

Biology, Ecology and Management of

Hoary Alyssum

(*Berteroa incana* L.)



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Terms in bold can be found in the glossary on page 12.

Cover photo by Hilary Parkinson.

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Hoary alyssum is an exotic annual to short-lived perennial forb designated as a noxious weed in Montana since 2008. Toxicity to horses has been reported when green or dried forage is contaminated by more than 30 percent. It can proliferate in forage crops, pastures, and rangelands and rapidly fills in areas disturbed or overgrazed. Maintaining healthy stands of vegetation and reseeding after major disturbances are the best ways to prevent establishment. Herbicides are an effective control option, and repeated applications may be necessary to treat plants that emerge throughout the growing season.

PLANT BIOLOGY

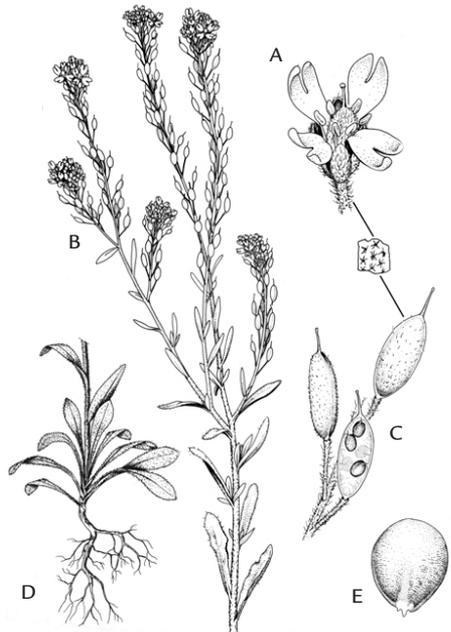
Identification

Hoary alyssum is a member of the mustard family (Brassicaceae). It has a slender **taproot** capable of deep soil penetration. The **basal rosette** has oval to lance-shaped leaves that are broadest at the tip and 1 to 2 inches (3-5 cm) long (Figure 1). Flowering stems are erect or semi-erect growing 7 to 30 inches (20-70 cm) tall and are usually branched at the top (Figure 2). Multiple stems are common. Stem leaves are alternately arranged, similar to rosette leaves in shape, but generally point upward and are smaller with less of a stalk, or stalkless. The margins of all leaves are entire (smooth to slightly wavy) with no teeth or lobes.



FIGURE 1. Basal rosette of hoary alyssum with long-stalked, oval to lance-shaped leaves. (photo by Jim Jacobs)

FIGURE 2. Hoary alyssum. A) flower with notched petals; B) top of mature stem with seed pods and inflorescence; C) seed pod, valve with seeds and membrane; D) lower part of plant and roots; E) seed. (courtesy of Suzanne Warwick and *Canadian Plant Journal*. Vol. 86, 2006)



Hoary alyssum flowers bloom from early spring to late fall, given adequate water and light. The flowers are small (0.10 inch across) with four ovate **sepals** that are green with white margins (Figure 3) and four white petals that are narrow at the base, but spread upwards and have a notch at the tip (Figures 2A and 4). There are two short outer stamens and four long inner stamens, four **nectaries**, and one pistil with a long **style** (Figure 3). The seedpods (**silicles**) are ellipsoid to ovoid, 0.2-0.3 inches (5-8 mm) long, slightly inflated with the persistent style at the tip (Figure 3). Flowers have long **pedicels** (Figure 3) and are clustered at the stem tips in **racemes**. Seed pods point upward to touch or nearly touch the main flowering stem (Figure 4).

Each seedpod contains 4 to 12 dark reddish-brown, small (1-1.5 mm) lens-shaped seeds with narrow wings on the margins (seed pods in Figure 3 are immature, so still green). The seedpod has two chambers divided by a translucent **septum** or membranous partition which remains on the pedicel after seed dispersal (Figure 5). The leaves, stems, sepals, and seedpods are covered with star-shaped (stellate) hairs (Figure 2A, C) giving the plant a gray appearance from which the common name descriptor, hoary, is derived.

Life History

Hoary alyssum reproduces only by seed. Seeds can germinate from early spring to late fall, limited mainly by water. Seedlings establishing in early July or sooner can flower and produce seed by early fall, thus reproducing

FIGURE 3. Anatomy of the hoary alyssum reproductive structures, enlarged to show detail. (photo by Matt Levin, MSU)

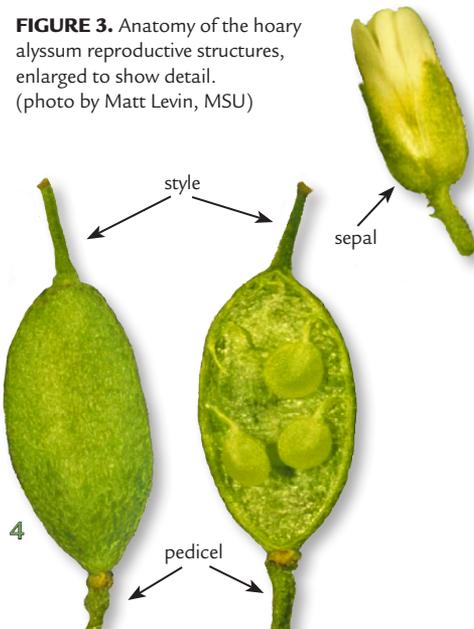


FIGURE 4. White hoary alyssum flowers with a notch in each petal. Seed pods point upward, pressed closely to the stem. (photo by Matt Lavin, MSU)

as annuals. Seedlings establishing in late July or later will remain as rosettes and produce flowers and seeds the following year, reproducing as winter annuals or biennials. Short-lived perennial reproduction was observed in plants that regrew after alfalfa cutting. Rosettes, but not flowering plants, accumulate nonstructural carbohydrates (sugars) in the roots until the first hard frost. These sugars are needed for winter hardiness, respiratory maintenance during dormancy, and growth following dormancy, and therefore rosettes generally survive winter, whereas flowering plants do not.

Flowers are insect pollinated, predominantly by small insects able to access the shallow nectaries in the small flowers, including syrphid and other flies (Diptera), wild bees, and wasps (Hymenoptera). Hoary alyssum can form a persistent seed bank and seeds can remain dormant but viable for approximately nine years. Across six sites in southwest Montana, hoary alyssum produced an



FIGURE 5. Hoary alyssum flower stalks and the translucent septum visible after seeds have dispersed. (photo by Hilary Parkinson)

SpeedyWeed ID

Hoary alyssum is quite distinct but may be confused with falseflax (*Camelina microcarpa*, which differs by the pale yellow flowers) or pennycress (*Thlaspi arvense*, which differs by the leaf margins which are dentate or toothed, and seedpod that is winged). If you are unsure whether a plant is hoary alyssum, check to make sure it has the following characteristics:

- Small white flower petals are notched (giving petals a rabbit-ear shape, Figures 2A and 4)
- Tiny star-shaped hairs that cover the plant (visible with a magnifying glass)
- Leaves that are entire (the leaf edges are smooth, not toothed, divided or serrated)
- Leaves on the flowering stems have no stalk, or a very small stalk
- Seedpods point upwards, positioned close to the stem, rounded in shape and with a distinct membranous partition or septum (Figure 5).

average of 584 ± 184 seeds per plant. On average, $53\% \pm 4\%$ of those seeds were viable. However, seed production and seed viability can vary greatly, even within a single site. For example, across the same six sites mentioned above, seed production ranged from 0 to 5,632 seeds per plant, and viability varied from 32% to 78%.

ECOLOGY

Habitat

Hoary Alyssum is adapted to the temperate continental climate characterized by cold winters and hot, dry summers. It is commonly found growing along roads, and trails, gravelly stream and lake banks, in lawns, farmyards, and vacant lots. It can also be found in pastures and hayfields. Hoary Alyssum thrives on dry and disturbed ground on coarse limestone and calcareous substrata with poor fertility. Across five sites infested with hoary Alyssum in southwest Montana, soil sandiness ranged from about 50% to 80%.

Germination and establishment of hoary Alyssum is primarily limited by light and water availability. Once established, light is more important for growth and reproduction than water. Plants in open areas can grow much larger and produce a greater quantity of seed compared to plants growing in vegetated areas. For example, in a Wisconsin alfalfa field, hoary Alyssum did poorly where alfalfa was vigorous with a shading canopy, but thrived when alfalfa growth was poor.

Spread and Establishment Potential

Hoary Alyssum is believed to have been originally transported to North America as a contaminant of clover and alfalfa seed. Contaminations of forage and lawn seed, as well as contaminated hay, are still considered likely means of long distance seed dispersal. Hoary Alyssum seed may also disperse long distances on mowers, vehicles, other machinery, and in contaminated soil and gravel. Seeds disperse through valves in the seed pod. It is believed most seed falls near parent plants. However, the winged margin and light-weight seed may enable wind and water dispersal.

Damage Potential

In pastures, hoary Alyssum decreases forage value as the woody stems of mature plants are low in crude protein and digestible carbohydrates. In hay fields, contamination of 30 percent or more of forage with hoary Alyssum is toxic to horses causing laminitis, limb edema, diarrhea, intravascular **haemolysis**, and **hypovolemic** shock. Mortality in horses has been associated with hay containing 30-70 percent hoary Alyssum. Mixed with alfalfa hay, hoary Alyssum can remain toxic for up to nine months.

CURRENT DISTRIBUTION AND STATUS

In Montana, hoary alyssum was first documented in 1905 in Gallatin County and has been reported in 32 counties (Figure 6). Reports are the highest in Gallatin, Ravalli, Madison and Carbon counties. Nationwide, hoary alyssum is reported throughout the continental United States except for the southeastern coastal states from Texas to North Carolina. It began to receive more attention as a pest in the 1950s and 1960s, when it began increasing in hay fields and pastures that were associated with drought, overgrazing, and poor soil fertility in the north central United States.

The state of Montana designated hoary alyssum as a Priority 2A noxious weed in 2008 and revised its status to priority 2B in 2015, indicating that hoary alyssum is becoming more prevalent in Montana and/or peoples' awareness of this noxious weed is increasing. A plant species is designated noxious by state or national agricultural authorities because it has the potential to directly or indirectly injure agricultural and/or horticultural crops, livestock, wildlife resources or humans. Regionally, it is noxious or has a special status in California, Colorado, Idaho, Montana, Oregon, Washington, Wyoming, Alberta, British Columbia, and Saskatchewan. Beyond the intermountain northwest, it is listed as a noxious weed in Michigan (based on reports available in March 2017).

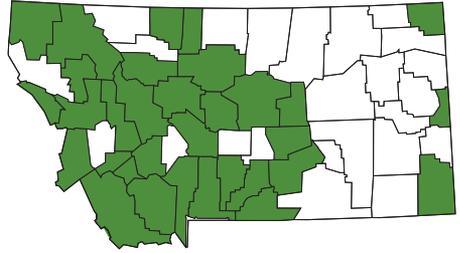


FIGURE 6. Counties in Montana where hoary alyssum has been reported. (Compiled records from INVADERS Database System, EDDMapS West, Consortium of Pacific Northwest Herbaria, Intermountain Region Herbarium Network, and MSU Schutter Diagnostic Lab.)

MANAGEMENT ALTERNATIVES

Mechanical control

Hand Pulling: Hand pulling to extract the root crown is an effective method to reduce hoary alyssum density on small-scale infestations and scattered plants that are either newly invading or persisting after herbicide treatments. Removing the root crown is most easily accomplished when the soil is moist and a shovel is used to pry up the tap root. When the soil is dry, the plant tends to break off above the root crown, enabling regeneration. Pulling will need to be repeated until the seed bank has been depleted. Plants with seedpods should be burned if conditions permit or sealed in plastic bags and disposed of in the trash to prevent seed spread.

Mowing: Mowing alone will not control hoary alyssum and may increase infestations by cutting down the shading canopy of neighboring

vegetation and spreading hoary alyssum seedpods (Figure 7). However, when combined with irrigation and nutrient management, mowing to a six-inch stubble height may increase the vigor of desired plants and reduce hoary alyssum seed production. Mowers must be carefully cleaned prior to and after use to prevent spread of weed seeds.

Tilling: Shallow tilling that severs the tap root below the root crown will kill hoary alyssum plants. However, this type of disturbance can favor the emergence of new hoary alyssum plants from the seed bank. Multiple tilling or tilling followed by application of herbicide to target establishing seedlings can be used to exhaust the supply of viable seeds in the soil. To prevent erosion, tilling is only recommended in cropland or in combination with seeding perennial competitive plants. As with any mechanical treatment, equipment should be washed after working in an infestation and before it is used on weed-free areas.

Prescribed Burning: Although information is limited on the use of prescribed fire to control hoary alyssum, fall burns may reduce seed production if seedpods are burned before seed release. However, fire may create a disturbance favorable to hoary alyssum establishment and sites should be monitored for weed occurrence and follow-up weed control should be applied where weeds are found.

Cultural Control

Revegetation: Sustainable suppression of hoary alyssum populations is more likely with desirable plants that will compete for light, water, and nutrients. Competing vegetation can greatly reduce seed production. In a study in Minnesota, hoary alyssum growing in plots cleared of other vegetation produced an average of 2,407 seeds per plot, whereas those growing in plots with existing vegetation produced an average of only 104

For highly disturbed sites where the existing vegetation has been lost, revegetation is strongly recommended to establish a competitive plant community.

- seeds per plant, a 96 percent reduction in
- seed production.
- Species selected for revegetating
- disturbed sites and hoary alyssum
- infestations should be appropriate for
- management objectives, adapted to site
- conditions, and competitive with the weed.
- Management objectives will determine if

non-native forage species or native species are seeded and species mixture components.

The environmental conditions of the site, including average annual precipitation, soil texture, elevation, and aspect should be considered when selecting species. Refer to Montana Plant Materials Technical Note

46, *Seeding Rates for Conservation Species for Montana*, and Extension Bulletin EB0019, *Dryland Pasture Species for Montana and Wyoming*, for species selection and seeding rates. State, area, and field resource specialists can help determine the most appropriate, site-specific species mix and timing of seeding for local conditions.

Irrigation: Hoary alyssum thrives under dry conditions. Irrigation can be used to increase the production of many forage plant species in cropland and pastures and increases their competitiveness with hoary alyssum. Good irrigation management combined with nutrient management of forage crops can prevent hoary alyssum invasion and help reduce infestations through plant competition.

Fertilization: Hoary alyssum thrives on sites with poor soil fertility. On cultivated pastures and hay meadows, nutrient management is important to maintain the competitiveness of desired forage over hoary alyssum. Nutrient management combined with judicious use of herbicides and reseeding (if necessary) is recommended where hoary alyssum invades pastures and hay meadows.

Biological Control

Insects: There are no insects for biological control of hoary alyssum available at this time.

Grazing: Grazing animals have not been used to control hoary alyssum. Domestic and wild mammals consume hoary alyssum where it occurs in sufficient quantities, and poisoning has only been reported in horses. Lambs rejected hoary alyssum in a Minnesota forage field trial. Goat utilization of weed-free hay was greater than utilization of hay contaminated with hoary alyssum in a Wisconsin study. Cattle will utilize hoary alyssum in their forage areas, but they generally select more digestible forages. Because the disturbance of overgrazing favors hoary alyssum establishment and reproduction, proper grazing that maintains the competitiveness of forage plants is important to prevent the spread of hoary alyssum in pastures and on rangeland.



FIGURE 7. Hoary alyssum plants that were mowed once but regrew and produced seed along a trail. (photo by Hilary Parkinson)

Chemical Control

Currently there are few herbicide formulations that list hoary alyssum on the label, but for control in rangelands and grass pastures, products containing the active ingredient metsulfuron-methyl (Escort®, Opensight®, Chaparral™) can be very effective. Anecdotal reports suggest 2,4-D at one quart/acre provides effective and economical control in rangelands and grass pastures. There are no broadleaf herbicides labeled

Chemicals should be applied judiciously to allow healthy plants to reestablish, or prior to seeding to reduce competition and enhance establishment of seedlings.

for control of hoary alyssum on grass/legume mixed pastures due to significant injury potential to the legume. Consult greenbook.net for up-to-date information on herbicide labels.

Spring applications when plants are actively growing and prior to bolting will be most effective. However, research in

southwest Montana found that several herbicides reduced hoary alyssum seed production and viability when applied across a range of growth stages from early to late flowering. Even herbicides sprayed at a late growth stage (when the average flowering stem was >50% covered with seed pods) reduced viable seed production. This research suggests that if hoary alyssum has not dropped all its seeds, even chemical treatment at late growth stages is beneficial. However, regardless of treatment timing, repeated applications are needed to target plants regenerating from the seed bank because hoary alyssum germinates and establishes throughout the growing season and from year to year.

For highly disturbed areas with hoary alyssum, reseeding following herbicide application is strongly recommended. Glyphosate (Roundup at one to two quarts/acre) will control hoary alyssum and other weeds on seedbed preparation treatments.

INTEGRATED WEED MANAGEMENT (IWM)

Good Range and Pasture Management

One of the key factors that favor weeds in range and pastures is overutilization. This weakens perennial grasses and decreases desirable plant cover, setting up an ideal scenario for weed invasion. Because many weeds are unpalatable, remaining grasses become overutilized even more, and weeds take advantage of the reduction in competition. Over time, this may result in severely degraded range and pastures dominated by undesirable weeds. Investment of time and money to restore such areas may be substantial.

Prevention is the number one priority in any IWM plan. Landowners must assess whether any of their daily or seasonal activities are likely to increase the chances of the plant invading and establishing on their land. The following preventive measures should be routine, and will reduce the chance of hoary alyssum, as well as other undesirable weed species, from establishing on site:

1. Thoroughly wash the undercarriage and wheels of vehicles and other machinery in a designated area before using them in uninfested areas.
2. Following any major disturbance on the property like construction, clearing of shrubs, or introduction of new soil or fill, monitor regularly through the growing season for three years or more. Hand pulling to eradicate new infestations while weeds are small is much more manageable compared to widespread patches that have had one or more years to develop a seed bank.
3. Keep pastures healthy by testing soils every three years and fertilizing if necessary. Do not overgraze.
4. Roadways, trails, and irrigation ditches should be maintained free of hoary alyssum as these areas may become sources for new populations.

For existing infestations:

On hay ground, IWM practices include nutrient management and irrigation management (where available) to maintain competitive shading forage plants. New infestations of hoary alyssum should be aggressively controlled using hand pulling. In alfalfa fields, it is important to maintain vigorous and competitive stands. Because herbicide options for controlling hoary alyssum within a stand are extremely limited, complete renovation may be necessary. In areas where hoary alyssum is especially problematic, managers may want to consider shorter lived varieties. For example, in Wisconsin a longer lived variety of alfalfa (five year) led to an increase in hoary alyssum compared to a shorter lived variety (three year).

On pastures and rangeland, herbicide applications may be necessary for large infestations. Chemical control of hoary alyssum can release remnant, desirable plants increasing their productivity. Herbicides can be applied prior to revegetation to reduce competition and enhance establishment of seedlings. Herbicides should be applied at the recommended rate and time for best results.

In farm yards, herbicide application and hand pulling should be used particularly where hay, tillage, and harvest equipment are stored. Equipment should be inspected for plant material (i.e., seeds) and cleaned before being taken to the field.

GLOSSARY

Basal - located at or near the base of a plant stem.

Inflorescence - a flower cluster.

Haemolysis - destruction or dissolution of red blood cells, with release of hemoglobin (may occur in horses when hoary alyssum is 20 to 30 percent or more of their diet).

Hypovolemic - of or relating to a decrease in the volume of circulating blood (may occur in horses when hoary alyssum is 20 to 30 percent or more of their diet).

Nectaries - glands that secrete nectar.

Pedicle - a small stalk or stalk-like part bearing a single flower.

Racemes - an inflorescence having stalked flowers arranged singly along an elongated unbranched axis.

Rosette - a circular cluster of leaves that radiate from a center at or close to the ground, as in the dandelion.

Sepals - a leaf-like division of the calyx of a flower (calyx is the sepals of a flower considered as a group; the calyx is the outermost whorl of a flower).

Septum - a thin wall or membrane that separates two parts or structures.

Silicle - a dry, elongated fruit with the length usually less than three times the width, and having two valves that fall away leaving a central partition.

Style - the slender part of a flower pistil, extending from the ovary to the stigma. The pollen tube grows through the style delivering the pollen nuclei to the ovary.

Taproot - the main root of a plant, usually stouter than the lateral roots and growing straight downward from the stem.

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ADDITIONAL RESOURCES

- Seeding Rates for Conservation Species for Montana, Montana Plant Materials Technical Note 46 https://www.nrcs.usda.gov/Internet/fse_plantmaterials/publications/mtpmctn12046.pdf
- Extension Bulletin EB0019. *Dryland Pasture Species for Montana and Wyoming*. <http://msuextension.org/publications/AgandNaturalResources/EB0019.pdf>
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