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# Identification and Management of Perennial Pepperweed (Tall Whitetop)

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Perennial pepperweed (*Lepidium latifolium* L.), often called tall whitetop, is one of the most troublesome noxious weeds in Nevada. It grows in all 17 counties, and despite many efforts to control it, populations continue to expand.

A native of southeastern Europe and southwestern Asia, it may have come into the United States as a contaminant in sugar beet seed in about 1900.

**What does it look like?**

A member of the mustard family (*Brassicaceae*), perennial pepperweed commonly grows 2 to 4 feet tall, but may reach 8 feet in wet or shady areas. Growth from buds on the root crown and/or roots begins in spring, forming a rosette. Plants bolt in May and bloom most often in June or July. Mature plants have the following characteristics:

Roots: Roots are large, coarse and brittle. Shallow roots extend laterally close to the soil surface for long distances. These creeping underground roots grow 3 to 10 or more feet long, and send up shoots to form new plants. Deep roots allow plants access to moisture deep in the ground. Plants can grow from root parts as small as one-tenth of an inch in thickness. Creeping roots are the most important method of reproduction for this weed.

Stems: Stems are somewhat woody, waxy and smooth. Multiple stems can grow from the root crown. Branching occurs at the leaf axils.

Leaves: Leaves are alternate, lance-shaped to ovate, green to grayish green, smooth and waxy. The leaf margins can be smooth or toothed, and the edges are sometimes curled. The leaves at the base of the plant are 4 to 11 inches long and have stalks. Leaves decrease in size toward the top of the plant, and stalks vanish, but leaves do not clasp the stem.

Flowers: Flowers are small, white and have four petals and six stamens. The flowers are arranged in 6 to 8 tight ball-like clusters at the ends of the stems in racemes. The flowers do **not** at any time form "down" that might blow in the wind, similar to thistles. Regrowth will bloom in fall if conditions are right.

Seeds: Seeds are produced in small hairy pods. The seeds are tiny and reddish-brown in color. Perennial pepperweed is a prolific seed-producer.

***Perennial pepperweed is most recognizable when blooming.***

Mature stands can produce more than 6 billion seeds per acre. Although most are shed in the fall, some seeds remain on the plant through winter.

Young seedlings of perennial pepperweed can be difficult to recognize, as they look like seedlings of other mustards. While many seeds are produced, it's unusual to find many seedling plants in the field. In most cases, new plants develop from buds on the creeping perennial roots. When moist conditions persist after spring floods or reservoir drawdowns, abundant seedlings have been observed.

Perennial pepperweed can be differentiated from the noxious weed hoary cress, often called "whitetop" (*Cardaria draba* L.), by its taller size and later bloom period. Also, the base of hoary cress leaves clasp (wrap around) the stem, and the stems only branch in the flowerheads.

**Where does it grow?**

Perennial pepperweed first infests moist or wet sites along streams, rivers, lakes and wetlands. It grows in riparian areas throughout the western United States and in several midwestern and eastern states. Perennial pepperweed tolerates salty soil and adapts well to many sites under adverse conditions. It grows in native hay meadows, abandoned agricultural lands, pastures, hayfields, residential areas and along roadsides. Given sufficient moisture in the first year of growth, plants will continue to grow in very dry sites in subsequent years, especially where the groundwater table is close to the land surface.

**How is it spread?**

Both perennial pepperweed seeds and roots from eroded banks can travel long distances in rivers and irrigation ditches to infest new areas. Flood irrigation carries perennial pepperweed seeds into and throughout native hay meadows, pastures and other irrigated lands.

Perennial pepperweed seeds and perennial roots are also spread in contaminated fill dirt or so-called "top soil" during construction and landscaping. They can

***Rosette***

***Stem leaf***

***Flowering stem***

***Infestations along rivers and lakes result in increased erosion and water quality impairment.***

***Infestations take over pastures and hay land, reducing their value.***

be picked up and distributed to uninfested areas on tires and all types of equipment used in haying, shipping of hay and farm products, construction, utility line maintenance, road maintenance, hunting, four-wheeling and other recreational activities. Contaminated straw used in erosion-control projects also moves this weed. Additionally, live seed is spread over long distances in dried flower arrangements. Livestock and several wildlife species may also disperse seed.

**Why should we be concerned?**

No benefit has yet been found for perennial pepperweed, and it has many bad aspects. This weed is a very competitive plant. It crowds out desirable vegetation, adversely impacts wildlife habitat, impairs scenic values and decreases biodiversity. In riparian areas, it interferes with the regeneration of willows and cottonwoods, reducing the cover and food available for birds, especially nesting waterfowl.

Perennial pepperweed lowers the quality of livestock feed from pastures and hay fields it infests. It reduces both protein content and digestibility, devaluing the hay nutritionally and economically. The accumulation of dead, woody stems inhibits grazing.

Left untreated, small infestations expand throughout pasture and hay land in just a few years. The weed interferes with production of weed-free forage and decreases the value and sellability of cropland.

Perennial pepperweed is a nuisance on golf courses and in parks and increases weed control costs.

**What can we do to control this weed?**

Perennial pepperweed is difficult to control due to its competitive nature and extensive, rapidly spreading root system. Because it has invaded many sites throughout the West, its eradication (complete elimination) would be very expensive and is thus unlikely. Instead, the goal is to control its spread using integrated weed management (IWM) practices. IWM uses prevention techniques and appropriate cultural, mechanical, biological and chemical weed control methods in a planned approach to maximize the effectiveness of the overall control effort.

Before getting started with control projects, first consider the eventual use of the site. For example, roadsides will be managed differently than pastures, riparian areas, alfalfa fields or gardens. Once you've determined your management goals for the site, you can select the appropriate tools to achieve those goals. Simply killing the perennial pepperweed and leaving a site unvegetated invites future infestation by other weeds. Revegetation with competitive species is key to the long-term control of any weed.

Also consider the size of the infestation, and how many years perennial pepperweed has been growing at the site. For large infestations that established many years ago, the initial goal should focus on

***Effective control of perennial pepperweed requires killing the below-ground root mass.***

containing the existing population and preventing the spread of seed and roots to new areas. In infested waterways, find the uppermost location at which perennial pepperweed occurs and work downstream with control efforts.

Prevention: Since it is unlikely that we'll be able to eradicate perennial pepperweed, efforts often focus on excluding it from uninfested areas. Surveys and monitoring help find the first perennial pepperweed plants in previously weed-free areas so they can be controlled during the first growing season. Always control infestations when they are first noticed, before entire fields or yards are engulfed. Seedlings are easier to kill than mature, established plants.

When working at sites that are infested with perennial pepperweed, continually monitor earth-moving equipment for seed or rootstock contamination, which can be carried to weed-free areas. Likewise, never use fill dirt from infested areas that may contain seed or perennial roots.

Seed sources should be certified free of perennial pepperweed seed, and infested hay should not be sold or transported through uninfested areas. Contact the Nevada Department of Agriculture, http://agri.state.nv.us, for information on hay and seed certification programs.

Cultural control: Vigorous plant communities will best withstand invasion by perennial pepperweed. Maintain healthy stands of desirable plants with appropriate species selection and irrigation. Long-term flooding has also been used to control perennial pepperweed. Plants must be inundated by several inches of water throughout the growing season for one or more years to kill them.

Mechanical control: Mechanical controls, including digging, mowing or tilling, are generally ineffective. These methods encourage plants to sprout from their crowns and perennial roots, and are not recommended except as part of an integrated approach using multiple tools. Shading or smothering with thick mulches is also ineffective.

Hand pulling or digging has been used in situations where only a few plants are present or in riparian areas where herbicides cannot be used due to the proximity of water or other management concerns. It is most effective in moist, loose soils where a slow and steady pulling action will remove 6 to 8 inches or more of the root. New plants readily sprout from root fragments, so hand-pulled areas must be monitored frequently and new growth pulled as soon as it appears. Pull or dig repeatedly at frequent intervals during the growing season for a number of years. This is a labor-intensive method that is only appropriate in limited circumstances where herbicides are not an option.

Tilling cuts roots into fragments, each of which can grow into a new plant, increasing the density of infestation. Repeated tilling or disking is not effective in controlling perennial pepperweed. Also, small root fragments are more likely to move offsite than are large root systems.

Mowing plants or cutting stems can be used to remove plant material or delay the onset of flowering and seed production. These treatments do not kill the plants and may even result in root expansion. Research has shown that pretreatment mowing can be useful to enhance the effectiveness of subsequent herbicide applications on regrowth.

However, soil moisture must be sufficient for regrowth to occur through the flowering stage.

Burning is often used to remove the accumulated dead material prior to herbicide application, but does not kill the roots. The dead material is sometimes difficult to burn due to a lack of fine fuels.

Biological control: Livestock grazing can be used as a tool in an integrated management approach, but grazing alone does not provide long-term control of perennial pepperweed. Sheep and goats especially will graze perennial pepperweed at any point up to the flowering stage. Carefully managed intensive grazing by sheep or goats can help decrease stem densities and suppress the weed, allowing desirable vegetation to thrive. Grazing also helps remove mature vegetation from sites, allowing more effective follow-up treatment with herbicides after plants have regrown. A heavy concentration of grazing animals may also break up the litter layer and stimulate the germination of desirable species.

When using grazing as an IWM tactic for controlling perennial pepperweed, be careful to quarantine animals for at least five days before moving them to weed-free areas. Studies have shown enhanced germination of seeds that have passed through livestock digestive tracts.

Currently, no insects or diseases are available to kill or debilitate the plant. An *Albugo* rust has been identified on the leaves of perennial pepperweed plants, especially during wet years, but the effects of the rust do not appear to provide control. Extreme care is needed to avoid introduction of an insect or disease that could affect a valuable crop species. Likewise, care must be taken to ensure the biological control will not infest native perennial *Lepidium* species. Two species within the genus *Lepidium* are listed as federal endangered species. The influence of a potential biological control organism on these closely related species must be clearly established before its use will be allowed by regulatory agencies.

***Goats will graze enthusiastically on perennial pepperweed, but grazing does not kill plants.***

Chemical control: In most cases, herbicides are needed to provide effective control of perennial pepperweed. However, chemical control is made more difficult by the robust root system. Prior to herbicide application, the site often must be pretreated to reduce the large amounts of semi-woody growth produced by perennial pepperweed during previous years. This thick residue makes it difficult to spray new growth because the herbicide becomes trapped on the dead overgrowth before it can reach the green leaves of the target plants. Sites with this dense residual vegetation are also difficult to walk through and move equipment across. Remove thatch prior to herbicide application by burning, raking, mowing, grazing, brush beating or other methods.

Many of the recommended herbicides are most effective when applied at bud to early bloom stage of plant growth (see Table 1), preventing seed set. A second application to any regrowth in the fall enhances control. Follow all label directions with care, do not spray during windy weather and never apply chemicals to open water—ponds, ditches, streams or wetlands—unless the herbicide is labeled for aquatic use. When possible, focus herbicide applications on the large lower leaves, not the upper leaves or flowers. This increases the amount of herbicide that is absorbed and increases the likelihood of killing more of the roots. It may take

**Table 1. Chemical Controls for Perennial Pepperweed**

| Active ingredient | Sample brand names* | Herbicide properties | Rate† | Timing |
|---|---|---|---|---|
| **2,4-D+** | Many | Broadleaf-selective herbicide; some brands approved for certain aquatic applications; somewhat effective in controlling perennial pepperweed; requires repeated applications | 1 – 4 lbs a.e./A; check product label | Best control when applied at bud to early flowering stages |
| **Chlorsulfuron** | Telar®, others | Broadleaf-selective herbicide; do not apply directly to water or to areas where surface water is present; provides good control in dry sites; has residual effects that can interfere with reseeding for one or more years | 0.75 – 1.5 oz a.i./A; add a nonionic surfactant per label instructions | Apply at bud to early flowering stages; can apply in the fall if green tissue is present |
| **Metsulfuron-methyl** | Escort®, others | Broadleaf-selective herbicide; do not apply directly to water or to areas where surface water is present; provides good control in dry sites; has residual effects that can interfere with reseeding for one or more years | 0.75 – 1.5 oz a.i./A; add a nonionic surfactant per label instructions | Apply at bud to early flowering stages; can apply in the fall if green tissue is present |
| **Imazapyr+** | Habitat®, Arsenal®, others | Broad-spectrum herbicide that may also harm grasses. Habitat® is approved for use in and around standing and flowing water. Do not apply Arsenal® directly to water or areas where surface water is present. | 2 – 6 oz a.e./A | Can apply at any time; best control when applied at bud to early flowering stages |
| **Imazapic** | Plateau® | Broad-spectrum herbicide; many established grasses are not substantially harmed by imazapic; cannot be used in water | 2-3 oz a.i./A; add MSO at 2 pints/A | Apply at flowering to post-flowering; can apply in the fall to rosettes |
| **Glyphosate+** | Roundup®, Rodeo®, Aquamaster®; many others | Nonselective herbicide; generally provides fair to poor control of perennial pepperweed; formulations available for use in and around aquatic sites. Not persistent in soil. | 3-4 lbs a.e./A; check product label | Mow plants prior to flowering and apply to plants after they regrow |

**Various other products containing mixtures of several active ingredients are also available. The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by Cooperative Extension is implied.*

*+Available in formulations that can be used in aquatic and riparian habitats.*

*†Always read and follow all label directions when using herbicides. Check rates before mixing. Abbreviations: a.e. = acid equivalents; a.i. = active ingredient; A = acre; MSO = methylated seed oil.*

two or more weeks following application for plants to show signs of death.When using pesticides near wet areas, be careful to avoid contaminating waterways. In sensitive sites, rather than using a spray applicator and risking herbicide drift into the water, consider applying the chemicals with a wipe or wick applicator. This device contains a sealed reservoir of herbicide and a porous wicking applicator at one end. The chemical is wiped or painted onto individual plants. While wipe applicators minimize risk to adjacent vegetation or sensitive resources, it is difficult to get an even application on plants and the technique is very labor-intensive. This method is typically recommended for small sites and not for ordinary use.

Chlorsulfuron (Telar®, others) and metsulfuron-methyl (Escort®, others), two sulfonylurea compounds, are very effective in controlling perennial pepperweed. They are not registered for use in wet areas, but can be used in range, pasture, noncrop and roadside applications. Add a nonionic surfactant per label directions to aid in spreading and uptake by the waxy leaves. These two chemicals, which are broadleaf weed killers, do not kill most established grass and grass-like species. Check current product labels for possible grazing restrictions. Both herbicides are available in formulations that can be applied to pasturelands. Repeated use of these compounds may suppress germination of grass seeds, so they should be used with care. Both have a residual effect that may last more than one year in alkaline soils, and for several years or longer in broadleaf crops such as alfalfa.

Unfortunately, both chlorsulfuron and metsulfuron are more expensive than many other common herbicides, kill most broadleaf plants, and may injure or kill native shrubs and trees as well as crops if not applied with care. Both herbicides also have some pre-emergent activity that may adversely affect the survival of seedlings from broadleaf plants, making it difficult to revegetate a site. However, if perennial pepperweed can be controlled with only one or two applications of chlorsulfuron or metsulfuron-methyl,

***In sensitive sites, use wipe applicators to avoid spray drift.***

the overall cost may be lower than other alternatives that require repeated applications over several years.

Another effective herbicide is imazapyr (Arsenal®, Habitat®, others), a nonselective pesticide that kills all vegetation indiscriminately, providing bare ground control. Imazapyr is labeled for use on noncroplands, such as road and utility rights-of-way. It is most effective when applied to actively growing foliage. Imazapyr is available in formulations registered for aquatic or riparian use (Habitat®, others).

Imazapic (Plateau®, Panoramic®) is also effective in controlling perennial pepperweed as well as many other broadleaf and grass species. It can be used in pastures, rangelands and many noncropland sites, including rights of way, turf areas, nonagricultural fence rows and nonirrigation ditch banks. It is effective on plants during the post-flowering stage, allowing applications to be delayed when needed to meet site objectives. While no grazing restrictions exist, hay cannot be harvested for at least 7 days following application. When using on sites that will be revegetated, see product labels for a list of tolerant species.

The phenoxy herbicides (variants of 2,4-D) result in death of perennial pepperweed shoots, but some roots and crown buds may rapidly sprout and grow. Repeated applications may therefore be required for up to five years or more to starve out the root system. Formulations of 2,4-D amine salts are available that can be used in water bodies or on ditch

banks. Check label directions when selecting a product.

Glyphosate (Roundup®) is less effective than 2,4-D in controlling perennial pepperweed and is not generally recommended. Since glyphosate is a nonselective herbicide, all vegetation to which it is applied will be killed or injured.

Researchers at the University of California, Davis have studied the effectiveness of mowing followed by herbicide application. If plants are mowed at the bud to early bloom stage and allowed to regrow to the same stage before treatment with herbicides, control was improved, especially with glyphosate application.

Site-specific chemical control recommendations are given in Table 1. Research is continuing on the control of this weed, and new methods and products continually being studied.

**Revegetation of infested sites**

To successfully manage perennial pepperweed, immediately after control, any residual perennial pepperweed thatch must be removed and desirable competitive vegetation established. Species that are highly competitive and spread by creeping perennial roots, such as tall wheatgrass (*Thinopyrum ponticum*), creeping wildrye (*Leymus triticoides*) and saltgrass (*Distichlis spicata*) may be successful. By selecting grasses, broadleaf-selective herbicides can continue to be used to control regrowth of perennial pepperweed. Sod-forming perennial grasses that grow a thick mat of vegetation compete best with the weed.

Results of a study by Wilson et al. (2008) showed that successful control and revegetation of dense infestations of perennial pepperweed took at least three years of IWM efforts, including removal of thatch, application of herbicides and reseeding. Spot treatment with herbicides was necessary in succeeding years. The same study found that burning, disking or mowing alone were not effective in controlling the weed. Successful revegetation with native grasses required use of mechanical controls in combination with herbicides.

**Monitoring**

Perennial pepperweed is very difficult to control, and sites must be monitored for up to five or more years and retreated when needed. Absence of plants one year after treatment should not be interpreted as success. New shoots from deep roots that survive an initial growing season after treatment may emerge during a subsequent growing season.

**References**


Jacobs, J. and J. Mangold. 2007. Ecology and Management of Perennial Pepperweed (*Lepidium latifolium* L.). USDA-NRCS Invasive Species Technical Note No. MT-11.

Peachy, E. (Editor). 2010. Pacific Northwest Weed Management Handbook. Oregon State University, http://uspest.org/pnw/weeds?01W_INTR00.dat, accessed 8/9/10.

Renz, M. 2000. Element Stewardship Abstract for *Lepidium latifolium* L. The Nature Conservancy, Davis, CA.

Renz, M.J. and R.G. Wilson. 2005. Perennial Pepperweed (*Lepidium latifolium* L.). New Mexico State University Weed Factsheet 11-06-05.

Schultz, B. 2007. Paradise Valley Weed Control Demonstration Plots: Perennial Pepperweed. University of Nevada Cooperative Extension Special Publication-07-06.

Wilson, R.G., D. Boelk, G.B. Kyser and J.M. DiTomaso. 2008. Integrated Management of Perennial Pepperweed (*Lepidium latifolium*). Invasive Plant Science and Mgmt. 1:17-25.

Young, J.A., C.D. Clements and R.R. Blank. 2002. Herbicide Residues and Perennial Grass on Established Perennial Pepperweed Sites. Journal of Range Mgmt. 55:194-196.

Zouhar, K. 2004. *Lepidium latifolium*. In: Fire Effects Information System. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: www.fs.fed.us/database/feis/[2010, August 9].