The Major Poisonous Plants on the Ranges of Montana
by
Marvin C. David

A Thesis
Presented to the Faculty
of the
School of Forestry
Oregon State College

In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science
June 1940

Approved:

[Signature]
Professor of Forestry
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>The Problem</td>
<td>1</td>
</tr>
<tr>
<td>Importance of the Problem</td>
<td>2</td>
</tr>
<tr>
<td>Review of Previous Studies</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Procedure and Sources of Data</td>
<td>3</td>
</tr>
<tr>
<td><strong>PLANT POISONING AND ITS PREVENTION</strong></td>
<td>4</td>
</tr>
<tr>
<td>Conditions of Poisoning</td>
<td>4</td>
</tr>
<tr>
<td>The Plant</td>
<td>4</td>
</tr>
<tr>
<td>The Animal</td>
<td>5</td>
</tr>
<tr>
<td>Climatic and Seasonal Influences</td>
<td>6</td>
</tr>
<tr>
<td>Amount of Food</td>
<td>7</td>
</tr>
<tr>
<td>Prevention of Poisoning</td>
<td>3</td>
</tr>
<tr>
<td>Eradication</td>
<td>8</td>
</tr>
<tr>
<td>Use of the Range when Plants are Least Poisonous</td>
<td>9</td>
</tr>
<tr>
<td>Allotment of the Range to Animals not Affected</td>
<td>9</td>
</tr>
<tr>
<td>Deferred Grazing</td>
<td>10</td>
</tr>
<tr>
<td>Care in Driving and Bedding</td>
<td>10</td>
</tr>
<tr>
<td>Salting</td>
<td>11</td>
</tr>
<tr>
<td>Treatment</td>
<td>11</td>
</tr>
<tr>
<td>Summary</td>
<td>12</td>
</tr>
<tr>
<td><strong>THE MAJOR POISONOUS PLANTS</strong></td>
<td>14</td>
</tr>
<tr>
<td>The Lily Family <strong>(Lilaceae)</strong></td>
<td>14</td>
</tr>
<tr>
<td>Death Camas <strong>(Zyadenus venenosus Wats)</strong></td>
<td>14</td>
</tr>
<tr>
<td>Swamp Camas <strong>(Zyadenus elegans Pursh)</strong></td>
<td>19</td>
</tr>
<tr>
<td>The Crowfoot Family <strong>(Ranunculaceae)</strong></td>
<td>21</td>
</tr>
<tr>
<td>Tall Larkspur <strong>(Delphinium cucullatum A. Nels)</strong></td>
<td>21</td>
</tr>
<tr>
<td>Low Larkspur <strong>(Delphinium bicolor Nutt)</strong></td>
<td>26</td>
</tr>
<tr>
<td>The Parsley Family <strong>(Umbelliferae)</strong></td>
<td>29</td>
</tr>
<tr>
<td>Water Hemlock <strong>(Cicuta occidentalis Greene)</strong></td>
<td>29</td>
</tr>
<tr>
<td>The Pea Family <strong>(Leguminosae)</strong></td>
<td>34</td>
</tr>
<tr>
<td>Species of Lupines <strong>(Lupinus spp.)</strong></td>
<td>34</td>
</tr>
<tr>
<td>White Loco <strong>(Aragaiaus lamberti Greene)</strong></td>
<td>40</td>
</tr>
</tbody>
</table>
THE MAJOR POISONOUS PLANTS
ON THE RANGES OF MONTANA

INTRODUCTION

By reason of large areas of grazing lands privately owned, state owned, or within the National Forest area upon which permits are available for regulation of grazing, growing of livestock is one of the leading industries of Montana. Although the day of the free open range when immense herds roamed at will over vast areas of public domain has long since past, the amount of stock has increased (23) as a result of the greater number of small farm herds.

THE PROBLEM

One of the outstanding obstacles to the full utilization of these more restricted ranges is the presence of plants which are poisonous to livestock. Poisonous plants have been the cause of heavy losses annually among domestic stock maintained on range and pasture. Not all poisoning can be prevented, but most of the heavy losses are directly due to lack of familiarity with the common poisonous plants and the seasons in which they are most dangerous.

The problem of having authentic, helpful material available to those concerned with the raising of livestock
is not limited there, but such information is needed by public officers who serve to lease government lands for grazing and help regulate such lands for their best usage.

**IMPORTANCE OF THE PROBLEM**

The importance of the problem is increasing as each grazing season brings reports that large numbers of livestock have been poisoned on sheep and cattle ranges. Stockmen unacquainted with true facts about various poisonous plants are coming to know them by costly experience. Available statistics are lacking but from an estimate found in several localities it seems probable that the average loss must be as great as five per cent or even higher in some areas. In Montana poisonous plant losses exceed all those caused by disease and predators, and within a single herd death camas and lupine losses have been known as great as sixty per cent. (26). In the main these losses are mature animals for the raising of which large sums have already been spent, amounting to thousands of dollars annually.¹

While the number of poisonous plants is comparatively large, yet those known to be persistently dangerous are far less than is ordinarily supposed. Through inability to recognize those that are detrimental, many owners suffer yearly losses thinking that some other cause is responsible.

¹On the National Forests in the West alone, poisonous plants cause losses of approximately $500,000 annually. (26)
Although the average stockman is probably better versed on the subject than the average student who enters fields related to grazing, men working under stockmen are not always fully acquainted with the conditions of poisoning by plants. The problem is of importance not only to such men as will be benefitted by being contacted by field men, but also to the field men themselves, who by their willingness to assist in any particular problem, will develop a finer spirit of cooperation.

REVIEW OF PREVIOUS STUDIES

Publications by United States government agencies of scientific research and by experiment stations of some states, usually located at the colleges within those states, are available on findings of poisonous plants, both as individual species and as a group. Several bulletins have concerned themselves with the poisonous plant problem in Montana, but for the most part do not include other investigations pertinent to the problem. References will be found at the end of this paper.

METHODS OF PROCEDURE AND SOURCE OF DATA

The writer has attempted to summarize the present knowledge and field observations of stock poisoning plants common to the state of Montana. Since much of the material of the general subject of poisonous plants is contradictory,
this paper attempts to collect the authoritative facts on
the problem that identification and a basic understanding
may be available.

The presentation is necessarily incomplete inasmuch
as special cases known to the stockman and those dealing
with minor poisonous plants, which are relatively
unimportant, are not treated here.

Sources of data were the Oregon State College Library,
library of the School of Forestry at Oregon State College,
a course of study in Range Plant Identification, and a
limited amount of field experience.

PLANT POISONING OF STOCK AND ITS PREVENTION

CONDITIONS OF POISONING

The major factors that contribute to the stock-poison-
ing problem are the condition of the plant, the condition
of the animal, the time of year, and the amount of food.
These factors vary greatly within any one region and from
year to year, and an allowance for any particular problem
must always be kept in mind.

THE PLANT. A poisonous plant may be defined as one
which, when taken internally, will cause a deleterious
effect. When the result is only illness, the effect is
spoken of as toxic; and when death occurs, the dosage is
referred to as lethal. Mere mechanical injuries caused by
the plant structure is not a part of this definition.
Poisonous plants are seldom consumed by preference but are taken mostly in the absence of good forage. Their palatability may be as good as accepted forage plants, especially in the succulent stage, but often unpleasant odors, acid or bitter tastes, chemical composition, or protective devices such as penetrating awns or spines render them poor substitutes.

Recognition of a poisonous plant is the primary step in solving the problem, but it is not enough to know that certain plants contain violent poisons, but consideration of its habitat, poisonous period, and poisonous parts need to be known. For example, larkspur is most dangerous before blossoming, while the toxic part of water hemlock is mainly in the bulb.

THE ANIMAL. Aside from individual and species differences of animals, physical conditions as well as fatigue factors are important considerations. Certain species, particularly the ruminants, are not as susceptible to certain poisonous plants as are other species, such as horses. Cattle are probably as susceptible to death camas as are sheep, but due to their larger body weight, seldom consume enough of the plant to be extensively poisoned, whereas losses among sheep are often heavy. Sheep seem to be immune to larkspur poisoning and are often used to graze it off for the protection of other livestock. Hungry animals driven hurriedly through an area where poisonous plants abound will devour almost any vegetation along the path,
and often when poisonous plants are the most conspicuous vegetation, serious losses may result.

Special care should be taken to see that new stock introduced to an area develop a taste for the desirable forage. Until they have done this there is always danger that the lethal amount of poisonous weeds may be consumed. Likewise young animals have to be watched since they are more subject to the effects of noxious herbs than are adult stock.

Sheep are extremely variable in their feeding habits, foraging on plants one day which they will not touch on others. However, this does not account for the observation that a few sheep always seem to escape poisoning under similar conditions. This fact may be attributed to individual differences of susceptibility, or variation of food selection. (12)

CLIMATIC AND SEASONAL INFLUENCES. Periods of deficient rainfall greatly increase losses among livestock from plant poisoning. (26) Waste places and weed patches which generally are not regarded as suitable pasture during seasons of normal rainfall are likely to be used. Such periods also are more favorable for the reproduction of weeds than for the competing wholesome plants. Especially is this true when plant cover is thin and the grazing is localized. Probably the best way to cope with invasion of unfavorable plants is to maintain a vigorous growth of desirable forage over the entire range at all
Seasonal variations are important to know, both from the standpoint of plant appearance and plant toxicity. Many plants mature early in the spring, as the first snows melt, and in a green and succulent stage attract animals; still others, as the lupines, remain green and conspicuous when other forage is drying up. Because of the height some poisonous weeds attain, they remain available after early fall snows when shorter forage is covered. While at elevational ranges, where prolonged, cold rainfall occurs during the growing season, animals may seek shelter in the box canyons and either feed on poisonous species that grow there or emerge ravenously hungry and eat unwholesome plants, such as larkspur. As the plant varies with the season, so varies its toxicity, which is an important factor to be recognized if stock losses are to be diminished.

AMOUNT OF FOOD. At the crux of the plant poisoning problem the single most important factor probably is the lack of desirable forage. Most poisonous species are less palatable than herbacious plants and will be avoided in the presence of good forage. So even if there are noxious weeds on a well-foraged land, the danger of losses by them is reduced to a minimum.

Marsh (14) points out that this is true also in regard to loco-poisoning, which is habit-forming in its
effect. He says if good feed were supplied during poor pasture seasons, few animals would become addicted to this weed.

PREVENTION OF POISONING

Inasmuch as the lack of good forage is an underlying cause of plant poisoning, it becomes evident that we must inspect the ways of managing the range and handling the animals which will make a material reduction in these losses.

ERADICATION. Eradication by the crowding out of harmful plants with introduced plants, by chemical destruction, and by close grazing (14) have proved to be ineffective means of extermination. Eradication by grubbing or digging the plants out has proved feasible where the harmful plants are of perennial growth and in well-defined groups. On small areas the equivalent in value of livestock saved will probably pay for the cost of grubbing in a single year, and on large areas a partial eradication may suffice if the weed is one which requires a considerable quantity of the plant to cause death. Specific methods of treatment are discussed under each plant.

USE OF THE RANGE WHEN PLANTS ARE LEAST POISONOUS.

By frequent inspection of the range weeds in question, stock can be kept away from them during dangerous periods. A chart at the end of the paper briefly gives plant parts and time of the year when they are most dangerous, but due
to differences in soil, season, and climatic variation, and altitudinal changes, only general dates are given to be used as a guide for the specific problem.

**ALLOTMENT OF THE RANGE TO ANIMALS NOT AFFECTED BY THE POISON.** To graze the range as much as possible by the proper classes of livestock gives considerable advantage where it can be practiced. Since the various kinds of foraging animals differ in selection of plants for their diet and in their susceptibility, full advantage can often be taken of such allocations (e.g. Areas with death camas might be grazed with cattle where sheep would be poisoned; larkspur, on the other hand, is not injurious to sheep.)

Non-susceptible animals used on different areas likewise tend to keep down poisonous plants by a tramping action.

**DEFERRED GRAZING.** Rotation in the use of the range may not only be beneficial in curbing poisonous plant growth but also of value in maintaining a higher carrying capacity of suitable forage. This principle has been recognized in the administration of the National Forests by restricting stock to certain poisonous areas during some seasons and deferred grazing on others to aid grass establishment. Such rotation, however, needs thorough knowledge and study of local range conditions and careful planning. No general plan should be adopted on individual ranges without consultation of local officers and expert advice. In time, rotated grazing should reduce
plant poisoning and improve the range.

**CARE IN DRIVING AND BEDDING.** It has been found that with both sheep and cattle when being moved from place to place, if they are allowed to drift leisurely they will spread and select their food. (14) If the animals are hungry or hurried on a drive, they will snatch eagerly at whatever they can reach and exercise no selective care in plants eaten. Where the practice of using fixed drive-ways is prevalent, the green forage is taken by the first few bands and only weeds or poisonous plants are left for succeeding bands.

Similarly, in the practice of bedding sheep, the best feed is taken first if the same bedding ground is used for two or three nights. By "bedding out" or "blanket herding" or by taking a new bedding ground every night, both the welfare of the sheep and the preservation of the range will be promoted. (26)

**SALTING.** At all times provision should be made for ample salt and other minerals known to be deficient in local forage. Failure to do this may cause a perverted appetite which in turn may cause the animals to consume poisonous vegetation, to become restless and difficult to handle, and at the same time to be physically unable to resist the effects of the poison. (4)

Salt should not only be in a form which animals can readily accept but also distributed to enable the carrying out of good range practices previously outlined. If other
minerals are lacking, such as phosphorus or calcium, the animals usually indicate the fact by chewing on old bones or eating dirt, and these elements should be provided in suitable form.

Along with proper salting methods goes an ample supply of water, the lack of which makes poisonous substances less readily eliminated by stock.

TREATMENT

Avoidance of serious livestock losses from poisonous plants lies almost wholly in the field of prevention rather than treatment of the animal. Where treatment can and is sometimes applied, considerable saving may be made. One of the biggest hindering factors is in diagnosis of the symptoms, many of which are not dissimilar from those caused by parasitic disease. Ability to make reliable diagnosis is usually not possessed by those who are in charge of the animals. Even when the herder observes the poisoning and recognizes the situation, he is often many miles from camp and in rough country, so that the delay would render treatment useless. To handle this obstacle some stockmen provide their herders with a small kit and a hypodermic syringe, and find the investment a profitable one.

When treatment is administered, care should be taken to keep the animal as quiet as possible and to be certain of the diagnosis and remedy. Without full assurance of this
a veterinarian should be called.

SUMMARY

1. Survey grazing lands and map the locations and areas of poisonous plants.

2. Identify each area as to species, period when most dangerous, etc.

3. Eradicate or fence where possible.

4. Use the range when the plants are least poisonous.

5. Graze infested areas with stock not affected by the plants.

6. Defer grazing in different seasons.

7. Use different sheep bedding grounds each night.

8. Avoid fixed driveways wherever possible; handle stock quietly; and avoid mass grazing.

9. Take special care with young animals and those new to the area.

10. Avoid over-grazing, either by over-stockling or prolonged grazing.
Death Camas in the spring, showing the dense, flowering head at the top of a single stem and the grass-like leaves. (ref. 12)
THE MAJOR POISONOUS PLANTS

THE LILY FAMILY (LILACEAE)

DEATH CAMAS
(Zyadenus venenosus Wats)

Common Names
Lobelia, poison camas, alkali grass, wild onion, poison grass, poison sego, squirrel food, sand corn, poison sego lily, mystery grass, zygadene.

Description
One of the most deadly of all plants on the range is death camas. (18) All species of this plant grow singly and have long, slender, almost grass-like leaves which mature at the early stages of growth, and are not readily distinguished from grass. (see fig. 1) These green leaves grow in a dense cluster from a bulb two or three inches under the ground. From the center of this cluster rises an unbranched flowerstalk six to twenty-four inches high. The flowers are numerous and are attached to the sides of the stalk along its upper one-fourth, terminating in a spike-like cluster. They are about one-fourth inch in diameter, yellowish-white, with three sepals and three petals which open in May and June. The seed ripens in July and germinates the next spring, producing small leafy plants without flowers. (24)
During the summer the bulb is formed which sends up the flower stalk the following spring. If carefully removed from the ground, the outer layers of this bulb will be found to be brownish-black in color. (4) Not only will the bulb distinguish it from most grasses, but there is also no sheath-like collar (ligule) surrounding the blades where they join the bulb.

Because the bulbs of death camas and edible camas resemble each other and grow on somewhat similar sites, confusion of them has proved occasionally disastrous to human life. The bulb of death camas is small and looks like an onion or edible camas, but it differs in that it does not have an onion-like odor. Whereas the flowers of the poisonous plant are greenish-yellow or white in color, those of edible camas are rich blue, larger in size, and all flowers are attached to one point at the tip of the stem. (3) The leaves are also wider, longer, and darker green than those of death camas.

**Animals Affected**

This plant is poisonous principally to sheep. (13) Horses are seldom, if ever, affected, but if they become sick are likely to recover soon. Cattle are occasionally poisoned, but not many die and poisoning occurs only when they are forced to graze closely in an area where the plants are unusually abundant. Hogs are not affected. The bulb is poisonous to man and occasionally children dig up the bulbs, mistaking it for edible camas. (12)
Distribution and Habitat

The plant grows everywhere in Montana and is found from British Columbia to South Dakota, Nebraska, Utah, and California. It may be found on all parts of the range except the driest portions and occurs in large numbers on the sides of foothills of mountains and on the plains. Ordinarily it does not grow along the banks of streams, but seems to be most abundant in localities where a moderate amount of moisture is present as a result of slow seepage.

Altitudinal Range

The altitudinal limits of this plant vary from 1900 to 3000 feet, and consequently, include the entire range at which sheep are grazed in Montana. Although limited to particular localities in the state, its abundance in these localities makes it an easy matter for sheep to find and eat sufficient plants, in a short time to produce fatal results.

Poisonous Periods

The plant is poisonous throughout its entire life, and the bulbs are poisonous in all seasons of the year. From a standpoint of stock poisoning the danger periods come in the spring before the tops dry up. This is due largely to the scarcity of the range food early in the season and consequently results in the heaviest losses of sheep in late May and early June. At low altitudes the plants may be withered and harmless, while on higher
slopes, short distances away, the plants may be more immature. (24).

Poisonous Parts

According to scientific investigation, Marsh (18) found that the parts of death camas are poisonous in the following order, beginning with the most toxic: seeds, mature pods, flowers, leaves, bulbs, roots, and young pods. The seeds are about four times more potent than any other part of the plant, but under range conditions this is not so important.

Recent experiments show (7) that lambs are not subject to poisoning from the ewe's milk, but once they begin foraging, they are more susceptible to the poison than older sheep.

Quantity Required to Produce Poison

Demonstrations (10) have shown that flowers, leaves, and bulbs are dangerous to sheep when one-half pound per hundredweight has been consumed, but smaller doses on the range may prove fatal, where sheep are driven hard and have no chance to recover. About the same amount per 100 pounds will cause sickness among cattle and horses. The poison principle of death camas is an alkaloid known as zygodendine. (24)

Symptoms

Poisoned sheep breath fast and convulsively, froth at the mouth, stagger and reel when moved, and finally fall
down and become unconscious. After reaching this stage very few recover, although they may lie in a sort of paralysis, being unable to lift their heads, for several days. (7)

Sheep which have eaten only a small amount of the plant may show the preliminary symptoms and then recover, but since the amount of the plant necessary to kill a sheep is quite small, most cases of poisoning result fatally.

Rectifications

There is practically no medical treatment known that will save sheep poisoned by *Zygodenus* poisoning, but if they are kept quiet, they may recover. (18). Pastures heavily infested with this plant should be avoided during early spring, or at least until the plant reaches blossoming stage. Such pastures are very dangerous, even though the grass is plentiful, but more dangerous if overgrazed. (10).

Other recognized practices are to make certain that sheep are fed well before making a drive through an infested area. Sheep "on the move" are less discriminating in their choice of food and may take a considerable quantity in a short time. Daily salting is also a preventative in that a deprived appetite might result in taking the plant. Cultivation destroys death camas, but it is seldom practical.
SWAMP CAMAS

(Zygadenus elegans Pursh)

Swamp camas has a less extensive distribution in Montana than death camas, but inasmuch as they resemble each other and the plant is abundant in certain limited areas, it should be mentioned. Swamp camas differs principally in having flowers about twice as large, greenish in color with purplish tint at the base, and separated more widely on the main stem. The leaves are wider, usually about one-half inch long, and generally it is taller in stature, depending upon the amount of moisture in the soil where it grows. (6)

As the name implies, swamp camas is restricted to wet ground and is often found at high altitudes in wet open ground in the forest. Hay examined in the stack has shown large amounts of the coarse material present, when no other poisonous plants were found, but poisoning resulting from it is less frequent.
Tall larkspur in blossom. A tall plant with flowers forming a loose head on the upper half of the stem and the lower portions being covered with deeply serrated leaves. (ref. 12)
Common Names
Purple larkspur, larkspur, "poison", "poison-weed", cow poison.

Description
The tall larkspur is a rank-growing single stem perennial plant attaining a height growth of from four to seven feet. The stem is usually unbranched and the lower two-thirds is leafy; the upper one-third is a loose-flowered spike. (see fig. 2) The leaves are large (often six inches across), deeply cleft, and resemble crow's feet, whence the family name. Leaves are graduated in size, the smallest ones being nearest the flowering head. The numerous flowers of gray purple or light bluish color are about three-fourths inch in diameter and have a "cock's spur" at the base. Black seeds are enclosed in three-lobed, smooth seed capsules. The entire plant is smoothly covered during most of its growth with a whitish bloom that rubs off easily. (6)

The leaves of tall larkspur are likely to be mistaken in its earlier stages with those of wild geranium. The two plants grown on similar situations, but even before the blooming periods the leaves of the geranium may be distinguished by the presence of two small stipules.
(appendages) where the leafstalk joins the stem and by the fine whitish hairs covering the leaf surface. (7)

Aconite is also difficult to distinguish from tall larkspur. Both are almost identical in form except that the leaves of aconite have shorter leaf stalks and a solid stem. (12)

**Animals Affected**

Larkspur is poisonous to both cattle and horses, with heavy losses occurring every year among cattle pastured at the higher altitudes. Sheep seem to be immune to larkspur poisoning and are recommended to be first grazed over infected areas as a safeguard to cattle. (3). Horses and mules seldom eat large enough quantities to be poisoned.

**Distribution and Habitat**

The plant is widely distributed in Montana, occurring as a rule in well-defined areas, especially on mountain slopes where it is mainly confined to moist, semi-shaded wooded areas. In the foothills it is more common in brushy ravines and in these places can often be fenced. (24)

**Altitudinal Range**

The tall "cock's spur" is found from the valley floor to 9000 feet elevation. (6) A lesser height growth but a deeper flower coloration is characteristic of plants at the upper limits of its range.

**Poisonous Periods**

The young plants are more poisonous and consequently most losses occur during the spring. As the season
progresses they are still dangerous until after blossoming time. (1) Cattle should always be kept away from infected localities both fall and spring, especially during heavy snow storms. In the spring a light snow fall makes this plant very conspicuous. Since at this stage of growth the leaves are most poisonous, the growth is succulent, and it occurs in advance stages where cattle are most likely to take shelter from the storm, livestock should be grazed away from broken slopes where it is established.

**Poisonous Parts**

Although the root is thought to be poisonous by some stockmen, experiments (19) tend to disprove this. Furthermore a brittle stem prevents the roots from being pulled from the ground except when it is very moist. The leaves, stems, and seeds are the main sources of poisoning in practically all larkspurs; the leaves and stems inflicting the main damage as the seeds are less likely to be eaten in the field. (2)

**Quantity Required to Produce Poisoning**

To be effective, governmental experiments (19) have proved it is necessary for the animal to consume 3% of its body weight in one day, but more could be eaten if the period was prolonged with only toxic symptoms resulting.

The toxic principle of any of the larkspurs has not been determined, but experts in the field consider it to be delphinun and allied alkaloids.
**Symptoms**

The most characteristic symptoms are the inability to walk without staggering, spasmodic movements when down, constipation, nausea, salivation, pronounced sweating, bloating (in the latter stages) and frequent convulsions resulting in death from respiratory paralysis. (13)

**Rectifications**

Doctors Marsh, Clawson and Marsh (19) state that cattle poisoned by larkspur should be turned with their heads uphill and kept quiet as possible. They should not be bled, but if bloating occurs should be paunched. In many cases the animals have been saved by the following treatment.

The dose given applies to an animal weighing 500 to 600 pounds; the injection to be doubled for animals weighing over 1010 pounds.

- Polysostigmine salicylate ...... 1 grain
- Pilocarpine hydrochloride ...... 2 grains
- Strychnine sulphate .............. ¼ grain

To supply the herder with a hypodermic syringe and tablets of this preparation that could be dissolved in water undoubtedly would justify the trouble and expense.

U.S.D.A. experiments with sheep show quite conclusively they can be fed on larkspur with entire immunity. Therefore it is well to graze off larkspur with sheep, before allowing cattle on the infected area. By keeping sheep closely herded on such areas helps to suppress the expansion of the plants both by actual consumption and by trampling. Eradications or fencing sometimes recommended
Low Larkspur. Bluish "cock's spur" flowers and "crows' feet" leaves easily identify this weed. (ref. 13)
LOW LARKSPUR

(*Delphinium bicolor* Nutt.)

**Common Names**

Same as for tall larkspur. ²

**Description**

The low larkspur is a very conspicuous, attractive plant appearing on many of the foothills of Montana in late spring. A perennial plant, it obtains a height of from six to sixteen inches from a cluster of tuberous roots. The stem is sparsely branched (see fig. 3) and bears deep purple flowers, and each one produces a "cock's spur" of which the name is a reminder. The seed pods are in small clusters of three or four on a stalk. They mature quickly after the blossoms fall, and the plant dies about midsummer. The leaves are deeply cleft and are terminus in short stems arising near the base of the main axis. In the higher altitudes the flowering plants may be found until June, but in the foothills it probably makes its appearance about a month earlier. (7)

It is not likely to be confused with tall larkspur as it is readily distinguished by its dark purple flowers and smaller size. In the earlier stages the leaves might be mistaken for those of the harmless wild geranium, but the flowers are entirely different.

² Refer to tall Larkspur for subject matter not discussed under this plant. It is applicable to both species.
**Altitudinal Range**

In Montana the low larkspur is more widely distributed than the tall species, being found up to altitudes of 10,500 feet on moderately moist hillsides and mountain ranges.

**Poisonous Periods**

Although the plant is poisonous throughout its entire life, most livestock losses occur in May or June. After this time the leaves die down and are not attractive to the animals. Low larkspur differs from the taller species which loses its poisonous properties after blossoming, but all infested areas are considered safe after the plants have bloomed. (19)

**Quantity Required to Produce Poison**

Nevada experiments (9) with larkspur showed that it took twenty to twenty-five pounds to kill a thousand-pound animal in good condition, but weaker or half-starved cattle succumbed with considerably smaller quantities.
Water Hemlock. The most deadly of poisonous range plants can be recognized by the whitish flowers which terminate the stems and the chambered root-stalks.

(ref. 24)
Common Names


Description

Water hemlock, which is one of the most violent of poisonous plants, is a smooth perennial growing from year to year from a thick, short root-stock or underground stem that bears clusters of underground stems. The stem stands erect to a height of two or three feet and branches several times. It is also smooth and hollow except at the node (joint) where the leaves are attached. Leaves are narrow, serrate, and doubly compound, attaining a length of two or three inches. Small, greenish-white flowers are born in dense clusters at the tip of each branch, and they usually open in July or August. (24) (See Fig. 4)

Water hemlock is often confused with several range plants, the most common of which is parsnip; it is erroneously called wild parsnip. Cultivated parsnip which has grown wild may be distinguished because it has yellow flowers, broader leaflets, and a solid tap root instead of chambered roots in clusters. It is usually found in ground
not so moist as that typical of water hemlock.

The poisonous plant is also sometimes mistaken for two other plants—a wild parsnip known botanically as Washingtonia which is not poisonous to stock and differs by branching only slightly, and by flowering several months earlier, usually in May or June; also, a marsh plant known as Sium, which duplicates water hemlock in habitat, size, shape, flower, color, etc.; however, the leaves differ by being single compound while those of water hemlock are double compound. (7)

Animals Affected

Sheep, cattle, horses, and sometimes man are poisoned by water hemlock, the largest losses occurring among cattle. Little is known of how goats are affected by the poison, and authors differ as to its effect on hogs. Man is rarely a victim of the plant but warning of the plant has been published to familiarize children of its dangers in several localities. (25)

Distribution and Habitat

Water hemlock is generally distributed throughout Montana and the Northwest. It does not thrive on dry hillsides, but is common along banks of streams, irrigation ditches, swamp-meadows, or wherever the ground is saturated with water.

Altitudinal Range

The plant is found from 1000 to 8000 feet elevation. (15)
Poisonous Periods

Experiments at the Nevada Agricultural Experiment Station (11) disclosed that the first green leaves and stems coming up in the spring of the year are deadly, but in summer or autumn when leaves and stems have developed, large quantities may be eaten by either sheep or cattle without harm. Roots are poisonous the year around, but ordinarily they are not available to stock in summer or fall months.

Poisonous Parts

As has already been pointed out, the bulb is always most poisonous. Tender green shoots are readily taken in the spring and have equally deleterious effects. The older tops are not poisonous. (17)

Quantity Required to Produce Poison

Conclusions concerning the poisons of water hemlock experiments (11) at University of Nevada were as follows:

1. "Two ounces, 1/8 of a pound, or more of old tuber (roots) are sufficient to kill ordinary range ewes or to make them sick.

2. Ten to twelve ounces, about 3 of a pound, of the old tubers, will prove fatal to mature cows.

3. A dose of 1 pound to one pound of the old tubers will kill a horse.

4. The young tubers are much less poisonous than the old ones, for it takes two to four times as much of the new tubers to kill an animal."

Drying does not seem to lessen its power in the tubers for it will retain its toxic power for several years, and young leaves are almost as powerful as the tubers.
The cicutoxin is the deadly poison and may be readily seen in the form of oily, yellow drops on freshly cut rootstalks.

**Symptoms**

Tests show that the animals are attacked by a series of spasms, which cause gnashing of teeth, the backward bending of the neck, and convulsions. Sheep and cattle usually go down with the first spasm and never get up again, but horses will repeatedly get up. Rapid kicking or stiffening of the legs, groaning, and similar convulsive movements succeed a quiet period in which just breathing was apparent before death. (11)

**Rectifications**

In most cases the poison acts so quickly that time does not permit the administration of antidotes. In cases of human poisoning, a physician should be summoned immediately, and an emetic promptly administered. A tablespoon of mustard in lukewarm water or warm salt water is practical. (25)

Some of the best measures for control are to avoid plowing up wet bottom pastures and by fencing off water areas where the animals tramp out the roots with their feet. (24) Also, care should be taken to destroy roots exposed where creek banks are washed out in high water.
Lupine. This woody plant of the prairie is characterized by the "sundial" leaf of seven leaflets.

(ref. 24)
THE PEA FAMILY (LEGUMINOSAE)

LUPINES

(Lupin species)

Common names

Sun dial, old maid's bonnet, Quaker's bonnet, Indian bean, wild bean, blue bean, blue pea, wild pea, pea vine.

Description

Although there are several species of poisonous lupines found within the borders of Montana, they are all known by the one name lupine, or by common names. Chestnut and Wilcox (6) point out the most important ones to be Lupinus leucophyllus, Lupinus sericeus, and Lupinus cyaneus, and since they are all so nearly the same, a general description will cover the entire group.

Lupines belong to the pea or pulse family and are so characterized by the pea-shaped flowers colored in varying shades of blue and white. These many-flowers form long loose spikes along the terminus of the branches; the stems, which gain a height from 10 inches to 3 feet, grow freely from a perennial root and are much branched. Most characteristic are the long-stemmed, compound leaves (see fig. 5) which radiate from a common center by which it gets the name sundial. Flowers appear in June or July followed by short pods of three to six seeds. The pod is similar to that of the pea and is usually hairy, as are many of the entire plants, giving it a gray-down appearance. (20)
Occasionally loco weed and lupines are labeled to be the same, but they are not alike either in their effect or appearance, the striking difference being in leaf characteristics.

**Animals Affected**

"Lupine is probably next to death camas in responsibility for sheep losses." (12) There have been occasional losses of cattle and horses, and in all probability goats and swine could become poisoned if a sufficiently large amount were consumed, but lupines are chiefly dangerous to sheep. "Horses seem to be especially fond of them and will sometimes eat the green plants with great greediness." (20)

**Distribution and Habitat**

Many types of lupines are found throughout the West. In Montana they are extremely abundant in foothills and dry slopes, but thrive under a variety of conditions. (24)

**Altitudinal Range**

Silvery lupine rarely extends above 8000 feet elevation (3) and sets a limit for the entire species above which their occurrence would not be sufficiently great to inflict any serious damage.

**Poisonous Periods**

Lupines are considered dangerous from the time the green pods appear (late summer) until the plants dry up in the fall. The seed and pods retain their poisonous
properties when dried and some losses result from the feeding of hay contaminated with lupines. Heavy losses also may occur if a band of sheep is overtaken by a snowstorm since the pods remain above the snow and the animals feed freely on them. It is not unusual for several hundred out of a band to be killed in this manner. (17)

Poisonous Parts

Experimental investigation by the U.S.D.A. (20) indicated that the parts of lupines are poisonous in the following order: seeds, fruits containing seeds, pods, and leaves. However, they differ somewhat in individual species. Whereas the seeds were most poisonous in most of the species examined, Beath (2) found the green fruits of Silvery lupin (Lupinus argenteus) to contain the most toxic substance.

In many regions lupines form a large part of the hay for all stock. If the harvesting of all lupines is postponed until latter August or September, the pods will have become fully ripe and split open, loosing the seeds, thus furnishing a better forage. (6)

Quantity Required to Produce Poison

Experiments show that one-half pound of seeds, one and one-half pounds of pods and seed, and three-fourths of pods alone produce toxic effects, but more scientific research should be made for a clearer understanding of this matter. (20)

The poisonous substance produced from experimental
evidence are alkaloids, the predominating one being a hepaticitis (20).

**Symptoms**

Animals may die shortly after the first symptoms appear or may live for several days.

"The amount necessary to produce the first symptoms of poisoning is so close to the amount that will cause death that it is difficult to find any symptoms that may be of value in applying remedies. This is due to the fact that the poisonous principle is excreted by the kidneys, and that the effects of the toxic substance are not accumulated in the body. Animals may eat any amount just under the toxic limit one day and repeat the performance the next day without any harmful results. If the amount of lupines pass beyond the toxic limit, however, death is most likely to occur." (7)

The above reason accounts for so large a percentage of deaths in any one band. When symptoms are exhibited before death they are most likely to be excessive frothing at the mouth, trembling, running around butting objects, sleepiness and convulsions. (15) When a hundred or more sheep are poisoned in one band there is much confusion, with sheep traveling in all directions.

**Rectifications**

For lupines there is no satisfactory remedy known that can be used advantageously for range animals, but losses can be largely prevented by proper handling of the sheep when the plant is in the pod stage. Almost all lupine poisoning occurs under the following conditions:

1. Sheep being driven from one range to another, and passing through lupine patches while hungry.
2. Sheep moving from summer range in early fall.

3. Sheep unloaded from cars in late summer and then driven through lupine patches.

4. Early fall snows covering grass and leaving lupin exposed.

5. Sheep on overgrazed or burned-over lands where lupines grow.

To hurry a band of sheep through a lupine patch can put a sheepman out of business in a few hours. As many as 600 (14) have been lost by "dogging" through. It is best to hold the band on good feed a few days, then drift them over the infested area slowly. It is well to scout over and routes of travel when moving sheep any distance in the fall of the year.
White Loco. A plant poisonous to all animals, the loco is well-known for the rattling noise the fruits make in the fall.

(ref. 24)
WHITE LOCO

(Aragallus lambertii Greene)

Common Names

Loco weed, rattle weed, woolly loco, stemless loco.

Description

The locos also belong to the pea family and have typical pea-blossom flowers, born on stems extending above the leaves. (See fig. 6) The white or stemless loco is the common one of Montana and attains a height growth of six to ten inches. (6) The flowers are white and some are tinged yellowish or bluish (other species have flowers of purple, red, or yellow). The compound leaves are low and spreading, and are olive gray in color from the presence of many small whitish hairs. Clusters of finely divided leaves usually arise along short stems or at or near the ground line. From the flowers is formed a pea-like pod which appears inflated and within which the seeds become detached when dry. The wind or any movement that shakes the plant causes these seeds to rattle, which gave rise to the common name, "rattle weed". (16)

The plants are most conspicuous during the month of June, when the white flowers are in full bloom. The seeds ripen in July when the plant is less outstanding but still noticeable from the rattle. The plant propagates entirely by seed, however, each season new leaves and flower stalks
are sent up from the old root which continues to live two or three years more. (7) The roots are long and deep reaching, enabling it to withstand drought well. (17)

White loco is easily mistaken for many false locos (species *Astrogalus*) which are not poisonous. The best distinguishing characteristic is a small spur on the keel petal of the flower. This slender spur is nearly 1/8 inch long, and is not present on the harmless loco.

![White Loco Flower Showing spur at end of keel](image)

![False Loco Flower Showing keel petal without spur](image)

**Animals Affected**

Sheep and horses are the animals most frequently affected by the loco disease. Cattle occasionally acquire the loco habit, but the cases are comparatively rare, although it is more common in Colorado, or southward. (17) Goats become locoed almost as readily as sheep and are more difficult to handle and herd when badly affected.

In Montana's past history the loco-habit at one time became so widespread among horses that raising them was abandoned, until the animals were disposed of and normal,
new stock imported.

Distribution and Habitat

Generally it is found in the plains region east of the Rocky Mountains, from Alaska to Mexico. This includes about two-thirds of the state. (17) The natural habitat is for the most part on rather dry, sandy soils like the prairie ranges. It seldom occurs on any prairie range at a distance greater than twenty miles from the mountains and appears to be spreading slowly into new territories. (6)

Altitudinal Range

Found from the foothills and dry benches of mountains, it grows to an altitude of 8000 feet, being most abundant on the northern aspects. (6)

Poisonous Periods

Loco is dangerous any time of the year if feed is the least bit short. In June the plants are eaten most freely, but stock continue to do so as long as they can find seed pods or leaves. (24)

Poisonous Parts

Little is known of the toxic principle of loco plants, (3) but whatever the causative agent may be, it seems to be quite equally distributed in all aerial parts.

Amount Required to Produce Poison

A large amount of loco must be eaten to cause symptoms of injury. Although experiments (6) along this line have not disclosed a great deal, it has been observed that the poison is slow acting and that symptoms do not appear until
until the habit of eating has been acquired.

Ordinarily stock will avoid loco, but once they start eating it an appetite for the weed develops and becomes fixed. It is a theory that sheep get the habit by imitation. If this is true it would be well to keep locoed sheep out of the herd. Once the habit is acquired, the plant is preferred even though an abundance of good forage is available. (12)

**Symptoms**

The most typical symptoms are a lack of muscular control, a drunken gait, and impaired senses. Horses usually become dull, if high-spirited, or act peculiarly. They may shy at small noises or pay no attention to loud noises that would ordinarily disturb them, or they may jump across a small rut, only to fall into a ditch that could have easily been jumped. Similar actions indicating defective senses are early symptoms, while a reduction of food and water consumption that ensues results in exhaustion and finally starvation. (7)

The first indication of locoed sheep is stubbornness and straying from the band. They become emaciated, ragged in appearance, sometimes shedding patches of wool, and rush from one loco plant to another as fast as they can eat. They later lose all sense of direction, and wander, finally succumbing for lack of food and water. (13) Lambs pick up the habit more easily than do older sheep.
Rectifications

The first good principle is to supply good feed and give laxatives; strychnine for cattle and Fowler's solution for horses. (13) Sheep should be removed from the band to prevent the habit from spreading, fed on alfalfa, which is possible in the milder cases, and sold.

It is apparent that the habit is first acquired on the range where there is a distinct lack of more valuable forage. Several things may be practiced to prevent the loco habit (24), namely:

1. Graze sheep in open formation to allow natural freedom in selection of forage.
2. Allow sheep to bed down wherever they are on the range rather than use the same bedding ground repeatedly.
3. Avoid close herding or massing.
4. Supply ample salt that the animals will not develop a perverted appetite.
5. Use semi-lococed horses as draft horses on good food.
Cocklebur. Upper--a branch of the mature plant with burs attached.
Lower--The young plant or cotyledon stage which causes many losses among pigs.

(ref. 21)
THE COMPOSITE FAMILY (COMPOSITAE)

COCKLEBUR

(Xanthium echinatum Murr)

Common Names
Burweed, sheep weed, clot-bur, hedgehog, Spanish thistle, bottom bur, ditch weed, bathurst bur, noogoora.

Description
Cocklebur is a coarse, bushy annual, one to three feet high, with roughened, angular, reddish-brown stems. The broad, rough leaves branch alternately from the main stem (see fig. 7) and are covered on surfaces with minute hairs. Small, yellowish flowers which might be easily overlooked give rise to clusters of bristly burs which are the conspicuous part of the plant. They are from \( \frac{1}{2} \) to 1\( \frac{1}{4} \) inches in diameter and covered with spiny hooks. (10)

Each bur is a fruiting body containing two slender seeds. Ordinarily only one seed germinates in the year following maturity, and the other in the second year or later. (22)

The young plants in the cotyledon stage are the most poisonous, and differ in appearance considerably. The seedlings have two long, slender leaves and a short terminal bud at the axis (see fig. 7). They are as succulent as they appear to be.

Animals Affected
The most severe losses from cockleburs are among swine and colts. Numerous cattle and sheep are killed by eating
this plant, as are sometimes horses, but largest losses are among young pigs which eat them most readily (21). In Montana cattle and sheep have been poisoned where feed is not abundant. (24)

Distribution and Habitat

The weed is almost universally known, but in Montana is most commonly found east of the Continental Divide. It grows on low alkaline ground, in moist places along roadsides or pastures, and along shores of lakes, ditches, and swamps. Old burs accumulate on the shores of lakes to become partially buried. With the receding of the water during dry seasons bands of young plants develop according to the moisture content of the ground, making for a succession of crops of cotyledons for several weeks. (22)

Altitudinal Range

Rarely found above 6000 feet, burweed is most common on the lower ranges. (6)

Poisonous Periods

As has already been pointed out, the plant is seldom eaten when it is in full leaf and bur stage. Germination of seeds occurs in the spring and up to the middle of July, depending upon localized environmental conditions.

Poisonous Parts

Seeds within the burs are the most poisonous parts, while a close second is the young cotyledon leaves. Fully formed leaves are mildly toxic, but are also bitter and seldom eaten, but young plants have no disagreeable
taste and are relished by the animals. The bur has the mechanical disadvantage of being unpalatable. (22)

Quantity Required to Produce Poisoning

Experiments by Marsh (22) showed a lethal dosage amounted to 15% of the pig's weight while below that amount to .7% proved to be a toxic dose.

The stage of the plant up to the time the first leaves are partially formed, the toxic substance was found to be Xanthium, which is not a cumulative poison but is rather rapidly eliminated. (24)

Symptoms (21)

The first symptoms in swine are depression, accompanied by frequent vomiting. As sickness advances, the animals showed signs of weakness, gasping, and spasmodic movements of the body. Occasionally running movements were noticed, or no movement preceded death.

In sheep and cattle extreme depression was the first index of toxicity, followed by similar symptoms mentioned above except for vomiting which was not present.

Rectifications

Beneficial remedial measures (22) may be produced by use of milk, oils, or fats if given in comparatively large doses (1-2 quarts or 2-3 ounces of lard etc.) soon after the plant has been eaten.

To prevent the animals from eating the weed is, again, the best means to avoid Xanthium losses. Pigs are attracted to margins of shallow ponds when cockleburs grow profusely
and are poisoned, as are other animals, which find the succulent growth when there is a lack of suitable forage.
## Chart of Montana's Poisonous Plants

<table>
<thead>
<tr>
<th>Plant</th>
<th>Outstanding Distinguishing Characteristics</th>
<th>Habitat</th>
<th>Dangerous Season</th>
<th>Dangerous Parts</th>
<th>Animals Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death camas</td>
<td>6-24&quot; tall; white flowering head; a dense cluster grass-like leaves</td>
<td>Foothills and plains</td>
<td>Spring</td>
<td>Flowers leaves bulbs</td>
<td>Sheep horses cattle</td>
</tr>
<tr>
<td>Zygadenus venenosus Watts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall Larkspur Delphinium</td>
<td>4-7' tall; bluish &quot;Cock's spur&quot; flowers, &quot;Crowfeet&quot; leaves, 7 lobes</td>
<td>Mountains wooded areas ravines</td>
<td>Spring summer fall</td>
<td>Leaves stems seeds flowers</td>
<td>Cattle horses mules</td>
</tr>
<tr>
<td>Low Larkspur Delphinium bicolor Nutt.</td>
<td>6-16&quot; tall; purple &quot;cock's spur&quot; flowers</td>
<td>Everywhere except in dense woods</td>
<td>Spring</td>
<td>Leaves stems flowers</td>
<td>Cattle</td>
</tr>
<tr>
<td>Water hemlock Cicuta occidentalis Greene</td>
<td>2-3' tall; white flowers all at tip of stem; chambered bulbs.</td>
<td>Wet places</td>
<td>All seasons</td>
<td>Young shoots</td>
<td>All including man cattle</td>
</tr>
<tr>
<td>Lupines Lupinus spp.</td>
<td>10-36&quot; tall; bluish-white, pea-like flowers; &quot;sundial&quot; leaves; hairy down covered</td>
<td>Dry hillsides prairies, ridges</td>
<td>Midsummer and early fall</td>
<td>Fruit flowers leaves</td>
<td>Sheep cattle horses</td>
</tr>
<tr>
<td>White loco Aragallus lambertii Greene</td>
<td>6-10&quot; tall; yellowish flowers on long stem &quot;rattle&quot; fruits; leaves low, clustered</td>
<td>Prairie ranges</td>
<td>All seasons</td>
<td>Flower fruit leaves</td>
<td>Horses sheep cattle</td>
</tr>
<tr>
<td>Cocklebur Xanthium echinatum Morr</td>
<td>1-3&quot; tall; young plants 2 slender green leaves; adult, bushy, burs</td>
<td>Roadsides, creeks, waste places</td>
<td>Spring early summer</td>
<td>Young</td>
<td>Hogs colts cattle sheep</td>
</tr>
</tbody>
</table>
REFERENCES CITED


