Managing Herbaceous Perennials in the Tahoe Basin’s Sensitive Habitats

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Lake Tahoe field study

**Background**

- Small invasions of perennials in Tahoe Basin
  - Knapweeds
  - Toadflax
  - Perennial Pepperweed

- Herbicides cannot be sprayed in sensitive areas

- Volunteer crews available for field work
Purpose of study

- Quantify if applying herbicide on a cut surface will:
  - Effectively control plants
  - Minimizes environmental impact

- Provide land managers with an effective management option in sensitive areas with large volunteer pools
Study Species

- Dalmatian toadflax  
  (*Linaria genistifolia ssp. dalmatica*)
- Diffuse knapweed  
  (*Centaurea diffusa*)
- Perennial pepperweed/Tall whitetop  
  (*Lepidium latifolium*)
Methods evaluated

Klipkleen / Dip & clip (greenhouse and field)

Cut and drop (greenhouse only)
**Herbicides and rates used**

Table 1. Rate of herbicides and active ingredients in the applied solutions

<table>
<thead>
<tr>
<th>HERBICIDE (ACTIVE INGREDIENT, AI)</th>
<th>FORMULATION&lt;sup&gt;1&lt;/sup&gt;</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telar® (chlorsulfuron)</td>
<td>75% AI</td>
<td>.282 ounces/gallon</td>
</tr>
<tr>
<td>Rodeo®&lt;sup&gt;2&lt;/sup&gt; (glyphosate)</td>
<td>53.8% AI</td>
<td>38.1%</td>
</tr>
<tr>
<td>Roundup®&lt;sup&gt;2&lt;/sup&gt; (glyphosate)</td>
<td>41% AI</td>
<td>50%</td>
</tr>
<tr>
<td>Transline® (clopyralid)</td>
<td>40.9% AI</td>
<td>25%</td>
</tr>
</tbody>
</table>

<sup>1</sup> There are many brands of herbicides that contain glyphosate, and the formulations may vary from those listed in this column. If the brand of herbicide being used has a different formulation than that listed in the table, adjust your rate accordingly.

<sup>2</sup> Rodeo is an aquatic labeled brand of the herbicide glyphosate that may be used in or near water according to label directions. Roundup is a terrestrial labeled brand of glyphosate that may not be used adjacent to or in water. Other brands of glyphosate will work as effectively as the two examples provided. Check the label to verify that the formulation and brand is licensed for the location being treated.
Greenhouse study: Perennial pepperweed

- **Methods:**
  - Dropper
  - Dipped clipper

- **Stage of plant:**
  - Flower bud
  - Flowering

- **Size of root fragment:**
  - 1-2 grams
  - 3-6 grams

- **Treatments used:**
  - Telar
  - Glyphosate
  - Cut only
  - Untreated control
Results of greenhouse study
Percent reduction in perennial pepperweed alive belowground biomass 45 days after treatment

% reduction in alive belowground biomass

P<0.05
Percent reduction in perennial pepperweed biomass
45 Days after treatment

Percent reduction in alive root biomass

1-2 g 3-6 g

Percent reduction in alive root biomass

P<0.001
Results of management methods on biomass allocation
45 days after treatment

<table>
<thead>
<tr>
<th></th>
<th>Telar</th>
<th>Glyphosate</th>
<th>Cut only</th>
<th>Uncut control</th>
</tr>
</thead>
<tbody>
<tr>
<td>prt alive</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>prt dead</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>new rts</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>subshoots</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Field sites

2 perennial pepperweed
Field sites

1 diffuse knapweed
1 Dalmatian toadflax
Data collection

- 5 Replicates/treatment
  - Untreated control
  - Cut only
  - Dip and clip (telar, glyphosate, transline)
  - Backpack spray
- Percent cover of all species in four 1m² quadrats/replicate
- Data collected pre-treatment & 1 yr post-treatment
Dalmatian toadflax
Dalmatian toadflax results

Percent cover of dalmation toadflax
1 year after treatment

* = sig. diff from untreated control p<0.05

- untreated
- cut
- telar
- glyphosate
- transline
- spray (tel)

Percent cover of Dalmation toadflax

![Bar chart showing percent cover of Dalmation toadflax for different treatments.](chart.png)
Changes in cover of Dalmatian toadflax over time

Year effect significant (p<0.001).
Year*treatment effect barely significant (p=0.053 using repeated-measures ANOVA.)
Changes in cover Dalmatian toadflax over time

Year effect significant (p<0.001).
Year*treatment effect barely significant (p=0.053) using repeated-measures ANOVA.
Control with glyphosate & telar
Changes in toadflax community composition after treatment using PCA

2004

2005

SAMPLES

▲ Untreated  ● Cut  ▼ Telar  ■ Glyphosate  ○ Transline  ▲ Spray
Diffuse knapweed site
Diffuse knapweed results

Percent cover of diffuse knapweed
1 year after treatment

* = sig. diff from untreated control p<0.05
Changes in diffuse knapweed community dynamics

- Treatments controlled diffuse knapweed
- Community changes not seen using PCA:
  - Treated plants replaced with bareground and litter
  - Few natives to re-establish
Perennial pepperweed: What happens when it rains?

- 2 inches above average rainfall in October 2004 (Carson City, NV)*
- 1.5 inches above average rain/snow in March 2005 (Glenbrook, NV)

* Yearly avg. precipitation in Carson City: 11.8”
% reduction in cover of perennial pepperweed 1 year after treatment

* = sig. diff from untreated control p<0.05
Changes in cover of perennial pepperweed over time

No significant year or year*treatment effect using repeated-measures ANOVA
Changes in cover of perennial pepperweed over time

No significant year or year*treatment effect using repeated-measures ANOVA
Sometimes spraying herbicide might help the target species.....
Treatment effects on perennial pepperweed community dynamics

- No changes in plant community dynamics with the treatment of perennial pepperweed in sprayed or dip and clip plots
  - Other factors (rainfall, flooding) outweighed effects of treatment
Conclusion data after one year of treatment...

### Table 2. Percent reduction in plant cover one year after treatment

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>DIFFUSE KNAPWEED</th>
<th>DALMATIAN TOADFLAX</th>
<th>PERENNIAL PEPPERWEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telar® (chlorosulfuron)</td>
<td>91%</td>
<td>81%</td>
<td>80%</td>
</tr>
<tr>
<td>Rodeo®¹ (glyphosate)</td>
<td>95%</td>
<td>81%</td>
<td>76%</td>
</tr>
<tr>
<td>Transline® (clopyralid)</td>
<td>99%</td>
<td>63%</td>
<td>(not applied)</td>
</tr>
<tr>
<td>Spot spray</td>
<td>97%</td>
<td>82%</td>
<td>45%</td>
</tr>
<tr>
<td>Cut only</td>
<td>53%</td>
<td>56%</td>
<td>24%</td>
</tr>
</tbody>
</table>

¹ While these are examples of formulated versions of glyphosate, many others are available and work as well as the mentioned brands.
Conclusions

- Treatment **reduces** but does not eliminate future years growth
  - Future management needed for seedlings/resprouts

- Both methods effective
  - If drop falls off reduced control

- Changes in plant community dynamics seen in toadflax site with the dip and clip method. Other sites/species have the potential for similar results.

- Rainfall plays significant role in establishment of plants.
For more information on our study please see University of Nevada Cooperative Extension

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