SDSU Extension

# BEEF

Chapter 53

# Pasture and Range Invasive Species Management

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Chapter 53:

# Pasture and Range Invasive Species Management

## Introduction

Understanding invasive species (weeds) and their effects on pastures is a necessary component to whole farm or ranch planning. Economically, invasive species management can be quite expensive and time consuming. Conversely, invasive species mismanagement can also have a negative impact on ranch resources (human and financial). It is often necessary to look beyond simply treating the specific weed or group of weeds in the pasture. Producers must challenge themselves to become familiar with invasive species, the processes and systems that invite or allow them to persist, and the opportunities to reduce input costs for weed control while exploring options for improving profitability. This chapter will focus primarily on the role and impacts of broadleaf flowering plants on rangelands and pastures and includes information on:

- Interpreting Weed Terminology and Law
- Integrated Pest Management (IPM)
  - Chemical control
  - Biological control
  - Cultural control
- Maintaining Ecological Balance In Pastures
- Assessing a Plant's Potential Value to Pasture and Livestock
  - Invasive grasses
  - Noxious and toxic plants
  - Identifying plants
- Implementing a Plan

### *Interpreting Weed Terminology and Law*

Invasive species (weed) control is a required component of sound range and pasture management, with many producers perceiving that control or removal of weeds equates to range health and thus additional profit potential. Further, control of a certain group of exotic invasive species known as 'noxious weeds' demands control

### Key Points

- Invasive species (weed) control is a required component of sound range and pasture management.
- Understanding invasive species law and terminology is critical to successful rangeland management.
- Successful producers will embrace the concepts of Integrated Pest Management and will become knowledgeable about how they can take advantage of certain invasive species that occur on their rangelands.
- Many resources exist to assist livestock producers with invasive species education management planning needs.

measures as defined in South Dakota state law (see chapter 38-22 of South Dakota Codified Law http://legis.sd.gov/statutes/DisplayStatute.aspx?Statute=38-22&Type=StatuteChapter). While landowners have a rather clear directive from the state regarding weed control requirements on private property, most are undereducated on weed identification and the general role and function of most broad leaf species in a rangeland plant community, whether those species are native, exotic, or invasive.

The South Dakota Department of Agriculture maintains an excellent website that can assist producers seeking more information on the structure and status of South Dakota's weed laws (https://sdda.sd.gov/). More specifically, interested parties can navigate to the Weed and Pest information section of the website for specific information on state and locally noxious weeds, Integrated Pest Management (IPM) practices, and a listing of county-level Weed Supervisors (https://sdda.sd.gov/ag-services/weed-and-pest-control/weed-pestcontrol/).

The language of weed management can be complicated, and it is helpful to start with the understanding of general terms:

| Term | Working Definition (as defined for common use) |
|---|---|
| Weed | Generally not a legal term. The term weed can apply to any plant that is out of place or deemed undesirable, regardless of origin. It is important to recognize that a weed may or may not actually be exotic or truly invasive, but it may be undesirable simply because it is located in a place that is deemed unacceptable. Further, a plant may be labeled as a weed because of erroneous perception or belief that it is undesirable or that it has no value. |
| Invasive Plant | Any plant that tends to reproduce and colonize aggressively or that displaces desirable vegetation or species and/or competes successfully for limited resources. Not all invasive plants in pastures are recognized as weeds by managers or producers. Most invasive plants are exotic, while a limited number are native, early successional species. |
| Native Plant | Generally any plant that naturally occurs in South Dakota or the surrounding region. Native plants can be invasive in pastures, but invasiveness is often a result of historic or current management that favors early successional species. Non-Native (Exotic) |
| Plant | Generally any plant that does not originate in South Dakota or the surrounding region. This term is most typically applied to plants that are believed to have originated somewhere other than the North American continent. Most exotic plants are undesirable in pastures, while not all are invasive in nature. |
| State Noxious Weed[1] | Any plant that meets certain criteria/characteristics as defined by the state of South Dakota, including but not limited to: perennial; rapid spread; requires special control measures; materially impacts production of crops or livestock; decreases the value of land; and is not native to the state of South Dakota. State noxious weeds must be controlled regardless of where it occurs in the state. |
| Locally Noxious Weed[1] | Any plant that meets certain criteria/characteristics as defined by the state of South Dakota, including but not limited to: Need not be perennial; rapid spread; requires special preventative measures; materially impacts production of crops or livestock; decreases the value of land. Locally noxious weeds need not necessarily be exotic species, and they must be controlled in counties where they are specifically listed. |
| [1] South Dakota Weeds, 2009 Edition. | |

The term weed can be broadly applied to any plant that is undesired or out of place based on a host of non-standard criteria. It is important to understand that the word weed has become a general term with no universal definition, and many native plants are considered to be weeds depending on location and tradition. This becomes problematic in pasture management because producers can be misled regarding what a weed is … or is not … and what their responsibilities for control may be.

In pasture management, the term weed is most often applied to non-native species or to those native species believed not to contribute to the health of the pasture or the livestock. This has led to an overly simplified view of what grazing lands should look like. Producers perceive that cattle eat primarily grass species and that grass should dominate the pasture, leading to an erroneous conclusion that if a plant is not grass, it is a weed and has no value to livestock production. This simplified approach can result in what is often a poorly evaluated decision to make a broad-scale application of chemicals to control broadleaf plants in pastures. Further, the assumption that broad-scale broadleaf plant control is profitable must be critically assessed at the ranch or pasture level to determine if the investment results in real profit without sacrificing plant diversity, pasture health, or animal needs.

## *Integrated Pest Management (IPM)*

Integrated Pest Management (IPM) is a system that considers the role of various tools for reducing or eliminating the pest. Generally, tools fall under the broad categories of legal, chemical, cultural, or biological controls. Central to a successful IPM strategy is the understanding that prevention is often the most economical approach (South Dakota Weeds 2009). In pastures, weed prevention may be difficult to achieve due to historic land uses or outside influence.

The box outlines IPM options recognized by the South Dakota Department of Agriculture, many of which can be effectively applied to native and tame pastures. It is common for pasture and range managers to rely heavily on chemical applications to control invasive broadleaf species, often not considering alternative options offered in IPM strategies.

**Integrated Pest Management**

1. Legal control
   a. Quarantines
   b. Certified seed
   c. Certified weed free forage
   d. Forced compliance
2. Chemical control
   a. Herbicides
   b. Application regimes
   c. Methodology
3. Biological control
   a. Natural competition
   b. Introduced competition
4. Cultural control
   a. Manual control
   b. Mechanical control
   c. Burning
   d. Smothering
   e. Natural competition
   f. Livestock manipulation
   g. Wildlife manipulation
   h. Soil disturbance management

**Chemical control:** Chemical control is a valuable tool in range and pasture weed management. The benefits of chemical control generally center on convenience in relation to time and labor management. Simply put, chemical control is often perceived as the easiest and most efficient way to achieve control of the targeted species. While chemical control can be effective, it should not be viewed as a singular tool. Weed resistance over time, non-target impacts to native or desirable vegetation, label restrictions on grazing/haying reentry, drift, and applicator error can lead to unforeseen 'costs' to the operation and the ecology of the landscape. SDSU Extension has compiled a comprehensive chemical guide as a resource for pasture and range managers (Moechnig et al. 2009). This resource is arranged in simple fashion by popular chemical brand name and provides information on chemistry, application rates, targeted species, precautions, and restrictions as provided by the manufacturers. Beyond this, chemical manufacturers have a great deal of information available in publications and via websites regarding specific products, Material Safety Data Sheets (MSDS), and product labels.

Chemical control of broadleaf plants should not be viewed as necessary without careful evaluation. Cattle will include a great many broadleaf plants in their diet if given the opportunity, up to 20-30%

(Fuhlendorf et al. 2009). Further, many broadleaf plants play a critical role in the overall function of rangeland nutrient cycles and soil health. Infestations of common plants such as common or western ragweeds *(Ambrosia artemisiifolia, A. psilostachya)*, goldenrods *(Solidago spp.)*, western snowberry or buckbrush *(Symphoricarpos occidentalis)*, prairie coneflower *(Ratibida columnifera)*, and other less desirable native broadleaf plants may indicate a need for a shift in grazing management rather than a 3-4 year spray rotation. Although judicious use of chemicals for targeted control of certain species may certainly have a place in a well-managed operation, producers should be willing to ask themselves the critical questions to ascertain whether their own management methods are the root cause of the weedy infestation, creating the symptoms that encourage the application of broadcast chemicals in the first place. Careful evaluation of target weed species in a pasture may indicate that an emphasis on asking why weeds persist, rather than simply focusing on the weeds, may lead to more efficient distribution of inputs (labor, chemicals, or grazing management), resulting in improved and long-term rangeland health and profitability.

In South Dakota, it is not uncommon for range and pasture managers to implement broadcast (ground or aerial) general herbicide applications on a 3-4 year return interval as a means of overall pasture management to control broadleaf plants. Little if any data exists to determine whether this investment results in real profit to individual animal or herd performance, often measured in weight gain. In a 2009 paper, researchers at Oklahoma State University analyzed whether the expense of a broadcast application of a non-selective general herbicide (Grazon® [2,4-D + Picloram]) resulted in profit derived from improved animal performance (Fuhlendorf et al. 2009). The study was conducted on mixed-grass prairie in Oklahoma where 25% of the rangeland is estimated to be treated annually with herbicides for general broadleaf plant control.

In that study, treatments were applied in 2001 and 2004. They found that broadleaf plants were consistently decreased while grass biomass increased in the years of the herbicide application, as expected. However, researchers could make no correlation between reductions in broadleaf plant populations and increases in animal performance as measured by daily rate of gain. Further, they found that year-to-year variability in animal performance was largely correlated with climate variation, not herbicide application. They analyzed several other studies and found no direct link between herbicide applications for control of flowering plants and animal performance. The authors concluded by stating that in their view, "the inability to reliably predict production of forage grasses is an insurmountable hurdle to efficiently capturing increased grass production by increasing stocking rate following reduction of forbs using herbicides." A powerful statement to consider when assessing input costs of broad-scale chemical applications on pastures.

**Biological Control:** Biological control generally refers to the use of plants, insects, or animals to create competition or to directly forage on all or part of the invasive plant. For example, biological control of a weed might be achieved if an alternative desirable plant can be established that will effectively compete with the weed for resources (nutrients, water, or sunlight). Similarly, biological control would also refer to the use of an insect or grazing animal that would forage on the weed, depleting the weed's ability to complete its life cycle through reducing its reproductive potential or the ability to store or capture resources in roots or leaves.

Several of South Dakota's state and locally noxious weeds have biological control options (primarily insects) that have proven effective in certain localities. Of these, perhaps the biggest success story has been the whole-scale use of biological agents for the control of leafy spurge *(Euphorbia esula)* across South Dakota. Based in part on the successes experienced in the leafy spurge program, state and federal agencies continue to experiment with a variety of alternative biological control agents (insects) for other state and locally noxious weeds, including but not limited to: Canada thistle *(Cirsium arvense)*, purple loosestrife *(Centoureo repens)*, salt cedar *(tamarix spp.)*, dalmation and yellow toadflax *(Linaria dalmatica, L. vulgaris)*, and musk and plumeless thistles *(Carduus nutans, C. acanthoides)*.

It is important to remember that biological control also refers to utilizing forage animals, and livestock can play a key role in managing weeds. See the 'Assessing a Plant's Potential Value' section of this chapter for specific information on the role cattle can play in managing noxious weeds and other invasive plants in South Dakota. Finally, producers who choose to use biological controls must understand that while an acceptable means of treatment, success of biological controls can be unpredictable. It is recommended that producers work with their County Weed Supervisor or other qualified advisor to develop an appropriate biological control strategy that ensures reasonable success while possibly integrating chemical and cultural controls during the transition phase to biological control.

**Cultural Control:** Perhaps the most underutilized suite of tools for invasive species management remains the cultural controls such as burning, grazing, or mechanical clipping. Cultural control generally equates to manipulating the physical structure of the plant, reducing or eliminating its ability to photosynthesize or to take in necessary resources (air, water, or nutrients). Prior to the advent of chemicals, cultural and biological controls were the mainstay of weed management. Conversely, today's grassland managers may not immediately select cultural controls as their tool of choice. When weighed against the pros and cons of chemical control, cultural control still has a reasonable place in an IPM program, especially when targeting annual or biennial plants and where non-target impacts or ecological balance must be considered.

The key to effective cultural control in pastures is analyzing the target species. Determining whether the plant is an annual, biennial, or perennial plant will help inform the manager if and when cultural control may be beneficial. Of equal importance is understanding the plant's primary mode of reproduction. For annual plants, an annual return interval of well-timed cultural controls can effectively break the cycle of seed production. For biennial and perennial plants, the manager must first understand the overall biology of the plant.

As an example, musk thistle *(Carduus nutans)* is primarily a biennial plant, producing a rosette of leaves the first year followed by a seed producing flower the second year. When utilizing a cultural control such as mowing, it would be of little benefit to attempt to mow the first year rosettes as the root stock will likely harbor enough stored nutrients to allow the plant to survive into its second year. In year two, the musk thistle will send up a seed stalk for reproduction, providing the manager a window of opportunity to break the reproductive cycle through mowing or cutting.

With any cultural control, it is advantageous to remove the plant prior to bud stage or flower maturation. Many invasive species have the ability to produce viable seed from the flower head and upper stalk even after cutting. Therefore, cutting a species like musk thistle when the flower is in full bloom and seed is starting to form may not prevent viable seed production. Cutting early and possibly returning for a second cutting will ensure adequate control. By repeating this process annually (even for biennial plants), the manager ensures control of all plants that may be cycling in any given year, effectively eliminating seed reproduction and eventually reducing or eliminating the seed bank.

Cultural control for perennial plants can be effective in preventing production of seed heads and/or fruiting if timed appropriately. In perennial species where primary reproduction is accomplished via rhizomes, roots, or plant parts, simply preventing seed production may not prevent reproduction. In this instance, combining cultural control with biological controls can be effective, as biological control agents such as insects often forage on roots and other plant parts, reducing the plant's ability to store carbohydrates and weakening its ability to survive winters and/or produce viable seed.

As with chemical and biological methods, discretion must be used when applying cultural controls to rangelands and pasture. While targeted cultural controls such as prescribed fire, mowing/clipping, and livestock manipulation can generally yield positive results in healthy rangeland, timing and intensity are very important considerations. In pastures and rangelands where invasive species are historically prevalent, chemical and cultural controls should be applied cautiously through small scale tests

if a reasonable threat exists that additional invasive species problems may result. It is not recommended that producers utilize soil manipulation in native rangelands and pastures, as such manipulation can invite additional weed problems and may negatively impact native species competition.

## Maintaining Ecological Balance in Pastures

Invasive species management in pastures can be as much an art as a science. While most pastures have some degree of non-native species, many also harbor certain native plants that are considered undesirable or non-beneficial to the pasture or livestock. Often, native broadleaf plants are simply lumped together in weed control guides, with little or no information provided on the origin or value of the plant to the landscape, wildlife, or livestock.

The list of native undesirable species is dominated by perennial broadleaf plants or shrubs, such as Canada goldenrod *(Solidago canadensis)* or western snowberry/buckbrush *(Symphoricarpos occidentalis)*. While these species may have relatively little grazing value, they may play a critical role in overall pasture health in regard to nutrient cycling and wildlife habitat. Further, broad-scale control of these plants via chemical application can have severe detrimental consequences to desirable native broadleaf plants. For instance, broad-scale application of non-selective herbicides to control thistles might also have undesirable impacts on native legumes, such as leadplant *(Amorpha canescens)*, which is palatable and desirable as a natural nitrogen fixer.

As stated earlier, the term weed is subjective and fairly nonscientific. For example, the 2009 Edition of South Dakota Weeds lists many native broadleaf plants, including prairie wild rose *(Rosa arkansana)*, prairie coneflower *(Ratibida columnifera)*, and American vetch *(Vicia americana)* as weeds. However, prairie rose is a showy prairie flower that does not pose problems in pastures. Prairie coneflower is occasionally utilized by livestock and may be an indicator of poor grazing management when in abundance. American vetch is highly palatable as livestock forage (Johnson and Larson 2007).

Maintaining ecological balance centers on understanding the contributions of individual plant species to the system as a whole. Well balanced native broadleaf plant populations contribute to the overall health of the pasture, even if the individual species are not highly desirable as forage. In general, many native broadleaf species serve as pollinators – plants that produce nectar and pollen. These plants in turn support insects and other animals (birds, bats, etc.) that spread the pollen for plant reproduction. These insect and animal populations contribute to the overall health of the system, cycling nutrients and providing diversity and ultimately resiliency to the pasture.

When producers view pasture management through the same lens that they view cropland management, the results can be detrimental. For example, a common desire among pasture managers is to want the pastures 'cleaned up' through the removal or control of any species perceived to be unpalatable to cattle or any species simply not recognized as contributing to livestock performance. Through heavy stocking rates and broad scale chemical applications, many South Dakota pastures have been managed toward grass-only systems that not only impede the survival of broadleaf plants, but also impede the sustainability of our best native grasses. Often, this management philosophy does not recognized the contributions of a diverse diet to animal health and can lead to additional weed problems through reduced competition.

## Assessing a Plant's Potential Value To Pasture And Livestock

In order to assess whether a plant is truly a weed or whether it has some intrinsic value to the system or to livestock diets, producers should consult a variety of resources. This is critical research to perform before enacting a control plan as such research may lead a livestock manager from a weed control plan to a weed use plan.

**Invasive grasses:** The suite of invasive species generally categorized as cool-season exotic grasses encompass great challenges for the health of South Dakota's rangelands. This group of grasses includes, but is not limited to: Kentucky bluegrass *(Poa pratensis)*, smooth brome *(Bromus inermis)*, Japanese brome *(B. Japonicus)*, cheatgrass *(B.*

*tectorum)*, crested wheatgrass *(Agropyron cristatum)*, intermediate wheatgrass *(A. intermedium)*, and quackgrass *(Elytrigia repens)* (Johnson and Larson 2007). These species are generally palatable when young and succulent. Their appeal to grazing animals lessens as they mature.

The establishment and persistence of exotic cool-season grasses can be indicative of historic management as well as an indicator of improper recent or current management. Once established, the persistence of these species is difficult to control even under the best grazing plans, and transitioning back to a native-dominated plant community can be difficult. We suggest that producers consult a range management professional or experienced grazing manager for guidance and advice on timing of use of these species throughout the grazing season.

Noxious and toxic plants: As discussed previously, producers are legally required to control noxious weeds. However, several control options do exist for these species, and producers should research the plant's forage potential as a means of control. A list of state and locally noxious weeds can be obtained at the South Dakota Department of Agriculture's Weed and Pest Control website at https://sdda.sd.gov/ag-services/weed-and-pest-control/weed-pestcontrol/. While it is imperative that landowners meet their obligations to control these plants, alternatives to chemical application should be evaluated, especially in relatively diverse native pastures.

There are limited published resources that are specific to poisonous plants in South Dakota, however the field guide *Plants that Poison Livestock in the Great Plains Area* lists several common pasture plants (native and non-native) and is a good reference in regard too the symptoms associated with plant toxicity (see reference list at the end of this chapter for information on how to obtain this guide). Producers should speak with local veterinarians and neighbors for more information on potentially toxic plants in their home area.

Researcher and author Kathy Voth is a leading expert in the emerging science of managing weeds with livestock. In *Cows Eat Weeds*, Voth (2010) outlines simple methods that any producer can implement to train cattle to eat a variety of weedy species, including many of the exotic species found on the South Dakota noxious weed list. With her simple techniques, Voth outlines how cattle can be trained to forage on a variety of weeds previously thought to be non-palatable. This type of innovation can provide alternatives to producers struggling with the expense, scale, or timing of traditional weed control on rangeland and pasture. By utilizing grazing as a means of cultural control, producers have the potential to decrease input expenses while reaping the benefits of inexpensive weed control through animal nutrition.

Most South Dakota producers have little or no experience in the biology of noxious weeds, and therefore questions arise as to which noxious species can be grazed safely. Unfortunately, information on the palatability of individual species can be difficult to find and can often times be contradictory. Location, time of year and even time of day can influence a plant's relative nutritional (or toxic) value. The relationship between toxins and nutrients in ruminant animals is complex, and in many cases livestock can successfully mix their own diets as long as enough variety is available (Kathy Voth pers. comm).

Table 1 is provided as a starting point for producers interested in grazing South Dakota's noxious weeds and is not intended to be a comprehensive list of all species livestock may consume. Rather, the table is provided as a general resource for noxious weed palatability and/or toxicity. It is important to note that Table 1 is based solely on research, experience, and opinion provided by Kathy Voth as she continues to explore the role of invasive species in livestock diets. The information contained within has not been independently verified by SDSU scientists, and producers are strongly encouraged to consult local resources if intending to utilize plants with known toxicity. When used in conjunction with other resources, Table 1 can help producers begin to formulate an appropriate plan for grazing South Dakota's noxious weeds.

**Identifying plants:** To understand invasive species, one must first be able to accurately identify the plant. Many landowners and producers struggle with a lack of plant identification skills. Simply

Table 1: Potential relative palatability of South Dakota's state and local noxious weeds.

| Forage Potential of State and Locally Noxious Invasive Plants of South Dakota | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Origin (Source: SD Dept. of Ag) | | Growth Type (Source: USDA Plant database) | | | Will cattle eat it? | | | | | Crude Protein Estimate or Range (%) | | | |
| Common Name | Scientific Name | Toxic – Avoid | State Noxious | Locally Noxious | Native | Exotic | Annual | Biennial | Perennial | Yes | Likely | No | Caution | No Info | Low | High | Trial Region | Notes from Kathy Voth: Based on literature, field trials, observations, and reported results from ranchers who've attempted to train cattle with Voth's system unless otherwise indicated. |
| Leafy spurge | *Euphorbia esua* | | x | | | x | | | x | x | | | | | similar to alfalfa | | MT, NV, NE, BC | No adverse effects; Beliefs of causing diarrhea and mouth sores are unfounded; Literature citing adverse affects actually referred to a different specific of spurge and has been miss-interpreted. |
| Canada thistle | *Cirsium arvense* | | x | | | x | | | x | x | | | | | 12 | 21 | many | No adverse effects; Easiest weed to train on; Rumen microbes need 5-7 days to adapt during the training period. |
| Perennial sow thistle | *Sonchus arvensis* | | x | | | x | | | x | x | | | | | na | | CA | No adverse effects; No toxins of concern. |
| Hoary cress | *Cardaira draba* | | x | | | x | | | x | x | | | | | na | | OR, NV | No adverse effects; Easy to train on. |
| Russian knapweed | *Centaurea repens* | | x | | | x | | | x | x | | | | | high | | OR, NV | No adverse effects; Easy to train on; High protein; Can offset other low quality forage; Some ranchers managing as forage. |
| Purple loosestrife | *Lythrum salicaria* | | x | | | x | | | x | | x | | | | na | | na | [1] Should have no adverse effects; No listed toxins; Likely could train on it; Likely relatively short palatability; Probably similar to reed canary grass (phalaris arundinacea). |
| Salt cedar | *Tamarix spp.* | | x | | | x | | | x | | | | | x | na | | na | [2] No trial information available |
| Absinth wormwood | *Artemisia absinthium* | | | x | | x | | | x | | | | | x | na | | na | No listed toxins; Plant is high in terpenes; Supplement this with proteins; Vegetation high in protein can serve as supplement; Don't start with this weed, teach others first. |
| Black henbane | *Hyoscyamus niger* | | | x | | x | x | x | | | x | | X | | na | | WY | Caution: Wyoming rancher reported cattle ate it with no training and no adverse effects. It can cause hallucinations, coma, and death to humans. Voth recommends not specifically training on this plant. |
| Bull thistle | *Cirsium vulgare* | | | x | | x | | x | | x | | | | | na | | many | No adverse effects; No toxins; Cattle trained on Canada thistle generally move to bull thistle and other thistles on their own. |
| Chicory | *Cichorium intybus* | | | x | | x | | x | x | x | | | | | na | | CO | Cattle consumed on their own after being trained on other weeds. |
| Common burdock | *Arctium minus* | | | x | | x | | x | | x | | | | | na | | na | No adverse effects; No toxins of concern; Voth has not trained on this, but other ranchers have used her system successfully. |
| Common mullein | *Verbascum thapsus* | | | x | | x | | x | | x | | | | | na | | CO | No specific targeted training on this plant. Cattle trained on other species being eating it on their own. Cattle seem to select for it when in flower. Cattle bite off the flower stems which then regrow, curving out from the orginal stem. |
| Common tansy | *Tanacetum vulgare* | X | | x | | x | | | x | | | | X | | na | | na | Do not train on this plant; Not edible and it is preferable if cattle avoid it. Do not worry if cattle take some in, they can mix their own diets. |
| Dalmatian toadflax | *Linaria dalmetica* | | | x | | x | | | x | x | | | | | na | | CO | No adverse effects; Colorado herd trained in 2008 still eating this; All plants in 500 acre pasture were bitten off in 2012; Graze early and often, cattle will learn to graze after flowering. Protein content drops after flowering. |
| Diffused knapweed | *Centaurea diffusa* | | | x | | x | x | | x | x | | | | | 7 | na | CO | No adverse effects; Cattle prefer this plant; Trial herd were trained to eat it when plant was bolting and when crude protein dropped to 7%; When combined with biocontrol, trained herds can reduce populations of this weed. |
| Field bindweed | *Convolvulus arvensis* | | | x | | x | | | x | x | | | | | na | | CO | Cattle consumed on their own after being trained on other weeds; Bindweed is a nitrate accumulator but no adverse effects reported. |
| Giant knotweed | *Polygonum sachalinense* | | | x | | x | | | x | | | | | x | na | | na | No trial information available. |
| Hounds tongue* | *Cynoglossum officinale* | X | | x | | x | | | x | | | | X | | na | | na | Toxic; Do not train on this plant; Not edible; Causes liver problems resulting in wasting; Trial goats have acclimated to it; Voth speculates that cattle trained on other weeds may be able to mix diets successfully but no specific trial work has been performed. |
| Musk thistle | *Carduus nutans* | | | x | | x | | x | x | x | | | | | na | | many | No avderse effects; No specific training trials; Cattle move to it naturally after training on Canada thistle; Cattle could be specifically trained on this. |
| Ox eye daisy | *Leucanthemum vulgare* | | | x | | x | | | x | x | | | | | na | | BC | No adverse effects; Rancher trained on it successfully. |
| Phragmites | *Phragmites australis* | | | x | | x | | | x | | x | | | | na | | na | [1] Should have no adverse effects; No listed toxins; Likely could train on it; Likely relatively short palatability … probably similar to reed canary grass (phalaris arundinacea). |
| Plumeless thistle | *Carduus acanthoides* | | | x | | x | | x | | | x | | | | na | | na | Edible; No specific experience; Should be similar to bull or musk thistle. |
| Poison hemlock* | *Conium maculatum* | X | | x | | x | | x | | | | | X | | na | | na | Toxic; Don't train on this plant; Many report livestock do eat this plant, but as of yet it is poorly understood; Cattle may be able to select dietary offsets, but Voth recommendes avoiding specific training to the plant. |
| Puncturevine | *Tribulus terrestris* | X | | x | | x | x | | | | | | X | | na | | na | Toxic; Do not train on this plant; Can lead to photosensitivity; Large quantities can lead to trouble walking and death. |
| Scotch thistle | *Onopordum acanthium* | | | x | | x | | x | | x | | | | | na | | na | No adverse effects; Train when plant is small because can be difficult for cattle to bite adult sized plants. |
| Spotted knapweed | *Centaurea maculosa* | | | x | | x | | x | x | x | | | | | similar to alfalfa | | CO | No adverse effects; Easy to train; Cattle utilize as a base forage; July grazing is preferred; protein is highest while native forb protein is low. |
| Sulfur cinquifoil | *Potentilla* | | | x | | x | | | x | | | | | x | na | | na | [2] No trial information available. |
| St. Johnswort* | *Hypericum perforatum* | X | | x | | x | | | x | | | | X | | na | | na | Toxic; Do not train on this plant; Can lead to photosensitivity; Cattle may be able to select dietary offsets; Voth recommends avoiding specific training. |
| Yellow toadflax | *Linaria vulgaris* | | | x | | x | | | x | x | | | | | na | | MT | No adverse effects; Cattle do well, most plants grazed. |

* Additional information available in Plants that Poison Livestock in the Great Plains Area. See reference at end of chapter.

[1] Limited trial information available for conclusive statements.

[2] No specific information available.

South Dakota state and locally noxious weeds listed are located at https://sdda.sd.gov/ag-services/weed-and-pest-control/weed-pest-control/

Source: Kathy Voth at the request of the author. Information on palatability based on literature reviews, field trials, and observation. Information not independently verified by SDSU.

identifying a plant and then trying to determine whether it is native or exotic and whether it poses a problem or an opportunity can be taxing. A host of simple literary references are available to producers seeking knowledge on plant identification.

One of the most common and accessible references is the South Dakota Weed guide (SD Dept. of Ag 2009). This reference book can be obtained for free from county extension offices or through the SD Department of Agriculture when available. The book is organized to help producers understand weed laws, classification, identification, and control options. In their book Grassland plants of South Dakota and the northern Great Plains, Johnson and Larson (2007) offer an excellent array of color photos, common and scientific names, plant descriptions, plant distribution, habitat, and general comments on uses and values of hundreds of native and exotic plant species. With these simple resources, cattle producers can obtain a better understanding of most plants that occur on South Dakota's rangelands.

While the above listed resources are helpful, it still can be difficult at times to assess a plant's origin, relative value, or potential uses. To further analyze an individual species, the United States Department of Agriculture (USDA), through the Natural Resources Conservation Service (NRCS), maintains the PLANTS Database website (http://plants.usda.gov/java/). This site allows the user to enter a plant's common or scientific name to access information on the plant's origin, current distribution, and other information. A simple chart reveals whether the plant is native (N) or introduced (I) to the Lower 48 states, Canada, and other regions. Figure 1 showcases several key features of the PLANTS database. Along with the plant's origin, users can quickly determine if a plant is an annual, biennial, or perennial, allowing improved formulation of a control or use plan based on the plant's specific ecology.

Another powerful and simple online tool to evaluate the relative value of a native plant to the ecology of a pasture is the Floristic Quality Assessment (FQI) database for plant communities of South Dakota and North Dakota provided by the United States Geological Survey's Northern Prairie Wildlife Research Center. This database assigns native species

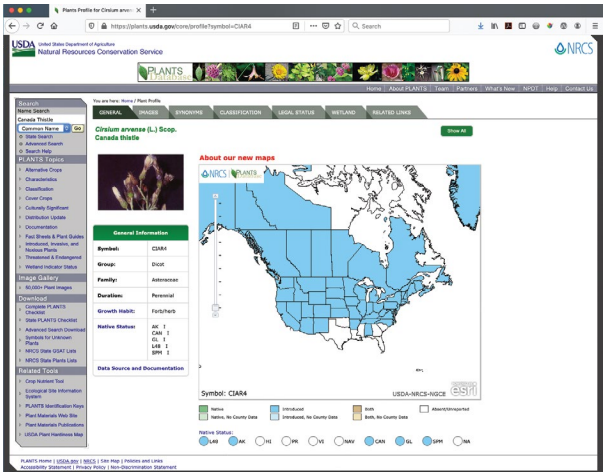


Figure 1: Screenshot of information available on NRCS's PLANTS database http://plants.usda.gov/java/.

a ranking score between 0 and 10. The purpose of the ranking is to help the user understand the relative value, abundance, and tolerance to disturbance of native plants. Plants receiving a high score of 10 are generally rare in abundance and distribution and have a low degree of tolerance for disturbance. This high score should encourage land managers to take precautions to protect these plants. Species receiving a 0 are generally abundant, widely distributed, and tolerate disturbance well. Species with a very low score are often considered weedy. A list of over 1,500 native plant species were scored, and the list can be accessed at http://www.npwrc.usgs.gov/resource/plants/fqa/appendix.htm.

Table 2 shows examples of various species as they are reported in the FQI database. Because the species are sorted alphabetically by scientific name, the user must first acquire the scientific name of the plant. This can be accomplished using either South Dakota Weeds (2009), by referencing Johnson and Larson (2009), or by using the USDA PLANTS online database. The FQI database only gives scores to native species, whereas exotic or introduced species are indicated by a non-score (asterisk). Note that FQI does not necessarily relate directly to the forage value of the plant. Some high-ranking plants may be susceptible to foraging, while others may be susceptible to trampling or other livestock impacts. Conversely, a low score cannot be interpreted as non-palatable, as in the case of common milkweed, which is generally very appealing to cattle. When analyzed along with grazing management methods,

the FQI score can serve as an indicator of rangeland health. An abundance of high-scoring plants is likely indicative of healthy rangeland and good management. Conversely, pastures dominated by exotic plants or low-scoring native plants is likely an indicator of past or current poor grazing management.

Table 2: Examples of information provided in the floristic quality index database for 5 common rangeland plants. http://www.npwrc.usgs.gov/resource/plants/fqa/appendix.htm.

```
ACRONYM:      CARACA
C-VALUE:      *
SCI. NAME:    CARDUUS ACANTHOIDES
COM. NAME:    Plumeless Thistle
PHYSIOGNOMY:  A-FORB
FAMILY:       Asteraceae
!!!!!!!!!!!!!!!!!!!!!!!!
ACRONYM:      ASCSYR
C-VALUE:      0
SCI. NAME:    Asclepias syriaca
COM. NAME:    Common Milkweed
PHYSIOGNOMY:  P-FORB
FAMILY:       Asclepiadaceae
!!!!!!!!!!!!!!!!!!!!!!!!
ACRONYM:      SOLCAC
C-VALUE:      1
SCI. NAME:    Solidago canadensis
COM. NAME:    Canada Goldenrod
PHYSIOGNOMY:  P-FORB
FAMILY:       Asteraceae
!!!!!!!!!!!!!!!!!!!!!!!!
ACRONYM:      ZIGVEN
C-VALUE:      7
SCI. NAME:    Zigadenus venenosus
COM. NAME:    Death Camass
PHYSIOGNOMY:  P-FORB
FAMILY:       Liliaceae
!!!!!!!!!!!!!!!!!!!!!!!!
ACRONYM:      AMOCAN
C-VALUE:      9
SCI. NAME:    Amorpha canescens

COM. NAME:    Lead Plant
PHYSIOGNOMY:  SHRUB
FAMILY:       Fabaceae
```

**When assessing a plant or weed, a series of critical questions should be asked:**

- What type of plant is it?
  - broadleaf plant
  - grass or grass-like
  - woody or shrub
- What is the lifespan of an individual?
  - annual
  - biennial
  - perennial
- What is the origin of the plant?
  - exotic
  - native
- How does it primarily propagate or spread?
  - seeds
  - roots
  - plant parts
- By what mechanism does it occur here?
  - always present
  - purposely planted
  - windblown
  - water transport
  - birds/other wildlife
  - livestock transport (rumen, hoofs, hair)
- By what mechanisms might it continue to persist?
  - grazing practices
  - soil conditions
  - lack of competition
  - population is established
- Is it a state noxious plant?
- Is it a locally noxious plant?
- Does this plant require control?
- If not required, is control of this plant considered necessary to healthy rangeland or pasture?
- What are the traditional control methods in this region?
- What are some innovative control methods others may be using?
  - timed fire
  - timed grazing
  - timed cutting/haying
- What are the potential negative consequences of the control options?
  - non-target species impacts
  - costs
  - time/labor
  - rift or other impacts to neighboring properties
  - incomplete control
  - short-term control
- What are the potential positive consequences of the control options?
  - cost savings
  - time and labor savings
  - profit potential (direct or indirect)

### *Implementing a Plan*

An integrated approach to weed management cannot be accomplished simply through application of chemicals. Producers concerned with the long-term profitability and viability of their rangelands must critically discern fact from fiction and seek advice on rangeland weed management from unbiased sources. Many chemical companies have excellent products and reputable staff ready to assist a producer in chemical weed control, but they often do not investigate the source of the weed problem and/or alternatives to chemical control. Chemicals are their business, and they are good at it. But, as with personal health care, before you visit the pharmacy, it is best to consult with a doctor to determine the source of the illness. Too often, rangeland managers head to the pharmacy first!!

The challenge in range management is balancing legally required management (such as the control of noxious weeds) with integrated management tools that allow our native systems to flourish. Identifying early infestations of invasive species and either chemically spot treating or mechanically removing them is much preferred to the alternative of allowing the population to increase and then reacting with a broadcast application of non-selective herbicides formulated primarily for grass-only retention. Pasture management should be focused on true objectives rather than perceived problems. Managers who consider pasture production and diversity as a top priority have a much different weed management program philosophy than those focused solely on 'cleaning up the pasture'.

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