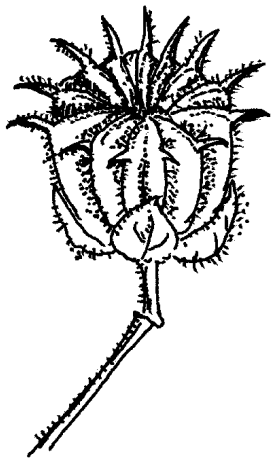
Velvetleaf

Abutilon theophrasti Medicus

Family: *Malvaceae* (Mallow)
Other Names: velvetweed, piemaker, elephant-ear, Indian mallow
USDA Code: ABTH
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Velvetleaf leaves are covered with soft hair, stems often have a purple tinge.
- The distinctively beaked fruits, the sides of which resemble the crimped edges of a piecrust.

Identification
Growth form: Annual forb.
Flower: Yellow to yellow-orange, five-petaled, flowers are born on stalks arising from the leaf axils.
Seeds/Fruit: Fruits are rounded with 9-15 segments arranged in a disk, each containing numerous gray-brown seeds.
Leaves: Leaves are alternate, heart-shaped, pointed at the end, 5 inches in width and attached on slender stems (Whitson et al. 1996). Leaves remain perpendicular to the sun all day (Duyssen 1997).
Stems: Mature plants are 2-7 feet tall. Stems are erect, branched, and the entire plant is covered with short, soft, "velvety" hairs.
Roots: Taproot
Seedling: The seed leaves (cotyledons) have slightly different shapes - one is nearly round and the other is more heart-shaped. Both cotyledon margins are entire, and cotyledons are covered on both surfaces with short hairs (Carey et al. 1993).



Fruit

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Velvetleaf is a serious weed problem in croplands in North America because of its high seedling vigor, rapid growth habit, tolerance to many herbicides, and ability to produce large amounts of seed (Starke and Renner 1995). Velvetleaf is often a major pest in corn, sorghum, milo, and spring wheat (Duyssen 1997). Velvetleaf seeds can contaminate chicken feed and reduce the salability of eggs (Duyssen 1997).
Ecological: Velvetleaf is able to produce large amounts of seed which remain viable for many years, and is a successful seed producer even under competition. Also, the roots of velvetleaf exude a chemical that inhibits fungal growth
Human: No information available.

Habitat and Distribution
General requirements: Velvetleaf is commonly found in cultivated fields, gardens, fencelines and waste areas. It thrives in sunny areas with rich soils.
Distribution: Velvetleaf is widespread throughout North America.
Historical: Velvetleaf was introduced from either China or India for commercial fiber production. It is believed that the entire North American population is derived from a single plant (Duyssen 1997).

Biology/Ecology

Life cycle: Flowering occurs from late June through October. Seeds may germinate throughout the growing season. Velvetleaf seeds have a hard seed coat, which contains bacteria and tannin-like compounds to protect them from infection (Duyssen 1997).
Mode of reproduction: Reproduces by seeds.
Seed production: A single plant may produce between 700 to 1,700 seeds (Duyssen 1997).
Seed bank: Seeds retain their viability in the soil for over 50 years, making eradication difficult (Whitson et al. 1996). If infestations are allowed to persist and establish a seed bank, this weed can be troublesome.
Dispersal: No information available.
Hybridization: No information available.

Control

Keys to Control:
- Maintain a healthy cover of perennial plants.
- Aggressively control infestations of velvetleaf before they can establish a persistent seed bank in the soil.

Biocontrol: None known.
Mechanical: Cutting or mowing plants after flowering but before seed set should eliminate the current year seed production.
Fire: No information available.
Herbicides: Applying metribuzin prior to germination will control velvetleaf in crops and fallow. Starke and Renner (1996) reported that consistent velvet leaf control in sugarbeets currently requires the use of preplant followed by post-emergence herbicides. They recommended trisulfuron combined with a nonionic surfactant (Starke and Renner 1996). In non-crop situations, glyphosate at 1.5 lb. ai/acre, or picloram at 0.5 lb., 2,4-D, or dicamba at 1 lb. ai/acre, can all be applied post-emergence to control velvetleaf. Atrazine and metribuzin are additional herbicides that will provide effective control in crop situations (Duyssen 1997). Herbicides should be applied before seed set.
Cultural/Preventive: Infestations of velvetleaf can be difficult to eradicate due to the long viability of seeds in the soil. The emergence of seedlings can be reduced by burial at depths greater than 3 inches. Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

Velvetleaf is usually not a problem in rangeland or forest situations. As with other annual plants which reproduce by seeds, velvetleaf can eventually be controlled by eliminating seed production until the soil seed bank is depleted. However, the long viability of seeds in the soil can make this plant especially hard to eradicate. Cut/pull or treat plants with herbicide prior to seed set.

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Jointed goatgrass

Aegilops cylindrica Host; ***Cylindropyrum cylindricum*** (Host) Löve

Family: *Poaceae* (Grass)
Other Names: jointgrass
USDA Code: AECY
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- The spike of jointed goatgrass forms an unbroken cylinder.
- Immature plants have marginal hairs on the leaf and at the stem juncture.

Identification
Growth form: Winter annual grass.
Flower: The seed head is 2-4 inches long with 5-10 spikelets (joints) per head.
Seeds/Fruit: Spikelets are 0.5 inches long with 1-3 viable seeds. At maturity spikelets separate with a segment of the stems still attached (Whitson et al. 1996).
Leaves: Leaves are alternate, simple, with a flap-like appendage (auricle) at the base, and a leaf blade 0.17-0.25 inch wide, with hairs.
Stems: Mature plants are generally 15-30 inches tall with one to many tillers.
Roots: Not rhizomatous. Short fibrous root system.
Seedling: No information available.

Similar Species
Exotics: Similar in appearance, and genetically related to, winter wheat.
Natives: None known.

Impacts
Agricultural: Jointed goatgrass has become a very serious weed in winter wheat and other cereal crops. Its genetic similarity, and similar growth characteristics to winter wheat make it very difficult to control without adversely harming crop production. Jointed goatgrass also infests rangeland surrounding wheat growing areas and land in the Conservation Reserve Program throughout the western United States (Morishita 1998).
Ecological: No information available.
Human: No information available.

Habitat and Distribution
General requirements: It can flourish in areas of less than 10 to more than 20 inches annual rainfall
Distribution: Jointed goatgrass is found throughout the western United States (Lyon 1998) at elevations up to 6,000 feet.
Historical: Jointed goatgrass is thought to have been introduced from Turkey in contaminated wheat (Stubbendieck et al. 1995).

Biology/Ecology
Life cycle: Jointed goatgrass flowers in early to mid June. Some jointed goatgrass seeds germinate soon after being shed from the plant and the remainder of the seeds may persist in the soil for years (Lyon 1998). Jointed goatgrass seeds usually germinate from early August through October, but they can also germinate in late spring and still mature if temperatures are low enough.
Mode of reproduction: Jointed goatgrass reproduces solely by seed.
Seed production: A jointed goatgrass plant can produce up to 100 spikes, 1,500 spikelets or joints, and up to 3,000 seeds (Lyon 1998).

Seed bank: Soil moisture plays an important role in jointed goatgrass seed viability and dormancy (Morishita 1998). Regardless of conditions, jointed goatgrass seeds rarely remained viable for over five years in the soil.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Mowing can be an effective control method if it is correctly timed. Mow soon after jointed goatgrass flowers, but before the seeds mature (Stahlman 1998).
Fire: Post harvest burning of winter wheat stubble in Washington reduced germination of jointed goatgrass seed lying on the soil surface by up to 90% (Stahlman 1998). To be effective, peak soil surface temperatures must reach 200°F or more for up to 60 seconds (Stahlman 1998). Spring burning of fallow or non-crop land will effectively kill jointed goatgrass and other winter annual weeds growing at the time, but will usually not destroy seeds on or in the soil.

Keys to Control:
- Prevent the production of new seeds.
- Deplete the existing soil seed bank with constant monitoring and control.

Herbicides: Because jointed goatgrass and wheat are genetically related, no currently registered herbicides will selectively control jointed goatgrass in winter wheat. Fallow is one of the best times to control jointed goatgrass because selectivity is not important. Jointed goatgrass is usually controlled best when plants are less than 4 inches tall, in the tiller stage, and non-stressed. Various combinations of atrazine plus hexazinone, metribuzin, or diuron have been reported to be effective in Colorado (Stahlman 1998). Glyphosate at 1.5 lb. ai/acre will also control jointed goatgrass. Glyposate at 0.5 lb. ai/acre applied when jointed goat grass is 2.5" tall provides excellent control in some situations (Beck et al. 1995).
Cultural/Preventive: Where jointed goatgrass is concerned "an ounce of prevention is worth a pound of cure." The key to control is to prevent further increase of jointed goatgrass seed in the soil seed bank and to optimize conditions that hasten depletion of viable seed in soil (Stahlman 1998). Seeds are difficult to distinguish from wheat, and are often spread by being planted with wheat or by uncleaned combines. Spread can be minimized by sowing jointed goatgrass-free seed wheat, covering trucks transporting contaminated grain, thoroughly cleaning machinery before moving from infested to non-infested areas, processing contaminated grain before feeding to livestock, and not baling or transporting contaminated straw to non-infested areas (Stahlman 1998).

Integrated Management Summary

Studies have shown that jointed goatgrass, winter wheat, and downy brome all compete for nutrients, moisture, and light (Morishita 1998). Comparatively, winter wheat is usually more competitive than jointed goatgrass, and both are much more competitive than downy brome. Jointed goatgrass also has a faster growth rate than downy brome (Morishita 1998). This faster growth rate, plus the use of herbicides that are more effective controlling downy brome than jointed goatgrass, may result in a weed species shift from downy brome to jointed goatgrass (Lyon 1998). An integrated management strategy should focus on preventing the establishment of new infestations in suceptible areas, and depleting the soil seed bank.

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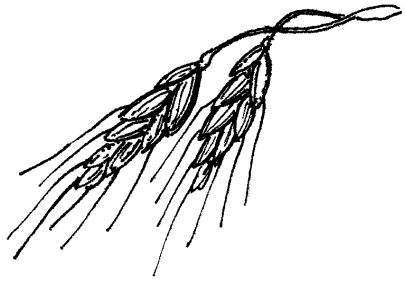
Downy brome

Bromus tectorum (L.); ***Anisantha tectorum*** (L.) Nevski

Family: *Poaceae* (Grass)
Other Names: cheatgrass, downy chess, early chess, drooping brome, downy cheat, slender chess, downy bromegrass, military grass, broncograss, Mormon oats
USDA Code: BRTE, ANTE6
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Downy brome can be identified by its drooping branches.
- In the late spring and early summer downy brome changes from green to purple to tan or brown allowing for easy identification. It often remains purple during the winter months.

Identification
Growth form: Annual or winter annual grass.
Flower: Downy brome panicles (loose, irregularly compound flowering part of plant with flowers borne on individual stalks) change color from green to purple to brown as the plant matures and eventually dries out. Branches are slender, drooping, hairy, flexuous, with up to eight spikelets.
Seeds/Fruit: Spikelets including awns are 0.8-2 inches long, nodding, with 2-8 florets.
Leaves: Leaves are light-green and hairy. Sheaths are fused except near the node at the bottom of each sheath. The lower sheaths are conspicuously hairy, while the upper sheaths are sometimes smooth.
Stems: Mature plants are generally 4-30 inches tall. Stems are erect, slender, glabrous, or slightly hairy.
Roots: The finely divided fibrous root system typically reaches a depth of about 12 inches, but can grow to 60 in. deep in the field (Hironaka 1961; Hulbert 1955).
Seedling: Downy brome seedlings can usually be distinguished by their hairy leaf blades and sheaths.



Similar Species
Exotics: Similar to Japanese brome *(Bromus japonicus)* and rye brome *(Bromus secalinus).*
Natives: None known.

Impacts
Agricultural: Downy brome can be a troublesome weed in winter wheat and other crops.
Ecological: Downy brome can greatly alter the species composition of dry native rangeland vegetation by competitive exclusion of reproduction of native plant species and by facilitation of wildfires (Mosky et al. 1999). Invasion of downy brome is greatest in drier environments, particularly in sagebrush-steppe communities. The process in which a pristine Great Basin shrub-steppe ecosystem deteriorates into one that is dominated by downy brome takes several years and has several distinct cycles. First, some sort of disturbance, such as heavy grazing, allows downy brome and other annuals to invade and proliferate. The dry stands of downy brome in the summer increase the frequency of fires. Initially, this creates an environment dominated by annual grasses, broom snakeweed (*Gutierrezia sarothrae*), and rabbitbrush (*Chrysothamnus* spp.). As fires become even more frequent, the area will be dominated by annual grasses alone, with the loss of surface soil, nutrients, and near permanent deterioration of the site. Species that are commonly displaced by downy brome include big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), bluebunch wheatgrass (*Agropyron spicatum = Pseudoroegneria spicata*), crested wheatgrass (*Agropyron cristatum*), western wheatgrass (*Agropyron smithii =*

Pascopyrum smithii), Sandberg bluegrass (*Poa sandbergii = Poa secunda*), needle-and-thread grass (*Stipa comata = Hesperostipa comata*), and Thurber's needlegrass (*Stipa thurberiana*)
Human: No information available.

Habitat and Distribution
General requirements: Downy brome is common in recently burned rangeland and wildlands, winter crops, waste areas, abandoned fields, eroded areas, and overgrazed grasslands (Upadhyaya et al. 1986). It can invade rangelands that have never been grazed by livestock (Svejcar and Tausch 1991).
Distribution: Common throughout Colorado from 4,000 to 9,000 feet. Widely distributed throughout North America. Although downy brome occurs in a variety of habitats, it is most prominent on the Columbia-Snake River Plateau, Wyoming Basin, and the northern edge of the Great Basin in disturbed sagebrush steppe communities (Rice and Mack 1991, West 1983).
Historical: No information available.

Biology/Ecology
Life cycle: Vast numbers of downy brome seedlings usually germinate after the first fall rain in infested areas (West 1983). The leaves typically grow little in the fall, and plants are normally 1-2 inches in height when covered by snow in December. The young, fall-germinated seedlings often over-winter in a semi-dormant state and complete their lifecycle the following spring (Upadhyaya et al. 1986). However, downy brome roots can grow in soil temperatures approaching freezing (West 1983), and roots will continue to grow throughout the winter until soil temperatures drop below about 37 degrees F. Plants head in late April to early May followed by flowering within a week (Upadhyaya et al. 1986). The seeds mature in mid to late June (Upadhyaya et al. 1986).

During ripening downy brome flowers turn purple and then brown as they mature. Once the seeds have matured, plants dry and become flammable. There is a correlation between plant color and moisture status during the drying process (FEIS 1996). Downy brome passes from green (>100% moisture content), to a purple hue (30-100% moisture content), to a straw color (<30% moisture content) as it dries (FEIS 1996). The onset of purple coloring should be taken as a warning that hazardous fire conditions will develop within two weeks (FEIS 1996).
Downy brome greens up earlier in the spring than most other species. Depletion of soil moisture is a mechanism by which downy brome suppresses seedlings of desirable, perennial grasses (Melgoza et al. 1990). In addition, thick mulch in dense downy brome stands favors downy brome seedling germination and establishment while inhibiting that of perennial bunchgrasses (Svejar and Tausch 1991).
Mode of reproduction: Reproduces by seeds.
Seeds production: Downy brome can be a prolific seed producer and is capable of producing up to 400 lbs. of seeds/acre (Upadhyaya et al. 1986). Seed production per culm, per plant, and per unit area is dependent on plant density and environmental factors (Upadhyaya et al. 1986). Average seed production per plant is generally lowest where plant density is highest (Rice and Mack 1991). If precipitation is adequate, the majority of downy brome seeds will germinate in the fall, or within a year of maturation (Upadhyaya et al. 1986). However, dry conditions can cause environmentally induced dormancy, which may last several years and break down at erratic intervals (Young and Evans 1985).
Seed bank: Low survival rates in the soil, but seeds may last in the seed bank for a few years.
Dispersal: Seeds are dispersed short distances by wind, and the long awns can attach to the fur or feathers of an animal, as well as clothing.
Hybridization: No information available.

Control
Biocontrol: Livestock grazing can help control downy brome. Two grazing periods each spring are required for at least two consecutive years. Plants should first be grazed at the stage just before the inflorescences emerge ("boot" stage), then grazed again before panicles emerge (about 3-4 weeks). Grazing intensity needs to be light enough to leave at least a 3-inch residual height to protect desirable grasses (Mosely 1996). Winter grazing downy brome can reduce mulch, thereby hindering downy brome establishment and favoring perennial grass establishment.

Keys to Control:
- Maintain healthy stand of perennial plants.
- Seeding may be needed where perennial grasses have been depleted.
- Manage grazing carefully in seeded areas to promote the establishment of new perennial plants.

Mechanical: Cutting is not a recommended control method for downy brome. Plants that are cut before seed ripening will produce new stems and seeds at the cut height. Plants that are cut after seed ripening will die, but by this point the seeds are already viable. In one study, repeated mowing (every three weeks) during the spring and summer was as effective at controlling downy brome seed production as an application of glyphosate (Ponzetti 1997). However, this method was very labor-intensive and a cost/benefit analysis should be conducted before any choice is made.

Hand-pulling downy brome plants in small infestations before seed set would effectively eliminate current seed production, but may not eliminate the infestation. The large seed production commonly associated with downy brome infestations will allow plants to recover for several years without noticeable reductions in plant density. Hence, any pulling program must be conducted for several years, or until the seed bank has been exhausted. Also, seeds that blow into the cleared areas from adjacent uncleared areas may negate the effects of pulling. When pulling, an effort should be made to extract as much of the root as possible so that the plant cannot simply regrow and produce new seeds.

Fire: Burning is usually conducted in Colorado in June after the plant has dried, but before the seeds have dropped (Carpenter and Murray 1998). However, some seeds will survive and if a burn is not followed by reseeding downy brome will recover to pretreatment proportions within 3 to 4 years (Carpenter and Murray 1998). Reseeding should be done in late fall (a dormant seeding).

Herbicides: There are several types of herbicides that can be used alone or combined to provide effective control of downy brome. Refer to the product label for detailed application directions so as to minimize the damage to non-target species. For relatively small infestations, a backpack sprayer is recommended to minimize the danger to non-target plants. However, infestations are often so large that a four-wheeler, tractor, or truck fitted with a sprayer is necessary. The following herbicides are divided into two groups, spring applied and fall applied.

In most cases, herbicide application should be made in early spring when non-target species are dormant to insure selective control. Downy brome was reported to be controlled best when the plants were 10 cm or less and growing vigorously at the time of application (Wiese et al. 1995). Spring applied herbicides include quizalofop, fluazifop-p-butyl, sethoxydim, glyphosate, and imazapic.

On sites where desirable plants are largely absent, control of downy brome must be followed by reseeding. Chemical fallow with glyphosate at 0.5 lb. ai/ac applied in the early spring when plants are actively growing is one option. The site can be reseeded in the fall (Mosely et al. 1999). Alternatively, one could graze downy brome plants twice with livestock then apply glyphosate.

Fall herbicide applications should be conducted after downy brome seeds have germinated and are beginning to grow. Fall applications are generally used in cropland situations by farmers growing winter wheat or other cool season crops. However, sometimes these herbicides are used in pastures and rangelands. Fall-applied herbicides for non-crop situations include sulfometuron methyl, and metribuzin.

Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, and maintaining healthy native communities.

Integrated Management Summary

Downy brome is characterized by its early maturation, high seed production, and vigorous growth under favorable environmental conditions. Although, downy brome readily invades perennial forage crops and rangeland under poor management, it also invades communities in the absence of disturbance (Douglas et al. 1990). In undisturbed sites, downy brome will most commonly spread along soil cracks and work its way outward into the natural community (Rice and Mack 1991). Downy brome has a dual role as a serious weed and important early season forage for cattle and sheep (Upadhyaya et al. 1986). Downy brome provides the bulk of early spring forage for all classes of stock on grazing lands in the Intermountain and Pacific Northwest regions (Upadhyaya et al. 1986). Lasting control of downy brome will require a combination of chemical control, physical control, vegetative suppression, and proper livestock management where land is grazed. This “cumulative stress” method will keep the plants constantly under stress, reducing their ability to flourish and spread. Also, a cumulative stress approach provides a level of redundancy in case one type of treatment is not implemented or proves to be ineffective (Carpenter and Murray 1998).

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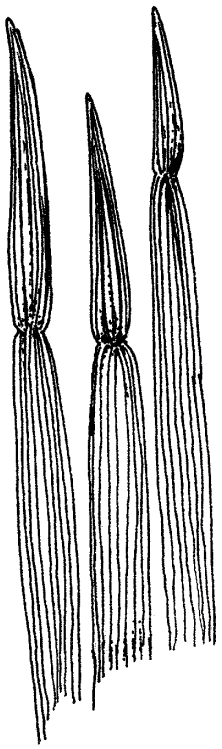
Quackgrass

Elytrigia repens (L.) Nevski; ***Agropyron repens*** (L.) Beauv.

Family: *Poaceae* (Grass)
Other Names: couchgrass
USDA Code: ELRE3
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Spikelets of quackgrass are arranged in two long rows, and borne flatwise to the stem.
- Quackgrass leaves are often constricted near the tips.

Identification
Growth form: Perennial grass.
Flower: Slender spike, resembling wheat heads.
Seeds/Fruit: Spikelets are arranged in two long rows, borne flat side to the stem. Florets are awnless, or with short straight awns.
Leaves: Leaf blades are flat, pointed, 0.25 0.5 inches wide, and have small ear-like appendages (auricles) at the junction of the blade and the sheath (Whitson et al. 1996).
Stems: Mature plants are usually 1-3 ft tall and have erect stems.
Roots: Rhizomes are yellowish-white, sharp pointed, and somewhat fleshy.
Seedling: Both leaf sheath and blade are hairless or sparsely hairy. Clasping auricles and a short membranous ligule are present (Carey et al. 1993).



Constricted leaf tips

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Quackgrass reduces productivity in crops, rangeland, and pasture.
Ecological: Quackgrass is a rapid invader and quickly stabilizes moist eroding soils. It invades mixed-grass prairies, stream banks, roadsides, ditches, crop fields, gardens, yards, and just about any disturbed, moist area. It is believed to be allelopathic (Whitson et al. 1996).
Human: No information available.

Habitat and Distribution
General requirements: Quackgrass is well adapted to moist soils in cool temperate climates. Optimum temperatures for growth are between 68 and 77 degrees F. Quackgrass is only moderately shade tolerant. Plant vigor is reduced when shading exceeds 50%. Some species that are commonly associated with quackgrass include sedge (*Carex* spp.), bulrush (*Scirpus* spp.), rush (*Juncus* spp.), crested wheatgrass (*Agropyron cristatum*), indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachrium scoparius*), smooth brome (*Bromus inermis*) Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvensis*) (FEIS 1996).
Distribution: Quackgrass is widely distributed in North America. In Colorado, it is primarily a problem in the southern San Luis Valley.
Historical: Introduced from Europe.

Biology/Ecology

Life cycle: Primary rhizome growth begins in early spring and then again in September and October with the onset of fall rains and cooler temperatures. Quackgrass flowers from June through August. Cross-pollination is necessary for seed production. Seeds germinate in fall or spring and plants are capable of producing seeds more than once per season.
Mode of reproduction: Quackgrass propagates mainly by rhizomes but also reproduces by seed.
Seed production: No information available.
Seed bank: Seeds may remain viable for up to 10 years.
Dispersal: No information available.
Hybridization: Although quackgrass is considered an undesirable weed species it is often crossed with other wheatgrasses to create hybrids for grazing.

Control

Biocontrol: None known.
Mechanical: Because of the ability of broken rhizome segments to grow and produce more plants, it is extremely difficult to control mechanically. Mowing and raking significantly reduced quackgrass biomass and prevented flowering the following season (FEIS 1996). However, it has also been reported that mechanical control only helped to stimulate bud production (Rutledge and McLendon 1998).
Fire: Burning may reduce the vigor and abundance of quackgrass (Rutledge and McLendon 1998).
Herbicides: Quackgrass can be controlled with glyphosate at 1.5 lb. ai/acre. Other effective herbicides include fluzifop-P-butyl, imazapyr and princep.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:

- A combination of mowing or burning followed by herbicide applications to new shoots can be used to eliminate seed production and exhaust the nutrient reserves in the roots.

Integrated Management Summary

Quackgrass is an early seral species in disturbed areas. This species initially forms a dense clump through extensive tillering. The following season plants may expand and form patchy to pure stands (Rutledge and McLendon 1998). Combining mowing or burning with herbicides may the most effective way to control quackgrass. Quackgrass may also be gradually replaced by other species through natural succession processes (Rutledge and McLendon 1998).

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Wild proso millet

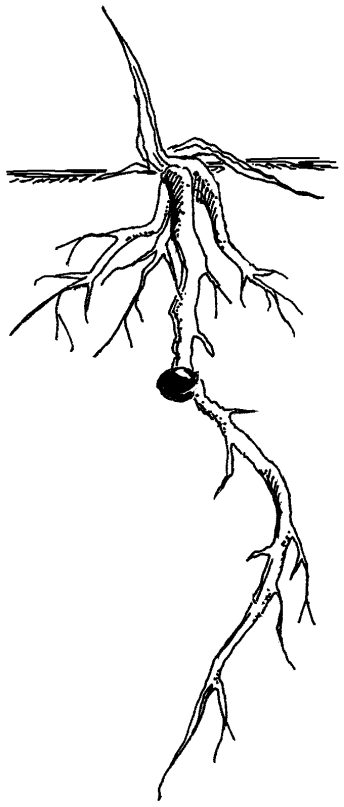
Panicum miliaceum L.

Family: *Poaceae* (Grass)
Other Names: Proso millet, broom corn millet
USDA Code: PAMI2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Seed color, ranging from olive brown to black, is the only way to distinguish wild proso millet from domestic proso millet (which has yellow or light brown seeds).
- Seedlings can be identified by the attached seed coat on the roots.

Identification

Growth form: Annual grass.
Flower: The inflorescence is a spreading panicle 6-12 inches wide and not fully extended from the leaf sheath.
Seeds/Fruit: Seeds are smooth, shiny, olive brown to black.
Leaves: Leaf blades are 0.5 to 0.75 inches wide. Sheaths are open with long spreading hairs. There is a fringe of dense hairs (ligule) at the base of the leaf blade.
Stems: Mature plants are 2-6 feet tall with erect stems that branch at the base.
Roots: Not rhizomatous, short fibrous root system.
Seedling: Both surfaces of the leaf blade as well as the sheath are densely hairy. The back of midrib often has a row of hairs protruding at a 90-degree angle. Auricles are lacking, and the ligule is hairlike. The large, shiny, dark brown to black seed coat often persists on the root system (Carey et al. 1993).



roots with attached seed coat

Similar Species

Exotics: Seed color, ranging from olive brown to black, is the only way to distinguish wild proso millet from domestic proso millet (which has yellow or light brown seeds).
Natives: None known.

Impacts

Agricultural: Wild proso millet is one of the fastest spreading weeds in the corn belt (Wilson 1992). It is a vigorous competitor in row crops (Whitson et al. 1996). Wild proso millet seems to be most competitive in corn, soybeans, and dry edible beans (Wilson 1992).
Ecological: Wild proso millet is usually not a problem in rangelands or natural areas.
Human: No information available.

Habitat and Distribution

General requirements: Wild proso millet is commonly found in crops and along field edges and roadsides. It grows especially well on rich, irrigated soil but can grow on a wide range of soils.
Distribution: Common in much of the United States.
Historical: Introduced from Europe.

Biology/Ecology

Life cycle: Seed germination will occur in the spring and throughout the summer when soil temperatures reach 68 degrees F (Wilson 1992). Flowering begins in July and continues throughout the summer. Seeds mature in late August through September (Wilson 1992).
Mode of reproduction: Wild proso millet is prolific seed producer and this is its sole means of reproduction.
Seed production: A single plant may produce between 400-2,100 seeds (Wilson 1992).
Seed bank: Wild proso millet seeds can remain viable in the soil for five or more years.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Wild proso millet is very suceptible to tillage. Cultivation, if properly timed, can provide 95% control of wild proso millet (Wilson 1992). Cultivation should begin as soon as the crop emerges and continue cultivation until the crop begins to close the row (Wilson 1992). Combining early season cultivation with either preplant or post-emergence herbicides has resulted in the most consistent wild proso millet control (Wilson 1992).

Keys to Control:
- Crop rotation, or raising alfalfa for at least four years can reduce wild-proso millet seed reserves.
- Kill wild proso millet before it can produce seed and spread.

Fire: No information available.
Herbicides: In non-crop situations glyphosate will provide excellent non-selective control of wild proso millet (Wilson 1992) Herbicides that can be used in crops include alachlor, butylate, pendimethalin + cyanazine, and nicosulfuron.
Cultural/Preventive: Prevention is the best control method. Always select clean, high quality, weed free seed. Clean farm equipment, especially combines, before leaving an infested field (Wilson 1992). Crop rotations can be used to control wild proso millet. Alfalfa is the best choice for long term control. The regular mowings of alfalfa prevents wild proso millet from producing seed (Wilson 1992). Four years of alfalfa cropping has the potential to reduce wild proso millet seed reserves by 90 percent.

Integrated Management Summary

Wild proso millet seed can be spread by harvesting equipment, uncomposted manure, birds, livestock, and irrigation water (Whitson et al. 1996). Infestations often start at field entrances or along roadsides, so careful attention should be paid to these areas to prevent establishment (Whitson et al. 1996). Wild proso millet is usually not a problem in rangelands or natural areas.

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Yellow foxtail

Setaria glauca (L.) Beauv.

Family: *Poaceae* (Grass)
Other Names: pigeongrass, pearl millet, yellow bristlegrass
USDA Code: SEGL2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Yellow foxtail can be distinguished from other foxtails by the long white hairs on the upper leaf blades near the throat, by the presence of five or more yellow or tawny bristles below each spikelet, and by leaf sheaths which are smooth on the margins.

Identification

Growth form: Annual grass.
Flower: The floral structure (panicle) is cylindrical, with crowded spikelets that are subtended by 5 to 10 long yellowish bristles.
Seeds/Fruit: Seeds are oval, green to yellow to dark brown, coarsely roughened, and approximately 0.12 inch long.
Leaves: Leaf sheaths are smooth, 2-8 inches long and 0.5 inch wide.
Stems: Mature plants are 1-3 feet tall. Stems are erect and branch at the base.
Roots: Short fibrous roots.
Seedling: The leaf blades are hairless except for long, wiry hairs on upper side near the base. Auricles are lacking, and the leaf has a hairlike ligule (Carey et al. 1993).

Similar Species

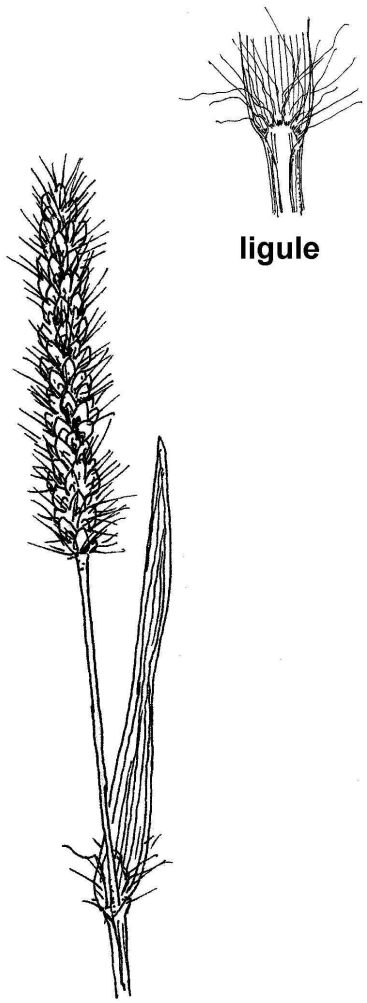
Exotics: Yellow foxtail can be distinguished from other foxtails by the long white hairs on the upper leaf blades near the throat, by the presence of five or more yellow or tawny bristles below each spikelet, and by leaf sheaths which are smooth on the margins.
Natives: None known.

Impacts

Agricultural: Yellow foxtail can be a serious problem in spring-seeded alfalfa, row crops, and small grain crops (Whitson et al. 1996). It can cause reductions in yields, increased cleaning costs, and expensive control measures (Steel et al. 1983). Additionally, yellow foxtail is a typical nuisance weed in gardens, along roadsides, and in waste places (Steel et al. 1983). If it is consumed in sufficient quantities, yellow foxtail can cause stomatitis in cattle and horses (Steel et al. 1983).
Ecological: It is mainly a problem in crops, but can push out native vegetation in disturbed areas.
Human: No information available.

Habitat and Distribution

General requirements: Yellow foxtail is commonly found in crops, along the edges of fields, roadsides, and in waste areas. It grows in a wide variety of soil types and environmental conditions. However, yellow foxtail prefers full sunlight and does not persist in shaded sites.
Distribution: Common throughout most of North America (Whitson et al. 1996).



Historical: Yellow foxtail is a native of Eurasia.

Biology/Ecology

Life cycle: Seedlings begin to emerge in May. Yellow foxtail begins to tiller two weeks after emergence. Flowering and seed production occur from July through September. Yellow foxtail is self-pollinated and seeds begin to form even before the floral structure emerges from the surrounding leaf (Steel et al. 1983).
Mode of reproduction: Yellow foxtail is an annual that reproduces exclusively by seed.
Seed production: The number of seeds per plant ranges from 540-8,460 depending upon environmental conditions (Steel et al. 1983).
Seed bank: Seeds may remain viable in the soil for over 10 years.
Dispersal: The seeds are dispersed by machinery, wind and animals.
Hybridization: No information available.

Control

Biocontrol: Close grazing by sheep will prevent a new crop of seeds from being shed (Steel et al. 1983).
Mechanical: In natural areas, yellow foxtail could be mowed or burned to eliminate seed production. However, since the seeds already in the soil may remain viable for six years, repeated treatments are necessary to deplete the seed bank.
Fire: See above.
Herbicides: Yellow foxtail is commonly controlled with herbicides. Herbicide control is typically most effective when yellow foxtail is between 2-4 inches tall. In non-crop situations, glyphosate at a rate of 1.5 lb. ai/acre should control yellow foxtail.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Yellow foxtail is commonly controlled by postemergence herbicides applied when the plants are 2-4 inches tall.
- Mowing, burning, or grazing can reduce seed production.

Integrated Management Summary

Although yellow foxtail is not normally a problem weed in natural areas, the best strategy to control this weed is to prevent it from becoming established in the first place. As with other annual plants which reproduce by seeds, control depends on eliminating seed production until the soil seed bank is depleted. Cut/pull or treat plants with herbicide prior to seed set, and repeat treatments as necessary.

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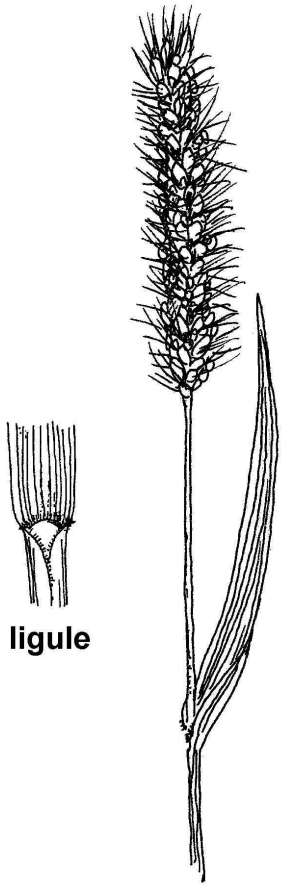
Green foxtail

Setaria viridis (L.) Beauv.

Family: *Poaceae* (Grass)
Other Names: pigeongrass, green bristlegrass, wild millet
USDA Code: SEVIV
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Green foxtail has long hairs on the axis of the flowers (rachis).
- Green foxtail lacks long twisting hairs on the upper surface of the leaf blade near the base that are found on the similar yellow foxtail (*Setaria glauca*).

Identification
Growth form: Annual grass.
Flower: The flowers are cylindrical with crowded spikelets that are subtended by 6 to 10 long yellowish bristles (Whitson et al.1996).
Seeds/Fruit: Seeds are oval, greenish to dark brown.
Leaves: The flattened leaf blades are usually less than 6 inches long. The leaf sheath is roughened and hairless.
Stems: Mature plants are 1-3 feet tall, with erect stems that branch at the base (Whitson et al. 1996).
Roots: Short fibrous roots
Seedling: Leaf blades are hairless; leaf sheath is hairless except for short hairs along margins. The leaf lacks auricles, and has a hairlike ligule (Carey et al. 1993).



Similar Species
Exotics: Green foxtail can be distinguished from yellow foxtail (*Setaria glauca*) by the lack of long twisting hairs on the upper surface of the leaf blade near the base. Green foxtail can be distinguished from bristly foxtail (*Setaria verticillata*) by the presence of long hairs on the axis of the flowers (rachis) and by the forward facing barbs of the setae (bristles). Giant foxtail (*Setaria faberii*) can be distinguished from green foxtail by its arching head up to 6.5 inches long and leaves that are hairy on the upper surface.
Natives: None known.

Impacts
Agricultural: Green foxtail is a nuisance in cultivated fields and irrigated valleys. It can be a serious problem in spring-seeded alfalfa, small grain, and row crops (Whitson et al. 1996). Green foxtail can cause yield reductions, cleaning costs, and expensive control costs. It is also reported to have allelopathic effects on cabbage seedlings (Douglas et al. 1985).
Ecological: No information available.
Human: No information available.

Habitat and Distribution
General requirements: Green foxtail is commonly found in irrigated crops, lawns, gardens, along roadsides, streams, and waste places. It prefers moist, medium to coarse textured soils. Species that are commonly associated with green foxtail include Canada thistle (*Cirsium arvense*), field penny-cress (*Thlaspi arvense*), quackgrass (*Agropyron repens*), flixweed (*Descurainia sophia*), and kochia (*Kochia scoparia*).

Distribution: Common throughout North America.
Historical: Green foxtail is a native of Eurasia.

Biology/Ecology
Life cycle: Green foxtail is a summer annual that overwinters as a seed on or below the soil surface. It generally emerges in April or May following periods of high rainfall. Flowering occurs from July to September and seeds can mature within two weeks of flowering. The seeds of green foxtail readily fall from the flower structures when mature (Douglas et al. 1985).
Mode of reproduction: Reproduces by seed.
Seed production: Green foxtail typically produces between 5,000-12,000 seeds per plant. However, the number of seeds per plant is highly dependent upon the size of the plant, and some plants may produce up to 34,000 seeds.
Seed bank: Seeds can remain viable for up to six years (Douglas et al.1985).
Dispersal: Seeds may be distributed by human activity, animals, birds, and water (Douglas et al.1985).
Hybridization: No information available.

Control
Biocontrol: None known.
Mechanical: In natural areas, green foxtail could be mowed or burned to eliminate seed production. However, since the seeds already in the soil may remain viable for six years, repeated treatments are necessary to deplete the seed bank.
Fire: No information available.
Herbicides: Green foxtail is commonly controlled with herbicides. Herbicide control is typically most effective when green foxtail is between 2-4 inches tall. In non-crop situations, glyphosate at a rate of 1.5 lb. ai/acre should control green foxtail. In crops, Forcella and Banken (1996) reported that 1994 corn yield losses due to green foxtail were minimized if nicosulfuron was applied any time before 300 growing degree days (10 degrees C base temperature) into the season. Green foxtail can also be controlled by triasulfuron in wheat, sunflower, barley, and rape; by diclofop in wheat, flax, rape, brown and yellow mustard; and by sethoxydim in rape, flax, sugar beets and soybeans (Douglas et al. 1985).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Maintain a dense stand of perennial plant species, especially grasses.
- Postemergence herbicides should be applied when the plants are 2-4 inches tall.

Integrated Management Summary
Green foxtail is generally considered a problem for agricultural production, but it may also invade disturbed rangeland and pasture. Most control methods are geared towards eliminating green foxtail from crops, and there is little information regarding the control of green foxtail in natural areas. As with other annual plants which reproduce by seeds, control depends on eliminating seed production until the soil seed bank is depleted. Cut/pull or treat plants with herbicide prior to seed set, and repeat treatments as necessary.

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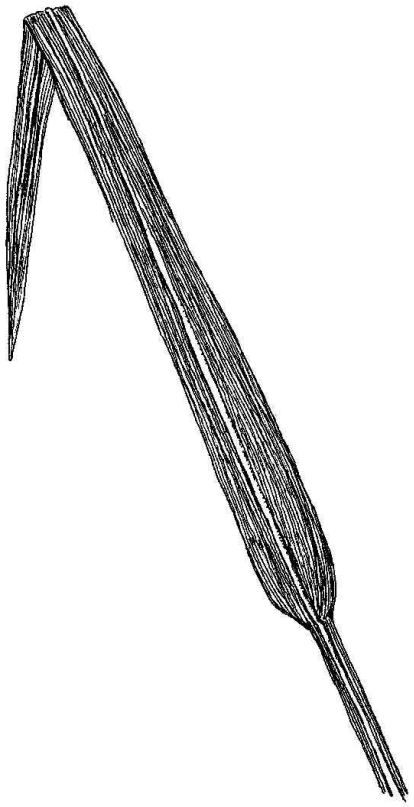
Johnsongrass

Sorghum halepense (L.) Persoon

Family: *Poaceae* (Grass)
Other Names: Johnson grass
USDA Code: SOHA
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Johnsongrass can be identified by its long, smooth leaves that have a conspicuous white midvein.
- Stems may be pink to rusty red near the base.



Identification
Growth form: Warm season perennial grass.
Flower: Mature flowers are large open panicles that bear many awn-tipped, shiny, reddish to purplish spikelets.
Seeds/Fruit: Seeds are reddish-brown, awned, and ovoid shaped.
Leaves: Leaf blades are flat with conspicuous midveins, and are often as much as 1 inch wide (Whitson et al. 1996).
Stems: Mature plants can grow 2-8 feet tall. Stems are typically 1.5 – 4.5 feet high, but can occasionally be taller. Stems may be pink to rusty red near the base (Virginia Natural Heritage Program 1999).
Roots: Thick creeping rhizomes.
Seedling: Both leaf sheath and blade are hairless. Plants lack auricles, and have a prominent, jagged, membranous ligule. Rhizomes are usually present at an early stage (Carey et al. 1993).

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Plants form hydrocyanic acid when under frost or moisture stress, making them toxic to livestock. Some crop species that are commonly invaded by johnsongrass include corn, alfalfa, grapes, and cotton. Johnsongrass is sometimes used to rehabilitate overgrazed ranges in the Southwest (FEIS 1996).
Ecological: Despite its use as a revegetation species and as hay, johnsongrass is considered one of ten worst weed species in North America (FEIS 1996). It aggressively crowds out native species, especially along riverbanks. It can take over irrigation ditches and field crops.
Human: Produces pollen which is a common allergen.

Habitat and Distribution
General requirements: Once thought to be strictly a warm-season grass, it has adapted and can be found in most of the western states. Johnsongrass invades native grasslands subjected to unnatural frequent flooding. It also invades irrigation ditches, waste areas, roadsides, cropfields, or any disturbed ground (FEIS 1996).
Distribution: Found in most of the western United States.
Historical: Johnsongrass is native to the Mediterranean region and was originally introduced as a forage crop.

Biology/Ecology

Life cycle: Johnsongrass can flower from May through November. However, specific flowering times are highly dependent on temperature (FEIS 1996).
Mode of reproduction: Johnsongrass recolonizes both by seed and from extensive, creeping rhizomes.
Seed production: Johnsongrass produces a large quantity of viable seeds (FEIS 1996).
Seed bank: Seeds can remain viable for 30 months in the soil (Holm et al.1991).
Dispersal: Seeds are dispersed by wind, water and animals (Holm et al.1991).
Hybridization: Can hybridize with cultivated sorghums (Holm et al.1991).

Control

Biocontrol: None known.
Mechanical: Small infestations can be controlled by hand pulling the plants when the soil is moist (Virginia Natural Heritage Program 1999). Mowing after seed head development but before flowering can be used to control johnsongrass. However, acceptable results will usually require multiple mowings per year over several growing seasons.
Fire: No information available.
Herbicides: Chemicals are usually effective in control of johnsongrass, as is proper crop rotation and management (FEIS 1996). Glyphosate at 1.5 lb. ai/acre applied when the plants are 12-18 inches tall will control johnsongrass. Fluzifop-P-butyl applied at 32-48 oz/acre can be applied when seedlings are actively growing and between 2-8 inches tall. Sulfometuron methyl can be applied early post-emergence with a reapplication when regrowth begins. Sulfometuron methyl works best when applied soils are moist to help translocate the herbicide to the root system.
Cultural/Preventive: Johnsongrass may also be controlled through fall and winter cultivation, which exposes the cold-sensitive rhizomes (FEIS 1996).

Keys to Control:

- Small stands can be controlled by hand pulling the plants when the soil is moist.
- Severe infestations can be controlled by repeated winter tilling.
- Herbicide applications can also be an effective control method.

Integrated Management Summary

This aggressive invasive perennial grass can be difficult to control, since it reproduces both by seed and by rhizome growth. Integrated control efforts should focus on preventing the spread of seeds and rootstock pieces, eliminating seed production and depleting the nutrient reserves in the root system.

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Chinese clematis

Clematis orientalis L.

Family: *Ranunculaceae* (Buttercup)
Other Names: oriental virginsbower, orange peel, lemon peel
USDA Code: CLOR
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Solitary, yellow-sepaled flowers weth feathery fruits.

Identification
Growth form: Perennial herbaceous to woody vine.
Flower: Flowers solitary, with four yellow sepals (petal-like structures), often nodding.
Seeds/Fruit: Each flower produces numerous feathery long-tailed achenes (single seeded fruits) which are conspicuous as the fruits mature.
Leaves: Opposite leaves, ternate (having 3 leaflets).
Stems: Vigorous climbing vines up to ten feet long.
Roots: No information available.
Seedling: No information available.
Other: Flowers are delicately scented.

Similar Species
Exotics: None known.
Natives: The native virgin's bower, *Clematis ligusticifolia*, has white-sepaled flowers in clusters, and is much more common, especially at lower elevations.

Impacts
Agricultural: No information available.
Ecological: In the past 25 years, Chinese clematis has spread especially rapidly, becoming weedy and constituting a threat to young trees and native shrubby and herbaceous species (Flora of North America Editorial Committee 1997).
Human: No information available.

Habitat and Distribution
General requirements: Most *Clematis* species prefer sunny, well drained soils, although they may be shade tolerant to some degree. In Utah, Chinese clematis is found in sagebrush, mountain brush, and ruderal habitats up to 7,500 feet (Welsh et al. 1987).
Distribution: *Clematis orientalis* has been naturalized in the Rocky Mountains since the late nineteenth century, and is now well established in Utah and Colorado, scattered in several other western states (Flora of North America Editorial Committee 1997). In Colorado, Chinese clematis is found in mountain areas in the south and central parts of the state.
Historical: Clematis species and hybrids are popular as ornamental garden plants.

Biology/Ecology
Life cycle: Perennial woody vine which flowers in summer to fall.
Mode of reproduction: Reproduces by seeds.
Seed production: No information available.

Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

The only recommendation available is for herbicide control with Escort® (metsulfuron). The rate is 1 oz of product per acre plus 0.25% v/v non-ionic surfactant (K.G. Beck, pers. comm.).

Integrated Management Summary

There is little or no information available on the control of Chinese clematis. Preventing the spread of this species by eliminating seed production from established stands, and discontinuing its use as an ornamental are possible strategies.

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=List C

Sulfur cinquefoil

Potentilla recta L.

Family: *Rosaceae* (Rose)
Other Names: rough-fruited cinquefoil
USDA Code: PORE5
Legal Status: Colorado Noxious List C (new in Colorado – call your county weed supervisor!)

Keys to Identification:
- Leaves are palmately compound, have 5-7 toothed leaflets, and somewhat resemble a marijuana leaf.
- Light-yellow flowers have five petals that are deeply notched.
- Leaf stalks have perpendicular hairs longer than the width of the stalk.

Identification
Growth form: Perennial forb.
Flower: Flowers are light-yellow with 5 petals.
Seeds/Fruit: Each flower produces numerous small seeds (.05 in long) that are slightly flattened.
Leaves: Leaves are alternate, palmately compound with 5-7 toothed leaflets on each leaf. Leafstalks have conspicuous perpendicular hairs, and leaves appear green on the underside.
Stems: Mature plants are 1-1.5 feet tall with one to several stems growing from well-developed rootstocks (Whitson et al. 1996).
Roots: Fibrous roots and lateral rhizomes.
Seedling: No information available.

Similar Species
Of the numerous *Potentilla* species found in Colorado, the majority of the alien species are annuals or short-lived perennials, and natives are mainly perennial. Important features to note for keying cinquefoil are leaflet number, floral characteristics, and the type and arrangement of hairs on the plant.

Impacts
Agricultural: Sulfur cinquefoil is unpalatable to grazing animals, therefore it reduces forage for livestock and wildlife where it is abundant (Rice 1999).
Ecological: Sulfur cinquefoil is a competitive early successional weed that persists until a woody cover is present. It can dominate a site within 2-3 years of first appearance (FEIS 1996). Sulfur cinquefoil has a long lifespan, and twenty year old plants are not uncommon (FEIS 1996). Sulfur cinquefoil has been known to invade bluebunch wheatgrass rangeland in good condition (FEIS 1996). In Montana, it is actually out-competing spotted knapweed on some sites (FEIS 1996). Some species that are commonly associated with sulfur cinquefoil include smooth brome (*Bromus inermis*), Canada bluegrass (*Poa compressa*), quackgrass (*Elytrigia repens*), timothy (*Phleum pratense*), annual ragweed (*Ambrosia artemisiifolia*), yellow toadflax (*Linaria vulgaris*), and spotted knapweed (*Centaurea maculosa*) (FEIS 1996).
Human: No information available.

Habitat and Distribution
General requirements: Although colonies of sulfur cinquefoil can be found in undisturbed sites, it is usually found in disturbed grasslands, shrubby areas, and old fields. Sulfur cinquefoil grows on dry sandy, gravelly, and rocky soils, and prefers climates with 13-50 inches of mean annual precipitation.
Distribution: Naturalized throughout much of North America. It is typically found in low to middle elevations in the intermountain west. Its distribution in Colorado is not well understood at this time but it is known to be present on the Western Slope and Front Range.

Historical: Sulfur cinquefoil is a native of Eurasia first introduced into North America before 1900 (FEIS 1996).

Biology/Ecology

Life cycle: Seeds of sulfur cinquefoil may germinate at any time during the growing season provided soil moisture is adequate. However, seeds don't germinate when temperatures are high (e.g. July and August). Growth begins early in spring. Sulfur cinquefoil flowers from May to July with peak flowering generally occurring in late June.
Mode of reproduction: Sulfur cinquefoil has an unusual means of vegetative reproduction. Annual regrowth each spring eventually causes individual plants to become several closely-spaced independent plants. Also, plants that are knocked to the ground can produce roots at the nodes.
Seed production: No information available.
Seed bank: Seeds may remain viable in the soil for more than four years.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: Acceptable biological control agents are difficult to find because damaging insects also attack strawberries (*Fragaria* spp.), which are genetically and physiologically similar to sulfur cinquefoil (FEIS 1996). Cattle, sheep and horses will not eat sulfur cinquefoil possibly due to high tannin concentrations; however, goats will eat sulfur cinquefoil (Rice 1999).

Keys to Control:
- Sulfur cinquefoil is commonly controlled with herbicides.
- Hand pulling can be used to control small infestations.

Mechanical: Small infestations can be controlled by hand digging. Sulfur cinquefoil cannot be controlled by mowing. When mowed monthly, sulfur cinquefoil develops bulky, spreading roots (FEIS 1996).
Fire: No information available.
Herbicides: Picloram is the most consistently effective and cheapest herbicide for the rosette stage through fall (Duncan 1993). Picloram (0.25 acid equivalent/ac) applied in fall or spring up to the late bud stage will provide several years of control (Rice 1999). A combination of 2,4-D and picloram (Grazon P+D™) can also be used to control sulfur cinquefoil (FEIS 1996). Repeated applications may be necessary. Sulfur cinquefoil is not damaged by clopyralid, therefore if clopyralid is applied to control other weed species sulfur cinquefoil may expand, filling in space occupied by the other weeds.
Cultural/Preventive: In cropland, sulfur cinquefoil can be controlled through frequent plowing.

Integrated Management Summary

Sulfur cinquefoil is a competitive weed that uses its early emergence to establish itself and push out desirable vegetation. It has even been observed to out-compete other noxious weed species. It is not a serious problem in cropland because it does not tolerate frequent plowing. This species is not yet widespread in Colorado, and should be a priority for immediate eradication if found. Small infestations can be controlled by hand pulling, but larger stands are commonly controlled with herbicides. Management programs for sulfur cinquefoil should focus on improving the competitiveness of other more desirable species, and preventing the spread of this weed.

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=List B

Dalmatian toadflax

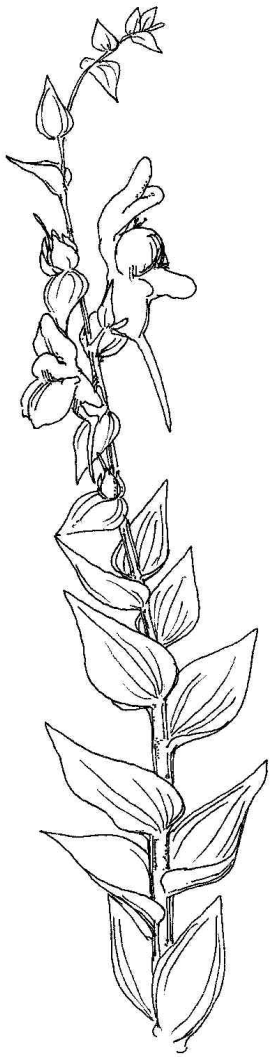
Linaria dalmatica (L.) Miller;
Linaria genistifolia ssp. ***dalmatica*** (L.) Marie and Petitmengin

Family: ***Scrophulariaceae*** (Figwort)
Other Names: broad-leaved toadflax, wild snapdragon
USDA Code: LIDAM
Legal Status: Colorado Noxious List B (top 10 worst)

Keys to Identification:
- Dalmatian toadflax can be easily identified by its bright-yellow, snapdragon-shaped flowers.
- Dalmatian toadflax can be distinguished from yellow toadflax by its larger flowers and more ovate leaves (rather than the linear, somewhat pointed leaves that are characteristic of yellow toadflax).

Identification

Growth form: Perennial forb.
Flower: Flowers are borne in loose, elongate, terminal racemes. Flowers are bright yellow and resemble snapdragons.
Seeds/Fruit: Fruits are egg-shaped to nearly round capsules. Seeds are sharply angular, and slightly winged.
Leaves: Leaves are broad, ovate to ovate-lanceolate, and are alternate, generally clasping but crowded.
Stems: Mature plants are up to three feet tall. A single toadflax plant contains from 1-25 vertical floral stems. which are thick-walled and somewhat woody.
Roots: The taproot may penetrate one meter into the soil. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.



Similar Species

Exotics: Yellow toadflax *(Linaria vulgaris)* is similar in appearance, but has more linear pointed leaves, and is generally a smaller plant.
Natives: None known.

Impacts

Agricultural: Low-till cultivation practices have contributed to the resurgence of toadflax populations on agricultural lands (McClay 1992). Dalmatian toadflax contains a glucoside, a quinoline alkaloid, and peganine which make it toxic to livestock (Rees et al. 1996). However, Dalmatian toadflax is generally considered unpalatable, and reports of livestock poisonings are rare.
Ecological: Dalmatian toadflax is a persistent, aggressive invader and capable of forming colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering the species composition of natural communities. New infestations of Dalmatian toadflax can occur in naturally occurring disturbances or in small openings in pristine or excellent-condition rangeland (Lajeunesse 1999). Dalmatian toadflax can rapidly colonize open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. Toadflax can significantly reduce crop yields and stress native communities. In one study, toadflax-free plots produced 2.5 times more grass than plots where toadflax was present (Robocker 1974). The seedlings of toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established both species of toadflax suppress other vegetation mainly by intense competition for limited soil water. Mature plants are

particularly competitive with winter annuals and shallow-rooted perennials (Robocker 1974).
Human: No information available.

Habitat and Distribution
General requirements: Dalmatian toadflax can adapt its growth to fit a wide range of environmental conditions, and is tolerant of low temperatures and coarse-textured soils.
Distribution: In Colorado, Dalmatian toadflax is commonly found between 5,000 to 6,500 feet in oak, aspen, sagebrush, mountain brush, and riparian communities. It can be found growing up to 9,000 feet (A. Green, pers. comm.).
Historical: Native to Mediterranean region.

Biology/Ecology
Life cycle: Spring emergence occurs about mid-April and depends primarily on temperature. During the first year the plant forms a rosette and develops a deep root system. Prostrate stems emerge in September and produce ovate leaves. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong upright floral stems that characterize mature toadflax plants develop after a winter's dormancy, and emerge about the same time as new seedlings in mid-April. A single plant will produce from 1-25 floral stems. Flowering occurs from May-August and seeds mature from July-September. Dalmatian toadflax can also reproduce vegetatively. Stems develop from adventitious buds on primary and lateral roots. Vegetative reproduction from root buds can occur as early as 2-3 weeks after germination, and is possible from root fragments as short as 1 cm in length (Zimmerman 1996). These buds can grow their own root and shoot systems, and become independent plants the next year. In addition to promoting growth, the large, deep, root systems of Dalmatian toadflax exploit water efficiently. The taproot may penetrate 3-4 feet into the soil and lateral roots may be 6-12 feet long.
Mode of reproduction: By seeds and vegetatively
Seed production: A mature Dalmatian toadflax can produce up to 500,000 seeds annually (Morishita 1991).
Seed bank: Seeds may remain viable in the soil for up to ten years.
Dispersal: Seeds are winged, and wind-dispersed.
Hybridization: No information available.

Control
Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on Dalmatian toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.

Keys to Control:
- Maintain a dense cover of vigorous perennial plants.
- Picloram, dicamba, and glyphosate are effective when applied during flowering.
- Hand pulling is effective for small areas, especially in sandy soils.

Mechanical: Cutting or removal of the above ground portion of toadflax plants reduces the current year growth, but it will not kill the plant. Cutting toadflax stands in spring or early summer is an effective way to eliminate plant reproduction through seed production and dispersal. However, the long dormancy of toadflax seeds requires that the process be repeated annually for up to ten years. Hand pulling toadflax before seed set each year can be an effective control method. The hand pulling experiment on The Nature Conservancy's Magnusson Butte Preserve in Washington showed that toadflax can be significantly reduced by pulling once a year as long as new seed is eliminated. Again, this method must be repeated annually for up to ten years to completely remove a stand. Sheep can help suppress Dalmatian toadflax infestations and reduce seed production. The sheep showed no ill effects from eating toadflax and showed good weight gain (Lajeunesse 1999).
Fire: No information available.
Herbicides: Herbicides have highly variable effects on Dalmatian toadflax, probably due to its high genetic variability. Fall applications of picloram 0.5-1.0 lb. ai/acre has provided excellent control for one year. However, the higher concentrations of picloram may be injurious to desirable plants, plus picloram has been ineffective on some sites. A tank mix of picloram + 2,4-D controlled over 90% of Dalmatian toadflax when applied pre-bloom or in the fall. A six-year study found that phenoxypropionic herbicides such as diclorprop were more effective at controlling toadflax than phenoxyacetic herbicides such as 2,4-D (Robocker 1968). 2,4-D, MCPA, MCPB, and mecoprop used alone do not control toadflax.

Cultural/Preventive: Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. Discing can be an effective method of toadflax control on agricultural lands. This method requires at least two years with eight to ten cultivations in the first year, and four to five cultivations the second year (Morishita 1991). Weed control should be accompanied by reseeding with a variety of plant species to occupy the site so as to prevent re-establishment of toadflax. An ideal mix of species would include cool- and warm-season plants as well as plants that root at a variety of depths. For example, shallow rooted, cool-season species such as Sandberg bluegrass (*Poa secunda*) compete with toadflax seedlings.

Integrated Management Summary

Management of Dalmatian toadflax must focus on both reducing the rate of vegetative spread and reducing seed production (Lajeunesse 1999). Successful management requires integrating as many control tactics as possible. Dalmatian toadflax has high genetic variability, and local populations can respond differently to control actions, especially herbicide treatments. Successful control can be obtained by pulling, or killing the plants with herbicide before toadflax seed production begins (Carpenter and Murray 1998). Since the plant also spreads through vegetative propagation, and the seeds can remain dormant for up to ten years, this process must be repeated every year for at least ten years to completely remove a stand. Competitive perennial grasses and forbs should be planted to utilize water and nutrients that would otherwise be readily available to toadflax.

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=List B

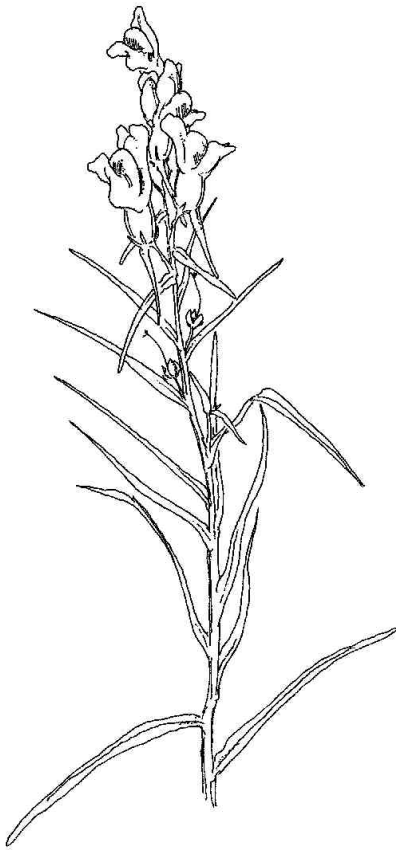
Yellow toadflax

Linaria vulgaris P. Miller

Family: *Scrophulariaceae* (Figwort)
Other Names: butter and eggs, wild snapdragon, common toadflax
USDA Code: LIVU2
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- Yellow toadflax can be identified by its yellow, snapdragon-like, flowers and disagreeable turpentine-like scent.
- It can be distinguished from dalmation toadflax by its leaves. The leaves of yellow toadflax are narrow, lance-shaped, and pointed at both ends. The leaves of dalmation toadflax are shorter, wider, and broad-based.

Identification
Growth form: Perennial forb
Flower: Flowers are bright yellow and resemble snapdragons. Flowers are arranged in a raceme at the ends of the branches.
Seeds/Fruit: Seed capsules are round-ovate, 0.3-0.5 inches long, and two-celled. Seeds are brown or black, circular, and surrounded by a notched wing.
Leaves: Leaves are soft, lance-shaped, and pale green. Leaves are mainly alternate but lower leaves appear to be opposite due to crowding.
Stems: Mature yellow toadflax plants are 1-3 feet tall with 1-25 smooth erect floral stems.
Roots: Taproots may be up to a meter in length. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.
Other: Closely related to Dalmatian toadflax *(Linaria dalmatica).*



Similar Species
Exotics: Leaves of Dalmatian toadflax *(Linaria dalmatica)* are shorter, wider, and broadbased, clasping the stem.
Natives: None known.

Impacts
Agricultural: Yellow toadflax contains a poisonous glucoside that is reported to be mildly poisonous to cattle (Morishita 1991). However, the plant is considered unpalatable and reports of livestock poisonings are rare.
Ecological: Yellow toadflax is quick to establish in open sites and is capable of adapting growth to a wide range of environmental conditions. Yellow toadflax aggressively forms colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering and simplifying the species composition of natural communities and reducing forage production for livestock and wildlife.
Human: No information available.

Habitat and Distribution
General requirements: Yellow toadflax has a highly variable habitat that depends on environmental factors such as shading, grazing, and soil type (Saner et al. 1995).

Distribution: Yellow toadflax now occurs throughout the continental United States and in every Canadian province and territory (Saner et al. 1995). In Colorado, yellow toadflax is abundant on the Western Slope, but can be found on the Front Range as well. It is typically found from 6,000 to 8,500 feet, but can be found up to 10,000 feet.
Historical: Yellow toadflax was introduced from Eurasia as an ornamental.

Biology/Ecology
Life cycle: Spring emergence occurs around mid-April and depends primarily on temperature. A smaller flush of seedlings can occur in the fall. Prostrate stems emerge in September and produce leaves that are ovate, 0.9-1.5 inches in size. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong, upright floral stems that are characteristic of mature toadflax plants develop after a winter's dormancy, and emerge about the same time as seedlings in mid-April. Flowering occurs from May through August and seeds mature from July through October (Saner et al. 1995). Yellow toadflax is self-incompatible and relies on insects for pollination. The two most important pollinators are bumblebees and halictid bees (Zimmerman 1996).
Mode of reproduction: Yellow toadflax can reproduce both by seeds and vegetatively. Vegetative reproduction enables a stand of toadflax to spread rapidly. Stems develop from adventitious buds on primary and lateral roots. These buds can grow their own root and shoot system, and become independent plants the next year. Yellow toadflax colonies persist mostly via vegetation means while those of Dalmatian toadflax persist both by vegetative and seed reproduction (Lajeunesse 1999).
Seed production: A mature plant can produce up to 30,000 seeds annually. A single stem has been reported to contain over 5,000 seeds (Saner et al. 1995).
Seed bank: Seeds can remain dormant for up to ten years.
Dispersal: Winged seeds aid wind dispersal. Seeds may also be dispersed by water and ants (Rutledge, 1998).
Hybridization: No information available.

Control

Keys to Control:
- Limit vegetative spread of colonies.
- Destroy seedlings that emerge from the soil seed bank.
- Maintain a cover of native perennial plants to discourage infestation elsewhere.

Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on yellow toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.
Mechanical: Hand pulling toadflax before seed set each year can be an effective control method especially in coarse-textured soils where large portions of the roots can be pulled. However, this method must be repeated as long as there are viable seeds in the soil (up to 10 years). Cutting or mowing yellow toadflax reduces the current year growth and possibly seed dispersal, but will not kill the plant. These techniques are not recommended to control any toadflax species (Lajeunesse 1999).
Fire: Burning is not a recommended control method for yellow toadflax (Saner et al. 1995). The large, deep root system protects the plant from burning. In fact, areas that have been recently disturbed by fire are susceptible to increased toadflax infestation.
Herbicides: Effectiveness of herbicides on both toadflax species is highly variable, reflecting in part their high genetic variability (Lajeunesse 1999). Yellow toadflax is difficult to control with herbicides. Herbicides should be applied during flowering when carbohydrate reserves in the root of the plants are at their lowest. Picloram or dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, will kill yellow toadflax plants in some situations. 2,4-D, MCPA, 2,4-DB, MCPB and mecoprop are ineffective on yellow toadflax (Lajeunesse 1999). Picloram+2,4-D at 0.5+1.0 lb. ai/acre (as Grazon P+D®) controlled 95-100% of yellow toadflax when applied for 1-3 consecutive years (Sebastian and Beck 1999).
Cultural/Preventive: In agricultural areas, miminum-till cultivation practices have contributed to the resurgence of toadflax populations (McClay 1992). By not tilling the soil, and subsequently damaging the root system of toadflax plants, toadflax colonies have been able to flourish. Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. This requires at least two years with 8-10 cultivations in the first year and 4-5 cultivations in the second year (Morishita 1991).

Integrated Management Summary

Yellow toadflax rapidly colonizes open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. The seedlings of yellow toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established, yellow toadflax suppresses other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials.

The key to controlling yellow toadflax is to limit vegetative spread of established colonies (by cutting, pulling, or spraying seed stalks prior to seed set, or by using insects to destroy flowers, seeds, or damage plants). Once current seed production has been controlled, toadflax seedlings that emerge from the soil seed bank must be destroyed every year until the seed bank is diminished.

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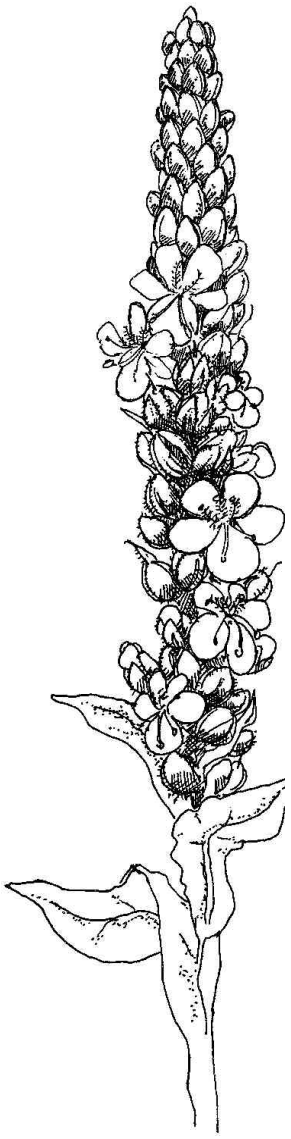
Common mullein

Verbascum thapsus L.

Family: *Scrophulariaceae* (Figwort)
Other Names: flannel leaf, fleawort, Jacobs staff
USDA Code: VETH
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Mullein can be easily identified by its yellow flowers grouped in a "corn cob" shaped flowering raceme.
- The leaves of mullein are alternate, overlapping, and densely wooly.

Identification
Growth form: Biennial forb
Flower: Flowers are 1 inch in diameter, five-lobed, and sulfur yellow in appearance. Flowers are grouped in a "corn cob"-shaped flowering raceme.
Seeds/Fruit: Many-seeded capsules, with small cylindrical seeds. Seeds have numerous ridges and grooves.
Leaves: Leaves are alternate, overlapping, light-green, and densely woolly. The rosette leaves are covered with soft, fine hairs.
Stems: Mature plants have a single, stout, erect, stem which can grow up to 6 feet in height (Whitson et al. 1996). The stem is longitudinally ridged by the bases of leaves that continue down the stem beyond the point of attachment. The stem is densely woolly with branched hairs.
Roots: Taproot.
Seedling: Produces a rosette the first year.



Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Common mullein is not considered palatable to livestock due to its woolliness. Common mullein is not considered a serious agricultural weed since it can be controlled by cultivation (Gross and Werner 1978).
Ecological: If mullein seeds are already present in the soil, mullein seedlings are likely to be the initial colonists in newly disturbed sites because the seeds are viable for decades (Hoshovsky 1986). If the seeds are not present when the disturbance occurs or when a field is abandoned, then the limited dispersal ability of the seeds will probably not enable mullein seeds to arrive and establish while bare ground is still available (Hoshovsky 1986). Common mullein can be hard to control due to its prolific seed production (Gross and Werner 1978). It is easily outcompeted in areas with a densely vegetated ground cover but readily grows in disturbed sites (Hoshovsky 1986). It is an ephemeral plant, which is eventually displaced by other plants in undisturbed sites (Hoshovsky 1986).
Human: No information available.

Habitat and Distribution
General requirements: Common mullein is commonly found throughout Colorado in pastures, meadows, fencerows, waste areas, and along river bottoms. Common mullein prefers dry, gravelly to sandy, coarse-textured soils (Gross and Werner 1978).
Distribution: Common mullein is found throughout Colorado from 4,500 to 9,500 feet, and is also common throughout temperate parts of North America (Rutledge and McLendon 1998).

Historical: Common mullein is native to Eurasia and was probably introduced to America as a medicinal herb. For centuries, mullein has been used as a remedy for coughs and stomach ailments. Aristotle recorded it as a fish poison and a methanol extract from the plant has been effective against mosquito larvae (Hoshovsky 1986).

Biology/Ecology

Life cycle: Seeds of common mullein germinate in the early spring, forming a rosette that continues to grow into late autumn and over winter (Gross and Werner 1978). The following spring the plant produces a tall stem topped with a flowering raceme. Flowering and seed production occur from June to August.
Mode of reproduction: Reproduces by seeds.
Seed production: Common mullein may produce 100,000 to 180,000 seeds per plant (Hoshovsky 1986).
Seed bank: Seeds may remain viable for 100 years (Hoshovsky 1986).
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: A curculionid weevil (*Gywmnaetron tetrum*), that is specific to common mullein has been introduced to America and is capable of reducing seed production by 50% (Hoshovsky 1986).
Mechanical: Mullein can usually be controlled using mechanical methods. Plants should be pulled as soon as they are large enough to grasp but before they produce seeds. Plants are best pulled after a rain when the soil is loose. Mullein stems can be cut or mowed to prevent flower and seed production. Stems must be cut below the root crown or rosettes will re-bolt.

Keys to Control:
- Manually remove plants before flowering.
- Maintain a dense cover of native vegetation and minimize the availability of bare soil.

Fire: Mullein is often an early invader of burned areas; fire is not recommended as a control method.
Herbicides: Metsulfuron at 0.6 oz. ai/acre, applied at very early bolt stage provides good control. Tebuthiuron at 4-6 lb. ai/acre has been reported to achieve long-term control of common mullein (Hoshovsky 1986). Repeated applications of tebithuron at half the initial rate will suppress regrowth (Hoshovsky 1986). Adding a surfactant to the herbicide mixtures will help penetrate the woolly hairs of mullein plants and increase the effectiveness of the treatment.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

As with other plants which reproduce solely by seed, integrated management efforts must include the elimination of seed production and the depletion of the seed bank. Combine herbicide or mechanical removal of rosettes with removal of seed heads from any plants that have bolted. Revise land management practices to promote the health of native plant comminities.

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Black henbane

Hysoscymas niger L.

Family: *Solanaceae* (Nightshade)
Other Names: insane root, stinking nightshade, fetid nightshade, hog's beam
USDA Code: HYNI
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Black henbane can be identified by its brownish-yellow flowers that have a network of purple veins.
- Black henbane has a characteristically foul odor.

Identification
Growth form: Biennial forb.
Flower: Flowers are brownish-yellow in appearance with dark purple veins, and are borne on long racemes in the axils of the upper leaves.
Seeds/Fruit: Fruits are approximately 1 inch long, five-lobed, and clustered on two rows that emerge in the fall. Each fruit capsule contains hundreds of tiny seeds. Seeds are kidney-shaped to oval, brownish-gray to black, and pitted.
Leaves: Leaves are alternate, coarsely toothed to shallowly lobed and pubescent with a characteristically foul odor (Whitson et al. 1996).
Stems: Mature plants are coarse, hairy, and 1-3 feet tall.
Roots: No information available.
Seedling: The large rosettes have serrated leaves that are covered with fine hair.
Other: Foliage has a pungent, foul odor at all growth stages.


Fruits

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Black henbane is poisonous to livestock. However, because of the foul odor of the plant, livestock will seldom graze it, and few cases of livestock poisonings have been reported (Morishita 1991).
Ecological: Black henbane usually establishes on disturbed or heavily grazed sites where it competes for moisture and nutrients with desirable plants.
Human: All parts of the plant are potentially poisonous.

Habitat and Distribution
General requirements: Black henbane is commonly found in pastures, fence rows, roadsides, waste places, and riparian areas. It does well in most soils, and will grow in a variety of environmental conditions. Black henbane growth is enhanced by increased levels of soil nitrogen (Morishita 1991).
Distribution: Black henbane is established on the Front Range along lower Boulder Creek (Weber 1976), and is also found on the Western Slope (A. Green, pers. comm.). Black henbane has spread throughout the United States, especially in the Northeast, Midwest, and Rocky Mountains (Morishita 1991).
Historical: Medicinal uses of black henbane date back to the 10th century (Morishita 1991). It has been used as a sedative and narcotic in cases of maniacal excitement, sleeplessness, nervous depressions, and various other ailments (Morishita 1991).

Biology/Ecology

Life cycle: Black henbane usually emerges in May. Black henbane flowers from June to September, with peak flowering usually in July. Two rows of pineapple-shaped fruits appear in the fall.
Mode of reproduction: Reproduces by seed.
Seed production: Each fruit capsule contains hundreds of tiny seeds.
Seed bank: Seeds are highly germinable and will remain viable in the soil for several years.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: There is no evidence of any biological control method for black henbane.
Mechanical: The most commonly recommended method of control is cutting, hoeing, or digging isolated plants before seed production (Morishita 1991). Since black henbane seeds may remain viable for several years, any mechanical control method must be maintained annually.
Fire: No information available.
Herbicides: Herbicides registered for use on black henbane include dicamba, 2,4-D, and picloram. Dicamba and 2,4-D at 1 lb. ai/acre have been effective for season-long control, while picloram at 1 lb. ai/acre provides residual control of germinating seeds the following year (Morishita 1991).
Cultural/Preventive: Maintain a cover of perennial plants. Due the long seed viability of black henbane, control practices must be maintained annually.

Keys to Control:
- Maintain a cover of perennial plants.
- Control black henbane plants before they produce seed.

Integrated Management Summary

Black henbane is usually found on disturbed and overgrazed soils. Therefore, guarding against disturbance and overuse can be a good preventive measure against black henbane. Mechanical control is the most commonly recommended method. Control plants in the spring or early summer (before seed production). A follow-up visit a month after the first treatment is recommended to pick up missed or late bolting plants.

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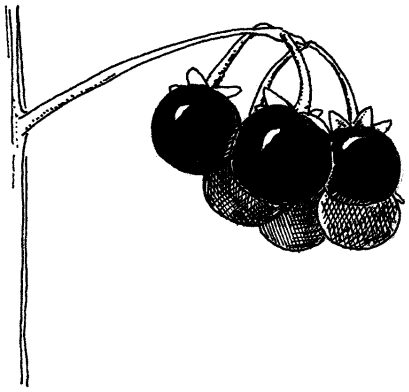
Black nightshade

Solanum nigrum L.

Family: *Solanaceae* (Nightshade)
Other Names: garden nightshade, common nightshade
USDA Code: SONI
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Black nightshade is distinguishable from hairy nightshade (*S. sarrachoides*) by the smooth appearance of the stems and leaves, and the smaller covering (calyx) on top of the berry.

Identification
Growth form: Annual or short-lived perennial forb.
Flower: Flowers are white to pale blue, small (0.25-0.5 inches wide), and are borne in clusters.
Seeds/Fruit: The fruits of black nightshade are green when immature but turn black upon maturity (Basset and Munro 1985).
Leaves: Leaves are alternate, ovate, wavy-edged, and tapered.
Stems: Mature plants range in size from 6 inches to 2 feet tall. Stems and leaves have a smooth appearance.
Roots: Plants have taproots.
Seedling: Seedling leaves are ovate, tapering to a pointed tip.


Fruits

Similar Species
Exotics: Black nightshade is distinguishable from hairy nightshade (*S. sarrachoides*) by the smooth appearance of the stems and leaves, and the smaller covering (calyx) on top of the berry.
Natives: None known.

Impacts
Agricultural: The berries of black nightshade plants frequently become mixed with harvested commodities, decreasing crop quality. The plants also cause problems in harvest operations. The plants form a sticky mass that can quickly plug combine screens and rotors (Basset and Munro 1985). Black nightshade berries have been reported to be poisonous to cattle, sheep, goats, pigs, ducks and chickens (Basset and Munro 1985).
Ecological: No information available.
Human: Can be poisonous to humans, especially if large quantities are consumed.

Habitat and Distribution
General requirements: Black nightshade is found on a variety of soils and climates from sandy/gravelly soils to fertile cultivated soils. Black nightshade does seem to prefer soils that are high in nitrogen. Black nightshade is commonly found on disturbed soils such as roadsides, rights-of-way, overgrazed rangeland, as well as cultivated fields, flowerbeds, and vegetable gardens.
Distribution: Reported from both east and west slope counties in Colorado.
Historical: Native to South America.

Biology/Ecology
Life cycle: Typically, black nightshade plants begin to germinate in spring and continue to germinate through the summer. Flowering begins by mid-June and the berries mature four to five weeks later. Full sunlight is needed for maximum flower initiation (Basset and Munro 1985).
Mode of reproduction: Reproduces by seed.

Seed production: Black nightshade is capable of producing 2,500-5,000 seeds per plant (Basset and Munro 1985).
Seed bank: Seeds can remain viable in the soil for more than 5 years.
Dispersal: The berries and seed of black nightshade are dispersed by rodents, birds, livestock, humans, and along watercourses.
Hybridization: Black nightshade is reported to be able to hybridize with other closely related nightshades (Basset and Munro 1985).

Control

Biocontrol: None known.
Mechanical: The prevention of seed dispersal through mowing, tillage and pulling of plants over the course of several years will help eradication.
Fire: No information available.
Herbicides: Herbicides are commonly used to control black nightshade. Post-emergence application of dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre will provide control of black nightshade. Other effective herbicides include atrazine, cyanazine, or linuron (Basset and Munro 1985).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Avoid soil disturbance and overgrazing livestock.
- Prevent black nightshade from producing seeds.

Integrated Management Summary

Black nightshade seedlings emerge throughout spring and most of the summer and grow rapidly, allowing competition with many crops (Basset and Munro 1985). It has been reported to become troublesome in fields where certain herbicides have been used to control other weeds but are weak on black nightshade (Whitson et al. 1996). As with other plants which reproduce solely by seed, integrated management efforts must include the elimination of seed production and the depletion of the seed bank. Use mechanical or chemical methods to prevent seed production, and revise land management practices to ensure the maintenance of desirable plant cover.

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Hairy nightshade

Solanum sarrachoides (L.) Sendtner **(*Solanum physalifolium*** Rusby**)**

Family: *Solanaceae* (Nightshade)
Other Names: hoe nightshade
USDA Code: SOSA8
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- Hairy nightshade is distinguishable from black nightshade (*Solanum nigrum*) by the hairy appearance of its foliage, and the covering calyx on top of the berry, which covers half of the fruit.

Identification

Growth form: Annual forb.
Flower: The flowers resemble those of the potato and tomato and have five white petals, and an enlarging green calyx (Whitson et al. 1996).
Seeds/Fruit: As the fruit matures, the calyx cups the lower half of the greenish or yellowish fruit (Whitson et al. 1996).
Leaves: Leaves are alternate, egg-shaped (ovate), tapered to the tip, covered with glandular hairs, and may feel sticky when handled.
Stems: Mature plants are 12-24 inches tall, spreading, and freely branching. The stems are light green, round or slightly angular with glandular hairs.
Roots: No information available.
Seedling: The first true leaves of hairy nightshade have wavy edges and prominent veins. The leaves have numerous fine, short hairs, especially along the underside of the main vein (Calweed 1997).

Fruits

Similar Species

Exotics: Hairy nightshade is distinguishable from black nightshade (*Solanum nigrum*) by the hairy appearance of its foliage, and the covering calyx on top of the berry, which covers half of the fruit.
Natives: None known.

Impacts

Agricultural: Hairy nightshade is a common weed of waste places and cultivated fields. It causes problems similar to black nightshade in that its berries frequently become mixed with harvested commodities, decreasing crop quality. Hairy nightshade can cause problems in harvest operations. The plants form a sticky mass that can quickly plug combine screens and rotors (Basset and Munro 1985). The plant contains toxic alkaloids, especially in the berries (Whitson et al. 1996). These berries have been reported to be poisonous to cattle, sheep, goats, pigs, ducks and chickens (Basset and Munro 1985).
Ecological: No information available.
Human: No information available.

Habitat and Distribution

General requirements: Hairy nightshade is found on a variety of soils and climates. It is commonly found on disturbed soils such as roadsides, rights-of-way, overgrazed rangeland, as well as cultivated fields, flowerbeds, and vegetable gardens. Hairy nightshade has been found on sandy/gravelly soils to fertile cultivated soils. It seems to prefer soils that are high in nitrogen.
Distribution: Widely distributed throughout North America.
Historical: No information available.

Biology/Ecology

Life cycle: Typically, hairy nightshade plants begin to germinate in the spring and continue to germinate through the summer. Flowering begins by mid-June and the berries mature four to five weeks later. Full sunlight is needed for maximum flower initiation (Basset and Munro 1985).
Mode of reproduction: Reproduces by seeds.
Seed production: Hairy nightshade is capable of producing 2,500-5,000 seeds per plant (Basset and Munro 1985).
Seed bank: No information available.
Dispersal: The berries and seed of hairy nightshade are dispersed by rodents, birds, livestock, humans, and along watercourses.
Hybridization: Hairy nightshade is reported to be able to hybridize with other closely related nightshades (Basset and Munro 1985).

Control

Biocontrol: No information available.
Mechanical: No information available.
Fire: No information available.
Herbicides: Herbicides are commonly used to control hairy nightshade. A post-emergence application of dicamba at 1 lb. ai/acre will control hairy nightshade. Atrazine, cyanazine, or linuron will also control small seedlings (Basset and Munro 1985).
Cultural/Preventive: The prevention of seed dispersal through mowing, tillage and pulling of plants over the course of several years will help eradication.

Keys to Control:
- Avoid soil disturbance and overgrazing livestock.
- Prevent hairy nightshade from producing seeds.

Integrated Management Summary

Hairy nightshade seedlings emerge throughout spring and most of the summer and grow rapidly. This allows it to compete with many crops (Basset and Munro 1985). It has been reported to become troublesome in fields where certain herbicides have been used to control other weeds but are weak on nightshade species (Whitson et al. 1996). As with other plants which reproduce solely by seed, integrated management efforts must include the elimination of seed production and the depletion of the seed bank. Use mechanical or chemical methods to prevent seed production, and revise land management practices to ensure the maintenance of desirable plant cover.

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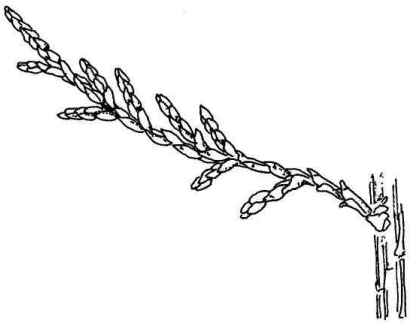
Saltcedar

Tamarix ramosissima Ledeb. and ***Tamarix parviflora*** DC.

Family: ***Tamaricaceae*** (Tamarisk)
Other Names: tamarisk, salt cedar
USDA Code: TARA, TAPA4
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Saltcedar is a tall shrub or small tree that has large sprays of small whitish or pinkish flowers that are born in finger-like clusters.
- Leaves are very small and scaly.

Identification
Growth form: Deciduous, loosely branched shrubs or small trees.
Flower: Flowers are whitish or pinkish and borne on slender racemes 2-5 cm long on the current year's branches and are grouped together in terminal panicles. Petals are usually retained on the fruit.
Seeds/Fruit: The seeds are borne in a lance-ovoid capsule.
Leaves: Leaves are minute, appressed scaly leaves, alternately arranged.
Stems: Branchlets are slender; plants may reach heights of 15 feet or more.
Roots: The primary root can grow to a depth of up to 30 meters or more (Baum 1978). Plants can develop spreading horizontal roots after reaching the water table. These can spread up to 50 meters and are capable of producing adventitious buds (DiTomaso 1996).
Seedling: No information available.



Branch

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: No information available.
Ecological: Saltcedar is an aggressive, woody invasive plant species that has become established over as much as a million acres of the western United States (Carpenter 1998). Saltcedar crowds out native stands of riparian and wetland vegetation. It increases the salinity of surface soil, rendering the soil inhospitable to native plant species. Saltcedar provides generally lower wildlife habitat value than native vegetation. It uses more water than comparable native plant communities and dries up springs, wetlands, riparian areas and small streams by lowering surface water tables. However, in places where beaver dams or other structures have raised the water table, saltcedar can be outcompeted by *Salix exigua* (R. Roberts, pers. comm.) Saltcedar widens floodplains by clogging stream channels and increases sediment deposition due to the abundance of saltcedar stems in dense stands.
Human: No information available.

Close up of leaves

Habitat and Distribution
General requirements: Saltcedar grows well on moist sandy, sandy loam, loamy, and clayey soil textures (FEIS 1996). Saltcedar is tolerant of highly saline habitats, and it concentrates salts in its leaves. Over time, as leaf litter accumulates under saltcedar plants, the surface soil can become highly saline, thus impeding future colonization by many native plant species. Saltcedar is not tolerant of shading. Shaded plants have altered leaf morphology and

reduced reproduction (FEIS 1996). Saltcedar commonly occurs along floodplains, riverbanks, stream courses, saltflats, marshes, and irrigation ditches in arid regions of the Southwest and the Southern Great Plains (FEIS 1996).
Distribution in Colorado: In Colorado, saltcedar is most commonly found between 3,400 to 7,000 feet (FEIS 1996), but can be found up to 8,000 feet (A. Green, pers. comm.). It is widespread in riparian areas throughout the western United States.
Historical: Introduced to North America for use as ornamental, windbreak, and erosion control.

Biology/Ecology
Life cycle: Saltcedar generally flowers in its third year of growth or later, but may flower during the first year (FEIS 1996). Saltcedar buds generally break dormancy in February or March. The flowers are most abundant between April and August, but may be found any time of the year in desert areas. Saltcedar flowers continuously under favorable environmental conditions but the flowers require insect pollination to set seed. Seedlings grow slowly and require saturated soils throughout the first 2-4 weeks of growth (FEIS 1996). Ideal conditions for first-year survival are saturated soil during the first few weeks of life, a high water table, and open sunny ground with little competition from other plants.
Mode of reproduction: Reproduces by seeds as well as vegetatively. Saltcedar sprouts from the root crown and rhizomes, and adventitious roots sprout from submerged or buried stems (FEIS 1996). This allows saltcedar to produce new plants vegetatively following floods from stems torn from the parent plants and buried by sediment.
Seed production: A mature saltcedar plant can produce 600,000 minute seeds annually (FEIS 1996).
Seed bank: Seeds are viable for up to 45 days under ideal conditions during summer, and can complete germination within 24 hours following contact with water (Carpenter 1998). Saltcedar seeds had no dormancy or after-ripening requirements.
Dispersal: The seeds are readily dispersed by wind and water.
Hybridization: No information available.

Control
Biocontrol: The USDA has permitted the release of two species of insects for saltcedar biocontrol but widespread releases have not yet been permitted (A.T. Carpenter, pers. comm.).
Mechanical: As an alternative to herbicides, a bulldozer or prescribed fire can be used to open up large stands of saltcedar. Once opened, the resprouts can be sprayed when they are 1 to 2 m tall using imazapyr, or imazapyr plus glyphosate, or triclopyr.
Fire: See above.
Herbicides: For larger areas (> 2 hectares) that are essentially monotypic stands of saltcedar, the best methods would likely be foliar application of imazapyr herbicide to the intact plants or burning or cutting plants followed by foliar application of imazapyr or triclopyr to the resprouted stems. Foliar application of imazapyr or imazapyr in combination with glyphosate can be effective at killing large, established plants. Over 95% control has been achieved in field trials during the late summer or early fall (Carpenter 1998). The herbicide can be applied from the ground using hand-held or truck-mounted equipment or from the air using fixed-wing aircraft. Foliar application of herbicide works especially well in monotypic stands of saltcedar, although experienced persons using ground equipment can spray around native trees and shrubs such as cottonwood and willow.

Keys to Control:
- Select the appropriate control method based on the size of the area and other environmental or cultural considerations.
- Re-seed controlled areas with desirable species to protect the soil resource and to prevent or retard saltcedar reinvasion.

Saltcedar eradication in areas that contain significant numbers of interspersed, desirable shrubs and trees is problematic. Depending upon site conditions, it may not be possible to rapidly kill saltcedar plants without also killing desirable shrubs and trees. It such situations, it may be necessary to cut and treat saltcedar stumps with herbicide, as outlined in the next paragraph. While this method is relatively slow and labor-intensive, it will spare desirable woody plants. Alternatively, it may be more cost-effective to kill all woody plants at a site and replant desirable species afterward.

For modest-sized areas (< 2 hectares), cutting the stem and applying herbicide (known as the cut-stump method) is most often employed. The cut-stump method is used in stands where woody native plants are present and where their continued existence is desired. Individual saltcedar plants are cut as close to the ground as possible with chainsaws, loppers or axes, and herbicide is applied immediately thereafter to the perimeters of the cut stems. Herbicides must be applied immediately to the cut because wound healing ocurrs very quickly and decreases herbicide penetration. The herbicides triclopyr and imazapyr can be very effective when used in this fashion. This treatment appears to be most effective in the fall when plants are translocating materials to their roots. The efficacy

of treatments is enhanced by cutting the stems within 5 cm of the soil surface, applying herbicide within one minute of cutting, applying herbicide all around the perimeter of the cut stems, and retreating any resprouts 4 to 12 months following initial treatment.

Cultural/Preventive: No matter how effective initial treatment of saltcedar might be, it is important to re-treat saltcedar that is not killed by initial treatment. After saltcedars are killed, other vegetation must be established to protect the soil resource and to prevent or retard saltcedar re-invasion (Frasier and Johnsen 1991). Establishing a canopy cover on treated areas with seeded grasses and planted cottonwood cuttings could reduce the chances of saltcedar successfully re-invading an area (Frasier and Johnsen 1991).

Integrated Management Summary

Saltcedar is native of Eurasia that was introduced as an ornamental and stream bank stabilizer. It is a pioneer species that establishes on freshly exposed alluvium, sand and gravel bars, and streambanks or floodplains after disturbance (FEIS 1996). Once established it often occurs in pure stands, persisting indefinitely in the absence of disturbance (FEIS 1996). It can replace or displace native woody species, such as cottonwood, willow and mesquite, which occupy similar habitats, especially when timing and amount of peak water discharge, salinity, temperature, and substrate texture have been altered by human activities. Saltcedar produces massive quantities of small seeds and can propagate from buried or submerged stems.

Saltcedar can be controlled by five principal methods: 1) applying herbicide to foliage of intact plants; 2) removing aboveground stems by burning or mechanical means followed by foliar application of herbicide to resprouts; 3) cutting stems close to the ground followed by application of triclopyr (Garlon™) to the cut stems; 4) spraying basal bark with triclopyr; and 5) digging or pulling plants (Carpenter 1998).

Selecting an appropriate control method involves considering the size of the area where saltcedar is to be controlled, restrictions on the use of particular herbicides or herbicides generally, the presence or absence of desirable vegetation where saltcedar is growing, the presence or absence of open water, adjacent land uses that might restrict prescribed burning, and the availability and cost of labor (Carpenter 1998).

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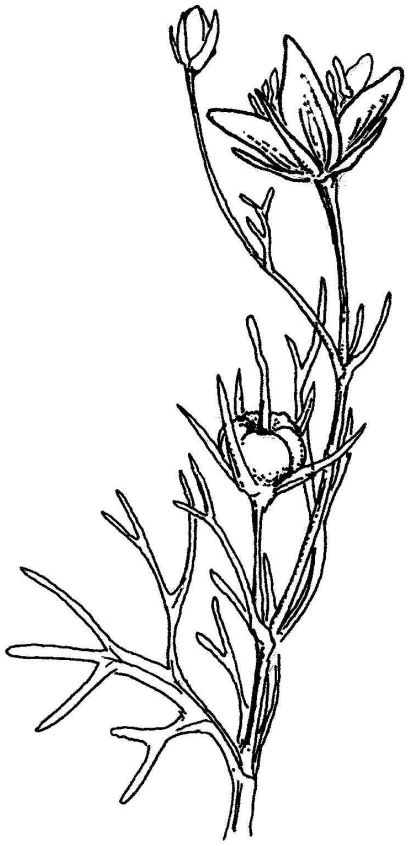
=List C

African rue

Peganum harmala

Family: *Zygophyllaceae* (Caltrop)
Other Names: Syrian rue
USDA Code: PEHA
Legal Status: Colorado Noxious List C (new in Colorado – call your county weed supervisor!)

Keys to Identification:
- The leaves are finely divided in long, narrow segments.
- Flowers are white with five petals.



Identification
Growth form: Perennial forb.
Flower: Flowers are white, have five petals, and are borne along the stem in the leaf forks.
Seeds/Fruit: The fruit is a 2- to 4-celled capsule that contains many seeds. Seeds are angular, dark brown with a distinctive smell.
Leaves: Leaves are alternate, smooth, and finely divided with long narrow segments.
Stems: Mature plants are highly branched and grow 1.5 feet tall and 3-4 feet in diameter.
Roots: No information available.
Seedling: No information available.

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: African rue is toxic to livestock and can replace valuable forage, subsequently reducing the productivity of pasture and rangeland.
Ecological: No information available.
Human: In Africa and Asia, the seeds are used to make dye for carpets and clothes. The seeds also contain harmala alkaloids, which when concentrated, can have a narcotic effect.

Habitat and Distribution
General requirements: African rue is adapted to relatively arid environments.
Distribution: African rue is present throughout New Mexico and is reported in Arizona, Texas, Washington, and Oregon (Whitson et al. 1996). It is not yet known to be present in Colorado but can be expected to first invade the southern reaches of Colorado, particularly along the New Mexico border.
Historical: African rue is a native of north Africa and was first recorded in the United States near Deming, New Mexico in 1928.

Biology/Ecology
Life cycle: Perennial herb.
Mode of reproduction: Reproduces both vegetatively and by seeds.
Seed production: No information available.

Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Pull or dig plants before seed set. Each year, remove any seedlings that arise from the seed bank.
Fire: No information available.
Herbicides: No information available.
Cultural/Preventive: Maintain a healthy cover of perennial plants.

Keys to Control:
- Maintain a healthy cover of perennial plants.
- Re-seed controlled areas with desirable species.

Integrated Management Summary

This species is not yet established in Colorado, and should be a priority for immediate eradication if found. There is little or no information available on the control of African rue. Control efforts should focus on detecting infestations as early as possible and eliminating them. Remove plants before seed set, and dispose of properly.

References

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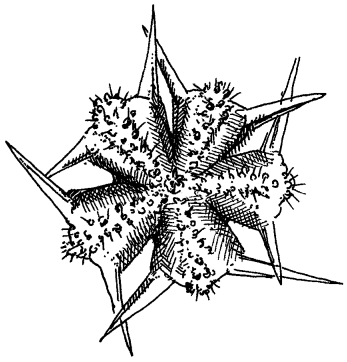
Puncturevine

Tribulus terrestris L.

Family: *Zygophyllaceae* (Caltrop)
Other Names: goathead, bullhead, Mexican sandbur, Texas sandbur
USDA Code: TRTE
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Puncturevine can be identified by its long, mat-forming, trailing stems.
- Mature plants have sharp, spiny burs that contain 2-4 seeds.

Identification
Growth form: Annual forb.
Flower: Flowers are yellow, have five petals, and are borne solitary on short stalks in the leaf axils.
Seeds/Fruit: The sharp-pointed fruits are about 0.5 inch in diameter and break into five sections at maturity. Each section contains 2-4 seeds.
Leaves: Leaves are opposite, hairy, and divided into 4-8 pairs of leaflets. Leaflets are oval and 0.25-0.5 inches long.
Stems: Mature plants have numerous, trailing stems that are 0.5 to 5 feet long.
Roots: Taproot.
Seedling: Seedling leaves are oval with at prominent central groove.



Fruits

Similar Species
Exotics: None known.
Natives: Puncturevine leaves are similar to those of *Caesalpinia* or *Hoffmanseggia* species, but these both have typical pea-family flowers.

Impacts
Agricultural: The hard, spiny burs of puncturevine can damage wool and injure livestock and other animals. Puncturevine can be toxic to livestock, especially sheep (WSU 1999).
Ecological: Forms dense mats on open ground.
Human: Notorious as a cause of bicycle tire punctures.

Habitat and Distribution
General requirements: Puncturevine commonly grows along roads, in pastures, cultivated fields, and waste places. It can grow in compacted soil, sandy or moist soils, and rich soils (WSU 1999).
Distribution: Puncture is common in eastern Colorado up to 6,500 feet (CWMA 1999), and is widely scattered across much of the United States.
Historical: Puncturevine is a native of southern Europe.

Biology/Ecology
Life cycle: Puncturevine begins germination soon after the first spring/summer rains of the season, and will germinate after any wet period. Flowering and seed production occur from July to October (Whitson et al. 1996). Flowers are only open in the morning.
Mode of reproduction: Reproduces by seeds.
Seed production: No information available.
Seed bank: Seeds may remain dormant in the soil for 4-5 years (Whitson et al. 1996).
Dispersal: Spiny burs are easily spread by attaching to animals, people, or tires.
Hybridization: No information available.

Control

Biocontrol: There are two insects: *Microlarinus lareynii*, a stem-boring weevil, and *M. lypriformus*, a fruit-boring weevil, that have been released in Colorado as biological controls of puncturevine. For more information regarding the availability of these species contact the Division of Plant Industry's Biological Pest Control Section.

Keys to Control:
- Eliminate seed production and destroy any new seedlings.
- Re-seed controlled areas with desirable species.

Mechanical: Puncturevine can be controlled by digging, hand pulling, or tilling infestations before flowering and seed production.

Fire: No information available.

Herbicides: Picloram or dicamba at 0.25 lb. ai/acre, 2,4-D at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, can be applied to plants during the seedling stage.

Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

This plant is hard to control due to its mat-forming behavior, which makes several control methods difficult, as well as its long seed dormancy in the soil. Use a combination of methods to eliminate seed production and destroy new seedlings.

References

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