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Assessment of biological control of exotic broadleaf weeds in intermountain rangelands[1]

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Abstract:

Since 1948, more than 30 biological control agents (primarily insects) have been released against 15 noxious broadleaf weeds of intermountain rangelands in Idaho and surrounding States. Biological control of St. Johnswort (*Hypericum perforatum*) represents the oldest and most successful program in the region, and yellow starthistle (*Centaurea solstitialis*) one of the newest programs. Despite the success of biological control, annual grassland systems are prone to successive invasions by exotic, broadleaf weeds, potentially resulting in the development of a biological control tread mill. Biological control must be considered in the context of an overall vegetation management program if successful rangeland restoration is the objective

Introduction

Since 1948, more than 30 biological control agents (primarily insects) have been released against 15 noxious broad leaf weeds of rangelands in Idaho and surrounding States (Harmon and McCaffrey 1989; PNW Weed Control Handbook 1992). Table 1 summarizes the number of agents released against nine weed species. These target weeds represent established programs with limited effort currently under way to release additional bioagents.

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Table 1. Biological control of rangeland weeds established programs.

Weed species	Number of agents established[1]
St. Johnswort (goatweed)	3 (2)
Rush skeletonweed	3
Mediterranean sage	1
Musk thistle	2
Plumeless thistle	2
Canada thistle	2 (1)
Russian thistle	1
Tansy ragwort	3
Puncturevine	2

[1]Numbers in parentheses represent potential new species that might be released or "inherited" from other program

The St. Johnswort (goatweed) (*Hypericum perforatum*) program represents the oldest and one of the most successful programs. Initiated in the late 1940's to early 1950's, three agents including two leaf-feeding beetles, *Chrysolina quadrigemina* and *C. hyperici,* and a root-boring beetle, *Agrilus hyperici,* have contributed to the successful control of this weed in the Intermountain West (Campbell and McCaffrey 1991). In northern Idaho, the overall abundance of *H. perforatum* fluctuates around an amount estimated at about 3 percent of that present in 1948 (Tisdale 1976). Canyon grasslands, in particular, have experienced excellent reduction of St. Johnswort in northern Idaho. This has been largely due to *C. quadrigemina* and *A. hyperici* (Campbell and McCaffrey 1991).

In British Columbia large amounts of the weed persist in cooler, moister areas dominated by *C. hyperici* (Williams 1985). The lack of control in these areas might be partially explained by the absence of *A. hyperici.* Cooler, moister areas of northern Idaho that are dominated by *C. hyperici* have *A. hyperici*, but do not have persistent St. Johnswort stands (Campbell and McCaffrey 1991).

New programs

Table 2 summarizes several of the biological control programs currently "in progress," representing programs where new bioagents are being acquired and introduced. The program aimed at control of yellow starthistle (*C. solstitialis*) was initiated in the early to mid-1980's (Turner and others, in press). Five insects have been cleared for release in Idaho, Washington, Oregon, and California.

All the insects are endophytic within the capitulum, and four of the five insects are already established within the region (Table 3). It will take several years for these insects to increase their populations and disperse. Given that *C. solstitialis* reproduces only by seed, it is expected that these insects will cause a significant reduction in the plant population.

Table 2. Biological control of rangeland weeds active programs.

Weed species	Agents established[1]	New agents
Diffuse knapweed	4	2
Spotted knapweed	4	3
Yellow starthistle	3	2
Leafy spurge	3	4
Dalmation toadflax	1 (2)	?
Yellow toadflax	1 (2)	?

[1]Numbers in parentheses represent bioagents not intentionally released.

Table 3. Biological control agents for yellow starthistle.

Agent	Type	Status
Bangasternus orientalis	weevil	established
Chaetorellia australis	fly	established
Urophora siruneseva	fly	established
Eustenopus villosus	weevil	established
Larinus curtus	weevil	released in 1992

Successive communities

The stability and value of successive plant communities have differed within areas following biological weed control. For example, in California the void created by St. Johnswort reduction was largely filled by a desirable perennial grass, *Danthonia californica* Bol., plus annual grasses, legumes, and forbs of varying forage value (Huffaker 1951; Huffaker and Kennett 1959). In northern Idaho, the forage species that replaced the weed have not resolved the problem of unstable plant communities. For example, Tisdale (1976) reported that St. Johnswort populations reduced by biological control were largely replaced by the same seral grasses (*Bromus* spp.) and forbs that were dominant prior to St. Johnswort's invasion of northern Idaho in the early 1900's.

Unfortunately, many of those replacement species were introduced annual grasses. The annual grasses provided an improvement in forage value when compared to St. Johnswort, but resulted in unstable plant communities subject to invasion by other weedy forbs and grasses (Tisdale 1976). In fact, yellow starthistle has replaced St. Johnswort as a major weedy forb in the Clearwater, Snake, and Salmon River canyons of northern Idaho (Campbell and McCaffrey 1991).

This situation illustrates the importance of evaluating biological weed control within the context of a broader strategy for ensuring the establishment of stable plant communities following weed control. Otherwise, the situation may eventually result in a "biological control treadmill" where successive biological control efforts are required to deal with invasive, exotic weedy forbs following biological control of the previous invaders. As noted by Harshman (1956), the next noxious weed may not be so amenable to biological control.

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