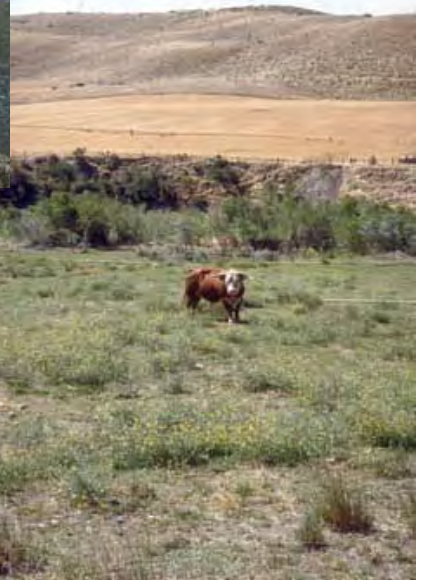


Fighting Invasive Weeds – A Northeastern Nevada Landowners' Guide to Healthy Landscapes

J. Kent McAdoo, Area Natural Resources Specialist, University of Nevada Cooperative Extension
Wayne S Johnson, Associate Professor, Department of Resource Economics, College of Agriculture, Biotechnology and Natural Resources; IPM Specialist, University of Nevada Cooperative Extension
Robert E. Wilson, Extension Educator, University of Nevada Cooperative Extension
Susan Donaldson, Water Quality Specialist, University of Nevada Cooperative Extension
Jessica Graham, Undergraduate Research Assistant, University of Nevada, Reno



Invasive weeds are everyone's business!



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Front Cover Photographs (clockwise from top):

1. Goat eating leafy spurge, by Dan Johnson
2. Man hand-seeding on a mountainside, by Scott Holmes
3. Cow standing in yellow starthistle-infested rangeland, by USDA ARS Archives, USDA ARS, #0022049, ForestryImages.org, www.invasive.org, November 18, 2002
4. FFA youth digging Dyer's woad, by Kent McAdoo
5. Russian knapweed among willows, by Kent McAdoo

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HOW TO USE THIS GUIDE

During the last few years in northeastern Nevada, several weed action groups have formed and have taken a very active role in weed education and management. In 2000, the Spring Creek Weed Action Team (SWAT), inspired by a group of “Woad Warriors” that met annually to pull Dyer’s woad from the area around the Spring Creek Marina in Elko County, began meeting to discuss the alarming spread of several noxious weed species in the Spring Creek area. Working with weed specialists from several agencies and the University of Nevada Cooperative Extension (UNCE), this group of approximately 25 individuals began to actively map weeds, educate the public, and implement weed control projects. They obtained 501c3 status and began applying for grant funds, partially for the purpose of creating additional educational materials.

SWAT asked UNCE to write a landowners’ guide that would serve as a comprehensive manual for managing noxious weeds in northern Nevada, and provided \$2,000 for producing the first printing of this material. The group had very specific ideas regarding what would make such a guide user-friendly. They requested a three-ring binder format to allow users the option of removing selected pages for lamination and use in field settings where carrying the entire manual is unnecessary. Also, because of this intended use, they requested that the section

addressing weed identification and management by species be comprised of separate, “stand alone,” single pages for each species. Therefore, the reader will note some redundancies regarding control methods. The three-ring binder format also gives users the option of adding updated information and/or additional material. *[Please note that due to the unexpectedly high costs of producing this guide in the three-ring binder format, we have also made it available as a spiral-bound publication.]*

Chapters One and Two of this guide give landowners necessary information about the responsibility of managing noxious weeds, management strategies, and safety considerations. Chapter Three emphasizes the importance of competing with weeds by planting desirable vegetation, and Chapter Four contains descriptions and control methods for weeds on a species-by-species basis. Appendices have been added for user convenience, including such topics as herbicide application calibrations, a list of licensed herbicide applicators, and where to get additional information on weeds.

Although much of the information in this guide is applicable to many areas of the Intermountain West, it has been written and assembled for northeastern Nevada, specifically Elko, Eureka, Humboldt, Lander, and White Pine Counties.

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Elko County Cooperative Weed Management Area

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The University of Nevada Cooperative Extension

Tri-County Weed Program



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Bureau of Land Management

CHAPTER ONE – FACING THE CHALLENGE OF INVASIVE WEEDS

The Problem with Invasive Weeds

To maintain their health and productivity, landscapes must be protected from the threat of invasive weeds. Many people are unaware that invasive weeds pose a very real environmental threat. When weeds are mentioned, they think of the dandelions in their lawn or the weeds in their vegetable gardens. But some weeds are so competitive that once they get started in an area, they can completely dominate the vegetation to the point that more desirable plant species are no longer present. Many of us have encountered large infestations of such weeds without even realizing what we were seeing.

Generally speaking, weeds are plants growing out of place or where they are not wanted. In such situations, weeds can actually reduce the value of the land. We often refer to the really aggressive weeds as “invasive” weeds. These weeds have become common in many areas because they grow vigorously and are competitive. They out-compete other species for light, water, nutrients, and space. Invasive weeds (see Appendix A – Glossary) are those that spread rapidly to dominate a site and are extremely difficult to control. They are generally nonnative species from Europe or Asia that were brought to North America. As extreme competitors, they sometimes form dense monocultures, or areas where they completely dominate and are the only plants growing. Because they reproduce very rapidly, are well adapted to a wide range of environments, and are very difficult to control, they are an economical and ecological threat. Some invasive weeds have been legally defined as “noxious” by Nevada state law, which describes noxious weeds as “detrimental or destructive and difficult to control or eradicate” (see Appendix B – Nevada Noxious Weed List).

What makes these weeds so terrible that people spend much time, energy, and money trying to get rid of them? It is because invasive weeds cause several problems; they

- ◆ crowd out desirable vegetation,
- ◆ cause crop and forage losses,
- ◆ reduce property values,
- ◆ ruin otherwise good wildlife habitat,
- ◆ cause problems in streams and wetlands,
- ◆ and become rangeland fire hazards.

Some invasive weeds can poison or injure livestock and humans, and certainly some weeds grow in such dense stands that they interfere with recreation.

For example, Scotch thistle, with its sharply-spined leaves, can grow in such dense stands that a fisherman has a difficult time walking to the creek. A recent study of invasive weeds on public lands in Nevada showed that the loss of wildlife-related recreation values ranged from \$5 million to \$17 million per year. In Montana, researchers estimate that spotted knapweed will infest 33 million acres of rangelands by 2009, resulting in annual forage losses of about \$155 million.



Kent McAdoo

Solid stands (monocultures) of noxious weeds such as Scotch thistle out-compete desirable native vegetation, thereby reducing livestock forage, wildlife habitat, and even recreational access.

The costs of weed control are both direct and indirect. First, property owners who must control invasive weeds will incur out-of-pocket expenditures for labor, herbicides, and often the revegetation necessary to effectively exclude weeds. Second, until noxious weeds are controlled, their presence results in damages and costs in the form of forfeited benefits, due to lost land uses as previously described (e.g., livestock grazing, wildlife habitat, outdoor recreation, etc.). Furthermore, because of the explosive growth potential of invasive weeds, the cost of control multiplies rapidly over time. A failure to act immediately when a weed invasion is first documented will cost the landowner proportionately larger sums of money as time goes by. A recent Nevada study of the noxious weed, perennial pepperweed (tall whitetop), showed that even a four-year delay in beginning a control program for this weed would cause the initial weed control costs to nearly triple.

Some ecologists think that the spread of noxious weeds may become one of the greatest environmental

disasters in North America. These nonnatives are spreading at an explosive rate, considered by some to be the equivalent of a “biological wildfire.” Scientists estimate that in parts of the West, weed-infested acreages may be increasing between 15 and 24 percent annually. Some weed species have gone from infesting just a few acres in the 1960s to contaminating hundreds of thousands, even millions, of acres today. On land administered by the Bureau of Land Management (BLM), more than 8 million acres are currently dominated by invasive weeds, compared to 2.5 million acres in 1985. Nationwide, 4,600 acres of wildlife habitat on public lands are being lost daily to invasive weeds. There is certainly reason to be concerned. An understanding of weed classification and biology is the first step in battling these invasive species.

Classification of Weeds

It is important to know whether the weed is a broadleaf plant (a dicot) or a grass (a monocot). As the name implies, broadleaf plants have broad leaves, and may either be woody (e.g., shrubs and trees) or herbaceous (e.g., dandelions and curly dock). The leaves have netted venation and the root system may be woody or herbaceous and form a taproot or extensive, deep, fibrous system. Grasses, on the other hand, have long narrow leaves with parallel veins and often have fibrous root systems. This distinction is critical because the selectivity of many herbicides is based on their differential effectiveness on monocots, dicots, or both.

Life Cycles

Weeds can be characterized by their life cycles. Some weeds are annuals, meaning that they germinate from seed, grow to maturity, drop seed, and die all in one growing season. Winter annuals complete their life cycle at low temperatures and usually mature and die by late spring. In dry environments, they use the available soil moisture before other plants have sprouted, giving them an advantage over desirable vegetation. Summer annuals occur spring through summer. Biennial weeds require two growing seasons to complete their life cycles. During the first season, they germinate and grow, usually as a low-growing plant or rosette. The next growing season, they mature and drop seed. Still other weeds are perennial species. These are plants that may go through all stages of growth in one season, and then go into dormancy. They continue to live for several more growing seasons, dropping seed each year. Many perennial weeds can establish not only from seeds, but also from pieces of roots and stems.



Sue Donaldson

A perennial pepperweed (tall whitetop) sprout that established from the creeping root system of this species.

Understanding the life cycle of a given weed species is necessary for implementing appropriate control measures. For example, mowing annual weeds to remove flowers can prevent seed set and reduce the potential for spread, but cultivating areas infested by some perennial weeds with creeping roots or underground stems (rhizomes) produces small pieces, each of which can generate a new plant! The information on species-specific control measures for weeds in Chapter Four is in large part based on life cycles.

Most invasive weeds are prolific seed producers. Depending on the species, it is possible for one plant to produce hundreds or even thousands of seeds. A large saltcedar tree may produce millions of seeds. The soil serves as both a reservoir (or “bank”) and a growth medium for weed seeds. In rangelands and riparian areas, most weed seeds are located within the top inch of the soil surface, whereas in cultivated soils most of the seeds are distributed in the upper six to twelve inches.

Weed seed survival in the soil depends on the species and depth in the soil. Typically, smaller seeds lose their viability more quickly than larger seeds. Species that produce seed with hard seed coats usually persist longer in the soil seed bank. Survival based on these variables may range from a few months to more than 30 years. By preventing weed seed production, up to 12 percent of the soil weed seed bank can be reduced annually in undisturbed soil and 25 percent per year in cultivated soil.

How Weeds Spread

In order to control weeds, it is very important to understand how weeds spread. If an area of land is scraped, burned, tilled, or otherwise has desirable vegetation removed, invasive weeds can move in very quickly because the competition from desirable plants

has been eliminated. If you have ever had a flower garden or vegetable garden, you may have noticed how rapidly even common garden weeds move into areas you have hoed or tilled with a roto-tiller.

Invasive weeds can spread rapidly across the landscape in many ways. In addition to being transported by wind and water, weeds are brought to an area in contaminated gravel, topsoil, and livestock feed, like hay. Even wildlife and livestock spread weed seeds from one area to another. Weed seeds are carried on animal hooves and hair, and some weed seeds pass through the digestive tracts of both wild and domestic animals and still remain viable. Uncomposted, fresh manure used to fertilize crops and gardens is another source of weed introduction. Weeds are moved about in mud on ATVs, boats, boat trailers, and all types of vehicles. Flooding streams, irrigation water, farm or construction equipment, and the use of uncertified seed are other vectors that distribute weed seed. Weeds have been brought in accidentally with straw bales used for environmental protection projects like erosion control, and some people have even had their yards contaminated by weeds like perennial pepperweed brought in with topsoil deliveries. It is really no wonder that weeds are spreading so quickly.

The Legal Mandate for Weed Control

All landowners should be familiar with the state laws regarding noxious weeds. Chapter 555 of the Nevada Revised Statutes (NRS) and Chapter 555 of the Nevada Administrative Code (NAC) address control of insects, pests, and noxious weeds. The legislation provides a definition of a noxious weed:

NRS 555.005.3. “Noxious weed” means any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate.

NRS 555.130. The state quarantine officer may declare by regulation the weeds of the state that are noxious weeds, but a weed must not be designated as noxious which is already introduced and established in the state to such an extent as to make its control or eradication impracticable in the judgment of the state quarantine officer.

The most important section addresses the responsibilities of the owner or occupant of a given piece of land:

NRS 555.150. Eradication of noxious weeds by owner or occupant of land. Every railroad, canal, ditch or water company, and every person owning, controlling or occupying lands in this state, and every county, incorporated city or district having the supervision and control over streets, alleys, lanes, rights-of-way, or other lands, shall cut, destroy, or eradicate all weeds declared and designated as noxious as provided in NRS 555.130, before such weeds

propagate and spread, and whenever required by the state quarantine officer.

This means that every property owner is responsible for controlling weeds on his/her land.

There is no specific governmental agency required to take care of your weed problems! If you do not control your weeds, the county can have the work done and bill you for the costs incurred by placing a lien on your property.

NRS 555.202. Legislative declaration. The legislature declares that it is primarily the responsibility of each owner or occupier of land in this state to control weeds on his/her own land, but finds that in certain areas this responsibility can best be discharged through control by organized districts.

Property owners can pool resources and information on weed control: form a weed control district (WCD) or a cooperative weed management area (CWMA) and collectively exclude invasive species and, if present, manage them together.

Weed Control Organizations

There are many active, citizen-led, weed control organizations in northern Nevada (see Appendix C – Citizen-Led Weed Control Organizations and Appendix D – Conservation Districts of Northeast Nevada). Weed conscious landowners looking for information should consider active involvement in one of these weed action groups. Appendices C and D contain contact information for these organizations. To learn more about where and how you can participate, contact your local University of Nevada Cooperative Extension (UNCE) office or the CWMA coordinator at the Nevada Department of Agriculture (NDOA).

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CHAPTER TWO – MANAGING INVASIVE WEEDS

Integrated Weed Management

Invasive weeds know no boundaries! Both public and private lands are at risk of infestation. Control or management of invasive weeds typically takes several years of persistence and dedication by everyone. This includes the public, many of whom may be unaware of the threat and uninformed about weed control strategies. Because weeds spread so rapidly and are difficult and expensive to manage, local public and private land managers and property owners must join together, define the problem, develop site and species-specific prevention and management strategies, pool resources, execute the plans, and celebrate the successes. Without pulling together locally, invasive weeds will continue to adversely impact your community and the environment.

How can we control and manage these invasive weeds? Typically, it is best to use an integrated approach that involves two or more methods. Integrated weed management (IWM) is defined in the Federal Noxious Weed Act as “a system for the planning and implementation of a program, using an interdisciplinary approach, to select methods for containing or controlling an undesirable plant species or group of species using all available methods...” In addition to increasing public awareness and education and coming together locally, successful IWM includes a combination of the following strategies: prevention, eradication, mechanical control, cultural control, biological control, and chemical control. The exact combination will depend on the invasive weed species involved, the environmental situation, and the available resources of those involved. To prepare an appropriate IWM plan, the following factors should be taken into consideration:

- ◆ The identity, biology (including life cycle), and source of the weed.
- ◆ The extent of the invasion and the site-specific environmental conditions of the infested area, including soils, water availability, nontarget vegetation and crops, and wild and domestic animal activity.
- ◆ Land-use objectives for the site or sites.
- ◆ The most appropriate method of control (see Chapter Four for options).

- ◆ Agreement and commitment among all the land managers and owners to apply the appropriate IWM strategies, including revegetation of the treated lands, both private and public, across jurisdictions and properties in a timely manner.
- ◆ Relative economics of control methods, based on severity and size of the infestation.
- ◆ Identification and procurement of resources necessary to implement the IWM strategies over several years.

Prevention

The first and most important step to be considered is prevention, i.e., keeping weeds from becoming established. This involves optimal soil, vegetation, and water management as follows:

- ◆ Learn to recognize potential invasive species and monitor properties and surrounding areas annually for invaders. Control them immediately, before they produce seed.
- ◆ Plant and maintain desirable plant species to compete with weeds.
- ◆ When planting, use weed-free certified seed.
- ◆ Minimize soil disturbance by vehicles, machinery, irrigation ditches, and livestock.
- ◆ Avoid driving in weed-infested areas.
- ◆ Remove weed seeds from clothing after walking in infested areas.
- ◆ Clean farm equipment, including herbicide sprayers, when moving between fields or pastures.
- ◆ After livestock have grazed a weed-infested area, feed them weed-free forage and wait at least five days before moving them to weed-free areas. It may be necessary to clean their hair of invasive weed seeds as well.
- ◆ Report new infestations of invasive weeds to the Nevada Department of Agriculture (NDOA), University of Nevada Cooperative Extension (UNCE), or the appropriate public land manager.

Eradication

Eradication is the removal of weeds and the seed reservoir from an area so they will not recur unless reintroduced. If invasive weeds are already present, but the infestation is new or relatively small,

eradication should be the primary strategy. Complete eradication is typically not physically or economically possible for large infestations. Where weeds can be eradicated, it is best to revegetate with desirable, competitive species to decrease the potential for future weed invasion (see detailed discussion of revegetation in Chapter Three). When eradication is not feasible, the management goal should be to reduce weed populations below the threshold at which they are environmentally and/or economically damaging, or at least to contain the infestation.

The steps of eradication are listed below:

- ◆ Monitor property and adjacent lands frequently for new infestations and initiate eradication immediately when weeds are found.
- ◆ Identify the source of the infestation and eliminate or isolate it by quarantine, sanitation, physical measures, etc.
- ◆ Pull isolated patches of invasive weeds, burning or burying (in a landfill) any seed heads if present.

Cultural Control

Cultural control includes methods used by the landowner/manager to encourage the growth of desirable species. In addition to planting adapted competitive species where necessary, other cultural controls may include burning, flooding, planting certified weed-free seed, using weed-free topsoil and hay, water management, plant nutrient management, and prescription grazing.



Burning this perennial pepperweed infestation removes residual dried vegetation so that herbicide application will be more effective—an example of integrated weed management.

A word to the wise: Knowing the biology of the weed will dictate which cultural control measures may be appropriate. For example, although some weeds can be at least partially controlled by burning, fire stimulates growth of other weed species (e.g.,

saltcedar). Some weeds, like perennial pepperweed, are burned or mowed not for control, but to remove old plant growth before herbicides are applied to the new growth.

Although prescription livestock grazing may also be considered a biological control method, it has been included in the cultural control section because it has the potential as a land management strategy for overall vegetation management. Livestock grazing, often in conjunction with chemical control, is sometimes used to keep large infestations of highly competitive noxious weeds, like leafy spurge, Russian knapweed, and perennial pepperweed, from expanding. Timing is critical, and it is usually necessary to apply high intensity grazing several times during the growing season. Although domestic sheep and goats are typical candidates for such control efforts, cattle and even geese may be used for control of some weed species. Please note that livestock should be kept isolated in a corral or other confined area for at least five days after grazing in weed-infested areas. Feed them only weed-free forage during this time so that they will not contaminate weed-free areas as they graze. Their coats may also need to be cleaned of invasive weed seeds before they are moved.



Domestic goats can be an effective method for containment of leafy spurge, especially when used in conjunction with an appropriate herbicide.

Mechanical Control

Mechanical weed control methods are those that physically interfere with plant growth. These methods include hand-pulling or digging, cultivation or hoeing, mowing or cutting, mulching (primarily for annual weeds), and plowing and tilling (primarily limited to weeds in agricultural crop fields). Mechanical control is typically used for annual and biennial weeds.

Before using any specific control method on a particular weed species, consider the biology of that weed. Some weeds, like Dyer's woad, can be successfully controlled if the digging occurs before the

plant has flowered and is repeated frequently. For some weed species, digging may require up to 15 years or more of repeated effort before root and seed reserves are depleted. In such cases, another treatment method may be more appropriate. Cultivation can result in soil erosion and may open the area for invasion by other weed species. Mowing or cutting can be effective for some weed species if timed before flowering, but may promote sprouting from the crowns and roots of other species, such as perennial pepperweed. Plowing buries seeds and exposes roots to drying conditions, while tilling distributes seeds and roots throughout the soil and may cause some weed species to proliferate. Frequent, repeated tilling may effectively kill some invasive weeds.



Kent McAdoo

Digging is one type of mechanical control that is very effective for some noxious weed species (like Dyer's woad, pictured here) if employed while infestations are relatively small.

Biological Control

Biological control (biocontrol) involves the intentionally managed use of a weed's natural enemies to reduce its population. Although many biological control agents are insects, other agents include parasites, nematodes, mites, plant pathogens (e.g., bacteria, fungi, and viruses), and vertebrates. The biocontrol agent must be host-specific, that is, it must injure only the target weed species and avoid damaging desirable vegetation. Typically, the biocontrol is introduced from the region where the specific weed originated. Usually, it takes the introduction of several biocontrol agents released in a noxious weed infestation, with each agent impacting the weed in a different way, before there is a reduction in the target weed population.

Most biological control agents do not completely eradicate a weed species. They reduce the weed population, and then decline in numbers because of the host plant's reduction. Successful biocontrol requires the identification of a suitable organism, introduction and adaptation to the environment, and

a sufficient infestation of the host weed species to support a viable population of the biocontrol organism. Studies have shown that six to ten years may be required to see the results from biocontrol.

Although biological control may be more economical than chemical control in the long run, it requires intensive management and planning, and results are highly variable. In North America, release of biocontrol agents for controlling specific weed species has produced results ranging from very successful to total failure. Most unsuccessful attempts have resulted from the inability of the introduced organism to adapt to its new environment or are perceptions that the biological control agent is unsuccessful because of a lack of understanding as to how it actually performs.

Some biocontrol agents have been used more successfully when combined with other control measures. Of the 31 weed species described in Chapter Four, biocontrol agents are available for 20. Please contact NDOA (see Appendix E) for more information on acquiring and releasing biological control organisms.

Chemical Control

Using herbicides or weed-controlling chemicals is one of the most common methods of controlling invasive weeds and can be very effective if the applicator understands both the biology of the weed species and the specific chemical being used.

For example, 2,4-D, an active ingredient in many herbicides, is only effective on broadleaf plants, although some grass seedlings can be injured and at excessive rates even established grasses and grasslike plants can be harmed. Glyphosate (the active ingredient in Roundup®) is nonselective and will kill both grasses and broadleaf plants. To determine which herbicides are in a given product, look at the "active ingredients" listed on the label. When using a nonselective herbicide, be aware that successful application may result in areas devoid of any vegetation. This condition will likely lead to reinvasion by the same or other invasive weeds unless desirable vegetation is planted to provide competition.

For all weeds, the most vulnerable time for effective control with appropriate chemicals is immediately after germination, during the seedling stage. At this point in their life cycle, all weeds, whether annual, biennial, or perennial, are essentially "equal" in terms of vulnerability, although the specific herbicide for best control may vary by species. If plants are already past this stage, then knowledge of other stages of vulnerability is necessary. Generally speaking, annuals and biennials are next most vulnerable during the vegetative stage of rapid growth before flowering, while perennials are most vulnerable

during the bud to early flowering stages of growth. Some deep-rooted perennial species, such as perennial pepperweed, leafy spurge, and Russian knapweed, usually require several applications before the weed is completely killed. Chapter Four details the biological characteristics (including life cycles) and recommended chemical control, as well as other control measures, for 24 invasive noxious weeds and seven other weed species that are considered troublesome by landowners. Note that some of these species can be controlled without the use of chemicals, but others require herbicides for effective control.

There are a few herbicides that have been classified as “restricted-use,” such as picloram (the active ingredient in Tordon®), by the State of Nevada. Purchase and use of these chemicals requires formal training and certification. For a list of certified pesticide applicators see Appendix F. **For all herbicides, reading and following label instructions is mandatory for both personal safety and environmental reasons. This also ensures that the application will be effective under normal conditions. Pesticide applications must be made according to labeled instructions; it is the law!**

Chemical injury to nontarget plants is a common side effect of herbicide application by untrained individuals. Impacts to these nontarget species result from misapplication, spray drift, or inappropriate application rates. Common symptoms of plant injury from herbicides include yellowing or bleaching, root stunting, distorted growth, and death. Many herbicide users think that increasing the recommended rates will give them better results on target plants. The truth is that higher application rates may be illegal and often interfere with effective chemical movement into the roots, especially of perennial species. The tops of target plants may be affected, but regrowth from the roots of perennial weeds often occurs. Higher rates also result in higher risk to nearby desirable plant species.

The risk of spray drift increases with increasing wind speed, higher temperatures, lower humidity, and wide pattern nozzle types. Never apply herbicides when the wind speed is more than ten m.p.h.. In Nevada, the best time to spray to avoid wind and high temperatures is typically early in the morning.

Some herbicides are very persistent in the soil as the alkalinity, pH greater than 7.0, of the soil increases. Herbicide soil activity may be prolonged for months, even years, affecting or even preventing future cropping or revegetation efforts.

Herbicide users should also be aware that inappropriate use of chemicals may result in contamination of our surface and groundwater supplies, especially in areas with shallow water tables. Only a few herbicides are labeled for use near water. Always mix herbicides and clean equipment in areas

away from wells and water bodies, preferably on impervious surfaces.

Using Herbicides Safely

Herbicides must be used with caution at all times. Follow the pesticide safety checklist below:

- 1. Read the label carefully, noting the personal safety and environmental precautions.** The label information isn't advertising—it's solid science and it is the law. It also includes the proper rate of pesticide use for various conditions, the relative toxicity of the product, directions for safe mixing and application, persistence in the soil, and any environmental precautions. It lists the product manufacturer's name and address, required protective clothing, and warnings about groundwater contamination and hazards to wildlife.
- 2. Wear appropriate personal safety equipment when handling pesticides.** Start by wearing a wide-brimmed hat, long-sleeved shirt, long pants, and chemical-resistant gloves. You should also wear sturdy rubber boots or leather shoes, not sneakers or sandals. Depending on the product you are using, it may be necessary to wear goggles and/or a respirator. In most cases, those that mix and load pesticides are also required to wear a chemical-resistant apron.
- 3. When mixing and loading chemicals, prevent spills that might contaminate water supplies.** One key spill-prevention step: Prevent tank overflow by never leaving a sprayer unattended during filling. Always fill the spray tank with herbicide from above while standing to the side of the tank.
- 4. While filling sprayers, avoid back siphoning by keeping the discharge end of the fill hose above the tank's water level.** If you put the end of the hose down into the tank, there is the real risk that the hose will suck water and chemicals back into the hose, and possibly into your well or home, when you turn off the water.
- 5. Never exceed labeled chemical rates and calibrate your sprayer before application.** After you have read the label and chosen the right product to apply at the prescribed rates, it is important to make sure your sprayer is delivering the right amount of product. Follow the calibration directions on the sprayer carefully (see Appendix G).
- 6. Prevent pesticide leftovers by mixing only needed quantities.** If you follow label instructions for rates and mix carefully, your tank should be empty as you complete the application.

7. **Never rinse equipment near wellheads, ditches, streams, or other water sources.** If needed, install a longer rinse-water hose to move the cleaning operations a safe distance from a well or other water source. The recommended separation distance is 100 yards. It is best to have an extra container for rinse water for cleaning the equipment away from any well or water source. Spray the rinse water in the spray tank out over the target area, following label directions.
8. **Always triple rinse or pressure rinse chemical containers before disposal or recycling.** If it has been properly rinsed and label instructions have been followed, the pesticide container may be disposed of with ordinary trash. However, the best place for it is a pesticide container collection and recycling facility.

What Can You Do About Weeds?

What can you do about the weed problem we have in northeastern Nevada? If you have read the first two chapters, you have done something. You have started educating yourself about noxious weeds. You can also help by participating in volunteer efforts to control weeds in your community. As a review, the list below summarizes the steps to take for effective weed control on your property and working with others around your community. See page 16 for a Weed Management Plan Checklist.

Fourteen Steps for Effective Weed Control

- ◆ Learn what problem weeds look like, from the seedling stage to the flowering and fruiting plant. For help, use the “Invasive Weed Identification for Nevada” publication, SP-03-09, available from a UNCE or NDOA office.
- ◆ Inspect your property often to catch the presence of weeds as early as possible.
- ◆ Identify your problem weeds. Whenever possible, bring a fresh sample stored in a paper bag to your local UNCE, Bureau of Land Management (BLM), or Natural Resources Conservation Service (NRCS) office. Be careful not to spread seeds while transporting the sample. Double bag the sample in plastic bags.
- ◆ Gather information on your weed. Obtain any available publications or other materials. UNCE offices have fact sheets discussing integrated weed management of specific invasive weeds. These publications may also be accessed on the Web at www.unce.unr.edu/pubs.html
- ◆ Learn the life cycle of the weed. Is it an annual, perennial, or biennial?

- ◆ Determine whether the weed is a broadleaf or grass plant.
- ◆ Evaluate the reproduction method and likely means of spread of the weed.
- ◆ Learn what time of year is best to control the weed.
- ◆ Keep desirable landscape plants or pastures healthy and vigorous so they can out-compete weeds. Don't overgraze pastures, or weeds will invade.
- ◆ Create a plan for the eventual revegetation of the land once the problem weeds have been eradicated.
- ◆ List and assess the treatment options for the weed and the site: cultural, mechanical, biological, and chemical.
- ◆ Prevent annual weeds from flowering and setting seed whenever possible. This can be done for some species by mowing or using another mechanical control method at the most effective time. Consider such alternatives as burning, if permitted, or mulching.
- ◆ Perennials cannot be controlled by interrupting the seed production. Instead, learn how the plant spreads and determine whether pulling, digging, or disking will be effective. Some perennials will require chemical applications for control.
- ◆ Complete your weed management plan and evaluate its success.

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Integrated Weed Management Plan Checklist

- Have I identified the location, species, life cycle, and reproduction method of my problem weed?
- Have I identified the extent of the infestation? Is there one plant, a few plants, nearly an acre, more?
- How is or will the site be used? What do I hope to do with the site? Does it require frequent cultivation or tilling, which may favor the increase of rhizomatous perennials? Are there other site conditions that cannot be changed?
- Have I incorporated prevention methods to keep from reintroducing weeds?
- Do I know what the most effective methods of control are? Have I considered cultural, mechanical, biological, and chemical controls?
- Can I afford to follow all the elements of my weed control plan? Is it economically viable?
- Have I read the herbicide safety information, product label, and materials safety data sheet (MSDS), so that I will not endanger myself, others, or the environment when applying herbicides?
- Does my plan help reach the goals of my community weed control district (WCD) or cooperative weed management area (CWMA)?

CHAPTER THREE – PLANTING DESIRABLE VEGETATION TO COMPETE WITH INVASIVE WEEDS

Competitive Planting for Effective Weed Control

The information in this chapter will help landowners improve their weed management plan; that is, planting their property with competitive plant species to out-compete both invasive and nuisance weeds. Many landowners focus so intently on weed removal that they overlook the need for desirable competitive vegetation. Without this component, weed control is typically a waste of time, money, manpower, and herbicide, because weeds will readily reinvade areas lacking competitive plant cover.

The old saying that “nature abhors a vacuum” is very appropriate in this context. Complete elimination of weeds in an area without maintaining sufficient desirable vegetation to colonize the site could result in a situation worse than the original weed infestation in just a few years. Without competition for soil moisture, sunlight, and nutrients, either the former invasive weeds will move back in with a vengeance, or another weed species or combination of species will move in to fill the void. This often leaves the landowner with a problem worse than he or she originally encountered. Therefore, a landowner with a weed infestation should first ask: *“Are enough desirable competitive plants present on the property or seeds in the soil to promote recovery without planting.”*

Assuring a healthy and desirable plant community following a weed control program can be as simple as selecting the appropriate weed management techniques and/or choosing the right combination of species to reseed, along with appropriate seeding methods. This chapter covers, step by step, the appropriate revegetation techniques and vegetation maintenance practices that will help meet your land-use objectives. Specifically, the topics addressed below include:

- ◆ The importance of soil conservation
- ◆ Weed control and seeding considerations
- ◆ Seedbed preparation
- ◆ Seed mixes
- ◆ When to plant
- ◆ How to plant
- ◆ Seed depths
- ◆ Applying fertilizer
- ◆ Mulching
- ◆ Seeding success and maintenance

The Importance of Soil Conservation

Soil is an essential natural resource for plant establishment, and its conservation should be the highest priority in those areas where seeding is necessary. Therefore, the retention and enhancement of soil should be a primary consideration in all management decisions, including seedbed preparation and choice of a seed mixture. If the planted vegetation does not establish rapidly, valuable topsoil may be lost through wind and/or water erosion, leaving the site only suitable for undesirable vegetation. When soils are mismanaged, vegetation ceases to produce as it once did, weeds again start replacing desirable plant species, recreation and scenic values are decreased, and management options for the production of livestock forage and/or wildlife habitat become limited.

The focus of this chapter is on revegetation that serves two primary functions: competing with weeds and holding the soil in place. Beyond these functions, seed mixes may serve other purposes as well. Typically, these are related to desired/long-term land use for any one or a combination of the following: livestock grazing, wildlife habitat, hay production, aesthetic value, etc. If the landowner has multiple land uses planned, the revegetation strategy should reflect this balance.



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After successfully controlling an invasive weed infestation, planting desirable species to compete with invasive weeds may be necessary when few or no desirable species are present in the area.

Weed Control and Seeding Considerations

The area to be seeded should be free from actively growing weeds. The specific method of weed control should be tailored to the weed species present. In

addition to herbicides, some weeds can be controlled by repeated pulling, mowing, grazing by livestock, or prescribed fire. Lightly tilling an area just prior to seeding can also be used to help control weeds before planting. However, perennial invasive weed species spread by root sprouting, and cultivation creates many small pieces of root that can produce new plants. Extensive cultivation is also not recommended if desirable perennial species are present, since these plants could be eliminated. For specific information on controlling invasive weeds, see Chapter Four of this publication. Additional information is available on-line at www.unce.unr.edu/publications/ or by contacting a local office of the University of Nevada Cooperative Extension (UNCE).

Please note that some herbicides, like chlorsulfuron, may have inhibiting effects on seed germination of desirable species for several years, particularly in alkaline soils with a pH of 7.5 or higher. Other herbicides have only short-term effects. As an example, a landowner could spray a property with a glyphosate-based herbicide (e.g., Roundup®, Landmaster™, etc.) to kill or severely impact undesirable existing vegetation. The area could then be safely seeded within ten days after chemical application without injury to the planted seeds. Because residual effects vary with each chemical product, be sure to always read and follow the label instructions and warnings.

Seedbed Preparation

Although tilling is sometimes necessary for weed control, as mentioned above, seedbeds should be prepared with as little soil disturbance as possible in order to retain soil moisture and organic matter and maintain soil structure. Keep in mind that any disturbance of the soil can also bring more weed seeds to the surface. Seedbed preparation can be initiated by combinations of weed control methods followed by a short fallow period to provide time for the soil moisture to begin replenishing, assuming precipitation or irrigation occurs. Minimum till or no-till drill seeding are options. Undisturbed conditions with reduced weed competition in fine-textured soils create an excellent environment for germination and establishment of seedlings. Take special care in very clayey areas not to overwork the soils, because this will result in a powdery dust that tends to crust and severely compact.

Seedbed preparation should be completed immediately prior to seeding to minimize the time period that the soil is subject to wind or water erosion without vegetative cover. Done properly, seedbed preparation can loosen compacted soils, provide water catchments (for plants), and create “safe-sites” for seed germination and seedling survival.

Equipment for seedbed conditioning for small landowners is often limited, but could include rippers, disk plows, etc. Methods can be combined to prepare a good seedbed.

For small areas, preparing the soil surface may be as simple as raking to provide a roughened surface. Raking creates only a small disturbance and provides microsites that hold water, thus enhancing seed germination.

In areas where deeper seedbed preparation is necessary to remove rocks and undesirable plants, topsoil materials should be tilled to a depth of approximately six inches. If the property includes steep terrain with greater than 20 percent slopes, tillage operations should be conducted on the contour (that is, moving across the slope horizontally instead of straight up and down the slope) to minimize erosion. The final seedbed should consist of a furrow-like configuration to help minimize erosion and capture available soil moisture.



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Furrow-like seed beds can be created in many ways. Even the cleat marks from track-mounted bulldozers can provide “safe-sites” for seed germination.

In soils that are very loose after seedbed conditioning, firm the soil before seeding to ensure that footprints made in the soil are no greater than one-half inch deep. If necessary, pack the soil with a roller or irrigate before seeding.

Seed Mixes

Emphasis should be placed on planting site-adapted, rapidly establishing species that hold the soil in place and compete vigorously with undesirable weeds. Long-term land-use goals such as livestock production, wildlife habitat, aesthetics, etc., must be balanced with the necessity of conserving soil and crowding out weeds. Areas can be seeded with additional species after weeds are successfully out-competed. However, landowners should always keep their long-term land-use goals in mind as they make decisions about seed mixes.

The recommendations discussed herein focus on the major plant communities in northeastern Nevada that are jeopardized by weed invasions. For help in determining which of the seeding tables (pages 22 and 23) apply to specific sites, contact the local office of the Natural Resources Conservation Service (NRCS) or UNCE (see Appendix E for agency contact information for northeastern Nevada). Appendix H contains the scientific names of recommended competitive plants used in revegetation.

Because rangeland communities are very diverse, the choice of plant species depends on numerous site-specific factors such as elevation, length of growing season, soil type, topographical exposure, annual precipitation, availability of irrigation water, and land-use goals as discussed above. All species selected must be adapted to the site conditions. Landowners may also consider the fire resistance of seeded species. Seed availability and price will affect final seed mix decisions.

In most situations it is best to use several seed species, as opposed to single-species seeding, for several reasons. First, no single species will thrive in all of the varied conditions present in an area. A multiple-species mix enhances potential seeding success because it increases the possibility that all available sites will be occupied with vegetation. For landowners with livestock production and/or wildlife habitat goals, mixtures provide variety of forage and/or cover. Mixtures also provide increased resistance to insects and parasites, extend the grazing period, and generally increase vegetation production and soil protection. Because many native range plant species are especially poor competitors with weeds, particularly in the initial phases of establishment, many of the species recommended in Tables 3-1 through 3-4 (pages 22 and 23) are introduced species. As sites become secured from weed invasion with more readily established species, other species can be interseeded to increase plant diversity.



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When planting vegetation to compete with noxious weeds, use a mixture of site-adapted, rapidly establishing desirable species.

This chapter recommends plant materials that have proven to be most reliable for establishing and stabilizing plant communities. Plant populations can be altered over time by changing the type, intensity, and timing of management actions, but soil cannot be easily replaced if it is lost. As mentioned previously, soil protection is vital to the future integrity and sustained production of the site.

Depending on the exact seed mix selected, seed may be purchased from local seed dealers or farm and ranch supply stores. Commercial seed companies typically have a greater selection, but may also have minimum order requirements. Always buy certified seed to guarantee the variety, absence of noxious weeds, and reliability of germination.

When to Plant

Seeding should normally be limited to the fall in northern Nevada unless irrigation is available throughout the plant establishment phase, which may be several months long. Seeding during the fall helps meet the cold (dormancy) requirements of seeds and stimulates seedlings to rapid growth the following spring. There is also less chance for seed depredation by seed-eating birds, rodents, and insects during this time, as well as the benefit of accumulated winter moisture.

Avoid seeding too early in the fall to ensure that seed germination is delayed until the following spring when the seedlings can take advantage of cooler temperatures and the moisture from winter snowfall. Most grass, forb (wildflower), legume, and shrub seeds will survive the winter. However, early fall seedings can be risky if germination does not occur soon enough to allow moderate root development prior to winter. Immature seedlings exposed to freezing temperatures can experience severe winter mortality, particularly in areas of limited snow cover. In northern Nevada, planting should normally be conducted from mid-October through the end of November. Temperatures at this time of year are cool enough to prevent seed germination, and soils are dry enough for successful planting.

How to Plant

For smaller areas and where sophisticated equipment is not available, landowners can achieve excellent results by broadcasting the seed manually using a hand spreader and lightly raking the seed into the soil. Some landowners have successfully seeded areas using an electric broadcast seeder mounted on the front of an ATV, with a harrow or even a piece of chain-link fence attached behind to cover the seeds with a thin layer of soil. In some situations, livestock



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Broadcast seeding with an ATV is effective when using a spring-toothed harrow (pictured), chain-link fence, or some other implement to lightly cover the seed with soil.

can be moved across the area to trample the seed into the soil.

Due to variable terrain and shallow, rocky soils, range plantings are among the most difficult to accomplish successfully. Unfortunately, simply broadcasting seeds on the soil surface does not provide the right germination conditions required by most seed species. Several technologies have been developed to cover seeds during the seeding process. For planting large areas, the use of specialized equipment capable of withstanding rugged conditions may be necessary. Rangeland drills and drag variations are commonly used to place and cover seed with a thin layer of soil in areas where rugged conditions limit the use of conventional drills. Modern drills equipped with precision seed depth placement and seed monitoring devices perform well on moderately difficult landscapes.



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Small farm tractors (shown here with meadow blanket harrow) and other equipment and accessories may be used successfully in seeding operations.

Seed Depths

Controlling seed planting depth is essential for a successful seeding. Although recommended planting depths vary with seed size, most grasses do best when planted $\frac{1}{4}$ to $\frac{1}{2}$ inch deep. The general rule is that the smaller the seed, the shallower it should be planted. Some very small grass, forb, and legume seeds should be seeded only $\frac{1}{8}$ to $\frac{1}{4}$ inch deep. A few forbs and some shrubs do best when broadcast on the surface of roughened soils. Optimal seeding depth also varies with soil texture. For example, on coarse-textured soils such as sand, seeds should be planted deeper than on finer-textured silt or clay soils.

Applying Fertilizer

Application of fertilizer on arid rangelands after seeding establishment is not usually recommended. Plants that respond well to short-term changes in the soil brought about by fertilization may fail when the fertilizer is depleted. This failure typically results in a reduction of desirable species and invasion by weed species. The site should be seeded with species that do not require fertilization for establishment and growth, and thus can continue to thrive without human assistance. Fertilizer is beneficial only during abnormally wet years. Applications made during dry years may prevent germination or reduce forage yields and plant vigor.

Nitrogen, often a significant component of fertilizer mixes, is not required for seed germination, but instead stimulates the growth of cheatgrass and other nitrogen-loving invasive weeds. Therefore, fertilizing the newly-planted site at seeding time or in early spring can result in a dense and robust weed infestation.

Fertilizer application may be desirable for irrigated pastures. For a more thorough discussion of this topic, the "Intermountain Pasture and Hay Meadow Handbook," (EB-00-03) is available from UNCE offices.

Mulching

Although mulching may be beneficial in some areas, it is not typically necessary, and may be cost-prohibitive. For most landowners, the most likely areas for mulch application would be sites that are windblown, southern slope exposures, and other sites that lose soil moisture rapidly.

Mulching involves placing a layer of material on the soil surface to increase soil moisture retention, prevent erosion, moderate soil temperatures, and increase seedling establishment. Although mulching may increase plant cover, density, and biomass in some instances, in other cases it may have no significant

influence on plant growth. Of the wide variety of mulching materials available, hay and straw are the most commonly used. When mulching with these materials, great care must be taken to ensure that the mulches are free of noxious weeds that could be unintentionally introduced to a planted site. Information for sources for weed-free hay has been included in Appendix I.

Where mulch is used, it should be applied in an appropriate manner, depending on slope, terrain, and access. Methods include manual application, special blowers, and mechanical spreaders. For best results, apply mulch two or three inches deep after seeding, and secure it by crimping into the soil using a straw crimper or the equivalent. Hydromulching is the most expensive method, but is sometimes used on very steep slopes and/or in areas requiring rapid plant establishment for mitigation against potential erosion.

Seeding Success and Maintenance

Seedlings from fall plantings should begin establishing in early spring. If spring precipitation is lacking, irrigation (if available) applied several times during the first two months after germination is beneficial. Under normal conditions, dryland seedings should be allowed at least two or three years for complete establishment. The diverse species in a seed mix may have a wide range of germination and growth requirements that will not all be met in a single year. Patience is a necessity when it comes to seeding establishment. If results are less than desirable after the first growing season, landowners may be tempted to plow the site and try again. Repeated soil disturbance of this nature often sets the stage for a new weed infestation.

If the seeded site is intended to be used for grazing by livestock, the area should be protected from grazing and trampling until the plants are adequately established. The root systems must be sufficiently developed so that grazing will not pull up the plants. On arid rangelands, this typically requires two growing seasons. However, depending on precipitation and site-specific factors, more or less growing time may be required. If perennial plants can be easily hand-pulled, they are not ready to be grazed.

If sustainable livestock grazing of a seeded area is a land-use goal, the grazing strategy should allow sufficient vegetation recovery for site maintenance. Manage grazed areas so that desirable vegetation is not severely depleted or damaged by livestock. Otherwise, reinfestation by invasive weeds may occur. Contact specialists with the Natural Resources Conservation Service (NRCS) or UNCE for additional information on livestock grazing management.

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Table 3-1. Recommended “Weed Competition” Seed Mixes (pls¹ lbs/acre²) for Salt Desert Shrub Areas (6 to 8 inches annual precipitation).

Species/Variety	Clay Soils	Sandy or Well Drained Soils	Shallow Water Table/Saline Soils (Greasewood Areas)
Grasses			
Siberian Wheatgrass/‘Vavilov’	9	9	
Russian Wildrye/‘Bozoisky’	6	6	
Tall Wheatgrass/‘Alkar’			10
Western Wheatgrass/‘Arriba’			7
Shrubs			
Fourwing Saltbrush/‘Rincon’	1	1	
Forage Kochia/‘Immigrant’	2	2	

Other adapted species (mostly native) that can be added to increase vegetation diversity:

Grasses: For deep water tables; Needle-and-Thread Grass, Indian Ricegrass (sandy soils), Bottlebrush Squirreltail, Basin Wildrye. For shallow water tables; Alkali Sacaton, Thickspike Wheatgrass, Beardless Wildrye, Saltgrass.

Forbs: Lewis flax, Palmer Penstemon, Desert Globemallow.

Shrubs: Shadscale, Spiny Hopsage, Nevada Ephedra, Winterfat.

Table 3-2. Recommended “Weed Competition” Seed Mixes (pls¹ lbs/acre²) for Sagebrush/Grass Areas (8 to 10 inches annual precipitation).

Species/Variety	Clay Soils	Moderate to Deep Loamy Soils	Shallow, Sandy or Gravelly Soils
Grasses			
Crested Wheatgrass/‘CD-II’		7	
Siberian Wheatgrass/‘Vavilov’	8		7
Russian Wildrye/‘Bozoisky’	4	4	
Thickspike Wheatgrass/‘Bannock’		2	4
Western Wheatgrass/‘Arriba’	4	2	
Indian Ricegrass/‘Nezpar’			4
Forbs (optional)			
Lewis Flax/‘Maple Grove’	1	1	
Palmer Penstemon/‘Cedar’	1	1	
Shrubs (optional)			
Fourwing Saltbrush/‘Rincon’	1	1	1
Forage Kochia/‘Immigrant’	1	1	1

Other adapted species (mostly native) that can be added to increase vegetation diversity:

Grasses: Snake River Wheatgrass, Basin Wildrye, Streambank Wheatgrass, Bottlebrush Squirreltail, Needle-and-Thread Grass. For areas with at least 10 inches precipitation: Intermediate Wheatgrass, Sherman Big Bluegrass.

Forbs and Legumes: Small Burnet, Ladak Alfalfa (higher precipitation areas), Yellow Sweetclover.

Shrubs: Wyoming Big Sagebrush, Spiny Hopsage, Winterfat, Bitterbrush (higher precipitation areas).

¹pls = pure live seed. Percent pls = (% purity X % total germination)/100.

²Pure live seed pounds per acre suggested for broadcast seeding, followed by dragging with a light harrow or other equipment to cover seed. If drill seeding, cut rates by one-half.

Table 3-3. Recommended “Weed Competition” Seed Mixes (pls¹ lbs/acre²) for Pinyon/Juniper Areas (10 to 14 inches annual precipitation).

Species/Variety	Clay Soils	Moderate to Deep Loamy Soils	Shallow, Sandy Soils
Grasses			
Intermediate-Pubescent Wheatgrass/‘Rush’	7	7	4 to 6
Crested Wheatgrass/‘CD-II’	5	5	
Siberian Wheatgrass/‘Vavilov’			6
Russian Wildrye/‘Bozoisky’	4		
Thickspike Wheatgrass/‘Bannock’		4	4
Sheep Fescue/‘Covar’			3
Forbs (optional)			
Dryland Alfalfa/‘Ladak’	1	1	
Blue Flax/‘Appar’	1	1	1
Shrubs			
Forage Kochia/‘Immigrant’	0.5 to 1	0.5 to 1	0.5 to 1

Other adapted species (mostly native) that can be added to increase vegetation diversity:

Grasses: Indian Ricegrass (sandy soils), Slender Wheatgrass, Bluebunch Wheatgrass, Needle-and-Thread Grass, Sherman Big Bluegrass, NewHy Wheatgrass (at least 14 inches precipitation).

Forbs: Pacific Aster, Globemallow, Small Burnet.

Shrubs: Wyoming Big Sagebrush, Mountain Big Sagebrush, Bitterbrush, Fourwing Saltbush.

Table 3-4. Recommended “Weed Competition” Seed Mixes (pls¹ lbs/acre²) for Irrigated Meadow Areas (alkaline/saline soils).

Species/Variety	Light Salinity	Moderate Salinity	Severe Salinity
	Single Species ³	Single Species ³	Single Species ³
Grasses, choose 1			
Tall Wheatgrass/‘Alkar’	14	15	15
Tall Fescue ⁴ /‘Johnstone’	16	16	
NewHy Wheatgrass		18	
Legumes, choose 1			
Alsike Clover/‘Aurora’	1	1	
Strawberry Clover/‘Salina’			1
Birdsfoot Trefoil/‘Empire’	1		

Other adapted species (mostly native) that can be added to increase vegetation diversity:

Grasses: For moderate to severe salinity, Alkali Sacaton and Beardless Wild Rye.

Forbs and Legumes: Sweet Clover species are very tolerant of saline/sodic conditions. Sainfoin may also be used unless there is a concern about long-term flooding.

¹pls = pure live seed. Percent pls = (% purity X % total germination)/100.

²Pure live seed pounds per acre suggested for broadcast seeding, followed by dragging with a light harrow or other equipment to cover seed. If drill seeding, cut rates by one-half.

³Choose only one species of grass, then sow it at the recommended seeding rate along with a legume.

⁴Tall fescue is very competitive and will eventually crowd out any legumes planted with it.

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CHAPTER FOUR – INVASIVE AND TROUBLESOME (NUISANCE) WEED IDENTIFICATION AND CONTROL

The herbicide alternatives included in Chapter Four have been prioritized based on relative effectiveness, ease of acquisition, and cost. As an example, if the herbicide 2,4-D is considered to be essentially as effective as picloram for control of a given weed species, then 2,4-D will be listed first because restricted-use certification is not required for its purchase and application and 2,4-D is less expensive.

This chapter is divided into two sections, Invasive Weeds (designated as “noxious” in Nevada) and Troublesome (Nuisance) Weeds. The weeds have been listed alphabetically by scientific name within

plant families in the text because their control measures are usually similar. On the back of this page (page 26), they are listed alphabetically by common name and scientific name along with their page number as a help to the reader.

Technical terms and standard abbreviations used in this chapter, on the Web, and on pesticide labels are defined in the glossary (Appendix A). Instructions for calibrating herbicide mixtures are included in Appendix G. For additional information and invasive weed management recommendations, peruse the Internet (see Appendix J).

Information herein is offered with no discrimination. Listing a product does not imply endorsement by the authors, University of Nevada Cooperative Extension (UNCE) or its personnel. Likewise, criticism of products or equipment not listed is neither implied nor intended. UNCE and its authorized agents do not assume liability for suggested use(s) of chemical or other pest control measures suggested herein. Pesticides must be applied according to the label directions to be lawfully and effectively applied.

Alphabetical by Common Name

Invasive (Noxious) Weeds

Black Henbane (<i>Hyoscyamus niger</i>)	69
Canada Thistle (<i>Cirsium arvense</i>)	47
Dalmatian Toadflax (<i>Linaria genistifolia</i>)	65
Diffuse Knapweed (<i>Centaurea diffusa</i>)	37
Dyer's Woad (<i>Isatis tinctoria</i>)	55
Hoary Cress/Whitetop (<i>Cardaria draba</i>)	53
Houndstongue (<i>Cynoglossum officinale</i>)	51
Leafy Spurge (<i>Euphorbia esula</i>)	59
Medusahead (<i>Taeniatherum caput-medusae</i>)	63
Musk Thistle (<i>Carduus nutans</i>)	35
Perennial Pepperweed/Tall Whitetop (<i>Lepidium latifolium</i>)	57
Poison Hemlock (<i>Conium maculatum</i>)	31
Puncturevine (<i>Tribulus terrestris</i>)	73
Purple Loosestrife (<i>Lythrum salicaria</i>)	61
Rush Skeletonweed (<i>Chondrilla juncea</i>)	45
Russian Knapweed (<i>Acroptilon repens</i>)	33

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Invasive Weeds

(All designated as noxious in Nevada)

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Cicuta maculata L. and
Cicuta douglasii (DC.) Coult. & Rose

Water Hemlock and Western Waterhemlock

Apiaceae



Water hemlock and western waterhemlock are native to the intermountain region, which includes Nevada. They are wetland plants and are frequently found along streams, irrigation and roadside ditches, in pastures, and other moist areas. These hemlocks are some of the most poisonous plants found in North America. The juice in the root is the most poisonous part of the plant. They are often mistaken for waterparsnip and other members of the parsley family (*Apiaceae*). Water and western waterhemlock are easily controlled when managed consistently and diligently. Graze hemlock-infested areas with livestock only when the ground is dry and hard.

Distinguishing features:

- ◆ Stems grow 3 to 7 feet tall and may be swollen at the base.
- ◆ Both species have pinnately divided leaves. The leaflets are toothed, and in western waterhemlock, the veins end at the bottom of each tooth.
- ◆ Flowers are white and occur in terminal umbels that are flat on top. Flowering occurs from June to September.
- ◆ Two round- to kidney-shaped seeds are produced by each flower. The ribs on the seed of western waterhemlock are much wider than the intervals between, whereas water hemlock seed has ribs that are as wide or narrower than the space between ribs.
- ◆ The roots have horizontal chambers, visible when the root is split in half. Take care checking the root because it is the most poisonous part of the plant. Wear gloves, a long-sleeved shirt, and long trousers when working around this plant to prevent incidental poisoning.

Mature water hemlock and western waterhemlock plants are nearly indistinguishable.



The alternate leaves are pinnately divided (below).



The roots contain a very poisonous toxin. Western waterhemlock has a chambered crown (right).

CONTROL MEASURES

Most Effective Strategy: A combination of herbicides and hand-pulling whenever individual plants are found will reduce populations to an easily-managed level quickly. Water hemlock and western waterhemlock are highly poisonous to both animals and humans, and there is evidence that the toxicity of the plant increases after herbicides are applied up until the time that the plant dries.

Mechanical Control: Hand-grubbing is very effective, but care must be taken to make sure the roots are removed entirely. Moist ground allows for easy removal. Burn all the plant pieces after removal. Wear gloves and protective clothing because the plant is poisonous (especially the crown, when ingested) and may cause skin irritation when handled without protection.

Cultural Control: Water hemlock and western waterhemlock are pulled out of the ground very easily in areas where the ground is moist and soft; thus, animals are likely to eat the entire plant. This increases the chances of livestock poisoning. Grazing should be postponed until the ground is dry and the plant is difficult to remove. Controlling the access of animals to habitats where these plants grow will reduce the risk of poisoning.

Biological Control: There are currently no biological control methods available for water hemlock or western waterhemlock.

Control Measures for Water Hemlock and Western Waterhemlock (Alias: *Cicuta maculata* and *Cicuta douglasii*) Continued

Chemical Control:

2,4-D ester

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply in the early bolting to flower bud stages of growth.

Remarks: 2,4-D ester is not labeled to use in or near water. Adding an appropriate surfactant to the mixture may increase its effectiveness.

Caution: Do not graze treated areas until plants have completely dried. Avoid drift to sensitive crops.

2,4-D amine

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply in the early bolting to flower bud stages of growth.

Remarks: If the plants are in or near water, ensure that the herbicide label states that it can legally be used in or near water.

Caution: Do not graze treated areas until plants have completely dried up. Avoid drift to sensitive crops.

MCPA

Rate: Use 2 quarts per acre or 2 pounds a.e. per acre.

Time: Apply in the early bolting stage of growth.

Remarks: Do not use in or near water.

Caution: Do not graze treated areas until plants have completely dried up to avoid livestock poisoning. Avoid drift to sensitive crops.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 3 pounds a.e. per acre.

Time: Apply glyphosate before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Conium maculatum L.

Poison Hemlock Apiaceae

Poison hemlock was introduced to North America from Europe and is now established in almost every state in the United States. This perennial grows along streams, irrigation and roadside ditches, and invades crop and pasture lands. All plant parts contain alkaloids and are poisonous. Poison hemlock can be mistaken for parsley. Animals do not eat it unless other food is scarce. Both poison hemlock and western water hemlock have large taproots. The purple spots on the stems of poison hemlock distinguish it from the other hemlocks. Poison hemlock is easily controlled when managed consistently and diligently.

Distinguishing features:

- ◆ The plant typically grows 4 to 8 feet tall.
- ◆ The stems are ridged and have distinct purple spots.
- ◆ The compound leaves are lacy, resembling parsley, and have a musty odor. The leaflets are less than 1/4 inch long. Seedlings may appear fern-like.
- ◆ White flowers are found from July to September at the end of branches in flat, umbel clusters.
- ◆ The fruits contain 2 light brown, 1/8-inch-long seeds that are paired, ribbed, and concave.

The leaves are divided 3 or 4 times, giving them a fern-like appearance (below).



Poison hemlock stems are covered with purple spots (right).



Mature poison hemlock plant.



CONTROL MEASURES

Most Effective Strategy: A combination of herbicides and hand-pulling whenever individual plants are found will reduce populations to an easily managed level quickly. Poison hemlock is highly poisonous to both animals and humans, and there is evidence that the toxicity of the plant increases after herbicides are applied up until the time that the plant dries.

Mechanical Control: Plowing or repeated cultivation will prevent establishment. If cultivation is not possible, mow the plants after they have bolted. A single mowing will not provide control. Repeated mowing will reduce the plant's competitive ability, deplete carbohydrate energy reserves in the taproot, and prevent seed production. Mowing close to the ground will also reduce the amount of leaf material available for livestock grazing. Hand-grubbing is effective, but not as effective as for control of western waterhemlock and water hemlock. Care must be taken to make sure the roots are removed entirely. Moist ground allows for easy removal. Burn all the plant pieces after removal. Wear gloves and protective clothing because this plant is poisonous when ingested and may also cause skin irritation when handled.

Cultural Control: Poison hemlock is pulled out of the ground very easily in areas where the ground is moist and soft, and thus animals are likely to eat the entire plant. This increases the chances of livestock poisoning. Grazing should be postponed until the ground is dry and the plant is hard to remove. Controlling the access of animals to habitats where this plant grows will reduce the risk of their poisoning.

Biological Control: The defoliating hemlock moth (*Aganopterix alstroemeriana*) feeds on all parts of the poison hemlock plant. No determination is available about the effectiveness of control.

Control Measures for Poison Hemlock (Alias: *Conium maculatum*) Continued

Chemical Control:

2,4-D ester

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply to plants in the early spring, rosette stage of growth.

Remarks: 2,4-D ester is not labeled to use in or near water. Adding an appropriate surfactant to the mixture may increase its effectiveness.

Caution: Do not graze treated areas until plants have completely dried. Avoid drift to sensitive crops.

2,4-D amine

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply to plants in the early spring, rosette stage of growth.

Remarks: If the plants are in or near water, ensure that the herbicide label states that the herbicide can legally be used in or near water.

Caution: Do not graze treated areas until plants have completely dried up. Avoid drift to sensitive crops.

MCPA

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply to plants in the early spring, rosette stage of growth.

Remarks: Adding diesel oil to the mixture may increase effectiveness, but cannot be used in or where it will contaminate water. Diesel oil may be used if not prohibited on the label.

Caution: Do not graze treated areas until plants have completely dried up. Avoid drift to sensitive crops.

Glyphosate (Roundup[®], Landmaster[™], Rodeo[®], or Aquamaster[™])

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Metsulfuron (Escort[®])

Rate: Use 1 to 2 ounces per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar[®])

Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar[®] per acre).

Time: Apply during preemergence or early postemergence when the plants are actively germinating or growing.

Remarks: When making postemergence applications, use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Imazapyr (Arsenal[®])

Rate: Use 2 to 4 pounds a.e. per acre.

Time: Apply prior to flowering.

Remarks: Arsenal[®] kills many annual and perennial grasses and broadleaf plants. Spot treat to avoid damaging nearby trees, shrubs, and forbs.

Caution: Do not graze or use near water. Use on noncropland and rights-of-way only.

Read and follow the label. It is the law!

Acroptilon repens (L.) DC. (Formerly *Centaurea repens*)

Russian Knapweed Asteraceae

Russian knapweed is native to Eurasia. It is a perennial in Nevada and can be found in cultivated fields, orchards, pastures, roadsides, and rangelands. It prefers areas where the water table is within 20 feet of the surface and can easily dominate cultivated fields and rangelands where its deep roots penetrate to free water. It is very difficult to control because of its deep, extensive roots. Even in deserts, the roots grow down to the water table, especially if the plant becomes established during moist years. Reproduction from the roots ensures the spread of separate plants to form a colony. Transporting infested soils and moving contaminated equipment spread this weed.

Distinguishing features:

- ◆ It grows 18 to 36 inches tall.
- ◆ The stems are erect and multibranched.
- ◆ Its leaves are blue-green, toothed, and covered with fine hair.
- ◆ Showy pink flowers bloom from June to September. The pearly bracts at the base of the flower head are rounded with papery margins. The flowers are small, solitary, ¼ to ½ inch long, urn-shaped, and usually pink, but can be white to purple.
- ◆ Dense colonies can establish from adventitious buds on the roots.

Mature Russian knapweed plant.



The bracts of the pinkish purple flowers have papery tips (right).



The fine hairs covering the toothed leaves of newly emerging plants give them a blue-green color (left).

CONTROL MEASURES

Most Effective Strategy: Once established, this plant is difficult to control. The most effective treatments combine herbicides and cultural controls. Treat with picloram (Tordon®) as soon as possible following the first hard freeze in the fall. Apparently, the plant carries the herbicide deeper into the roots while storing carbohydrates for the winter. The following spring, bury, burn, or remove all plant material from the soil surface because it will kill newly germinating crop or native seedlings (allelopathy). Sow seeds of competitive plants that are tolerant of picloram, such as grasses, to create cover. Annual retreatment with picloram will be necessary for several years until no new Russian knapweed seedlings emerge.

Mechanical Control: Mechanical and physical methods are not effective. They require too many repeated treatments. If employed, deep plowing must be repeated at least every 21 days or whenever root fragments grow and reach the soil surface. If plowing and cultivation are not repeated frequently, the root fragments will grow, increasing the size and density of the infestation.

Cultural Control: Russian knapweed can be poisonous to horses if grazed repeatedly. Cattle, sheep, and goats can safely graze Russian knapweed, especially in the spring when the shoots are young and tender. They eat other vegetation as Russian knapweed becomes older and less palatable.

Biological Control: The Russian knapweed stem and leaf gall, a Turkish nematode (*Subanquina picridis*), was released in 1984 but has not proven effective because it migrates too slowly to new plants. Three fungal diseases affect this weed. *Alternaria* spp. attacks the leaves and stems, *Puccinia acroptili* attacks the stems, and *Sclerotinia sclerotiorum* infests the crown. All 3 can be applied to cause a minor amount of plant stress. They do not kill the plant.

Control Measures for Russian Knapweed (Alias: *Acroptilon repens*) Continued

Chemical Control:

Picloram (Tordon 22K®)

- Rate: Apply Tordon 22K® at 2 to 4 pints per acre or 1/2 to 1 pound a.e. per acre. Spot treat at a rate up to 2 quarts per acre (1 pound a.e. per acre). At lower rates, tank mix with 1 pound a.e. per acre 2,4-D to improve control.
- Time: Apply picloram during active growth from bud to midflowering or to fall regrowth after the first frost.
- Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.
- Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Imazapic (Plateau®)

- Rate: Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre.
- Time: Apply Plateau® at 12 ounces per acre with 1 quart per acre of methylated seed oil when Russian knapweed begins fall senescence up through or right after full senescence. Otherwise, control will be poor.
- Remarks: Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.
- Caution: No grazing restrictions exist, but do not harvest hay for at least 7 days following application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Clopyralid (Transline® or Stinger®)

- Rate: Apply 2/3 pint per acre or 1/4 pound a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time: Apply from full bloom until late fall after a killing frost. Use the lowest rates after a killing frost in the fall.
- Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species competing with Russian knapweed. Clopyralid only reduces the vigor and stand of Russian knapweed.
- Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Metsulfuron (Escort®)

- Rate: Apply 1 1/2 to 2 ounces per acre.
- Time: Apply during the rosette to full bloom stages of growth.
- Remarks: Suppression (reduced plant vigor and stand) is only achieved with full coverage. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).
- Time: Apply at prebloom to bloom stages of growth or late in the fall.
- Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effects on any competitive vegetation. Do not contaminate water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

- Rate: Use 1 to 2 pounds of Dicamba per acre.
- Time: Apply when plants are in the rosette stage of growth.
- Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.
- Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

- Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.
- Time: Apply when plants are actively growing before flower bud formation.
- Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.
- Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Carduus nutans L.

Musk Thistle Asteraceae

Musk thistle, also known as nodding thistle, is a native of southern Europe and Asia that invades pasture and forest lands, ditch banks, waste areas, and stream banks. It is a biennial or sometimes a winter annual. Musk thistle competes with and decreases desirable forage. Its dense growth and spiny nature inhibits the use of an area by people and animals. It only spreads by seed, which can remain viable in the soil for over a decade. An isolated plant can easily expand into a large infestation over a few years.

Distinguishing features:

- ◆ This robust plant grows up to 6 feet tall or more.
- ◆ Its spiny leaves are waxy, up to 10 inches long, deeply lobed (5 points per lobe), dark green with a light green midrib, with yellow spines on lobed, white margins.
- ◆ Solitary flowers are borne at the stem tips in midsummer. The 1½- to 3-inch diameter heads bend (nod) to the side. Blossoms are deep rose to violet and sometimes white. They are surrounded by spine-tipped bracts that are lanceolate to ovate, spreading to reflexed at the middle.

Musk thistle plants grow up to 6 feet tall.



The purple flower head with distinctive bracts “nods” to the side (left).



Seedlings have a light green midrib and yellow spines on lobed margins (right).

CONTROL MEASURES

Most Effective Strategy: Once established, this biennial is difficult to control. Efforts should be focused on the first year of the plant’s growth. Research and experience have shown the most effective treatment is a combination of herbicides, appropriate biological control agents, and cultural controls. Consistent and uniform spring and early summer herbicide applications control musk thistle. Areas of bare soil must be seeded with competitive vegetation. Retreatment is necessary whenever new seedlings emerge. Efforts must be continued until the soil seed reservoir is depleted.

Mechanical Control: Where possible, tillage and cultivation are effective. Tilling, hoeing, and hand-pulling must be completed in the rosette stage or early after the flower stalk starts to elongate but before the plant flowers and produces seed. If performed at a later stage of plant development, this may spread musk thistle. Small infestations may be controlled by cutting the root just below the soil surface. Mowing is not recommended because it produces a prostrate plant that may still flower and produce seed if the growing season is sufficiently long.

Cultural Control: Reestablish desirable vegetation to provide competition.

Biological Control: Three insects have been released in the United States for control of musk thistle: a seed weevil (*Rhinocyllus conicus*), a beetle (*Trichosiocalus horridus*), and a leaf and shoot miner (*Cheilisia corydon*).

Chemical Control:

Picloram (Tordon®)

Rate: In the fall, apply ½ to ¾ pound of Tordon 22K® per acre (⅛ to ⅜ pound of Picloram a.e. per acre). In the spring, apply ½ to ¾ pint Tordon 22K® (⅛ to ⅜ pound of Picloram a.e. per acre) plus 1 pound a.e. per acre of 2,4-D. For bolted musk thistle, apply before flowering at the rate of ½ to 1 pint of Tordon 22K® per acre (⅛ to ¼ pound Picloram a.e. per acre) plus 1 pound a.e. per acre of 2,4-D.

Time: Apply at the rosette stage of growth before bolting in the spring or in the fall prior to the freezing of the soil.

Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Control Measures for Musk Thistle (Alias: *Carduus nutans*) Continued

Clopyralid (Transline® or Stinger®)

- Rate:** Apply 1/3 to 1 pint per acre or 2 pounds a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time:** Apply after rosette's emergence to bolting stage of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are no larger than 3 to 6 inches tall.
- Remarks:** Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with musk thistle.
- Caution:** Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

- Rate:** Use 2 to 4 quarts Curtail per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.
- Time:** Apply after most rosettes have emerged but before flower bud formation.
- Remarks:** Apply only in rangeland, pastures, and noncropland.
- Caution:** Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Metsulfuron (Escort®)

- Rate:** Apply 1/2 to 1 ounce per acre.
- Time:** Apply during the rosette to full bloom stages of growth.
- Remarks:** Certain musk thistle biotypes are more sensitive to Escort® and may be controlled with 1/4 to 1/2 ounce per acre. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate:** Use 1/2 to 1 ounce a.i. per acre of chlorsulfuron (2/3 to 3/4 ounce Telar® per acre).
- Time:** Apply preemergence or early postemergence when plants are actively germinating or growing.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Sulfometuron methyl (Oust®)

- Rate:** Use 6 to 8 ounces per acre.
- Time:** Apply in late spring to early summer.
- Remarks:** Use the higher rate in areas of dense weed growth or when soil contains more than 2 1/2 percent organic matter.
- Caution:** Annual retreatment may reduce the vigor of desirable plants, particularly at higher recommended rates, where crested wheatgrass or brome is grown. Excessive injury to nontarget species may occur if a surfactant is used. Do not apply more than 8 ounces per acre per year. Use a drift control agent according to the manufacturer's recommendations. Use in accordance with label directions.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

- Rate:** Use 1 to 2 pounds of Dicamba per acre.
- Time:** Apply when plants are in the rosette stage of growth.
- Remarks:** Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.
- Caution:** Avoid drift to sensitive crops. Read and follow the label directions.

2,4-D amine/ester and/or dicamba

- Rate:** Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.
- Time:** Apply prior to flower bud formation. Repeat herbicide applications may be necessary during the growing season to kill newly germinating seeds. When musk thistle is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks:** Annual treatments are needed to control musk thistle seedlings or rosettes.
- Caution:** It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Read and follow the label. It is the law!

Diffuse Knapweed

Asteraceae

Centaurea diffusa

Diffuse knapweed is a very competitive rangeland weed that occupies pastures, roadsides, and waste areas. It is native to Eurasia and is widely distributed in the western United States. It grows 12 to 24 inches tall as a diffusely branched annual or short-lived perennial. Its lower leaves are pinnate and its upper leaves are bract-like. The small, narrow, white-to-pink (or sometimes purple) flowers are not deciduous and produce brown to grayish achenes. The margins of the flower bracts are fringed like a comb and have a slender spine at each tip. The spines are not recurved. Flowering occurs July through September.

Distinguishing features:

- ◆ Leaves are finely divided, gray-green, and bract-like on the upper branches and pinnate at the base of the plant.
- ◆ The small, white-to-pink flower heads do not fall off the stems when the seeds mature.
- ◆ The bracts of the flower have comb-like margins and a slender spine at their tip.

Diffuse knapweed grows 12 to 24 inches tall.



Young, highly divided, gray-green leaves (right).

Spined flower bracts have fine teeth along the spine's margin (below).



CONTROL MEASURES

Most Effective Strategy: Once established, this plant is difficult to control. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Plant bare soil with competitive vegetation. Retreatment is necessary when new knapweed seedlings emerge. A long-term effort must be continued until the soil seed bank is depleted.

Mechanical Control: Persistent hand-pulling, before plants produce seed, controls small infestations. The entire plant must be removed. Properly dispose of flowering plants after removal. Repeated tillage, 7 inches deep, reduces diffuse knapweed stands and encourages grass growth. Fire may increase the establishment of diffuse knapweed. Mowing can increase seed production so is not recommended.

Cultural Control: Carefully managed, repeated grazing by sheep and goats early in the spring when grasses are dormant reduces diffuse knapweed seedlings and rosettes.

Biological Control: Several biocontrol agents are available. Two gall flies (*Urophora affinis* and *U. quadrifasciata*) redirect plant energy from seed production to the formation of galls to encompass the fly's eggs. The sulfur knapweed moth (*Agapeta zoegana*) mines within the root. A seedhead moth (*Metzneria paucipunctella*), the peacock fly (*Chaetorellia acroliphi*), the bronze root borer (*Sphenoptera jugoslavica*), the green clearwing seed head fly (*Terellia virens*), the blister mite (*Aceria centaureae*), a Turkish nematode (*Subanquina picridis*), 2 root moths (*Pelochrista medullano* and *Pterolonche inspersa*), and 3 seed head weevils (*Larinus minutus*, *L. obtusus*, and *Bangasternus fausti*) also reduce plant vigor. The soil fungus, *Sclerotinia sclerotiorum*, infects diffuse knapweed and causes wilting or death of individual plants. Another fungus, *Puccinia jaceae*, works on the leaves of the plant. Each biological agent is effective only under specific environmental conditions.

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre. Lower application rates may require annual spot treatment. At lower rates, tank mix with 1 pound a.e. per acre 2,4-D to improve control.

Time: Apply from rosette to midbolting stages or to fall regrowth.

Remarks: Up to 4-years control of diffuse knapweed seedlings has been demonstrated in picloram research plots. Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Control Measures for Diffuse Knapweed (Alias: *Centaurea diffusa*) Continued

Clopyralid (Transline® or Stinger®)

- Rate:** Apply $\frac{2}{3}$ to 1 pint per acre or 4 to 6 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time:** Apply anytime plants are actively growing. The optimum time is after rosettes have emerged but before flower bud formation. The lower rate of $\frac{1}{4}$ pint per acre provides control only when the plants are 3 to 6 inches tall.
- Remarks:** Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with diffuse knapweed.
- Caution:** Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

- Rate:** Use 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.
- Time:** Apply after most of the rosettes have emerged but before flower bud formation.
- Remarks:** Only apply in rangeland, pastures, and noncropland.
- Caution:** Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Metsulfuron (Escort®) (Tank Mix)

- Rate:** Use $\frac{1}{2}$ to 1 ounce metsulfuron combined with 8 fluid ounces dicamba and 16 fluid ounces 2,4-D per acre.
- Time:** Apply from rosette to full bloom stages of growth.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Imazapyr (Arsenal®)

- Rate:** Apply 3 to 4 pints per acre.
- Time:** Use as a postemergence application only.
- Remarks:** Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.
- Caution:** Use on noncropland only.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

- Rate:** Use $\frac{1}{2}$ to 1 pounds of Dicamba per acre.
- Time:** Apply when plants are in the rosette stage of growth.
- Remarks:** Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check label for tank mixing instructions.
- Caution:** Avoid drift to sensitive crops. Read and follow the label directions.

2,4-D amine or ester

- Rate:** Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.
- Time:** Apply prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season to kill newly germinated seeds. When diffuse knapweed is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks:** Annual treatments are needed to control diffuse knapweed seedlings and rosettes.
- Caution:** It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

- Rate:** Use 1 $\frac{1}{2}$ pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.
- Time:** Apply when plants are actively growing before flower bud formation.
- Remarks:** Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.
- Caution:** Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Centaurea maculosa Lam.

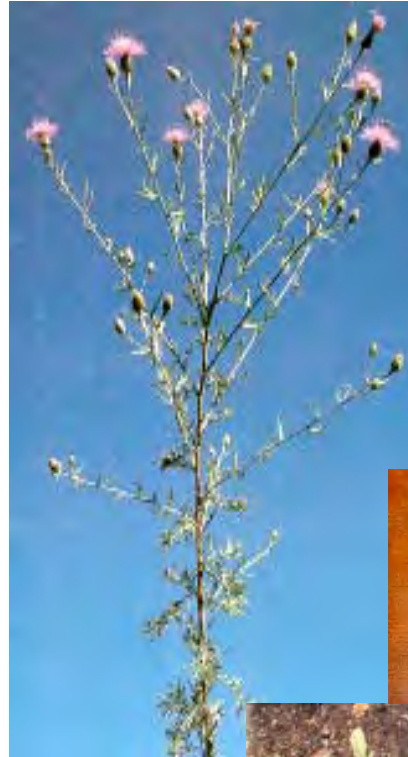
Spotted Knapweed Asteraceae

Spotted knapweed, introduced from Eurasia as a contaminant in alfalfa and clover seeds, is one of the leading problem weeds in the United States. This biennial plant can dominate rangelands that receive less than eight inches of annual precipitation. Difficult to control because of its prolific seed production and early seedling emergence, it flourishes in areas with more moisture or at higher elevations where moisture is more reliable. It suppresses the growth of other plants by releasing inhibiting chemicals from its roots. Large plants may produce up to 25,000 seeds that remain viable in the soil for five years or more. Its seed survives rangeland fires to recolonize after the first moisture following the fire, before most native species. Consistently eliminating new seedlings is key to reducing the soil seed bank and controlling spotted knapweed. Missing one year of control will negate any previous efforts to manage it.

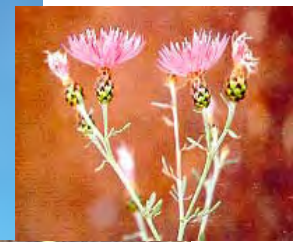
Distinguishing features:

- ◆ A rosette of small leaves appears the first year. Leaves are deeply lobed, 6 inches long, and up to 1 inch wide, particularly near the base of the second-year plant.
- ◆ Spotted knapweed develops a very deep root system.
- ◆ Spotted knapweed grows up to 4 feet tall the second year.
- ◆ Flowering stalks emerge from the rosette the second year. Flowers are pink to purple (occasionally white), solitary, up to 1 inch in diameter, and bloom from June to October.
- ◆ Seeds are brownish, less than 1/4 inch long, and have a short tuft of bristles at the tip.

Mature spotted knapweed plant.



Pinkish purple flowers have fringed bracts tipped with dark spots (below).



Spring rosettes have deeply lobed leaves (right).



CONTROL MEASURES

Most Effective Strategy: Once established, this plant is difficult to control. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Plant bare soil with competitive vegetation. Retreatment is necessary when new spotted knapweed seedlings emerge. A long-term effort must be continued until the soil seed bank is depleted.

Mechanical Control: Persistent hand-pulling, before plants produce seed, controls small infestations. The entire plant must be removed. Properly dispose of flowering plants after removal. Repeated tillage, 7 inches deep, reduces spotted knapweed and encourages the growth of grasses. Fire may increase the establishment of this plant. Repeated mowing can reduce seed production if it is delayed until seeds are near maturity but before they reach full maturity and are viable.

Cultural Control: Carefully managed, repeated grazing by sheep and goats early in the spring when grasses are dormant reduces spotted knapweed seedlings and rosettes.

Biological Control: Several biological control agents are available for suppressing spotted knapweed. Two gall flies (*Urophora affinis* and *U. quadrifasciata*) redirect plant energy from seed production to formation of galls to encompass the fly's eggs. The sulfur knapweed moth (*Agapeta zoegana*) mines within the root and in Nevada has been found to be quite effective in reducing plant vigor. However, it does not spread rapidly. Also a root boring beetle (*Cyphodectonus achates*), a seed head moth (*Metzneria paucipunctella*), a peacock fly (*Chaetorellia acroliphi*), the bronze root borer (*Sphenoptera jugoslavica*), the green clearwing seed head fly (*Terellia virens*), the blister mite (*Aceria centaureae*), 2 root moths (*Pelochrista medullano* and *Pterolonche dispersa*), and 3 seed head weevils (*Larinus minutus*, *L. obtusus*, and *Bangasternus fausti*) reduce plant vigor with varying degrees of success. The soil fungus, *Sclerotinia sclerotiorum*, infects spotted knapweed and can cause wilting or death of individual plants. The bacteria, *Pseudomonas syringae* pv. *syringae*, also infects this plant species. Each biological agent is effective only under specific environmental conditions.

Control Measures for Spotted Knapweed (Alias: *Centaurea maculosa*) Continued

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre. Lower application rates may require annual spot treatment that may be improved by tank mixing with 1 pound a.e. per acre 2,4-D.

Time: The optimum application of picloram is from the rosette to midbolting stages of growth or to fall regrowth.

Remarks: Up to 4-years control of spotted knapweed seedlings has been demonstrated in picloram research plots. Adjustment of the application rate will affect the selectivity of picloram. At the recommended rate, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

Rate: Apply at 1 to 1 1/3 pints per acre or 6 to 8 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.

Time: Apply anytime plants are actively growing, including any fall regrowth. Optimum time to apply is after most rosettes have emerged but before flower bud formation.

Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with spotted knapweed.

Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

Rate: Apply 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2.0 pounds a.e. 2,4-D per acre.

Time: Apply after most of the rosettes have emerged but before flower bud formation.

Remarks: Only apply in rangeland, pastures, and noncropland.

Caution: Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Metsulfuron (Escort®) (Tank Mix)

Rate: Use 1/2 to 1 ounce metsulfuron combined with 8 fluid ounces dicamba and 16 fluid ounces 2,4-D per acre.

Time: Apply from rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1/2 to 1 pound of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Dicamba is frequently used in a tank mix with other herbicides to increase its effectiveness. Check label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

2,4-D amine or ester

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season to kill newly germinating seeds. When spotted knapweed is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.

Remarks: Annual treatments are needed to control spotted knapweed seedlings or rosettes.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not contaminate water unless using a product specifically formulated for use in water.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Centaurea solstitialis L.

Yellow Starthistle Asteraceae

Yellow starthistle is a Mediterranean annual weed that dominates rangelands, roadsides, pastures, and fields primarily in Oregon, Washington, California, and Idaho. It completely changes the natural habitat it invades. Its spines are injurious and restrict movement of recreationists, livestock, and wildlife. It is poisonous to horses, causing a nervous disorder called “chewing disease.” Yellow starthistle seed survives most rangeland fires to recolonize after the first moisture following the fire, before most native species. Prolific seed production and early seedling emergence ensures that it dominates areas with sufficient annual precipitation. It will flourish even in Nevada’s deserts that receive less than eight inches of annual precipitation. Consistently eliminating new seedlings is key to reducing the soil seed bank and eventually its infestation. Because of its tremendous seed production, missing one year of control negates any previous efforts to manage it.

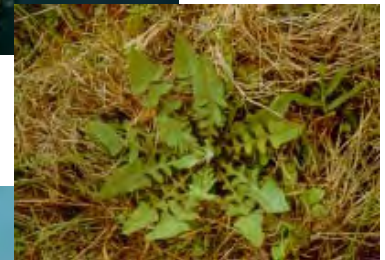
Distinguishing features:

- ◆ It grows up to 36 inches tall as a multibranched plant.
- ◆ After seed germination in the fall or spring, the first leaves form a rosette of deeply lobed leaves up to 8 inches long.
- ◆ Lower leaves, 2 to 4 inches long, are deeply lobed. Upper leaves are more narrow, pointed, smaller, and form fringe-like extensions along the stems. Stems and leaves of mature plants have a woolly appearance.
- ◆ Yellow flower heads are located singly at the tips of branched stems with outward-pointing, up to 2-inch-long, stiff spines. Flowers bloom from May to December.

Mature yellow starthistle plant.



Seedling plant leaves have deeply lobed margins with pointed tips (below).



Yellow starthistle flowers with up to ¾-inch-long spines (left).

CONTROL MEASURES

Most Effective Strategy: Once established, this plant is difficult to control. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Plant bare soil with competitive vegetation. Retreatment is necessary when new yellow starthistle seedlings emerge. A long-term effort must be continued until the soil seed bank is depleted.

Mechanical Control: Persistent hand-pulling, before plants produce seed, controls small infestations. Severing the root a few inches below the soil surface is sufficient. Properly dispose of flowering plants after removal. Repeated tillage, 7 inches deep, reduces yellow starthistle stands. Burning alone is ineffective and may increase plant size and seed production. Burning followed by a fall herbicide treatment may be effective. Mowing is not recommended. The plant becomes prostrate and may produce more seed than an upright plant.

Cultural Control: Grazing with sheep, goats, or cattle is effective if done after the bolting stage and before the flowering, spiny stage. Goats will continue grazing after the spines have appeared. After mechanical or chemical control, establish desirable vegetation to occupy the vacant space and to compete with yellow starthistle seedlings.

Biological Control: Several biological control insects suppress yellow starthistle. A gall fly (*Urophora sirunaseva*) redirects plant energy from seed production to formation of galls to encompass the fly’s eggs. The hairy weevil (*Eustenopus villosus*), peacock fly (*Chaetorellia australis*), flower weevil (*Larinus curtus*) and false peacock fly (*Chaetorellia succinea*—effective, spreading naturally, inadvertently introduced, and legally unavailable for distribution) all attack the flower heads. Their larvae feed on the seeds. The bud weevil (*Bangasternus orientalis*) feeds on the seed head. The blister mite (*Aceria centaureae*) produces leaf galls, but release has not occurred to date in Nevada.

Control Measures for Yellow Starthistle (Alias: *Centaurea solstitialis*) Continued

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre.

Time: Apply when soil moisture is adequate and weeds are actively growing. Control is best in the spring up to the time of flower bud formation.

Remarks: Up to 3-years control of yellow starthistle seedlings has been demonstrated in picloram research plots. Adjustment of the application rate will affect the selectivity of picloram. At the recommended rate, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

Rate: Apply at 1/3 to 1 pint per acre or 2 to 6 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.

Time: Apply from the rosette to bolting stages of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are 3 to 6 inches tall.

Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with yellow starthistle.

Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: Chlorsulfuron partially controls yellow starthistle. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Imazapyr (Arsenal®)

Rate: Apply 3 to 4 pints per acre.

Time: Use as a postemergence application only.

Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.

Caution: Use on noncropland only.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Apply 1/2 to 1 pound of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Squarrose Knapweed

Centaurea virgatta Lam. var. *squarrosa* (Willd.) Boiss.

Asteraceae

Squarrose knapweed, a very competitive rangeland weed, is native to the eastern Mediterranean. It is found in California, Utah, Colorado, and Nevada, where it grows 12 to 36 inches tall. It is a long-lived perennial with a large, deep tap root. Its lower leaves are dissected and its upper leaves are bracts along the much-branched stems. The small flower clusters containing four to eight, rose- or pink-colored flowers appear from June to August, are deciduous when mature, and only produce three to four seeds each. The bracts of the seed head are spined, the central spine is large, and they are recurved. Seeds are easily spread by livestock and wildlife.

Distinguishing features:

- ◆ A showy plant, it is often confused with diffuse knapweed, but squarrose knapweed is a true perennial.
- ◆ Leaves are deeply lobed (incised), gray-green near the base of the plant, and bract-like on the upper branches.
- ◆ The small, pink flower heads produce 3 to 4 seeds each and then fall off the stems.
- ◆ The bracts of the flower are recurved spines; the center spine is the largest.

Young, highly incised, gray-green leaves (below).



Highly branched, rose- to pink-flowered squarrose knapweed plant.



Flower heads showing recurved bract tips (below).



CONTROL MEASURES

Most Effective Strategy: Once established, this plant is difficult to control. Research and experience have shown that the most effective treatment is a combination of herbicides, appropriate biological control agents, and cultural controls. Spring and early summer herbicide applications effectively control adult and rosette plants if done consistently and uniformly. Plant bare soil with competitive vegetation. Retreatment is necessary as new squarrose knapweed seedlings emerge. A long-term effort must be continued until the soil seed bank is depleted.

Mechanical Control: Persistent hand-pulling during the spring and throughout the growing season, before plants produce seed, can control small infestations. The entire plant must be removed. Roots will resprout when broken off, making hand pulling ineffective. Dispose of flowering plants after removal. Repeated tillage, 7 inches deep, will help reduce squarrose knapweed and encourage grass growth. Fire increases the establishment of squarrose knapweed. Mowing can increase seed reproduction, so it is not recommended.

Cultural Control: Carefully managed, repeated grazing by sheep and goats early in the spring when grasses are dormant reduces squarrose knapweed seedlings and rosettes.

Biological Control: Four biological control agents are available for suppressing squarrose knapweed. Two gall flies (*Urophora affinis* and *U. quadrifasciata*) redirect plant energy from seed production to the formation of galls to encompass the fly's eggs. A root moth (*Pterolonche inspersa*), and a head weevil (*Bangasternus fausti*) reduce plant vigor with varying degrees of success. Each biological agent is effective only under specific environmental conditions.

Control Measures for Squarrose Knapweed (Alias: *Centaurea virgatta*) Continued

Chemical Control:

Picloram (Tordon®)

- Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre. Lower application rates will require annual retreatment. Control with lower rate may be improved by tank mixing with 1 pound a.e. per acre 2,4-D.
- Time: Apply from rosette to midbolting stages of growth.
- Remarks: Up to 4-years control of squarrose knapweed seedlings has been demonstrated in picloram research plots. Adjustment of the application rate will affect the selectivity of picloram. At the recommended rate, picloram will not damage established perennial grasses.
- Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Read and follow the label. It is the law!

Chondrilla juncea L.

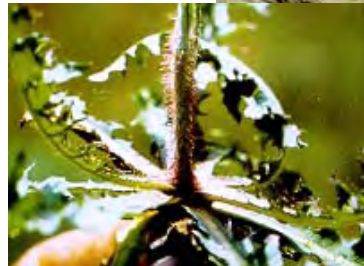
Rush Skeletonweed Asteraceae

Rush skeletonweed, a long-lived perennial native to Asia and the Mediterranean, infests millions of acres throughout Idaho, Oregon, Washington, California, and Montana. It inhabits well-drained, sandy and rocky soils along roads, in rangelands, grain fields, and pastures. Rush skeletonweed is very difficult to control, establishing easily in disturbed soils, wastelands, and managed rangelands. The seedlings are early to emerge and use available soil moisture before other more favorable species can germinate. A single plant may produce thousands of seeds, and the roots are adventitious, often growing as deep as eight feet. It recolonizes quickly after rangeland fire, since buried seed and roots are able to form new plants from as deep in the soil as four feet. Rush skeletonweed establishes solid stands in very wet or dry environments. Seed production is reduced with drought conditions. Missing one year of control negates any previous management efforts.

Distinguishing features:

- ◆ Rush skeletonweed grows 12 to 48 inches tall.
- ◆ Rush skeletonweed grows whenever temperatures are above freezing.
- ◆ Sharply-toothed leaves form a basal rosette that withers as the flower stem develops. The bottom 4 to 6 inches of stem has distinct, coarse, downward pointing, red hairs near the rosette.
- ◆ Stems and leaves produce a milky sap when cut or damaged.
- ◆ Flowering heads contain 7 to 15 yellow, strap-shaped ray flowers that are about $\frac{3}{4}$ inch in diameter. They bloom from mid-July until frost.

Mature rush skeletonweed plant.



Stems have red hairs just above the rosette when stem elongation starts in early summer (left).

Strap-shaped, yellow petals have a flat end with distinct lobes (right).



CONTROL MEASURES

Most Effective Strategy: Once established, this plant forms solid stands and is difficult to control. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Apply herbicides when basal leaves are present. Plant bare soil with competitive vegetation. Retreatment will be necessary when new rush skeletonweed seedlings emerge. A long-term effort must be continued until the soil seed bank of rush skeletonweed seed is depleted.

Mechanical Control: Persistent hand-pulling, before plants produce seed, will control small infestations. The entire plant must be removed. Properly dispose of flowering plants after removal. Tillage or cultivation is ineffective and may actually increase the infestation by spreading root fragments which form new plants. Fire may increase the establishment of rush skeletonweed because seeds remain viable after low intensity fires.

Cultural Control: Grazing with sheep in a continuous schedule may reduce infestations. Planting competitive legumes will complement the grazing and help decrease the infestation.

Biological Control: A rust (*Puccinia chondrillina*) and a gall mite (*Aceria chondrillae*) attack plants with narrow rosette leaves. A gall midge (*Cystiphora schmidtii*) attacks all 3 forms of rush skeletonweed (plants with narrow, intermediate, or broad leaves in the rosette). These insects have been released in North America. These controls do not kill the plant, but severely stress it.

Control Measures for Rush Skeletonweed (Alias: *Chondrilla juncea*) Continued

Chemical Control:

Picloram (Tordon®)

- Rate: Apply Tordon 22K® at 2 to 4 pints per acre or 1/2 to 1 pound a.e. per acre. Annual retreatments will be required at lower application rates. Results may be improved by tank mixing with 1 pound a.e. per acre 2,4-D.
- Time: Apply picloram from late fall to early spring until just before or during bolting.
- Remarks: Rush skeletonweed reduces crop yields by as much as 70 percent, so it is critical to treat small infestations. Picloram is the most effective treatment available, but retreatment is necessary. The application rate affects the selectivity of picloram and at the rate recommended, picloram will not damage established perennial grasses.
- Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

- Rate: Apply 1/3 to 1 pint per acre or 2 to 6 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time: Apply after the emergence of rosettes until the bolting stage of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are no larger than 3 to 6 inches tall.
- Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with rush skeletonweed.
- Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remains active in the soil and may contaminate water.

Metsulfuron (Escort®)

- Rate: Apply 1 ounce metsulfuron with 8 fluid ounces of dicamba and 16 ounces of 2,4-D per acre.
- Time: Apply from rosette to full bloom stages of growth.
- Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Imazapyr (Arsenal®)

- Rate: Apply 3 to 4 pints per acre.
- Time: Use as a postemergence application only.
- Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.
- Caution: Use on noncropland only.

2,4-D amine or ester

- Rate: Use 2 quarts per acre or 2 pounds a.e. per acre.
- Time: Apply 2,4-D prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season for newly germinated seeds, particularly following rains.
- Remarks: 2,4-D reduces above ground plant growth, but will not prevent new plant development from root buds. Repeated treatments are necessary.
- Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not contaminate water unless using a product specifically formulated for use in water.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

- Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.
- Time: Apply when plants are actively growing before flower bud formation.
- Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.
- Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Cirsium arvense (L.) Scop.

Canada Thistle Asteraceae

Canada thistle is an aggressive perennial from Europe that has spread across North America. It occupies croplands, rangelands, waste areas and rights-of-way. Canada thistle adapts to most environments and forms large colonies that are difficult to control due to its creeping roots and long-lived seed that is easily spread by wind, animals, equipment, and as a contaminant of seed and feed. Mechanical control, tilling, plowing, or even mowing creates more plants from the adventitious roots. Infestations of Canada thistle significantly reduce land and crop values.

Distinguishing features:

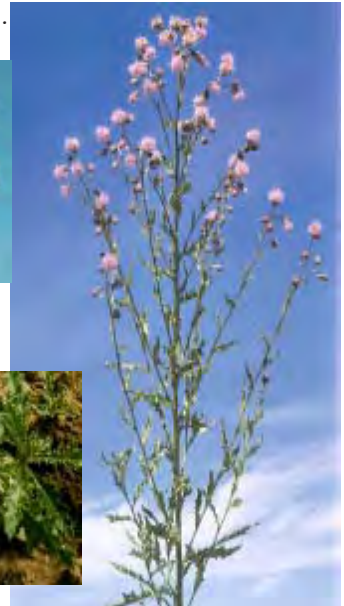
- ◆ The ridged, branched stems grow 12 to 48 inches tall.
- ◆ The 1- to 8- inch-long leaves are irregularly lobed with spines at each lobe tip. Upper leaves are smaller than lower leaves.
- ◆ Purple to light pink flowers appear in July and August, forming clusters at the branch ends. The individual, erect flower heads are up to ¾ inch across and have spineless bracts.
- ◆ The flat, ⅛-inch-long, brown seeds have tufts of hair on the top.

Mature Canada thistle plant (right).



Clusters of purple flower heads have spineless bracts (above).

Rosettes with spiny-tipped, wavy leaves appear in early spring (right).



CONTROL MEASURES

Most Effective Strategy: Canada thistle is difficult to control, especially in croplands. Seedlings are easily controlled, but once the deep roots are established, control is difficult. A combination of mechanical, cultural, and repeated applications of herbicides can decrease Canada thistle populations. Once this plant becomes established, eradication is virtually impossible and a long term management plan is needed.

Mechanical Control: Frequent cultivation (at least every 21 days during the growing season) is effective but only when plants are seedlings or when new plants grow from root pieces. Repeated mowing in alfalfa and other forage crops controls Canada thistle.

Cultural Control: Good sanitation practices when handling hay and livestock products or when transporting equipment help control seed spread. Intensive grazing by sheep or goats in its early stages of growth may reduce its spread. Mature Canada thistle is not palatable to livestock due to the spines on its leaves, so grazing's effect on established plants is minimal. Grasses and alfalfa can successfully compete with Canada thistle when good management practices are used, but alfalfa will not establish in an extensive infestation.

Biological Control: There are 3 commercially available biocontrol agents for Canada thistle. They are the Canada thistle stem weevil (*Ceutorhynchus litura*), Canada thistle bud weevil (*Larinus planus*), and the thistle stem gall fly (*Urophora cardui*) that was released in 1977 in Elko County.

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or ¼ to ½ pound a.e. per acre. Lower application rates may require annual spot treatments. Control from a lower rate may be improved by tank mixing with 1 pound a.e. per acre 2,4-D.

Time: Apply when most basal leaves have emerged but before bud stage, or apply to regrowth in the fall. Apply Tordon 22K® at a rate less than 1 ½ pints per acre (¾ pounds a.e. per acre) only under favorable conditions and in combination with 1 pound a.e. per acre of 2,4-D. Retreatment may be required.

Remarks: Up to 4-years control of Canada thistle seedlings has been demonstrated in picloram research plots. Adjustment of the application rate will affect the selectivity of picloram. At the recommended rate, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

Rate: Apply at ⅔ to 1 ⅓ pints per acre or 4 to 8 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.

Time: Apply after most basal leaves have formed through flower bud formation. May also be applied to fall regrowth.

Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with Canada thistle.

Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remains active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

Rate: Apply 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.

Time: Apply after most of the rosettes have emerged but before flower bud formation.

Remarks: Apply only in rangeland, pastures, and noncropland.

Caution: Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Control Measures for Canada Thistle (Alias: *Cirsium arvense*) Continued

Imazapic (Plateau®)

Rate: Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre.

Time: Apply as a postemergence application 12 ounces Plateau® with 1 quart methylated seed oil per acre. This provides control and/or suppression of all above ground Canada thistle biomass. For best results, apply in the rosette to early bolting stages of growth. Applications made at flowering will knock down existing foliage but may result in sprouting from the roots.

Remarks: Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.

Caution: No grazing restrictions exist, but do not harvest hay for at least 7 days following an application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Triclopyr (Garlon®)

Rate: Use 1 to 8 quarts per acre of Garlon 4® or 2 to 3 gallons of Garlon 3A®.

Time: Apply when plants are actively growing.

Remarks: Can be mixed with other products to increase effectiveness of both products.

Caution: Follow the label recommendations closely. Avoid water contamination, do not apply on irrigation ditches. At application rates of 2 quarts per acre or less, wait 7 days to harvest hay and 14 days to graze after application. At application rates of 4 quarts per acre, do not harvest hay until the next growing season.

Imazapyr (Arsenal®)

Rate: Apply 4 to 6 pints per acre.

Time: Use as a postemergence application only.

Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.

Caution: Use on noncropland only.

Sulfometuron methyl (Oust®)

Rate: Use 6 to 8 ounces per acre.

Time: Apply in late spring to early summer.

Remarks: Use the higher rate if weed growth is exceptional or when soil contains more than 2 1/2 percent organic matter.

Caution: Annual retreatment may reduce the vigor of desirable plants, particularly at higher recommended rates, where crested wheatgrass or brome is grown. Do not apply more than 8 ounces per acre per year. Excessive injury to nontarget species may occur if a surfactant is used. Use a drift control agent according to the manufacturer's recommendations. Use in accordance with label directions.

MCPA

Rate: Use 6 pounds a.i. per acre.

Time: Apply from the bud to early bloom stages of growth and again in the fall.

Remarks: Apply when weeds are young and continue treatment for 2 to 3 years. Apply in 20 to 100 gallons water carrier per acre.

Caution: Do not plant crops for 3 months following treatment. Use according to label instructions.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Apply 1 to 2 pounds a.i. per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Dicamba is frequently used in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

2,4-D amine or ester

Rate: Use 1 to 2 pounds a.e. per acre.

Time: Apply prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season for newly germinating seeds. When Canada thistle is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.

Remarks: Annual treatments are needed to control Canada thistle seedlings or rosettes.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not contaminate water unless using a product specifically formulated for use in water.

Metsulfuron (Escort®)

Rate: Use 1/2 to 2 ounces per acre.

Time: Apply anytime plants are growing well.

Remarks: Suppression (reduced plant vigor and stand) is only achieved with full coverage. Escort® is not considered effective on Canada thistle, but can be tank mixed with other products to broaden the spectrum of weed control. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).

Time: Apply during the prebloom to bloom stages of growth or late in the fall.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing, before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Onopordum acanthium L.

Scotch Thistle Asteraceae

Scotch thistle is an aggressive plant from Europe and western Asia that has naturalized, often forming dense stands impenetrable by people, wildlife, and livestock. In Nevada, it grows along roadsides, fence lines, ditch banks, open dry areas, and in pastures. It is rarely found in gardens and cultivated fields. Scotch thistle may grow as an annual, biennial, or short-lived perennial. In most of Nevada, it grows as a biennial and produces a large, distinctive rosette in the first year. The second year, Scotch thistle produces many large, branched, winged stalks with smaller leaves, flowers, and seeds. Scotch thistle reproduces only from seed, which is dispersed by water, wind, equipment, animals and humans.

Distinguishing features:

- ◆ It grows more than 8 feet tall.
- ◆ During the first year, a rosette forms with leaves that can be 24 inches long and 12 inches wide.
- ◆ The second-year leaves are large, hairy, coarsely lobed, and have a velvet-gray appearance. The midrib of the leaves is white. The stems have very wide wings.
- ◆ The flowers are globe-shaped, 1 to 2 inches in diameter, upright, spiny, and violet to reddish in color. They are borne singly on branch tips from June to September.

Mature scotch thistle plant.



Flowers are violet to reddish, and the stems are winged (above).

Rosette leaves are covered with white hair, giving them a grayish green color (below).



CONTROL MEASURES

Most Effective Strategy: Scotch thistle is a biennial, so effective control can be achieved by destroying the plant during the rosette stage before seed development. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Plant bare soil with competitive vegetation. Retreatment is necessary when new Scotch thistle seedlings emerge. A long-term effort must be continued until the soil seed bank of Scotch thistle seed is depleted.

Mechanical Control: Small infestations may be controlled by cutting the taproot below the soil surface or by hand-pulling the plant. Tillage kills the plant. Mowing makes the stand more uniform so that herbicide application is more effective but does not kill Scotch thistle. Mowing before seed development and dispersal will limit the amount of seed available for germination. Mowing is only recommended when used with a follow-up herbicide application.

Cultural Control: Goats will graze Scotch thistle in the rosette stage, but sheep and cattle avoid the plant. Establish desirable vegetation to provide competition to Scotch thistle.

Biological Control: There are currently no biological control agents available for Scotch thistle.

Control Measures for Scotch Thistle (Alias: *Onopordum acanthium*) Continued

Chemical Control:

Picloram (Tordon®)

- Rate:** In the fall, apply Tordon 22K® at 1/2 to 3/4 pint per acre or 1/8 to 3/8 a.i. per acre. In the spring, apply 1/2 to 3/4 pint Tordon 22K® at 1/8 to 3/8 pound a.e. per acre plus 1.0 pound a.e. per acre 2,4-D.
- Time:** Apply at the rosette stage, before bolting, in the spring or in the fall prior to the soil freezing.
- Remarks:** Adjustment of the application rate will affect the selectivity of picloram. At the recommended rate, picloram will not damage established perennial grasses.
- Caution:** This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains soil active for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

- Rate:** Apply at 1/3 to 1 pint per acre or 2 to 6 ounces a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time:** Apply after the rosette's emergence and bolting stage of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are 3 to 6 inches tall.
- Remarks:** Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with Scotch thistle.
- Caution:** Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

- Rate:** Apply 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.
- Time:** Apply after most of the rosettes have emerged but before flower bud formation.
- Remarks:** Only apply in rangeland, pastures, and noncropland.
- Caution:** Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Metsulfuron (Escort®)

- Rate:** Use 1 to 2 ounces per acre.
- Time:** Apply from the rosette to full bloom stages of growth.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate:** Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).
- Time:** Apply during preemergence or early postemergence when plants are actively germinating or growing.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

2,4-D amine or ester and/or dicamba

- Rate:** Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.
- Time:** Apply prior to flower bud formation. Repeat herbicide applications may be necessary during the growing season to kill newly germinating seeds. When Scotch thistle is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks:** Annual treatments are needed to control Scotch thistle seedlings or rosettes.
- Caution:** It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Read and follow the label. It is the law!

Houndstongue Boraginaceae

Cynoglossum officinale L.

Houndstongue is a biennial introduced from Europe that is widely distributed across North America, including northern California, Nevada, and Oregon. It invades irrigated and dry pasture land, especially if overgrazed, and disturbed areas. Houndstongue is toxic to livestock. Horses confined to small areas infested with the weed are particularly susceptible. Numerous hooked burrs on its seed coat cling to clothing and fur of domestic animals and wildlife, resulting in wide distribution. Restrict animal movement for a period of time after they have been removed from an infested area and before being released to areas free of houndstongue. Seeds will drop off with shed hair or the animals can be clipped. Seeds can remain viable on the soil's surface for two years. Keep the holding area free from houndstongue. Long-term control includes planting competitive species and seeding problem areas with fast growing grasses.

Distinguishing features:

- ◆ In the first growing season, a low-growing rosette is formed. The stem then grows 1½ to 4 feet tall the second season.
- ◆ The abundant stems are stout, with leaves from base to tip, and are simple or branched at maturity.
- ◆ Its leaves are tongue-shaped (hence the name), and are attached closely to the stem, with the uppermost leaves clasping the stem.
- ◆ The fused petals of the flower are reddish purple. Flowering occurs from May to August.
- ◆ Its seeds are contained in prickly, 1/3 -inch-long, 4-lobed nutlets that cling to animal fur and clothing.

Mature houndstongue plant.



In the second year, flowers produce an abundant supply of seeds (below).



Rosettes form in the first year of the 2-year growth cycle (right).



CONTROL MEASURES

Most Effective Strategy: Once established, houndstongue is difficult to control because its prickly seeds are easily spread by animals of all types. Because this plant is a biennial, control should be focused on the first year of its growth. The most effective treatments combine herbicides, biological control agents, and cultural controls. Consistent, uniform herbicide applications in spring and early summer control rosettes and mature plants. Plant bare soil with competitive vegetation. Retreatment is necessary when new houndstongue seedlings emerge. A long-term effort must be continued until the soil seed bank is depleted.

Mechanical Control: Clipping and mowing close to the ground during flowering can greatly reduce seed production. Digging, pulling, and cutting are considered ineffective, but can be successful if the root crown is severed and all plants are disposed of properly. If mechanical methods are used, they must be performed frequently. This is feasible for only small infestations. Houndstongue's young rosettes will not survive regular cultivation (about every 21 days when frequent moisture is available).

Cultural Control: An initial broadleaf herbicide application is necessary to reduce problem weeds before and after seeding. Plant a grass species adapted to the soil and climate that is easily established and is very competitive.

Biological Control: A flea beetle (*Longitarsus quadriguttatus*) has a strong preference for houndstongue. The adult flea beetles emerge in late May to mid-June until October and feed on above-ground plant parts. A root mining weevil (*Mongulones cruciger*) may also be used for houndstongue control.

Control Measures for Houndstongue (Alias: *Cynoglossum officinale*) Continued

Chemical Control:

2,4-D amine or ester

Rate: Use 2 pounds a.e. per acre.

Time: Apply 2,4-D in the early spring prior to bloom.

Remarks: Repeated herbicide applications may be necessary during the growing season whenever new plants are present.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Metsulfuron (Escort®)

Rate: Use 1 to 2 ounces per acre.

Time: Apply from the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 1 ounce per acre of chlorsulfuron (1 1/3 ounces of Telar® per acre).

Time: Apply at the prebloom stage in early spring and to rosettes in the fall.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Picloram (Tordon®)

Rate: Use 1/4 pound a.e. per acre.

Time: Apply anytime plants are growing well.

Remarks: Houndstongue is not listed specifically on the Tordon® label, so no recommendation is made about its effectiveness on the plant. Picloram is reported to give fair to good control of houndstongue. Adjustment of the application rate will affect the selectivity of picloram. At the rate recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Read and follow the label. It is the law!

Cardaria draba (L.) Desv.

Hoary Cress/Whitetop Brassicaceae

Hoary cress, or whitetop, is a member of the mustard family. This perennial weed commonly grows in dry, disturbed, alkaline soils, but can grow in a variety of soils and moisture conditions. Hoary cress is highly competitive; it reduces forage production and displaces native vegetation because it starts growing early in the spring and uses the available soil moisture other plants depend upon. In Nevada's desert, its expansive root system collects any available springtime surface water. Hoary cress grows from both seed and root fragments. Its deep root system, vegetative reproduction, and exceptional seed production make this plant difficult to control. Like many members of the mustard family, hoary cress produces a significant percentage of hard seed with delayed germination, which ensures seeds are available for germination for many years. Glucosinolates in hoary cress can be toxic to cattle.

Distinguishing features:

- ◆ It grows up to 24 inches tall, but is often shorter on very dry sites.
- ◆ Multiple stems can arise from the base.
- ◆ The leaves are bluish green, waxy, and lance-shaped. The upper leaves have 2 lobes that clasp the stem.
- ◆ The many, small white flowers form rounded clusters at the top of each stalk in late spring. Heart-shaped seed capsules follow immediately. Seeds often germinate and produce overwintering rosettes.

Mature hoary cress plant.



This perennial starts growth very early in the spring (below).



Small, white flowers with 4 petals develop bladder-like seed capsules in midsummer (left).

CONTROL MEASURES

Most Effective Strategy: Hoary cress is difficult to control once established. Research and experience have shown that the most effective treatment is a combination of herbicides and cultural controls. Cleaning equipment and using weed-free hay limits the number of infestations. Finding and controlling hoary cress during its first year is the best management strategy. Metsulfuron or chlorsulfuron are effective at killing hoary cress, but these chemicals remain active in alkaline soils for many years, making establishment and maintenance of competitive vegetation difficult after treatment and limiting the effectiveness of these herbicides over the long term. If the infestation is on highly alkaline soil, use repeated applications of 2,4-D coupled with efforts to grow competitive vegetation. This must include seeding with an appropriate species for maximum production of competitive vegetation. A long-term effort over many years is required to have any effect on an infestation. Missing even 1 year of control severely reduces the effectiveness of years of control efforts.

Mechanical Control: Small infestations can be controlled by digging and completely removing the plant, including the roots, within a few days after emergence. This must be continued until no new seedlings emerge, at least 4 to 6 years or more. Do not till or mow an established plant stand. This stimulates the rhizomes to grow new plants.

Cultural Control: Moderate grazing by sheep or goats in the rosette stage provides some control by lowering hoary cress density and preventing flowering. Do not graze later in the season, since this will stimulate vegetative growth. Hoary cress may be toxic to cattle. Planting competitive legumes such as alfalfa or clover can reduce an infestation. Flooding is effective on heavy soils, but hoary cress must be completely submerged for weeks to kill it, which may also kill desirable vegetation. Flooding also reduces land fertility due to the leaching or erosion of nutrients from the soil.

Biological Control: There are currently no biological controls available for hoary cress.

Control Measures for Hoary Cress (Alias: *Cardaria draba*) Continued

Chemical Control:

Imazapic (Plateau®)

- Rate:** Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre. The lower rate is sufficient in many sites.
- Time:** Apply at bud to full bloom (May or June).
- Remarks:** Use 1 quart of Plateau® per acre MSO surfactant to improve coverage and control. Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.
- Caution:** When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

2,4-D amine or ester

- Rate:** Use 2 pounds a.e. per acre.
- Time:** Apply 2,4-D in the spring prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season whenever green leaf material is present (every 4 to 6 weeks). When hoary cress is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks:** When possible, use 2,4-D on hoary cress populations before cultivating fields in the spring. Reapply 2,4-D in the fall if new weed growth occurs.
- Caution:** It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not contaminate water unless using a product specifically formulated for use in water.

Metsulfuron (Escort®)

- Rate:** Use 1 to 2 ounces per acre.
- Time:** Apply from the rosette to full bloom stages of growth.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate:** Use 0.5 to 1 ounce per acre of chlorsulfuron (0.67 to 1.33 ounce of Telar® per acre).
- Time:** Apply during preemergence or early postemergence when plants are actively germinating or growing.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

MCPA

- Rate:** Use 6 pounds a.i. per acre.
- Time:** Apply from the bud to early bloom stages of growth and again in the fall.
- Remarks:** Apply when weeds are young and continue treatment for 2 to 3 years. Apply in 20 to 100 gallons water carrier per acre.
- Caution:** Do not plant crops for 3 months following treatment. Use according to label instructions.

Read and follow the label. It is the law!

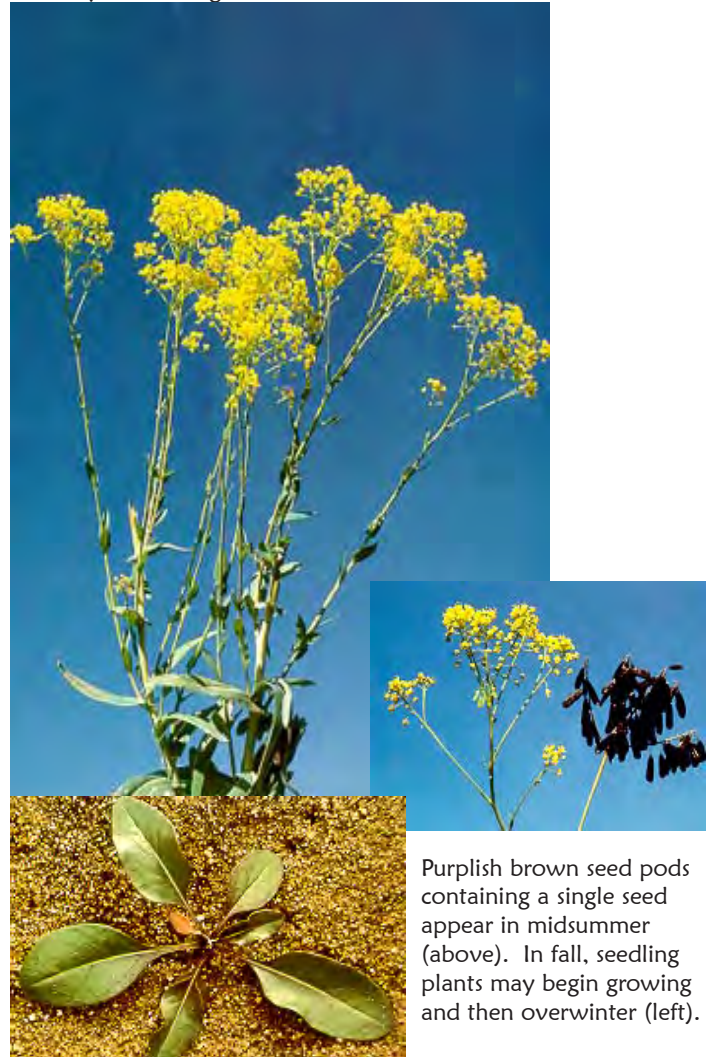
Isatis tinctoria L.

Dyer's woad, also known as Marlahan mustard, can be a winter annual, a biennial, or a short-lived perennial. It is native to Europe and invades rangeland, grain fields, pastures, ditch banks, waste areas, roadsides, and fence rows. It can also be found in orchards and in cultivated row crops. Unlike many other weeds in the mustard family, Dyer's woad does well in undisturbed land. Its mustard yellow flower is seen as early as April, and seeds mature in June or July. A rust fungus has been found that is effective in keeping this weed in check on rangelands.

Distinguishing features:

- ◆ The plant grows 1 to 3 feet tall.
- ◆ Multiple stems can arise from the base. The outer flower stalks are longer than the inner ones.
- ◆ The alternate, lance-shaped leaves are bluish green with a white to cream-colored midvein. The upper leaves are smaller and clasp the stem with ear-like projections.
- ◆ The small, bright yellow flowers are borne in clusters in late April and May. Seeds are produced in abundance.
- ◆ The seed pod is 1/2 to 3/4 inch long and contains a single brownish yellow seed.
- ◆ Its thick taproot can exceed 5 feet in depth, and can produce a new stem if the original is clipped off.

Dyer's woad grows 1 to 3 feet tall.



Purplish brown seed pods containing a single seed appear in midsummer (above). In fall, seedling plants may begin growing and then overwinter (left).

CONTROL MEASURES

Most Effective Strategy: Dyer's woad is a very difficult plant to control once it becomes established. Research and experience have shown that the most effective treatment is a combination of herbicides and cultural controls. Cleaning equipment and using weed-free hay limits the number of infestations. Finding Dyer's woad in its first year of establishment and initiating control efforts then is the best opportunity for control. Metsulfuron or chlorsulfuron are effective at killing Dyer's woad, but these chemicals remain active in alkaline soils for many years, making establishment and maintenance of competitive vegetation difficult after treatment and limiting the effectiveness of these herbicides over the long term. If the infestation is on highly alkaline soil, use repeated applications of 2,4-D coupled with efforts to stimulate growth of competitive vegetation. This may include seeding with an appropriate species and fertilization for maximum production of the competitive vegetation. A long-term effort over many years is required to have any effect on an infestation. Missing even 1 year of control severely reduces the effectiveness of past efforts.

Mechanical Control: Repeated tilling or hand-pulling small infestations is effective. Cutting off the tops before seed is produced will reduce the spread of Dyer's woad. Bag the pulled or cut plants, remove them from the area, and burn them.

Cultural Control: Sheep will graze Dyer's woad if there is no other forage available. This does more damage than good since they distribute seed and cause the plant to branch more and ultimately produce more seeds. Planting desirable vegetation after eradication of Dyer's woad will reduce chances for reinvasion and invasion by other weeds.

Biological Control: The rust, *Puccinia thlaspeos*, is used successfully to control Dyer's woad. To use it, chop up Dyer's woad that has been infested with the rust before it produces seed and spread the clippings over uninfested Dyer's woad patches.

Control Measures for Dyer's Woad (Alias: *Isatis tinctoria*) Continued

Chemical Control:

2,4-D amine or ester

- Rate: Use 2 pounds a.e. per acre.
- Time: Apply 2,4-D in the spring prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season whenever green leaf material is present (every 4 to 6 weeks). When Dyer's woad is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks: When possible, use 2,4-D on Dyer's woad populations before cultivating fields in the spring. Reapply 2,4-D in the fall if new weed growth occurs.
- Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not contaminate water unless using a product specifically formulated for use in water.

Metsulfuron (Escort®)

- Rate: Use 1/2 to 1 ounce per acre.
- Time: Apply from emergence to the full bloom stages of growth.
- Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).
- Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.
- Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Read and follow the label. It is the law!

Perennial Pepperweed/Tall Whitetop

Lepidium latifolium L.

Brassicaceae

Perennial pepperweed, or tall whitetop, is a native of southern Europe and western Asia. It has naturalized in many parts of the United States, including Nevada. Many western states have declared this weed noxious. This perennial grows in waste places, wet areas, ditches, roadsides, and croplands, including alfalfa fields. It also grows in low-rainfall desert areas where its root system collects any available water. In streambeds, perennial pepperweed causes bank destabilization because of its lack of fine root hairs to hold the soil. It is a problem in hay bales because it does not cure. Its robust, spreading roots and numerous seeds make its control very difficult. Like many members of the mustard family, perennial pepperweed produces a significant percentage of hard seed with delayed germination, which ensures seeds remain viable in the soil for many years. Mechanical measures such as disking or mowing spread the plant. Chemical controls must be timed properly and applied only after last season's dead stems and leaves are removed or the effort is wasted.

Distinguishing features:

- ◆ This weed grows 12 to 48 inches, or taller. The leaves and stems are covered with a waxy layer.
- ◆ The green to gray-green leaves are blade-shaped (lanceolate). The lower leaves are larger than the upper leaves.
- ◆ The entire top of the plant blooms in dense clusters of small, white flowers in late spring (June). There may be sporadic blooms on young plants through the fall.
- ◆ The seeds are reddish brown.

Mature perennial pepperweed plant.



Leaves and stems are covered with a waxy layer (below).



Dense flower clusters appear in late spring (right).



CONTROL MEASURES

Most Effective Strategy: Perennial pepperweed is one of the most difficult of Nevada's noxious weeds to control. Research and experience have shown that the most effective treatment is a combination of herbicides and cultural controls. Cleaning equipment and using weed-free hay limits the number of infestations. Finding perennial pepperweed in its first year of establishment and initiating control efforts is the best management strategy. Metsulfuron or chlorsulfuron are effective at killing perennial pepperweed, but these chemicals remain active in alkaline soils for many years, making establishment and maintenance of competitive vegetation difficult after treatment and limiting the effectiveness of these herbicides over the long term. If the infestation is on highly alkaline soil, use repeated applications of 2,4-D coupled with efforts to stimulate growth of competitive vegetation. This may include seeding with an appropriate species and fertilization for maximum production of the competitive vegetation. A long-term effort over many years is required to manage an infestation. Missing even 1 year of control severely reduces the effectiveness of past efforts.

Mechanical Control: Hand-pulling can be used for small infestations or where herbicides cannot be used. It is most effective in moist, loose soils. Pulling must be continued until no new seedlings emerge, possibly 4 to 6 years or more. Digging, tilling, or mowing is ineffective: such efforts encourage plants to sprout from their crowns, perennial roots, and plant pieces.

Cultural Control: Repeated, intensive grazing by sheep or goats may provide some control, especially in combination with herbicides. Maintain healthy stands of desirable plants to be competitive with tall whitetop. Burning or bailing of last year's dead stems and leaves is necessary to allow herbicide applications to reach the current year's growing leaf surfaces.

Biological Control: There are currently no biological controls available for perennial pepperweed, but research is ongoing.

Control Measures for Perennial Pepperweed (Alias: *Lepidium latifolium*) Continued

Chemical Control:

2,4-D amine or ester

Rate: Use 2 pounds a.e. per acre.

Time: Apply 2,4-D prior to bud formation. Repeated applications during the growing season whenever green leaf material is present (every 4 to 6 weeks). Mow perennial pepperweed at the bud stage, remove the clippings, and allow the plant to return to the bud stage in the late summer, then apply 2,4-D. After a season of intense grazing, apply 2,4-D to small plants in the fall.

Remarks: 2,4-D must move into the root system to be effective. Thoroughly wet the plant but do not over-apply the herbicide because it will not translocate to the root.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Metsulfuron (Escort®)

Rate: Use 1 to 2 ounces per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 0.75 to 2 1/4 ounces per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Imazapic (Plateau®)

Rate: Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre.

Time: For best results, always use a methylated seed oil at 2 pints per acre. Apply in the fall after a late frost (late October through November). As long as there is some green and/or leaf tissue remaining, good control can be achieved. This timing usually corresponds with fall basal growth. Applications made prior to this will result in poor control.

Remarks: Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.

Caution: No grazing restrictions exist, but do not harvest hay for at least 7 days following application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Glyphosate (Roundup®, Aquamaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing before flower bud formation. Repeated applications will be necessary; a single application is marginally effective.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Imazapyr (Habitat® or Arsenal®)

Rate: Use 1 1/2 pints to 2 quarts per acre.

Time: Apply to nearby establishing plants or at bud stage. A fall application may be effective too.

Remarks: Remove stubble before making an application. If plants are tall, mow them, remove the mowed material and allow the plant to resprout before making the application.

Caution: Registered for use around water. It is not necessary to wet the foliage until the herbicide runs off. Do not allow the herbicides to drift.

Read and follow the label. It is the law!

Euphorbia esula L.

Leafy Spurge Euphorbiaceae

Leafy spurge, a Eurasian native, has spread aggressively in rangelands throughout the northern United States. In Nevada, it is present in Elko, Humboldt, Washoe, Nye, and White Pine Counties in rangelands, pastures, and disturbed soils. It can cause severe irritation to the mouths and digestive tracts of some domestic and wild grazing animals. The extensive root system of this long-lived perennial may grow to depths of 40 feet or more. Efforts should be made to find and eradicate new infestations before this happens. Once the root system is developed, complete control may never be achieved. Seed capsules explode when dry, shooting the seeds up to 15 feet. Seeds remain viable in the soil for up to eight years. With long-term diligence, leafy spurge numbers can be reduced so that it does not dominate extensive acreages.

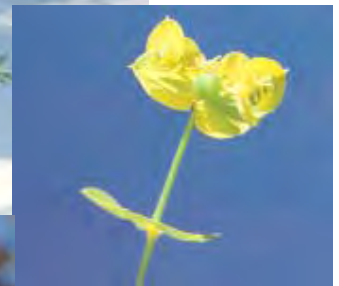
Distinguishing features:

- ◆ The plant grows up to 3 feet tall with a deep root system.
- ◆ Its alternate leaves are narrow and linear with smooth margins that are ¼ inch wide and 1 to 4 inches long.
- ◆ The true flowers are small, light-green, and enclosed by a pair of larger, yellowish green, heart-shaped bracts. Flowering occurs from June through midsummer.
- ◆ The shoots are erect and pale green. Stems and roots have a milky latex that is damaging to eyes and sensitive skin.
- ◆ Pink buds, capable of forming new shoots and roots, are common on crowns and roots.

Mature leafy spurge plant.



Heart-shaped, yellow bracts surround the 3-celled seed capsule (below).



Pink shoot buds form on the crown and roots of leafy spurge (left).

CONTROL MEASURES

Most Effective Strategy: Leafy spurge is one of the most difficult of Nevada's noxious weeds to control. Its extensive root system ensures the plant adequate water under most conditions, and food reserves to carry it through harsh times, including many control treatments. A combination of herbicides and cultural controls have proven to be the most effective treatment. Cleaning equipment and using weed-free hay limits the number of infestations. Finding leafy spurge in its first year of establishment and initiating control efforts then is critical. Established infestations should be regularly and intensively grazed by sheep or goats to limit top growth, seed production, and its spread. Follow summer-long grazing with a fall herbicide application. If that is not possible, repeated spring grazing will slow its spread. Efforts may include seeding with appropriate species to provide competitive vegetation. A long-term effort over many years is required to have any effect on an infestation. Missing even 1 year of control reduces the effectiveness of the past efforts.

Mechanical Control: Intensive, repeated cultivation throughout the growing season is somewhat effective in reducing above-ground plant materials. Mowing and burning reduces seed production, but plants will regrow from the perennial root system.

Cultural Control: Repeated grazing during the growing season by sheep or goats is useful in keeping leafy spurge from spreading. It does not eliminate plant populations due to its extensive root system, so grazing must be continued frequently.

Biological Control: More than one biotype of leafy spurge has been introduced into the United States. Many of the introduced biocontrol agents are specific to an individual leafy spurge biotype and will not thrive on other biotypes. The minute spurge flea beetle (*Aphthona abdominalis*) and a defoliating moth (*Simyra dentinosa*) have been released in Elko County. The brown-legged leafy spurge flea beetle (*Aphthona lacertosa*) has been released in Humboldt County. How well these species become established in Nevada, reproduce, and infest leafy spurge has yet to be determined. Some of the research conducted in the northern Great Plains on biocontrol agents for leafy spurge is applicable to Nevada. Other flea beetles that are available include: *Aphthona cyparissiae*, *A. czwalinae*, *A. flava*, *A. nigricutis*. Five moths, *Chamaesphecia crassicornis*, *C. empiformis*, *C. tenthrediniformis*, *C. astiformis*, and *C. hungarica*, feed on the roots. The Italian fly (*Dasineura* sp. nr. *capsulae*), the hawk-moth (*Hyles euphorbiae*), an Italian bug (*Oncochila simplex*), and another fly (*Pegomya euphorbiae*) feed on various parts of the plant. Other biological control agents are being tested regularly for release.

Control Measures for Leafy Spurge (Alias: *Euphorbia esula*) Continued

Chemical Control:

Picloram (Tordon®)

- Rate:** Apply Tordon 22K® at 2 to 4 pints per acre or 1/2 to 1 pound a.e. per acre. Spot treat at a rate up to 2 quarts per acre (1 pound a.e. per acre). At lower rates, tank mix with 1 pound a.e. per acre 2,4-D to improve control.
- Time:** Apply at the true flower stage of growth or apply to fall regrowth. Reapply when the level of control falls below 80 percent.
- Remarks:** Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.
- Caution:** This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Imazapic (Plateau®)

- Rate:** Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre.
- Time:** For best results, apply in the late summer or fall (August through mid-October). Consecutive year applications will optimize long-term control. Applying Plateau® at 12 ounces per acre in the spring or fall, or 4 ounces per acre in the spring following an 8-ounces per acre fall treatment, may result in excessive injury to cool season grasses in some areas. For best results, always use a methylated seed oil at 2 pints per acre. Nitrogen fertilizer applied at a rate of 2 pints per acre may also increase leafy spurge control.
- Remarks:** Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.
- Caution:** No grazing restrictions exist, but do not harvest hay for at least 7 days following application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

- Rate:** Use 1 to 2 pounds of Dicamba per acre.
- Time:** Apply when plants are in the rosette stage of growth.
- Remarks:** Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.
- Caution:** Avoid drift to sensitive crops. Read and follow the label directions.

Read and follow the label. It is the law!

Purple Loosestrife

Lythraceae

Lythrum salicaria L.

Purple loosestrife is an attractive, rhizomatous perennial from Europe. This showy plant has escaped from gardens and now forms dense monocultures along and in streams, canals, ditches, and wetlands. It impedes water flow, crowds out native vegetation, and reduces wildlife habitat. The seeds are small, easily dispersed, and can remain viable in the soil for years. Purple loosestrife also spreads vegetatively. Small pieces of root can produce new plants when they contact moist soil. Do not be tempted by this popular ornamental and do not share this plant with your gardening friends; instead, destroy any you may be growing. Nurseries in Nevada have been asked not to sell this plant.

Distinguishing features:

- ◆ It grows 1½ to 8 feet tall.
- ◆ The stems are 4-sided, smooth or hairy, and multibranched.
- ◆ Its leaves are 4 inches long or less, lance-shaped, pointed, and either opposite or whorled at the nodes.
- ◆ The rose-purple flowers are 1 inch in diameter and have 5 to 7 wrinkled petals that look crushed. They are arranged in long, upright clusters (racemes) that bloom from late June to September.
- ◆ Mature seed capsules persist through winter, are 1/8 to 3/8 inch long, and one plant can produce 2 million seeds.

Mature purple loosestrife plant.



Showy rose-purple flowers bloom in long vertical clusters (below).



Opposite or whorled, lance-shaped leaves have smooth margins (left).

CONTROL MEASURES

Most Effective Strategy: Purple loosestrife is difficult to control once it becomes well established. Research and experience have shown that the most effective treatment is a combination of herbicides, appropriate biological control agents, and cultural controls. Spring and early summer herbicide applications effectively control plants if done consistently and uniformly. Retreatment is necessary whenever new seedlings emerge. This is a long-term effort that must be continued until the soil seed reservoir is depleted.

Mechanical Control: Hand-pulling may be effective on seedlings with small roots. Repeated cultivation weakens purple loosestrife. Properly clean equipment to avoid spreading plant parts to new areas. Cultivation must also be repeated because new plants grow from damaged roots. Mowing or drying and burning are not recommended for control, but they may be used to reduce the production of seed or to make the stand shorter and more uniform to improve the effectiveness of an herbicide application.

Cultural Control: Grazing is not effective. Cattle will not eat it, and sheep and goats prefer not to. Grazing may even promote its growth and spread. Flooding kills seedlings, but only slows the growth of established plants unless they are completely submerged for weeks. Flooding infestations with either salty water or water low in salts will kill purple loosestrife but will also kill desirable vegetation. Replanting the site with a competitive species is necessary.

Biological Control: Two beetles (*Galerucella californiensis* and *G. pusilla*), a root weevil that feeds on the foliage (*Hylobius transversovittatus*), and a flower-feeding weevil (*Nanophyes marmoratus*) have been introduced in the United States for purple loosestrife control. These insects do not attack Nevada natives or crop plants. Diseases weaken purple loosestrife by making it more susceptible to other control methods and environmental stresses. The four pathogens currently used on purple loosestrife include: *Septoria lythrina*, *Alternaria alternate*, *Botrytis cinerea*, and *Collectotrichum californiensis*.

Control Measures for Purple Loosestrife (Alias: *Lythrum salicaria*) Continued

Chemical Control:

Glyphosate (Roundup®, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply glyphosate before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Triclopyr (Renovate 3™)

Rate: For broadcast applications, use 6 to 8 quarts per acre. If using a backpack sprayer, use 5 to 7.6 ounces per 4 gallons of water.

Time: Apply at the bud to midflowering stages of growth. Use a follow-up application the following year to control resprouts.

Remarks: Use a nonionic surfactant labeled for aquatic weed control in the spray mixture.

Caution: Thorough wetting of the foliage and stems is required. Use at least 50 gallons of water as the carrier per acre for ground broadcast applications.

Metsulfuron (Escort®)

Rate: Use 1 to 2 ounces per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Imazapyr (Arsenal®)

Rate: Apply 3 to 4 pints per acre.

Time: Only use as a postemergence application.

Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.

Caution: Use on noncropland only.

Read and follow the label. It is the law!

Medusahead

Taeniatherum caput-medusae (L.) Nevski

Poaceae

Medusahead is an extremely competitive, winter annual grass that crowds out even unwanted species like cheatgrass. It was introduced from Eurasia and now dominates millions of acres of semiarid rangeland in the Pacific Northwest, northern California and small infestations in Nevada. Affected rangelands suffer a 40 to 75 percent reduction in grazing capacity. Infestations in the Great Basin have mainly occurred in areas formerly inhabited by sagebrush-grass or bunchgrass that receive 10 to 20 inches precipitation. Control of small, isolated occurrences is critical to reducing this weed's spread. Medusahead prefers low summer precipitation, and does best in clay soils that shrink, swell, and crack. Once dominant, rehabilitation or restoration of the area can be very difficult and expensive. The barbs or awns on the seed head may cause disease-prone wounds to grazing animals. They often become caught in dogs' paws and hikers' socks.

Mature medusahead plant.



This highly competitive plant crowds out all other vegetation (above).



Twisted awns or beards are a characteristic used to identify medusahead (left).

Distinguishing features:

- ◆ It grows 6 to 24 inches tall with a fibrous, shallow root system.
- ◆ The leaf blade is narrow, $\frac{1}{8}$ inch wide, and in cross section is rolled in the stalk. When mature and dried out, the stalk is purple-tan and very wiry.
- ◆ The inflorescence and seeds form in May and June. The seeds germinate in the fall.
- ◆ The barbed awn of the mature seed is twisted and can be 1 to 4 inches long. The twisted awn distinguishes medusahead from foxtail barley and squirreltail.

CONTROL MEASURES

Most Effective Strategy: Using a combination of mechanical control with burning or herbicides has provided good results. Control of small, isolated infestations is important to reduce the impact of medusahead on rangelands. Reseeding with competitive vegetation and careful grazing management must follow any control effort to prevent medusahead from regaining dominance.

Mechanical Control: Spring plowing or disking can be effective. Do not let this plant go to seed. Prescribed fire is effective if the seeds are not mature and have not been disseminated. Conduct burning when the seed is in the soft dough stage, in late spring. This also removes the litter layer, allowing desirable species to establish. Mowing is not effective.

Cultural Control: Early spring grazing with sheep or cattle can be effective if the foliage is green and it occurs before the seedhead forms. Grazing must be combined with additional control methods. Do not graze after the seed awns are formed.

Biological Control: A crown root fungus (*Fusarium culmorum*) is moderately effective in controlling medusahead. Research is being carried out in the Great Basin on possible root pathogens. No insects are currently available for medusahead control.

Control Measures for Medusahead (Alias: *Taeniatherum caput-medusae*) Continued

Chemical Control:

Glyphosate (Roundup® or Landmaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply glyphosate in the early spring while the plants are small and before the seed head is produced.

Remarks: Repeated applications may be required. Herbicides are most effective after the area has been burned and germinating plants are very small. Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Paraquat dichloride (Gramoxone®)

Rate: Use 1 to 1 1/4 pints per acre.

Time: Apply in the spring after 90 percent node formation but before full bloom for 2 consecutive years.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Do not apply more than once per season.

Imazapic plus glyphosate (Journey™)

Rate: Use 10.7 to 32 ounces product per acre.

Time: May apply as a preemergence or postemergence application. Follow specific label recommendations.

Read and follow the label. It is the law!

Dalmatian Toadflax

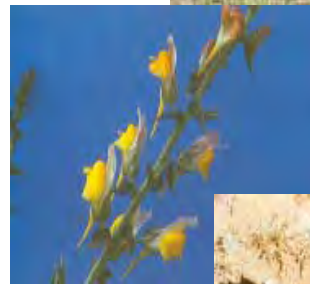
Linaria genistifolia ssp. *dalmatica* Scrophulariaceae

Dalmatian toadflax, introduced from southeastern Europe, is a short-lived perennial that grows aggressively on rangelands and along roadsides. It crowds out desirable forage and alters native habitats. Dalmatian toadflax exists in scattered patches throughout the northern and western United States and is spreading rapidly. It reproduces by seed (viable up to 10 years) and vegetatively by spreading roots with adventitious buds. Its deep root system and waxy leaves that repel herbicides make it difficult to control. Dalmatian toadflax adapts its growth to fit a range of habitats and is tolerant of low temperatures. It is very competitive in areas where summers are dry.

Distinguishing features:

- ◆ It grows up to 3 feet tall with multiple, semi-woody stems.
- ◆ Egg-shaped to lance-shaped leaves are dense and grow alternately along the stem. They have a smooth edge, clasp the stem, are waxy, and gray-green in color.
- ◆ Flowers are $\frac{3}{4}$ to $1\frac{1}{2}$ inches long with a long spur. They appear in May through August, are snapdragon-shaped, showy, and bright yellow with an orange, bearded throat.
- ◆ Irregularly-angled, black seeds contained in 2-celled fruit capsules about $\frac{1}{4}$ inch long are produced July through October. Many germinate in fall producing an overwintering rosette.

Dalmatian toadflax grows up to 3 feet tall.



Showy yellow flowers appear in midsummer (above).



Leaves individually clasp the stem (left).

CONTROL MEASURES

Most Effective Strategy: Once well established, dalmatian toadflax is difficult to control. Research and experience have shown that the most effective treatment is a combination of mechanical control, herbicides, and cultural controls. Hand-pulling and/or using a long, sharp rod to break roots off as deeply as possible, combined with herbicides, gives the best control of dalmatian toadflax. An extensive root system and high seed production require frequent, consistent treatment for effective control. The waxy surface of the leaf resists herbicide applications unless a surfactant is used to aid absorption. A long-term effort must be continued until the majority of the soil seed reservoir is depleted.

Mechanical Control: Several years of hand-pulling or cultivation of young plants in small infestations, before they go to seed, will provide control, especially in sandy or moist soils. Mowing or burning are not recommended.

Cultural Control: Providing plant competition with desirable vegetation slows dalmatian toadflax from establishing on rangelands.

Biological Control: Two insects have been released for controlling dalmatian toadflax. The toadflax moth (*Calophasia lunula*) was released in Lincoln County near Pioche in 1978 with no apparent effect. The root-boring moth (*Etheobalea intermediella*) was released in 1999. Six other insects are available, but they have not been released in Nevada.

Control Measures for Dalmatian Toadflax (Alias: *Linaria genistifolia*) Continued

Chemical Control:

Imazapic (Plateau®)

Rate: Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre.

Time: For best results, use a methylated seed oil at 2 pints per acre. Apply in the fall when the top 25 percent of the plant is dead, usually after a late frost (late October through November). As long as there is some green and/or leaf tissue remaining, good control can be achieved. This timing usually corresponds with fall basal growth. Applications made earlier result in poor control.

Remarks: Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.

Caution: No grazing restrictions exist, but do not harvest hay for at least 7 days following application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 2 to 4 pints per acre or 1/2 to 1 pound a.e. per acre. Spot treat at a rate up to 2 quarts per acre (1 pound a.e. per acre). At lower rates, tank mix with 1 pound a.e. per acre 2,4-D to improve control.

Time: Apply in the fall or summer when plants are actively growing through the full bloom stage of growth.

Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 1 1/2 to 2 1/4 ounces a.i. per acre of chlorsulfuron (2 to 3 ounce of Telar® per acre).

Time: Use as a preemergence or postemergence application when plants are actively germinating or growing.

Remarks: Apply as a high volume, foliar spray using a minimum of 24 gallons of water carrier per acre. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Metsulfuron (Escort®)

Rate: Use 1 1/2 to 2 ounces per acre.

Time: Apply anytime plants are growing well.

Remarks: Suppression (reduced plant vigor and stand) is only achieved with full coverage. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils above, pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Only apply to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Read and follow the label. It is the law!

Linaria vulgaris (L.) Mill.

Yellow Toadflax Scrophulariaceae

Yellow toadflax, a Eurasian native, was first brought to the United States in the 1600s as an ornamental. The yellow flowers, with their bearded, orange throat resemble snapdragons. Yellow toadflax is an aggressive short-lived perennial that invades rangelands and forests and can successfully out compete grasses. It also invades roadsides, waste areas, and cultivated fields, spreading by both seed and underground roots. A mature plant produces 15,000 to 30,000 seeds. Yellow toadflax is sold through catalogs and nurseries as “wild snapdragon” or “butter and eggs.” It is unknowingly recommended and illegally sold for use in Nevada gardens.

Distinguishing features:

- ◆ Multi-stem plant growing 1 to 2 feet tall.
- ◆ Alternately borne leaves are pale green, narrow, 2 ½ inches long, and numerous along the many stems.
- ◆ The flowers are yellow with a bearded, orange throat and yellow spurs. They form on multiple branches at the end of the main stems from May through September.
- ◆ The perennial growth form varies from erect to creeping.
- ◆ Brown, 2-celled fruits contain many dark brown to black, small seeds with a flattened, papery, circular wing. They mature from July to October.

Yellow toadflax grows 12 to 24 inches tall.



Narrow, linear leaves are pointed at both ends. Snapdragon-like, yellow flowers have an orange throat and a spur-like tail (right).

CONTROL MEASURES

Most Effective Strategy: Due to its extensive root system, yellow toadflax is difficult to control once it becomes established. Research and experience have shown that the most effective treatment is a combination of mechanical control, herbicides, and cultural controls. Hand-pulling and/or using a long, sharp rod to break roots off as deeply as possible, combined with herbicides, gives the best control of yellow toadflax. Its extensive root system and high seed production require frequent, consistent treatment for effective control. A long-term effort must be continued until the majority of soil seed reservoir is depleted, which may take years.

Mechanical Control: Several years of hand-pulling or cultivation of young plants (before they go to seed) in small infestations will provide control, especially in sandy or moist soils. Mowing, grazing, or burning are not recommended. If consumed in large quantities as the only feed available, yellow toadflax may be poisonous to livestock.

Cultural Control: Providing plant competition with desirable vegetation slows yellow toadflax from establishing on rangelands.

Biological Control: Eight insects are being used to control yellow toadflax. Of them, 3 show a substantial impact: an ovary feeding beetle (*Brachyterolus pulicarius*) and two weevils (*Gymnetron antirrhini* and *G. netum*) that feed on the seed capsules. The defoliating toadflax moth (*Calophasia lunula*) debilitates the plant. A beetle released in Nevada did not become established.

Control Measures for Yellow Toadflax (Alias: *Linaria vulgaris*) Continued

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 4 pints per acre or 1 pound a.e. per acre. Retreatment may be necessary for adequate control.

Time: Apply in the fall or summer when plants are actively growing through the full bloom stage of growth.

Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 1 1/2 to 2 1/4 ounces a.i. per acre of chlorsulfuron (2 to 3 ounce of Telar® per acre).

Time: Apply chlorsulfuron to actively growing plants in the bud to bloom stage of growth.

Remarks: In most cases chlorsulfuron will only suppress yellow toadflax. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to the herbicide persistence in soil and effect on any competitive vegetation. Do not contaminate water.

Metsulfuron (Escort®)

Rate: Use 1 1/2 to 2 ounces per acre.

Time: Apply anytime plants are growing well.

Remarks: Suppression (reduced plant vigor and stand) is only achieved with full coverage. Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 4 to 6 pounds of Dicamba per acre.

Time: Apply the herbicide in early spring before yellow toadflax reaches bloom stage.

Remarks: Repeated applications will be necessary for complete control.

Caution: Dicamba seriously injures or kills most broadleaf plants. Avoid drift to sensitive crops. Read and follow the label directions.

Read and follow the label. It is the law!

Black Henbane

Solanaceae

Hyoscyamus niger L.

Black henbane is an annual or biennial plant in the Nightshade family. Originally from Europe, it was introduced as an ornamental and medicinal plant in the seventeenth century and has since spread throughout the United States. It is common in pastures, fence rows, roadsides, and waste areas. It grows best in sandy or well-drained, loamy soils with moderate fertility. It has a large, deep tap root. Black henbane reproduces by seed. It is not normally grazed by animals and is consumed only when more palatable forage cannot be found. The alkaloids this plant contains have poisoned livestock, but these same alkaloids are used as medicines under controlled conditions. Black henbane is considered a poisonous plant to humans and animals.

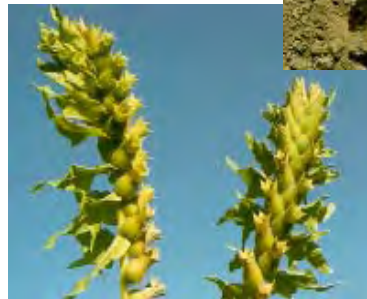
Distinguishing features:

- ◆ The weed has an unpleasant odor at all growth stages, especially when the tissue is crushed.
- ◆ Mature plants are 1 to 3 feet tall.
- ◆ Its 8-inch long leaves are alternately arranged along the stems. They are soft, stalkless, and coarsely toothed to shallowly lobed with sticky hairs.
- ◆ The 2-inch, yellowish brown flowers have a purple center. Purple veins are located on long flower stalks (racemes) in axils of the upper leaves. Flowering occurs from June to September.
- ◆ Its fruits are pineapple-shaped, about 1 inch long, and each capsule contains hundreds of tiny black seeds.

Mature plants grow up to 3 feet tall.



The rosettes have serrated leaves covered with fine hair (above).



The pineapple-shaped fruits contain tiny, black seeds (left).

CONTROL MEASURES

Most Effective Strategy: Research and experience have shown that the most effective treatment is a combination of herbicides and cultural controls. Spring and early summer herbicide applications effectively control young and mature plants if done consistently and uniformly. Any areas of bare soil must be seeded with competitive vegetation. Retreatment is necessary whenever new seedlings emerge. This is a long-term effort that must be continued until the majority of the soil seed reservoir is depleted.

Mechanical Control: Hand-pulling (with gloves) or digging may be effective, but only if the taproot is removed entirely. Plants with mature fruits should be put in bags and removed or burned in order to prevent dispersal of the seed. The area must be monitored for new seedlings for at least 4 years. Mechanical control is only feasible for small infestations. Black henbane can be controlled before it goes to seed by plowing, disking, or cultivation. Plants with mature fruits can be burned to kill the seed and reduce their spread.

Cultural Control: Do not graze black henbane; it is poisonous to livestock. Good vegetative cover will reduce considerably the chance of a black henbane infestation.

Biological Control: There are currently no known biological controls for black henbane.

Control Measures for Black Henbane (Alias: *Hyoscyamus niger*) Continued

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre.

Time: Apply when there is adequate soil moisture and the weeds are growing actively.

Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the early stages of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Read and follow the label. It is the law!

Tamarix spp.

Saltcedar, also referred to as tamarisk, is a small, shrubby, deciduous tree native to Eurasia. Introduced in the 1800s, it has naturalized throughout the desert Southwest, particularly along waterways and in wetlands. Saltcedar is well adapted to salty, alkaline soils, temperature extremes, and windy sites. Its aggressive root system uses much groundwater, out-competing native species by forming dense stands. In many sites, saltcedar forms a pure stand that is almost impenetrable. Few, if any, plants grow under its canopy. Salts accumulate in the soil from its leaf litter and the excretion of salt from its leaves. Nurseries in Nevada are not to sell this perennial plant; it is listed as a noxious weed by Nevada Administrative Code.

Distinguishing features:

- ◆ Saltcedar grows 5 to 20 feet tall and as wide.
- ◆ Smooth, woody stems are reddish brown, turning gray and fissured as the tree ages.
- ◆ Leaves are small, scale-like, and give the slender stems a wispy, green appearance.
- ◆ Flowers are pink to white, blooming from spring through late summer. Very attractive, from a distance they look like pink feathers at the end of the stems.
- ◆ One plant can produce 100,000s of seeds, even much more.

Mature saltcedar plant.



The small, 4 to 5-petaled flowers are pink and are borne in finger-like clusters (below).



Smooth, woody stems are dark brown to reddish brown (left).

CONTROL MEASURES

Most Effective Strategy: This is a very difficult plant species to control once it becomes well established in a water way or along a water system. Using a combination of mechanical control, biological control, and herbicides has proven to be the most effective method of reducing saltcedar infestations. Check the higher elevations of all drainages as seed appears to be moved by birds to the upper ends of water systems. Control efforts should start at the upstream portion of the water way. Foliar applications of herbicides are effective on smaller saltcedar plants. After they become well established and grow to a large size, mechanical cutting and treatment of the stumps have proven effective. Follow-up treatments are necessary to control missed or newly emerging plants. To avoid stimulating new growth, do not burn treated plants for a least 2 years following herbicide applications. This is a long-term effort which must be continued until the roots and seeds in the soil are depleted.

Mechanical Control: Plowing, cutting, mowing, chaining, and burning fail to control saltcedar on large scale projects because the plants resprout. Use of a root plow has been successful in some areas. Success has been achieved after a fire when plant root crowns are removed before the next growing season and all new growth is removed as it occurs.

Cultural Control: No cultural control methods have been found to be effective.

Biological Control: A leaf beetle (*Diorhabda elongata*) was released in Schurz, Stillwater, and Lovelock, Nevada. Research continues on its adaptability, reproductive ecology, and predation of saltcedar. This leaf beetle is successfully defoliating trees and spreading across northern Nevada. It may take several seasons of defoliation to kill trees outright. A mealy bug (*Trabutina mannipara*) has been released in the United States for saltcedar control, but it is not adapted to colder, drier environments and was therefore not released in Nevada.

Control Measures for Saltcedar/Tamarisk (Alias: *Tamarix* spp.) Continued

Chemical Control:

Triclopyr (Garlon®)

Rate: Use 1 to 8 quarts per acre of Garlon 4®.

Time: Apply when plants are actively growing.

Remarks: For best results, use a basal-bark or cut-stump treatment. Use higher rate when brush is greater than 15 feet in height. Mix with 2,4-D or picloram to increase effectiveness of control.

Caution: Follow the label recommendations closely. Avoid water contamination, do not apply on irrigation ditches.

Imazapyr (Arsenal®)

Rate: Apply 4 to 6 pints per acre.

Time: Use as a postemergence application only.

Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.

Caution: Use on noncropland only. See table below for application methods.

Considerations	Imazapyr (Arsenal®) Treatment Methods		
	Cut-Stump	Basal-Bark	Foliar
Plant Growth Stage	Effective in all stages of plant growth, triclopyr works best in summer and fall.	All stages, but most effective when applied to stems less than 3 inches in diameter and treated when dormant compared to spring or summer applications.	Best results occur with an aerial application of imazapyr in the late summer to early fall (August to September). Stop before fall dormancy begins.
Treatment Process	Paint the cut stumps immediately with triclopyr (within 10 minutes, sooner is better). Use a water-soluble dye to track the treated plants.	Spray the lower uncut 15 inches of the plant with triclopyr in an oil carrier. Be sure to spray the entire bark surface of the stem.	Herbicides and wetting agent are broadcast-applied. Both ground application and aerial applications are equally effective.
Herbicide Application	Thoroughly treat each stump, especially the cambium layer just inside of the bark. Stumps must be wetted completely for good control.	For low volume applications: Mix 25 to 30 gallons triclopyr with oil to make a 100 gallon mixture. Apply to plants with stems less than 3 inches in diameter.	Apply imazapyr with surfactant until the saltcedar is wet, but not dripping. Do not disturb the crown and roots of large trees for 2 to 3 years to allow imazapyr to move throughout the tree, which prevents resprouting.
Effectiveness	Most popular and effective in areas unsuitable for aerial or ground applications. Use this method near water to avoid drift and contamination.	Inconsistent results. Retreatment of the stems that were not killed is difficult compared to cut-stump treatment. Use in rocky areas or when labor is not available for treating cut stumps.	Effective on large stands with few nontarget plants growing among the saltcedar. The shoots normally die within 1 year, the roots within 2 years.
Retreatment	It is necessary to follow up to control any missed stems.	May need to retreat the following year.	Retreat if necessary.

Imazapyr (Habitat®)

Rate: Broadcast aerially at 3 quarts per acre. For spot treatment and ground application, use a 1% v/v (volume of product/volume of water) spray to cover (not wet) the foliage.

Time: Early spring and fall before leaf fall.

Remarks: Will control undesirable vegetation growing in or around wetlands, riparian and surface waters.

Caution: Remove livestock before treatment and for 30 days following treatment. Do not produce hay for 30 days from treated area.

Glyphosate (Roundup®, Aquamaster™, Rodeo®, or Aquamate™)

Rate: Use a 50 percent or 100 percent solution.

Time: Immediately after cutting the stem.

Remarks: Will control, partially control, or suppress when used as a cut-stump treatment.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Tribulus terrestris L.

Puncturevine Zygophyllaceae

Puncturevine, or goathead, forms a mat one to ten feet in diameter. The trailing stems, up to five feet long (depending on the available moisture), radiate and grow out from the center of the plant. This introduced annual from southern Europe has spread throughout the United States in waste areas, along roads, and in pastures and fields. It prefers dry, well drained, sandy sites. The seeds are found in hard, spiny burrs that can penetrate skin, bicycle tires, and even sidewalls of automobile tires. The spiny burrs are harmful to livestock, are objectionable in hay, and reduce the quality of wool fleece.

Distinguishing features:

- ◆ The stems form a mat that trails from the center of the plant 1 to 5 feet. It produces a strong taproot.
- ◆ The pinnately compound leaves are apposite, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, and covered with fine hairs. Each leaf has 4 to 8 pairs of leaflets.
- ◆ Small, yellow flowers form in the leaf axils on the stem. Flowers appear from July to October.
- ◆ The 5-section fruit breaks apart at maturity into spiny burrs (nutlets) containing 2 to 4 seeds each.
- ◆ Puncturevine spreads by seeds that can remain viable in the burr for 4 to 5 years, or more.

Mature puncturevine plant.



Yellow, 5-petaled flowers develop into circular, spiny fruits (burrs) that break into sections when ripe (below).



Hairs appear on each leaflet of the pinnately compound seedling leaves (left).

CONTROL MEASURES

Most Effective Strategy: Research and experience have shown that the most effective treatment is a combination of herbicides, cultural, and/or biological controls. Spring and early summer herbicide applications effectively control young and mature plants if done consistently and uniformly. Herbicides do not kill seeds. Any areas of bare soil must be seeded with competitive vegetation. Retreatment will be necessary whenever new seedlings emerge. This is a long-term effort that must be continued until the soil seed reservoir is depleted.

Mechanical Control: Removing plants with a hoe or shovel can be effective if done frequently. Cut the tap root, collect the plant and place it in a bag and dispose of the whole in a landfill or burn it. Repeated cultivation just after germination and before seed production is effective.

Cultural Control: After mechanical or chemical treatments, establish desirable vegetation to occupy the vacant space and to compete with new puncturevine seedlings.

Biological Control: The stem boring weevil (*Microlarinus lareynii*) and the fruit boring seed weevil (*M. lypriformis*) are effective.

Control Measures for Puncturevine (Alias: *Tribulus terrestris*) Continued

Chemical Control:

2,4-D amine or ester

Rate: Use 2 pounds a.e. per acre.

Time: Apply 2,4-D in the early spring, prior to bloom.

Remarks: Repeated herbicide applications may be necessary during the growing season whenever new plants are present.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Chlorsulfuron (Telar®)

Rate: Use 0.75 to 2 1/4 ounces a.i. per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Imazapyr (Arsenal®)

Rate: Apply 3 to 4 pints per acre.

Time: Use as a postemergence application only.

Remarks: Apply higher rates where dense or well-established infestations occur. Use a tank mix with Tordon®, Garlon®, Banvel®, Escort®, or Telar® to increase its effectiveness. Tank mixing with 2,4-D has resulted in reduced performance by Arsenal®.

Caution: Use on noncropland only.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when plants are actively growing before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Troublesome (Nuisance) Weeds

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Arctium minus (Hill) Bernh.

Burdock Asteraceae

Burdock, a native of Europe, grows throughout most of North America along streambanks and roadsides, in pastures, and in waste areas. A biennial, burdock produces a large rosette of coarse, heart-shaped leaves with wavy margins during the first season. The second year, it produces coarse, branching stalks with smaller, thick leaves. The leaves are widest at their base, wooly beneath, and dark green above. Purple flowers occur from midsummer through September. Flowers and fruits are borne in the axils of leaves and at the ends of branches. The spiny heads produce 1/4-inch, slightly flattened and curved achenes (seeds). The prickly fruit is easily entangled in animal hair and fleece, after which the seed can be distributed widely.

Distinguishing features:

- ◆ This coarse plant grows 3 to 10 feet tall.
- ◆ Heart-shaped leaves are alternate, 6 to 18 inches long, dark green above, and wooly beneath.
- ◆ Stems are hollow, coarse, and branched.
- ◆ Flowers are purple heads with hooked outer bracts. Spiny fruits become entangled in animal coats. The seed is spread afar by animals and on equipment.
- ◆ This plant produces up to 15,000 seeds.

A coarse-textured burdock plant.



Purple flower heads produce spiny fruits (right).



Rosette leaves are large with wavy margins (left).

CONTROL MEASURES

Most Effective Strategy: Burdock is a troublesome biennial that reproduces from seed. Prevent seed production and distribution. The prickly seed attaches easily to animals' coats and to equipment, so it is important to clean both before allowing them into uninfested areas. Effective treatment combines mechanical tillage, hand-pulling, chemical treatments, and revegetation with competitive species.

Mechanical Control: Tillage, cultivation, and hand-pulling are effective if done during the first year while the plant is a rosette or during bolting the second year. Do not allow the plant to flower the second year. Otherwise, the plant will have to be removed, bagged, and burned or buried to prevent the spread of seeds.

Cultural Control: This plant is not grazed. Plant competitive vegetation following mechanical and chemical treatments.

Biological Control: Disease, insects, and other pests do not effectively stress burdock. No biological controls are available.

Control Measures for Burdock (Alias: *Arctium minus*) Continued

Metsulfuron (Escort®)

Rate: Apply 1/2 to 1 ounce per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Triclopyr (Garlon®, Remedy®)

Rate: Apply 1/2 to 1 ounce per acre.

Time: Apply during the rosette to full bloom stage of growth.

Remarks: Treat when the leaves are fully developed and the plant is actively growing in spring or early summer.

Caution: Mix with other herbicides, spray oils, or surfactants in the order directed by the label. Use a minimum of 10 gallons of water per acre for a ground application and 2 gallons per acre, or greater, by airplane.

2,4-D amine/ester and/or dicamba

Rate: Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.

Time: Apply prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season to kill newly germinating seeds.

Remarks: Annual treatments are needed to control burdock seedlings or rosettes.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Clopyralid (Transline® or Stinger®)

Rate: Apply 1/3 to 1 pint per acre or 2 pounds a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.

Time: Apply from the time of rosette's emergence to bolting stage of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are no larger than 3 to 6 inches tall.

Remarks: Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with burdock.

Caution: Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remain active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

Rate: Use 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.

Time: Apply after most rosettes have emerged but before flower bud formation.

Remarks: Apply only in rangeland, pastures, and noncropland.

Caution: Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 0.66 to 0.75 ounces a.i. per acre of chlorsulfuron (1/2 to 1 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Read and follow the label. It is the law!

Cirsium vulgare (Savi) Tenore

Bull Thistle Asteraceae

Bull thistle is widely distributed and degrades fields, pastures, fence lines, roadsides, and rangelands across North America. A native of Eurasia, this biennial grows two to five feet tall as a gangly, branched, and spiny plant. It produces a short fleshy taproot and a rosette of leaves during the first season. Winged, erect, branched stems that are medium to dark green grow the second year. The leaves are pinnately lobed, prickly-hairy on the upper surface, and woolly beneath. The 1 1/2- to 2-inch wide, deep purple to white flowers can be very showy. Each has a narrow, vase-shaped base (involucre) with spine-tipped bracts as its base. The flowers are borne singly or in clusters at the ends of the branches from July through September. A plant can produce thousands of seeds. Each seed has a ring (plume) of white hairs at one end, which may be shed.

Distinguishing features:

- ◆ This thistle grows 2 to 5 feet tall with spiny, winged stems.
- ◆ The alternate leaves are lance-shaped, pinnately lobed, green, prickly-hairy on the upper surface, and woolly on the lower surface.
- ◆ The 2-inch purple to white flowers have slender-spined bracts on the vase-shaped involucre.
- ◆ The 1/16 -inch, light-colored seeds have a dark stripe and circle (plume) of white hairs on them.

Dark green stems and leaves contrast with the purple flowers of bull thistle.



Purple flower with spine-tipped bracts of the involucre (below).



Young, prickly rosette leaves. (left).



CONTROL MEASURES

Most Effective Strategy: Bull thistle only reproduces from seed; therefore, preventing seed production and distribution is paramount. To reduce its spread, use only clean, certified weed-free seed and feeds (hay and grains). Allow only cleaned, weed-free mowers, tillers, vehicles, and other equipment onto lands without bull thistle. Monitor lands and give high priority to controlling new infestations. Effective treatments include combinations of mechanical, cultural, herbicide applications, and revegetating the site with competitive plants.

Mechanical Control: Where possible, tillage, cultivation, hoeing and hand-pulling are effective during the rosette stage to bolting stage of growth, but before flowering. Mowing is not recommended because some seed is always produced.

Cultural Control: Reestablish desirable vegetation to provide competition following control measures. Moderate grazing to stimulate and invigorate grass stands protects sites from bull thistle invasion, but overgrazing causes bare spots that are easily infested.

Biological Control: The gall-forming, seed-eating fly, *Urophora stylata*, has successfully established in Oregon and Washington, but other thistle-attacking pests are only incidentally found on bull thistle. Disease organisms have not been effective.

Control Measures for Bull Thistle (Alias: *Cirsium Vulgare*) Continued

Picloram (Tordon®)

- Rate:** Apply Tordon 22K® at 2 to 4 pints per acre or 1/2 to 1 pound a.e. per acre. Spot treat at a rate up to 2 quarts per acre (1 pound a.e. per acre). At lower rates, tank mix with 1 pound a.e. per acre 2,4-D to improve control.
- Time:** Apply picloram during active growth from bud to midflowering or to fall regrowth after the first frost.
- Remarks:** Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.
- Caution:** This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Clopyralid (Transline® or Stinger®)

- Rate:** Apply 1/3 to 1 pint per acre or 2 pounds a.e. per acre. Use a nonionic surfactant at a rate of 1 to 2 quarts per 100 gallons of water carrier.
- Time:** Apply after rosette emergence and bolting stage of growth. The lower rate of 1/4 pint per acre provides acceptable control only when the plants are no larger than 3 to 6 inches tall.
- Remarks:** Clopyralid, a selective herbicide, effectively kills plants in the Asteraceae family but does not harm most plant species that compete with bull thistle.
- Caution:** Use Transline® in noncroplands only and Stinger® in croplands, but do not rotate to any crop other than wheat, barley, oats, or grass for 1 year after treatment. Do not apply by airplane when a temperature inversion exists. Follow label directions. These products remains active in the soil and may contaminate water.

Clopyralid plus 2,4-D (Curtail®)

- Rate:** Use 2 to 4 quarts per acre or 0.19 pound a.e. clopyralid and 1 pound a.e. 2,4-D per acre or 0.38 pound a.e. clopyralid and 2 pounds a.e. 2,4-D per acre.
- Time:** Apply after most rosettes have emerged but before flower bud formation.
- Remarks:** Only apply in rangeland, pastures, and noncropland.
- Caution:** Do not permit lactating dairy animals or meat animals being finished for slaughter to graze treated fields within 1 week following treatment. Do not plant broadleaf crops in treated areas until an adequately sensitive bioassay shows no detectable clopyralid is present in the soil. Do not apply by airplane when a temperature inversion exists. Follow label directions. This product remains active in the soil and may contaminate water.

Metsulfuron (Escort®)

- Rate:** Use 1 to 2 ounces per acre.
- Time:** Apply during the rosette to full bloom stages of growth.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

- Rate:** Use 0.75 to 2 1/4 ounces a.i. per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).
- Time:** Apply during preemergence or early postemergence when plants are actively germinating or growing.
- Remarks:** When making postemergence applications, use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.
- Caution:** Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

2,4-D amine or ester

- Rate:** Use 1 to 2 quarts per acre or 1 to 2 pounds a.e. per acre.
- Time:** Apply prior to flower bud formation. Repeated herbicide applications may be necessary during the growing season to control newly germinating seeds. When bull thistle is present in cereal crops, apply 2,4-D before the cereal crop reaches the boot stage.
- Remarks:** Annual treatments may be needed until all the seeds in the soil have germinated.
- Caution:** It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Read and follow the label. It is the law!

Curlycup Gumweed

Grindelia squarrosa (Pursh) Dunal

Asteraceae

Curlycup gumweed, sometimes called rosinweed, is found in overgrazed pastures, on rangelands, along roadsides, and in waste areas. This native biennial or short-lived perennial is extremely drought resistant and prefers dry areas, often forming pure stands where conditions are favorable. It tolerates alkaline soils. Curlycup gumweed is undesirable as forage and unpalatable to livestock. Extracts from the plant are used in a number of medicines for treatment of bronchial spasm, asthma, whooping cough, and rashes from poison ivy. It reproduces by seed and flourishes in heavily grazed pastures.

Distinguishing features:

- ◆ The plant grows 12 to 36 inches tall from a taproot.
- ◆ Its alternate, oblong leaves are 1 to 3 inches long with saw-toothed margins. They are gland-dotted and secrete a sticky substance.
- ◆ The bright yellow flowers are borne singly on the ends of branches in midsummer. They are 1 inch in diameter with curved bracts that exude a sticky substance.
- ◆ The fruits produce achenes. These oblong, cream-colored seeds are 4-angled and deeply ridged.

Curlycup gumweed grows 12 to 36 inches tall.



Leaves are rounded, with a toothed margin, and covered with a sticky resin (right).



The curved bracts of the involucre surrounding the yellow flower secrete a sticky resin (left).

CONTROL MEASURES

Most Effective Strategy: Curlycup gumweed is a relatively easy weed to control if competitive vegetation is present. Herbicide applications assist in controlling this weed. Treatments may be necessary for a number of years to completely control curlycup gumweed.

Mechanical Control: Cultivation early in the year when the plants are small can be effective. Curlycup gumweed reproduces by seed. Mowing to interrupt seed production can help control plants, but may encourage prostrate growth with flowering and seed production later during the growing season. Burning is not an effective means of control.

Cultural Control: Do not allow grazing of curlycup gumweed, not only because it is a poor forage, but because grazing increases stand densities. Curlycup gumweed will not out compete desirable plants in most situations, so encourage competitive vegetation.

Biological Control: There are currently no forms of biological control for curlycup gumweed.

Control Measures for Curlycup Gumweed (Alias: *Grindelia squarrosa*) Continued

Chemical Control:

2,4-D amine or ester

Rate: Use 2 pounds a.e. per acre.

Time: Apply 2,4-D in the early spring, prior to bloom.

Remarks: Repeated herbicide applications may be necessary during the growing season whenever new weed plants are present.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Metsulfuron (Escort®)

Rate: Use 1 to 2 ounces per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Read and follow the label. It is the law!

Halogeton glomeratus (Stephen ex Bieb.) C.A. Mey.

Halogeton Chenopodiaceae

*H*alogeton is an annual weed originally from Asia that has invaded millions of acres in the western United States. Although not very competitive, halogeton easily invades disturbed or overgrazed lands, dry lake beds, burned over areas, and waste areas. It usually grows along roadsides and livestock trails. It prefers the alkaline soils and semiarid environment of high desert, winter livestock ranges. This plant produces toxic oxalates that are very poisonous to sheep and may also affect cattle. Halogeton resembles Russian thistle when young, except that its fleshy, tubular, spine-tipped leaves have minute cottony hairs at their axils.

Distinguishing features:

- ◆ Halogeton grows from 3 to over 18 inches tall. Its main stems branch from the base, are spreading at first, and then erect.
- ◆ Plants are blue-green in the spring and early summer, but turn red or yellow by late summer.
- ◆ The small, fleshy leaves grow in bunches and are nearly tubular and tipped with a delicate needle-like spine.
- ◆ Its green- to cream-colored, subtle flowers are borne in leaf axils in the fall.
- ◆ It produces brown seeds that remain viable up to 10 years. Its black seeds are not as viable, often inviable.

Halogeton can grow to over 18 inches.



The fleshy leaves terminate with a needle-like structure (below).



Cream-colored flowers surround each plant stem (left).

CONTROL MEASURES

Most Effective Strategy: If vigorous, competitive, perennial vegetation is established, halogeton can be crowded out from an area. This is most easily done by tillage, to control any existing halogeton plants, and then seeding with competitive vegetation. Restrict grazing until halogeton plants are no longer visible.

Mechanical Control: Tillage and pulling will effectively control halogeton as it has a simple, shallow root system. Flowering plants may contain seeds and should be removed and destroyed to prevent reseeding the treated area. To ensure success, this control method should be coupled with the reestablishment of competitive vegetation. Periodic mowing close to the soil surface can reduce seed production, but surviving branches below the reach of the mower blades will continue to produce viable seed. Prescribed burning is not effective because halogeton burns poorly. Fire disturbance often enhances seed germination and favors the growth of dense stands of halogeton.

Cultural Control: Halogeton competes poorly with established perennial vegetation. Overgrazing, human disturbance, and fire typically reduce desirable vegetation and increase the amount of bare soil, encouraging invasion and establishment of halogeton. Livestock readily consume this toxic plant, but care should be taken when grazing it to avoid poisoning by the sodium oxalate. Halogeton can be safely consumed by livestock in spring only if it is a regular, minor portion of the dietary intake. It becomes more toxic as the growing season progresses and is toxic even after the plant has dried, e.g. during the winter and early spring. Livestock do not need to graze it to become poisoned. Simply licking the surface moisture will allow them to consume sufficient quantities of the insoluble sodium oxalate salt crystals to become poisoned.

Biological Control: The stem-boring moth, *Coleophora parthenica*, has been released for halogeton control, but has never become successfully established in Nevada. Research on other possible biological control agents is ongoing.

Control Measures for Halogeton (Alias: *Halogeton glomeratus*) Continued

Chemical Control (herbicide control on saline soils or in areas of low moisture are unreliable):

2,4-D amine or ester

Rate: Use 2 pounds a.e. per acre.

Time: Apply 2,4-D in the early spring to new growth.

Remarks: Chemical control is effective but must be followed by planting desirable vegetation to occupy the site soon after the halogeton plants are killed.

Caution: It is not lawful to apply more than 2 pounds a.i. per acre per year. Avoid drift to crops, especially with a volatile ester formulation. Follow the label directions. Do not apply near or over water unless using a product specifically formulated for use in water. Do not graze treated areas with livestock after applying 2,4-D until after the plants have dried up completely and decomposed.

Read and follow the label. It is the law!

Cheatgrass/Downy Brome

Poaceae

Bromus tectorum L.

Cheatgrass, or downy brome, is an aggressive winter annual grass that reproduces by seed. Introduced from the Mediterranean region in the late 1800s, it is widely distributed throughout North America and is common along roadsides, in waste areas, overgrazed pastures, rangelands, and cultivated crops. Cheatgrass now dominates millions of acres in the Great Basin. This plant competes with desirable perennial grasses for moisture and becomes a nuisance and a fire hazard after maturity. The awns can injure the eyes and mouths of grazing livestock and contaminate fleece. Cheatgrass is a common contaminant of crop seed that is very difficult to remove. It is especially troublesome to separate from desirable grass seed.

Distinguishing features:

- ◆ Cheatgrass grows 4 to 30 inches tall, and only produces a shallow root system.
- ◆ Its leaf sheaths and flat blades are densely covered with soft hair. Ligules are short.
- ◆ The 1-sided inflorescences are dense, slender, usually drooping, and 2 to 6 inches long. They mature in late spring or early summer (May to June).
- ◆ The slender, nodding spikelets are $\frac{3}{8}$ to $\frac{3}{4}$ inch long and produce mature seeds in June.
- ◆ Seeds are $\frac{1}{4}$ to $\frac{5}{8}$ inch long, with $\frac{3}{8}$ to $\frac{5}{8}$ inch long awns that are usually purplish at maturity. They germinate in the fall and overwinter as seedling plants or they germinate at low temperatures in January and February.

Mature cheatgrass plant.



Cheatgrass plants are covered with hairs at all stages of growth (below).



Mature seedheads are 2 to 6 inches long, with seeds and awns (right).

CONTROL MEASURES

Most Effective Strategy: Establishment of competitive vegetation that will tolerate fire to some extent is a critical element in controlling cheatgrass infestations. Cheatgrass invades bare soil after fire and expands its infestation. Fire breaks are a useful tool to limit the size of an infestation while establishing competitive vegetation. Herbicides are useful in reducing cheatgrass plant populations while establishing competitive vegetation. Other methods that reduce or eliminate seed production by cheatgrass for a minimum of 3 years may be useful. This helps maintain the competitive advantage of other plant species.

Mechanical Control: Plowing, disking, or cultivation before production of flowers (inflorescences) are effective in combination with other efforts. Poorly timed burning is largely ineffective and favors the growth of cheatgrass. However, burning in late spring can destroy the current year's seed and if hot enough some seed in the soil.

Cultural Control: Livestock grazing in the late spring and then again 3 to 4 weeks later to remove the seed may be effective if repeated for at least 2 years.

Biological Control: No insects or diseases are currently available for cheatgrass control.

Control Measures for Cheatgrass (Alias: *Bromus tectorum*) Continued

Chemical Control:

Imazapic (Plateau®)

- Rate:** Use 8 to 12 ounces of Plateau® per acre or 2 to 3 ounces a.i. per acre. A lower rate of 4 to 6 ounces may be effective in some sites.
- Time:** Apply in the fall.
- Remarks:** For best results, always use a methylated seed oil at 2 pints per acre. Use on noncroplands and rights-of-way sites. Plateau® may not control some naturally occurring weed biotypes (plants within a species with a slightly different genetic makeup) with resistance to this and/or other herbicides with an ALS/AHAS enzyme inhibiting mode of action. When treating ALS/AHAS resistant biotypes, tank mix Plateau® with an appropriately registered herbicide having a different mode of action and sequentially treat the area to ensure control.
- Caution:** No grazing restrictions exist, but do not harvest hay for at least 7 days following application of Plateau®. When cool-season grasses such as bluegrass and smooth brome are present, do not exceed 8 fluid ounces per acre.

Sulfometuron methyl (Oust®)

- Rate:** Use 1 ounce per acre. Can be used at 3 to 5 ounces per acre.
- Time:** Apply in late spring to early summer.
- Remarks:** Use the higher rate if weed growth is exceptional or when soil contains more than 2 1/2 percent organic matter.
- Caution:** Annual retreatment may reduce the vigor of desirable plants, particularly at higher recommended rates, where crested wheatgrass or brome is grown. Excessive injury to nontarget species may occur if a surfactant is used. Do not apply more than 8 ounces per acre per year. Use a drift control agent according to the manufacturer's recommendations. Use in accordance with label directions.

Glyphosate (Roundup®, Rodeo®, or Aquamaster™)

- Rate:** Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.
- Time:** Apply at either the vegetative stage of growth or during the seed's early dough stage for 3 consecutive years.
- Remarks:** Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.
- Caution:** Follow the label recommendations and precautions, especially for use in and near water.

Atrazine

- Rate:** According to the formulation: 1 to 2 pints (4 L); 0.63 to 1 1/4 pounds (80 WP); 0.55 to 1 1/10 pounds (90 DG) per acre.
- Time:** Apply from October to November, after the perennial grasses are dormant.
- Remarks:** Requires moisture to activate the atrazine application. It controls cheatgrass during germination.
- Caution:** Apply only once a year and only when perennial grasses are dormant. Apply to roadsides only. Some formulations of atrazine are **restricted-use**, requiring that a certified applicator purchase and apply the product.

Paraquat dichloride (Gramoxone®)

- Rate:** Use 1 to 1 1/4 pints per acre.
- Time:** Apply in the spring after 90 percent node formation but before full bloom for 2 consecutive years.
- Remarks:** Use a nonionic surfactant to increase the herbicide's effectiveness.
- Caution:** This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Do not apply more than once per season.

Imazapic plus glyphosate (Journey™)

- Rate:** Use 10.7 to 32 ounces product per acre.
- Time:** May apply as a preemergence or postemergence application. Follow specific label recommendations.
- Remarks:** Controls annual, biennial, and perennial weeds especially cheatgrass and medusahead.

Imazapyr (Arsenal®)

- Rate:** Apply 2 to 3 pints per acre.
- Time:** Use as a postemergence application only.
- Remarks:** Apply higher rates where dense or well-established infestations occur.
- Caution:** Use on noncropland only.

Read and follow the label. It is the law!

Rumex crispus L.

Curly Dock Polygonaceae

Curly dock is a deeply taprooted perennial native to Eurasia. Very widespread, it is especially common in wet meadows, along ditches, and in waste areas, but it is also found in pastures, cultivated crops, and rangelands. It grows well in deep, moist soils. Broadleaf dock (*Rumex obtusifolius* L.) is often confused with curly dock, but it has broader, less waxy leaves and one to three spines on the wing structure of the fruit. Curly dock seed is easily dispersed by wind and water, and the species can also produce new plants from taproot cuttings.

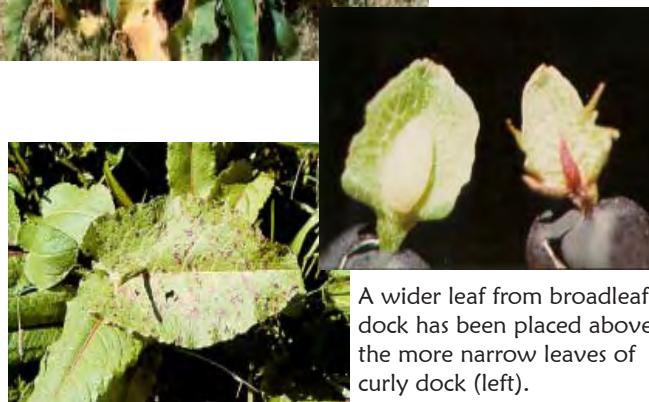
Distinguishing features:

- ◆ Curly dock grows 2 to 5 feet tall and has a taproot.
- ◆ Its erect stems are often reddish and slightly ridged.
- ◆ The 4 to 12 inch long leaves are mostly basal, lack hairs, and have curly or wavy margins.
- ◆ Small flowers develop in dense, green, spike-like, terminal and axillary clusters from June to September.
- ◆ The inflorescences and seeds turn reddish brown at maturity.
- ◆ Seeds are enclosed in a papery, sometimes corky, winged structure, $\frac{1}{8}$ to $\frac{3}{16}$ inch long.

Mature curly dock plant.



Below, the curly dock fruit (left) has smooth wing margins while the broadleaf dock fruit (right) has spined wing structures.



A wider leaf from broadleaf dock has been placed above the more narrow leaves of curly dock (left).

CONTROL MEASURES

Most Effective Strategy: Curly dock is a relatively easy plant to manage if control is conducted in a regular, consistent manner. A combination of mechanical control and herbicides has been found to be the best method of controlling curly dock. Remove the seed stalk prior to seed production by mowing or cultivation and then use an herbicide to kill the plants. Since the plants germinate readily from seed, control must be repeated annually until the soil seed reservoir is depleted.

Mechanical Control: Use a shovel to remove the crown about 2 inches below the soil surface. Mowing will reduce seed production and top growth, but will not control curly dock because it is a perennial plant.

Cultural Control: Curly dock is not readily eaten by livestock.

Biological Control: There are no insects or disease organisms currently available for curly dock control.

Control Measures for Curly Dock (Alias: *Rumex crispus*) Continued

Chemical Control:

Picloram (Tordon®)

Rate: Apply Tordon 22K® at 1 to 2 pints per acre or 1/4 to 1/2 pound a.e. per acre.

Time: Apply up to the bolting stage of growth.

Remarks: Adjustment of the application rate affects the selectivity of picloram. At the rates recommended, picloram will not damage established perennial grasses.

Caution: This **restricted-use herbicide** must be applied by, or its application supervised by, a certified applicator. Follow the label directions. Picloram remains active in the soil for a long time. Do not contaminate water.

Metsulfuron (Escort®)

Rate: Use 1/2 to 1 ounce per acre.

Time: Apply during the rosette to full bloom stages of growth.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to pasture, rangeland, and noncrop sites. Follow the label directions. Do not contaminate water.

Chlorsulfuron (Telar®)

Rate: Use 0.75 to 2 1/4 ounces a.i. per acre of chlorsulfuron (1 to 3 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: Use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Triclopyr (Garlon®)

Rate: Use 1 to 8 quarts per acre of Garlon 4® or 2 to 3 gallons of Garlon 3A®.

Time: Apply when plants are actively growing.

Remarks: Can be mixed with other products to increase effectiveness of both products.

Caution: Follow the label recommendations closely. Avoid water contamination; do not apply on irrigation ditches. At application rates of 2 quarts per acre or less, wait 7 days to harvest hay and 14 days to graze after application. At application rates of 4 quarts per acre, do not harvest hay until the next growing season.

Sulfometuron methyl (Oust®)

Rate: Use 6 to 8 ounces per acre.

Time: Apply in late spring to early summer.

Remarks: Use the higher rate if weed growth is exceptional or when soil contains more than 2 1/2 percent organic matter.

Caution: Annual retreatment may reduce the vigor of desirable plants, particularly at higher recommended rates, where crested wheatgrass or brome is grown. Excessive injury to nontarget species may occur if a surfactant is used. Do not apply more than 8 ounces per acre per year. Use a drift control agent according to the manufacturer's recommendations. Use in accordance with label directions.

Dicamba (Clarity™, Diablo™, Fuego™, Vanquish™, Veteran™, or Banvel®)

Rate: Use 1 to 2 pounds of Dicamba per acre.

Time: Apply when plants are in the rosette stage of growth.

Remarks: Use higher rates when treating dense or tall vegetative growth. Use in a tank mix with other herbicides to increase its effectiveness. Check the label for tank mixing instructions.

Caution: Avoid drift to sensitive crops. Read and follow the label directions.

Glyphosate (Roundup®, Landmaster™, Rodeo®, or Aquamaster™)

Rate: Use 1 1/2 pints to 2 quarts according to label rates plus 2 quarts of nonionic surfactant per acre.

Time: Apply when the plant is actively growing before flower bud formation.

Remarks: Glyphosate is a nonselective herbicide that kills most plants, including those that compete with new weed seedlings. Wait 10 days after treatment, then seed with locally adapted species.

Caution: Follow the label recommendations and precautions, especially for use in and near water.

Read and follow the label. It is the law!

Ranunculus testiculatus Crantz.

Bur Buttercup Ranunculaceae

Bur buttercup is a low-growing annual that is native to southeastern Europe. It has become a common weed in small grain crops, pastures, rangelands, waste areas, and along roadsides in most western states, including Nevada. Bur buttercup is especially competitive in dryland, small grain crops and is highly toxic to sheep and cattle. The sap in the plants can cause skin blistering on susceptible people. The prickly seeds stick to shoes, clothes, and animal fur, easily spreading the weed. This weed can cause significant agricultural losses and out compete native species. Millions of acres of sagebrush-grass rangelands are currently infested. In rangelands, growth and development is very dependent upon soil moisture and weather. Infestation levels may fluctuate year to year.

Distinguishing features:

- ◆ This short plant only grows 2 to 5 inches tall.
- ◆ The basally attached, grayish green leaves are 1 to 4 inches long and resemble a crow's foot. They have blades that are divided into finger-like segments.
- ◆ The small, yellow flowers have 5 petals and develop early in spring.
- ◆ The flowers develop into stiff, spiny, brown burrs about 1/2 to 3/4 inch long that contain seeds..

Bur buttercup plants grow 2 to 5 inches tall.



Bur buttercup seedlings have deeply toothed leaves (below).



The yellow flowers have 5 petals and develop into stiff burrs (right).



CONTROL MEASURES

Most Effective Strategy: Maintaining competitive vegetation is the most efficient method of keeping bur buttercup under control. Using an herbicide may be necessary if competitive vegetation cannot keep the weed from proliferating.

Mechanical Control: Repeated tillage and cultivation throughout the year before flowering occurs is effective. Mowing is ineffective.

Cultural Control: Do not graze this weed. It is poisonous to livestock. Planting grasses may help control the density of this weed; however, it may still flourish in the interspaces among bunchgrasses.

Biological Control: There are currently no biological control agents for bur buttercup.

Control Measures for Bur Buttercup (Alias: *Ranunculus testiculatus*) Continued

Chemical Control:

Chlorsulfuron (Telar®)

Rate: Use 0.66 to 0.75 ounces a.i. per acre of chlorsulfuron (1/2 to 1 ounce of Telar® per acre).

Time: Apply during preemergence or early postemergence when plants are actively germinating or growing.

Remarks: When making postemergence applications, use a nonionic surfactant to increase the herbicide's effectiveness. In alkaline soils, above pH 7.5, reestablishment of competitive vegetation may be difficult due to residual herbicidal action on germinating seedlings.

Caution: Apply only to noncrop sites. Chlorsulfuron is a selective broadleaf herbicide that also affects many grasses. Follow the label directions, especially as they apply to herbicide persistence in the soil and effect on any competitive vegetation. Do not contaminate water.

Chemical Control For Croplands:

Harmony Extra® is registered for control of bur buttercup in small grains such as wheat or barley. For alfalfa crops, Balan®, Gramoxone®, Lexone®, Sencor®, and Velpar® are recommended. Contact an office of the University of Nevada Cooperative Extension or your chemical dealer for specific recommendations.

Read and follow the label. It is the law!

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Photographs courtesy: *Weeds of the West*.

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APPENDIX A – GLOSSARY

A.: acre.

achene: a small, one-celled, wingless, but often plumed, dry, indehiscent fruit, as of grains.

acid equivalent: a.e., acid equivalent of an ingredient among pesticides (herbicides).

active ingredient: a.i., active ingredient (chemical) in a product that is responsible for the pesticidal effect.

adventitious: a bud, shoot or root that is produced on a plant where it would normally not be produced.

a.e.: acid equivalent of an ingredient among pesticides (herbicides).

a.i.: active ingredient (chemical) in a product that is responsible for the pesticidal effect.

alkaloid: bitter, colorless, organic compounds (bases) of many plants; many are poisonous if ingested.

allelopathy: the effect, usually negative, that compounds produced in plants have on the growth and development of other plants as they become available by leaching or decay.

alternate: leaf and twigs not opposite or whorled, but alternating along the stem.

amine: alternate, less volatile formulation of an herbicide, specifically 2,4-D.

angiosperm: a plant that produces seed enclosed in a pod or seed coat, as opposed to gymnosperms that do not have enclosed seeds.

annual: completing the life cycle in one growing season or year.

anther: pollen bearing structure (male) of a flower; anther and filament make up the stamen.

awn: a terminal, slender bristle on an organ.

basal: relating to, or situated at the base.

bearded: bearing long stiff hairs.

biennial: a plant that completes its growth in two years; the first year it produces leaves, often a rosette, and stores food; the second year it produces an upright stalk with flowers, fruits, and seeds.

biocontrol: use of a living organism (microorganism, insect, bird, mammal, etc.) to control a pest.

biotype: subgroup within a species, differing in some respect from the species, that is capable of reproducing a resistant variety.

bolt: to produce a flowering stalk and thus flowers, fruits, and seeds.

boot: a sheath enclosing the inflorescence, usually in grasses.

boot stage: the developmental stage, usually of grasses, where the boot forms.

bract: a reduced leaf subtending a flower.

bud: an undeveloped stem, leaf, or flower.

calyx: the external, leaf part of a flower composed of sepals that are usually green, but may be colored.

capsule: dry, dehiscent fruit composed of more than one carpel or seed chamber.

chlorosis: loss of green color in foliage and stems.

contact herbicide: herbicide that causes localized injury to plant tissue upon contact.

corolla: collectively the petals of a flower.

cotyledon (seed leaf or leaves): the primary leaf or leaves of the embryo.

creeping: to grow along the ground or some structure.

crown: the persistent base of an herbaceous perennial.

cultivar: cultivated variety; term for a man-made variety or selection of a particular plant.

days to harvest: the least number of days between the last pesticide application and the harvest date, as set by law. Also called harvest interval.

dehiscent: splitting open; many capsules or seedpods dehisce to cast their seed.

dentate: irregularly, sharply pointed teeth facing outward from the margin (edge) of the leaf.

dicot or dicotyledon: plants of the angiosperms with two cotyledons or seed leaves.

divided: deeply lobed leaves, the sinuses extending to the base of the leaf or midrib.

dough stage: growth and developmental stage of fruit maturity from flowering, through milk, dough and full ripening. The endosperm of the kernel changes from watery, to milky and then early dough, soft dough and hard dough before ripening completely with a hardened kernel.

drift: movement of a pesticide (herbicide) off the target by wind or volatilization.

dry granular (DG): herbicide formulated as a dry granule. The number before the DG, i.e., 90 DG is the percentage of active ingredient present in the product.

emulsifier: surface active substance used to stabilize suspensions of one liquid in another; for example, oil in water; often used in pesticide formulations, i.e., emulsifiable concentrate.

encapsulated formulation: pesticide enclosed in capsules (or beads) of thin polyvinyl or other material to control the rate of release of the chemical and extend the period of diffusion.

entire: margins smooth without teeth or lobes, i.e., leaf margins or edges.

ephemeral: lasting for a day or less.

ester: more volatile formulation of an herbicide, specifically 2,4-D.

filament: stalk supporting the anthers of the stamen (male structure of a flower).

flowable: A type of pesticide formulation in which a very finely divided pesticide is mixed in a liquid carrier.

flower: seed-producing structure of a plant.

foliar application: application of a pesticide to the leaves or foliage of plants.

forb: herbaceous plant other than grass.

formulation: way in which basic pesticide is prepared for practical use; includes preparation as wettable powder, granular, emulsifiable concentrate, and the like.

fruit: ripened ovary and its associated tissues; all the tissues and structures that enclose the mature embryo.

general use pesticide (GUP): pesticide which can be purchased and used by the general public without undue hazard to the applicator and environment as long as the instructions on the label are carefully followed.

glandular: bearing glands; glandular hairs have glands or a sticky substance at their end.

glaucous: covered or whitened with a bloom (waxy or powdery coating with a whitish appearance).

granular: dry formulation of pesticides and their components in discrete particles less than 10 mm³ in size.

growth regulator: organic substance effective in minute amounts for controlling or modifying growth processes of plants or insects.

gymnosperm: a plant that produces naked seed, as opposed to an angiosperm that enclose seed in a fruit.

habitat: the normal environmental situation in which a plant or animal lives.

harvest interval: period between last application of a pesticide to a crop and the harvest as permitted by law. Also called days to harvest.

herb: a plant without persistent woody stem.

herbaceous: pertaining to an herb; leaflike color and texture; nonwoody plant; dying to the ground each year.

hybrid: a sexual cross between two species.

indehiscent: not splitting open, as an achene.

inert ingredient: any substance in a product having no pesticidal action; it may have nonpesticidal actions.

inflorescence: flowering part of a plant; generally used for flowering cluster.

invasive weed: a plant that establishes itself rapidly in an area, often becoming dominant or a monoculture, to the exclusion of native or desirable plants, and is detrimental, destructive, difficult, and expensive to eradicate or control.

involucre: a whorl of bracts (phyllaries) below a flower, flower cluster, or fruit.

lanceolate: lance-shaped; several times longer than wide, broadest toward the base and pointed at the tip.

lateral: borne on the side of a structure or object; coming from the side.

leaf: flat thin part of a plant growing from the base or stem.

legume: plant in the Fabaceae family; usually forms a symbiotic relationship with nitrogen fixing bacteria (*Rhizobia*) on its roots; a seed from such a plant (pea, bean) used for food; a forage (alfalfa, vetch) of the same family.

lignified: containing lignin, the complex, insoluble carbohydrates that make up the main part of woody tissue.

ligule: a thin appendage of a grass leaf at the junction of the blade and petiole.

liquid (L): liquid herbicide formulation. The number before the L, i.e., 4L means four pounds of active ingredient per gallon of product, a 2L product contains two pounds of active ingredient per gallon.

linear: narrow and flat with sides or edges parallel as in a leaf.

lobed: bearing lobes; generally the sinuses are not halfway to the base of leaf or midrib, as in oak leaves.

midrib: the middle vein of a leaf.

monocot or monocotyledon: plants of the angiosperms with one cotyledon or seed leaf.

monoculture: only one species present.

monoecious: having male and female flowers on the same plant.

necrosis: usually localized death of tissue, e.g., leaf spots, cankers, etc.

node: the joint of a stem where a leaf originates.

nonselective herbicide: a chemical that is generally toxic to plants without regard to species; toxicity may be a function of dosage, method of application, and the like.

noxious weed: a weed arbitrarily defined by Nevada State Law (NRS 555.005); "...means any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate" and is designated so (NRS 555.130) by listing in the Nevada Administrative Code (NAC 555.010). See Appendix B.

ovate: flat egg-shaped; oval-shaped.

over top application: application over the top of transplanted or growing plants, such as by airplane or raised spray boom of ground rigs; a broadcast or banded application above the plant canopy.

ovoid: solid ovate or solid oval.

palmate: in a leaf, having the lobes or divisions radiating from a common point.

pappus: a crown of bristles or scales on an achene.

perennial: a plant whose life cycle extends for three or more years; plants may be herbaceous or woody.

persistent: remaining attached after like parts normally fall off.

persistent herbicide: herbicide that, when applied at the recommended rate, remains in the soils from months to years and will harm susceptible crops planted in normal rotation after harvesting the treated crop or will interfere with regrowth of native vegetation in noncrop sites for an extended period of time.

personal protective clothing (PPE): clothing and equipment that reduce dermal (skin) and sometimes inhalation exposure to pesticides by the applicator.

petal: one of the leaves of a corolla in a flower.

petiole: a leafstalk.

pinnate: compound leaf with leaflets arranged on each side of a common petiole.

plant growth regulator: a chemical that increases, decreases, or changes the normal growth or reproduction of a plant.

postemergence: after emergence of the specified weed or crop.

preemergence: prior to emergence of the specified weed or planted crop.

preplant application: treatment applied on the soil surface before seeding or transplanting.

preplant soil incorporated: herbicide applied and tilled or watered (1/2 inch of water) into the soil before seeding or transplanting.

prostrate: lying flat upon the ground.

rate: amount of active ingredient applied to a unit area regardless of percentage of chemical in the carrier (dilution).

ray flowers: generally a showy, strap-shaped flower as in the head of a sunflower; as opposed to the less showy disk or tube flower.

recurved: curved outward, downward, or backward.

reflexed: bent or curved backward or downward

residual: having a continued lethal effect over a period of time--months or years.

residual herbicide: herbicide that persists in the soil and injures or kills germinating weed seedlings over a relatively short period of time. Can affect a susceptible crop planted too soon.

restricted use pesticide (RUP): a pesticide, designated by the EPA, that can be purchased and applied only by certified applicators, because of its inherent toxicity or potential hazard to the environment.

rhizomatous: stem growing laterally, partly or wholly beneath the soil.

root: the portion of the plant, generally below ground, that anchors the plant and absorbs moisture and nutrients from the soil.

rosette: dense, basal cluster of leaves arranged in a circular fashion around the stem, usually at ground level.

seed: that part of the plant containing the mature embryo from which a new plant can grow.

seed bank: accumulation of seeds in the soil as a reservoir for future germination, often over several years.

selective pesticide (herbicide): a pesticide that, while killing the pest, spares most of the other fauna or flora, including beneficial species, either through differential toxic action or through the manner in which the pesticide is used (formulation, dosage, timing, placement, etc.).

senescence: becoming old; phase of plant development from maturity to death when metabolic breakdown products accumulate, respiration increases, and plant tissues lose dry weight.

sepal: a leaf or segment of the calyx in a flower.

serrate: with sharp teeth directed forward; often said of leaf edges.

simple: of only one part; not divided into separate segments; not compound.

soft dough stage: period of seed development when the interior tissues of the seed are pliable if the seed coat is broken.

soil application: application of pesticide made primarily to soil surface rather than to vegetation.

soil incorporation: mechanical mixing of herbicide with the soil.

soil persistence: length of time that a pesticide application on or in the soil remains effective.

spine: a sharp-pointed, stiff, woody tissue.

spot treatment: application to localized or restricted areas, as differentiated from overall, broadcast, or complete coverage.

stamens: one of the pollen-bearing organs of a flower; male part; made up of filament and anther.

stem: the main stalk of a plant; supports leaves, flowers, and fruit.

stolon: above ground, horizontal or creeping stem, which roots at its nodes or tip, producing a new plant.

suppression: the slow down of growth and development or both of a plant or plant community by external means, usually by growth regulators, pesticides, lack of water, etc.

surfactant: ingredient that aids or enhances the surface-modifying properties of a pesticide (herbicide) formulation (wetting agent, emulsifier, or spreader).

tank mix: mixture of two or more pesticides in the spray tank at the time of application. Such mixture must be cleared by the Environmental Protection Agency (EPA).

taproot: a primary, stout, vertical root giving off small laterals but not dividing.

taxonomy: orderly classification (naming) of plants and animals according to their natural relationships.

terminal: of, or at the end of something.

tolerance: amount of pesticide residue permitted by federal regulation to remain on or in a crop. Expressed as parts per million (ppm).

toothed: a small, pointed, marginal lobe; as on a saw, dentate.

translocation: transfer of food or other materials such as herbicides from one plant part to another.

trichome: plant hairs borne on leaves and stems.

tuber: a thickened, solid, and short underground stem with many buds, e.g., a potato.

turion: tuber-like tissue of aquatic plants.

umbel: a flat or rounded flower cluster (inflorescence).

variety: taxonomic subdivision of a species of plant.

volatilize: to vaporize.

wettable powder (WP): pesticide formulation of toxicant mixed with inert dust and a wetting agent that mixes readily with water and forms a short-term suspension (requires tank agitation). The number before DG is the percentage of the active ingredient in the product, i.e., 50 WP is formulated with 50 percent active ingredient.

wetting agent: compound that causes spray solutions to contact plant surfaces more thoroughly.

whorled: with three or more leaves or other structures growing at a node arranged in a circle around a stem.

wings (winged): thin expansions bordering or surrounding a stem.

winter annual: plant that starts germination in the fall, lives over winter, and completes its growth, including seed production, early the following season.

woody: plant with lignified secondary wall thickening; wood-like tissue.

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APPENDIX B – NEVADA NOXIOUS WEED TIERED LIST

This information is current as of March 25, 2005

For the most current information go to http://agri.nv.gov/nwac/PLANT_No WeedList.htm

Definitions:

Category A Weeds Weeds not found or limited in distribution throughout the state; actively excluded from the state and actively eradicated whenever found. Actively eradicated from nursery stock dealer premises. Control required by the state in all infestations.

Category B Weeds Weeds established in scattered populations in some counties of the state; actively excluded where possible. Actively eradicated from nursery stock dealer premises. Control required by the state in areas where populations are not well established or previously unknown to occur.

Category C Weeds Weeds currently established and generally widespread in many counties of the state. Actively eradicated from nursery stock dealer premises. Abatement at the discretion of the state quarantine officer.

Category A Weeds:

<u>Common Name</u>	<u>Scientific Name</u>
African rue	<i>Peganum harmala</i> L.
Austrian fieldcress	<i>Rorippa austriaca</i> (Crantz) Bess.
Austrian peaweed	<i>Sphaerophysa salsula</i> (<i>Swainsona salsula</i>)
Camelthorn	<i>Alhagi pseudalhagi</i> (Bieb) Desv.
Common crupina	<i>Crupina vulgaris</i> Cass.
Dalmatian toadflax	<i>Linaria (genistifolia ssp.) dalmatica</i>
Dyer's woad	<i>Isatis tinctoria</i> L.
Eurasian watermilfoil	<i>Myriophyllum spicatum</i> L.
Giant salvinia	<i>Salvinia molesta</i> (Mitchell)
Goatsrue	<i>Galega officinalis</i> L.
Houndstongue	<i>Cynoglossum officinale</i> L.
Hydrilla	<i>Hydrilla verticillata</i> (L.f.) Royle
Iberian starthistle	<i>Centaurea iberica</i> Trev. ex Spreng.
Leafy spurge	<i>Euphorbia esula</i> L.
Malta starthistle	<i>Centaurea melitensis</i> L.
Mayweed chamomile	<i>Anthemis cotula</i> L.
Mediterranean sage	<i>Salvia aethiopsis</i> L.
Perennial sowthistle	<i>Sonchus arvensis</i> L.
Purple loosestrife	<i>Lythrum salicaria</i> L., <i>virgatum</i> & cultivars
Purple starthistle	<i>Centaurea calcitrapa</i> L.
Rush skeletonweed	<i>Chondrilla juncea</i> L.
Spotted knapweed	<i>Centaurea maculosa</i> Lam.
Squarrose knapweed	<i>Centaurea virgata</i> Lam. var. <i>squarrosa</i>
Sulfur cinquefoil	<i>Potentilla recta</i> L.
Syrian beancaper	<i>Zygophyllum fabago</i> L.
Yellow starthistle	<i>Centaurea solstitialis</i> L.
Yellow toadflax	<i>Linaria vulgaris</i> (L.) Mill.

Category B Weeds:

<u>Common Name</u>	<u>Scientific Name</u>
Carolina horsenettle	<i>Solanum carolinense</i> L.
Diffuse knapweed	<i>Centaurea diffusa</i>
Medusahead	<i>Taeniatherum caput-medusae</i> (L.) Nevski
Musk thistle	<i>Carduus nutans</i> L.
Russian knapweed	<i>Acroptilon repens</i> (L.) DC.
Scotch thistle	<i>Onopordum acanthium</i> L.
White horsenettle/Silverleaf nightshade	<i>Solanum elaeagnifolium</i> Cav.

Category C Weeds:

<u>Common Name</u>	<u>Scientific Name</u>
Black henbane	<i>Hyoscyamus niger</i> L.
Canada thistle	<i>Cirsium arvense</i> (L.) Scop.
Green fountain grass	<i>Pennisetum setaceum</i> (Forsk.) Chiov.
Hoary cress/Whitetop	<i>Cardaria draba</i> (L.) Desv.
Johnsongrass	<i>Sorghum halepense</i> (L.) Pers.
Perennial pepperweed/Tall whitetop	<i>Lepidium latifolium</i> L.
Poison hemlock	<i>Conium maculatum</i> L.
Puncturevine	<i>Tribulus terrestris</i> L.
Saltcedar/Tamarisk	<i>Tamarix</i> spp.
Water hemlock	<i>Cicuta maculata</i>

Policy statement regarding noxious weed abatement statutes NRS 555.005-201 issued by the Nevada Department of Agriculture March, 2005:

Chapter 555, sections .005-.217 of the Nevada Revised Statutes authorize the Nevada Department of Agriculture (NDOA) to investigate noxious weeds and require landowners or occupants to control such weeds. This statutory duty requires a noxious weed policy which recognizes that weeds vary as to their potential and actual harm to Nevada's agriculture and environment. Overall noxious weed significance is the basis for determining what prevention or control activities are appropriate, at what level, and when and where those activities should be conducted.

1. Noxious weed ratings are intended to be used as aids to inform land owners and managers and other interested persons as to a particular noxious weed's environmental, agricultural and biological significance, as well as its importance to the general public, and the action recommended by NDOA to deal with the pest.
2. Each pest rating represents NDOA's view of the statewide importance of the noxious weed to the crops, livestock, public health, wildlife, water quality and beneficial uses of land in Nevada. Local conditions may dictate more stringent action against a pest than recommended at a state level.
3. It is NDOA's policy to use the "Noxious Weed Tier System" to determine what action is to be taken consistent with existing statutes which include authority for: the promulgation of quarantine, abatement for eradication and/or control; holding and inspecting; establishing weed control districts; and for other regulatory activities.

At the time NDOA lists a species, it will also give a rating of A, B, or C. These ratings reflect the NDOA's view of the statewide importance of the noxious weed, the likelihood that eradication or control efforts would be successful, and the present distribution of noxious weeds within the state. These lists will be in the Nevada Administrative Code (NAC 555.010).

APPENDIX C – CITIZEN-LED WEED CONTROL ORGANIZATIONS

Current as of Nov. 6, 2004, for updates go to http://agri.nv.gov/nwac/PLANT_WeedGroupList.htm

Nevada Weed Groups:

LOCATION	CONTACT	TELEPHONE	E-MAIL/FAX
*Alpine County/ Upper Carson Watershed	Angela Mushrush (acting)	775-782-3661 x107	angela.mushrush@nv.usda.gov
*Carson City	JoAnne Skelly	775-887-2252	skellyj@unce.unr.edu
*Churchill County	Nancy Dunham	775-423-2828	ccmosquito@oasisol.com
*Clark County	Elyse Benson	702-262-9047 x111	elyse.benson@nv.usda.gov
Clark County MSHCP Weed Working Group	Maria Ryan	702-257-5550	ryanm@unce.unr.edu
*Elko County	Eleanor O'Donnell	775-738-8431 x101	eleanor.odonnell@nv.usda.gov
*Gerlach (Northern Washoe)	Donna Potter	775-557-2015 x36	DPotter@empirellc.com
*Humboldt Watershed	Helga Hussey	775-778-1295	jhussey@sbcglobal.net
Humboldt County Task Force	Brad Schultz	775-623-6304	schultzb@unce.unr.edu
Lander County Weed Team	Mike Mitchel	775-635-5565	775-635-8309
*Lassen County, CA SWAT	Carolyn Gibbs	530-257-0456	cgibbs@ca.blm.gov
*Las Vegas Wash Weed Partnership	Elizabeth Bickmore	702-822-3385	elizabeth.bickmore@lvvwd.com
*Lincoln County	Cory Lytle	775-726-3101	cory.lytle@nv.usda.gov
*Lower Truckee	Robin Powell	775-574-0101 x12	biopowell@gbis.com
*Newark/Long Valley	Jack Neal	775-761-4933	none
*Northern Nye and Esmeralda Counties	Jim Marble	775-482-7238	nyenro@co.nye.nv.us
*Pershing County	Carl Clinger	775-273-2552	carlclinger@gbis.com
*Railroad Valley	Annette George	775-863-0286	annetters2001@yahoo.com
*Ruth/Robison	Linda Gleason	775-289-2904	ir0nw00d@juno.com
*Snake Valley	Tom Baker	775-234-7327	tombaker125@sbcglobal.net
*Southern Nye County	Renie Youngmans	775-553-2392	youngmansoasis@beattynv.com
*Spring Creek Region	Jill Wilkinson	775-753-8295	springcreekweeds@yahoo.com

*Groups organized as Cooperative Weed Management Areas (CWMA).

Nevada Weed Groups continued:

LOCATION	CONTACT	TELEPHONE	E-MAIL/FAX
*Storey County	Dean Haymore	775-847-0966	scbd@reno.quik.com
*Surprise Valley (Northern Washoe)	Alan Uchida	530-279-6101	auchida@ca.blm.gov
*Tahoe Basin Weed Coordinating Group	Sue Donaldson	775-784-4848	donaldsons@unce.unr.edu
Tri-County Weed Group	Brandon Vaught	775-289-4459	ely-tcw-1@sbcglobal.net
*Truckee Meadows	Patti Bakker	775-786-9955	pbakker@gbis.com
*Walker River Basin	Jason Dukek	775-463-2265 x106	jason.dukek@nv.usda.gov
*Washoe Valley	Jim Griel	775-771-5510	jpgreil@pyramid.net
*West Central Lyon County	Kevin Piper	775-883-3525	klpipe@aol.com
*White River Valley	Michelle Gubler	775-238-0275	nvweedmanager@yahoo.com

*Groups organized as Cooperative Weed Management Areas (CWMA).

Nevada Weed Control Districts:

LOCATION	CONTACT	TELEPHONE	E-MAIL/FAX
Churchill County	Nancy Dunham	775-423-2828	ccmosquito@oasisol.com
Diamond Valley	Ellen Mariluch	775-237-5251	dvweed@eurekanv.org
Douglas County	Larry Hughes	775-782-9835	lhughes@co.douglas.nv.us
Lovelock Valley	Bill Denier	775-273-7220	none
Paradise Valley	Tony Lesperance	775-578-3770	775-578-3771
Walker River	Bud Stinson	775-463-6566	bddnst1@aol.com

APPENDIX D – CONSERVATION DISTRICTS OF NORTHEAST NEVADA

Current as of July, 2005. Be advised that Chairmanships change periodically, contact the NRCs field offices for updates or go to <http://www.nv.nrcs.usda.gov/contact/nvcd.html>.

The Elko County Association of Conservation Districts (located in the NRCs Elko Field Office)

CHAIRMAN: Fred R. Zaga
Administrative Assistant: Eleanor O'Donnell
555 West Silver Street, Suite 101, Elko, NV 89801
Phone: 775-738-8431, extension 101 or 775-744-4260
Fax: 775-738-7229
Email: eleanor.odonnell@nv.nacdnet.net

CLOVER – CHAIRMAN: Brad Dalton, HC 60, Box 130, Wells, NV 89835
Phone: 775-752-3817, Cell Phone: 775-752-0869

DUCK VALLEY – CHAIRMAN: Rudy Blossom, Box 193, Owyhee, NV 89832
Phone: 775-757-2001

JIGGS – CHAIRMAN: Fred R. Zaga, HC 30, Box 346, Spring Creek, NV 89815
Phone: 775-744-4620

LAMOILLE – CHAIRMAN: Ed Sarman, HC 36, Box 61, Spring Creek, NV 89815
Phone: 775-753-6230

NORTHEAST ELKO – CHAIRMAN: Agee Smith, P.O. Box 232, Wells, NV 89835
Phone: 775-752-3135, Cell Phone: 775-752-0605

OWYHEE – CHAIRMAN: Pete Mori, HC 32, Box 280, Tuscarora, NV 89834
Phone: 775-756-6553

RUBY VALLEY – CHAIRMAN: Cassidy Neff, HC 60, Box 632, Ruby Valley, NV 89833
Phone: 775-779-2327

STARR VALLEY – CHAIRMAN: Mark Howell, P.O. Box 130, Wells, NV 89835
Phone: 775-752-3855, Fax: 775-752-3078

Eureka County - NRCs Ely Field Office

P.O. Box 323, Eureka, NV 89316
Phone: 775-237-5251, Fax: 775-237-7427

EUREKA – CHAIRMAN: Patsy Tomera, Stonehouse Ranch, HC 65-11, Carlin, NV 89822
Phone: 775-754-2333, Fax: *51

Humboldt County - NRCs Winnemucca Field Office

1200 Winnemucca Boulevard East, Winnemucca, NV 89445
Phone: 775-623-5025 ext. 101, Fax: 775-625-1200

PARADISE/SONOMA – CHAIRMAN: Joe Sicking, P.O. Box 39, Paradise Valley, NV 89426
Phone: 775-578-2244, Cell Phone: 775-427-3234
Email: sickings@hotmail.com

QUINN RIVER – CHAIRMAN: Leon Frey, SR Box 180, Winnemucca, NV 89445
Phone: 775-272-3267

Lander County - Conservation District Office

815 North Second Street, Battle Mountain, NV 89820
Phone: 775-635-5565, Fax: 775-635-8309

LANDER COUNTY – CHAIRMAN: Tom Reichert, HC 61, Box 6180, Austin, NV 89310

White Pine County - NRCS Ely Field Office

Tim Stack and Chris Jasmine
HC 33, Box 33451, 744 E North Industrial Way, Ely, NV 89301
Phone: 775-289-4065. Fax: 775-289-6629

WHITE PINE – CHAIRMAN: Dr. Tom Sanders, P.O. Box 150456, East Ely, NV 89301
Phone: 775-289-2276

APPENDIX E – AGENCY CONTACTS

LOCAL NORTHEAST NEVADA CONTACTS

County Weed Contacts

Elko County

Contact your local Conservation District
(see Appendix D)

Eureka County

Diamond Valley Weed Control District
701 S. Main, P.O. Box 714, Eureka, 89316
775-237-6137
E-Mail: dvweed@eurekanv

Humboldt County

County Road Superintendent
50 W. Fifth Street, Winnemucca, 89445
775-623-6416
E-Mail: hcrdsupt@co.humboldt.nv.us

Paradise Valley Weed District
P.O. Box 210, Paradise Valley, 89426
775-578-3770

Lander County

Contact your local
University of Nevada Cooperative Extension Office
(listed to the right)

White Pine County

Tri-County Weed Program
995 Campton Street, Ely, 89301
775-289-4459
E-Mail: ely-tcw-1@sbcglobal.net
http://www.whitepinecounty.net/tri_county.htm

University of Nevada Cooperative Extension

<http://www.unce.unr.edu>

Elko County

701 Walnut Street, Elko, 89801
775-738-7291

Eureka County

701 S. Main Street
P.O. Box 613, Eureka, 89316
775-237-5326

Humboldt County

1085 Fairgrounds Road, Winnemucca, 89445
775-623-6304

Lander County

815 N. Second Street, Battle Mountain, 89820
775-635-5565

White Pine County

995 Campton Street, Ely, 89301
775-289-4459

STATE CONTACTS

Nevada Department of Agriculture

http://agri.nv.gov/PLANT_NoXWeeds_index.htm

State Office

350 Capitol Hill Avenue, Reno, 89502
775-688-1182, ext. 269

Elko

1351 Elm Street, 89801
775-738-8076

Winnemucca

1200 E. Winnemucca Boulevard, 89445
775-623-6502

Nevada Division of Forestry

<http://www.forestry.nv.gov>

State Office

2525 S. Carson Street, Carson City, 89701
775-684-2500

Nevada Division of State Parks

<http://parks.nv.gov>

State Office

901 S. Stewart Street, Carson City, 89701
775-684-2770

Berlin-Ichthyosaur State Park

HC 61, Box 61200, Austin, 89310
775-964-2440

Cave Lake State Park

P.O. Box 151761, Ely, 89315
775-728-4460

South Fork State Recreation Area

353 Lower South Fork, Unit 8, Spring Creek, 89815
775-744-4346

Ward Charcoal Ovens State Historic Park

P.O. Box 151761, Ely, 89315
775-728-4460

STATE CONTACTS continued

Nevada Department of Transportation

<http://www.nevadadot.com>

State Office

1263 S. Stewart Street, Carson City, 89712
775-888-7000

District 3 Office

1951 Idaho Street, Elko, 89801
775-777-2700

Ely Maintenance Station

1401 E. Aultman Street, 89301
775-289-1700

Winnemucca Maintenance Station

725 W. 4th Street, 89445
775-623-8000

FEDERAL CONTACTS

Bureau of Land Management

<http://www.blm.gov> or <http://www.blm.gov/weeds>

Nevada State Office

1340 Financial Boulevard, Reno, NV 89520
775-861-6400

Battle Mountain Field Office

50 Bastian Road, 89820
775-635-4000

Elko Field Office

3900 E. Idaho Street, 89801
775-753-0200

Ely Field Office

775 N. Industrial Way, HC33, Box 33500, 89301
775-635-4000

Winnemucca Field Office

5100 E. Winnemucca Boulevard, 89445
775-623-1500

National Park Service

<http://www.nps.gov>

Great Basin National Park

Baker, 89311
775-234-7331 ext. 228

Natural Resource Conservation Service

<http://www.nrcs.usda.gov>

Nevada State Office

1365 Corporate Boulevard, Reno, 89502
775-857-8500

Elko Field Office

555 W. Silver Street, Suite 101, 89801
775-738-8431 ext. 118

Ely Field Office

744 E. N. Industrial Way, 89301
775-289-4065 ext. 106

Winnemucca Field Office

1200 E. Winnemucca Boulevard, 89445
775-623-5025 ext. 101

USDA Forest Service

<http://www.fs.fed.us>

Humboldt-Toiyabe National Forest

1200 Franklin Way, Sparks, 89431
775-331-6444

Humboldt-Toiyabe National Forest Weed Coordinator

2035 Last Chance Road, Elko, 89801
775-738-5171

Austin/Tonopah Ranger District

100 Midas Canyon Road, P.O. Box 130, Austin, 89310
775-964-2671

Ely Ranger District

825 Avenue E, Ely, 89301
775-289-3031

Mountain City Ranger District

2035 Last Chance Road, Elko, 89801
775-763-6691

Ruby Mountain/Jarbidge Ranger District

140 Pacific Avenue, P.O. Box 246, Wells, 89835
775-752-3357

APPENDIX F – FINDING LICENSED HERBICIDE APPLICATORS AND SEED VENDORS

The University of Nevada Cooperative Extension and the Nevada Department of Agriculture provide training annually in the safe use of pesticides for general knowledge and certification of applicators who apply restricted use pesticides. In order to apply restricted-use pesticides (RUPs) in the state of Nevada, you must be certified or be under the direct supervision of someone who is certified. To become certified, applicators must pass an exam which is administered by the Nevada Department of Agriculture. Contact the University of Nevada Pesticide Safety Education Program (775-784-1931) for details on upcoming training sessions.

For the most current information, go to http://agri.nv.gov/nwac/PLANT_NoXWeed_liccc.htm or contact the Nevada Department of Agriculture at 702-486-4690.

Licensed Herbicide Applicators in Northeast Nevada:

COMPANY	ADDRESS	TELEPHONE	E-MAIL
Apex Pest Control	P.O. Box 151541 Ely, NV 89315	775-289-6000	kjorstad@sbcglobal.net
GA Weed Control	693 South Westcott Spring Creek, NV 89615	775-738-8691	
Morris Ag-Air & Sons, Inc.	P.O. Box 209 Orovada, NV 89425	775-272-3365	morrisagair@hotmail.com
Neil's Pest Control	493 Commercial Street Elko, NV 89801	775-738-4368	janellh@citlink.net
Purchem Environmental	879 Silver Oak Drive Spring Creek, NV 89815	775-753-7033	purchem@ctnis.com
Ron's Spray Service	710 Grass Valley Road Winnemucca, NV 89445	775-623-5053	ronseed@onramp.bz
Simplot Soilbuilders	P.O. Box 99 Winnemucca, NV 89445	775-623-2005	
Slater Seeding	P.O. Box 817 Elko, NV 89803	775-738-9817	slaterseed@ctnis.com
Tipton's Pest Control	P.O. Box 1555 Elko, NV 89803	775-753-6382	tipton@elko.net

Seed Vendors:

COMPANY	ADDRESS	TELEPHONE	E-MAIL
Black Canyon Seed	1475 West Central Road Emmett, ID 83617	208-365-3851	seedman@micron.net
Central Utah Seed	826 North 400 East Ephraim, UT 84627	435-283-4344	
Comstock Seed	917 Highway 88 Gardnerville, NV 89410	775-746-3681	ed@comstockseed.com

Seed Vendors continued:

COMPANY	ADDRESS	TELEPHONE	E-MAIL
Freemont Trading Company	P.O. Box 386 Ephraim, UT 84627	435-283-4701 800-671-5323	maplelf@cut.net
Gooding Seed Company	P.O. Box 57 Gooding, ID 83330	208-934-8441	mrrgsc@northrim.net
Granite Seed	1697 West 2100 North Lehi, UT 84043	801-768-4422	don@graniteseed.com
Grassland West	2148 West 550 North Kaysville, UT 84037	888-456-7712	styner@hibek.net
Idaho Grimm Growers	P.O. Box 276 Blackfoot, ID 83221	208-785-0830	idgrimm@ida.net
Intermountain Seed Company	P.O. Box 62 Ephraim, UT 84627	435-283-4703	
Mountain West Seed Company	19 North 100 West Ephraim, UT 84627	435-283-4704	mtnwseed@cut.net
Native-Seed Company	3005 South Main Street Salt Lake City, UT 84115	801-971-9065	kyle.wagstaff@cgv.edu
NP Seed Company	206 East 300 South Manti, UT 84642	435-835-8301	
Paul Seed Company	P.O. Box 156 Paul, ID 83347	208-438-5858	elkmastr@pmt.org
Plummer Seed Company, Inc.	P.O. Box 70 Ephraim, UT 84627	435-283-4844	plumseed@mail.sisna.com
Ron's Seed and Supply	710 Grass Valley Road Winnemucca, NV 89445	775-623-5053	ronseed@onramp.bz
Stevenson Intermountain Seed	P.O. Box 2 Ephraim, UT 84627	435-283-6639	ron@stevensonintermountainseed.com
Wagstaff Seed	1900 East Oakhill Lane P.O. Box 68 Wallsburg, UT 84082	435-654-3439	
Wheatland Seed	P.O. Box 513 1780 North Highway 69 Brigham City, UT 84302	435-734-2371 800-676-0191	oboyce@wheatlandseed.com
Willow Creek	593 East 900 South 79-16 Ephraim, UT 84627	435-283-4701	

APPENDIX G – CALIBRATIONS FOR HERBICIDE APPLICATION

Modern herbicides must be applied at specific rates to control weeds and to minimize potential health, environmental, or safety problems. Over or under application results in less than desirable control of weeds and increases the risk of problems. This is **NOT** a case of “*if a little is good, a lot is better.*” Accurate application rates are a must to achieve weed control and should be within five percent for best results.

Calibration is often presented with many mathematical calculations which tend to impress us only with the difficulty of the calibration process. To simplify the calibration process, this method has completed most of the math for you.

Hand Pesticide Application Calibration

The instructions below are designed to be used with individual backpack or other hand-carried application equipment or nozzles when applying emulsifiable concentrates or other liquid pesticide formulations.

Because each of us move at different speeds, have different application equipment, and have a different idea of what constitutes full coverage, EACH person must calibrate his/her hand application equipment before they make an herbicide application. This way, the pesticide mixture can be adjusted for individual differences and the appropriate pesticide application rate can be obtained.

Follow These Instructions:

1. Clean your sprayer thoroughly with soap and water, sudsy ammonia or a commercial tank cleaner. Dispose of the rinse material appropriately. Make sure your application equipment is working properly and the hoses and fittings do not leak. Fill sprayer to a designated mark with clean water.
2. Measure an 18 1/2-foot by 18 1/2-foot spot in a typical weedy area. Spray this area uniformly with water and record the number of seconds it takes to evenly cover the area. Remember that consistency is vital to uniform coverage. Develop a smooth, sweeping motion with the spray wand while you walk at a comfortable pace. Keep the pressure constant.
3. Spray water into a large container for the same length of time it took you to spray the plot in step two. Be sure to maintain the same pressure used in step two. Measure the fluid ounces you collect. If the product you are using is formulated at four pounds active ingredient (a.i.) per gallon, the ounces of water collected for that specific time converts directly to gallons per acre of pesticide mixture to be applied (i.e., 30 ounces of water sprayed is equal to a rate of 30 gallons per acre).
4. The first three steps should be repeated twice more and results averaged for accuracy.
5. To determine the amount of herbicide needed to mix in a gallon of water, read Table G-1 on page G-3. If the pesticide you are using is formulated at a rate different than four pounds active ingredient per gallon, you will need to do the additional math described at the bottom of the Table.

For example: Controlling a certain weed requires three quarts per acre of a particular product with four pounds active ingredient per gallon. Your spray volume calculated above is 30 gallons per acre. According to the chart, you would mix 3.2 fluid ounces of the product per gallon of water to apply the correct amount of herbicide per acre. If your backpack sprayer holds four gallons of water, then you would add 12.8 fluid ounces of the product to your sprayer tank. (3.2 fluid ounces X 4 = 12.8 fluid ounces. If needed, divide that out by using the handy conversion on the bottom of page G-3.)

Calibration of Your Field Sprayer

The instructions below are designed to be used with tractor-, ATV- or pickup-mounted application equipment, when applying emulsifiable concentrates or other liquid herbicide formulations.

Because of various field conditions, different application equipment, and different speeds crossing a field, EACH piece of application equipment must be calibrated before it is used for herbicide applications. This way, the herbicide mixture can be adjusted and the appropriate herbicide application rate obtained.

Follow These Instructions:

1. Clean your sprayer thoroughly with soap and water, sudsy ammonia, or a commercial tank cleaner. Dispose of the rinse material appropriately. Make sure all your equipment is working properly. Fill sprayer with clean water.
2. Measure a specific distance such as 88, 100, 200, or 300 feet in a typical area of the field you will be spraying. If using a tractor, set your tractor RPM and select a gear which will be used in that field. If using an ATV or truck, decide upon a gear and speed that will be used. Spray the measured distance from a running start at the specified speed or RPM. Record the time needed to cover the distance.
3. Place a measured container under each nozzle to collect the spray. Turn on the spray bar the same length of time it took to spray the distance in step two. Because of the variability between nozzles, it is best if each nozzle is collected separately. Record the amount collected in each container and add them together. Divide the total by the number of nozzles to get an average spray quantity per nozzle. If any nozzle sprays ten percent over or under the average, clean it or replace it and repeat step three. If you replace a nozzle, use the same size, type, and model for the replacement.
4. The total amount collected in step three is converted to gallons per acre. Do this by multiplying the distance originally measured (traveled) by the width of the spray pattern to obtain the area of the plot sprayed. Divide the area of the plot sprayed by 43,560 (number of square feet per acre) to obtain the fraction of an acre sprayed. Now you know the plot area sprayed and the liquid volume sprayed on the plot. Divide the area into the quantity of liquid to obtain the number of gallons of water applied per acre.
5. To determine the amount of pesticide you need to mix in a gallon of water, read Table G-1 on page G-3. You only need to do additional math if the pesticide you are using is formulated at a different rate than four pounds active ingredient per gallon.

For example: Controlling a certain weed requires three quarts per acre of a particular product with four pounds active ingredient per gallon. Your spray volume calculated above is 30 gallons per acre. According to the chart, you would mix 3.2 fluid ounces of the product per gallon of water to apply the correct amount of herbicide per acre. If your tank holds 100 gallons of water, then you would add two gallons and two quarts of the product to your 100 gallon sprayer tank. (3.2 fluid ounces X 100 = 320 fluid ounces. Divide that out by using the handy conversion on the bottom of page G-3.)

References

Wilson, R.E. *Calibration of Your Field Sprayer*. University of Nevada Cooperative Extension Fact Sheet FS-96-06.
Wilson, R.E. *Hand Pesticide Application Calibration*. University of Nevada Cooperative Extension Fact Sheet FS-96-07.

Table G-1. Volume of pesticide (4 pounds active ingredients per gallon) to mix in one gallon of water.¹

Spray Water Volume (Gallons per Acre)	Desired application rate of pesticide per acre			
	1 qt	2 qts	3 qts	4 qts
10	3.2 fl oz	6.4 fl oz	9.6 fl oz	12.8 fl oz
15	2.1 fl oz	4.3 fl oz	6.4 fl oz	8.5 fl oz
20	9.6 tsp	3.2 fl oz	4.8 fl oz	6.4 fl oz
30	6.4 tsp	2.1 fl oz	3.2 fl oz	4.3 fl oz
40	4.8 tsp	1.6 fl oz	2.4 fl oz	3.2 fl oz
50	3.8 tsp	1.3 fl oz	1.9 fl oz	2.6 fl oz
60	3.2 tsp	6.4 tsp	1.6 fl oz	2.1 fl oz
70	2.8 tsp	5.5 tsp	1.4 fl oz	1.8 fl oz
80	2.4 tsp	4.8 tsp	7.2 tsp	9.6 tsp
100	1.9 tsp	3.8 tsp	5.8 tsp	7.7 tsp

¹This chart only applies to pesticides that have **four pounds of active ingredients per gallon**. Read the label. If the pesticide concentration you are using is different from four pounds per gallon active ingredient, you will need to divide the pesticide mixture number (oz or tsp) in the chart by four and then multiply that answer by the number of pounds of active ingredient per gallon listed on your product label. That quantity would then be mixed per gallon of water in your sprayer.

Handy Conversions:

3 teaspoons (tsp)	= 1 tablespoon (tbsp)	2 tablespoons	= 1 fluid ounce
8 fluid ounces	= 1 cup	1 cup	= 16 tablespoons
2 cups	= 1 pint	2 pints	= 1 quart
4 quarts	= 1 gallon	1 gallon	= 128 fluid ounces
1 acre	= 43,560 square feet	1 acre	= 128 - 18 1/2' x 18 1/2' plots

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APPENDIX H— COMMON AND SCIENTIFIC NAMES OF RECOMMENDED REVEGETATION SPECIES

<u>Common Name</u>	<u>Scientific Name</u>
Grasses	
Bluegrass, Big	<i>Poa ampla</i>
Fescue, Sheep	<i>Festuca ovina</i>
Fescue, Tall	<i>Festuca arundinacea</i>
Needle-and-Thread Grass	<i>Hesperostipa comata</i>
Ricegrass, Indian	<i>Achnatherum hymenoides</i>
Sacaton, Alkali	<i>Sporobolus airoides</i>
Saltgrass, Inland	<i>Distichlis spicata</i>
Squirreltail, Bottlebrush	<i>Elymus elymoides</i>
Wildrye, Basin	<i>Leymus cinereus</i>
Wildrye, Beardless	<i>Leymus triticoides</i>
Wildrye, Russian	<i>Psathyrostachys juncea</i>
Wheatgrass, Bluebunch	<i>Pseudoroegneria spicata</i>
Wheatgrass, Desert (Crested)	<i>Agropyron desertorum</i>
Wheatgrass, Intermediate	<i>Elytrigia intermedia</i>
Wheatgrass, Newhy	<i>Elymus hoffmanii</i>
Wheatgrass, Siberian	<i>Agropyron fragile ssp. sibericum</i>
Wheatgrass, Slender	<i>Elymus trachycaulus</i>
Wheatgrass, Snake River	<i>Elymus wawawaiensis</i>
Wheatgrass, Streambank	<i>Elymus lanceolatus</i>
Wheatgrass, Tall	<i>Elytrigia elongata</i>
Wheatgrass, Thickspike	<i>Elymus macrourus</i>
Wheatgrass, Western	<i>Pascopyrum smithii</i>
Forbs	
Alfalfa, Ladak	<i>Medicago sativa</i>
Aster, Pacific	<i>Aster chilensis</i>
Burnet, Small	<i>Sanguisorba minor</i>
Clover, Alsike	<i>Trifolium hybridum</i>
Clover, Strawberry	<i>Trifolium fragiferum</i>
Flax, Blue	<i>Linum perrene</i>
Flax, Lewis	<i>Linum lewisii</i>
Globemallow, Desert	<i>Sphaeralcea ambigua</i>
Penstemon, Palmer	<i>Penstemon palmeri</i>
Sainfoin	<i>Onobrychis viciifolia</i>
Sweetclover, yellow	<i>Melilotus officinalis</i>
Trefoil, Birdsfoot	<i>Lotus corniculatus</i>
Shrubs	
Big Sagebrush, Mountain	<i>Artemisia tridentata ssp. vaseyana</i>
Big Sagebrush, Wyoming	<i>Artemisia tridentata ssp. wyomingensis</i>
Bitterbrush, Antelope	<i>Purshia tridentata</i>
Ephedra, Nevada	<i>Ephedra nevadensis</i>
Hopsage, Spiny	<i>Grayia spinosa</i>
Kochia, Forage	<i>Kochia prostrata</i>
Saltbush, 4-wing	<i>Atriplex canescens</i>
Shadscale	<i>Atriplex confertifolia</i>
Winterfat	<i>Krascheninnikovia lanata</i>

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APPENDIX I – WEED-FREE FORAGE SOURCES

Current as of June 2, 2004, for updates, go to http://agri.nv.gov/nwac/PLANT_WFHProducers2004.htm

Weed-free Forage Producers:

PRODUCER	ADDRESS	TELEPHONE	PRODUCTS
Avi Kwa Ame Farms	P.O. Box 5229 Mojave Valley, AZ 86446	928-346-1232	Alfalfa
Funeral Mountain Ranch	P.O. Box 10 Amargosa Valley, NV 89020	775-372-5355	Alfalfa
O'Toole Ranches	HC 61, Box 6214 Austin, NV 89310	775-964-2464	Grass
Jack Healy	4955 Franktown Road Carson City, NV 89704	775-883-6192	Grass
George Panagopoulos	720 South California Avenue Ely, NV 89301	775-289-6137	Alfalfa/Grass
Bensons	P.O. Box 158 Eureka, NV 89316	775-237-5437	Alfalfa
Ernie Fanning	1743 Finch Lane Gardnerville, NV 89410	775-782-0386	Grass
Heise Land and Livestock	1125 Highway 88 Gardnerville, NV 89410	775-265-2318	Grass, Oats, Alfalfa, Alfalfa/Grass
Rod Goodwin	1423 Orchard Road Gardnerville, NV 89410	775-782-3428	Alfalfa
Stodieck Farm	1000 Waterloo Lane Gardnerville, NV 89410	775-782-2863	Alfalfa, Grass
Brent Gardner	P.O. Box 229 Lund, NV 89317	775-238-5439	Alfalfa
Gibson Farms	Highway 318, P.O. Box 203 Lund, NV 89317	775-238-5359	Alfalfa
Lane Hendrix	P.O. Box 222 Lund, NV 89317	775-238-5345	Alfalfa
Orvan Maynard	P.O. Box 64 Lund, NV 89317	775-238-5352	Alfalfa
Quarter Circle Five Ranch	P.O. Box 265 Lund, NV 89317	775-238-5338	Alfalfa
Park Cattle Company	1300 Buckeye Road Minden, NV 89423	775-782-2144	Alfalfa, Grass

Weed-free Forage Producers continued:

PRODUCER	ADDRESS	TELEPHONE	PRODUCTS
JP Ranch	Box 50 Montello, NV 89830	775-776-2422	Alfalfa
Kings River Ranch	Star Route, Box 129 Orvada, NV 89425	775-859-0349	Alfalfa
Hi Desert Hay and Livestock	P.O. Box 3819 Tonopah, NV 89049	775-482-8208	Alfalfa
Deer Run Ranch	5440 Eastlake Boulevard Washoe Valley, NV 89704	775-882-3643	Alfalfa
Jim Greil	5375 Eastlake Boulevard Washoe Valley, NV 89704	775-888-9877	Alfalfa
Jim Whited	HC 60 Box 203 Wells, NV 89835	775-752-3949	Alfalfa
John Ritter	288 Pete Hendricks Lane Yerington, NV 89447	775-463-2002 775-771-8258	Alfalfa, Oats, Alfalfa/Grass, Straw
Nevada Onion	61 Bowman Lane Yerington, NV 89447	775-463-3642	Alfalfa, Grass, Cubes
Robert Copper	984 Highway 208 Yerington, NV 89447	775-463-3040	Grass, Straw
Snyder Livestock Company	P.O. Box 550 Yerington, NV 89447	775-463-2677	Alfalfa

Retail Suppliers:

SUPPLIER	ADDRESS	TELEPHONE
Benson's Feed	2750 Highway 50 East Carson City, NV 89701	775-882-3999
Fernley Hay and Grain	808 Highway 40 Fernley, NV 89408	775-575-2137
Wakimoto Farm Store	11925 South Las Vegas Boulevard Las Vegas, NV 89123	702-361-3441
Green's Feed	4701 North Virginia Street Reno, NV 89506	775-323-1502

APPENDIX J – WEBSITES FOR WEED INFORMATION

Animal and Plant Health Inspection Service Noxious Weeds Program:

<http://www.aphis.usda.gov/ppq/weeds/>

Arizona Department of Agriculture Plant Services Division:

<http://www.azda.gov/PSD/psd.htm>

Bureau of Land Management's Weeds Website:

<http://www.blm.gov/weeds/>

California Department of Food & Agriculture Encycloweedia:

http://www.cdfa.ca.gov/encycloweedia/encycloweedia_hp.htm

California Invasive Plant Council:

<http://www.cal-ipc.org/>

Center for Invasive Plant Management:

<http://www.weedcenter.org/>

Colorado Weed Management Association:

<http://www.cwma.org/>

Federal, State & International Invasive Species Activities & Programs, Including Databases:

<http://www.invasivespecies.gov>

Aquatic Plants Database: <http://www.invasivespecies.gov/databases/apdb.shtml>

International Database: <http://www.invasivespecies.gov/databases/intldb.shtml>

Terrestrial Plants Databases: <http://www.invasivespecies.gov/databases/tpdb.shtml>

Federal Interagency Committee for the Management of Noxious and Exotic Weeds:

<http://ficomnew.fws.gov/>

Florida Exotic Pest Plant Council:

<http://www.fleppc.org/>

Global Invasive Species Database:

<http://www.issg.org/database/>

Global Invasive Species Information Network (GISIN):

<http://www.gisinet.org/>

Great Basin Restoration Initiative:

<http://www.fire.blm.gov/gbri>

Idaho Department of Agriculture:

<http://www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/indexnoxweedmain.php>

Idaho Weed Control Association:

<http://www.idahoweedcontrol.org>

Integrating Weed Control & Restoration for Great Basin Rangelands:

<http://www.ag.unr.edu/ifafs>

Invaders Database System:

http://invader.dbs.umt.edu/Noxious_Weeds/

Lander County Conservation District:

<http://lccdnv.org>

Montana War on Weeds – Weed Information and Weed Control:

<http://mtwow.org/>

National Biological Information Infrastructure:

<http://cain.nbii.gov>

California: <http://cain.nbii.org/>

Great Basin: <http://greatbasin.nbii.gov/>

Invasive Species: <http://invasivespecies.nbii.gov/>

Natural Resource Projects Inventory:

<http://www.ice.ucdavis.edu/nrpi>

Nature Conservancy:

<http://nature.org/>

NatureServe Invasive Species Assessments:

<http://www.natureserve.org/>

Nevada Department of Agriculture , Noxious Weeds:

<http://agri.nv.gov/nwac>

New Mexico Department of Agriculture, Noxious Weed Act :

<http://nmdaweb.nmsu.edu/DIVISIONS/APR/weed.html>

New York Botanical Garden Catalog of Invasive Plant Species of the United States :

<http://sciweb.nybg.org/science2/hcol/inva/index.asp>

Oregon Department of Agriculture, Plant Division Noxious Weed Control Program:

http://egov.oregon.gov/ODA/PLANT/weed_index.shtml

Plant Conservation Alliance, Weeds Gone Wild:

<http://www.nps.gov/plants/alien/index.htm>

Plants Database, Natural Resources Conservation Service:

<http://plants.usda.gov/>

Rangelands West:

<http://rangelandswest.org>

US National Park Service's Weeds Gone Wild (Alien Plant Invaders of Natural Areas)

<http://www.nps.gov/plants/alien/>

University of California Cooperative Extension Weed Research & Information Center:

<http://wric.ucdavis.edu/>

University of Florida's Center for Aquatic and Invasive Plants:

<http://aquat1.ifas.ufl.edu>

University of Montana Invaders Database System:

<http://invader.dbs.umt.edu/>

Utah Bureau of Land Management, Partners Against Noxious Weeds:

<http://www.blm.gov/utah/resources/weeds/index.html>

Utah Department of Transportation, Unwanted Weeds:

<http://www.dot.state.ut.us/mnt/Roadside/weeds.htm>

Utah Department of Agriculture and Food, Noxious Weed Program:

http://ag.utah.gov/plantind/noxious_weeds.html

Washington State King County Noxious Weed Control Program Weed Photos:

<http://dnr.metrokc.gov/wlr/lands/weeds/weedid.htm>

Washington State Noxious Weed Control Board:

<http://www.nwcb.wa.gov/INDEX.htm>

Weed Science Society of America:

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

Weeds Australia:

<http://www.weeds.org.au/>

Western Society of Weed Science:

<http://www.wsweedscience.org>

Wyoming Weed and Pest Council:

<http://www.wyoweed.org/>