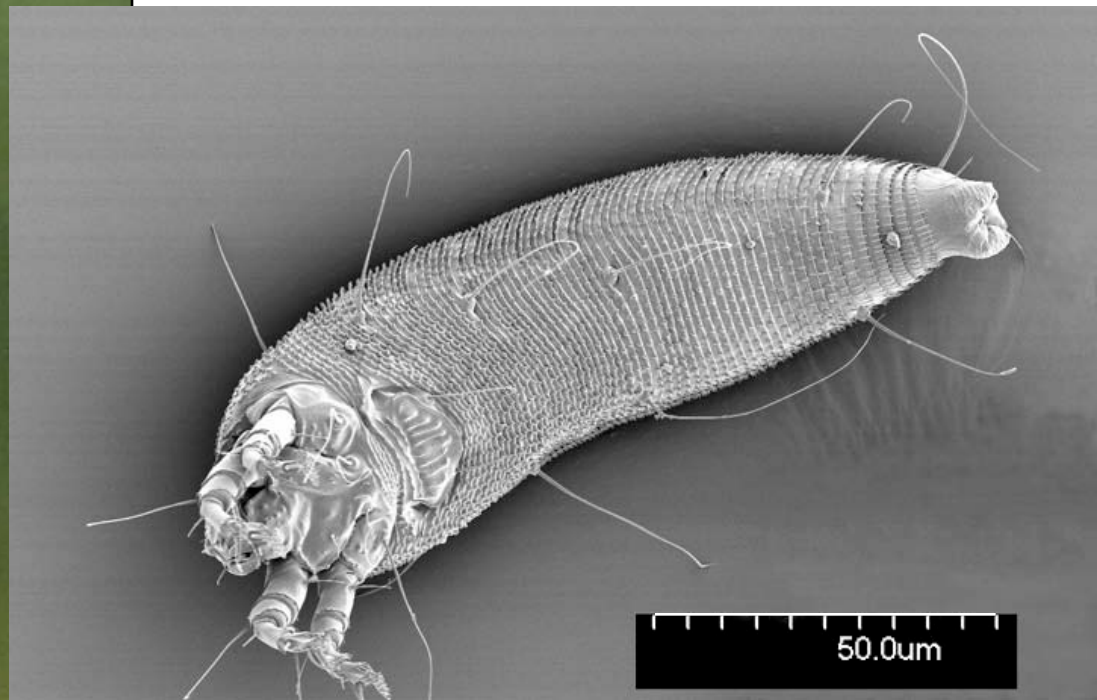


From S. Rilke (1999), Revision der Sektion *Salsola* s.l. der Gattung *Salsola* (Chenopodiaceae).

Russian Thistle Blister Mite

Aceria salsolae (Acari: Eriophyidae)

scanning electron micrograph

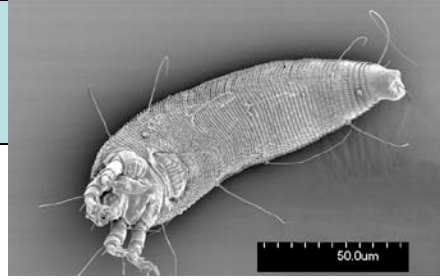


Damage to *Salsola tragus* by *Aceria salsolae*

Infesting nontarget test plants

Mite colony on *Salsola* cuttings

Host Specificity Results



No-choice population (survival + reproduction)

- **Develops on 5 *Salsola* spp. (all alien weeds)**
- **Occasional on alien *Bassia, Kochia***
- **Dead mites remaining on *Suaeda***

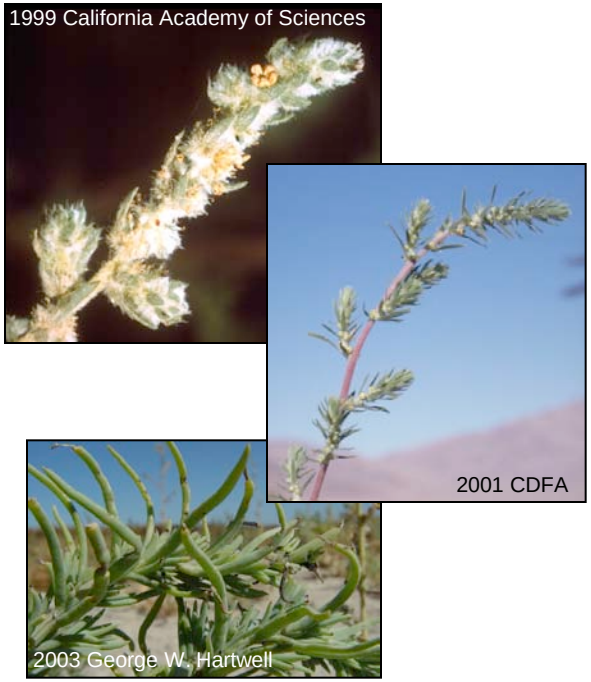
Choice

- **Not done in lab because disperse by wind.**

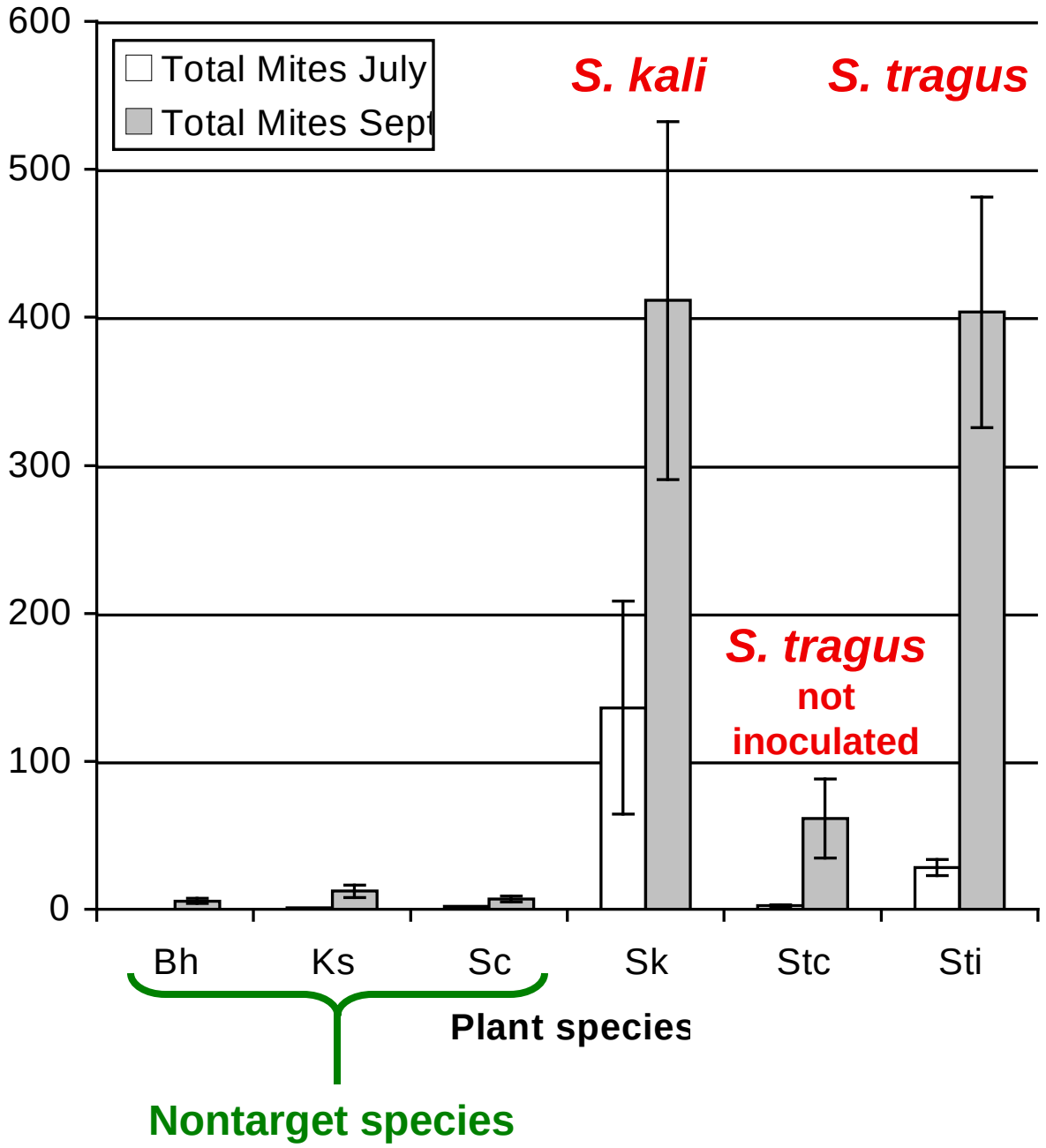
Field experiment in Italy

Field Experiment in Rome, Italy

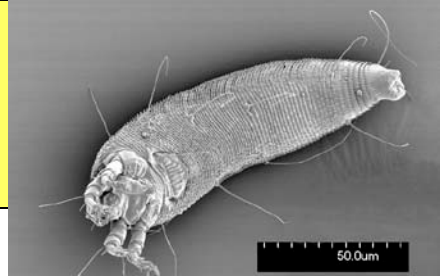
Field Experiment in Italy



Bassia hyssopifolia
Kochia scoparia
Suaeda calceoliformis



Conclusions for *Salsola* mite



- **Attacks only a few species of alien *Salsola*.**
- **Native *Suaeda*, etc. are not at risk.**
- **Petition was "approved" by Technical Advisory Group, 2005.**
- **Release permit denied by USDA-APHIS, 2009.**

Conclusions

Field experiments showed higher levels of host plant specificity than laboratory experiments

This was sufficient for TAG members to conclude that the agents are safe to release

APHIS-PPQ denied permits based on no-choice laboratory results