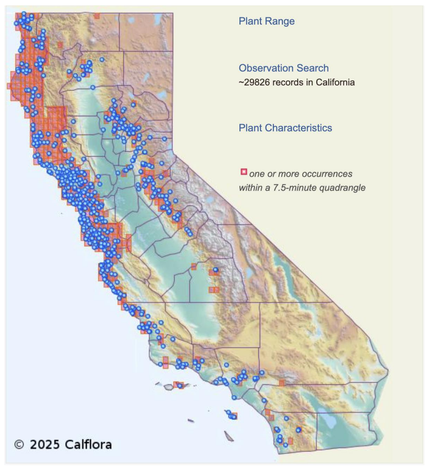
Risk assessment of the French broom psyllid, a prospective biological control agent of French broom

Lincoln Smith, USDA Agricultural Research Service (Retired), linsmith@sbcglobal.net



Order:	Fabales
Family:	**Fabaceae**
Subfamily:	Faboideae
Clade:	Meso-Papilionoideae
Clade:	Genistoids
Tribe:	**Genisteae**
Subtribe:	Genistinae
Genus:	**Genista**

French broom (*Genista monspessulana*)

Goal: Find an agent to attack French broom and reduce its impact in California without harming nontarget species.

Strategy: Test closely related nontarget plant species to see if the psyllid can damage them or complete development. Laboratory tests show the physiological limits, and field experiments show behavioral/ environmental limits.

Lupines are the most closely related species in North America.

Experiments have been conducted in France at the USDA and CSIRO laboratories, in Australia and in the USDA laboratory in Albany, CA between 2000 and 2022.

Psyllid (*Arytinnis hakani*)

- Eggs embedded in plant stems
- Nymphs and adults feed on phloem (sugar)
- Multiple generations per year
- No dormant life stage (requires food all year)
- Adapted to cool temperatures [less active during summer]
- Gregarious
- In surveys in the Mediterranean Region, it was found attacking only French broom

Types of Host Specificity Experiments

Laboratory Larval Transfer Tests. Newly emerged nymphs are transferred on to test plants to see how long they survive and develop.

Laboratory No-Choice Oviposition & Development tests. Females are held in small tube cages on plants to see if they will lay eggs and how long nymphs will survive and develop.

Laboratory Choice-Without-Target Oviposition & Development Tests. Females are released in cages with several plant species to see where they will lay eggs and how long nymphs will survive and develop.

Field Experiments. Test plants (target & non-target species) are placed at various distances from infested French broom plants to see if they will be attacked.

Closest Families (Papilionioideae)

	No. spp. tested	No. eggs/ plant	No. L1-L3 nymphs/ plant	No. L3-L5 nymphs/ plant	No. adults/ plant
FAMILY FABACEAE					
Tribe Amorpheae	**1**	0.00	0.00	0.00	0.00
Tribe Bossiaceae	**2**	0.00	0.00	0.00	0.00
Tribe Brongniartieae	**1**	0.00	0.00	0.00	0.00
Tribe Crotalarieae	**1**	0.00	0.00	0.00	0.00
Tribe Fabeae	**3**	0.00	0.00	0.00	0.00
Tribe Galegeae	**1**				
Tribe Indigofereae	**1**	0.00	0.00	0.00	0.00
Tribe Loteae	**2**	0.00	0.00	0.00	0.00
Tribe Mirbelieae	**10**	0.00	0.00[a]	0.00	0.00
Tribe Phaseoleae	**4**	0.00	0.00	0.00	0.00
Tribe Psoraleae	**1**				
Tribe Thermopsis	**1**				
Tribe Trifolieae	**4**	0.00	0.00	0.00	0.00

Data from Andy Sheppard and Thierry Thomann, CSIRO

Economic Families

	No. spp. tested	No. eggs/ plant	No. L1-L3 nymphs/ plant	No. L3-L5 nymphs/ plant	No. adults/ plant
FAMILY MIMOSACEAE					
Tribe Acacieae	**12**	0.00	0.00	0.00	0.00
Tribe Caesalpiniaceae	**2**	0.00	0.00	0.00	0.00
FAMILY APIACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY ASPARAGACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY BRASSICACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY CHENOPODIACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY LAMIACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY MALVACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY OXALIDACEAE	**1**	0.00	0.00	0.00	0.00
FAMILY POACEAE	**2**	0.00	0.00	0.00	0.00
FAMILY ROSACEAE	**2**	0.00	0.00	0.00	0.00
FAMILY SOLANACEAE	**1**	0.00	0.00	0.00	0.00

Data from Andy Sheppard and Thierry Thomann, CSIRO

Closest Subtribe (Genistinae)

Test Plant	Loca-tion	Test	No. eggs/ plant	No. L1-L3 nymphs/ plant	No. L3-L5 nymphs/ plant
FAMILY FABACEAE					
Tribe Genisteae					
Subtribe Genistinae					
Calicotome spinosa	FR	cwot	0.04	0.00	0.00
Chamaecytisus proliferus	AU	nc		0.01	0.00
Chamaecytisus proliferus	FR	cwot	0.05	0.00	0.00
Cytisus 'Porlock'	FR	cwot	**0.58**	**1.30**	**2.33**
Cytisus scoparius	AU	nc		0.00	0.00
Cytisus scoparius	FR	cwot	0.00	0.00	0.00
Cytisus striatus	FR	cwot	0.00	0.00	0.00
Cytisus x praecox "Warminster Broom"	FR	cwot	0.00	0.00	0.00
Cytisus x spachianus	AU	nc		0.00	0.00
Cytisus x spachianus	FR	cwot	0.13	0.26	0.12
Genista monspessulana	AU	cwot	**1.00**	**1.00**	**1.00**
Genista monspessulana	FR	cwot	**1.00**	**1.00**	**1.00**
Laburnum anagyroides	FR	cwot	0.03	0.01	0.00
Spartium junceum	FR	cwot	0.07	0.16	0.19
Ulex europeaus	AU	nc		0.00	0.00
Ulex europeaus	FR	cwot	0.00	0.00	0.00

Data from Andy Sheppard and Thierry Thomann, CSIRO

Results

Lupines

Performance relative to on French broom[1]

	Physiological Tests: CSIRO Choice-without-target tests				CSIRO Larval transfer	Hogg No-choice	Ecological Tests: CSIRO / EBCL Field Experiments								
							CSIRO Field		2006		2012		2021		2022
Test Plant	No. eggs/ plant	No. L1-L3 nymphs/ plant	No. L3-L5 nymphs/ plant	No. adults/ plant	LT survival to adult	egg x Max Adult	Larvae/ plant 0 m	Larvae/ plant 4 m	Larvae/ plant 0 m	Larvae/ plant 5 m	Larvae/ plant 1 m	Larvae/ plant 5 m	Psyllids/ plant 5 m	Psyllids/ plant 10 m	Psyllids/ plant 5 m
French broom	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**			**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
L. affinis	0.04	0.00	0.00	0.00	0.00	0.10									
L. albifrons					0.00	0.24			0.07	0.00			0.00	0.00	0.01
L. arboreus	0.02	0.01	0.00	0.00	0.00	0.04	0.07	0.00					0.00	0.00	0.00
L. bicolor	0.01	0.00	0.00	0.00	0.00										
L. chamissonis					0.00	0.00							0.00	0.00	0.00
L. cocinnus	0.00	0.00	0.00	0.00	0.00										
L. elegans	0.00	0.00	0.00	0.00	0.00										
L. formosus					0.15	0.77					0.02	0.00	0.00	0.00	0.02
L. longifolius	0.16	0.13		0.04	0.00	0.05					0.05	0.00	0.00	0.00	0.00
L. luteolus	0.00	0.00		0.00											
L. microcarpus var. *densiflorus*	0.00	0.00	0.00	0.00	0.44	0.00					0.00	0.00			
L. perennis	0.01	0.02			0.00										
L. polyphyllus	0.00	0.00	0.00	0.00	0.00										
L. pusillus	0.00	0.00	0.00	0.00	0.54	←	desert habitats								
L. rivularis	0.00	0.00	0.00	0.00											
L. succulentus	0.00	0.00	0.00	0.00											
L. texensis	0.00	0.00		0.00	0.00										
Paynter threshold	0.14	0.34	0.34	0.34	0.34	0.33	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57

1 Ratio is (performance on nontarget)/(performance on target), thus 0 = no attack, 1 = attack on nontarget the same as on French broom.

Original data from: Andy Sheppard and Thierry Thomann (CSIRO); Gaylord Desurmont and René Sforza (USDA-EBCL); Brian Hogg and Lincoln Smith (USDA-ARS).

Conclusions

- The psyllid *A. hakani* has high potential for impacting French broom (successful in Australia).
- It has only been recorded on French broom in the native range.
- In laboratory and field experiments it is capable of ovipositing and developing on some nontarget plants in 3 closely related genera in the subtribe Genistinae: *Cytisus*, *Lupinus* and *Spartium*. The ornamentals *Cytisus* 'Portlock' and 'Yellow dwarf' are likely to be at risk of attack.
- Nymphs could complete development on *Lupinus affinis*, *L. albifrons*, *L. arboreus*, *L. chamissonis*, *L. formosus*, *L. microcarpus*, *L. longifolius* and *L. pusillus*.
- In greenhouse experiments the psyllid had no impact on growth of *Lupinus arboreus*, whereas it reduced growth and survival of French broom.
- For North American native lupines, laboratory experiments indicate that *Lupinus formosus* and *L. microcarpus* are at highest risk, but field experiments indicate very low risk of attack. *Lupinus pusillus* occurs in the Great Basin, far from French broom habitat, so would not be at risk.
- A petition is being written as a first step toward requesting approval to release the psyllid in the continental USA.