Biological Control of Russian Thistle (Tumbleweed)

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Abstract

Russian thistle (*Salsola tragus*) is an important alien weed that first appeared in the 1870s and has invaded about 100 million acres in the western U.S. Tumbleweeds invade fallow fields, clog irrigation systems, are hazardous to automobile traffic, spread wildfires and harbor insect pests that transmit viruses to many vegetable crops. Two moth biological control agents that were introduced in the 1970s have became widely established, but they are not providing sufficient control. We have evaluated several prospective new agents of this weed and have rejected two of them because they are not sufficiently host specific. A petition was submitted to the USDA-APHIS Technical Advisory Group (TAG) in Dec. 2004 requesting permission to release the blister mite (*Aceria salsolae*) to control Russian thistle. A seed-feeding and stem-boring caterpillar, *Gymnancyla canella*, is undergoing a third year of host-specificity evaluation in Albany. Two interesting weevils (*Anthypurinus biimpressus* and *Baris przewalskyi*) have been discovered during foreign exploration in Tunisia and Kazakhstan. These new biological control agents should help reduce the populations of this weed to innocuous levels over extensive regions. Successful biological control would provide self-perpetuating long-term management of this weed, reduce the need to apply pesticides, and increase the productivity and utility of millions of acres in the western U.S.

Russian thistle (tumbleweed, *Salsola tragus*, Chenopodiaceae) is an alien weed that first appeared in North America in Bonhomme county, South Dakota in 1874, and has invaded about 100 million acres in the western U.S. Because it is alien and is not closely related to any native North American species, it has been targeted for classical biological control (Goeden and Pemberton 1995, Pitcairn 2004). The plant is native to central Asia and historically has been called *S. australis, S. iberica, S. kali*, and *S. pestifer* (Mosyakin 1996, 2003). Similar weedy species in North America include *S. paulsenii* (barbwire thistle), which occurs primarily in desert habitat, and *S. collina* (slender Russian thistle), which occurs east of the Rocky Mountains. Recent botanical studies using morphological characters and molecular genetics have revealed the existence of two newly described species. *Salsola australis* (sometimes called "type B") apparently originates from Australia and occurs in the San Joaquin Valley and southern coastal zone of California. *Salsola* x *ryanii* is a hybrid between *S. tragus* and *S. australis* (F. Hrusa unpubl. data). *Salsola tragus, paulsenii* and *collina* all originate from Eurasia.

Two species of moths (*Coleophora klimeschiella* and *C. parthenica*) were evaluated and introduced in the 1970s for biological control of *S. tragus* (Goeden 1973). *Coleophora klimeschiella* is a case-forming caterpillar that feeds on leaves, and *C. parthenica* larvae mine the stems. Both moths became widespread, but predators and parasites prevent them from being abundant enough to control the weed (Goeden et al. 1987, Müller et al. 1990). Further foreign exploration in the Mediterranean Region by R. Sobhian led to the discovery of several prospective new biological control agents (Table 1). Evaluations conducted by R. Sobhian (USDA-ARS, European Biological Control Laboratory) demonstrated that two of these are

specific enough to warrant further evaluation, and that two should be eliminated from further consideration.

The blister mite (*Aceria salsolae*) is an eriophyid mite that destroys the young growing tips of the plant, stunting its growth and preventing development of flowers. The blister mite has been evaluated for host plant specificity, and its ability to damage the plant in quarantine experiments at the USDA-ARS quarantine laboratory in Albany, CA. These studies demonstrated that the mite attacks only a few closely related species of *Salsola*, all of which are invasive alien weeds. A petition was submitted to the USDA-APHIS Technical Advisory Group (TAG) in Dec. 2004 (Smith 2005), and TAG recommended approval of release in Aug. 2005. An application for a release permit was submitted to USDA-APHIS-PPQ in Nov. 2005. APHIS has not yet completed review of the permit application. Both AHIS and the California Department of Food and Agriculture must approve the permit before the mite can be released.

Caterpillars of the moth, *Gymnancyla canella*, commonly attack Russian thistle on beaches of southern France. Larvae feed on developing seeds and stems, causing extensive damage. Host specificity tests have been conducted for several years at Montpellier France and in the Albany quarantine laboratory and are expected to be finished in another year.

Foreign cooperators are exploring new regions in Central Asia (Turkey, Kazakhstan and Uzbekistan) and have discovered many species of beetles attacking Russian thistle. Several of these are thought likely to be host-specific (Table 1). Initial experiments to evaluate host plant specificity are being conducted by cooperators in Italy. Access to Central Asia greatly improves our chances of finding safe, effective biological control agents because this appears to be the region of highest biodiversity of this plant.

These new biological control agents should help reduce the populations of this weed to innocuous levels over extensive regions. Successful biological control would provide self-perpetuating long-term management of this weed, reduce the need to apply pesticides, and increase the productivity and utility of millions of acres in the western U.S.

In anticipation of obtaining permission to release the blister mite. We have begun to select sites in a variety of climatic zones in California and collect baseline data on *Salsola* abundance.

Table 1. Status of prospective biological control agents of Russian thistle.

Taxonomic name	Common name	Current information
Evaluated species		
Aceria salsolae (Acari: Eriophyidae)	blister mite	The mite attacks developing tips. Petition "approved" by TAG, release permit submitted to APHIS (Smith 2005).
Gymnancyla canella (Lepidoptera: Pyralidae)	seed and stem moth	Caterpillar feeds on seeds and young branch tips. Host specificity testing almost completed.
Colletotrichum gloeosporioides	rust	More damaging to Russian thistle type A than to type B (Bruckart et al. 2004). Being evaluated by W. Bruckart USDA-ARS, Maryland.
Uromyces salsolae	rust	Damages Russian thistle type A (Hasan et al. 2001). Being evaluated by W. Bruckart USDA-ARS, Maryland.
Kochiomyia [=*Desertovelum*] *stackelbergi* (Diptera: Cecidomyiidae)	gall midge	Uzbekistan strain attacks *Salsola* type A more than type B. Apparently requires a yet unidentified fungal symbiont to reproduce (Sobhian et al. 2003b). Research suspended.
Lixus incanescens [=*salsolae*] (Coleoptera: Curculionidae)	stem weevil	Adults feed on many plants in choice test at Montpellier, France (Sobhian et al. 2003a). Rejected.
Piesma salsolae (Hemiptera: Piesmatidae)	plant bug	Develops on beets in no choice lab test at Montpellier, France (R. Sobhian pers. com.). Rejected.
New species		
Anthypurinus biimpressus (Coleoptera: Curculionidae)	jumping weevil	Found in Tunisia in 2004. Larvae and adults feed on leaves. Biology is unknown.
Baris przewalskyi (Coleoptera: Curculionidae)	weevil	Abundant on *Salsola* in Kazakhstan in 2004. Biology is unknown.
Salsolia morgei (Coleoptera: Curculionidae)	weevil	Found in Kazakhstan in 2004. Reported to be monophagous.

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