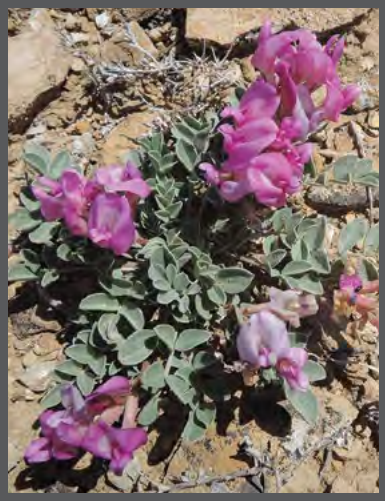
Plants Poisonous to Livestock in Montana and Wyoming

Considerations for Reducing Production Losses



USDA United States Department of Agriculture

Natural Resources Conservation Service
Plant Matrials Technical Note MT-124

MONTANA STATE UNIVERSITY | EXTENSION

Montana State University Extension

UNIVERSITY OF WYOMING | College of Agriculture and Natural Resources Extension

University of Wyoming Extension
Bulletin B-1359

Acknowledgements

Plants Poisonous to Livestock in Montana and Wyoming represents a cooperative effort among individuals within the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS), Montana State University (MSU) Extension, and University of Wyoming (UW) Extension. This publication is adapted with permission from Poisonous Range Plants of Montana (Leininger et al. 1977) and Plants Poisonous to Livestock in the Western States (Panter et al. 2011). We acknowledge and thank previous authors for those documents and contributions to this field of study.

Contributors (alphabetical order)

Haylee Barkley, USDA-NRCS, Pathways Program, Bozeman, MT
Karen Clause, USDA-NRCS, Range Management Specialist, Pinedale, WY
Jane Mangold, Ph.D., MSU, Professor and Extension Invasive Plant Specialist, Bozeman, MT
Ted Nelson, DVM, USDA-NRCS, Supervisory District Conservationist, Livingston, MT
Noelle Orloff, MSc, MSU, Associate Extension Specialist, Bozeman, MT
Monica Pokorny, MSc, USDA-NRCS, Plant Materials Specialist, Bozeman, MT
Derek Scasta, Ph.D., UW, Assistant Professor and Extension Rangeland Specialist, Laramie, WY
Barton Stam, MSc, UW, Range Extension Educator, Thermopolis, WY
Susan Tallman, MSc, USDA-NRCS, Area Agronomist, Bozeman, MT
Daniel Tekiela, Ph.D., UW, Assistant Professor and Extension Specialist of Invasive Plant Ecology, Laramie, WY

We express our appreciation to the following reviewers:

Daniel Cook, Ph.D., USDA-ARS Poisonous Plant Research Laboratory, Research Plant Physiologist, Logan, UT
Marko Manoukian, MSU, Phillips County Extension Agency, Malta, MT
Jennifer Paddock, USDA-NRCS, District Conservationist, White Sulphur Springs, MT
J. Daniel Rodgers, Ph.D., UW, Associate Professor and Extension Rangeland Specialist (retired), Laramie, WY
Joseph Scianna, USDA-NRCS, Plant Materials Center Manager, Bridger, MT
Clinton Stonecipher, USDA-ARS Poisonous Plant Research Laboratory, Range Technician, Logan, UT
Kevin Welch, Ph.D., USDA-ARS Poisonous Plant Research Laboratory, Research Toxicologist, Logan, UT

Suggested citation:

USDA-NRCS, MSU, and UW. 2020. Plants Poisonous to Livestock in Montana and Wyoming, Considerations for Reducing Production Losses. USDA-NRCS Plant Materials Technical Note MT-124 and University of Wyoming Extension Bulletin B-1359. USDA-NRCS, Bozeman State Office, Bozeman, MT. 43 pg.

This publication is available electronically (free) and in hard copy from the NRCS Montana and Wyoming Plant Materials Program, Montana State University Extension, and University of Wyoming Extension websites.

Cover photos:

Front top and bottom left: lupine (*Lupinus* sp.) and poison hemlock (*Conium maculatum*), M.Lavin, MSU;
Front bottom center and bottom right: larkspur (*Delphinium* sp.) and milkvetch (*Astragalus* sp.), USDA-NRCS.
Back top and center: poison hemlock (*Conium maculatum*) and foxtail barley (*Hordeum jubatum*), M. Lavin, MSU;
Back bottom: deathcamas (*Zigadenus venenosus*), T. Nelson, USDA-NRCS.

Table of Contents

Introduction

Poisonous plants contain or produce substances that cause sickness, metabolic disorders, death, or health concerns in animals when ingested. Each year these plants adversely affect 3 to 5% of the cattle, sheep, goats, and horses that graze western United States rangelands, pasture, and forest lands. There are many plants in Montana and Wyoming that have been suspected of being poisonous. However, these plants vary in their toxicities, the types of animals affected, and the environmental conditions when poisoning occurs. For example, a plant species might provide good forage for sheep yet be poisonous to cattle and horses. Another plant may provide excellent nourishment in small amounts or during certain seasons but be poisonous under different conditions.

Poisonous plants will always be present on rangeland, pasture, and forest lands, and may be intentionally planted as cover crops or forages on croplands. Many poisonous plants are native to Montana and Wyoming and naturally occur in plant communities. Other poisonous plants are introduced (i.e. non-native) species, and some of these introduced species are invasive and spreading across the region. Mismanagement of rangeland and pasture can allow these introduced and native poisonous plants to increase since some of them are unpalatable. Additionally, poor livestock management may increase the likelihood of poisoning. Rangeland and pasture should be regularly inspected for poisonous plants and the information used to make prudent livestock and grazing management decisions.

Black henbane (*Hyoscyamus niger*)[1], an introduced invasive species from Europe, can increase with poor pasture management. Its foliage has a pungent odor and is not usually consumed by livestock unless desirable forage is lacking. When consumed, symptoms of poisoning include dilated pupils and convulsions.

Wild onions (*Allium* sp.) are native plants that emerge in the early spring in a variety of plant communities. Livestock can exhibit poisoning effects if their diets contain large quantities (e.g. 25% diet) of onion leaves.

This publication describes signs of poisoning and livestock affected (Table 1), toxic doses and factors influencing toxicity (Table 2), and the habitats where these poisonous plants grow in Montana and Wyoming (Table 3). The publication also describes environmental and management conditions leading to livestock poisoning along with management considerations to prevent or minimize impacts.

Economic Impacts of Poisonous Plants

Poisonous plants cause an economic loss to the livestock industry. In 1992, the economic value from direct losses of cattle and sheep in the 17 western states was $340 million dollars, which would exceed $600 million today when adjusted for inflation. In addition, there are indirect economic impacts from poisonous plants associated with increased management costs.

Direct impacts include the following effects on animals:

- Death
- Abortions
- Birth defects
- Weight loss due to illness or decreased feed intake
- Lengthened calving interval
- Decreased fertility
- Decreased immune response
- Increased organ damage (e.g. lungs, liver, nervous system, etc.)
- Loss of breeding stock due to mortality, functional inefficiency, etc.

[1] Nomenclature, common and scientific names, follows USDA PLANTS Database, 2019.

Halogeton (*Halogeton glomeratus*) has red stems and fleshy leaves. It has caused hundreds of livestock deaths in a single day at one location in various western states. Livestock should not be allowed to become hungry or thirsty while grazing in areas infested with halogeton, as they will graze indiscriminately. Proper rangeland management is the best way to minimize livestock losses.

Indirect losses include the following management costs:

- Building and maintaining fences
- Increased feed requirements
- Increased medical treatments
- Altered grazing programs
- Decreased forage availability
- Decreased land values
- Increased stress on livestock managers

Identifying Poisonous Plants

There is no single rule or characteristic that can be used to determine a toxic plant from a non-toxic plant. To protect animals from poisoning, learn to identify poisonous plants that are common to the area and obtain reliable information on their poisonous properties. Some poisonous plant publications focus on plant identification; however, this publication does not because plant identification resources are readily available. We provide a list of resources to aid in identification in the Resources and References Section below.

Sudden onset of illness with no apparent cause may indicate poisoning by a toxic plant. If plant poisoning is suspected, the responsible plant(s) must be identified, which is sometimes a difficult task. Symptoms may be similar across multiple poisonous plants, all symptoms may not manifest, and some symptoms may be atypical. Sometimes poisoning is even caused by a plant not commonly recognized as toxic. Examine the rangeland or pasture for poisonous plant species.

The maintenance of regular, detailed livestock management records can be a useful tool when diagnosing plant poisoning for an animal displaying symptoms. For example, information about the date animals entered a pasture, where they moved from, their general health prior to symptom onset, and utilization of suspected plants can all be important. If the animal is alive, careful observations and notes about its behavior should be made. If the animal has recently died, an inspection in the digestive tract (or a complete necropsy) for identifiable plant parts is recommended, along with an examination for abnormal-appearing organs. Contact a veterinarian or other qualified individual for help making a diagnosis. Whether or not an animal is treated for plant poisoning may be decided by behavioral observations, noted above, and by correct identification of the suspected poisonous plant. Ultimately, correct identification of the plant is essential for any long-term proactive corrective action and should be considered an important starting point if problems occur.

When the presumed causal plant is identified, it should be collected for verification by someone with plant identification expertise. Collect the entire plant or, if too large, representative parts of the plant (roots, stems, leaves, flowers, fruits, and unique attributes). Record information regarding date, location, habitat, plant size, and plant growth characteristics. Photographs of the plant and its habitat are also useful. Soon after collection, press the specimen between two pieces of newspaper or cardboard to air dry. Alternatively, place the plant in a bag in a refrigerator for short term storage if needed. If mailing the specimen for verification, place the pressed sample or bag in a padded envelope or box. Use caution when handling specimens as some plants are toxic to humans too!

Submit samples to one of the following:

- Local Extension or USDA-NRCS offices
- Montana State University Schutter Diagnostic Laboratory (http://diagnostics.montana.edu/)
- University of Wyoming Herbarium (http://rmh.uwyo.edu/data/search.php)
- USDA-ARS Poisonous Plant Research Laboratory (https://www.ars.usda.gov/pacific-west-area/logan-ut/poisonous-plant-research/)

Factors Influencing Plant Toxicity to Livestock

Plant-related

Dose

The dose (i.e. amount consumed) needed for a plant to cause undesirable effects to livestock depends on factors like the amount and concentration of a toxin and how rapidly it is consumed. In plants, the dose is influenced by growing season, growth stage, palatability, and growing conditions. Some plants are lethal after one exposure or a short duration of time, other plants may require ingestion of large amounts before affecting livestock, and other plants cause poisoning weeks or months after ingestion. Acute poisoning occurs when animals are exposed to a toxic dose on one occasion or for a short time and symptoms are relatively instantaneous. For example, cattle or sheep consuming small amounts of poison hemlock will exhibit symptoms of poisoning within an hour. Chronic poisoning is long-term, repeated, or continuous exposure to a toxin. The toxins accumulate in the animal's body over time, symptoms are delayed, and damage is usually irreversible. For example, cows consuming lupine during their early gestation period may show no evidence of poisoning until they give birth to calves with cleft palates and skeletal defects (i.e. crooked calf syndrome).

Information on what constitutes a toxic dose is only available for commonly problematic species in Montana and Wyoming (Table 2), and, in many cases, is based on limited scientific research. The toxic dose is dependent on plant-related factors discussed below, as well as animal-related factors such as animal health, species, and age.

Season and Plant Growth Stage

Poisonous plants vary in their toxicities and palatability with season and growth stage. Rangeland and pasture should be examined for the kinds, quantities, and distribution of poisonous plants before livestock are allowed to graze. Some areas should be avoided during the most dangerous season if dense stands of poisonous plants grow there. For example, some plants are most palatable during their early growth stages, making spring the most dangerous period for poisoning.

Chokecherry (*Prunus virginiana*) leaves have finely toothed margins and a short, pointed tip. The toxic substance in chokecherry, hydrogen cyanide, is found principally in the leaves. Leaves become less toxic as the growing season progresses.

Some poisonous plants are most toxic when they are immature, others when mature, and still others are equally toxic at all growth stages (see Tables 1 and 2). Toxic substances are often concentrated in certain plant tissues, and negative impacts may only be apparent

Lupines (*Lupinus* spp.) have palmately compound leaves which radiate from a central point. Lupine poisoning can be reduced by keeping hungry animals away from lupine in early growth stages and in late summer when the plant contains seeds that are very toxic.

Poison hemlock (*Conium maculatum*) is 2 to 20 feet tall with white flowers, finely dissected leaves, and purple spots on the stem. Livestock poisoning is most common in the early spring when tender, succulent, highly toxic new leaves begin growth.

when consumed at the time of year when these tissues are available. For example, plants with toxins most concentrated in seeds should not be grazed during seed development and ripening.

Palatability

Palatability is important because it determines livestock utilization of poisonous plants. Many poisonous plants are not very palatable, so animals will usually select more palatable, non-poisonous species. If an area does not offer enough palatable non-toxic forage, however, animals are more likely to consume toxic quantities of poisonous plants. In addition, palatability is highly variable and can change over the growing season or in response to recent climatic events (e.g. frost) or vegetation management. For example, many species, including poisonous plants, are more palatable for a few weeks following herbicide or fertilizer application.

Arrowgrass (*Triglochin maritima*) has fleshy, dark-green, grass-like leaves and a slender flower stalk. Arrowgrass plants quickly become toxic when stressed or damaged from drought, frost, or cutting. Foliage that re-grows following harvest is also toxic.

Growing Conditions

Plants growing during stressful conditions (e.g. drought, freezing) commonly have increased toxicity levels. For example, arrowgrass grown with adequate moisture does not cause hydrogen cyanide poisoning, but when growth is stressed or stunted from inadequate moisture, arrowgrass quickly becomes toxic. This problem can be exacerbated by a lack of palatable forage during drought which can cause livestock to eat any plant available, even species with toxic properties.

The concentration of different elements in soil can influence several species of poisonous plants. For example, certain species of saltbush and milkvetch growing in soils high in selenium accumulate toxic quantities of this element, whereas the same saltbush species may provide good forage on soils low in selenium.

Shadscale saltbush (*Atriplex confertifolia*) has grayish bark, alternate leaves, and fruits with four conspicuous wings. It accumulates high levels of selenium when growing in selenium-rich soils and can cause chronic selenium poisoning when consumed by livestock .

When certain species grow in the same vicinity and are grazed in combination, toxic effects can vary. For example, sheep feeding on horsebrush just following or in conjunction with black sage and then exposed to bright sunlight may develop a characteristic swelling of the head called bighead (i.e. photosensitization). Sheep grazing horsebrush alone may experience toxic impacts without developing bighead.

Component of Hay

Plant toxicity may increase, decrease, or remain static when foliage dries. This factor and the plant's stage of development when harvested, is important in determining toxicity of hay containing poisonous plants. When poisonous plants are mixed with non-poisonous plants and fed together in hay, livestock are unable to discriminate between them as readily as when grazing in a field and are consequently more vulnerable to poisoning. Areas containing substantial amounts of poisonous plants should not be hayed, and hay containing poisonous plants should not be fed to livestock without consulting with the local Extension agent, NRCS employee, or another qualified person.

Horsetail species (*Equisetum* spp.) have hollow, jointed stems, and grow in moist to wet meadows and pastures. Horsetail can have whorls of branches at the joints (left photo) or a single, unbranched stem (right photo). It is often cut and incorporated in hay where it retains toxic properties when dry. Cattle or horses fed hay containing more than 20% horsetail can experience gastrointestinal and nervous system poisoning effects.

Animal-related

Animal Species, Gender, Size, and Age

Some poisonous plants have a more negative effect on one specific class of livestock, while other plants are equally toxic across all classes. Different classes of livestock preferentially graze certain types of plants. For example, cows and horses prefer grasses, while sheep prefer forbs and shrubs. Rangeland and pasture should be inspected for the kinds and quantities of poisonous plants before grazing. This information can be used to decide what class of livestock should be grazed. Livestock losses may be prevented by grazing those animals that will not be harmed by the poisonous plants present. Also, skin color can determine susceptibility of animals to photosensitivity after eating certain poisonous plants. For example, light- to white-skinned individuals (Hereford cows, white-faced horses) are more photosensitive and will suffer sunburned faces or udders.

Toxicity to some poisonous plants is gender-specific, particularly as it pertains to animal reproduction. For example, ingestion of ponderosa pine needles by male cattle appears harmless while it may cause abortions in pregnant females. Additionally, the size of animals within a class of livestock may be proportional to the quantity of toxin required to cause poisoning. As animal size increases, the amount of poisonous plant needed to be consumed to cause toxicity symptoms also increases. Younger animals are usually more susceptible to poisoning than older animals. It has been shown that yearling steers may be more susceptible to larkspur poisoning than two-year-old steers.

Ponderosa pine (*Pinus ponderosa*) can cause abortions during the last trimester of pregnancy if cattle graze approximately 5 to 6 pounds of needles. The needles are generally grazed during the winter when forage is lacking or snow-covered. Prevent poisoning by limiting access to ponderosa pine during the last trimester.

Animal Health

Animals within the same livestock class or breed may vary in their susceptibility to plant toxicity. For example, in a study that dosed Angus steers with larkspur and then imposed the steers to stressful conditions, 40% were considered resistant and the remaining 60% were too sensitive to even impose the stress without risk of death. Livestock in poor condition or subjected to adverse conditions or stress (e.g. temperature, exertion, etc.) are usually more susceptible to poisoning than non-stressed animals in good condition. Hungry animals may ingest higher quantities of a poisonous plant, while satiated animals are more selective and tend to consume lower doses of a toxic plant. In general, an animal will consume less poisonous plant tissue when it can graze selectively.

Milkvetch species (*Astragalus* spp.) have pea-shaped flowers and grow in a variety of native habitats. Many milkvetch species can cause acute or chronic poisoning of livestock. Cattle will readily eat some toxic milkvetch species even when other forage is available. To reduce livestock losses, prevent animals from grazing these plants for extended periods, feed protein supplements, and avoid stressing cattle that have grazed toxic milkvetch species.

Animal Response to Toxin

Some toxins quickly change to harmless substances upon ingestion or are rapidly eliminated after entering the body and are therefore usually of little danger to an animal. Alternatively, toxins rapidly absorbed into the animal's circulatory system following ingestion are very dangerous.

Conditions Leading to Livestock Poisoning and Management to Reduce Impacts

The most effective way to prevent livestock loss from poisonous plants is to properly manage rangeland, pasture, forest, and livestock. Develop a grazing plan that improves or maintains rangeland or pasture condition and prevents poisoning. Plans should consider poisonous plants in the area, allowing animals to avoid them or graze them at the most appropriate time. Poisoning typically occurs when livestock are enticed by hunger or other stressful conditions, although there are exceptions where animals may show an unexplained preference for a poisonous plant. Livestock managers should know what poisonous plants are present and how to prevent animal intake. Hundreds of plants are poisonous to livestock at certain doses. Many are always toxic, whereas others are toxic only under certain conditions. In some situations, a poisonous plant may even form an important part of livestock diets without negative effects on the animals (e.g. greasewood).

Grazing Rangeland and Pasture that Are in Poor Condition

A common condition under which plant poisoning occurs is grazing rangeland and pasture that are in poor condition. Generally, as vegetation is overgrazed, palatable species are reduced in abundance and less palatable species, including invasive and/or poisonous plants, increase. As pasture condition continues to decline, animals have to consume increasing quantities of less palatable and possibly poisonous plants to meet their nutritional requirements. The association between scarcity of forage and increased consumption of poisonous plants cannot be ignored when trying to mitigate toxicity issues. Livestock managers should use good grazing management, graze during the correct season, and use appropriate animal stocking rates.

Hungry Animals on Infested Rangeland, Pasture or Cover Crop

Hungry animals graze less selectively than satiated animals and tend to eat whatever is within close proximity. Hungry animals should never be exposed to areas with large concentrated populations of poisonous plants. Poisoning often occurs when animals consume too much or eat too rapidly, behavior typical of hungry animals.

Early Season Grazing on Rangeland

When native rangeland or pastures are grazed too early in the growing season, the earliest growing


Photo: USDA-NRCS


Photo: M. Lavin, MSU

Many invasive plants have poisonous properties including houndstongue, blueweed, field bindweed, hoary alyssum and more (see Table 3). Houndstongue (*Cynoglossum officinale*) is an invasive biennial forb that is sometimes harvested in hay where it can cause poisoning. Animals may graze pasture containing poisonous invasive plants without ill effects if ample good forage is available.

species must carry the grazing load. If palatable, non-poisonous plants are unavailable, livestock will eat whatever is available, including poisonous plants. Several poisonous plants (e.g. low larkspur, lupine, deathcamas) are among the first to emerge in the spring and are in their most succulent stages. Livestock should not be released onto rangeland or pasture until adequate desirable forage is available to support grazing.

Livestock Familiarity with the Area

Animals new to an area, especially previously confined animals, tend to graze less selectively and may consume a greater diversity of plants (including poisonous plants) than animals which are familiar with the area. In other words, they are naïve to toxic plants in a new pasture. Where livestock are grazed in unfamiliar areas, handlers should watch animals carefully. Be especially careful when grazing newly acquired livestock that are in unfamiliar rangeland or pasture. Once an animal becomes familiar with an area and its toxic plants, it may be safe to graze the pasture. For example, on rangelands where locoweed is abundant, it is safe to graze only those animals which are acquainted with locoweed but do not seek it out for consumption.

Improper Herding, Driving and Bedding

Crowded animals need time to scatter across an area large enough to allow selective grazing. When animals are crowded, they may be forced to eat whatever vegetation is available. Livestock managers can minimize poisonous plant consumption by using open or loose herding methods with slow movement.

Animals often become nervous when they are driven or trailed. When being moved, animals are also unable to quickly satisfy their hunger like they would under normal pasture conditions, and they become less selective in their plant consumption. Animals that are both hungry and driven quickly are even more susceptible to poisonous plants. To minimize losses, animals should be satiated and driven slowly through areas with poisonous plants.

Livestock prefer to graze late in the evening and in the morning after leaving their bedding grounds. They are less selective in their grazing habits during these times and are more likely to consume toxic quantities of poisonous plants. The risk of plant poisoning increases when animals are bedded down in the same area for several nights.

High-use areas are subject to overgrazing of palatable plants, resulting in an increase of unpalatable plants, many of which are poisonous. Livestock managers can

Meadow deathcamas (*Zigadenus venenosus*), a perennial with long linear leaves, is one of the first plants to begin growth in early spring. Without enough other forage, deathcamas species may be heavily grazed and will cause livestock losses.

Locoweed species (*Oxytropis* spp.) are poisonous at all stages of growth throughout the year including when dried. Livestock that have never grazed locoweed will usually avoid it; however, once consumed, an animal can become habituated to grazing locoweed. Livestock owners can reduce losses by removing locoweed-eating animals from the herd.

Greasewood (*Sarcobatus vermiculatus*) is adapted to saline soil where it uptakes and accumulates soluble sodium and potassium oxalates in the fleshy leaves. It can be safely eaten by livestock in moderate amounts with other forage. However, poisonings can occur when livestock eat large amounts of greasewood leaves or buds in a short period of time.

reduce losses by selecting new trails and bedding grounds when possible.

Inadequate Nutrient Supply

Animals with nutrient deficiencies often seek plants that contain high levels of the nutrient that the animal is lacking. For example, salt-deficient animals may seek out and excessively consume salt-accumulating plants like greasewood. To minimize losses, place salt and phosphorous supplements in several locations in the pasture and throughout the entire period of use of the pasture. Salt and phosphorous supplements can also be used to improve livestock distribution and lure them away from areas supporting poisonous plants. Do not place salt and other supplements in an area where poisonous plants are growing.

Water Quantity and Quality

Animals tend to graze indiscriminately when they have been without water for more than two days and are finally given the opportunity to drink. Therefore, do not place or develop water in areas where toxic plants are present. Always provide animals with an adequate supply of water.

Water quality is an important aspect of livestock management and animal performance. If water sources become contaminated with fertilizers or manure, blue-green algae can proliferate and lead to poisoning. Pesticide drift may also contaminate water sources and endanger livestock. Additionally, elevated levels of nitrates, metals (e.g. copper, lead, zinc), and other elements (e.g. selenium, arsenic, boron) in soil can lead to unsafe levels in surface and groundwater. Have water sources tested annually, determine if results are within recommended water quality standards, and take steps to determine the source of any problem.

Environmental Conditions

Late spring and early fall snowstorms may cover shorter, more desirable species, leaving taller statured poisonous plants like tall larkspur, deathcamas, and lupine as the only vegetation available to livestock. Poisoning potential may be compounded in the fall if fruiting (podded) plants extend above the snow, and those fruits are highly toxic. To minimize losses, either move or feed supplements to livestock subjected to these conditions.

Following heavy rain, some poisonous plants become more palatable or toxic because the rain stimulates new plant growth. This is especially problematic if other vegetation becomes matted and entangled, making it difficult for livestock to graze as discriminately as under drier conditions. When this situation arises, consider moving livestock to other areas or feeding supplements to reduce consumption of poisonous plants.

Drought can lead to early maturation of many palatable plants. In contrast, several poisonous plants remain green during drought (e.g. deep-rooted lupines or locoweed; evergreen yew or laurel). As a result, these poisonous plants may become more attractive to livestock, receive more use, and increase the risk of poisoning. The adverse effects of drought are worsened

Many plant species with poisonous properties, including tall larkspur, water and poison hemlock, iris, and buttercup, grow near livestock water sources such as seeps, springs, or wet meadows (see Table 3). Livestock should be moved from areas where poisonous plants surround water developments, especially during the species' toxic window. Tall larkspur (*Delphinium occidentale*) poses a risk of poisoning during flower and early seedpod growth stages.

on overgrazed rangeland and pasture where more palatable non-poisonous plants were already stressed. These areas are also susceptible to an increase of poisonous plants when wet years follow drought.

Well-managed rangeland and pasture leaves some forage to carry-over for use during drought. During extended droughts, livestock numbers may need to be reduced or supplemental feeding initiated.

Cultural Practices

Cultural practices, such as spraying herbicides or spreading fertilizer, may increase the palatability of poisonous plants for a short time after application. Certain herbicides (e.g. glyphosate, 2,4-D) will increase the plant sugar content and sweetness, making it more palatable to livestock. Salt-based herbicides can also make poisonous plants more attractive. All animals should be kept off rangeland or pasture supporting poisonous plants for at least two weeks following applications of herbicides or fertilizers, and always follow grazing restrictions on the product label.

Grazing System

Grazing systems vary by timing, frequency, duration, and intensity of livestock use and can be manipulated to help manage poisonous plants. *Timing* refers to the season grazing occurs, and *frequency* is how often a pasture is grazed. *Duration* is how long a pasture is grazed. *Intensity* involves stocking density (i.e. number of animals per acre) and is the cumulative effect grazing animals have on forage during a time period. For example, an intensive grazing management system does not necessarily lead to high grazing intensity (utilization) but it does require management that optimizes stocking density and duration to achieve utilization objectives.

Timing can be manipulated to avoid grazing when plants are most toxic. Intensity can be manipulated in some situations to alter the selectivity or amount of a plant that is consumed by each animal. For example, high intensity grazing systems (i.e. a higher density of animals for a shorter amount of time in a pasture) result in lower forage selectivity. While this could lead to increased consumption of poisonous plants, and must be carefully managed, this approach may also limit the amount of exposure any single animal has to a poisonous plant, thus limiting dose. High intensity grazing systems are most effective when there is adequate non-toxic forage and fewer poisonous plants.

It is important to note that pastures that are grazed with high frequency and long duration can expose livestock to higher risk of consuming a toxic dosage of a poisonous plant as the livestock exhaust preferred forages. However, when livestock are moved more frequently to new pastures with adequate high-quality forage, the risk of consuming poisonous plants decreases.


Photo: M. Lavin, MSU


Photo: USDA-NRCS

Locoweed species (*Oxytropis sericea* pictured here) grow in a variety of habitats, have pea-shaped flowers that can be white, yellow, blue or purple, and can remain green when other vegetation is dormant. Livestock owners can reduce locoweed losses by keeping animals off pastures until good forage is available.

Because some poisonous plants are more palatable or available at certain times of the year, seasonal grazing can be a consideration for avoiding poisonous plants at toxic doses. In the example of tall larkspur, infested pastures could be grazed early or late, ultimately avoiding the toxic window (or the time when toxicity is greatest) that occurs for about five weeks at the start of the flowering stage and ends in the pod stage. However, a grazing system that relies on grazing a pasture every year during the same season can also result in decreases in palatable, non-poisonous plants and increases in less palatable and poisonous plants, particularly in a rangeland setting.

Multi-species Grazing

The use of different livestock species in a multi-species grazing approach is a strategy to mitigate toxicity. For example, sheep can tolerate larkspur at doses four times greater than cattle, so larkspur poisoning of sheep is rare. A strategy of grazing sheep prior to grazing cattle could reduce larkspur abundance and decrease the risk of cattle consuming larkspur later.

Crop and Cover Crop Grazing

Crop and cover crop management, harvesting, and storage may influence the risk of livestock poisoning. Most toxicity risks with grazing cover crops are associated with nitrates in small grains, hydrogen cyanide (HCN, also known as prussic acid) from sorghum and sorghum-sudangrass, and mycotoxins such as fusarium and ergot from various grass species. In general, monocultures or low diversity cover crops on highly fertilized land pose the highest risk of accumulating nitrates and affecting livestock if grazing is too heavy. Similarly, appreciable quantities of HCN can accumulate in new growth of cover crop species following clipping, drought, frost, hail damage, or grazing. Risks of poisoning from crops can be reduced by waiting to graze until plants have reached the proper height, maintaining a six-inch stubble height, grazing during daylight only, and waiting to graze until one week after a killing frost. In addition, when selecting species for a cover crop mix that will be grazed, plant a diverse cover crop mix, use certified seed, and select varieties low in HCN to minimize the risk of poisoning. A cover crop sample should be tested for nitrates prior to grazing.

Larkspur (*Delphinium* spp.) is highly palatable to cattle, and losses occur when cattle graze larkspur-infested areas when it is abundant or growing in large patches. Low larkspur (*Delphinium bicolor*), with its characteristic blue-purple spurred flowers, completes its lifecycle in the early spring. Livestock losses can be prevented by deferring grazing until plants lose their flowers and pods when it rapidly senesces.

Cover crops usually palatable and nutritious to livestock can pose a poisoning risk during periods of environmental stress or as a result of crop management, harvest, or storage.

Care for Impacted Animals

Preventing livestock poisoning is usually easier than curing a poisoned animal. There is often no antidote available for a plant toxin, and rangeland or pasture conditions may make treatment difficult. When a poisoned animal is found alive, if possible and without causing stress, it should be placed in a cool, shaded area with proper food and water. However, care should be taken when moving animals. Moving animals impacted from consuming a poisonous plant (e.g. larkspur) can exacerbate the problem. Contact a veterinarian as soon as possible to diagnose and treat the animal.

Help with poisonous plant problems may also be obtained from local veterinarians:

- Wyoming State Veterinary Laboratory (http://www.uwyo.edu/wyovet/)
- Montana Veterinary Diagnostic Laboratory (http://liv.mt.gov/Diagnostic-Lab)

Control of Poisonous Plants

Many poisonous plants in Montana and Wyoming are native species and a natural part of plant communities. Most native poisonous plants do not naturally dominate the plant communities where they occur, or their presence is the result of disturbance. Generally, control of native poisonous plant species is not needed. Instead, good grazing management strategies should be implemented to allow desired species to outcompete poisonous ones. Proper stocking rates and the initiation of a good grazing system may reduce the abundance of poisonous species through competition with desired non-poisonous species. In addition, several poisonous native plant species have beneficial forage attributes which offset their poisonous properties. For example, greasewood is poisonous when eaten nearly exclusively but is valuable forage when consumed with a moderate amount of other desirable forage plants. If small scale management of native poisonous plants is necessary, mechanical (mowing, digging), cultural (exclusion fence, proper land management), biological (selective grazing, insects), herbicides, and/or revegetation can be used.

In contrast, many introduced (i.e. non-native) plant species with toxic properties can form dense infestations. Many of these species have weedy or invasive properties, and some are listed on county or state noxious weed lists (e.g. leafy spurge, common tansy; Table 3). Be aware that some herbicides (e.g. 2,4-D) may increase palatability of the toxic plants. Also, herbicides may impact desirable non-target plants and reduce diversity and quality of the vegetation. If chemical control is necessary, obtain management information from your local Extension, Montana Weed District, or Wyoming Weed and Pest office.

Leafy spurge (*Euphorbia esula*) can form dense infestations that can cause skin and gastrointestinal issues for cattle but can be managed by sheep grazing. Control methods for poisonous plants will depend on the species, site condition, and size of the infestation.

Poisonous Substances and Other Forage Problems

Poisonous plants contain at least one of the following:

- Substances that are directly poisonous to livestock. Alkaloids contained in certain lupine species and oxalates contained in halogeton are common examples.
- Substances that are themselves harmless, but become toxic as they decompose slightly before or upon ingestion by the animal. Chokecherry leaves, for example, contain the glycosides amygdalin and prunnasin which, upon hydrolysis (mixing with rumen microbes), forms highly toxic hydrogen cyanide (also known as prussic acid or hydrocyanic acid).
- Substances absorbed from soil and accumulated to toxic levels by the plant. For example, several milkvetch species can accumulate selenium.
- Substances which make parts of the affected animal hypersensitive. An example is the pigment hypericin (contained in St. Johnswort) that causes white-skinned animals to be hypersensitive to sunlight.
- Miscellaneous substances such as toxic elements or metals (fluorine, arsenic, etc.) that can accumulate on or in plants found near industrial developments, toxic products formed by fungi in moldy hay or silage, contact irritants, and poor water quality caused by blue-green algae blooms.

Principal Toxins

The most common toxic substances in Montana and Wyoming plants are described below. Less common toxic substances are described in the Glossary.

Alkaloids

Alkaloids are generally present in plants as an organic acid. There are over 40 different types of alkaloids that cause poisoning, and some plants may contain more than one. Alkaloids are always present and well-distributed throughout plant tissues. The relative toxicity and concentration of individual alkaloids varies among plant species and populations. Common human-consumed alkaloids include caffeine and nicotine. Types of toxic alkaloids include steroidal, pyrrolizidine, indolizidine, piperidine, diterpenoid, quinolizidine, and tropane.

Symptoms:

Alkaloids ingested by livestock cause a strong physiological reaction. Alkaloids, such as those found in larkspur, induce muscular paralysis. Swainsonine, associated with locoweed, causes significant poisoning issues referred to as "locoism." Signs of locoism may include depression, circling, staggering, reproductive failure, heart failure, and weight loss. In addition, a compromised immune system stemming from locoism may lead to other ailments such as foot rot, pneumonia, warts, and other infections. Alkaloid symptoms of the extremities (i.e. feet and ears) include vasoconstriction and reduced blood flow. Teratogenic species, including locoweed, groundsel, false hellebore, lupines, and poison hemlock, harm the developing fetus if plants are consumed at certain stages of gestation.

Plants containing alkaloids include but are not limited to: tall and low larkspur, monkshood, poison hemlock, deathcamas, nightshades, black henbane, locoweed, lupines, tansy ragwort, houndstongue, milkvetch, yew, false hellebore, and others.

Cardiac Glycosides

Cardiac glycosides have direct effects on cardiac function. Cardiac glycosides are present throughout the plant, especially the leaves, and retain reduced toxicity when dried. Small quantities of ingested plants can cause symptoms.

Symptoms:

Cardiac glycosides directly impact the gastrointestinal tract causing hemorrhagic enteritis, abdominal pain, and diarrhea. Cardiac glycosides also inhibit the cellular membrane sodium-potassium pump which results in a progressive decrease in electrical conductivity through the heart and blocks cardiac activity. While low doses of cardiac glycosides can be beneficial by slowing heart rate, increasing the contraction force and increasing cardiac output, animals consuming toxic doses develop heart and digestive disturbances leading to death. Additional signs of poisoning include rapid breathing, cold extremities, and a rapid, weak, irregular pulse caused by cardiac arrhythmias and heart block. Death typically occurs within 24 hours of the onset of symptoms.

Nightshade species (*Solanum nigrum* pictured here) have tomato-like, star-shaped flowers with five petals. They are not usually palatable to livestock but cause issues when harvested with hay or grain crops then fed to livestock. Losses can be minimized through pasture management and weed control.

Plants containing cardiac glycosides:

Milkweeds and dogbanes can cause cardiac glycoside poisoning. However, cases of cardiac glycoside problems are rare, especially for dogbane.

Milkweed species (*Asclepias speciosa* pictured here) can have broad or linear leaves arranged alternately or in whorls. It is most dangerous when actively growing, but toxicity decreases with drying. Livestock tend to consume milkweed when other forage is limited, after a frost, or when it is incorporated in hay.

Cyanogenic Glycosides

Cyanogenic glycosides are indirectly toxic in that they hydrolyze to produce hydrogen cyanide (HCN, also known as prussic acid) in the presence of certain enzymes and when acted upon by microorganisms in the plant or rumen. Hydrogen cyanide is a highly toxic, rapidly acting poison that inhibits oxygen utilization by cells. Some plants naturally have high levels of cyanogenic glycosides, especially in early growth stages, rapidly growing plant parts, and seeds. In other plants, the level of cyanogenic glycosides is influenced by climatic conditions, soil factors, and other factors that slow growth. Enzymatic conversion to HCN is enhanced when plant cells are damaged from drought, wilting, freezing, or crushing, or when stressed from low soil moisture, high nitrogen, low phosphorous, or herbicide applications. Avoid grazing plants high in cyanogenic glycosides while these conditions exist and wait at least a week after a severe drought or frost before grazing. Hydrogen cyanide deteriorates with time; therefore, dried hay is safe to consume.

Symptoms:

Hydrogen cyanide rapidly inactivates cellular respiration leading to a characteristic cherry-red venous blood from the failure of oxygen releasing at the tissues. The heart and brain are affected by a lack of oxygen, causing death to occur within one to two hours or several minutes in acute cases. Signs of poisoning prior to death include difficulty breathing, frothing at the mouth, irregular pulse, dilated pupils, staggering, muscle tremors, bright red mucous membranes, and convulsions. Chronic ingestion of low levels of cyanogenic glycosides can cause various neuropathies, musculoskeletal deformities, and goiter. Cattle and sheep (ruminants) are more susceptible to HCN poisoning than horses (monogastrics). Fetuses are also extremely sensitive to HCN poisoning.

Plants containing cyanogenic glycosides:

Hydrogen cyanide poisoning is most commonly associated with Johnsongrass, sudangrass, sorghum-sudan grass, chokecherry, serviceberry, and arrowgrass.

Serviceberry (*Amelanchier alnifolia*) grows up to 13 feet tall and produces clusters of white flowers in early spring. The upper ½ to ¾ edge of the leaf is toothed which distinguishes it from chokecherry whose leaves are toothed along the entire edge. Like chokecherry, serviceberry produces hydrogen cyanide and foliage is especially poisonous in the early flowering stage.

Nitrate

Nitrate poisoning is caused by excessive consumption of nitrate (NO_3) or nitrite (NO_2). Under normal conditions, nitrates are converted during digestion to nitrite; the nitrite then becomes ammonia which in turn is converted to protein. When high levels of nitrates are consumed, nitrite will accumulate in the rumen. Since nitrite is up to ten times more toxic than nitrate, poisoning can occur. Nitrate poisoning is a problem for ruminants (cattle, sheep) but is unlikely in monogastric animals (horses) because monogastric animals can't readily convert nitrate to nitrite in their digestive systems.

Nitrates are most concentrated in plant stems and stalks, and to a lesser degree leaves; they do not accumulate in flowers or seeds. Nitrate levels are highest in young plants and decrease with maturity. Nitrates decrease only slightly with drying, so feeding nitrate-rich hay can be a problem.

Symptoms:

Nitrite is absorbed into the bloodstream and converts hemoglobin to methemoglobin which interferes with the ability to carry oxygen from the lungs to the tissues. Signs of nitrate poisoning are related to the lack of oxygen in blood including: blue to chocolate brown mucous membranes

Russian thistle (*Salsola tragus*), a highly branched herbaceous weed with spine-tipped leaves, can accumulate nitrate. Many plants, including crop and weed species, can accumulate nitrate. Plants containing between 0.5% to 1.5% nitrates can have sublethal effects on livestock, while plants with more than 1.5% nitrates may be lethal to livestock.

or blood, difficulty breathing, rapid pulse, salivation, staggering, coma, and death. Sublethal or chronic nitrate poisoning can cause abortion during any stage of gestation due to lack of oxygen.

Plants containing nitrates:

Rangeland and pasture plants known to accumulate nitrates include redroot pigweed, lambsquarters, kochia, curly dock, Russian thistle, nightshades, and Johnsongrass. Grazed crop or cover crop species known to accumulate nitrates include barley, oats, millet, rye, sorghum-sudangrass, wheat, corn, alfalfa, sugar beet, rape, radish, and turnip.

Contact your local Extension or Department of Agriculture office for assistance testing forage for nitrate content. In Montana, MSU Extension offers an in-office test to rapidly assess the presence of high forage nitrates. In Wyoming, the Department of Agriculture offers feed and forage analyses for nutrients and toxic constituents.

Oxalates

Oxalates cause problems when livestock are not accustomed to grazing oxalate-containing plants. Animals can tolerate grazing oxalate-containing plants if they have other plants in their diet to dilute oxalate in the rumen. For example, cattle can graze sites dominated by greasewood if there is ample grass. However, if there is very little grass and greasewood leaves have dropped to the ground, cattle intake of greasewood may increase along with the risk of oxalate poisoning. Also, gradually introducing ruminants to oxalate-containing plants can increase rumen microflora that degrade oxalate and minimize impacts. Supplementing livestock's diet with dicalcium phosphate before and during high-risk oxalate exposure, can effectively reduce losses.

Symptoms:

Oxalates occurs in two forms: insoluble calcium oxalate and soluble oxalates. Insoluble calcium oxalate, a needle-like crystal, causes severe damage to kidney tubules. This chronic form of oxalate poisoning leads to renal failure and death. Soluble oxalates rapidly combine with and decrease serum calcium and magnesium, thus impairing normal cell membrane function. This acute oxalate poisoning causes muscle tremors, weakness, collapse, and death.

Plants containing oxalates include halogeton, redroot pigweed, lambsquarter, kochia, sorrel, curly dock, greasewood, and purslane.

Kochia (*Bassia scoparia*) has green or reddish stems, linear leaves, and is often covered with silver or rusty hairs. Kochia and other members of the goosefoot family (Chenopodiaceae) have been associated with oxalate and nitrate poisoning, although occurrences are uncommon.

Saponins

Saponins are naturally occurring glycosides in plants that have soap-like compounds. Saponins increase the permeability of membranes and may cause hemolysis of red blood-cells, thus releasing hemoglobin.

Symptoms:

Plants containing saponins may act as a diuretic causing diarrhea. Other symptoms include biliary obstruction, bloat in ruminants, photosensitivity, salivation, acute hepatopathy, and death. Some saponin containing plants (e.g. oats) are beneficial when consumed, increasing and accelerating the ability to absorb compounds such as calcium and silicon that assist in digestion.

Plants containing saponins include snakeweed, puncturevine, kochia, and bouncingbet.

Selenium

Selenium is an essential nutrient for animals, but it accumulates in certain plants to levels that are toxic to livestock when those plants are growing in selenium-rich soils. For example, some species of saltbush provide good forage on soils with low selenium levels but are poisonous when growing on soil high in selenium. Selenium-rich soils are derived from cretaceous shales and glacial deposits and are generally found in semi-arid areas. Plant uptake is variable and depends on the chemical form of selenium, soil pH, temperature, moisture, plant species, and stage of plant growth.

Symptoms:

Selenium intoxication can occur as acute or chronic poisoning. Signs of acute selenium poisoning, occurring when animals ingest more than 50 parts per million (ppm), include abnormal posture, unsteady gait, abdominal pain, increased pulse and respiration rate, and sudden death. Chronic selenium poisoning is more common, with symptoms including rough coat (bob-tail, roached-mane), hair loss, hoof lesions, lameness, defective hoof growth, and reduction in fertility.

Plants containing selenium:

Plants with more than 5 ppm selenium are potentially toxic. Primary selenium accumulator or indicator plants may accumulate up to several thousand ppm selenium. Obligate accumulator species, including milkvetch and princesplume, can cause acute poisoning but are rarely consumed due to poor palatability. Secondary selenium accumulator plants may contain up to several hundred ppm selenium, but lesser amounts are much more common. This group includes aster species, milkvetch, saltbush, Indian paintbrush, curlycup gumweed, and snakeweed. The low-accumulator group, including alfalfa, corn, and grains, rarely accumulate more than 50 ppm selenium and usually only 5 to 12 ppm. However, it is the low-accumulator plants that cause the most toxicity problems because they are commonly grazed by livestock and can lead to chronic selenium poisoning.

Milkvetch species (*Astragalus* spp.) have pinnately compound leaves and pea-shaped flowers and are primary selenium accumulators. To prevent animals from eating excessive amounts of selenium, identify areas of high selenium soil and develop a grazing or forage-production plan.

Other Forage Problems and Disorders

Bloat

Bloat is caused by the entrapment of fermentation gases in the rumen. Bloat usually occurs when livestock consume lush legumes such as alfalfa or white clover. Soluble proteins in forages and other small particles within the cells of the plant are rapidly released once they reach the rumen. These proteins and particles are attacked by slime-producing rumen microbes, which cause a buildup of stable foam. The foam, often due to the presence of saponins, decreases the animal's ability to expel rumen gases that are created from fermentation of plant material. These gases begin to accumulate, causing pressure on the diaphragm, leading to bloat.

Symptoms:

Livestock suffering from bloat will begin to swell rapidly on the left side. Kicking at their sides or stomping their feet are other signs the animal is experiencing discomfort. Breathing may be labored, and urination and defecation frequent. In severe cases, the rumen can become distended, and death may occur.

Plants causing bloat include alfalfa, clovers, brassicas, cultivated grains, and sweetclovers.

Alfalfa (*Medicago sativa*) is an important forage species with trifoliate leaves and purple or blue, occasionally yellow, flowers. Risk of poisoning from alfalfa and other forage legumes depends on the amount and rate of consumption, composition of the animal's diet, the plant's accumulation of toxic chemicals (e.g. selenium, nitrate), and how the crop was managed, harvested, or stored.

Mechanical Injuries

Mechanical injuries are physical issues caused by spines, sharp seeds, burs, and awns. The plant may not be poisonous, but the injuries can cause symptoms that resemble a toxin effect.

Symptoms:

The injury may result in sores and inflammation on the tongue, gums, eyes, nose, and skin. Sores can lead to localized skin infections or a general infection from bacteria entering the circulatory system. Additional injuries include plant fibers that may lodge in the stomach or intestines and fibers imbedded in eyelids causing lesions to the eyeball. Animals suffering mechanical injury may stop eating and develop a poor condition.

Plants causing mechanical injuries include bristlegrass, cheatgrass, needlegrasses, foxtail barley, rye, wild oats, burdock, and cactus.

Some plant species, although not poisonous, can cause injury to animals resulting in discomfort, inflammation, or poor condition. Mechanical injuries can be caused by native or non-native species with long awns such as foxtail barley (*Hordeum jubatum*), needle-and-thread, or cheatgrass.

Mycotoxins

Mycotoxins are toxins produced by mold (fungi). The host plant itself may not be toxic (e.g. alsike clover, sweetclover), but toxicity problems can occur with improper feed (seeds, hay, silage) harvest and storage. Some fungi cause toxicity problems in specific plant species (e.g. perennial ryegrass, tall fescue, lupine). Major classes of mycotoxins include aflatoxins, trichothecenes, fumonisins, zearalenone, ochratoxin, and ergot alkaloids (e.g. endophyte-infested fescue, swainsonine).

Symptoms:

Symptoms will vary depending on the mold involved. Mycotoxins in lupine can cause severe liver, kidney and muscle disease. Ergot alkaloids in tall fescue cause vasoconstriction at the extremities, elevated respiration

rate, convulsions, lameness and tenderness of the legs, poor hair condition, loss of extremities (hooves, ears, tails), decrease in milk production, difficult births, and abortion.

Plants commonly containing mycotoxins include alsike clover, red clover, corn, sweetclovers, perennial ryegrass, tall fescue, and lupine.

Photosensitization

Photosensitization can be caused from consuming plant species containing light-sensitive compounds that, once absorbed in the gastrointestinal tract, circulate in the blood. In primary photosensitization, photodynamic compounds accumulate in blood vessels at the skin surface, particularly in non-pigmented skin, and ultraviolet light transforms compounds into toxins. As a result, skin becomes abnormally sensitive to sunlight causing severe inflammation and damage. Secondary photosensitization, which is more common than primary photosensitization, is caused by a variety of plant toxins that cause liver damage or liver disease. The damaged liver cannot excrete phylloerythrin (a bacterial breakdown of chlorophyll), and it accumulates in the bloodstream. As phylloerythrin circulates and is exposed to ultraviolet light, it causes oxidative injury to blood vessels and skin tissue. Animals do not readily eat plants containing liver-damaging substances (e.g. pyrrolizidine alkaloids) unless they lack quality forage or are exposed to plants in hay. Since ingesting damaging substances is cumulative, liver disease and associated photosensitization may take many months to appear.

Symptoms:

Signs of primary photosensitization include severe skin irritation, photophobia (e.g. seeking shade), rubbing and shaking the head, excessive eye tearing and discharge, redness of non-pigmented skin, increased sensitivity of skin, and swelling around ears, eyelids, lips, and nose. Skin can ooze serum, form crusts, lose hair, and slough white skin. Lameness can occur from impacts to hooves. Secondary photosensitization, in addition to symptoms of primary photosensitization, includes signs of liver failure such as weight loss, neurologic signs (e.g. yawning, drowsiness, aimless wandering, head pressing, increased licking, and coma), jaundice, abdominal distention, and diarrhea.

Plants causing photosensitization:

Plants associated with primary photosensitization are buckwheat, St. Johnswort, and cow parsnip. Plants associated with liver damage leading to photosensitization include horsebrush, tansy ragwort, groundsel, fiddleneck, houndstongue, and blueweed. In addition, moldy plants and blue-green algae can cause liver damage from photosensitization.


Photo: T. Nelson, USDA-NRCS

Photo: T. Nelson, USDA-NRCS

St. Johnswort (*Hypericum perforatum*), identified by the five-petaled yellow flowers with black glands on the petal margins, can form dense patches in mountains, foothills, rangelands and disturbed areas. Animals that eat St. Johnswort and are exposed to direct sunlight develop photosensitization in the white areas of the body. Affected animals should be moved out of direct sunlight and provided free access to fresh water and feed.

Volatile Oils

Volatile oils are organic compounds that readily vaporize or evaporate. They are responsible for a plant's odor and a bitter taste, and, in some plants, are part of the plant's defense to herbivory and insects. Toxicity varies with plant species.

Symptoms:

Livestock exposed to plants with volatile oils may have dermatitis or skin and mucous membrane irritation. When ingested, volatile oils may cause digestive tract irritation, vomiting, reduced rumen activity, damage to the mucous lining of the digestive tract, nervousness, altered milk taste, and diarrhea.

Plants containing volatile oils include sagebrush, sagewort, buttercup, and horseweed.

Table 1. Signs of poisoning and conditions under which plant species can be dangerous to livestock. Symptoms listed for each plant are those most likely to be observed. Not all symptoms will be seen in all toxicities, and signs of poisoning may vary greatly depending on dosage and the time taken to consume the dose. Also, individual animals respond differently to specific toxins.

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Alfalfa* (*Medicago sativa*)	X	X	X	X	stem, leaves	all	bloat, nitrate, selenium, photosensitization	gastrointestinal, integumentary, reproductive, respiratory	Death (ruminants), bloat, overgrown hooves, reproduction problems, labored breathing, frequent urination and defecation, photosensitivity
Alyssum, hoary (*Berteroa incana*)				X	all; seeds	all	unknown	gastrointestinal, musculoskeletal, reproductive	Death, abortions, lameness, diarrhea, swollen lower legs, joint stiffness, laminitis, increased foot temperature
Arrowgrass* (*Triglochin maritima, T. palustris*)	X	X	X	R	all	spring	cyanogenic glycoside (HCN)	blood, all systems	Sudden death, convulsions, cyanosis, diluted pupils, cherry-red blood and tissue, increased salivation, rapid heart rate, abnormal and heavy breathing, weakness, anxiousness
Aster, woody (*Xylorhiza glabriuscula*)	X	X		X	stem	no data	selenium	integumentary, musculoskeletal	Death, abortions, lameness, diarrhea, swollen lower legs, joint stiffness, laminitis, increased foot temperature
Baneberry (*Actaea rubra*)	X			X	all; berry	summer	glycoside	gastrointestinal	Irritation to the mouth and gastrointestinal tract, colic, diarrhea, salivation, bitter milk when lactating
Beet, sugar (*Beta vulgaris*)	X	X	X		all; tops	fall	bloat, nitrate, cyanogenic glycoside (HCN), mycotoxin	cardiovascular, gastrointestinal, musculoskeletal, nervous, respiratory	Death, bloat, goiter, congestion of rumen and abomasum, hypothyroidism, blindness, diarrhea, red-colored urine, and pulmonary emphysema, hemolytic anemia, pulmonary emphysema, blindness, staggering, depression, reduced weight gain
Birdsfoot trefoil (*Lotus corniculatus*)	X	X			all	all	nitrate, cyanogenic glycoside (HCN)	all systems	Sudden death, increased salivation, heavy breathing
Black henbane (*Hyoscyamus niger*)	X			X	all	no data	alkaloid	gastrointestinal, musculoskeletal, nervous	Intestinal stasis, convulsions, ataxia, colic, bloat, diarrhea, decreased salivation, dilated pupils, increased heart rate
Blueweed (*Echium vulgare*)	X			X	all	no data	alkaloid, photosensitization	integumentary, liver, musculoskeletal, nervous, ocular	Severe weight loss, muscle atrophy, photosensitivity, jaundice, incoordination, depression, aimless wandering, head pressing, eye tearing
Bouncingbet (*Saponaria officinalis*)	X	X		X	seeds	summer, fall	saponin	gastrointestinal, liver	Decreased rumen activity, colic, anorexia, excessive salivation, diarrhea, liver toxicity
Brackenfern* (*Pteridium aquilinum*)	X	X		X	all	summer, fall, and in hay	glycoside, thiaminase	cardiovascular, nervous, ocular, renal	Death, blindness, hemorrhages, depression, nasal and rectal bleeding, bloody urine, anemia, high fever, loss of appetite, difficulty breathing, excessive salivation (cattle, sheep); convulsions, seizures, weight loss, incoordination, fast pulse, crouching stance, weakness (horses)

[1] X = known affects, R = rarely affects, S = suspected to affect

[2] plant part or time of year; most susceptible plant part or most dangerous time of year

* toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Brassicas – canola, kale, radish, turnip (*Brassica* spp.), radish (*Raphanus sativus*)	X	X	X		all; tops	fall	bloat, nitrate, cyanogenic glycoside (HCN), mycotoxin	cardiovascular, gastrointestinal, musculoskeletal, nervous, respiratory	Death, bloat, goiter, congestion of rumen and abomasum, hypothyroidism, blindness, diarrhea, red-colored urine, and hemolytic anemia, pulmonary emphysema, blindness, staggering, depression, reduced weight gain
Buckthorn (*Rhamnus cathartica*)	S			X	fruit, leaves	spring, summer, fall	glycoside	gastrointestinal	Nausea, stomach cramps, vomiting, diarrhea
Buckwheat (*Fagopyrum esculentum*)	X	X	X	X	all	summer, fall, and in hay	fragopyrin, photosensitization	integumentary, ocular	Photosensitivity, tearing
Buttercup (*Ranunculus* spp. and *Ceratocephala testiculata*)	X	X		X	all	all	glycoside, volatile oils	gastrointestinal	Abdominal pain, irritation of digestive tract, reddening of oral mucous membranes, diarrhea, excessive salivation
Chokecherry* (*Prunus virginiana*) and *Pin cherry* (*P. pensylvanica*)	X	X	X	R	all; young stems & leaves, seeds	spring, summer	cyanogenic glycoside (HCN)	gastrointestinal, cardiovascular, respiratory, all organs	Sudden death, coma, convulsions, muscular spasms, difficulty breathing, bloat, mucous membranes appear pink/red, venous blood is cherry red, nervousness, weakness, staggering, excessive salivation
Clover, alsike (*Trifolium hybridum*)	X	X	X	X	all	all	bloat, mycotoxin, nitrate, photosensitization	integumentary, liver, nervous	Bloat (ruminants), enlarged liver, weight loss, photosensitivity, jaundice, depression, aimless wandering, walking in circles, head pressing, yawning
Clover, red (*Trifolium pratense*)	X	X	X	X	all	all	alkaloid, bloat, mycotoxin, nitrate, photosensitization	gastrointestinal, integumentary, reproductive	Bloat (ruminants), excessive salivation, dehydration, photosensitivity, reproduction problems
Clover, white (*Trifolium repens*)	X	X	X	R	all	all	bloat, glycoside, nitrate, photosensitization	gastrointestinal, integumentary, musculoskeletal, reproductive, respiratory	Bloat (ruminants), muscular tremors, increased respiratory rate, staggering, recumbency, photosensitivity, drowsiness, weakness, reproduction problems
Cocklebur* (*Xanthium strumarium, X. spinosum*)	X	X	X	X	sprouts, seeds	spring, summer	glycoside	gastrointestinal, nervous, renal, liver	Sudden death, coma, liver damage, convulsions, ataxia, incoordination, vomiting, abdominal pain, loss of appetite, depression, weakness
Corn* (*Zea mays*)	X	X	X	R	stems	summer, fall	mycotoxin, nitrate, selenium	cardiovascular, gastrointestinal, reproductive, respiratory	Death, congestion of rumen and abomasum, muddy cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, acidosis, watering eyes, reduced milk flow, reduced weight gain, abortion, infertility
Cow parsnip (*Heracleum maximum*)	X				flowers, seeds	summer, fall	furanocoumarin, photosensitization	integumentary	Photosensitivity

[1] X = known affects, R = rarely affects, S = suspected to affect

[2] plant part or time of year; most susceptible plant part or most dangerous time of year

* toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Curlycup gumweed (*Grindelia squarrosa*)	X	S		X	leaves	no data	selenium	integumentary, musculoskeletal	Heart atrophy, liver failure, lameness, bone and joint degeneration, anemia, reduced reproduction performance, loss of long hairs of the main and tail (horses, cattle); reduction in fertility (sheep)
Deathcamas* (*Zigadenus* spp.)	X	X	X	X	all; bulb, mature leaves	all; spring	alkaloid	gastrointestinal, musculoskeletal, nervous	Sudden death, coma, convulsions, ataxia, prostration, vomiting, staggering, lowered temperature, excessive salivation, tremors, labored breathing, weakness
Dock, curly* (*Rumex crispus*)	X	X		X	all; leaves, stem	no data	oxalate, nitrate	musculoskeletal, gastrointestinal, renal	Sudden death, coma, muscle tremors, kidney failure, abdominal pain, incoordination, salivation, depression, weakness, reluctance to move
Dogbane* (*Apocynum cannabinum,* (*A. androsaemifolium*)	X	X	X	X	leaves	all; hay	cardiac glycoside	cardiovascular, gastrointestinal, ocular	Sudden death, coma, cyanosis, irregular heartbeat, rapid pulse, blue coloration of mucous membranes, abdominal pain, vomiting, diarrhea, weakness, dilation of pupils
Elderberry, red* (*Sambucus racemosa*)	X	X		R	all	fall, spring	cyanogenic glycoside (HCN)	cardiovascular, nervous, reproductive, respiratory	Sudden death, abortions, increased heart rate, increased respiratory rate, panting, open mouth breathing, extreme difficulty breathing, venous blood is cherry red, mucous membranes bright red, excitement
False hellebore* (*Veratrum* spp.)	X	X	X		all; leaves, roots	spring, summer, fall	alkaloid	gastrointestinal, nervous, reproductive	Birth defects, abortion, coma, convulsions, irregular heartbeat, prostration, difficult respiration, vomiting, excessive salivation, weakness, irregular gait
Fescue, tall (*Schedonorus arundinaceus*)	X	X		X	leaves, seeds	summer, and in hay	alkaloid, mycotoxin, nitrate	cardiovascular	Gangrene in extremities ('fescue foot'), impaired reproduction and milk production, heat stress, failure to shed winter coat (cattle); poor reproduction (horses)
Fiddleneck* (*Amsinckia menziesii,* (*A. lycopsoides*)	X	R	R	X	all	no data	alkaloid (pyrrolizidine), photosensitization	Gastrointestinal, musculoskeletal, nervous, ocular, renal, all systems	Rectal prolapse, red urine, edema of the legs, photosensitivity, photophobia, jaundice, weight loss, severe depression, aimless walking, diarrhea, incessant licking of objects, head pressing (cattle, horses); weight loss, appetite loss (sheep, goats)
Field bindweed (*Convolvulus arvensis*)				X	all; seeds	no data	alkaloid (tropane)	gastrointestinal	Colic
Field pennycress (*Thlaspi arvense*)			X		all; seeds	no data	glycoside	gastrointestinal	Death, profuse swelling of the fore stomach, colic, bloody diarrhea, tainted milk
Flax (*Linum* spp.)	X	X	X	R	all	no data	cyanogenic glycoside (HCN)	cardiovascular, respiratory	Sudden death, cyanosis, cherry-red venous blood, difficulty breathing, excessive salivation, nervousness, weakness
Flixweed (*Descurainia sophia*)	X				all; young plants	spring	unknown, photosensitization	gastrointestinal, integumentary, musculoskeletal, nervous, ocular	Blindness, severe photosensitivity, difficulty chewing and swallowing, weight loss, head pressing

[1] X = known affects, R = rarely affects, S = suspected to affect

[2] plant part or time of year; most susceptible plant part or most dangerous time of year

* toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Goldenbanner (*Thermopsis montana*)	X			S	all; seed pods	all; hay	alkaloid	musculoskeletal	Death, ataxia, weakness, unable to stand
Grains, cultivated (oats, barley, rye, triticale, wheat)	X	X	X	X	stems	spring, fall	bloat, nitrate, mycotoxin, selenium	cardiovascular, gastrointestinal, reproductive, respiratory	Death, bloat (ruminants), congestion of rumen and abomasum, tetany, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced weight gain, abortion, rapid pulse, infertility
Greasewood* (*Sarcobatus vermiculatus*)	X	X	X	S	leaves, buds	spring, fall, winter	oxalate	musculoskeletal, renal	Death, coma, kidney failure, recumbency, muscle tremors, tetany, loss of appetite, slow pulse, weakness, collapse, incoordination, depression, reluctance to move, drooling
Ground ivy (*Glechoma hederacea*)				X	all	spring, and in hay	volatile oils	respiratory	Sweating, salivation, labored breathing, pupil dilation
Groundcherry, longleaf (*Physalis longifolia*)				X	all	spring, and in hay	volatile oils	respiratory	Sweating, salivation, labored breathing, pupil dilation
Groundsel* (*Senecio* spp.)	X	R	R	X	all	all	alkaloid (pyrrolizidine), photosensitization	All systems, liver	Death, rectal prolapse, hemolysis, red urine, anemia, incoordination, photosensitivity, swelling and redness to skin around eyes, jaundice, diarrhea, depression, circling, aimless wandering, head pressing, excessive tearing, weakness, weight and appetite loss
Halogeton* (*Halogeton glomeratus*)		X			all	spring	tetradymol, photosensitization	hepatic, integumentary	Death, abortions, liver swelling and failure, rapid weak pulse, difficulty breathing, prostration, twitching, secondary photosensitivity, redness and edema of the tissues of the head, swelling of head (ears, lips, face), incoordination, anorexia, depression, lagging behind in herd
Hemlock, poison* (*Conium maculatum*)	X	X	X	X	all; seeds	all; spring	alkaloid	all systems	Sudden death, abortions, coma, respiratory paralysis, birth defects, ataxia, muscle tremors, cyanosis, rapid weak pulse, incoordination, abdominal pain, nervousness, weakness, salivation, frequent urination and defecation, dilated pupils
Hemlock, water* (*Cicuta douglasii*)	X	X	X	X	all; roots	spring	cicutoxin	musculoskeletal, cardiovascular, nervous, respiratory	Sudden death, coma, severe convulsions, respiratory paralysis, rapid pulse and breathing, muscle degeneration, excessive salivation, vigorous chewing, teeth grinding, dilated pupils
Hemp (*Cannabis sativa*)	R			X	no data	no data	cannabinoid	gastrointestinal, musculoskeletal	Death, coma, intoxication, vomiting, salivation, muscle tremors, ataxia

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Horsebrush* (*Tetradymia canescens*)		X			all	spring	tetradymol, photosensitization	hepatic, integumentary	Death, abortions, liver swelling and failure, rapid weak pulse, difficulty breathing, prostration, twitching, secondary photosensitivity, redness and edema of the tissues of the head, swelling of head (ears, lips, face), incoordination, anorexia, depression, lagging behind in herd
Horsetail* (*Equisetum* spp.)	X	R	S	X	all	all; hay	thiaminase	gastrointestinal, nervous	Death, coma, convulsions, seizures, weakness and incoordination of the hind legs, recumbency, weight loss, depression, appear blind and have difficulty seeing, diarrhea
Horseweed, Canadian (*Conyza canadensis*)	S			X	all	no data	volatile oils, tannic acid, gallic acid	integumentary	Irritated skin, mucous membranes, and nostrils
Houndstongue* (*Cynoglossum officinale*)	X	R	R	X	all	all; hay	alkaloid (pyrrolizidine), photosensitization	integumentary, liver, nervous, musculoskeletal	Death, rectal prolapse, red urine, edema of legs, photosensitivity, jaundice, weight loss, walking in circles, diarrhea, depression, excessive yawning
Huckleberry, false (*Menziesia ferruginea*)	X	X	X	X	all	spring, fall	neurotoxic diterpenoid	cardiovascular, gastrointestinal	Convulsions, recumbency, incoordination, irregular heartbeat, hypotension, colic, vomiting, depression
Indian breadroot, silverleaf (*Pediomelum argophyllum*)	X	X	X	X	seeds	no data	photosensitization	integumentary	Photosensitivity
Indian paintbrush (*Castilleja* spp.)	R			R	stem	no data	selenium	integumentary, musculoskeletal	Lameness, long hairs of the main and tail break
Iris, Rocky Mountain (*Iris missouriensis*	X				all	no data	irisin	gastrointestinal, integumentary	Colic, abdominal pain, burning sensation of mouth and throat, vomiting, diarrhea, irritated skin
Iris, yellowflag (*Iris pseudacorus*)	X				no data	no data	glycoside	gastrointestinal, integumentary	Abdominal pain, vomiting, diarrhea, irritated skin
Jimsonweed* (*Datura stramonium*)	X	X	X	X	all; seeds	no data; hay	alkaloid (tropane)	cardiovascular, gastrointestinal, ocular	Colic, rumen stasis, muscular twitching, paralysis, respiratory paralysis, incoordination, excessive thirst, loss of appetite, bloat (ruminants), increased heart rate, dilated pupils, impaired vision, subnormal temperature, dry muzzle, decreased salivation
Johnsongrass* (*Sorghum halepense*)	X	X	X	X	all	all; wilted, regrowth	cyanogenic glycoside (HCN), nitrate	all systems	Sudden death, convulsions, abortions or limb deformities, cyanosis, cherry-red venous blood and mucous membranes, increased salivation, difficult breathing, nervousness, weakness, urinary incontinence, ataxia, hind leg weakness
Knapweed, Russian* (*Acroptilon repens*)				X	all; green plants	no data	DDMP	gastrointestinal, respiratory, nervous	Death from starvation, muscle tremors, facial paralysis, unable to take hold of and chew food (chewing disease), inhalation pneumonia, severe weight loss, incoordination, dehydration, depression, excessive salivation

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Kochia* (*Bassia scoparia*)	X	X	S	X	all	all; hay	nitrate, oxalate, thiaminase, sulfate, alkaloid, saponin, photosensitization	all systems; kidney, liver	Sudden death, blindness, kidney failure, liver disease, brown colored mucous membranes and blood, severe difficulty breathing, gastrointestinal inflammation, incoordination, photosensitivity, depression, depressed appetite, dehydration, swollen eyelids, crusty muzzle, weight loss
Labrador tea (*Ledum glandulosum*)	X	X	X	R	all	all; winter	neurotoxic diterpenoid	gastrointestinal	Convulsions, incoordination, recumbency, irregular heartbeat, hypotension, colic, vomiting, depression
Lambsquarters* (*Chenopodium album*)	X	X	X		all	no data	nitrate, oxalate, sulfate	reproductive, respiratory	Sudden death, acute respiratory failure, abortion
Larkspur* (*Delphinium* spp.)	X	R		R	all; new growth, seeds	spring (low), summer (tall)	alkaloid (diterpene), bloat	musculoskeletal, gastrointestinal, respiratory, nervous	Death, muscular or respiratory paralysis, tremors, incoordination, stiffness, staggering, falling, muscle tremors, collapse, bloat, weakness, nervousness, regurgitation, vomiting, salivation
Laurel (*Kalmia polifolia*)	X	X	X	X	all	spring, fall	neurotoxic diterpenoid	all systems	Convulsions, incoordination, recumbency, irregular heartbeat, hypotension, colic, vomiting, depression
Leafy spurge (*Euphorbia esula*)	X	R	R	X	sap	no data	diterpene esters	gastrointestinal, integumentary	Colic, vomiting, reddening and swelling or blistering of the skin, eye irritation, weight loss when exclusively fed leafy spurge, diarrhea, excessive salivation
Locoweed* (*Oxytropis* spp.)	X	X	X	X	all	all; hay	alkaloid (swainsonine)	gastrointestinal, reproductive, congenital, nervous, cells, liver	Birth defects, abortions and fetal death, decreased fertility, congestive heart failure, liver damage, incoordination, stiff and irregular gait, abnormal behavior, aggressiveness, loss of direction, excitability, weight loss, depression, weakness, staring, difficulty eating, exaggerated mouth movement, dull coat
Lupine* (*Lupinus* spp.)	X	X	R	S	all; seeds	all; hay	alkaloids, mycotoxin	musculoskeletal, nervous, hepatic, reproductive, respiratory	Death, respiratory failure, coma, birth defects (crooked legs, cleft palate), abortion, convulsions, incoordination, difficult breathing, muscle twitching, loss of muscle control, lethargy, head pressing, depression, nervousness, excessive salivation, dry coat
Mallow, common (*Malva neglecta*)		X			leaves, seed	no data	oxalate, nitrate	musculoskeletal, nervous	Staggering, lameness
Matrimony vine (*Lycium barbarum*)	X	X			no data	no data	alkaloid (solanaceous)	gastrointestinal, nervous	Death, convulsions, vomiting, diarrhea, excitement
Milkvetch* (*Astragalus* spp.) (not *A. cicer*)	X	X	X	X	all	all; spring, summer	alkaloid (swainsonine), selenium, nitrotoxin	integumentary, musculoskeletal, nervous, reproductive	Death, abortions, birth defects, brain hemorrhages, respiratory distress, load breathing (roaring disease), collapsed lung, decreased male fertility, blindness, weakness, loss of control of hind limbs, prostration, collapse, decreased body condition, lameness, abnormal behavior, loss of direction, knocking of hocks and feet when walking, breaking of long hairs of the mane and tail, spastic jaw movements, depressed, nervousness

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Milkweed* (*Asclepias* spp.)	X	X	X	X	all	all; actively growing, hay	cardiac glycoside, selenium	cardiovascular, gastrointestinal, musculoskeletal, nervous, respiratory	Death, convulsions, seizures, respiratory paralysis, recumbency, rapid weak pulse, difficult breathing with grunting sounds, abdominal pain, colic, bloat (ruminants), diarrhea staggering, weakness, muscle tremors, reluctance to stand, incoordination, deep depression, elevated temperature, dilation of pupils
Millet (*Pennisetum glaucum*)	X	X	X		stems	fall	nitrate	cardiovascular, gastrointestinal, reproductive, respiratory	Death, congestion of rumen and abomasum, muddy cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced milk flow, reduced weight gain, abortion and infertility
Monkshood* (*Aconitum columbianum*)	X	X	X	X	all; seeds, roots	summer	alkaloids	cardiovascular, gastrointestinal, musculoskeletal, respiratory	Sudden death, recumbency, increased respiratory rate, difficulty breathing, muscle weakness, staggering gait, bloating, excessive salivation
Mountain mahogany, curl-leaf and true (*Cercocarpus ledifolius, C. montanus*)	R				all	no data	cyanogenic glycoside (HCN)	all systems	Sudden death, abortions, difficulty breathing (open-mouth breathing), respiratory failure, collapse, mucous membranes cherry-red in color, venous blood cherry red, nervousness, weakness, excitement, excessive salivation
Nightshade* (*Solanum* spp.)	X	X	X	X	all; fruit, leaves	all	alkaloid, nitrate	all systems	Death, coma, bloat (ruminants), shock, kidney failure, muscle tremors, irregular heart rate, weak pulse, incoordination, colic, labored breathing, jaundice, weakness, diarrhea, drowsiness, excess salivation, depression, drowsiness, dilated pupils
Onion* (*Allium* spp.)	X	R	R	X	leaves	spring, summer	alkaloid, sulfide	cardiovascular, respiratory, renal	Possible death, recumbency, fast weak pulse, collapse, increased respiratory rate, anemia, red-brown urine, pale mucous membranes, weakness, staggering
Penstemon (*Penstemon* spp.)	R	R		R	leaves	no data	selenium	integumentary, musculoskeletal	Lameness (horses), circular ridges in all feet, loss of long hairs of mane and tail
Pheasant's eye* (*Adonis aestivalis*)	R	R		X	leaves, flowers	no data	glycoside	cardiovascular, gastrointestinal	Sudden death, erratic heartbeat, colic, decreased gut motility, diarrhea, vomiting
Pine, ponderosa* (*Pinus ponderosa*)	X	R	R		needles, bark	all; winter, spring	isocupressic acid	renal, reproductive	Abortion, congenital defects, persistently retained placenta, renal failure, incoordination, aimless wandering
Princesplume (*Stanleya pinnata*)	X	X	X	X	leaves	no data	selenium	integumentary, musculoskeletal	Death, lameness, sloughing of the hoof (horses), circular ridges in all feet, loss of long hairs of the mane and tail
Puncturevine (*Tribulus terrestris*)	X	X			leaves, stems	no data	saponin, nitrate, photosensitization	hepatic, integumentary, musculoskeletal	Lameness, biliary stasis, photosensitivity, jaundice; swelling of the head (sheep)

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Purslane (*Portulaca oleracea*)	R	R		R	all	no data	oxalate	musculoskeletal, renal	Death, coma, kidney failure, muscle tremors, tetany, recumbency, weakness, depression, reluctance to move
Redroot pigweed* (*Amaranthus retroflexus*)	X	X	X	X	all	all	oxalate, nitrate	gastrointestinal, musculoskeletal, renal	Death, renal failure, fluid around kidneys, ataxia, bloat (ruminants), recumbency, muscle weakness and tremors, knuckling at the fetlock joints, decreased rumen activity
Reed canarygrass (*Phalaris arundinacea*)	X	X		X	leaves	fall	alkaloid, nitrate, selenium	musculoskeletal, nervous, respiratory	Death, weakness, stagger, increased respiratory rate, increased water intake, reduced animal performance, grass tetany, diarrhea
Ryegrass, perennial (*Lolium perenne*)	X	X		X	leaves	no data	alkaloid, mycotoxin, nitrate, photosensitization	integumentary, nervous	Incoordination, collapse, muscle spasms, staggering (ryegrass staggers), head shaking, photosensitivity, grass tetany
Sage, lanceleaf (*Salvia reflexa*)	R	R	R		stem	hay	nitrate	gastrointestinal, musculoskeletal	Colic, muscle weakness, diarrhea
Sage, sand and fringed (*Artemisia filifolia, A. frigida*)				X	leaves	fall, winter	lactone, monoterpene, volatile oils	gastrointestinal, nervous	Ataxia (front forequarters), falling down, abnormal behavior, circling, excitable, unpredictable
Sagebrush, big* (*Artemisia tridentata*)		S			leaves	all	lactone, volatile oils	gastrointestinal, nervous	Death, abortions
Sagewort, green and white (*Artemisia dracunculus, A. ludoviciana*)	X			X	leaves	no data	volatile oils	gastrointestinal, integumentary	Skin irritation, reduced rumen activity, vomiting, diarrhea
Saltbush (*Atriplex* spp.)	X	X		X	leaves	no data	selenium	integumentary, musculoskeletal	Lameness, cracked or deformed hooves, loss of long hairs of the mane and tail
Scotch broom (*Cytisus scoparius*)	X	X		X	no data	no data	alkaloid	gastrointestinal, musculoskeletal	Congenital malformations, muscle degeneration, muscle tremors, incoordination, colic, anorexia, excessive salivation
Scrambled eggs (*Corydalis aurea*)	X	X			no data	no data	alkaloid	nervous	Sudden death, convulsions, restlessness, twitching of facial muscles
Serviceberry* (*Amelanchier alnifolia*)	X	X	X		all; not berries	spring, summer	cyanogenic glycoside (HCN)	all systems	Sudden death, abortions, coma, convulsions, collapse, staggering, difficulty breathing, mucous membranes appear pink/red, venous blood is cherry red, excessive salivation, nervousness, excitement
Snakeweed* (*Gutierrezia sarothrae*)	X	X	X	X	all	spring	saponin, selenium	gastrointestinal, musculoskeletal reproductive, liver	Abortions, liver necrosis and degeneration, decreased male fertility, sloughing of nasal mucosa, weight loss, stomach pains, diarrhea followed by constipation

[1] X = known affects, R = rarely affects, S = suspected to affect

[2] plant part or time of year; most susceptible plant part or most dangerous time of year

* toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Sneezeweed* (*Hymenoxys hoopesii*)	R	X		R	all	summer, fall, hay	sesquiterpene lactone	gastrointestinal, musculoskeletal respiratory	Death, rumen stasis, ataxia, liver degeneration, inhalation pneumonia, irregular pulse, bloat, weight loss, lambs become stiff and wasted, muscle tremors, decreased appetite, vomiting, dehydration, depression, weakness, teeth grinding, frothing at mouth, coughing
Sorghums*, forage, grain, sorghum-sudangrass, sudangrass (*Sorghum bicolor, S. x drummondii, S. bicolor* var. *sudanense*)	X	X	X	R	all	summer, fall	nitrate, cyanogenic glycoside (HCN)	cardiovascular, gastrointestinal, reproductive, respiratory	Death, acidosis, congestion of rumen and abomasum, muddy or red cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced milk flow, reduced weight gain, abortion and infertility
Sorrel (*Oxalis* spp.)	R	R	R	R	no data	no data	oxalate	musculoskeletal, renal	Death, coma, kidney failure, tetany, recumbency, muscle tremors, weakness, depression, reluctance to move
St. Johnswort* (*Hypericum perforatum*)	X	X	R	X	leaves, flowers	all; spring, hay	hypericin, photosensitization	integumentary	Photosensitivity, reddening and edema, severe itching, blistering, sloughing of white skin, scratching head; convulsions, rapid respiration and pulse, loss of condition, elevated temperature, crouching, restlessness
Suckleya, poison (*Suckleya suckleyana*)	X	X			all	summer	cyanogenic glycoside (HCN)	cardiovascular, gastrointestinal, nervous, respiratory reproductive	Death, abortion, collapse, pink or red mucous membranes, cherry-red blood, difficulty breathing, nervousness, excitement, excessive salivation, weakness
Sunflower (*Helianthus* spp.)	X	X	X		stems	no data	nitrate	cardiovascular, gastrointestinal, reproductive, respiratory	Death, congestion of rumen and abomasum, muddy cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced milk flow, reduced weight gain, abortion, infertility
Sweetclover, yellow and white* (*Melilotus officinalis*)	X	R		X	moldy feed	hay	dicoumarol, mycotoxin, bloat	all systems	Anticoagulant effects; death, bloat (ruminants), lameness, internal and external hemorrhaging (e.g. nose, eye chamber, during birthing), large swellings over protuberant body areas, anemia, bloody and black feces, weakness
Sweetpea (*Lathyrus* spp.)				X	no data	no data	unknown	musculoskeletal	Lameness
Tansy, common (*Tanacetum vulgare*)	S		S	S	leaves	no data	alkaloid, volatile oils	cardiovascular, gastrointestinal	Abortions, convulsions, rapid weak pulse, stomach pain, salivating
Tansy mustard (*Descurainia pinnata*)	X				all	spring, summer	unknown, photosensitization	gastrointestinal, integumentary, nervous, ocular	Blindness, difficulty eating (tongue appears paralyzed), severe photosensitivity, weight loss, head pressing, aimless wandering

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 1, (cont.)

Plant Species	Livestock Affected[1]				Plant Part[2]	Time Year[2]	Toxin or Disorder	Organ or System Affected	Symptoms
	Cattle	Sheep	Goat	Horse					
Tansy ragwort* (*Senecio jacobaea*)	X	X	X	X	all	spring, summer, hay	alkaloid (pyrrolizidine), photosensitization	all systems	Rectal straining, liver cirrhosis, fluid buildup in abdomen, bile duct proliferation, red urine, photosensitivity, swelling and redness to skin around eyes, diarrhea, stomach pain, aimless wandering, head pressing, excessive tearing, lethargy, weakness, anemia, incoordination, dragging rear feet, weight loss, appetite loss, depression
Teff (*Eragrostis tef*)	X	X	X		stems	fall	nitrate	cardiovascular, gastrointestinal, reproductive, respiratory	Death, congestion of rumen and abomasum, muddy cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced milk flow, reduced weight gain, abortion and infertility
Thistle, Canada (*Cirsium arvense*)	R				stems	no data	nitrate	cardiovascular, gastrointestinal, reproductive, respiratory	Death, congestion of rumen and abomasum, muddy cyanotic mucus membranes, shortness of breath, cyanosis, staggering, chocolate-brown blood, watering eyes, reduced milk flow, reduced weight gain, abortion, infertility
Thistle, Russian* (*Salsola tragus*)	X	S			stems	no data	nitrate	cardiovascular, musculoskeletal, reproductive	Abortions, fetal death, recumbency, increased heart rate, increased respiratory rate, difficulty breathing, brown colored mucous membranes, staggering gait
Tobacco, coyote* (*Nicotiana attenuata*)	X	X	X	X	all; green growth	no data	alkaloid (nicotine)	gastrointestinal, musculoskeletal, nervous, reproductive	Birth defects, abortion, coma, convulsions, paralysis of the muscles of the respiratory and cardiovascular system, muscle tremors, staggering, incoordination, diarrhea, excessive salivation
Vetch, hairy (*Vicia villosa*)	X			X	all; seeds	fall	nitrate, photosensitization	cardiovascular, gastrointestinal, integumentary, nervous	Death, convulsions, hyperproteinemia, excessive bleeding, bloat (cattle), thickening of skin, photosensitivity, swollen lymph nodes, abnormal behavior, difficulty standing, itching and rubbing of infected areas, diarrhea, poor appetite, hair loss
Whitetop (*Cardaria draba*)	S		S		leaves, seeds	fall	glucosinolates	endocrine	Anti-thyroid symptoms
Yellow starthistle* (*Centaurea solstitialis*)				X	all	all	DDMP	gastrointestinal, respiratory, nervous	Death from starvation, brain necrosis, muscle tremors, facial muscles hypertonic (wooden expression), facial paralysis, unable to chew food or drink (chewing disease), mouth held open, tongue protrudes, inhalation pneumonia, severe weight loss, incoordination, dehydration, depression, excessive salivation
Yew* (*Taxus brevifolia*)	X	X	X	X	all; leaves	all; winter	alkaloid (taxine)	cardiovascular, gastrointestinal, musculoskeletal, respiratory, nervous	Sudden death, coma, circulatory failure, convulsions, slow heart rate, gastric distress, muscle trembling, vomiting, difficulty breathing, incoordination, diarrhea, nervousness, fatigue, dilated pupils

[1] X = known affects, R = rarely affects, S = suspected to affect [2] plant part or time of year; most susceptible plant part or most dangerous time of year * toxic dose information available for species in Table 2

Table 2. Toxic doses for commonly diagnosed plant poisonings in Montana and Wyoming. Symptoms of livestock poisoning may not be evident until a toxic threshold is reached.

Plant Species	Toxic Dosage (bw = body weight; n/a = not applicable)			
	Cattle	Sheep/Goats	Horses	Comments
Alfalfa (*Medicago sativa*)	22 ppm (selenium) 10,000 ppm (nitrate)	10,000 ppm (nitrate)	22 ppm (selenium)	Selenium accumulated in the leaves. Nitrate levels are higher in lower stalks and stems.
Arrowgrass (*Triglochin* spp.)	0.1 - 1.5% bw	0.1 – 5.0% bw	Rarely affected	Flowering spikes contain twice the amount of toxin and require half the dosage. Plants lose toxicity with drying (e.g. hay). Plants more toxic when stressed from drought or frost.
Brackenfern (*Pteridium aquilinum*)	No data	No data	3 - 5% bw	Consumption for at least 30 days. Live and dried plants are toxic. Roots and young shoots with highest toxicity.
Chokecherry (*Prunus virginiana*)	0.1 - 0.6% bw	0.1 - 0.4% bw	Rarely affected	Consumption 0.1 to 0.6% bw of leaves depending on growth stage or 0.24% bw fresh twigs (lethal). Fresh, bruised, wilted (drought or frost), and dry leaves are poisonous. Young leaves more toxic than mature leaves. Seed stones are poisonous.
Cocklebur (*Xanthium* spp.)	0.75 – 3.0% bw	0.75 – 3.0% bw	No data	Consumption of fresh green sprouts (cotyledon stage) and seeds (burs). Toxicity is not present in mature plants.
Corn (*Zea mays*)	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	Many factors affect toxicity, but generally 0.05% bw is minimum lethal dose.
Deathcamas (*Zigadenus* spp.)	1% bw	0.5 - 2.5% bw	No data	Consumption of green plant can be lethal. Toxic risk greatest at early vegetative growth stages followed by the flower and pod stages.
Dock, curly (*Rumex crispus*)	10 – 20 lbs/day	No data	No data	Signs can occur within 5 hours of consumption of green plant, and death follows within a day. All parts of the plant are toxic.
Dogbane (*Apocynum* spp.)	0.03 - 0.05% bw	0.03 - 0.06% bw	0.03 - 0.05% bw	Toxic dose depends on rate of consumption and digestion. Death may occur 6 to 12 hours after consumption. Dried plants remain toxic.
Elderberry, red (*Sambucus racemosa*	0.25% bw	0.25% bw	n/a	Ingestion of wilted leaves can cause death in 1 hour or less. New growth and re-growth are also toxic.
False hellebore (*Veratrum spp.*)	No data	6 - 12 oz	n/a	Dosage is for leaves and stems, but the roots are 5 to 10 times more poisonous. Poisonous at all growth stages.
Fiddleneck (*Amsinckia* spp.)	0.1% bw	Rarely affected	0.1% bw	Dosage is for consumption over 2 weeks resulting in liver disease. Clinical signs may not appear for 2 to 8 months after consumption.
Greasewood (*Sarcobatus vermiculatus*)	1.5 - 5% bw	1.5 - 5% bw	No data	Toxic if eaten quickly or when a major component of livestock diet. Losses occur when eating large quantities of leaves that have fallen to the ground in the fall and winter or new growth in spring. Increases in toxicity as growing season advances. Can be valuable forage if animals are adapted to oxalate containing plants and consumed with non-toxic forage.
Groundsel (*Senecio* spp.)	1 - 5% bw (acute)	200 – 300% bw (chronic)	1 - 7% bw (acute)	Consumption of 1 – 5% within a few days can be lethal. Chronic poisoning caused by accumulative consumption of a total intake of 25 to 150% bw over several months.
Halogeton (*Halogeton glomeratus*)	0.3 - 1.5% bw	0.3 - 1.5% bw	Rarely affected	Becomes more toxic as growing season advances. Peak toxicity at maturity. Toxicity depends on other forage availability.

Table 2, (cont.)

Plant Species	Toxic Dosage (bw = body weight; n/a = not applicable)			
	Cattle	Sheep/Goats	Horses	Comments
Hemlock, poison (*Conium maculatum*)	0.1 – 1.0% bw	0.1 – 1.0% bw	0.1 – 1.0% bw	Consumption of green plant (lethal). Seeds, especially when immature, are more toxic than other plant parts. Remains toxic when dried.
Horsebrush (*Tetradymia canescens*)	n/a	0.5 - 1.25%	n/a	Sheep are mainly affected by this plant when eaten in conjunction with black sagebrush (*Artemisia nova*).
Horsetail (*Equisetum* spp.)	Feed containing >20% horsetail.	Rarely affected.	Feed containing >20% horsetail.	Symptoms appear 2 to 5 weeks after consumption. Fresh and dry plants are toxic.
Houndstongue (*Cynoglossum officinale*)	5 - 10% bw	Rarely affected	2% of dry matter intake/day	Horses that consume around 1 plant per day for 2 weeks show symptoms. Lethal for cattle when eating 5% or more of their total daily diet of mature plants for periods exceeding 15 days.
Jimsonweed (*Datura stramonium*)	1 – 5% bw of seeds	No data	0.5% bw of seeds for 10 days	Toxins present in all plant parts, increasing with maturity and remain after drying. Seeds have highest concentration.
Johnsongrass (*Sorghum halepense*)	0.25% bw	0.25% bw	0.25% bw	Ingestion in the form of wilted leaves can result in death in an hour or less.
Knapweed, Russian (*Acroptilon repens*)	n/a	n/a	86 - 200% bw	Consumption over 1 to 3 months.
Kochia (*Bassia scoparia*)	>50% of diet	>50% of diet	>50% of diet	Toxicity varies with growth stage. More problems associated with mature, droughty plants.
Lambsquarters (*Chenopodium album*)	>1% nitrates	>1% nitrates	n/a	Animals impacted after consuming plants with >1% nitrates.
Larkspur (*Delphinium* spp.)	0.5 - 3.5% bw	Rarely affected (3 – 21%) bw	Rarely affected	Highly palatable and highly toxic to cattle. Toxicity for both low and tall larkspur is most prevalent at flowering stage and decreases after seed drop. Toxicity declines over growing season. Fresh or dried plants toxic. Seeds remain toxic.
Locoweed (*Oxytropis* spp.)	30 - 50% bw in dry weight	No data	81 lbs in 4 - 6 weeks	Symptoms appear 2 to 9 weeks after consumption.
Lupine (*Lupinus* spp.)	0.1 - 1.5% bw	0.5 - 1.5% bw	Rarely affected	Species vary in toxicity levels. Toxic substances throughout plant and concentrated in seeds. Younger plants more toxic than mature plants. Seed stage especially toxic. Smaller doses poisonous if cattle eat lupine daily for 3 to 7 days.
Milkvetch (*Astragalus* spp.) (not *A. cicer*)	0.2 - 0.8% bw	8 oz	No data	Toxic dose depends on rate of consumption and digestion. All plant parts and growth stages are toxic, fresh or dried, but toxicity decreases as plant matures and dries. Less dangerous after seed dispersal.
Milkweed (*Asclepias* spp.)	0.05 – 2.0% bw	0.05 – 2.0% bw	0.05 – 2.0% bw	Species vary in toxicity levels. Narrow leaf species are the most toxic and broad-leaf species relatively non-toxic. Toxicity risk when plant is actively growing. Risks decrease with drying but plant remains toxic.
Monkshood (*Aconitum columbianum*)	No data	No data	0.075% bw	All parts are toxic with roots, seeds and pre-flowering leaves highest in concentration.
Nightshade (*Solanum* spp.)	0.1 - 0. 3% bw	0.1 - 0.3% bw	0.1 - 0.3% bw	Toxicity of the leaves and fruit is present in all growth stages. Higher toxicity in fall than spring and in berries than leaves. Dried plants remain toxic.

Table 2, (cont.)

Plant Species	Toxic Dosage (bw = body weight; n/a = not applicable)			
	Cattle	Sheep/Goats	Horses	Comments
Onion (*Allium* spp.)	25% of diet	Rarely affected	No data	Toxicity increases with the pungency of onion.
Pheasant's eye (*Adonis aestivalis*)	Rarely affected	16 oz green weight	No data	Dosage is fatal to sheep.
Pine, ponderosa (*Pinus ponderosa*)	4.8 - 6 lbs dry or green needles or bark	Rarely affected	n/a	Cattle appear to eat needles when stressed such as during winter snowstorms or shortage of forage. Consumption per day for more than 3 days (abortion). Cattle in last trimester are most susceptible.
Redroot pigweed (*Amaranthus retroflexus*)	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	Many factors affect toxicity, generally 0.05% bw is minimum lethal dose for nitrate accumulation. Oxalate levels remain high in dry plants.
Sagebrush, big (*Artemisia tridentata*)	n/a	0.75 lbs for 1 – 3 days	n/a	Occasionally toxic to sheep. Found to be lethal in experiments. For most species, sagebrush is a useful forage plant.
Serviceberry (*Amelanchier alnifolia*)	0.1 - 0.6% bw	0.1 - 0.4% bw	n/a	Consumption 0.1 to 0.6% bw of leaves depending on stage of growth or 0.24% bw fresh twigs (lethal). Wilted leaves more toxic than fresh leaves.
Snakeweed (*Gutierrezia sarothrae*)	10 - 20% bw	10 - 20% bw	No data	Consumption over 2 weeks is lethal. Cattle abort after eating 20 lbs green weight. Green and dry plants toxic. Toxicity increases on sandy soils.
Sneezeweed (*Hymenoxys hoopesii*)	Rarely affected	2 lbs green leaves	Rarely affected	Consumption daily for 10 days is lethal.
Sorghum-sudangrass, and sudangrass (*Sorghum* spp.)	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	0.5 - 1.5% nitrate	Many factors affect toxicity, but generally 0.05% bw is minimum lethal dose.
St. Johnswort (*Hypericum perforatum*)	1% bw	4% bw	No data	Toxic concentrations vary by plant phenology and location. Toxic at all growth stages.
Sweetclover, yellow and white (*Melilotus officinalis*)	10 – 20 mg/kg of feed (100 days); 60 – 70 mg/kg of feed (21 days	Rarely affected	10 – 20 mg/kg of feed (100 days); 60 – 70 mg/kg of feed (21 days)	Toxins are found in moldy feed and not in a pasture setting. Sweetclover hay can remain toxic for 3 to 4 years and can be used if diluted with uncontaminated feed (1:3).
Tansy ragwort (*Descurainia pinnata*)	5 - 10% bw	5% bw	3 - 7% bw	Total intake of 25 to 50% bw over several months. Hay retains toxicity for months.
Thistle, Russian (*Salsola tragus*)	0.5 - 1.5% nitrate	No data	n/a	Many factors affect toxicity, but generally 0.05% bw is minimum lethal dose.
Tobacco, coyote (*Nicotiana attenuata*)	2% bw	No data	No data	Consumption of 2% bw fresh plant is lethal.
Yellow starthistle (*Centaurea solstitialis*)	n/a	n/a	86 - 200% bw	Consumption of plant green weight over several weeks causes impacts. Young horses most susceptible.
Yew (*Taxus brevifolia*)	0.5% bw	0.5% bw	0.1% bw	Consumption of green or dry foliage, bark, seeds, and aril surrounding seeds are all toxic. Foliage is readily eaten by livestock.

Table 3. Plant family, native status, noxious weed designation, and habitat descriptions for poisonous plant species in Montana and Wyoming.

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Alfalfa	*Medicago sativa*	Fabaceae	F	I					X	X		X		Fields, roadsides
Alyssum, hoary	*Berteroa incana*	Brassicaceae	F	I		X	X		X	X		X	X	Meadows, pastures, fields, roadsides
Arrowgrass	*Triglochin maritima, T. palustris*	Juncaginaceae	G	N		X	X		X	X	X			Damp, wet, marshy areas, irrigated pastures, saline and alkaline soils
Aster, woody	*Xylorhiza glabriuscula*	Asteraceae	F	N				X		X				Dry alkaline soils, clay or bentonitic soil of steppe, badlands
Baneberry	*Actaea rubra*	Ranunculaceae	F	N		X	X		X	X	X			Moist soils of forests, along streams
Beet, sugar	*Beta vulgaris*	Chenopodiaceae	F	I								X		Cultivated
Birdsfoot trefoil	*Lotus corniculatus*	Fabaceae	F	I					X	X		X	X	Roadsides, fields, pastures
Black henbane	*Hyoscyamus niger*	Solanaceae	F	I	W		X	X	X	X		X	X	Roadsides, fields, pastures
Blueweed	*Echium vulgare*	Boraginaceae	F	I	M					X	X	X	X	Roadsides, fields, meadows, river gravel bars, vacant lot
Bouncingbet	*Saponaria officinalis*	Caryophyllaceae	F	I						X			X	Roadsides, woodlands, pastures
Brackenfern	*Pteridium aquilinum*	Polypodiaceae	F	N		X					X			Moist to wet forest, woodlands and meadows, thickets within forested landscapes, along streams, valleys to subalpine
Brassicas	*Brassica* spp., *Raphanus sativus*	Brassicaceae	F	I								X	X	Cultivated
Buckthorn	*Rhamnus cathartica*	Rhamnaceae	S	I	M					X	X		X	Fields, wooded areas, vacant lots, riparian corridors
Buckwheat	*Fagopyrum esculentum*	Polygonaceae	F	I								X	X	Cultivated, reported to escape into disturbed soils and roadsides
Buttercup	*Ranunculus* spp. and *Ceratocephala testiculata*	Ranunculaceae	F	N, I	M	X	X	X	X	X	X	X	X	Moist meadows, grasslands, irrigated hay fields, along roads, lawns
Cherry, pin	*Prunus pensylvanica*	Rosaceae	S	N		X	X		X	X				Open forest, woodlands, thickets; up to lower subalpine
Chokecherry	*Prunus virginiana*	Rosaceae	S	N		X	X		X	X	X			Riparian thickets, forests, pine and ash woodlands, rocky slopes, stony soil of grasslands
Clover, alsike	*Trifolium hybridum*	Fabaceae	F	I					X	X		X	X	Moist areas, roadsides, fields, pastures
Clover, red	*Trifolium pratense*	Fabaceae	F	I					X	X	X	X	X	Meadows, fields, lawns, roadsides, streambanks
Clover, white	*Trifolium repens*	Fabaceae	F	I							X	X	X	Meadows, moist grasslands, roadsides, fields
Cocklebur	*Xanthium strumarium, X. spinosum*	Asteraceae	F	N					X	X	X	X	X	Streambanks, roadsides, fields, farmyards, pond and reservoir edge
Corn	*Zea Mays*	Poaceae	G	I								X		Cultivated, rarely escaping
Cow parsnip	*Heracleum maximum*	Apiaceae	F	N		X	X			X	X			Moist soil of avalanche slopes, thickets, open forest, woodlands, often along streams

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Table 3, (cont.)

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Curlycup gumweed	*Grindelia squarrosa*	Asteraceae	F	N				X	X	X	X		X	Margins of wetlands, streambanks, roadsides, disturbed sites, vernally moist
Deathcamas	*Zigadenus* spp.	Liliaceae	F	N		X	X	X	X	X	X			Many species in MT and WY that vary in habitat; Meadows, open forest, along streams, stony calcareous soil, ridges, grasslands, and sagebrush steppe; up to subalpine
Dock, curly	*Rumex crispus*	Polygonaceae	F	I		X	X		X	X	X		X	Moist to wet, disturbed sites, ditches, roads, streams, wetlands
Dogbane	*Apocynum cannabinum, A. androsaemifolium*	Apocynaceae	F	N		X	X		X	X	X			Rocky soil, along streams, forest openings, open wooded areas, meadows, roadsides
Elderberry	*Sambucus* spp.	Caprifoliaceae	S	N		X	X			X	X			Moist open forest and woodlands, thickets, avalanche slopes, along streams; valleys to subalpine
False hellebore	*Veratrum* spp.	Liliaceae	F	N		X					X			Wet riparian meadows, thickets, moist forest openings, avalanche slopes; up to subalpine
Fescue, tall	*Schedonorus arundinaceus*	Poaceae	G	I						X		X	X	Moist meadows, pastures, ditch banks and irrigated fields
Fiddleneck	*Amsinckia menziesii, A. lycopsoides*	Boraginaceae	F	N						X		X	X	Dry soils, cultivated areas, roadsides, lawns, pastures
Field bindweed	*Convolvulus arvensis*	Convolvulaceae	F	I	B				X	X		X	X	Fields, pastures, vacant lots, roadsides
Flax	*Linum* spp.	Linaceae	F	N, I		X	X	X	X	X			X	Grasslands, sagebrush steppe, badlands, woodlands, meadows, fellfields, roadsides
Flixweed	*Descurainia sophia*	Brassicaceae	F	I			X	X	X	X		X	X	Disturbed soils of fields, roadsides, pastures
Goldenbanner	*Thermopsis montana, T. rhombifolia*	Fabaceae	F	N		X	X	X	X	X	X			Moist meadows, thickets, woodlands, sagebrush steppe, forest, along stream, pastures
Grains, cultivated		Poaceae	G	I								X	X	Cultivated
Greasewood	*Sarcobatus vermiculatus*	Chenopodiaceae	S	N				X	X	X				Saline soil of stream terraces, badlands, dry alkaline soils
Ground ivy	*Glechoma hederacea*	Lamiaceae	F	I						X	X		X	Shaded, moist soil of farmyards and pastures, streambanks
Groundcherry, longleaf	*Physalis longifolia*	Solanaceae	F	N					X			X	X	Dry soils of grasslands, fields, roadsides
Groundsel	*Senecio* spp.	Asteraceae	F	N, I				X	X	X			X	Hay fields, roadsides, farmyards, waste areas
Halogeton	*Halogeton glomeratus*	Chenopodiaceae	F	I				X	X	X			X	Barren areas, saline soil of arid areas, disturbed steppe in arid valleys, dry lakebeds, abandoned dry farm fields
Hemlock, poison	*Conium maculatum*	Apiaceae	F	I						X	X		X	Moist, disturbed soil along streams, ditches, cool open slopes

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Table 3, (cont.)

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Hemlock, water	*Cicuta douglasii*	Apiaceae	F	N		X	X			X	X			Wet meadows, marshes, along streams, wetlands
Hemp	*Cannabis sativa*	Cannabaceae	F	I					X	X		X	X	Fields, roadsides
Horsebrush	*Tetradymia canescens*	Asteraceae	S	N			X	X	X	X				Grasslands, dry sagebrush steppe and grasslands
Horsetail	*Equisetum* spp.	Equisetaceae	F	N		X	X		X	X	X			Moist to wet soil meadows, pastures, forests, streambanks, lake shores at all elevations
Horseweed, Canadian	*Conyza canadensis*	Asteraceae	F	N					X	X			X	Disturbed meadows, rangelands, grasslands, roadsides
Houndstongue	*Cynoglossum officinale*	Boraginaceae	F	I	B	X	X	X	X	X	X	X	X	Disturbed ground of pastures, fields, roadsides, grasslands, meadows, woodlands, forests, riparian areas
Huckleberry, false	*Menziesia ferruginea*	Ericaceae	S	N		X	X			X				Cool, moist, upland slopes in coniferous forests, forming dense thickets on north slopes; valleys to subalpine
Indian breadroot, silverleaf	*Pediomelum argophyllum*	Fabaceae	F	N				X	X	X				Dry grasslands, sagebrush steppe, desert shrubland, roadsides, and woodlands; often in sandy soils
Indian paintbrush	*Castilleja* spp.	Scrophulariaceae	F	N		X	X	X		X	X			Moist grasslands, sagebrush steppe, moist to wet meadows, thickets, forest openings, near streams; up to alpine
Iris, Rocky Mountain	*Iris missouriensis*	Iridaceae	F	N		X	X		X	X	X			Moist to wet meadows, thickets, woodland margins
Iris, yellowflag	*Iris pseudacorus*	Iridaceae	F	I	M					X	X			Marshes, wet meadows, wetlands, stream banks, irrigation ditches
Jimsonweed	*Datura stramonium*	Solanaceae	F	I						X		X	X	Disturbed soils, roadsides, railroad rights-of-way, farmyards, cultivated areas
Johnsongrass	*Sorghum halepense*	Poaceae	G	I						X		X	X	Moist soils of disturbed sites, roadsides, ditches, waste areas, alluvial bottom land, cultivated fields, pastures
Knapweed, Russian	*Acroptilon repens*	Asteraceae	F	I	B			X	X	X		X	X	Fields, grasslands, meadows, roadsides, stream terraces
Kochia	*Bassia scoparia*	Chenopodiaceae	F	I					X	X		X	X	Disturbed soil of roadsides, pastures, rangeland, farmyards, cultivated fields, tolerant of saline soil
Labrador tea	*Ledum glandulosum*	Ericaceae	S	N		X	X			X	X			Moist to wet forests and meadows; valleys to subalpine
Lambsquarters	*Chenopodium album*	Chenopodiaceae	F	N, I				X	X	X		X	X	Disturbed soils of roadsides, fields, rangeland, pastures
Larkspur, low	*Delphinium bicolor, D. nuttallianum, D. geyeri,* and others	Ranunculaceae	F	N			X	X	X	X				Grasslands, sagebrush steppe, open forest or woodland, rocky ridges
Larkspur, tall	*Delphinium barbeyi, D. occidentale, D glaucum,* and others	Ranunculaceae	F	N		X	X				X			Deep, moist soils, mountain meadows, aspen stands, along streams or around seeps and springs

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Table 3, (cont.)

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Laurel	*Kalmia polifolia, K. microphylla*	Ericaceae	S	N		X					X			Moist meadows and forests, bogs, around lakes; up to alpine
Leafy spurge	*Euphorbia esula*	Euphorbiaceae	F	I	B		X	X	X	X	X		X	Grasslands, meadows, woodlands, riparian forest, pastures and prairies
Locoweed	*Oxytropis sericea, O. lambertii,* and others	Fabaceae	F	N			X	X	X	X				Grasslands with well-drained soil, rangeland, sagebrush steppe, dry woodlands, pastures, and exposed ridges at all elevations
Lupine	*Lupinus sericeus, L. caudatus, L. leucophyllus, L. argenteus, L. plattensis, L. polyphyllus, L. pusillus,* and others	Fabaceae	F	N		X	X	X	X	X	X			Many species of lupine in MT and WY; not all are poisonous; Species listed are most commonly cited for toxins; varied habitat from dry, sandy soil of grasslands, sagebrush steppe, streambanks, moist meadows, dry, open forest, woodlands; all elevations
Mallow, common	*Malva neglecta*	Malvaceae	F	I						X		X	X	Disturbed pastures, barnyards, waste areas
Matrimony vine	*Lycium barbarum*	Solanaceae	S	I						X		X	X	Fields, roadsides, farmsteads, waste areas
Milkvetch	*Astragalus* spp. (not *A. cicer)*	Fabaceae	F	N		X	X	X	X	X	X			Many species in MT and WY vary in habitat and toxicity; Stony, moist soil of grasslands, sagebrush steppe, alkaline meadows, gravel bars, thickets, near wetlands or streams, open forest, limestone-derived soil, clay soil; all elevations
Milkweed	*Asclepias* spp.	Asclepiadaceae	F	N					X	X	X	X	X	Meadows, streambanks, grasslands, badlands, pine woodlands, fields, roadsides, ditches, marshes, prairie potholes
Millet	*Pennisetum glaucum*	Poaceae	G	I								X		Cultivated
Monkshood	*Aconitum columbianum*	Ranunculaceae	F	N		X	X				X			Moist to wet meadows, open moist forest, along streams; up to subalpine
Mountain mahogany, curl-leaf and true	*Cercocarpus ledifolius, C. montanus*	Rosaceae	S	N		X	X	X						Stony slopes, cliffs, rock outcrops, on limestone or sandstone, open pine forest
Nightshade	*Solanum* spp.	Solanaceae	F	N, I					X	X	X	X	X	Riparian forests, woodlands, thickets, grasslands, pastures, along streams, disturbed soils, ditches, roadsides, fences, farmyards, cultivated field edge
Onion	*Allium* spp.	Liliaceae	F	N		X	X	X	X	X	X			Many species in MT and WY that vary in habitat; grasslands, sagebrush steppe, open forest, meadows, woodlands, thickets, riparian areas, rock outcrops; all elevations

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Table 3, (cont.)

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Penstemon	*Penstemon* spp.	Scrophulariaceae	F	N		X	X	X	X	X			X	Sandy, rocky or well-drained soil; grasslands, sagebrush steppe, rock outcrops, open forest and woodlands, roadcuts, meadows; all elevations
Pheasant's eye	*Adonis aestivalis*	Ranunculaceae	F	I								X	X	Escaped ornamental plant, weed in cultivated fields, pastures, roadsides
Pine, ponderosa	*Pinus ponderosa*	Pinaceae	T	N		X	X		X	X				Drier forests, rocky exposures associated with grasslands
Princesplume	*Stanleya pinnata*	Brassicaceae	F	N				X	X	X	X			Clay soil and dry, selenium-rich soil on open slopes, barren hills and flats, streambanks, badlands
Puncturevine	*Tribulus terrestris*	Zygophyllaceae	F	I						X	X		X	Dry, sandy or gravelly soil of streambanks, pastures, roadsides, waste areas
Purslane	*Portulaca oleracea*	Portulacaceae	F	I								X	X	Rich disturbed soil of farmyards, waste areas, cultivated fields
Redroot pigweed	*Amaranthus retroflexus*	Chenopodiaceae	F	N					X	X	X	X	X	Cultivated fields, roadsides, streambanks, waste areas
Reed canarygrass	*Phalaris arundinacea*	Poaceae	G	I					X	X	X			Streambanks, ditch banks, wetlands, mostly at lower to middle elevations.
Ryegrass, perennial	*Lolium perenne*	Poaceae	G	I									X	Disturbed sites, roadsides, trail sides, and newly planted lawns
Sage, lanceleaf	*Salvia reflexa*	Lamiaceae	F	N					X	X		X	X	Disturbed areas, roadsides, fields, pastures, and waste areas
Sage, sand and fringed sage	*Artemisia filifolia, A. frigida*	Asteraceae	S	N				X	X	X				Many species in MT and WY that vary in habitat; Stony or sandy soils of grasslands, sagebrush steppe, open meadows, coniferous woodlands
Sagebrush, big	*Artemisia tridentata*	Asteraceae	S	N		X	X	X	X	X	X			Deep soils of sagebrush steppe, steep open slopes, dry plains and hillsides; valleys to subalpine
Sagewort, green and white	*Artemisia dracunculus, A. ludoviciana*	Asteraceae	F	N		X	X	X	X	X	X		X	Grasslands, meadows, sagebrush steppe, streambanks, roadsides, talus slopes
Saltbush	*Atriplex* spp.	Chenopodiaceae	S	N		X	X	X	X	X				Usually on alkaline or saline soil of sagebrush steppe, grasslands, badlands
Scotch broom	*Cytisus scoparius*	Fabaceae	S	I	M					X			X	Moist roadsides
Scrambled eggs	*Corydalis aurea*	Fumariaceae	F	N		X	X	X		X	X			Moist, open forests, disturbed areas; valleys to subalpine
Serviceberry	*Amelanchier alnifolia*	Rosaceae	S	N		X	X	X	X	X	X			Moist to dry forests, grasslands, meadows, woodlands, streambanks, avalanche slopes; valleys to lower subalpine
Snakeweed	*Gutierrezia sarothrae*	Asteraceae	F	N		X	X	X	X	X				Sagebrush steppe, grasslands, juniper woodlands, badlands, pastures; valleys to subalpine

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Table 3, (cont.)

Plant Species	Scientific Name(s)	Plant Family	Lifeform[1]	Native[2]	Noxious[3]	Habitat								Habitat Description
						Mountains	Foothills	Shrubland	Plains	Valleys	Wet Areas	Cropland	Disturbed	
Sneezeweed	*Hymenoxys hoopesii*	Asteraceae	F	N		X								Moist slopes and well-drained meadows; up to subalpine
Sorghums, forage, grain, sorghum-sudangrass, sudangrass	*Sorghum bicolor, S. x drummondii, S. bicolor* var. *sudanense*	Poaceae	G	I								X		Cultivated, rarely escaping
Sorrel	*Oxalis* spp.	Oxalidaceae	F	N, I					X	X	X	X	X	Open forests, prairies, fields, streambanks, waste areas
St. Johnswort	*Hypericum perforatum*	Clusiaceae	F	I	B	X	X			X			X	Grassland, open forest, pastures, meadows, roadsides, disturbed areas
Suckleya, poison	*Suckleya suckleyana*	Chenopodiaceae	F	N					X			X	X	Sparsely vegetated soil of receding lakes and ponds or flood areas, cultivated fields
Sunflower	*Helianthus* spp.	Asteraceae	F	N, I					X	X	X	X	X	Disturbed soil of fields, grasslands, rangeland, streambanks, wet meadows, thickets, roadsides, cultivated fields
Sweetclover, yellow and white	*Melilotus officinalis*	Fabaceae	F	I					X	X	X	X	X	Roadsides, fields, streambanks, grasslands, rangeland, open slopes in badlands
Sweetpea	*Lathyrus* spp.	Fabaceae	F	N		X	X			X		X	X	Roadsides, fields, thickets, meadows, moist areas, open aspen or pine forest
Tansy, common	*Tanacetum vulgare*	Asteraceae	F	I	B				X	X	X		X	Moist disturbed meadows, along streams and ditches
Tansy mustard	*Descurainia pinnata*	Brassicaceae	F	N		X	X	X	X	X		X		Grasslands, cultivated fields, roadsides, waste areas
Tansy ragwort	*Senecio jacobaea*	Asteraceae	F	I	M	X				X			X	Disturbed soil of open forest, meadows, pastures, often associated with timber harvest or fire
Teff	*Eragrostis tef*	Poaceae	G	I								X		Cultivated, rarely escaping
Thistle, Canada	*Cirsium arvense*	Asteraceae	F	I	B	X	X		X	X	X	X	X	Moist disturbed soils of fields, meadows, thickets, roadsides, woodlands, open forest, streambanks, wetlands
Thistle, Russian	*Salsola tragus*	Asteraceae	F	I					X	X		X	X	Dry disturbed soils of roadsides, cultivated fields, dry lake beds, waste areas
Tobacco, coyote	*Nicotiana attenuata*	Solanaceae	F	N			X		X	X	X		X	Sandy or gravelly soil of streambanks, hills, railroad right-of-way, waste areas
Vetch, hairy	*Vicia villosa*	Fabaceae	F	I						X		X	X	Roadsides, cultivated fields, grasslands
Whitetop	*Cardaria draba*	Brassicaceae	F	I	B	X	X	X	X	X	X	X	X	Fields, roadsides, streambanks
Yellow starthistle	*Centaurea solstitialis*	Asteraceae	F	I	B		X	X		X		X	X	Fields, grasslands, roadsides, disturbed areas
Yew	*Taxus brevifolia*	Taxaceae	S	N		X	X			X	X			Wet forest, humid environments, usually on acid soils

[1] G = grass / graminoid / grass-like, F = forb / broadleaf plant, S = shrub, T = tree

[2] N = Native, I = Introduced to Montana and Wyoming

[3] State-listed noxious weed in Montana (M), Wyoming (W), or both (B).

Resources and References

Carlson, M. and B. Anderson. 2013. Cyanide Poisoning, University of Nebraska Lincoln Extension NebGuide G2184, Lincoln, NE. Available at: http://extensionpubs.unl.edu/

Cornell University. 2007. Brown midrib sorghum sudangrass: successfully growing a high energy grass for dairy cows. Cornell University Cooperative Extension, Agronomy Fact Sheet Series 14, Ithaca, NY. Available at: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet14.pdf

Dorn, R.D. 2001. Vascular Plants of Wyoming. Mountain West Publishing, Cheyenne, WY.

Drewnoski, M., B. Anderson, P. Kononoff, and B. Reynolds. 2019. Nitrates in Livestock Feeding. University of Nebraska Extension NebGuide G1779, Lincoln, NE. Available at: http://extensionpubs.unl.edu/

Forero, L., G. Nadar, A. Craigmill, J. DiTomaso, B. Puschner, and J. Maas. 2010. Livestock-Poisoning Plants of California. University of California Agricultural and Natural Resources Publication 8398, Davis, CA. Available at: https://anrcatalog.ucanr.edu/

Gadberry, S. and J. Jennings. 2016. Nitrate Poisoning in Cattle. University of Arkansas Division of Agriculture Research and Extension, FSA3024, Little Rock, AR. Available at: https://www.uaex.edu/publications/

Glunk, E., K. Olson-Rutz, M. King, D. Wichman, and C. Jones. 2015. Nitrate Toxicity of Montana Forages. Montana State University Extension MontGuide MT200205AG, Bozeman, MT. Available at: https://store.msuextension.org/

Green, B.T., K.D. Welch, J.A. Pfister, C.G. Chitko-McKown, D.R. Gardner, and K.E. Panter. 2014. Mitigation of larkspur poisoning on rangelands through the selection of cattle. Rangelands 36(1):10-15.

Green, B.T., D.R. Gardner, D. Cook, J.A. Pfister, K.D. Welch, and J.W. Keele. 2018. Age-dependent intoxication by larkspur (*Delphinium*) in Angus steers. Toxicon 152:57-59.

James, L.F., D.B. Nielsen, and K.E. Panter. 1992. Impact of poisonous plant on the livestock industry. Journal of Range Management 45(1):3-8.

Knight, A.P. and R.G. Walter. 2001. A Guide to Plant Poisoning of Animals in North America. International Veterinary Information Service, Ithaca, NY.

Leininger, W., J. Taylor, and C. Wambolt. 1977. Poisonous Range Plants of Montana. Montana State University Cooperative Extension Service Bulletin 348. Montana State University, Bozeman, MT.

Lesica, P. 2012. Manual of Montana Vascular Plants. Brit Press, Fort Worth, TX.

Majak, W., B. Brooke, and R. Ogilvie. 2008. Stock-poisoning Plants of Western Canada. Government of Canada, Agriculture Canada.

Montana Department of Agriculture. 2019. Montana state-listed noxious weeds. Montana Department of Agriculture, Noxious Weeds Program, Helena, MT. Available at: https://agr.mt.gov/Weeds

Montana State University, Schutter Diagnostic Lab, 119 Plant BioScience Building, P.O. Box 173150, Bozeman, MT 59715-3150. (406) 994-5150 plantid@montana.edu Website: http://diagnostics.montana.edu/

Panter, K., M.H. Ralphs, J. Pfister, D. Gardner, B. Stegelmeier, S. Lee, K. Welch, B. Green, T. Davis, and D. Cook. 2011. Plants Poisonous to Livestock in the Western States. U.S. Department of Agriculture, Agricultural Research Service, Agriculture Bulletin 415, Logan, UT. Available at: https://www.ars.usda.gov/is/np/PoisonousPlants/PoisonousPlants.pdf

Pokorny, M. and J. Mangold. 2020. Montana's Noxious Weeds. Montana State University Extension Service EB0159, Bozeman, MT. Available at: https://store.msuextension.org/

Sallenave, R. 2016. Water quality for livestock and poultry. New Mexico State University Cooperative Extension Service, Guide M-112, Las Cruces, NM. Available at: aces.nmsu.edu/pubs/_m/M112.pdf

Smith, M., J. Waggoner, and S. Sims. 2010. Larkspur: Managing grazing to avoid poisoning cattle. University of Wyoming Range Facts MP-111.13, Laramie, WY. Available at: http://www.wyoextension.org/publications/

Stonecipher C.A., D. Cook, K.D. Welch, D.R. Gardner DR, and J.A. Pfister. 2020. Seasonal variation in toxic steroidal alkaloids of foothill deathcamas (*Zigadenus paniculatus*). Biochemical Systematics and Ecology 90:104044.

Stonecipher C.A., K.D. Welch, S.T. Lee, D. Cook, and J.A. Pfister. 2020. Geographical and seasonal variation in water hemlock (*Cicuta maculata*) toxins. Biochemical Systematics and Ecology 89: 104012.

Stubbendieck, J., M. Carlson, C. Dunn, B. Anderson, and D. Redfearn. 2018. Nebraska Plants Toxic to Livestock, Including Bloat-Causing Plants, Rangeland, Pastureland, and Cropland. University of Nebraska Extension EC3037, Lincoln, NE. Available at: https://extensionpubs.unl.edu/

Taylor, J. E. and J. R. Lacey. 2004. Range Plants of Montana. Montana State University Extension Service Bulletin EB 122, Bozeman, MT. Available at: https://store.msuextension.org/

Texas A&M University. 2019. Plants of Texas Rangelands: Virtual Herbarium. Texas A&M AgriLife Extension System, Department of Ecosystem Science and Management, College Station, TX. Available at: https://rangeplants.tamu.edu/common-name-index/

USDA, NRCS. 2020. Cover Crops. Agronomy Technical Note MT-93. USDA-NRCS, Bozeman State Office, Bozeman, MT. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/mt/home/

USDA, NRCS. 2019. The PLANTS Database. National Plant Data Team, Greensboro, NC 27401-4901 USA. Available at: http://plants.usda.gov

Voss, J.L. 2019. Guide to Poisonous Plants. Colorado State University, College of Veterinary Medicine and Biomedical Sciences, Fort Collins, CO. Available at: https://csuvth.colostate.edu/poisonous_plants

Weathers, Shirley A. 1998. Field Guide to Plants Poisonous to Livestock: Western U.S. Rosebud Press, Fruitland, UT.

Whitson, T., L. Burrill, S. Dewey, D. Cudney, B. Nelson, R. Lee, and R. Parker. 2002. Weeds of the West. The Western Society of Weed Science, Newark, CA.

Wyoming Department of Agriculture. 2018. Wyoming state designated noxious weeds, Wyoming Department of Agriculture, Weed and Pest Program, Cheyenne, WY. Available at: http://wyagric.state.wy.us/divisions/ts/sections-a-programs/weed-a-pest

Glossary

Acute poisoning – Adverse effects from a substance resulting either from a single exposure or from multiple exposures in a short period of time.

Alkaloid – Naturally occurring basic, organic, nitrogenous compounds.

Anemia – Deficiency of red blood cells or hemoglobin in the blood.

Ataxia – Loss of full control of bodily movements.

Bloat – A disease in livestock characterized by an accumulation of gas in the stomach. To make or become swollen with fluid or gas.

Cannabinoids –Psychoactive chemicals, obtained from plants of the Cannabis genus, that have toxic effects on the nervous system.

Chronic poisoning – Adverse effects from a substance result of a long-term exposure when toxins accumulate over time and damage is permanent.

Cicutoxin – An unsaturated alcohol which acts on the central nervous stimulant.

Colic – Severe, often fluctuating pain in the abdomen caused by intestinal gas or obstruction in the intestines.

Congenital – Existing at birth, but not hereditary.

Cotyledon – An embryonic leaf in seed-bearing plants, one or more of which are the first leaves to appear from a germinating seed.

Cyanosis – Blue coloring of the lining of the mouth.

Cystitis – Inflammation of the bladder.

Dicoumarol – Toxic product synthesized from coumarin in moldy sweetclover.

DDMP – A complex compound (2,3-dihydro-3,5-dihydroxy-6-(H) -pyran-4-) that inhibits the dopamine transporter system of the brain affecting cranial nerves.

Edema – Excess of watery fluid collecting in the cavities or tissues of the body.

Endophyte – An organism, often fungi or bacteria, living within a plant between living plant cells. The relationship with the plant varies from symbiotic to bordering on pathogenic.

Fetal mummification – Shriveling or shrinkage of fetus by absorbing all fluid of fetus and uterus.

Forb – A broad-leaved herbaceous plant.

Furanocoumarins – Organic chemical compounds associated with photosensitivity through ingestion and direct contact with the skin. When the phytochemicals enter the nucleus of epithelial cells and form a bond with the DNA, it causes the cells to die resulting in the skin being unable to protect itself from sunlight.

Gallic Acid – A substance, occurring in a free state or combined as gallotannin, causing skin and mucosal irritation.

Glycoside – Any group of organic compounds occurring within plants that produce sugars and related substances upon hydrolysis.

Hemolysis – Rupture or destruction of red blood cells.

Hepatic – Relating to, affecting, associated with, supplying or draining the liver.

Hepatopathy – An abnormal or diseased state of the liver.

Hydrogen cyanide (HCN) – (also known as prussic acid) Extremely toxic, volatile, rapidly acting poison that inactivates cellular respiration by depriving cells of oxygen.

Hypericin – A phototoxin contained in pigment glands that fluoresce in the presence of sunlight and causes acute inflammation and necrosis of cells of the skin capillaries. Only white or unpigmented skin areas are affected. These areas itch and become red, swollen, and sore, and the skin may peel or come off in large sheets (photosensitization).

Hypertonic muscle – Too much muscle tone so that areas are stiff and difficult to move.

Irisin – A toxin chemical found in Iris rhizomes which can cause abdominal pain, burning sensation of the mouth and throat, and vomiting if ingested and mild skin irritation upon skin exposure.

Integumentary – The outer protective layer of an animal or plant. The integumentary system comprises the skin and its appendages (hair, hooves) which protect the body from damage.

Isocupressic acid –A diterpene acid that interferes with blood flow to the uterus and can induce abortion in cattle in the last three months of pregnancy.

Jaundice – Yellowing of the skin or whites of the eyes, caused by obstruction of the bile duct, liver disease, or excessive breakdown of red blood cells.

Laminitis – Inflammation of the sensitive layers of tissue inside the hoof in horses and other animals. It can cause extreme lameness.

Monoterpene – A class of terpenes produced in plants that often have a strong odor and may protect the plants.

Mycotoxin – A toxin produced by a fungus. Major classes of mycotoxins include aflatoxins, trichothecenes, fumonisins, zearalenone, ochratoxin, and ergot alkaloids.

Neurotoxic diterpenoid – Toxins, including andromedotoxin and grayanotoxin, present throughout the plant. Symptoms of poisoning include vomiting, depression, hypotension, irregular heartbeat, colic, convulsions, inability to coordinate voluntary muscles and recumbency.

Nitrotoxin – Neurotoxin compounds contained in some milkvetch species that are poisonous to cattle, sheep and horses with cattle being the most commonly affected. Symptoms of nitrotoxin poisoning include weakness (staggered gait, clicking of hooves while walking), ataxia, muscle tremors, depression, recumbency and death.

Oxalate – Poisonous salt of dibasic acid.

Petechial hemorrhage – Tiny pinpoint red mark caused when the body is deprived of oxygen.

Photophobia – Extreme sensitivity to light.

Photosensitivity – Light sensitivity causing abnormal skin reaction to direct sunlight exposure.

Photosensitization – Sensitization of the skin to light. The development of an abnormal capacity to react to sunlight typically by edematous swelling and dermatitis.

Plains – Plains and valleys are the lowest elevation habitat in a given area. Plains are influenced by the Great Plains which generally have more growing season precipitation than valleys.

Poison – A substance that can cause the illness or death of a living organism when introduced or absorbed. Synonym: toxin; Adjective: poisonous.

Prostration – Lying stretched out on the ground.

Prussic acid – (also known as hydrogen cyanide) Extremely toxic, volatile, rapidly acting poison that inactivates cellular respiration by depriving cells of oxygen.

Rectal prolapse – Rectal walls have prolapsed to a degree where they protrude out the anus and are visible outside the body.

Recumbency – Laying down, unable to walk or remain standing.

Renal – Relating to the kidneys.

Rumen stasis – Collapse of ruminal function, cessation of normal rhythmic contractions for more than two minutes.

Selenium – An essential trace nutrient for animals. In certain plants it accumulates to levels that are toxic to livestock when those plants are growing in selenium-rich soils.

Sesquiterpene lactone – A terpene (sesquiterpene) containing a lactone ring. It can cause allergenic (irritate eyes, nose, gastrointestinal tracts) or neurotoxic (necrosis or death of neural tissue) effects.

Sulfate – A salt or ester of sulfuric acid. Animals consuming plants with high levels of sulfate will reduce sulfate to hydrogen sulfide in the rumen resulting in degenerative changes in the brain causing depression, blindness or death.

Tannic acid – A form of tannin that is a weak acid and a type of polyphenol found in some plants.

Tannin – A bitter-tasting organic substance present in some galls, barks, and other plant tissue.

Teratogen – A chemical or agent (e.g. alkaloid) which crosses the placenta and interferes with embryo or fetus development producing an embryonic or fetal defect. Extent of the defect depends on the teratogen and the stage of development.

Tetany – A stimulated neuromuscular activity caused by deficiencies of calcium and/or magnesium.

Tetradymol – A sesquiterpene that is a liver toxin.

Thiaminase – An enzyme that produces thiamin (vitamin B1) deficiency in livestock by destroying ingested thiamine after ingestion and reducing thiamine availability. Thiamin deficiency results in retinal degeneration, blindness, depression, weight loss, and hemorrhaging syndrome.

Thujone – A ketone and monoterpene, which occurs naturally, has a menthol odor, and may cause effects resembling epilepsy.

Toxin – A substance produced by a living organism that is poisonous to another living organism. Synonym: poison; Adjective: toxic.

Valley – Valley and plains are the lowest elevation habitats in a given area. Valleys are generally in mountainous areas and rain-shadows.