INTEGRATED MANAGEMENT TECHNIQUES FOR PERENNIAL PEPPERWEED

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Introduction

Perennial pepperweed is a long-lived herbaceous perennial capable of forming large monoculture populations in a wide range of environments, including floodplains, irrigation channels, rangeland, riparian areas, brackish marshes, and crop fields (Young et al. 1998, Renz 2001). Both the California Department of Food and Agriculture (CDFA) and California Invasive Plant Council (Cal-IPC) list perennial pepperweed as a noxious weed of great ecological concern in California. Over the past 10 years, it has spread rapidly throughout the west especially in flood plains and riparian habitats (Miller et al. 1986). The rapid spread is associated with the ease in which perennial pepperweed roots and seeds move downstream during periods of flooding or high water (Blank and Young 1997). This characteristic also increases erosion along heavily infested streambanks (Wilson et al. 2004). Large perennial pepperweed populations negatively impact nesting habitat for wildlife, interfere with willow re-generation, and reduce alfalfa and irrigated pasture productivity (Young et al. 1995). Dense infestations also reduce plant diversity and increase soil surface salinity (Blank and Young 1997).

Established perennial pepperweed populations are difficult to control and require multiple years of intensive management (Wilson et al. 2004). Suppressing the extensive root system is critical for successful control. Management plans should include prevention, monitoring, and treatment of satellite populations before plants develop extensive roots. Several post-emergent herbicides control perennial pepperweed, but repeat applications are necessary to treat re-spouting shoots and seedlings. Non-chemical controls (mowing, tillage, burning, and grazing) are useful in removing accumulated thatch, suppression, and/or preparing a site for re-vegetation, but they do not provide effective control since plants quickly re-sprout from vast root reserves.

In an effort to improve current perennial pepperweed management techniques, a study was established in Lassen County to evaluate herbicides and integrated control strategies. The study also evaluated methods for re-vegetating areas heavily infested with perennial pepperweed. Treatments were chosen to increase control options for the diverse array of sites perennial pepperweed infests including waterways, irrigated pasture, and upland range.

Methods

Sites were located at the CDFG Honey Lake Wildlife Area and Mapes Ranch in Lassen County. Both sites were heavily infested with perennial pepperweed and had significant litter (thatch) accumulation from old stems. Perennial pepperweed cover averaged 50% at Honey Lake Wildlife area and 71% at Mapes Ranch in July 2002 before treatments were initiated. Both sites had less than 5% desirable vegetation cover before treatments were initiated. The experimental design was a split-split-plot design with four replications. The treatments are listed below.

<u>Whole plot treatments-</u> (120 ft x 60 ft)

1. untreated (no alteration to the site)
2. winter burn
3. spring mowing at flowering
4. winter grazing
5. tillage (disking)

<u>Sub-plot treatments</u>- (30 ft x 60 ft)

A. untreated
B. chlorsulfuron at 1.5 oz ai/A
C. 2,4-D ester at 1.9 lb ae/A
D. glyphosate at 3 lb ae/A

<u>Sub-sub-plot treatments</u> - (30 ft x 30 ft)

a. untreated
b. drill seed native grass mix

Initial burning, mowing, cattle grazing, and tillage were conducted before herbicides were applied. The burn was conducted in the winter between February and April. A winter burn was preferred because of the lack of burning restrictions and desired perennial grasses are dormant. The objective was to burn perennial pepperweed litter to prepare the site for seeding with a drill. Winter grazing consisted of fencing cattle at a high stocking rate (100+ cows per whole plot) with supplemental feed (alfalfa and grass hay). The purpose of grazing was to trample and break apart the perennial pepperweed litter layer and graze coarse grasses such as tall wheatgrass. Spring or summer grazing was not used since cattle preferentially graze desirable grasses over perennial pepperweed. Spring mowing (flail mower) was conducted after perennial pepperweed flowered. The purpose of mowing was to cut and break apart the litter layer and change perennial pepperweed's growth pattern to increase herbicide efficacy. Fall disking was used for the tillage treatment. Although disking is not recommended because it spreads perennial pepperweed root fragments, tillage incorporates litter into the soil and prepares an optimal seedbed for drill-seeding. Burning, mowing, and grazing were repeated in 2004.

In spring 2003, chlorsulfuron, 2,4-D, or glyphosate was applied when perennial pepperweed reached the flower-bud stage. In mowed plots, the herbicide application was delayed until September to allow mow plants to re-grow to the flower-bud stage. In disked plots, glyphosate and 2,4-D were re-applied in September to control perennial pepperweed root fragments whose buds re-sprouted subsequent to the spring herbicide application. All herbicides were applied at 20 gallons per acre with recommended surfactants using a CO2 backpack sprayer.

In March 2004, selected plots were seeded with a cool season, perennial grass mix using a no-till drill. Re-vegetation in winter grazing plots consisted of broadcasting seed a week before grazing to allow livestock to trample the seed into the soil. Grass species included *Leymus triticoides*, *Phalaris arundinacea, Leymus cinereus,* and *Pascopyrum smithii*.

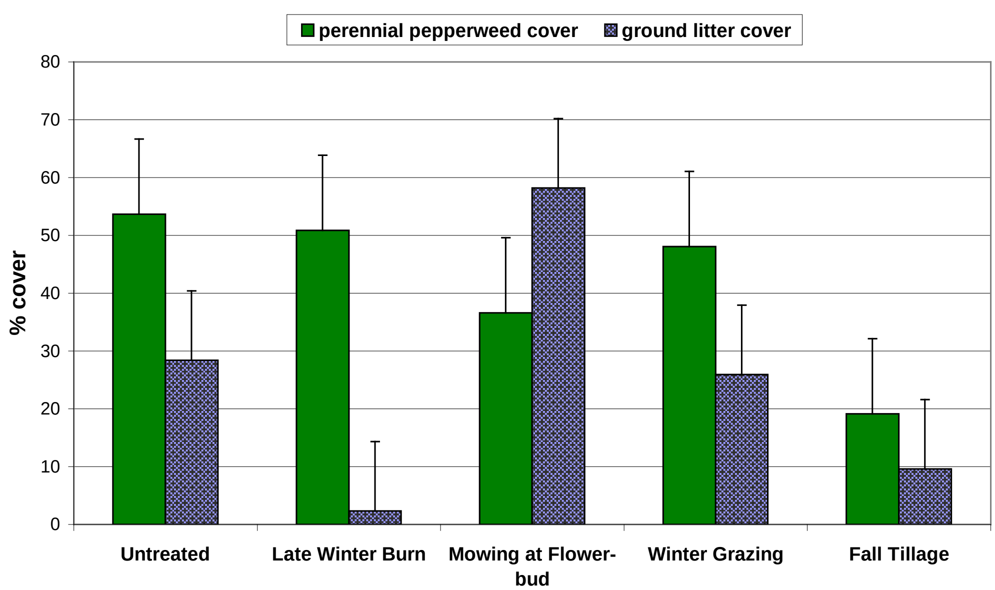
Percent cover of all plant species, bare ground, perennial pepperweed standing thatch, and ground litter were measured in spring and fall 2003 and 2004 to determine treatment effects. Perennial grass density and cover were recorded in spring and fall 2004 to access seeded grass establishment and vigor. Data was collected in three, randomly placed 1 m2 quadrats in each sub-plot.

Results

Preliminary results suggest integrating non-chemical controls with herbicides can provide effective management of perennial pepperweed. Burning and tillage were successful at removing accumulated thatch before herbicide treatment (figure 1), and mowing and tillage significantly reduced perennial pepperweed cover compared to untreated, burned, and grazed plots the year of herbicide application (figure 2). Several treatments provided effective control of perennial pepperweed one year after herbicide application. At both sites, all herbicide treatments significantly reduced perennial pepperweed cover compared to the control (figure 3). Overall, integrating non-chemical controls (burning, grazing, mowing, or tillage) with herbicides did not influence herbicide efficacy on perennial pepperweed (figure 3). In a few cases, burning and mowing decreased herbicide efficacy, but the effect was dependent on site conditions. For example, burning reduced chlorsulfuron efficacy at the Mapes site but had no effect on herbicide efficacy at the Honey Lake wildlife area (figure 3). The reason for decreased control at the Mapes site is unknown, but is likely due to high soil organic matter and the large amount of ash left after the burn. At both sites, tillage commonly decreased herbicide control (figure 3).

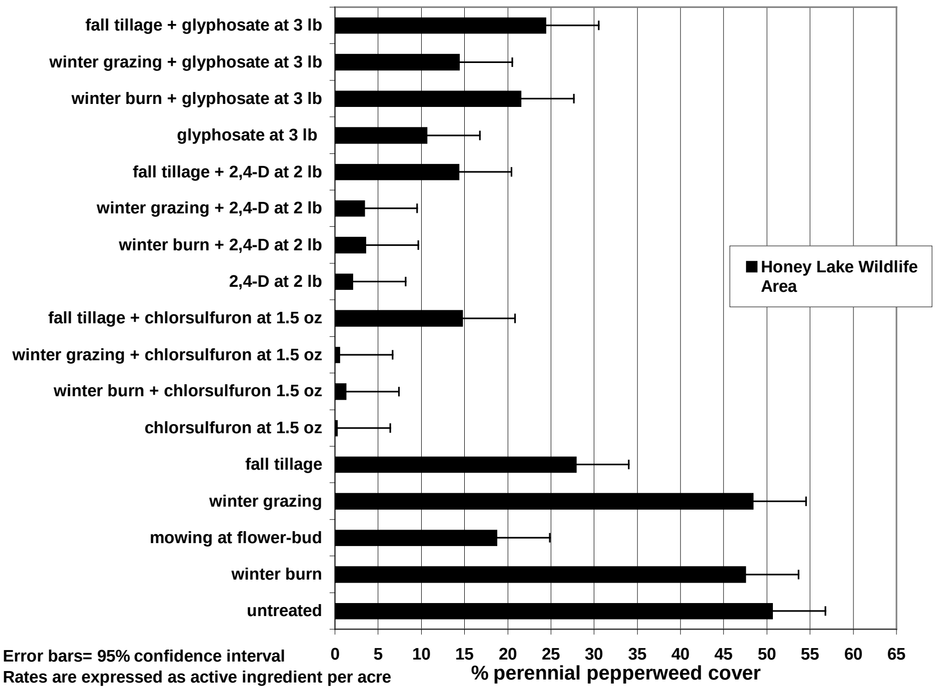
Drought conditions during spring 2004 provided inadequate moisture for perennial grass establishment. For this reason, plots will be re-seeded in March 2005. Although perennial grass establishment was poor, visual evaluations suggest integrating non-chemical and chemical control strategies significantly improves perennial grass establishment (figure 4). At the Mapes site, the following treatments improved perennial grass establishment compared to plots treated with herbicides or non-chemical controls alone: tillage plus 2,4-D, tillage plus glyphosate, winter grazing plus 2,4-D, and winter burning plus 2,4-D. The reason for improved grass establishment with these treatments is likely due to two factors: 1) tillage and burning did an excellent job at removing perennial pepperweed litter allowing exact seed placement with the drill; 2) 2,4-D and glyphosate suppressed perennial pepperweed re-growth allowing perennial seedlings to utilize all available soil moisture. Future results will provide a better understanding of the long-term success of integrating control strategies for perennial pepperweed management.

Figure 1. The Influence of Burning, Cattle Grazing, Mowing, and Tillage on Perennial Pepperweed and Ground Litter Cover Immediately Before Herbicide Application (averaged between sites)



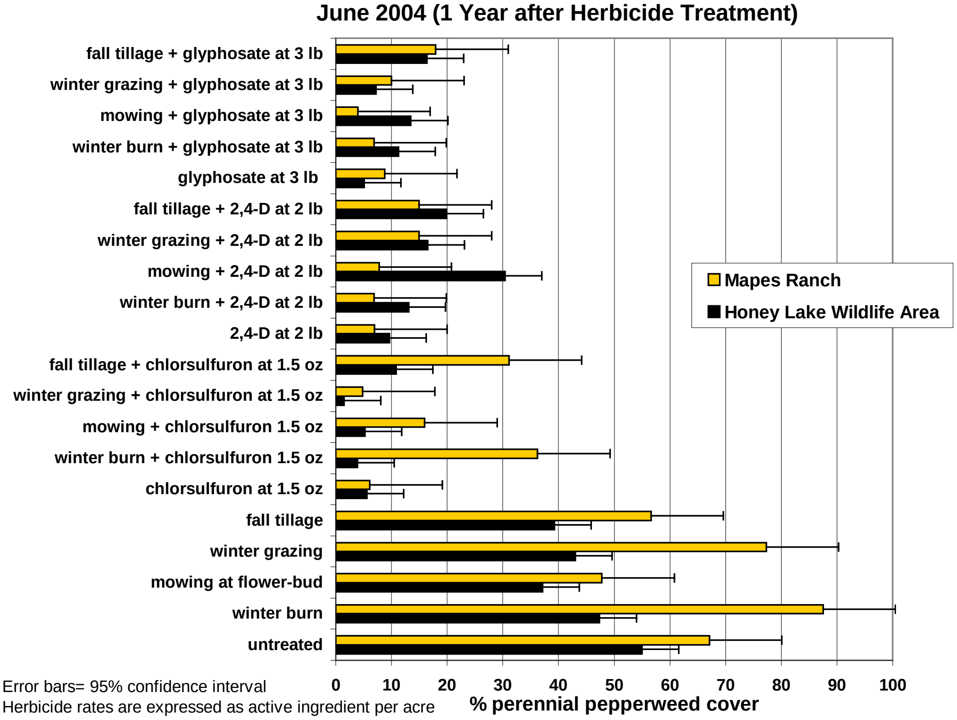
error bars= 95% confidence interval

Figure 2. The Effect of Control Methods on Perennial Pepperweed Cover August, 2003 (2 Months after Herbicide Treatment)



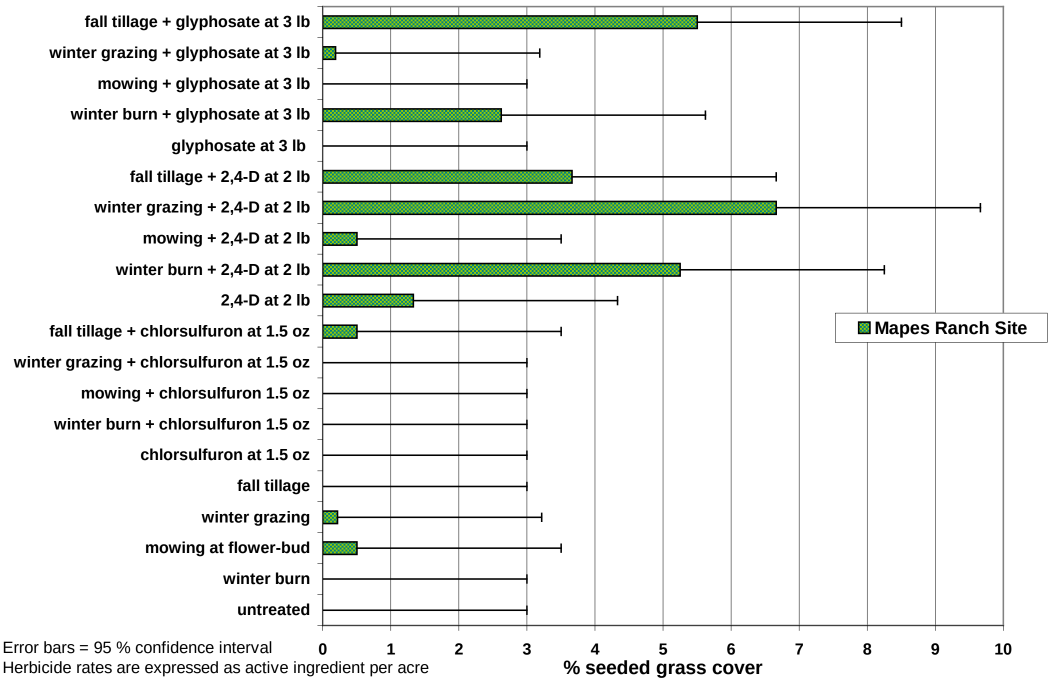
Error bars= 95% confidence interval
Rates are expressed as active ingredient per acre

Figure 3. The Effect of Control Methods on Perennial Pepperweed Cover June 2004 (1 Year after Herbicide Treatment)



Error bars= 95% confidence interval
Herbicide rates are expressed as active ingredient per acre

Figure 4. The Influence Integrating Non-chemical and Chemical Controls on Perennial Grass Establishment (6 months after treatment)



Error bars = 95 % confidence interval
Herbicide rates are expressed as active ingredient per acre

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