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Poisonous Plants on Rangelands

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Introduction

Poisonous, or toxic, plants contain compounds that may cause death, reproductive problems, birth defects, neurological, digestive, or physiological disorders in livestock. Poisonous plants are a major economic loss to the livestock industry every year, and can affect three to five percent of cattle, sheep, goats, and horses (Panter et al., 2011). In 1991, poisonous plants caused an estimated $340 million in losses, which is equivalent to approximately $580 million in 2020 (James et al., 2011 and Frisvold, 2020). Locoweed poisoning alone is estimated to cause $100 million in losses annually (Cook et al., 2009). The economic impact of poisonous plants of livestock can both direct and indirect losses (Panter et al., 2011). Direct losses are effects on animals and include death, abortions, birth defects, decreased fertility, and decreased organ function. Indirect losses are management costs and include increased medical treatments, decreased land values, lost time to increased management, and increased feed requirements.

These toxins in vegetation are often called secondary compounds and are made by plants in response to grazing, microbes, other plants (allelopathy), or environmental stresses. Poisonous plants are grouped according to their primary type of poison. The more common types of poisons include:

1. Alkaloids
2. Glycosides
3. Organic acids
4. Resins
5. Phytotoxins
6. Minerals
7. Miscellaneous unknown poisons

Identifying poisonous plants is complex due to environmental interactions. Growth state, ecological site, weather, and plant part can all modify toxicity and are all species specific. Aside from environmental issues, animal factors also add to the complexity. Age, experience, body condition, diet selection, and kind/class of animal also play a role in the presence and magnitude of poisoning.

Alkaloids

Alkaloids are complex compounds containing Nitrogen that form salts with acids. In most cases poisonous alkaloids produce a strong physiological reaction in animals, primarily through the nervous system. These poisons may produce violent acute or chronic reactions. Symptoms include nervous disorders, bloating, difficulty breathing, trembling muscles, intoxication, and salivation. Poisoning can lead to death; however, animals can recover if a lethal dose is not eaten (Knight and Walter, 2001).

Alkaloids are found in a wide variety of plants, including desert tobacco (*Nicotiana obtusifolia*; Photo 1). Nicotine is the poisonous principle in this plant and although it is unpalatable to livestock it is an agricultural weed that may accidentally end up in hay. A lethal dose is approximately 2% of the animal's weight.

Photo 1. Desert tobacco (*Nicotiana obtusifolia*) Max Licher

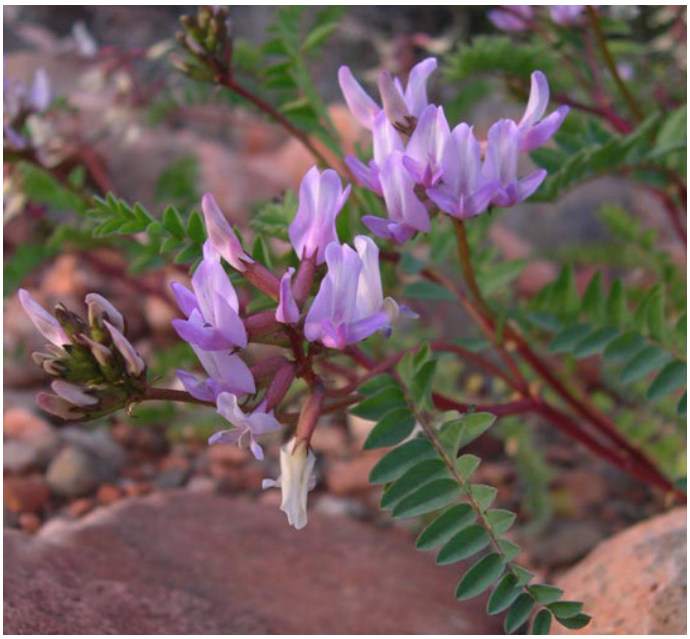

Photo 2. Freckled milk vetch *Astragalus lentiginosus*) Max Licher

Photo 4. Copperweed (*Oxytenia acerosa*) Max Licher

Locoweeds (*Astragalus* and *Oxytropis* genera) contain poisonous alkaloids which cause typical "loco" poisoning (Photo 2). Nearly 100 different species occur in these genera in Arizona but not all are poisonous. If the species of locoweed is poisonous, all plant parts are toxic in all stages of growth, even when dry. Consumption of locoweed by cattle, depending on the species, can cause immediate death or chronic poisoning leading to general staggering and eventual death.

Threadleaf groundsel (*Senecio flaccidus*) is toxic to animals through a number of different alkaloid compounds (Photo 3). Cattle and horses are sensitive to groundsel poisoning while sheep and goats are not. Often, a vitamin A-fortified supplement will reduce consumption of the plant.

Copperweed (*Oxytenia acerosa*) plants often grow where moisture is plentiful, and soils are high in salts (Photo 4). This perennial species is high in alkaloids and is poisonous to all livestock. Leaves are most poisonous at maturity.

Deathcamus is a catch-all name for several species that are high in alkaloids and poisonous to livestock, such as foothill deathcamas (Zigadenus paniculatus; Photo 5). Although several kinds of livestock can be affected, sheep are most likely to become ill and die from eating any part of the plant. Larkspur plants likely cause more

Photo 3. Threadleaf groundsel (*Senecio flaccidus*) Max Licher

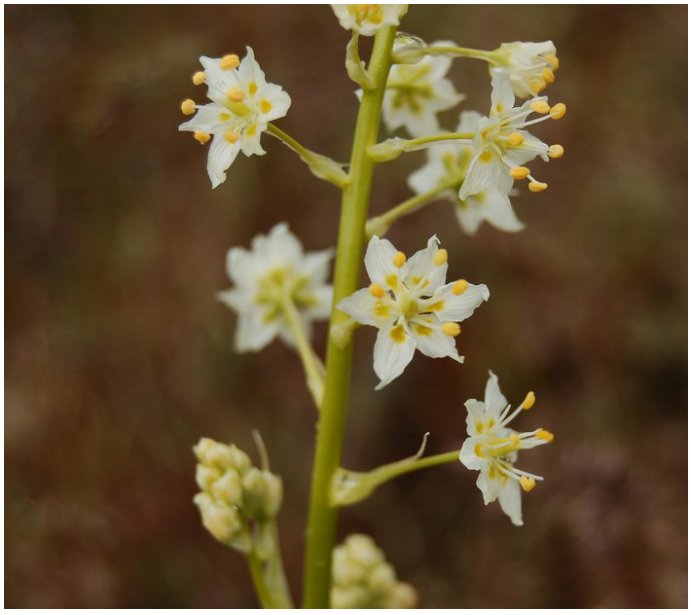

Photo 5. Foothill deathcamas (*Zigadenus paniculatus*) Tony Frates

Photo 6. Tall larkspur (*Delphinium barbeyi*) Max Licher

Photo 7. Johnson grass (*Sorghum halepense*) Max Licher

cattle losses in the western states than any other poisonous plant. There are several species of larkspur in Arizona, including tall larkspur (*Delphinium barbeyi*; Photo 6) and two lobedlarkspur (*Delphinium nuttallianium*; Photo 6). Alkaloids in larkspurs affect the respiratory system. New growth on leaves and flowers and seeds have the highest alkaloid concentration, and plants are less poisonous as they mature.

Glycosides

Poisonous glycosides produce several compounds. Hydrocyanic acid (HCN), also called prussic acid, is the most common. Animals poisoned by HCN die of asphyxiation because HCN blocks the release of oxygen from red blood cells to tissue cells. Symptoms include weakened animals that foam at the mouth and if a sample of blood is collected it will be bright red (Allison et al., 2016). Cattle are most susceptible and upon absorption of a toxic dosage of HCN, death may occur in as little time as a few minutes to approximately an hour (Panter et al., 2011).

HCN producing plants in Arizona include Johnson grass (*Sorghum halepense*; Photo 7). Danger from HCN poisoning in Johnson grass is greatest when plants have been exposed to drought or frost and during periods of rapid plant growth. Chokecherry (*Prunus virginiana*), contains HCN which accumulates during drought or frost (Photo 8). Chokecherry can also poison animals when large amounts of leaves and stems are eaten during a short amount of time.

Photo 8. Chokecherry (*Prunus virginiana*) Max Licher

Cardiac glycosides affect the cardiovascular system by slowing heart rate but intensifying heartbeat (Allison et al., 2016). Cardiac glycosides cause hemorrhaging, abdominal pain, and diarrhea (Knight and Walter, 2001). Broadleaf milkweed (*Asclepias latifolia*), horsetail milkweed (*A. subverticillata*), and orange sneezeweed (*Hymenoxys hoopseii*) all contain cardiac glycosides (Photos 9 and 10). Oleander (*Nerium oleander*) a common ornamental shrub also contains cardiac glycosides, while this plant rarely grows on native rangelands there have been cases of poisoning due to dumped yard waste on public lands.

Photo 9. Broadleaf milkweed (*Asclepias latifolia*) Max Licher

Photo 10. Orange sneezeweed (*Hymenoxys hoopseii*) Max Licher

Oxalic acid is the most common poison in the organic acid group. This acid often produces colic, coma, and eventually death due to kidney failure. Rumen microflora may become adapted to low levels of oxalates over a period of several days. Poisoning occurs when non-adapted animals consume large amounts of the plant (Knight and Walter, 2001). Animal losses due to high levels of oxalates are often more common in sheep. High calcium diets seem to prevent oxalic acid poisoning.

Photo 11. Greasewood (*Sarcobatus vermiculatus*) Gregory Gust

Greasewood (*Sarcobatus vermiculatus*) and Russian thistle (*Salsola tragus*) contain oxalic acid (Photo 11). Dock (*Rumex crispus*) contains oxalic acid, in which concentrations increases as the plant matures (Photo 12). Many oaks, including Gambel oak (*Quercus gambelii*) and Shinnery oak (*Quercus havardii*) contain a related organic acid, tannic acid, which is also poisonous but probably causes most economic losses through reducing herd reproductivity.

Photo 12. Dock (*Rumex crispus*) Russ Kleinman and Karen Blisard

Resins

Resins and resinoids affect both nerve and muscular tissues. The symptoms of resin poisoning are varied. Milkweed (*Asclepias*) and spurge (*Euphorbia*) genera are examples of poisonous plants containing poisonous resins.

Whorled milkweed (*Asclepias verticillata*) contains poisonous glycosides and resins which are partially retained in the plant after it is dry. This makes milkweed poisonous at all stages of growth, even after maturity. Whorled milkweed is a common agriculture weed that is accidentally baled in hay.

Minerals

Several minerals cause poisoning in livestock through plant consumption. In Arizona, nitrogen and selenium are the primary minerals of concern.

Nitrates

High nitrate levels in plants commonly poison livestock on both range and cropland. Many plants naturally accumulate nitrates within their tissues but when levels surpass 1.5% nitrates dry weight, plants are more likely to be lethal to livestock (Panter et al., 2011). Losses most frequently occur during drought or frost, after heavy application of Nitrogen (N) fertilizer and on soils high in N. When nitrites are absorbed into the bloodstream, they bind with hemoglobin, which prevents animals from being able to uptake oxygen and eventually suffocates them. Symptoms of nitrate poisoning include blue membranes, excessive urination and salivation, difficulty breathing and brown blood color.

Horses and pigs are less likely than ruminants to be poisoned by plants high in nitrate because they cannot easily convert nitrate to nitrite in the digestive systems (Knight and Walter, 2001). Cattle are more frequently poisoned than other animals. Nitrates can cause abortions in cattle even at low, non-lethal amounts. Death is relatively rapid once enough plant material with high nitrate content is consumed, but symptoms can be treated with methylene blue.

Species that may accumulate poisonous concentrations of nitrate are numerous and include carelessweed or pigweed (*Amaranthus palmeri*), London rocket (*Sisymbrium irio*), tansy mustard (*Descurainia pinnata*) and Russian thistle (*Salsola tragusa*; Photos 13, 14, and 15, respectively). All four of these species are common agricultural weeds in Arizona and can accidentally be harvested and baled with hay Filaree (*Erodium cicutarium*), which is a valuable forage plant, occasionally develops high concentration of nitrates during periods of rapid growth.

Photo 13. Pigweed (*Amaranthus palmeri*) Max Licher

Photo 14. London rocket (*Sisymbrium irio*) Max Licher

Photo 15. Tansy mustard (*Descurainia pinnata*) Max Licher

Selenium

Plants growing on soils containing over two parts per million (ppm) of selenium may accumulate poisonous levels of this mineral. There are two types of plants that accumulate selenium: obligate species and facultative species. Obligate species are plants which require selenium for growth and are indicators of selenium-bearing soils. Facultative selenium absorbers are plants that will accumulate selenium but are not limited to growing in soils containing selenium. Snakeweed (*Guterrezia sarothrae*), and southern goldenbush (*Isocoma pluriflora*), and four-wing saltbush (*Atriplex canescens*) are facultative selenium absorbers (Photos 16,17, and 18).

Photo 16. Snakeweed (*Guterrezia sarothrae*)

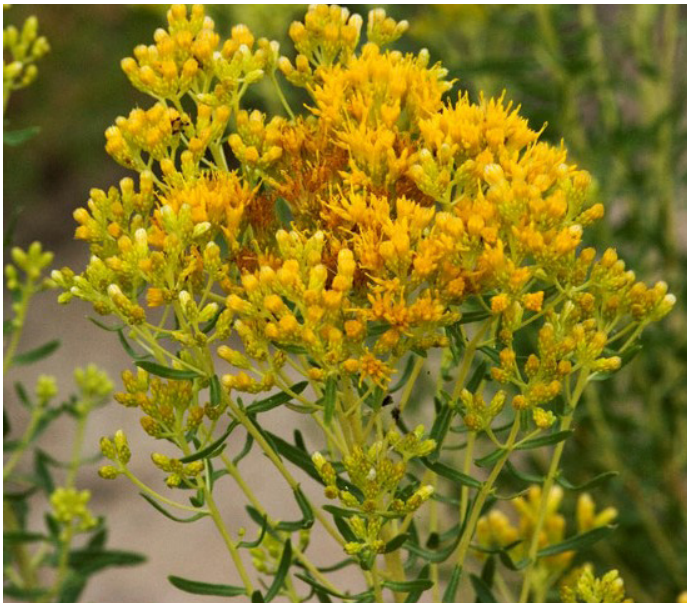

Photo 17. Southern goldenbush (*Isocoma pluriflora*) Patrick Alexander

Photo 18. Four-wing saltbush (*Atriplex canescens*) Max Licher

Consumption of these plants by livestock can cause acute or chronic poisoning. Symptoms include lack of appetite, difficulty breathing, thirst, frequent urination, depression, and collapse (Allison et al., 2016). Chronic selenium intoxication occurs in one or two forms, blind staggers or alkali disease. Blind staggers is caused by selenium consumption of plants containing less than 200 ppm of selenium for one or two weeks. This type of poisoning causes aimless wandering/stumbling over objects that can easily be avoided. Alkali disease develops after consumption of usually cultivated plants containing five to 40 ppm of selenium for periods of up to a month or longer. Alkali disease causes severe lameness due to hoof deformity and erosion of the joints (Knight and Walter, 2001). Other symptoms include mane and tail hair falling out, starvation, and thirst; the latter two will eventually cause death (Knight and Walter, 2001).

Grass Tetany

Grass tetany or grass staggers is a nutritional disease resulting from an imbalance of magnesium and potassium. The most common occurrence of tetany is during the first weeks of spring when grass is rapidly growing. If grass has a high concentration of potassium and low concentration of magnesium, and livestock are not able to mobilize magnesium stores from their bones, they may develop tetany. Grass tetany generally affects mature cattle and is most common in the ten-week period after calving (Allison et al., 2016). Symptoms include, twitching of the face, ear and body, cessation of grazing, staggering, erratic actions, and more flighty actions than normal (Allison et al., 2016).

Tetany can be prevented by providing a high magnesium supplement during the early spring. Treatment of affected animals by injection of calcium or magnesium salts can prevent death; however, it is recommended this method should performed by a veterinarian because if injections are administered incorrectly there is a risk of heart failure.

Miscellaneous Poisonous Principles

Numerous other poisonous substances are still being discovered in plants. Tremetol, an alcohol found in burrowed (*Isocoma tenuisecta*) is an example of a miscellaneous poison. All parts of the burroweed plant are poisonous (Photo 19). These plants may also cause milk sickness in calves from drinking the milk of cows grazing them. Lantana (*Lantana camara*), a common ornamental shrub contains triterpenoids which are liver toxins. Leaves and berries contain toxins that can affect not only cattle, sheep, horses but also dogs, cats, rabbits and guinea pigs. Liver failure is most common in cattle. Like oleander, lantana does not grow on rangelands and poisonings occur due to dumped lawn waste.

Photo 19. Burrowed (*Isocoma tenuisecta*) Liz Makings

There are many plant species in the southwest that can cause a range of poisoning symptoms, from general discomfort to death. Many of which are not included here. As such, it is strongly recommended that if an unknown plant is encountered in an area that is to be grazed, the identity of that plant is established prior to allowing livestock to graze. Your Natural Resource Conservation Service Range Conservationist or your local Cooperative Extension Agent are two excellent sources of information. Additional plant identification and poisonous plant resources include:

- http://swbiodiversity.org/seinet/
- https://cals.arizona.edu/yavapaiplants/
- https://plants.usda.gov/java/
- https://www.ars.usda.gov/is/np/PoisonousPlants/PoisonousPlants.pdf
- A Guide to Plant Poisoning of Animals in North America by Anthony Knight and Richard Walter

Preventing Animal Poisoning

When possible, defer grazing when plants are most poisonous to allow desirable forage to grow and to allow poisonous plants to decline in toxicity, if applicable. Early spring is often a dangerous period for poisoning because many poisonous plants start to green up and grow before other desired forage species. However, this is not always the case, for example, tansy mustard (*Descurainia pinnata*) is not poisonous when young but turns poisonous from the time it starts to bloom until the seed pods mature. Larkspur species (*Delphinium*) are highly palatable and poisonous during flowering; mountain mahogany (*Cercocarpus montanus*) is highly poisonous for several weeks after the first frosts. Therefore, knowing which poisonous plants occur in a pasture is key. Livestock should not be placed on seasonal rangelands until desirable forage plants have grown enough to support grazing.

If grazing must occur, use good grazing management practices to reduce or eliminate the chances for plant poisonings. Stocking rates should be flexible to match forage demand with forage supply. Grazing systems which give additional rest to plants during drought are preferred over continuous grazing. Livestock distribution within a pasture becomes even more important during drought situations. Strategic supplemental feeding may help reduce losses from poisonous plants. You may need to supplement in early spring or other times when the quality of range forage is poor to prevent consumption of evergreen or early growing poisonous plants. Supplementing adequate

Photo 20. Mountain mahogany (*Cercocarpus montanus*) Patrick Alexander

Photo 21. Arrowgrass (*Triglochin palustris*) Paul Rothrock

protein and phosphorus may keep animals from seeking out poisonous plants that are high in protein. Vitamin A deficiency, also common on drought stressed rangeland, may alter the grazing habit of the animal and cause it to consume poisonous plants that would not normally be included in their diet. Several dietary additives can potentially ameliorate the adverse effects of tannins or terpenes, including polyethylene glycol (PEG), activated charcoal, and calcium hydroxide. PEG has a high binding affinity for tannins and has been shown to increase intake of tannin rich forage.

Be aware of weather-related poisoning issues, especially in years of above average rainfall, drought, and frost. Above average winter and spring rainfall will usually result in early, rapid growth of spring forbs, many of which are poisonous. During drought, palatable plants may mature rapidly, dry up, leaving poisonous plants as the only green forage available. Some species of poisonous plants also increase their concentration of poison during drought (e.g. Arrowgrass: *Triglochin maritima* and *T. palustris*). Careful observation of livestock grazing habits during drought is critical. Pastures historically overgrazed can cause problems earlier, but even well managed pastures may cultivate poisonous plant. Frost periods may cause some forage to accumulate poisons. If at any time supplemental hay is being provided during inclement weather be careful to not feed hay that contains poisonous plants.

Kind or class of animal grazing in an area may determine degree of animal response to poisoning. Some poisonous plants are equally poisonous to all livestock, while others are more dangerous to certain kind/classes of animals. Here are a few examples:

- Most lupine species (*Lupinus*) are poisonous to sheep, but rarely to horses and cattle.
- Horses are more susceptible to locoweed than cattle or sheep.
- Larkspur effects cattle more than sheep.
- Horses and sheep are more susceptible to halogeton (*Halogeton glomeratus*) than cattle (Photo 22).

Photo 22. Halogeton (*Halogeton glomeratus*) Gordon Scott

- Abortions caused by ingesting ponderosa pine (*Pinus ponderosa*) or snakeweed (*Gutierrezia sarothraeare*) are common in cattle, but rare in sheep or goats.
- Bracken fern (*Pteridium aquilinum*) is poisonous to cattle and horses.
- Cattle may be more susceptible to oak (*Quercus*) poisoning compared to sheep or goats.
- Lactating females are more susceptible to poisoning than other animals.
- Younger animals are more susceptible to poisoning than older animals.

Arizona Livestock Incident Response Team

Arizona Livestock Incident Response Team (ALIRT) is designed to diagnosis numerous unexplained animal deaths likely caused by disease or plant poisoning. The goal is to provide trained first responders to gather data and information for timely diagnosis in order to reduce further livestock losses and help mitigate economic effects and impacts on surviving animals. If an ALIRT response is designated through the Arizona Department of Agriculture State Veterinarian's Office (https://agriculture.az.gov/animals/state-veterinarians-office), the program covers the cost for an ALIRT trained private veterinarian to conduct a ranch visit and investigate an unusual livestock death event. This includes costs for sample collection and laboratory costs for sample analysis. The ALIRT program is **not** intended to respond to normal animal health events or replace normal interactions with a veterinarian. A team response is also **not** available for single animal health problem or poor reproductive performance.

If an unexpected or undetermined animal health, behavior, or death is suspected, contact your veterinarian, an ALIRT veterinarian or local county Cooperative Extension Agent. ALIRT Telephone Numbers: Office of the Arizona State Veterinarian 1-888-742-5334 option 5 or Arizona Veterinary Diagnostic Laboratory 1-520-621-2356. Additional contact information can be found at https://extension.arizona.edu/alirt-incident-reporting.

Summary

In Arizona there are approximately 300 species of poisonous plants. Several different plant species may have the same toxin and show similar symptoms. Individual species can also contain several different toxins which manifest as different symptoms. These factors make diagnosis difficult. Good grazing management is the least expensive and most effective way to reduce the prevalence of poisoning. Knowing which plants are poisonous and how they affect livestock is also a critical step in preventing poisoning. Provide supplemental salt and minerals to maintain animal health, increase food selectivity, and improve animal distribution. Contact a local veterinarian if animals display unusual behavior to prevent or mitigate animal loss from plant poisoning.

Update of *Arizona Ranchers' Management Guide* Russell Gum, George Ruyle, and Richard Rice, Editors. Arizona Cooperative Extension. Originally published 1993 Edited 2000.

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