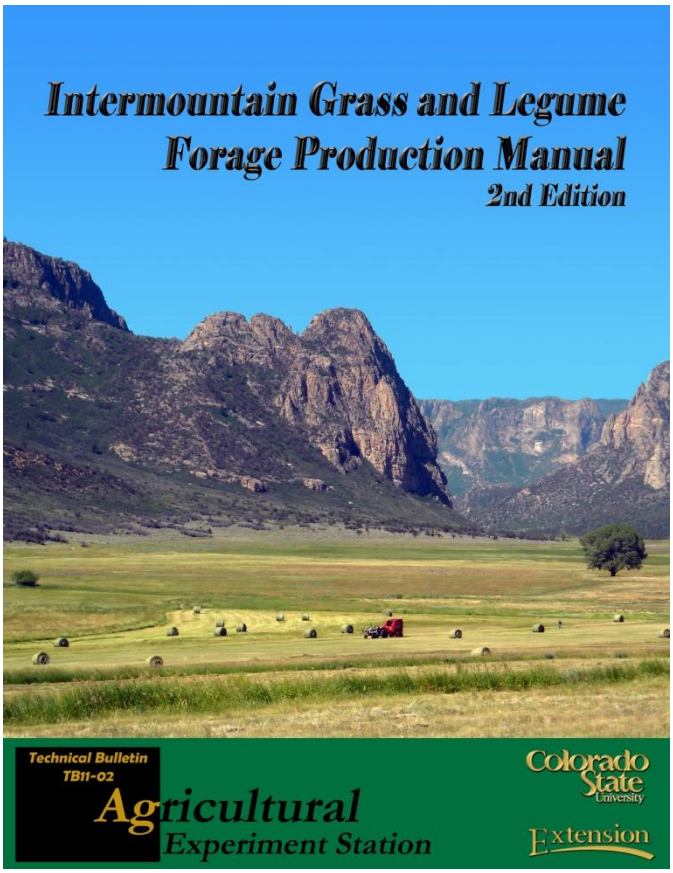

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Section I

Irrigated Pasture/Mountain Meadows

Chapter 5

Weed Management in Grass Pastures and Hayfields

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Weed Prevention and Control

Weeds compete against newly seeded or established grasses and will reduce pasture quality, yield, and overall productivity and profitability. By promoting forage health and vigor, pastures are more competitive against weeds. This is crop management, not weed management. Controlling weeds does not necessarily mean an increase in forage yield. As a rule though, every unit of weeds produced, reduces forage by an equivalent amount. If available resources are used to make the crop grow better, rather than sustaining weeds, a yield increase can be expected and the impact of weeds should be reduced. It is important that the forage species and variety be carefully selected for the site and the grazing objectives. Then fertility, soil pH, irrigation, drainage, grazing management, mowing, and periodic overseeding all have the potential to positively influence crop growth and the ability of grasses to compete with weeds.

The best results are achieved by controlling weeds before establishing new grass stands

Grasses are a moderately deep rooted perennial crop and, once established, can compete well with annual weeds and to some extent with perennial weeds, but this is no guarantee that perennial grasses will eliminate perennial weeds. During establishment, perennial grasses do not compete well with annual weeds because the grasses tend to have lower seedling vigor than weeds. Established perennial weeds have deep, well developed root systems that can produce very competitive plants much sooner than grass seedlings. Consequently, established patches of perennial weeds generally reduce establishment of newly seeded grass, resulting in sparse or open spaces where grasses are less competitive and weeds thrive. Controlling weeds before establishing new grass stands is key to achieving the best results!

Without proper management, broadleaf weeds can directly compete with forage grasses to reduce their nutritional value and longevity. Weeds can replace desired grass species, filling in gaps or voids that reduce yield and overall quality of the hay or pasture. Biennial and perennial weeds are often the most significant weed problems for grass hay and pasture producers. Both biennials and perennials produce seed each year, potentially starting new infestations. In addition, creeping perennial weeds reproduce from underground roots or rhizomes. Perennial rooting structures can survive for several years in the soil and are often unaffected by occasional mowing or livestock grazing.

Good cultural practices, including maintaining optimum soil fertility, using a suitable cutting schedule for grass forages, and rotational grazing and periodic mowing in grass pastures, can help keep a crop competitive against weeds. A critical time for weed control is during the establishment year. If interseeding is used, be sure the

existing vegetation is adequately controlled. In general, use pre-plant tillage or herbicides, companion seedings, mowing, and/or a postemergence herbicide to ensure that weeds are not a problem during the establishment year.

Weed control can be accomplished in many cases with use of herbicides, depending on the weed species present. Broadleaf perennial weeds can generally be chemically controlled with little or no injury to the grass crop. However, a relatively clean, weed-free field and seedbed is still the best first step in establishing or maintaining a competitive pasture. A clean seedbed needs to be followed by good management practices relating to fertility, irrigation, and harvesting as well as control of weeds, diseases, and insects to maintain a productive and competitive pasture for years to come.

Several herbicides are labeled for broadleaf weed control in grass hayfields and pastures, but not all allow cutting the grass for hay, and most herbicides have grazing restrictions. Weed control in grass pastures is limited to controlling broadleaf weeds and is generally accomplished with postemergence, translocated herbicides. These herbicides are absorbed by the foliage and move within the plant. As a result, they may produce a toxic effect a considerable distance from the point of entry. As might be expected, postemergence applications are greatly affected by the age of the weeds and the growing conditions. As a general rule, postemergence herbicide applications should be made when the weeds are young and/or actively growing because they are easiest to control then. Adverse environmental conditions such as hot, dry weather before herbicide application make postemergence applications less effective than when applied during warm, moist weather. In addition, rainfall shortly after postemergence applications may reduce the effectiveness of the herbicide.

For control of summer annual weeds such as common lambsquarters, translocated herbicides should be applied to the foliage of seedling plants in the spring or early summer. The rosettes of winter annual weeds such as shepherdspurse should be treated in the fall or early spring. Most problem weeds in grass pastures are either biennial or perennial broadleafs. Postemergence treatments for biennial weeds such as common burdock, or simple perennials such as dandelion, should be applied to the rosettes in the fall or early spring before these plants bolt (send up a flower stalk).

Postemergence herbicide applications are most effective when weeds are young and/or actively growing

Foliar treatments for creeping perennial weeds such as common milkweed must be made when they are actively growing and have a large leaf area. The ideal time for treating them is after they have reached the bud stage in mid to late summer. During this period, they have their maximum leaf area and are storing food reserves for the winter. Translocated herbicides applied during this period are absorbed by the leaves and moved into the underground reproductive and storage organs with the food reserves. Because the herbicides recommended for broadleaf weed control in pastures will kill legumes, they should not be used if legumes are present. In all cases, grazing and haying restrictions on the labels must be followed carefully.

Weed Life Cycles and Treatment Timing

Timing is one of the most critical aspects of successful weed control. Regardless of which control methods are used, implementing those methods at the correct stage of weed development will increase the chances

for successful control in the shortest period of time and with the least cost.

Methods differ by weed growth habit. The ideal time to mechanically or chemically control **annual (winter or summer), biennial (a plant requiring two years to complete its life cycle before it dies), or simple perennial weeds** is prior to flower stalk initiation when the weed is a small seedling or in the rosette stage (growing close to the ground). Weeds are easier to eradicate at this stage because there are few reserves for the plant to use in regrowth and this early treatment also eliminates seed production which helps to decrease the weed seed bank in the soil. **Creeping perennials** are plants that spread primarily by stolons, rhizomes, or underground lateral root systems once they are established. The general rule for chemically controlling creeping perennials is to treat at the bud to flower stage or in the fall. These two stages of development are when chemicals are best translocated to the root system. The definition of "fall" will vary considerably, depending on elevation and the weed species being targeted. This period can be anywhere from late August to sometime in November. Canada thistle is an exception in this class of weeds. It is most effectively treated in early growth stages before bud set as well as in the fall.

For most weed species, as long as green tissue is present, chemical applications in the fall should provide an adequate level of control. For example, if at least 50% of field bindweed plants are still green, control can be effective. For weed species such as Russian knapweed, plants can be treated with an effective herbicide well into winter and still achieve excellent control. As long as latex is still present in the shoots of leafy spurge, late fall applications with an appropriate herbicide can be effective. Thus, fall herbicide application are effective, but specific recommendations should be obtained for the particular weed species.

The general rule for chemically controlling creeping perennials is to treat at the bud to flower stage or in the fall

Note: Mechanically controlling creeping perennials by tillage or hand-weeding normally requires 5 to 8 years for adequate control, making it a poor choice for forage production operations (timing for mechanical control measures of creeping perennials is completely different than when chemicals are used). With mechanical control, the vegetative growth of any class of weeds should be removed shortly after emergence and as many times as any new growth emerges during the season. Plants use stored carbohydrates in the root system to emerge; therefore, by never allowing the vegetative growth to have time to restore carbohydrates to the root system, the plant will eventually be killed. Tillage at the third leaf stage can accomplish this goal.

For specific herbicide recommendations and local environmental conditions, consult your local Extension office.

Competition

Weed competition in pasture systems has not been studied extensively. Without question, weeds can compete directly with forage grasses or pasture to reduce their nutritional value and longevity. However, the impacts of weed species, density, and soil and climatic factors are not well established in pasture systems. In general, biennial and perennial weeds pose the biggest problems for pasture producers. Both biennials and perennials produce seed each year, potentially starting new infestations. Perennial rooting structures can survive for several years in the soil and are often unaffected by occasional mowing or livestock grazing. Pasture-invading weed species should be assessed for their competitive ability, or their poten-

tial to reduce desired forage species; their invasiveness—their potential to multiply and increase; their yield, quality, and nutritive value relative to desired forage species; and the cost and effectiveness of control measures—cultural, mechanical, and chemical.

General aspects about weed competition in forages include: Assess a weed's competitive ability, invasiveness, nutritive value, and potential for control. Weeds that emerge with the crop in the spring are generally more competitive which leads to reduced establishment and yields. Control problem weeds during the first 60 days after seedling establishment. Weeds that emerge beyond 60 days after establishment will have little influence on that year's forage yield. Later-emerging weeds may still influence forage quality. Winter-annual weed competition in early spring is most damaging to early-season forage yield. Broadleaf weeds that are biennial or perennial are generally more competitive than grassy weeds.

Prevention is the most important tool for managing weeds

Weed Management

Managing weeds in pasture systems begins long before crop establishment. Certain types of weeds are potentially serious problems in forage production, so it is important to eliminate them in advance. If these weeds are not removed before the seeding is made, they can persist for many years. The cost of controlling weeds before or at the time of seeding should be considered an investment that will return dividends over the life of the stand.

Cultural Management

Cultural practices that aid in weed control include anything that makes the crop more competitive against weeds. In the establishment year, these measures include: preparing the seedbed properly, planting on the optimum date, fertilizing properly, planting at the proper seeding rate (**Note:** increasing the seeding rate above the recommended rate can be beneficial), choosing high quality crop seed that is free of weeds, and selecting adapted species and varieties for the planting conditions in the region. In general, perennial grasses are more competitive against weeds than legumes. Provide a seedbed at planting that is free of live weeds. A weed-free seedbed can be achieved using either tillage or a burndown herbicide. It is important that emerging forage species do not compete for limited resources as they establish in the early weeks after planting. In addition, emerged vegetation can harbor insects or pathogens that could attack young, susceptible forage seedlings. Date of planting can influence the weeds that emerge. Most grass and legume forage species are relatively slow to establish. Consider spring versus fall establishment based on weed history and when you might anticipate weed problems. For example, if the field has been planted to corn or other summer annual crops, then summer annual weeds will likely be the biggest weed threat during establishment. Late summer may be a better time for establishment in this situation. In spring seedings, plant early before summer annuals emerge to give the new forage seedlings an advantage. With late summer seedings, plant before September, the month during which winter annual weeds generally begin to emerge. The dominant weed species in a field, along with its potential severity, may help determine the best time for planting.

In established pasture systems, prevention is the most important tool for managing weeds. Research shows that pasture weeds can be controlled by increasing forage competition. In fact, crop growth rate stands as the single best measure of plant response to weed competition in forages. Maintaining a dense, competitive forage stand is key to preventing weed invasion and interference.

Weeds are opportunistic. Germination and establishment are favored by open areas and disturbance. Overseed with desirable forage species when necessary to keep open areas at a minimum. Rotationally graze to keep traffic effects minimal, and do not overgraze to ensure that forages remain competitive with weeds. Test soils for nutrients and annually fertilize to keep forage stands healthy and competitive. Control harmful insects or pathogens when necessary—they weaken forage stands and give weeds the opportunity to establish. Develop monitoring programs to locate infestations and place priority on controlling small infestations so they do not expand. Preventing weed infestations also means preventing dispersal of seeds or vegetative plant parts into non-infested areas.

Between 5% and 15% of weed seeds pass safely through the digestive system of ruminants such as sheep, goats, cattle, and deer

Vehicles, equipment, humans, wind, water, birds, wildlife, pets, and livestock can spread weed seeds. Animals may disperse seeds by picking them up in their coats or fur, or between the pads of their feet. Cattle have been shown to readily pick up burs of several weeds when grazing forested range. Clean infested animals regularly, particularly new animals that may be carrying new weed problems. Ruminants also ingest weed seeds in the field—between 5 and 15% pass safely through sheep, goats, cattle, and deer. Be cautious of feed or hay infested with noxious weed seed. In the western United States, certified weed-seed-free forage is required on public lands by federal land agencies.

Key points on weed management:

1. When establishing a new pasture or hayfield, consider seedbed preparation, planting date, fertilization, seeding rate, using high-quality seed, and selecting adapted species and varieties.
2. In established pasture systems, prevention is the most important tool for managing weeds.
3. Overseed with desirable forage species when necessary to minimize open areas (i.e. bareground).
4. Rotationally graze to keep traffic effects minimal and do not overgraze.
5. Test soils for nutrients and fertilize as needed to keep forage stands healthy and competitive.
6. Prevent dispersal of seeds or vegetative structures into non-infested areas.

Mowing and Hand Removal

Once forages are well established, regular mowing helps to control weeds. Repeated mowing reduces the competitive ability of weeds, depletes carbohydrate reserves in their roots, and prevents them from producing seed. Some weeds, mowed when they are young, are readily consumed by livestock. Mowing can kill or suppress annual and biennial weeds. It can also suppress perennials and may restrict their spread. Mow at a height above the grass seedlings when weeds are 8 to 10 inches in height to reduce shading created by weeds. A single mowing will not satisfactorily control most weeds. However, mowing three or four times per year over several years can reduce and sometimes eliminate certain weeds, including Canada thistle. Also, mow along fences and borders to help prevent the introduction of new weeds. Regular mowing helps prevent weeds from establishing, spreading, and competing with desired grasses and legumes.

Hand removal may be the preferred way to control some weeds. When you see a po-

tential new weed, dig it, pull it, or remove the seedheads before seeds can disperse. This technique works particularly well for annuals and biennials if the infestation is small with only a few plants present. For perennials, it may be difficult to remove all vegetative structures effectively. Properly dispose of weeds after removal to prevent seed or vegetative structure dispersal. This may require burning, burying, or transporting the weeds to local landfills.

Key points about mowing and hand removal:

1. Repeated mowing reduces competitive ability, depletes root carbohydrates, and prevents seed production.
2. Mow at a height above the grass seedlings when weeds are 8 to 10 inches tall to reduce shading.
3. If you see a new weed, dig it, pull it, or remove the seedheads before seeds can disperse.

Most herbicides for broadleaf control in grass pasture systems should *not* be applied to seedling forage grasses until visible tillers are present (3rd to 4th leaf stage)

Herbicides

Herbicides provide a convenient, economical, and effective way to manage weeds. They allow fields to be planted with less tillage, allow earlier planting dates, and provide additional time to perform other tasks on the farm. Herbicides are not the only weed control tool, but without their use, mechanical and cultural control methods become that much more important. In pasture systems, a number of herbicides are available for broadleaf weed control in grass forages. Few are available for grass-legume mixtures or for the control of grassy weeds in grass forages. Before establishment, herbicide choices are limited to those used for controlling emerged vegetation. Preplant, soil-incorporated herbicides are not common for pasture systems. Most herbicides for pasture systems should be applied postemergence to the weeds once the forage is well established. In pasture systems, spot spraying may be an economical alternative for scattered infestations of weeds.

Remember, young annual weeds in the seedling stage are most susceptible to control with herbicides. Spray biennial weeds in the rosette stage prior to bolting. Perennials are most susceptible to control with systemic herbicides in the bud to bloom stage or in early fall. Most herbicides for broadleaf control in grass pasture systems should *not* be applied to seedling forage grasses until visible tillers are present (3rd to 4th leaf stage). Established forage grasses and legumes are more herbicide tolerant than seedling forages. Most herbicides have haying or grazing restrictions following application.

Below are some general rules to follow before using an herbicide in established forage stands:

1. Thin or irregular stands do not thicken once weeds are removed. Be sure there are sufficient desired species to fill in the gaps, or overseed if necessary.
2. Weeds tolerant of the herbicide may invade the space left by susceptible species, ultimately creating a more severe weed problem.
3. If weeds make up 50% or greater of the stand, it may be time to renovate or rotate to a different crop.
4. If weeds become a problem in established forages, several herbicide options are available. Many products have harvesting, feeding, or grazing restrictions following their use.

Biological Control

Biological control is the deliberate intro-

duction or manipulation of a pest's natural enemies, with the goal of suppressing the pest population. It has been used to manage insects, vertebrates (mice and rats), pathogens, and weeds. Biological control is not intended to eradicate the target weed, but rather to exert enough pressure on the pest to reduce its dominance to a more acceptable level. Biological control can be cost effective, environmentally safe, self-perpetuating, and well suited to an integrated weed management program. Its limitations are that it is a long-term undertaking, its effects are neither immediate nor always adequate, and only certain weeds are potential candidates.

Biological control can be used to help keep weedy species in check in both rangeland and irrigated pasture systems

Biological control tools for weeds have included insects, mites, nematodes, pathogens, and grazing animals (e.g., sheep and goats). Historically, insects and mites have been the most important biological control tools for weeds. The emphasis for developing biological control agents for weed management has been on western rangeland and natural areas. Although slow in coming, biological weed control may have a major impact on managing problem weeds in pasture systems in the future.

Biological control agents for biennial thistles, leafy spurge, field bindweed, several species of knapweed, and other species of perennial weeds are widely established over the Intermountain West. Many of these agents will attack sites on their own if proper conditions exist.

Livestock Grazing and Weed Control

Targeted livestock grazing is another form of biological control that can be used to help keep weedy species in check in both rangeland and irrigated pasture systems. This can be a very effective tool when used in conjunction with other weed control measures such as herbicides, mowing, and tillage. Using grazing animals to manage weeds is appealing to ranchers because it makes use of existing ranch resources while reducing the use of chemicals.

Grazing management involves controlling the kind and class of animal, and the time (season, month, and phenological state), intensity (stocking density or rate), and duration (length of grazing and rest periods) of grazing. Often, noxious weeds are not preferred by grazing animals. By increasing stock density, grazing animals utilize the most desired species first, but eventually consume the target weed as they use up the preferred species. In some cases, plant toxins, such as alkaloids or tannins, can cause toxicity in some animal species, and forced consumption will result in detrimental health effects. For example, tansy ragwort is far less toxic to sheep than cattle. Also, goats are able to consume higher levels of tannins than other livestock species, which makes them desirable for grazing woody-type plants that could potentially cause toxicity to other animals. Additionally, timing of livestock impact on target weed species is often the most critical factor for optimal weed control. Timing and duration of impact is also essential in preventing harm to desirable species.

Sheep and goats have been used successfully for controlling many broadleaf weeds including yellow starthistle, scotch broom, spotted knapweed, leafy spurge, Dalmatian and yellow toadflax, and tansy ragwort (sheep particularly). Additional research is underway using sheep and goats for firebreak control in chaparral and forest areas. This work uses browsing activity to impact

woody species that pose significant threats as fuel for wildfires.

The key to using livestock for weed control is to plan for what you want, rather than for what you don't want! Clear, measurable objectives are key to the management of vegetation. Planned grazing is crucial to achieving proper control of timing, intensity, and duration of grazing.

Specific Weed Control

Thistles

Thistles are especially troublesome following cool, wet summers and falls when seed production and seedling establishment are high. An integrated weed control program that combines chemical, cultural (such as crop rotation or grass competition), mechanical, and biological methods is most likely to be successful.

Keys to controlling thistles include:

1. Establish a three- to five-year management program using several integrated methods.
2. Control small patches before they spread.
3. Use proper stocking rates and rotational grazing.
4. Reseed disturbed areas immediately with desired species.

Biennial Noxious Thistles

Biennial thistles, such as musk (*Carduus nutans* L.), plumeless (*Carduus acanthoides* L.), scotch (*Onopordum acanthium* L.), and bull [*Cirsium vulgare* (Savi) Tenore], are not as difficult to control as the perennial thistle species, but spread rapidly by seed and can become severe problems in some areas. All biennial thistles considered noxious are native to Europe or Eurasia and were introduced into North America as seed contaminants. Biennial thistles spread by seeds (achenes) that are produced in considerable numbers by the noxious species, ranging from 8,400 seeds per plant for plumeless thistle to 120,000 seeds per plant for musk thistle.

Biennial thistle seed generally germinates in the summer and fall, and the plant over-winters as a rosette. The following spring, the plant resumes vegetative growth, bolts, and flowers. Numerous, generally large flower heads are produced from May to October, depending on the species. After setting seed, the plants die thereby completing the life cycle. Occasionally, biennial thistles have winter annual, annual, or short-lived perennial characteristics.

Biennial thistles tend to invade overgrazed or otherwise disturbed pastures, rangeland, roadsides, and waste areas. Movement into cropland is generally from nearby non-cropland or roadsides. Biennial thistles reproduce only from seed, so the key to a successful management program is to control the plants before flowering.

Perennial Native and Noxious Thistles

Because they spread by both roots and seeds, perennial thistles, such as Canada [*Cirsium arvense* (L.) Scop.], are generally more difficult to control than the biennial thistles. Top growth control is not enough; one must design a program to deplete the root system for effective control of a perennial thistle.

Canada thistle was introduced from Europe, and like many introduced weeds, has spread rapidly because of the lack of natural enemies. Perennial noxious thistles are aggressive invaders and can become the dominant species in an area within a few seasons of introduction if not properly controlled.

Thistle Control

Prevention is the best control method for both perennial and biennial thistles. Thistles often invade overused or disturbed land such as cultivated fields. Plant weed-free seed to help prevent introduction into cropland and

to keep field borders thistle free. The best preventive measure in non-cropland is to maintain thick plant cover and reseed disturbed areas with a desired species as soon as possible. Proper grazing management and rotational grazing practices should be established and maintained to prevent thistle establishment in pastures.

Controlled and rotational grazing can prevent thistle establishment because overgrazing weakens desired species, making the pasture more susceptible to invasion. Properly grazed pastures prevent thistle establishment. An adequate fertility program insures a healthy and vigorous pasture with species that are competitive against thistle. Avoid spreading thistle seed to uninfested areas with manure, mowers, or other farm equipment. Establishing competitive grasses can reduce the size of rosettes and decrease thistle height, root weight, and crown size.

Mowing perennial thistles during the growing season followed by fall application of an herbicide can result in high levels of control

Once thistle invades an area, several control options are available depending on the location and land use. Control options include cultural, mechanical, chemical, and biological methods. It is generally better to combine two or more control options in an integrated management program rather than relying on a single control method.

Mechanical Control

Repeated mowing will reduce thistle infestations, especially if the plants are biennial. Mow whenever the plants are in the early bud growth stage to prevent seed set. Several mowings a year are needed because plant populations vary in maturity. Mow as close to the ground as possible. If plants are cut above the terminal bud before the stems elongate, they likely will regrow. It is important to mow before the flowers start showing color because plants mowed after that will likely produce some viable seed. Mowing for several years will reduce root vigor of the perennial species and will prevent seed production, reducing the seed reserve. Mowing should be combined with a chemical control program for best results.

Tillage can be an effective method for perennial thistle control and will lead to complete control of biennial species if done properly. Rotating from perennial to annual forage crops for several years is an excellent way to get biennial thistles under control. For the perennial species, fields must be cultivated before thistles reach 3 inches in height and repeated multiple times before regrowth reaches 3 inches until freeze-up. Cultivation depletes the energy reserves of the root system and eventually will control an established stand. Persistence and proper timing are important for control.

The problem with mechanical control is that fallowing and repeated cultivation for one or more seasons prevents crop production and may expose fields to soil erosion. Integrating cultural, mechanical, and chemical control practices into a single system is the preferred approach for perennial thistle control.

Chemical Control

Long-term control of thistles with herbicides depends on timely application for maximum effectiveness and on retreatment to reduce the seed bank of all thistles and root reserves of perennial thistles. Mowing during the growing season to reduce root reserves of perennial thistles followed by fall application of an herbicide can result in high levels of control. There are numerous herbicides available that can be used to control thistles including aminopyralid, picloram (restricted use pesticide), clopyralid, dicamba, and chlorsulfuron. For specific herbicide recommendations, consult

your local Extension office. As always, read and follow all label directions prior to herbicide applications.

Biological Control

Insect biocontrol agents have been released on both musk and Canada thistle with limited success. The seed weevil, *Rhinocyllus conicus*, was introduced from Eurasia to control musk thistle by reducing seed production. Larvae develop in the flower head and consume the seed as it develops. The weevils can reduce seed production by nearly 80%, but they are attracted more to earlier blooming rather than later blooming flowers. The late season flowers produce seeds with little damage from the weevil, which sustains the musk thistle population. It takes 5 to 10 years to build a high enough population of insects to greatly reduce seed production.

R. conicus also attacks seed heads of Canada thistle and many other thistle species, both native and introduced. However, the resulting damage to thistle populations has been minimal to date.

Another weevil introduced for musk thistle control is *Trichosirocalus horridus* which feeds on the apical meristem of the thistle rosette and developing stems. The feeding causes multiple stems to be formed when the plant bolts instead of a single stem. The multiple stems produce small flowers with few seeds, which is beneficial to the *Rhinocyllus* population. However, even with the two biological agents working together, musk thistle is only partially controlled. A second control method, such as an herbicide, is needed to stop the spread of the weed.

Two biological control agents have been introduced for Canada thistle control, and a third was accidentally introduced. To date, none have been effective at reducing the weed on a large scale. Larvae of the *Ceutorhynchus litura* weevil feed on the underground parts of Canada thistle which weakens the plant and makes it susceptible to winter-kill. The effects of the weevil must be supplemented by another biocontrol agent or chemical control for effective control. A gall-producing fly, *Urophora cardui*, causes meristematic galls, but does little long-term damage to the perennial thistle. The Canada thistle bud weevil, *Larinus planus*, was an accidental introduction into North America. The insect feeds on developing flowers to prevent seed production. Although *L. planus* can survive under a wide range of climates, it has not reduced established Canada thistle stands.

The painted lady butterfly, *Vanessa cardui*, can be a very effective biological control agent, but only on an intermittent basis. Larvae of the butterfly feed on Canada thistle plants and can significantly reduce infestations. However, the insect generally is only found in southern states such as Arizona and New Mexico and will build up populations large enough to migrate north only once every 8 to 11 years. The insect will migrate north as far as Canada, and those fortunate enough to reside within the migratory pathway will see a dramatic decrease in Canada thistle.

Hoary Cress

Hoary cress or whitetop (*Cardaria draba* L.) is a perennial member of the mustard family. New plants can grow from both seed and root fragments. Leaves grow very rapidly after seedling emergence, and lateral roots develop within 3 weeks. Seedlings over-winter as rosettes, and usually bloom in May. After producing seed, the plant continues to grow until heavy frost.

Hoary cress is highly competitive once it is established, and can quickly dominate an area. Each flowering stem can produce 850 seeds annually. With the possibility of producing seed twice a year, the surrounding area can become saturated with seeds. Seeds are spread by wind, irrigation/waterways,

and vehicles. Buried seeds remain viable for up to 3 years.

Competitive forages like alfalfa can reduce the extent of hoary cress infestations

Hoary cress doesn't propagate by seedling establishment alone. A single plant can send out rhizomes that will spread over 12 feet in the first year. This spread can continue to grow at a rate of 2-5 feet per year. These rhizomes send up shoots that develop into new plants. An average of 50 new shoots is produced every year. In addition to these creeping rhizomes, an extensive root system can grow up to 30 feet in 2-3 growing seasons. Lateral roots branch off a main taproot and spread through the surrounding area. Each root has buds that can develop into additional rhizomes and new shoots.

Hoary cress can form dense monocultures, similar to leafy spurge, that displace native plants, degrade wildlife habitat, and decrease species diversity. Additionally, hoary cress contains a toxin (glucosinolates) which can affect cattle. This weed can also invade cultivated fields and reduce forage for hay or grazing.

This species does have some benefits in that the flowers provide nectar for honeybees, and the seeds can be used as a substitute for pepper.

This plant grows in open, unshaded areas, and is often found with other exotics such as Russian knapweed. Hoary cress requires moderately wet sites (12-16 inches). Invasion of dry rangeland sites is unlikely. It prefers alkaline soils that are wet during late spring, but it will also grow on other soils. Lands most likely to be invaded are subirrigated pastures/croplands, rangelands, ditch banks, roadsides, and waste areas.

Control and Management

Hoary cress is a difficult weed to control. Eradication is only an option with very small patches. Control requires an integrated plan with constant monitoring. Containment is the best option when dealing with this weed. Create a perimeter and attack any plants that get out. Digging can be successful on small, new sites. New shoots must be dug up within 10 days after emergence. Sites must be rechecked throughout the growing season for 4 years.

Herbicides are effective, but are best used on small sites or around a perimeter (example herbicides: 2,4-D, chlorsulfuron, metsulfuron, and metsulfuron methyl). No biocontrol is available.

Mowing combined with herbicide application can provide effective control. Mechanical tillage is not a very viable option for control because of the rhizomatous root system. Just as with plants like Canada thistle, fields must be tilled throughout the growing season up until frost every time regrowth reaches 3 to 4 inches in height for control to be effective. Planting competitive forages like alfalfa in the crop rotation can reduce the extent of hoary cress infestations.

Chicory

Chicory (*Cichorium intybus* L.) is a perennial that invades grass pastures at a rapid rate and thus, decreases production. It initially grows as a rosette of irregularly-toothed basal leaves. Then, later in the season, leafless stems emerge with sky-blue, daisy-like flowers scattered along their length. Flowers generally bloom in the morning, track the sun, and close when sunlight is brightest at mid-day. Only a few flower heads open at a time and each head opens for a single day. Chicory reproduces only by seeds.

Plants produce a thick, deep, sturdy taproot that contains a very bitter, milky juice. Young leaves are oblong to egg-shaped, pale green, shiny, and contain a bitter, milky

juice in the midvein. The erect, round, hollow, nearly leafless stems produce stiff spreading branches that can grow 1 to 5 feet tall. Lower portions of stems are hairy. Upper portions are generally without leaves, making stems appear scraggly. When cut, stems exude a milky sap.

Rosette leaves are 2 to 6 inches long, oblong or lance-shaped, and covered with rough hairs on both the upper and lower surfaces. Rosette leaves of chicory closely resemble those of dandelion; however, basal leaves of chicory are coarser and have more prominent hairs compared with dandelion leaves. Margins of basal leaves are either deeply dissected with pointed lobes or they may be shallowly toothed. Stem leaves are small, sparse, alternate (1 leaf per node), lance-shaped, and clasping. Stem leaves have smooth or slightly toothed edges.

The showy flowers are clustered in heads that are 1 to 1 1/2 inches wide, short-stalked or stalkless, and borne in clusters of 1 to 4 on the upper branches. Each flower head consists of many individual, bright blue, petal-like flowers that are square-ended and toothed. The single-seeded fruits are about 1/8 inch long, dark brown, wedge-shaped, and 5-angled. Flowering occurs from June through September. The average plant produces about 3,000 seeds.

Control and Management

Chicory plants will regrow if mowed; however, they do not tolerate cultivation. Therefore, deep tillage will provide control. There is no known biological control for chicory.

Herbicides should be applied while chicory is actively growing. Dicamba, metsulfuron, and triclopyr plus clorpyralid have been shown to be effective. Be sure to follow all label instructions for specific rates, timing, and restrictions.

Burdock

Common burdock (*Arctium minus*) is a biennial, thus completing its life cycle in two years. It is a member of the Aster family (*Asteraceae*). In the first year of growth, the plant forms a rosette. The second year, the plant is erect. Burdock plants can take 4 or more years to flower under field conditions with moderate to high densities of grasses.

The stout, grooved, rough stem has multiple branches, and grows 2 to 6 feet tall. The large heart-shaped leaves are alternate, dark green, smooth above, whitish green, and woolly-hairy beneath. The flowers are pink, lavender, purple, or white in numerous heads, ¾ inch across. The head is enclosed in a prickly bur composed of numerous smooth or woolly bracts tipped with hooked spines, flowering July to October. It reproduces only by seeds with one plant producing up to 15,000 seeds. Large thick taproots branch out in all directions.

Common burdock is found in places where the soil is not disturbed; therefore, it is not commonly found in cultivated areas. This is because it is a biennial, so it needs areas that are not severely disturbed on an annual basis. It grows in pastures, along roadsides, ditch banks, stream banks, old fields, waste places, and neglected areas. It can be found in full or partial shade.

Common burdock indirectly affects the development of economically important plants by hosting powdery mildew and root rot. It reduces the value of sheep's wool due to the seed heads entangling in it and significantly reducing its quality. It is also responsible for tainting milk products if grazed in large quantities.

Control and Management

Many practices and herbicides can be used to maintain and control common burdock. Top growth removal through mowing or cutting is effective as well as pulling or digging the plant at flowering. Pulling may be difficult due to the large taproot. Seed

heads should be removed before seed set. It can also be effectively controlled using any of several readily available general use herbicides such as glyphosate or clopyralid. Read and follow all label directions.

Wild Caraway

Wild caraway (*Carum carvi* L.) is a biennial or short-lived perennial that is a particularly troublesome weed in mountain hay meadows, irrigated pastures, and along irrigation ditches. It tends to thrive in relatively wet areas. Typically, it comes up the first year and overwinters as a rosette, produces a flower stalk and seeds the second year, and then dies. It is a prolific seed producer with each plant yielding several thousand seeds. Wild caraway has finely divided leaves much like a carrot (they belong to the same plant family). Numerous, small, white to pinkish flowers are produced in umbrella-like clusters at the top of hollow stems. It starts growth early in the spring and completes its life cycle earlier than the grasses with which it grows. As a consequence, forage quality of hay is significantly reduced because the stems are mature and dry at the time of harvest. Cattle tend to sift the caraway stems out of the hay as they eat, which leads to increased levels of waste.

Control and Management

Because wild caraway reproduces only by seeds, any practice that eliminates seed production will ultimately reduce plant populations. Small infestations can be controlled by hand pulling or cutting during the bolting phase before seed set. During flowering, caraway can be mowed to remove the flowers and minimize seed set. This is a practical control measure, even in grass pastures or hayfields, because caraway plants mature early and elevate their flowers on stalks that stick out above the grass where they are easily removed by mowing without harming the grass.

In pasture situations, grazing can be used to reduce caraway density. In the spring, caraway is very palatable to livestock and they will readily graze it through the early bolting phase. Once a plant starts to bolt, the apical meristem is elevated and if removed, will no longer produce seed heads. An added advantage of grazing caraway to reduce its density is that it is also high in protein and digestibility during the period when animals will readily consume it.

Wild caraway can also be easily controlled with herbicides such as metsulfuron or 2,4-D. Metsulfuron can be applied from bolting to bud growth stages while 2,4-D can be applied from the rosette to bud growth stages. Rosettes can be controlled in both the spring and fall with 2,4-D. Although 2 qts/acre (4 lb a.e./gal. formulation) is the recommended rate for 2,4-D, rates as low as 1 to 1.5 pts/acre have been used successfully to control caraway rosettes early in the spring. This early application at lower rates also helps to minimize detrimental effects on desired forages such as red and alsike clover. Read and follow all label directions.

Healthy pastures and hayfields can prevent many weeds from establishing

Leafy Spurge

Leafy spurge (*Euphorbia esula* L.) is a very competitive weed that displaces other plant species in rangeland, pastures, and riparian areas. It is a deep-rooted perennial that spreads by both seeds and an extensive, creeping root system. The roots can extend up to 30 feet into the soil and have a wide, lateral spread. The entire plant is pale-green in color and exudes a white, milky sap from both stems and leaves. The sap can damage eyes or cause skin irritation. The stems are smooth with alternate leaves that are narrow and linear (1 to 4 inches long). The flowers

are small, yellowish-green and have a pair of heart-shaped yellow-green bracts that subtend each one. Each plant can produce up to 130,000 seeds which are born in capsules that explode when ripe, projecting seeds up to 15 feet away from the mother plant.

Control and Management

Due to its extensive root system, leafy spurge is very difficult to control once established. Monitor property regularly for new infestations because young plants are much easier to control compared to established plants. The best offense against leafy spurge is to maintain healthy pastures and hayfields that prevent it from becoming established. Several control measures can be deployed to manage infestations of leafy spurge.

Hand pulling or other mechanical control measures are not viable options for controlling leafy spurge due to its extensive root system. Repeated mowing can limit seed production, but does little for long-term control. There are several biological control measures including grazing with both sheep and goats. Grazing can be combined with the use of several species of flea beetles that feed on leafy spurge plants. The 3 species of flea beetles that are known to feed on leafy spurge and help to keep it in check are *Apthona nigriscutis, A. lacertosa*, and *A. cyparissiae*. For effective control of leafy spurge, the goal is to exhaust its root reserves and deplete the soil seed bank. This generally involves multiple control measures, including the use of herbicides.

There are several herbicides that are known to be effective for controlling leafy spurge. Picloram applied in the spring, just after bloom, and/or in the fall can significantly reduce leafy spurge. This is a restricted use pesticide that requires an appropriate license to purchase and apply. Imazapic applied in the fall prior to a hard freeze or fosamine applied in the spring during bloom to post-bloom stage can also be effective. Even with the most effective herbicides, you have to realize that this is a long-term effort that will take multiple applications over multiple years. Read and follow all label directions.

Russian Knapweed

Russian knapweed [*Acroptilon repens* (L.) DC.] is another deep-rooted perennial weed that spreads by both seeds and an extensive, creeping root system. It is particularly troublesome in rangeland and pasture systems where it displaces desired vegetation and reduces forage values. This species is toxic to horses, often causing serious injury or death. It is also known to be allelopathic which means it releases a toxic substance into the soil that can inhibit growth of surrounding vegetation.

Stems of Russian knapweed can reach 3 feet in height and are covered with short, stiff hairs. The leaves also have stiff hairs. The flowers are pink to purple in color and form in the shape of an urn at the tips of upper stem branches. This species can be distinguished from other knapweeds by the pointed, papery tips of the rounded bracts that surround the flowers.

As with most weeds that invade pastures and hayfields, the best control is to prevent establishment. Maintaining a thick, vigorous plant cover by proper fertilization and grazing management will discourage establishment of Russian knapweed. Disturbed areas are particularly susceptible to invasion by this species. If an infestation does occur, there are several control methods that can be used to manage this species.

Control and Management

Disturbed areas or areas where Russian knapweed has been controlled with herbicides or other methods need to be reseeded as quickly as possible with competitive grasses. There is no biological control currently available for this species although this

may change in the near future as several are being investigated. Mowing several times during the growing season can suppress, but not control, Russian knapweed. One of the best approaches for controlling this species is to mow it several times during the season to reduce its root reserves and then apply an herbicide in the fall when the plant is translocating carbohydrate to the roots.

There are several herbicides that are effective against Russian knapweed. Aminopyralid, picloram (restricted use pesticide), chlorsulfuron, clopyralid, and clopyralid plus 2,4-D can all be applied in the spring when plants are in the bud to mid/late flowering stage. All of these herbicides can also be applied in the late fall to rosettes or dormant plants with high levels of success, especially when the plants have been stressed by mowing. Read and follow all label directions.

Western whorled milkweed retains its toxicity after drying

Milkweeds

Milkweeds (*Asclepias* spp.) are native to the US and all contain toxic compounds that can cause livestock poisoning. Toxicity varies by species. The western whorled milkweed [*A. subverticillata* (A. Gray) Vail] is found throughout most of the Intermountain Region and is one of the most toxic milkweed species. It can be found growing in pastures and hayfields. Milkweeds contain various toxic cardiac glycosides that have effects on the heart and resinoids that have direct effects on the respiratory, digestive, and nervous systems causing breathing difficulties, colic and diarrhea, muscle tremors, seizures, and head pressing. Milkweeds are most toxic during rapid growth, and retain their toxicity when dry, so it's important to check hay for milkweed pods before feeding it to animals.

Western whorled milkweed has narrow, linear leaves arranged in whorls and contains a milky sap or latex. The flowers are produced in terminal or axillary umbels consisting of two, 5-parted whorls of petals, the inner one being modified into a characteristic horn-like projection. Flower color is typically white. The characteristic follicle or pod contains many seeds, each with a tuft of silky white hairs that aids in its wind born dispersion. This particular species spreads by both seeds and horizontal, creeping rootstalks.

Luckily, western whorled milkweed is not very palatable to livestock due to the milky latex, but animals will consume it when other forage is in short supply such as overgrazed pastures or during drought. The greatest potential for poisoning occurs from feeding hay that contains milkweed because it remains toxic when dry and animals may or may not be able to sort it from other forages in the hay.

Control and Management

Control of western whorled milkweed by pulling is only short term because of the creeping root system. The plant will return the next season. Picloram (restricted use pesticide) is one of the most effective herbicides for controlling western whorled milkweed. Dicamba, dicamba plus 2,4-D, chlorsulfuron, metsulfuron, and metsulfuron plus chlorsulfuron herbicides have been shown to give varying degrees of control. Read and follow all label directions.

Summary

There are times when direct and immediate action against invading weeds is necessary. These times include:

1. Weeds that are new to a farm or ranch when they are limited in number and distribution. New weed invaders should be controlled mechanically with a shovel, hoe, or other implement, chemically, or with ap-

propriate use of livestock grazing before they become well established. Noxious weeds, however, must be controlled and if they are new invaders onto a farm or ranch, aggressive action is required to affect their eradication. The best approach often means using an appropriate herbicide at the correct rate and timing, or if the noxious weed is an annual or biennial, complete removal by shovel or other physical means can be appropriate.

2. Poisonous plants can cause livestock losses. Implement control measures in grazing areas that are small enough and accessible. Exclusionary fencing might be appropriate in serious cases, but herbicides or shovels are good tools if plants are widespread and relatively few. Poisonous plants frequently are the first to appear in spring. Delay introducing livestock into these areas until adequate forage is available to prevent animals from being forced to eat these species and then remove them before lack of feed forces them to eat these toxic plants.
3. Certain perennial weeds – such as leafy spurge, field bindweed, and quackgrass – are difficult to control simply with competition from vigorous forage plants. Herbicides, physical removal, or tillage are common methods, but grazing animals capable of consuming these plants, such as goats or sheep, may be effective. Grazing can be especially effective when integrated with other control measures over the course of a growing season. Keeping perennial weeds under constant stress using multiple methods can result in effective control.
4. If weeds have become so dense as to dominate growing vegetation and the forage species so thin that they do not provide a nutritionally adequate feed source or profitable operation, starting over may be the only viable solution.

Finally, use best management practices and other economically feasible resources to promote growth of desired forage species so they will be more competitive against weeds. This concept is helpful in correcting certain weed problems and in slowing or preventing the invasion of new weeds. Herbicides can be a useful tool for managing weeds in forages. Livestock grazing management follows closely behind herbicides in overall importance. The best chemical for controlling weeds in forages is probably fertilizer, although fertilize only according to soil test results. Nitrogen is especially important for stimulating grasses and increasing their ability to compete with weeds. Keep in mind that excess soil nitrogen can favor weed germination, establishment, and growth, especially when you are establishing grasses.

Herbicides are very useful tools for controlling weeds. Because their use is accompanied by sometimes confusing and complex rules and regulations, it will normally be best for you to identify the specific weed(s) you need to control and then ask your Extension office for the best product to use along with the best time and method of application. **ALWAYS READ THE LABEL FOR SAFETY WARNINGS, RATES, AND CONDITIONS WHERE USE IS AND IS <u>NOT</u> ADVISABLE.**