

Biology, Ecology and Management of

# Whitetop

(*Cardaria* spp.)



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**MONTANA**  
STATE UNIVERSITY

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Terms in bold can be found in the glossary on page 10.

Cover photo by Jane Mangold, Montana State University.  
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Globe-podded whitetop (*Cardaria pubescens*), lenspod whitetop (*C. chalapensis*), and heart-podded whitetop (*C. draba*) are three closely related exotic mustards often referred to collectively as ‘whitetop.’ Whitetop is sometimes called hoary cress. All three whitetop species have small white flowers with four petals and six stamens and grayish-green, arrowhead shaped leaves that clasp around the stem at their base. Whitetop is well adapted to moist habitats, especially sub-irrigated pastures, hay fields, rangeland, roadsides, and ditch banks. Whitetop also invades cropland, especially alfalfa. Successful management of whitetop requires the use of integrated weed management strategies. This includes combining strategies to prevent the movement of these weeds, containing existing infestations, and integrating control methods to reduce weed infestations to tolerable levels.

## PLANT BIOLOGY

### Identification

The three species of whitetop are members of the mustard family (Brassicaceae). The flowers have four petals and six stamens (cover photo). Individual white flowers are  $\frac{1}{8}$  to  $\frac{1}{4}$  inch (3-6.3 mm) long, are borne on slender  $\frac{1}{2}$  inch (1.3 cm) long **pedicels** and appear collectively as a flat-topped **inflorescence**. Dense blooming stands look very much like a patch of late-melting snow (cover photo).

These species can’t be distinguished from each other until after seed pods are formed. Globe-podded whitetop has small, purplish, globe-shaped seed pods (Figure 1). The seed pod of lenspod whitetop is flat and round (Figure 2). Heart-podded whitetop has a heart-shaped, broad, flat seed pod (Figure 3). In all species, the seed pod is tipped with a ‘beak’, which is rare for the mustard family. Each pod is approximately  $\frac{1}{2}$  inch (1.3 cm) long and contains two to four seeds.



**FIGURE 1.** Seed pods of globe-podded whitetop (photo by Richard Old, [bugwood.org](http://bugwood.org)).



**FIGURE 2.** Seed pods of lenspod whitetop (photo by Steve Mattson).



**FIGURE 3.** Seed pods of heart-podded whitetop (photo by Javier Peralta).



**FIGURE 4.** Claspng leaves of whitetop (photo by Luigi Rignanes).

The plants normally grow from 10 to 24 inches (25.4-61 cm) tall. They have both **basal** and stem leaves. Basal leaves taper to a short stalk that attaches to the crown near the ground. Stem leaves are grayish-green, arrowhead shaped, with smooth or occasionally finely toothed edges. All leaves have a covering of soft white hairs. Leaves range from  $\frac{3}{4}$  to three inches (2-7.6 cm) in length and are arranged alternately along the stem. The base of each leaf clasps around the stem at the point of attachment (Figure 4).

### Life History

All three whitetop species are herbaceous, **rhizomatous**, relatively long-lived **perennials**.

They begin their life-cycle in the fall with seed germination and seedling establishment. Occasionally, seeds germinate in the spring. Seedling leaves grow very rapidly, and lateral roots develop within three weeks. Seedlings overwinter as **rosettes**.

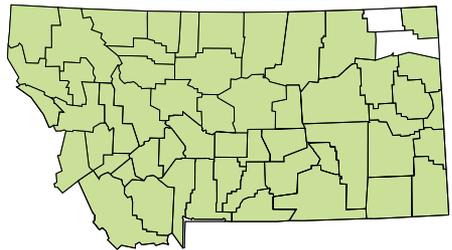
Established plants and first year rosettes initiate growth very early in the spring. These species frequently bloom in April and May, with seed production beginning about a month later. After blooming, the plants continue to grow until frost. If conditions remain suitable, they will flower and produce a second crop of seeds late in the summer.

### CURRENT STATUS AND DISTRIBUTION

Globe-podded whitetop is native to eastern Europe and western Asia, northern Iran and Afghanistan and can now be found in Argentina and North America as well. Lenspod whitetop is native to eastern Europe and



**FIGURE 5.** States and provinces in North America where whitetop has been reported (NRCS Plants Database, <http://plants.usda.gov/>).



**FIGURE 6.** Counties in Montana where heart-podded whitetop (*Cardaria draba*) has been reported (INVADERS Database System, <http://invader.dbs.umt.edu>).

western Asia and is common in Pakistan, northern India, Afghanistan, Iran, Iraq, Syria and Israel. It has been introduced into England, Argentina and North America. Heart-podded whitetop is native to the Balkan Peninsula, Armenia, Turkey, Israel, Syria, Iraq and Iran. It has been introduced onto every continent in the world.

The whitetop species probably arrived in North America in contaminated alfalfa seed. In the United States, globe-podded whitetop was first collected at Ypsilanti, Michigan in 1919; lenspod whitetop at Chino, California in 1918; and heart-podded whitetop at Long Island, New York in 1862. These species are now widely distributed across the United States and Canada (Figure 5). In Montana, heart-podded whitetop was first identified in Gallatin County in 1916. This species can be found in nearly every Montana county and infests about 84,000 acres (Figure 6). Reports of the other two species are rare in Montana, but are becoming more common.

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## SpeedyWeed ID

Whitetop can be identified by small, white, four-petaled flowers and flat-topped inflorescences. Several other species could be mistaken for whitetop. These include the noxious weed perennial pepperweed (*Lepidium latifolium*) which has **sessile, lanceolate** leaves and a clustered inflorescence (Figure 7); and the native common yarrow (*Achillea millifolium*) which has white flowers and fern-like leaves (Figure 8).

- white flowers, clasping leaves, heart-shaped pods . . . . heart-podded whitetop (*Cardaria draba*)
- white flowers, clasping leaves, globe-shaped pods . . . . globe-podded whitetop (*Cardaria pubescens*)
- white flowers, clasping leaves, round, flat pods . . . . lenspod whitetop (*Cardaria chalapensis*)
- clustered white flowers, sessile, lanceolate leaves . . . . perennial pepperweed (*Lepidium latifolium*)
- white flowers, fern-like leaves . . . . . common yarrow (*Achillea millifolium*)



**FIGURE 7.** White flowers and sessile leaves of perennial pepperweed (photo by Joe DiTomaso).

**FIGURE 8.** White flowers and fern-like leaves of common yarrow (photo by Georg Slickers).

## ECOLOGY

### Habitat

All three species grow in a variety of soil and range types and can form dense monocultures (cover photo) similar to other noxious weeds. They require moderately moist sites with annual precipitation of 12 to 16 inches (30.5-40.6 cm) and are best adapted to alkaline soils that are wet during late spring. However, alkaline soils are not a requirement for invasion. Sites susceptible to invasion are mainly sub-irrigated pastures, rangeland, ditch banks, roadsides, and waste areas. Invasion of arid rangeland by whitetop is unlikely.

These weedy species are also well-adapted to cropland, especially under irrigation. They are a serious problem in small grains, stubble and fallow fields, alfalfa, peas, onions, sugar beets, and several other crops.

In some states, these weeds are problematic in small grains, alfalfa, peas, onions, sugar beets, and other crops. These species can also be problematic in Conservation Reserve Program (CRP) lands. In Montana, whitetop species are predominantly found in alfalfa, pastures, rangeland, roadways and small grain fields.

All three whitetop species grow in open, unshaded areas. These weeds are generally found in disturbed areas dominated by other exotic species, such as smooth brome (*Bromus inermis*) and Russian knapweed (*Centaurea repens*).

### Spread and Establishment Potential

Seeds are spread by wind, through water along waterways and irrigation systems, on vehicles and machinery (especially during cultivation), and in hay and crop seed. A single plant of these species can produce from 1,200 to 4,800 seeds per year. Heart-podded whitetop is the most prolific and can produce as many as 850 seeds per flowering stem. Seeds remain viable in the soil for approximately three years. In one study, germination rates of one-year old, two-year old, and three-year old heart-podded whitetop seeds were 84, 31 and 0 percent, respectively. This species is capable of germinating in salt stressed environments.

The majority of research on the biology, ecology and management of whitetop has been conducted on heart-podded whitetop. Based on the lack of research on the other two species, and the similarities among them, the information presented here is generalized to cover all three species. Small infestations spread via rhizomes. A single plant can spread to an area 12 feet (3.6 m) in diameter in its first year of growth. Subsequent radial increases range from two to five feet per year. The rate of perimeter expansion appears to be related to the competitive ability

of the vegetation surrounding a patch of whitetop. The deep root system and its ability to reproduce vegetatively make these weeds very difficult to control. The root system consists of a vertical taproot which develops several lateral roots (Figure 9). Lateral roots eventually turn down to become vertical roots. These frequently reach depths much greater than the parent roots. Growth in root length is rapid, reaching 12 to 30 feet (3.6-9.1 m) by the second or third growing season. In some cases, whitetop roots can reach the water table. Both the vertical and lateral roots produce **adventitious** buds, which develop into rhizomes and shoots.



**FIGURE 9.** The creeping roots of whitetop (photo courtesy of Steve Dewey, Utah State University, [bugwood.org](http://bugwood.org)).

All of the whitetop species are capable of producing many shoots. Shoot development tends to occur at or just above the point where lateral roots bend downward and become vertical. However, buds can form on any part of the root system. Under experimental conditions without competition, a single plant produced over 450 shoots in a single year. With competition, they rarely produced more than 50 shoots per square yard.

### **Damage Potential**

Whitetop species displace native plant species, reduce biodiversity, wildlife habitat and forage production, and are a serious threat to the cattle and tourism/recreation industries. Whitetop contains glucosinolates which can be toxic to cattle.

### **MANAGEMENT ALTERNATIVES**

Successful management of whitetop requires the use of integrated weed management strategies. This includes combining strategies to prevent the movement of these weeds, containing existing infestations, and integrating control methods to reduce weed infestations to tolerable levels.

### **Prevention**

The most cost effective method for managing these weeds is to prevent their invasion and establishment. Establishment can be prevented by frequent monitoring to detect and eradicate new plants early.

In order to reduce the possibility of invasion, seed dispersal must be limited. It is important to limit seed dispersal by refraining from driving

vehicles and machinery through infested areas during the seeding period and by washing the undercarriage of vehicles before leaving infested areas. Livestock should not graze infested areas during flowering and seed-set, or they should be transported to a holding area for 10 to 14 days after grazing to allow time for seed digestion and excretion of seeds.

In cropping systems, it is important to avoid whitetop patches during cultivation to prevent spreading root fragments throughout the field. Similarly, avoiding small infestations during harvesting will limit the spread of seeds in hay and crop seed. Furthermore, screening irrigation water before applying it to the field will minimize seed spread through ditches and irrigation canals.

Recreationists, including campers, hikers, off-road vehicle enthusiasts, and horseback riders spread weed seeds. They should be careful to brush and clean their equipment and animals and place discards in a hot fire before leaving an area. They should also use weed-seed free forage.

Proper livestock grazing management is essential to maintain competitive grass plants to slow or prevent weed encroachment. A grazing plan should be developed for any management unit involved in a weed prevention program. This management plan should include a grazing system which alters the season of use, rotates livestock to allow plants to recover before being grazed, and promotes litter accumulation.

An integral part of any integrated weed management program is the commitment to contain existing weed infestations. Generally, this includes a long-term program of annual spraying of the outside perimeter of the infestation with herbicides.

Detecting satellite infestations and implementing eradication programs is an important step in integrated weed management. Local systematic surveys along roadways, railways and waterways to detect weed infestations as early as possible are important. Once an infestation is found, a small-scale eradication plan consisting of scheduled control treatments, revegetation, follow-up monitoring, and costs should be designed and implemented.

### **Mechanical Control**

Diligent hand pulling or grubbing can provide control of very small infestations. Successful hand pulling or digging requires complete plant removal within 10 days after weed emergence throughout the growing season for two to four years. Hand pulling of only above ground plant parts is ineffective. Hand pulling and digging can be a useful method for controlling new introductions of whitetop in riparian areas and around the yard. Removing whitetop is best accomplished when the soil is moist.

Successful eradication on arable land by cultivation is difficult since it requires exhausting the root reserves. Cultivation six inches deep must be repeated within 10 days of weed emergence throughout the growing season for two to four years.

Mowing to ground level during flowering reduces plant biomass and seed production, but does not provide long-term control. Research indicates that mowing integrated with a subsequent herbicide application about a month later can be effective.

### **Cultural Control**

Planting competitive legumes, such as alfalfa, can reduce whitetop in crop-pasture rotations. Extremely dense stands of legumes can successfully compete for soil moisture and shade the weeds.

Flooding can be a useful method for controlling whitetop, but its use is limited because flooding may permanently damage desirable plants. Therefore only a limited number of acres may be suited for flooding. Flooding is useful in areas with soil texture heavy enough to hold water without excessive seepage, and where fertility loss following prolonged submersion and drainage is minimal. Successful flooding to control these weeds requires continuous submersion from May until September in most cases.

### **Biological Control**

Several insect species are currently being tested as potential biocontrol agents. Among these are three weevils: a gall-forming weevil (*Ceutorhynchus cardariae*), a seed-feeding weevil (*Ceutorhynchus turbatus*), and a root-mining weevil (*Melanobaris semistriata*). Two other insect species, a shoot-mining flea beetle (*Psylliodes wrasei*) and a gall mite (*Aceria drabae*) are also under investigation for use as biological control agents.

### **Chemical Control**

Whitetop species can be controlled using herbicides, although it is difficult. Successful control usually depends on an aggressive re-application program. On rangeland, roadsides and waste areas apply metsulfuron (Escort®) at 0.5 to 1 ounce/acre, metsulfuron + chlorsulfuron (Cimarron X-tra®) at 2 ounces/acre, or chlorsulfuron (Telar®) at 0.5 to 1 ounce/acre to actively growing rosettes in early spring, to regrowth before bud stage, or to fall regrowth before killing frost. Treatment after bloom is generally less effective. It is important to apply these herbicides with adequate water (at least 10 gallons of water/acre) and to use a nonionic surfactant at the label rate. 2,4-D is somewhat effective if applied before the bud stage. Consult label for appropriate

rates. In cereal grains, metsulfuron (Ally®) applied at 0.10 ounce/acre provides reasonable control of whitetop species. Higher application rates will result in crop injury. These weeds can be effectively controlled in stubble and fallow, but it is important to follow the replanting instructions on the label for subsequent crops.

There are no herbicides currently registered for use on alfalfa, peas, and sugar beets that control whitetop. Two products, imazamox (Raptor®) and imazethapyr (Pursuit®), are listed for use in alfalfa but are limited to suppression only. For successful control of whitetop, management should be done during another part of the crop rotation.

### **INTEGRATED WEED MANAGEMENT (IWM)**

- Prevention is key. In the event whitetop plants are found, immediate treatment is necessary to prevent spread.
- Monitor and clean vehicles and equipment to prevent transport of seeds between sites.
- Disturbance will facilitate weed establishment. Routinely monitor vegetation, especially after a disturbance, and remove weeds as soon as possible. Continue monitoring following removal.
- Small to moderate infestations may be controlled by cutting in combination with chemical treatment.
- Severe infestations may require repeated chemical treatment. Re-seeding of infested areas may be necessary in cases of severe infestation (refer to Montana State University publications EB19, *Dryland pastures in Montana and Wyoming*, and EB0170, *Revegetation Guidelines for Western Montana*).

### **GLOSSARY**

**Adventitious** – not in the usual place.

**Basal** – located at bottom of stem.

**Inflorescence** – arrangement of the flowers of a plant.

**Lanceolate** – narrow, tapered on both ends and wider at the middle.

**Pedicels** – stalk of a single flower in an inflorescence.

**Perennial** – survives for more than two years.

**Rhizomatous** – bearing underground creeping stems.

**Rosette** – circular cluster of leaves, compact and basally arranged.

**Sessile** – without a stem or stalk.

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