



Field Guide for Managing Perennial Pepperweed in the Southwest



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Perennial pepperweed (*Lepidium latifolium* L., formerly *Cardaria latifolia* L.)

Mustard family (Brassicaceae)

Perennial pepperweed is an invasive plant that has been listed as a noxious weed in New Mexico. This field guide serves as the U.S. Forest Service's recommendations for management of perennial pepperweed in forests, woodlands, and rangelands associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also administers 4 national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Perennial pepperweed (synonyms: broadleaved pepperweed, tall whitetop, peppergrass, iron weed) is an introduced perennial broadleaved plant native to Eurasia. It is similar in appearance to hoary cress (*Cardaria draba*), which is also called whitetop. However, pepperweed is considerably taller than hoary cress, and its upper leaves do not clasp the stem. Perennial pepperweed shoots emerge early in the spring forming a rosette that will persist for several weeks. By middle to late spring, plants produce an inflorescence of white flowers after bolting. Flowering shoots senesce after seed production, although new rosettes can emerge in the fall in moist soils.

Growth Characteristics

- Perennial herbaceous plant; average height is 3 to 5 feet; may grow up to 8 feet.
- Rhizome-like creeping roots that smell like horseradish; dense, semi-woody crown.
- Foliage is glabrous and green to gray-green in color.
- Multi-stemmed; stems are upright, dull-gray-green and waxy; may have reddish spots.
- Rosettes have ovate to oblong leaves with entire to serrate margins on long petioles. Young leaves on the stems are sessile to lanceolate with smooth to jagged edges. Mature leaves are alternating and 1 to

2 inches wide, 4 to 12 inches long with a small stem connecting the leaf to the branch; older leaves lack the small connecting stem and decrease in size toward the top of the plant.

- White, 4-petaled flowers occur in dense, bunched panicles on each stem; May-July flowering.
- Fruits are small, round to oval-shaped, 2-chambered pods, each with two flattened seeds.

Ecology

Impacts/Threats

Perennial pepperweed develops dense, monotypic stands that can reduce availability of quality forage for cattle and horses, degrade wildlife habitat, and lower diversity of flora and fauna species. The weed acts as a salt pump, i.e., it draws salt ions from deep within the soil profile and increases salinity near the surface, which can be disadvantageous for plants intolerant to salt.

Site/Distribution

This weed invades disturbed areas and is common in riparian areas, flood plains, wetlands, pastures, and alfalfa fields; it is also widely found along roadsides and irrigation ditches. Large infestations of perennial pepperweed occur in the Rio Grande River watershed in central New Mexico, and new populations are emerging throughout the State.

Spread

Perennial pepperweed spreads either by seed or roots; however, seedlings are rarely seen in the field. Plants mostly originate from its creeping root system which may expand at a rate of 10 feet per year. Root segments produce adventitious buds; pieces as small as 1 inch in length are capable of generating new shoots. Fragments might be spread over long distances as a contaminant in transported soil, hay bales used for erosion control, and alfalfa hay used for feed. Seed or root fragments easily adhere to surfaces and undercarriages of vehicles and road maintenance equipment.

Invasive Features

With extensive carbohydrate reserves stored in its large root system, perennial pepperweed produces new shoots that emerge early and grow rapidly in the spring. Perennial pepperweed tolerance to alkaline and saline soils allows it to thrive in a wide range of habitats. Invasions often occur in sensitive areas, thus possibly limiting control options.

Management

Early detection and proactive management should be used to control perennial pepperweed since well-established stands are difficult to control. Frequent monitoring is critical to locate new plants before they become established. When new infestations are discovered, plants should be removed immediately to prevent further

spread. The following actions should be considered when planning an overall management approach:

- Healthy plant communities should be maintained to limit perennial pepperweed infestations. If necessary, include revegetation methods to reduce the possibility of further invasion.
- Periodically check areas where the soil has been disturbed for presence of root fragments or sprouts of perennial pepperweed.
- Eradicate new populations of perennial pepperweed as early as possible.
- Combine mechanical, cultural, biological, and chemical methods for most effective perennial pepperweed control.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Roadsides, fence lines, or non-crop areas	Mow at flower bud stage; apply herbicide to re-sprouts. Hand pull or grub small patches.	Use seed, mulch, and fill materials certified to be weed-free. Clean machinery following activity in infested areas. Train road crews and the public to identify and report infestations; map reported populations.	USDA-approved biocontrol agents are unavailable.	Spray at flower bud stage. For ground application, use truck-mounted or tractor-pulled spraying equipment. Wash under vehicle after application to prevent spread.
Rangeland or pasture	Disking alone can spread the weed; combine any cultivation with herbicide control. Use of prescribed fire is not recommended except to remove dead material.	Use seed and forage hay certified to be weed-free; use pellets for horses in backcountry areas. Monitor areas where soil was imported or hay was used for erosion control. Reseed with desirable competitive plants.	Use prescribed grazing with sheep or goats in the spring followed by herbicide at flower bud stage. Closely manage grazing to prevent overuse.	Spray at flower bud stage. For extensive and dense infestations, use ground or aerial broadcast spraying. For sparse infestations, use backpack or hand-held sprayer. Wash under vehicle after application to prevent spread.
Riparian areas, wilderness, and other natural areas, and/or small infestations	Hand pull or grub small patches; remove as much of the root as possible; bag and dispose of debris appropriately.	Use seed and forage hay certified to be weed-free; use pellets for horses in backcountry areas. After passing through infested areas, inspect and remove any seed or root fragments from animals, clothing, and vehicles.	Same as above.	Spray at flower bud stage. Use backpack or hand-held sprayers or use wick method for individual plant treatment (IPT). Broadcast spraying by aerial or ground methods may be used on thicker stands, if allowed.

* Choice of a particular management option must be in compliance with existing regulations for the land resource.

- Detect, report, and map large infestations. Keep annual records of reported infestations.

Table 1 summarizes some management options for controlling perennial pepperweed under various situations. Further details on these management options are explained below. Choice of individual control method(s) for perennial pepperweed depends on the extent and density of infestation, current land use, and site conditions (accessibility, terrain, microclimate, other flora and fauna present, etc.). Other important considerations include treatment effectiveness, overall cost, and the number of years needed to achieve control. More than one control method may be needed for a particular site.

Physical Control

Although labor intensive, physical methods used consistently and repeatedly are effective at controlling perennial pepperweed. In general, effectiveness of physical methods is improved when combined with herbicide control.

Manual Methods

Hand pulling or digging – Seedlings are easily controlled by hand pulling, hoeing, or grubbing; but these techniques do not work well on established plants since shoots quickly re-sprout from deep roots. Ideally, remove as much of the above and below ground plant parts as possible, and dispose of debris by bagging and depositing bags in a landfill, or by burning.

Mechanical Methods

When using machinery to manage perennial pepperweed, the equipment should be cleaned to prevent movement of seed or root fragments into un-infested areas.

Mowing – Without care, mowing can contribute to further spread and increased densities of perennial pepperweed. It is a helpful tool for removing accumulated dead stems and fits well in an integrated approach. While not effective in reducing perennial pepperweed stands, mowing can enhance the effectiveness of herbicides. For best results, mow perennial pepperweed at the bolting or flower bud stage and allow shoots to re-sprout before applying herbicide. Mowing causes the plant to produce larger leaves that are perpendicular to the ground thereby

allowing better herbicide coverage.

Tillage – By itself, cultivation can spread viable root fragments and contribute to increased densities of perennial pepperweed. Cultivation in combination with well-timed herbicide use and mowing can reduce population size in areas suitable for these practices. Research using this integrated approach has reported up to 95 percent reduction in perennial pepperweed biomass. Perennial pepperweed infestations should be disked in the fall. When plants re-sprout and form flower buds in the spring, mowing should then be used. Allow plants to re-sprout and reach flower bud stage once again before applying herbicide. Anticipate that further spraying may be needed later.

Prescribed Fire

Burning actively growing perennial pepperweed is not recommended as shoots rapidly regrow shortly after fire. However, it can be helpful for removing old growth and is also acceptable as a means to dispose of plant debris.

Flooding

Where conditions are feasible, continual flooding can be an effective control method. As an example, a perennial pepperweed population that was inundated for 2 consecutive years was nearly eliminated at a California site. However, plants that escaped flooding (e.g., those growing on levees) required further management.

Cultural Control

Early detection and plant removal are critical for preventing perennial pepperweed establishment. Land managers, the local public, and road crews should be educated on identifying nonnative noxious species so that suspected infestations will be reported. Vehicles, humans, and livestock should be discouraged from traveling through infested areas. A program to check and remove seeds and root fragments from vehicles, equipment, and livestock should also be implemented to help stop dispersal. Seed and materials used for mulch, forage, or fill should be certified to be weed-free; pellets may be used for horses in backcountry areas. Reseeding with competitive desirable species should be considered for areas failing to recover naturally following suppression efforts.

Biological Control

Grazing

Intensive livestock grazing early in the growing season can effectively suppress populations, but perennial pepperweed quickly recovers once animals are removed. Therefore, grazing should be integrated with other tools. Goats, sheep, and cattle will graze new foliage growth but will stop eating perennial pepperweed when the early flowering stage is reached. Horses reportedly have been poisoned after eating the weed in hay.

Classical Biological Control

No classical biocontrol agents (insects, pathogens, etc.) have been approved by USDA for perennial pepperweed control.

Chemical Control

Herbicides can be an effective tool for managing perennial pepperweed, especially when used as part of an integrated strategy. Table 2 has a summary of common herbicide choices. Herbicide choice depends on label restrictions, land use objectives, and cost. Aquatically approved herbicide formulations and surfactants must be used in or near water. Each herbicide product will have different requirements and restrictions according to the label. Read and understand prior to any application. Consult the registrant if you have questions or need further detail.

Herbicide Application

Herbicide applications should be timed to coincide with the period when carbohydrate root reserves are lowest. For perennial pepperweed, this is during the early flowering or bud stage. If young plants or seedling are found, apply herbicides as soon as possible to prevent them from producing new lateral shoots from the root.

Chemical “mowing” with herbicide has been used for perennial pepperweed in some inaccessible areas such as riparian communities that do not allow mechanical methods. Chemical mowing retards growth of a plant while allowing it to provide erosion protection. Results have varied and while plant suppression is usually achieved, complete control with this method is rare. Apply herbicide such as imazapic when perennial pepperweed is in the flower bud

stage; then repeat chemical mowing in late summer to plants that have re-sprouted. For sites where water is not present year round, chlorsulfuron may be used as long as the herbicide has time to degrade within soil before water returns. Rates described in table 2 may be used to perform the chemical mowing.

Herbicides may be applied with wicks, backpack or hand-held sprayers, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. Any equipment used to spray herbicide should be calibrated. For sparse populations, one person or a small team can spray or wick perennial pepperweed in an area using individual plant treatment (IPT). Spray plants directly by wetting the foliage and stems without dripping using an adjustable spray nozzle attached to a backpack or hand-held sprayer. Wick plants in riparian areas with 100 percent solution of 2,4-D for several consecutive years to suppress perennial pepperweed while allowing desirable plant species reestablish. Precautions should be taken if non-target plants (including woody species) need to be protected. This includes situations where spray drift, soil erosion, or water movement potentially could occur.

Integrated Control Methods

Regardless of the management approach, perennial pepperweed typically cannot be effectively controlled by using only one method. A combination of control methods, as outlined in this guide, should always be considered in a long-term approach to perennial pepperweed control. For example, the combination of physical methods used in conjunction with chemical control can be quite effective.

Management Strategies

Small or isolated infestations on otherwise healthy sites should be given high priority for treatment, followed by treatment of corridors such as waterways and irrigation structures that have a high likelihood for spreading pepperweed. To enhance long-term control, consider an approach that encourages and maintains competitive desirable plants. A healthy, well maintained native plant population can dramatically slow the introduction and spread of perennial pepperweed.

Table 2. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example ¹	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution) ²	Time of Application	Remarks
Chlorsulfuron	Telar	1–2 ounces	NA	Flower bud stage.	Selective; safe for labeled grasses; use 0.25% v/v NIS ³ ; provides 1–2 years control. Not for use near water bodies. If area is mowed before herbicide is applied, lower rate is effective.
Metsulfuron	Escort Ally [others available]	0.75–1.0 ounce	NA	Flower bud stage or in fall.	Selective; safe for most perennial grasses; add 0.25% v/v NIS ³ . Not for use near irrigation water. May apply in fall if part of plant is still green.
Glyphosate	Rodeo Roundup [others available]	Depends upon formulation: 3 quarts Rodeo 1 gallon Roundup	Rodeo: 0.75–2% + NIS ³ Roundup: 2%	Flower bud stage.	Nonselective; if infestation is dense, mow, then apply glyphosate when regrowth reaches flower bud stage. Rodeo is labeled for use in or near aquatic areas. Good treatment if reseeding is planned.
2,4-D ester or amine ⁴	Several products and manufacturers	Depends upon formulation (1–2 pounds per acre)	5%	Same as above.	Selective; apply annually for 2 years or more to control established stands. If infestation is dense, mow first and apply to regrowth at flower bud stage.
Triclopyr	Garlon 3A [others available]	3 quarts	5%	Flower bud stage in spring or in the fall to rosettes.	Selective; safe for most perennial grasses; add 0.25% v/v NIS ³ ; labeled for riparian areas and use near water bodies; chemically mow second application: 2 quarts/ac is effective.
Imazapyr	Arsenal Habitat [others available]	2–3 pints	3%	Same as above.	Nonselective; total vegetation control. Labeled for fence lines, rights-of-way, railways, and aquatic situations. Add 0.25% v/v NIS ³ for post-emergent use. In addition to spray drift, non-target plants may also be killed or injured by imazapyr through runoff, residue movement in soil, or root exudates from treated plants.
Imazapic	Plateau	12 fluid ounces	5%	Same as above.	Selective but may retard growth of some grasses. This herbicide is the preferred alternative to imazapyr if protection of desirable plants is needed.

¹ Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with perennial pepperweed.

² Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

³ NIS is an abbreviation for nonionic surfactant which is an additive commonly recommended by herbicide labels for post-emergent foliar application of herbicide.

⁴ 2,4-D is a restricted use pesticide in New Mexico only. A certified applicator’s license is required for purchase and use.

Because each treatment situation is different, any strategy adopted for managing perennial pepperweed must involve careful planning and a long-term commitment. Complete eradication will likely require 3 to 10 years of repeated control methods. Since it is ordinarily useless to treat an area only one time without retreatment, sufficient resources must be allocated for the area where control is attempted. After initial treatment, it is especially important that resources are also available to respray or retreat the treated area as necessary. Components of a successful control program for perennial pepperweed should include monitoring of treated areas and taking measures to control missed plants and newly emerged seedlings. Monitoring should be conducted in early spring and late summer to detect rosettes that form the leading edge of expanding populations.

References and Further Information

- Boelk, D.A. 2005. Least Wanted: Perennial Pepperweed Fact Sheet. Plant Conservation Alliance. Available at <http://www.nps.gov/plants/alien/fact/lela1.htm> (accessed July 2010)
- Davison, J.C., E. Smith, and L.M. Wilson. 2007. Livestock Grazing Guidelines for Controlling Noxious Weeds in the Western United States. A Western Region Sustainable Agriculture, Research and Education Project. EB-06-05. Pp. 36–37. Available at http://www.cnr.uidaho.edu/rx-grazing/Livestock_Graizng_Guidelines%28Davison_et_al.%202007%29.pdf (accessed July 2010)
- Duncan, K, K. McDaniel, and M. Renz 2005. Chemical Weed and Brush Control for New Mexico Rangelands. New Mexico State University College of Agriculture and Cooperative Extension Service. Pp. 11. Available at http://aces.nmsu.edu/pubs/_circulars/CR_597.pdf (accessed July 2010)
- Encyclopedias Datasheets. California Department of Food and Agriculture. Available at <http://www.cdffa.ca.gov/phpps/ipc/weedinfo/lepidium.htm> (accessed July 2010).
- Howald, A. 2000. Perennial Pepperweed (*Lepidium latifolium*) In: C.C. Bossard et al. (eds.) Invasive Plants of California's Wildlands. University of California Press. Berkley, CA. Available at <http://www.cal-ipc.org/ip/management/ipcw/online.php> (accessed July 2010)
- Invasive Plant Atlas of the United States. Available at <http://www.invasive.org/weedus/index.html> (accessed July 2010)
- Jacobs, J. and J. Mangold. 2007. Ecology and Management of Perennial Pepperweed. USDA/NRCS Invasive Species Technical Note Number MT-11. Available at ftp://ftp-fc.sc.egov.usda.gov/MT/www/technical/invasive/Invasive_Species_Tech_Note_MT11.pdf (accessed July 2010)
- Renz, M.J. 2001. Element Stewardship Abstract for *Lepidium latifolium* L. Available at <http://www.invasive.org/weedcd/html/esas.htm> (accessed July 2010)
- Renz, M.J., C.E. Bell, C. Wilen, and J. DiTomaso. 2002. Perennial Pepperweed: Foreign Invader in California's Wildlands. University of California WEED Research and Information Center. Available at <http://wric.ucdavis.edu/information/pepperweed.html> (accessed July 2010)
- Renz, M.J. and R.G. Wilson. 2005. Perennial Pepperweed. NMSU Weed Factsheet. Available at http://weeds.nmsu.edu/pdfs/perennial_pepperweed_factsheet_11-06-05.pdf (accessed July 2010)
- USDA Forest Service. 2006. Weed of the Week: Perennial Pepperweed (*Lepidium latifolium* L.). Available at http://www.na.fs.fed.us/fhp/invasive_plants/weeds/perennial_pepperweed.pdf (accessed July 2010)
- USDA Plants Database. 2010. Available at <http://plants.usda.gov/index.html>. (accessed July 2010)
- Zouhar, K. 2004. *Lepidium latifolium*. In: Fire Effects Information System. USDA, Forest Service, RMRS, Fire Sciences Lab (Producer). Available at <http://www.fs.fed.us/database/feis/> (accessed July 2010)

Suggested Web Sites

For information on invasive species:

National Invasive Species Information Center

<http://www.invasivespeciesinfo.gov/>

Invasive.Org

<https://www.invasive.org/species.cfm>

For information about calibrating spray equipment:

NMSU Cooperative Extension Service Guide

A-613 Sprayer Calibration. Available at

http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online:

<http://www.cdms.net/>

**For more information or
other field guides, contact:**

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
Albuquerque, NM 87102

**Or visit the Southwestern Region's
website for invasive species:**

<http://www.fs.usda.gov/goto/r3/invasivespecies>



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