Non-Chemical Vegetation Management Solutions
Southern Oregon Forestry Note #9
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Abstract: This note summarizes non-chemical vegetation management control methods including manual (hand) and mechanical methods, mulching, fire, grazing, hot water/foam treatments, and indirect strategies such as shading. Methods are described for control of unwanted trees, woody shrubs, and grasses and other herbaceous vegetation. The discussion focuses on weed control in forest management, especially that directed at improving the growth and survival of planted trees, but the methods described are applicable to other situations.

INTRODUCTION
If you’re trying to grow trees, weed control is critical. Brush, unwanted trees, grass, and other vegetation compete with trees for limited supplies of water, sunlight, and nutrients. How important is good weed control? In an experiment in southern Oregon, trees were planted in a grassy area with no site preparation or follow-up control of the grass. Survival ranged from 0% - 22% in the test plots evaluated. In an adjacent area with good grass control, survival was 98%. In another series of test plots that were planted, control of grass and manzanita led to 250% volume gains per year for three years. However, many landowners are reluctant to use herbicides to control competing vegetation. For these owners, having a range of non-chemical vegetation management options is important.

Vegetation Management “Rules”
The following “rules” are important to keep in mind when designing a non-chemical vegetation management strategy.

Rule #1 – It will grow back
- Most shrubs (brush) and hardwood trees store energy in underground storage organs such as burls, root crowns, and roots
- Most resprout readily following cutting or fire (a few don’t)
- Many spread via rhizomes (underground spreading roots) and re-grow from root fragments
- Treatments that cut or remove the above ground portion of the plant usually don’t kill it – but repeated treatments may reduce plant vigor, and provide enough growing space so that planted seedlings can become established

Rule #2 – Watch out for grass!
Grasses and forbs are major competitors for soil moisture. Even a seemingly light cover of grass surrounding a planted tree can be enough to spell its demise.
- Grass grows when soils are cold and conifer root growth is inhibited
- Develops a dense, fibrous root system
- Rapidly depletes soil moisture
- Matures early and sets seed while conifers still growing
• A dense grass cover is great habitat for voles (meadow mice) which can gnaw around the base of seedling trees, often killing them.

**Rule #3 – Beware the soil seedbank**
Many weed seeds are stored in the soil. Some can remain viable for decades, even centuries, germinating only under favorable conditions such as those provided after timber harvest or fire expose mineral soil. In an experiment in the Midwest, one square foot of soil, 6” deep, contained up to 3,068 viable seeds, the equivalent of 133 million per acre! Site preparation activities such as scarification and slash piling, and even hand removal of deep-rooted plants expose mineral soil and stir up the soil seedbank, providing ideal conditions for germination and early growth. Seeds deposited by the wind or animals also invade recently disturbed sites.

**Rule #4: Thresholds for survival and growth differ**
A relatively small reduction in weed competition can result in dramatic improvements in the survival of planted seedlings. To achieve significant growth gains over no treatment, however, much greater reductions in vegetative competition are needed – perhaps around 70%.

**Rule #5: Know what weeds like…**
• Bare mineral soil
• Lots of sunlight
• Abundant soil moisture
• Freedom from competition

These conditions often result from timber harvest, site preparation, and related activities. Efforts to control one weed, such as manual or mechanical removal of blackberry, may also disturb the soil, setting the stage for a weed invasion. Weeds don’t thrive in situations where there is:
• Lots of shade
• Competition
• Organic matter

**WEED CONTROL METHODS**

There are three basic methods of weed control:
• Direct control methods (manual, mechanical, biological, etc.)
• Indirect methods (shade, organic matter retention)
• Prevention

**Direct Methods**

**Manual Weed Control**

Hand methods: **Scalping**
• Scalp 2’-3’ square as part of planting process
• Most suitable for light annual weeds
• Much more difficult with sod, established pasture
• Rapid recovery of vegetation limits effectiveness
• The bigger the scalp the better
• Very labor intensive, especially with established perennial grasses and forbs

Tools: Hazel hoe, hoedad, McLeod

**Grubbing**
- Grub out roots & root crowns
- Best when soils are loose and moist. Rocky soils? Forget it.
- Tools – hazel hoe, mattock, McLeod
- Extremely labor intensive
- Can be effective when large area grubbed – 5+ foot radius around seedling

**Weed pulling**
- Best for annuals and tap-rooted plants. Good for shrub and tree seedlings without spreading root systems.
- Tools include mattock, Root Talon, Weed Wrench, and others, used to lever weeds out
- Very labor intensive
- Minimal impact

**Brushcutting**
- Chainsaw or brushcutter to clear away competing brush/trees
- Most species will re-sprout; many will regrow to original size within one growing season
- Alder is a notable exception – trees 2” and larger can be felled at ground line mid-June to mid-August with little or no re-sprouting
- Don’t wait - 1st year is most important
- Cut brush in summer when below-ground reserves are lowest
- Two or more cuttings per season
- Recommended treatment area is 5+ foot radius around tree; no significant growth effect if smaller radius (but may improve survival)

**Girdling**
- For control of trees or shrubs with single trunk
- Cut away a strip of bark and inch of so wide all the way around the trunk
- Cut parallel lines three or more inches apart
- Make sure to get through the inner bark and cambium, all the way to the wood
- Can use knife, axe, saw, chainsaw
- Some species will spout at base
Mechanical Vegetation Control

Scarification
- Typically done with cat. Uproot and pile brush.
- Brush rake is more effective and will result in less soil in the piles
- Many stems/roots will be severed and left in the ground, where they may resprout
- Results in substantial soil disturbance, sets the stage for invasion by other weeds
- Don’t overdo it

Brush-cutters and mowers
A wide variety of brush-cutting and mowing equipment is available. This equipment chops, chips, crushes, or otherwise breaks apart brush, small trees, and slash into small pieces or chips that lie on the ground surface, leaving a relatively light to dense fuelbed depending on the amount of material processed. The cutting head is usually horizontally-mounted and may be an integral part of the prime mover, or an attachment that is either pulled behind or mounted in front. For example, the "Brush mulcher" is a small, tracked machine with a forward-mounted cutting drum. This device walks over brush and small trees (up to 3" diameter) and shreds them, forming a "mulch" layer.

Mowing has been used extensively in central Oregon to treat highly flammable bitterbrush in areas around subdivisions where prescribed burning would be dangerous or socially unacceptable. The mower is a heavy duty brush cutter attached to a tracked machine or 4-wheel drive tractor.

A potential advantage of treatments is that the heavy surface organic layer shades the ground and reduces weed germination. Other fuels treatments such as mechanical piling and burning that expose mineral soil may result in more weed problems.

The presence of a dense surface layer of woody material may also inhibit the germination and growth of desirable grasses and forbs.

Potentially beneficial effects on soils include 1) retention of organic matter on site; 2) reductions in soil erosion by leaving a surface organic layer; and 3) increase in soil moisture retention by shading the soil surface.

The long term effect on soils of mechanically treating vegetation and leaving a dense surface layer of woody material is not well understood. If the material is left on site, it will gradually decompose into the duff layer. The rate of decomposition depends primarily on soil moisture and temperature. On dry sites, experience suggests that slash decomposes very slowly, sometimes over a decade or more. The addition of a dense layer of woody material to the forest floor is unlikely to tie up soil nitrogen unless it is thoroughly mixed into the soil.

Tillage/Ripping/Subsoiling
Especially useful for site preparation on pastures, old fields, log landings, roads, and other compacted surfaces.
As a weed control method, is most effective against annuals and shallow-rooted perennials. However, roots of other species may be fragmented, and these may re-sprout, resulting in spreading further spread of weed problems.

**Mulching**
- A mulch is a barrier placed on soil to reduce water loss & control weeds
- Examples used in forestry: reinforced Kraft paper with asphalt core, newspaper, black plastic, clear plastic, fabric (polyethylene), organic materials including straw and wood chips.
- Weed mats:
  - Scalping first helps moisture penetration
  - Hard to pin down on rocky soils
  - Watch for signs of rodents under mats
  - Take 1-1.5 minutes to install
  - Maintenance needed
  - Kraft paper - tends to rot from corners, short duration (1 year +/-)
  - Newspaper - lasts longer, cheaper (2 yrs)
  - Polyethelyne films - long lasting, expensive
  - Organics variable - 1+ years
  - Cost comparison:

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kraft paper mat</td>
<td>3x3</td>
<td>$0.75</td>
</tr>
<tr>
<td>Newspaper</td>
<td>2.5' sq.</td>
<td>Free?</td>
</tr>
<tr>
<td>Vispore mat</td>
<td>3x3</td>
<td>$0.75</td>
</tr>
<tr>
<td>Pak square</td>
<td>5x5</td>
<td>$2.35</td>
</tr>
<tr>
<td>Chips</td>
<td>Varies</td>
<td>Free?</td>
</tr>
</tbody>
</table>

- Expensive unless newspaper or organics used
- Require maintenance
- Effective for grass & herb control; increased survival over no treatment
- Usually ineffective for woody shrubs/trees, but can control small shrub seedlings
- 3’ x 3’ mat minimum; smaller not effective, bigger for enhanced growth

**Prescribed Fire**
Broadcast burning – effective for site preparation, sets back brush, difficult to implement on small ownerships due to liability concerns, smoke management issues

Underburning:
- Apply low intensity broadcast burn under canopy to kill some shrub seeds, stimulate others to germinate, injure shrub/hardwood seedlings
- Repeat burn for much greater control
- Technically feasible, logistically challenging, seldom done
Vegetation Management with Livestock
- Controlled grazing can reduce weed competition to benefit tree survival & growth, reduce fire hazard, reduce unwanted weeds, and increase access.
- The objective is important: Focus with forest grazing has been animal production; focus with prescription grazing is reducing tree competition; tough to have best of both.

Variable results:
- Cattle grazing in Klamath pine country & SW OR has been successfully used to reduce competition and increase tree growth.
- Sheep used successfully in Coast Range to reduce brush competition.
- Several N. CA. studies: Cattle & sheep grazing had NO beneficial effect on tree survival & growth.

Timing and duration of grazing:
- A delicate balance: Grazing intensity must be high enough to substantially reduce competition, but not so high as to encourage move to trees.
- What is optimal for weed control may not be optimal for animal production.
- Grazing for weed control most effective between conifer budset & budbreak when conifers least palatable, other vegetation most palatable.
- Many shrub species not very palatable, may increase as a result of grazing (poison oak, etc.).

Browse damage:
- Graze when other vegetation palatable, trees least palatable (generally between budset & budbreak).
- Trees can tolerate some browse damage, especially if terminal left intact.
- Cattle damage mostly from trampling & rubbing; most sheep damage is from browsing (can tube trees to protect, or using fencing).
- Goats very damaging to trees - will eat foliage & bark.
- Learned behavior - remove problem animals.

Cattle & sheep:
- Mostly grazers, minor browsing.
- Intensive management required: herding, fending, watering, salt.
- For optimal weed control (suboptimal animal production), expect to pay.

Goats:
- Mostly browsers of woody vegetation.
- Most useful for noxious weed control, or when damage to desirable vegetation not a concern.
- Short term, very intensive tmt best.
Hot Water-Foam Treatment
The Waipuna system uses a foam concentrate (Alkyl Polyglycoside – sugar extracts derived from corn and coconut) added to water that is heated to steam temperature, then applied topically to undesirable plants. Effective treatment depth is approximately ½ to ¾ “ into the soil, thereby killing both noxious weeds and their seeds in one application. Treatment can occur, regardless of weather, during any season, and is effective immediately upon application. Treated sites may be re-entered and reseeded immediately thereafter. Since the Waipuna system does not use herbicides, it can be used in virtually any area regardless of proximity to wildlife, waterways, organic gardens, schools, threatened & endangered plants, or humans. The system leaves no residue in the soil and no special licensing or permits are required.

Local experience suggests that the technology is intriguing, but the limitations are speed (it's really slow), and it’s only really useful on annual weeds or plants. If you want to treat perennials, you'll only top-kill them, and have to re-treat the following year, but that too could weaken plants over time, and eventually kill them.

Biological Control Methods
• Use insects, fungi and other natural enemies of target weed species to achieve control
• Oregon Department of Ag. has introduced 42 species against 20 target plants. Most are forbs such as thistles.
• Biocontrol agents reduce biomass of target plants, seldom kill them outright
• Any biocontrol effort would have to be coordinated with ODA
• New biocontrol agents include fungi, including one that affects Himalayan blackberry

Indirect Weed Control Methods
Indirect weed control methods work by modifying the environment that undesirable vegetation grows in. Indirect methods are based on a few principles of weed ecology:
• Many competitive shrubs are shade intolerant
• Thick layer of organic material inhibits seed germination & growth
• Therefore, modifying the environment through silvicultural techniques such as group selection harvest, organic matter retention, shading, and preharvest burning may help limit and control undesirable vegetation.

A case study of a group selection timber harvest in northern California showed the following:
• Small openings (<1 acre) in stand; partial shade in opening
• In opening, manzanita foliar cover <1%, ht. 2.6 ft.
• In nearby cleacut, manzanita density 16x as great, foliar cover 18x as great, plants twice as tall
• Tree growth was slower in small gap, but trees able to release
Organic matter limits weeds, as shown by the following example:

<table>
<thead>
<tr>
<th>Organic matter</th>
<th>Deerbrush</th>
<th>Manzanita</th>
<th>Grasses</th>
<th>Forbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Density (plants/acre)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-90%</td>
<td>1917</td>
<td>250</td>
<td>417</td>
<td>1333</td>
</tr>
<tr>
<td>10-20%</td>
<td>3750</td>
<td>2250</td>
<td>14250</td>
<td>1250</td>
</tr>
</tbody>
</table>

On a project in the Jacksonville watershed in southern Oregon:
- Better pine seedling growth and survival on thick organic matter vs. cleared area (manzanita seed germination inhibited, more moderate soils temps, increased moisture)
- Native grass seeding appeared to inhibit manzanita germination

COSTS AND COST-EFFECTIVENESS OF NON-CHEMICAL TREATMENTS – SOME DATA

Study #1:
Ponderosa pine planted; competing vegetation included manzanita, other brush
Treatments:
- grub 2 ft radius around each tree 1 time
- grub 2’ once, re-grub and expand to 4’ second time
- grub 4’ once
- grub 4’ once, then out to 6’ next time
- control - no treatment of surrounding vegetation

Results: Survival was 94-98%, no difference among treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hours/Acre</th>
<th>Cost ($/acre)</th>
<th>Caliper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0.88</td>
</tr>
<tr>
<td>Grub 2’ radius</td>
<td>12</td>
<td>90</td>
<td>0.9</td>
</tr>
<tr>
<td>Grub 2’-4’ radius</td>
<td>51</td>
<td>382</td>
<td>1.1</td>
</tr>
<tr>
<td>Grub 4’ radius</td>
<td>25</td>
<td>188</td>
<td>0.9</td>
</tr>
<tr>
<td>Grub 4’-6’ radius</td>
<td>77</td>
<td>578</td>
<td>1.43</td>
</tr>
</tbody>
</table>

Study #2
- Jeffrey pine planted on low site in N. California
- Main competition is manzanita, cheatgrass, snowbrush
- Treatments are control, grazing with cattle for 5 years, spraying once with Velpar, grubbing to a 4 ft. radius around each tree for 3 consecutive years
- Results are for 5th year

Height/Caliper of Pine Seedlings by Treatment
**Study #3**

*Douglas-fir seedling survival and caliper*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Survival (%)</th>
<th>Caliper (inches)</th>
<th>Cost ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual – 2 ft</td>
<td>77</td>
<td>0.94</td>
<td>264</td>
</tr>
<tr>
<td>Manual – 4 ft</td>
<td>89</td>
<td>1.06</td>
<td>549</td>
</tr>
<tr>
<td>Manual – 6 ft</td>
<td>89</td>
<td>1.27</td>
<td>617</td>
</tr>
<tr>
<td>Chemical – broadcast</td>
<td>88</td>
<td>1.49</td>
<td>46+</td>
</tr>
<tr>
<td>Control</td>
<td>42</td>
<td>0.8</td>
<td>0</td>
</tr>
</tbody>
</table>

**Study #4**

*Stem diameter of ponderosa pine seedlings, by treatment*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Caliper (inches)</th>
<th>Cost ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual – 4 ft 1x</td>
<td>3.67 b</td>
<td>210</td>
</tr>
<tr>
<td>Manual – 4 ft 3x</td>
<td>4.38 bc</td>
<td>865</td>
</tr>
<tr>
<td>Manual – Entire plot 2x</td>
<td>6.33 a</td>
<td>1696</td>
</tr>
<tr>
<td>Chemical – Velpar</td>
<td>6.08 ac</td>
<td>102</td>
</tr>
<tr>
<td>Control</td>
<td>2.92 b</td>
<td>0</td>
</tr>
</tbody>
</table>

**SUMMARY**

- Effects of manual & mechanical treatments usually very temporary - competing vegetation grows back rapidly from roots, rhizomes, or from seed
- Just removing above-ground plant parts generally ineffective for long-term control of sprouting species, though plant vigor could be reduced with repeated treatments
- Clear brush within 5’ radius around seedling for growth effect
- Mulching effective for grass control but not brush; 3’x3’ minimum size
- Burning similar to mechanical treatments in effectiveness but limited by smoke mgmt, liability, other concerns
- Prescription grazing can be effective if done correctly; timing is key concern
- Indirect methods (shade, organic matter retention) may be very cost effective ways of managing weeds
- Overall, non-chemical weed control methods can be viable but usually more expensive (measured in labor or dollars) compared to chemicals
- Some species (e.g., knotweed) are virtually impossible to control without herbicides
- Non-chemical methods best suited for small scale jobs, situations where commitment to follow-up treatments is strong, and/or where lots of volunteer or cheap labor is available
Sources of Tools

Forestry Suppliers, Inc.
http://www.forestry-suppliers.com/
800-647-5368

Ben Meadows
http://www.benmeadows.com/
1-800-241-6401

Terra Tech
http://www.terratech.net/
1-800-321-1037

The Root Talon is available for $47, plus $5.25 shipping, directly from the manufacturer. Contact:
Lampe Design, LLC
262 South Griggs Street
St. Paul, MN 55105
(651)699-4963
Email: jl@usinternet.com
The Root Talon also has a web site with bigger pictures!

The Weed Wrench comes in several sizes. Prices range from $82-$189, plus shipping.
The Weed Wrench Company
P.O. Box 512
Grants Pass, OR 97528

Useful Publications

The Nature Conservancy’s Weed Management Handbook has chapters on manual and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides.
http://tncweeds.ucdavis.edu/handbook.html

Relevant OSU Extension Publications:
EC 1388 Intoduction to Conifer Release
EC 1188 Site Preparation: An Introduction for the Woodland Owner
EM 8776 Perennial Weed Biology and Management
EC 1563 Pacific Northwest’s Least Wanted List: Invasive Weed Identification and Management
Available through Oregon State University Extension and Experiment Station
Communications: http://eesc.orst.edu/agcomwebfile/EdMat/EdmatIndexAg.html