Management Practices to Minimize Death Losses of Sheep Grazing Halogeton-Infested Range

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Highlight: *Data concerning the ecology of* Halogeton glomeratus *are reviewed. Information collected in a number of experiments in which halogeton was fed to sheep is summarized to formulate a management program for the prevention of halogeton poisoning in sheep.*

Halogeton [*Halogeton glomeratus* (M. Bieb) C. A. Mey.], a poisonous plant introduced into the Intermountain Region nearly 40 years ago, has established a permanent niche for itself in the cold desert vegetation of the region. Physiologically well adapted to the harsh, saline, arid environment of the cold desert, this pioneer annual has secured its place in the intermountain flora through prolific seed production, development of two physiologically different kinds of seeds, and early establishment of seedlings each spring (Cronin, 1965). However, halogeton cannot compete successfully with established perennials nor can it establish enduring dominance in vegetation on the more mesic and less saline sites (Tisdale and Zappetini, 1953).

Halogeton produces more than 70 seeds per inch of stem. Approximately one-third are brown seeds, produced during the early part of the flowering period. A low rate of germination helps brown seeds survive 10 or more years in the soil. After about the middle of August, the plant produces black seeds. These seeds germinate early in the spring, and they germinate rapidly after the onset of favorable environmental conditions. Survival of black seeds for more than a year in the field remains highly questionable. Rapid germination of black seed early in the spring provides halogeton seedlings with a competitive advantage over seedlings of most other species. The long-lived but slowly germinating brown seeds provide the species with a mechanism for surviving adverse periods of low seed production, low seedling survival, or both (Cronin, 1965).

Most of the dense stands of halogeton grow on physiologically dry saline soils. On these soils, halogeton challenges our present control methods and defies our efforts to eradicate it. Treatments with herbicides may temporarily suppress halogeton, but it is the pioneer reinvading the site when the toxicity of the herbicide disappears. Treatment with certain herbicides such as 2,4-D injures the perennial shrubs and increases the space likely to be invaded by halogeton (Cronin, 1960).

The prospects of improving the density or production of forage on these saline soils through grazing management are not fully understood. However, as much as 20 years' total protection from grazing has failed to produce any significant changes in the vegetation in some areas, but some improvement seems to be being made in other areas.

Reseeding with perennial grasses has been used successfully to control halogeton. However, the effectiveness of reseeding has been limited to the more mesic and less saline sites. Little research and no positive results have been reported for revegetating the more xeric sites.

Much harsher sites than are now being reseeded could be artificially revegetated by applying all available management tools. The site should be fallowed the summer before it is reseeded. The land can be fallowed either mechanically or by herbicide treatments. Seed should be planted in the fall. Herbicide treatments can be applied the next spring to remove seedlings of weedy species because they use the soil moisture and nutrients essential for survival of the grass seedlings. The reseeding should be

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protected from all grazing by both domestic and native animals until the seeded species reach maturity (Cook, 1965). Grazing should be maintained at a level to assure vigorous and reproductive plants to prevent reinvasion by halogeton.

Halogeton is grazed readily by sheep and cattle and constitutes a fairly large part of the diets of both sheep and cattle under certain conditions. Animals are poisoned during late fall, winter, and early spring on cattle and sheep range where halogeton grows (Cook and Stoddard, 1953).

Signs of poisoning include depression, weakness, recumbency, coma, and death (Cook and Stoddard, 1953). On autopsy, hemorrhage can be seen on the surface of the rumen. Crystalline deposits may be seen on the cut surface of the kidney if it is viewed closely. Histologoically, crystalline deposits and hemorrhage can be seen in the rumen wall and in the renal tubules (Van Kampen and James, 1969). Analysis of the blood reveals a hypocalcemia (James, 1968).

The toxic principle in halogeton consists of soluble salts of oxalic acid, primarily as sodium and potassium salts (Cook and Stoddard, 1953). These salts of oxalic acid react readily in solutions containing calcium or magnesium ions to form insoluble calcium or magnesium oxalate. Halogeton is unique because it produces a high proportion of soluble to insoluble salts (Williams, 1960).

Other species that inhabit the cold desert and are closely related to halogeton contain salts of oxalic acid. They include Russian thistle (*Salsola kali*), greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), salt sage (*Atriplex nuttallii*), and others. However, only greasewood and Russian thistle contain concentrations of soluble oxalates normally dangerous, but soluble oxalates in Russian thistle only rarely reach the potentially dangerous concentration.

When sheep or cattle graze halogeton, three things may occur (James, 1972): (1) the soluble oxalates can be detoxified by metabolic activities of the rumen microflora (James et al., 1967): (2) the soluble oxalates may react with calcium ions in the rumen to form the insoluble calcium oxalate that is excreted in the feces, or (3) the soluble oxalates may be absorbed into the bloodstream where they react with the blood calcium and other constituents (James, 1968).

Oxalate intoxication is a complex phenomenon. A number of adverse reactions take place. A severe hypocalcemia results from the exhaustion of calcium in the bloodstream by the formation of the insoluble calcium oxalate. Calcium oxalate crystals form in the rumen wall and in the kidneys and damage these organs. Shock may follow (Van Kampen and James, 1969). The oxalates may also interfere with the action of the lactic dehydrogenase and succinic dehydrogenase enzymes (James, 1968). These enzymes are vital links in energy metabolism.

Chronic poisoning apparently does not exist in oxalate poisoning (James and Butcher, 1972). Poisoned animals either die quickly or they recover without lasting signs of injury. Animals are poisoned only when they eat excessive amounts of halogeton in a short period of time (James and Butcher, 1972).

Certain microorganisms are capable of detoxifying the oxalate ion. Ingestion of sublethal levels of soluble oxalates can increase the rate of degradation of oxalate by the rumen (James et al., 1967). This change in the rumen microflora permits the animal to ingest as much as 75% more soluble oxalate without intoxication (Van Kampen and James, 1969).

If soluble oxalates are ingested rapidly, the microflora cannot detoxify them fast enough to prevent their absorption into the bloodstream, and the animal becomes intoxicated. (James et al., 1967).

Allowing ruminants to graze plants with low levels of oxalate or to graze small amounts of plants such as halogeton permits the adaptation of the rumen microflora to the oxalate and consequently increases protection against oxalate poisoning. This adaptation lasts for only short periods of time (2-3 days).

Some interacting factors related to halogeton poisoning are: (1) amount of halogeton ingested, (2) rate consumed, (3) concentration of soluble oxalates in the plants, (4) the amount of other forage in the rumen, and (5) recent exposure to oxalate-producing plants.

A sheep may eat large amounts of halogeton if ingested slowly over the grazing period, whereas the same amount may prove lethal if ingested rapidly. The soluble oxalates may constitute from 8 to over 30% of the plant's dry weight (Williams, 1960). The higher the oxalate content of the plant, the more toxic it is. The amount of other forage in the rumen determines how much halogeton an animal is likely to eat and how fast. Also, the rumen content may dilute the toxic oxalate that is ingested and thus influence the rate of absorption. Sheep adapted to oxalates can graze more halogeton than those not so adopted (James et al., 1970).

Water consumption is controlled by three factors: dry matter intake, salt intake, and ambient temperature (Winchester and Morris, 1956; James et al., 1968a and b). Soluble salts, including the soluble salts of oxalic acid, influence the amount of water consumed by an animal. Animals on a high salt diet consume more water than those on a normal diet. Five gallons of water is required to excrete each pound of salt absorbed from the rumen (Cardon et al., 1951). Sheep fed diets with high halogeton content respond in the same manner.

Water intake is also influenced by the amount of dietary dry matter; and, conversely, if water intake is reduced, feed consumption decreases. Therefore, an animal may be made hungry by withholding either feed or water (James et al., 1970). Sheep are usually poisoned on halogeton when they have been made hungry by a lack of water or feed. After their thirst has been quenched, they are then ready to graze. Under these conditions, they are less selective in their grazing. On sites where halogeton, or any other toxic plant, dominates, the animal may become intoxicated. Such grazing patterns may be lethal. Most large numbers of sheep are lost after they leave water points along established trails where the depleted native shrubs have been replaced by heavy stands of halogeton. Many sheep in the field have been poisoned on halogeton during periods of moderating temperatures, which cause an increase in water intake by the sheep.

Sheep poisoned on halogeton drink excessive amounts of water during intoxication (James et al., 1968a and b). Limited success has been achieved in the treatment of halogeton-poisoned sheep by the force feeding of water (James and Johnson, 1970).

Although the success of this treatment has been limited, it is the only effective method of treating this malady and illustrates the importance of water in this type of poisoning.

The reaction of calcium with the oxalate radical in a solution to form an insoluble and nontoxic substance has contributed to the popularity of the concept of using calcium as an alleviator of halogeton poisoning (Cook and Stoddard, 1953). Dicalcium phosphate was once recommended on the basis of experiments where sheep survived a lethal dose of halogeton. The halogeton was force-fed simultaneously with enough calcium (dicalcium phosphate) to combine with the oxalate in the halogeton. In subsequent experiments, researchers learned that lesser amounts of the dicalcium phosphate failed to prevent poisoning of a sheep fed a lethal amount of halogeton. The amount required to prevent intoxication was larger than can be practically used under range conditions. Further, when the mineral was administered 2 to 4 hours after a lethal level of halogeton was given, it was of no value in preventing death (James and Johnson, 1970). Currently, the concept of a practical alleviator for halogeton poisoning is not recommended by researchers (James and Johnson, 1970). However, they do advocate the use of mineral supplements for general nutrition. Most of these supplements contain calcium salts and many include dicalcium phosphate.

Although the livestock industry has, in part, learned to "live with halogeton," it remains as a constant threat to the individual stockman. Successful stockmen who have grazed their animals within the halogeton area have suddenly, through carelessness, neglect, or a unique set of circumstances, sutained catastrophic losses.

Implementation of the following management practices should minimize deaths in sheep from halogeton poisoning.

1.) Avoid overgrazing and all other activities that will remove or deplete the existing perennial vegetation. Destroying or weakening the perennials reduces forage production and increases the susceptibility of the area to invasion by halogeton.

2.) Develop a grazing program that will allow your range to improve. Healthy, vigorous perennial vegetation will prevent invasion by halogeton.

3.) Reduce grazing pressure during periods of drought. The added stress of grazing on the perennials during drought can destroy them.

4.) Avoid grazing or graze very lightly during the growing season of the perennials. The growing season for the perennial vegetation of the cold desert is during late winter and spring but sometimes extends into early summer when soil moisture is favorable.

5.) Supply adequate water and forage of a good variety. It is economical to haul water (Hutchings, 1954 and 1958).

6.) Watch your livestock, know what they are grazing, and know what will be available for grazing. (Have a grazing plan.)

7.) Allow sheep time to adapt by grazing safe amounts of oxalate. This allows time for the rumen microorganisms to adapt to the oxalate. These organisms metabolize oxalates into nontoxic components. Supplying small, safe amounts of oxalates will encourage adaptation of rumen microorganisms. Grazing plants low in oxalate content such as shadscale, Russian thistle, and salt sage will adapt a sheep in about 4 days.

8.) Introduce animals to halogeton-infested areas gradually. Even after a short absence (2-3 days) from halogeton areas, they should not graze in dense stands.

9.) Do not unload animals from truck into halogeton unless both supplemental feed and water are available.

10.) Never allow hungry animals to graze in large, dense patches of halogeton often found on old bedgrounds, along trails or roads, and around watering places in the desert of the Intermountain Region. This rule includes animals currently grazing halogeton. The animal is poisoned when too much halogeton is ingested rapidly.

11.) Do not trail thirsty sheep into watering places surrounded by halogeton without supplementing them with other food. Thirst inhibits grazing; sheep will not graze until they have been watered. Even small quantities of supplemental food will increase the selectivity of the grazing animal.

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