

# Integrating 2,4-D and Sheep Grazing to Rehabilitate Spotted Knapweed-infested Rangeland

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## Introduction

The pervasiveness and persistence of invasive plants, combined with the cost of control, supports implementation of integrated management. Integrated weed management involves the deliberate selection, integration, and implementation of effective invasive plant management strategies with due consideration of economic, ecological, and sociological consequences. Grazing animals can be a major component of integrated invasive plant management. Integrating grazing with other weed management techniques, such as herbicide application, has shown considerable promise. The objective of this study was to determine the effects of integrating 2,4-D and repeated sheep grazing on spotted knapweed-infested plant communities. We hypothesized that integrating a single spring 2,4-D herbicide application would remove adult plants, grazing would control new growth, and spotted knapweed density, cover, and biomass would decrease, allowing grasses to reoccupy the site.

## Experimental Protocol

Studies were conducted from 1997 to 2001 on two sites in western Montana near Missoula (site 1) and Drummond (site 2). Spotted knapweed density was approximately 38 and 116 plants/yard<sup>2</sup> at the onset of the study for sites 1 and 2, respectively. Four treatments were applied in a randomized

complete block design and replicated three times at each site. The treatments were: 1) a control that received no 2,4-D or repeated grazing; 2) repeated sheep grazing of 95 percent knapweed utilization or 60 percent grass utilization repeated three times in 1998, 1999, and twice in 2000 and 2001; 3) 2,4-D amine applied in spring 1997 at the rate of 11.4 lb a.i./acre; and 4) 2,4-D amine applied in spring 1997 at the rate of 11.4 lb a.i./acre, combined with repeated sheep grazing of 95 percent knapweed utilization or 60 percent grass utilization repeated thrice in 1998, 1999, and twice in 2000 and 2001. Density (plants/yard<sup>2</sup>) and biomass (lb/acre) of spotted knapweed and biomass of grass were sampled in September 1998 through 2001. Spotted knapweed and grass cover were sampled in 1999, 2000, and 2001.

## Results and Discussion

Strong evidence was found supporting the hypothesis that integrating a spring 2,4-D application to remove the adult plants combined with repeated sheep grazing to control seedling and juvenile plants would decrease spotted knapweed density, cover, and biomass, allowing residual grasses to reoccupy the sites. Combining 2,4-D and sheep grazing caused the greatest decrease in spotted knapweed density 5 years

after treatment began (Table 1). Herbicide treatment changed the knapweed population to younger plants that are more palatable to sheep, which prefer seedlings and regrowth from crowns over that of associated grasses.

## Management Implications

Herbicide studies in the late 1970s and 1980s demonstrated 2,4-D application resulted in at least 80 percent spotted knapweed control for a single year when applied early in the growing season. Research conducted beyond a single growing season indicated substantial site-to-site variation. Over time, spotted knapweed rosette density, cover, and biomass generally increased, suggesting that the sites will return to spotted knapweed dominance when herbicide management is used alone without repeated applications.

Spotted knapweed is highly nutritious and sheep tend to prefer broad-leaved forbs to either grasses or shrubs. Sheep provide good control of spotted knapweed, and in some cases, the level of control was better than that of 2,4-D alone. Grasses appear to respond favorably to the grazing system of 95 percent spotted knapweed or 60 percent grass utilization applied in this study. The combination of 2,4-D application and repeated sheep grazing may allow perennial grasses to better compete with spotted knapweed. The integration of the herbicide application and sheep grazing may prove more effective in controlling spotted knapweed than herbicide application alone.

**Table 1. Spotted knapweed and grass biomass at Missoula and Drummond, Montana, in the control (no treatment), sheep grazing, 2,4-D, and combined sheep grazing and 2,4-D treatments. Means are combined over the years.**

<i>Treatment</i>	<i>Biomass (lbs/acre)</i>			
	<i>Missoula</i>		<i>Drummond</i>	
	<i>Spotted knapweed</i>	<i>Grass</i>	<i>Spotted knapweed</i>	<i>Grass</i>
None	672	59	560	64
Sheep	158	55	288	95
2,4-D	223	217	529	242
Sheep + 2,4-D	46	158	242	193