Keep in mind the following management practices for grazing a larkspur-infested area. In this way, animals can be kept from eating amounts large enough to cause serious losses.

1. Graze a larkspur-infested area with older animals. They are less likely to eat poisonous plants than are young animals with still-inquisitive grazing habits.

2. Where possible, use sheep, rather than cattle, on infested areas. Sheep are less susceptible.

3. Delay grazing until after the poisonous plant has flowered and shed seed. This will almost completely prevent livestock losses. Larkspurs lose their toxic effect as they grow older.

4. When larkspur occurs in only small localized areas of the range it is possible to prevent livestock use of those areas by fencing, herding, salting, or stock water control until after larkspur has matured.

5. Feed animals well before moving them through an infested area, and move them slowly. Livestock cease to be selective in their grazing habits when they are driven rapidly, and are more likely to eat poisonous plants if they are not allowed to graze at their normal rate.

6. Chemical control may be necessary where larkspur is fairly well scattered through a range area, and deferment of grazing is impractical. (See below, "Controlling Larkspurs.")

CONTROLLING LARKSPURS

The elimination of larkspurs from an infested range is difficult. Where only scattered plants occur, hand grubbing is the most reliable method.

The low larkspurs have been controlled by spraying with the low-volatile ester of 2,4-D, but timing of the spray is important. Two pounds of 2,4-D per acre, applied from the time of emergence to the rosette stage, have controlled low larkspur, but have not eliminated it. These early-sprayed areas can usually be grazed with safety in the same season that they are sprayed since the older plants are killed back and regrowth does not occur during the grazing period. With a heavy cover of forage or other vegetation, the small seedlings may not be contacted by the spray. Late spraying of older plants is not recommended because it is not so effective, and may actually result in increased palatability, thus causing losses that would not normally occur.

Ground application with high volume (50 to 100 gallons per acre) may be more effective in heavy vegetation than airplane applications of 5 to 10 gallons per acre. Repeat treatments in succeeding years will be necessary to reduce the infestation further, and spot treatment of scattered plants may be necessary as they develop from seeds in the soil.

A combination of 2,4-D sprays with management practices to encourage the desirable range species will combine the effects of competition and spray for the greatest reduction in larkspur stand.

Chemical control of tall larkspur has not been successful in California.

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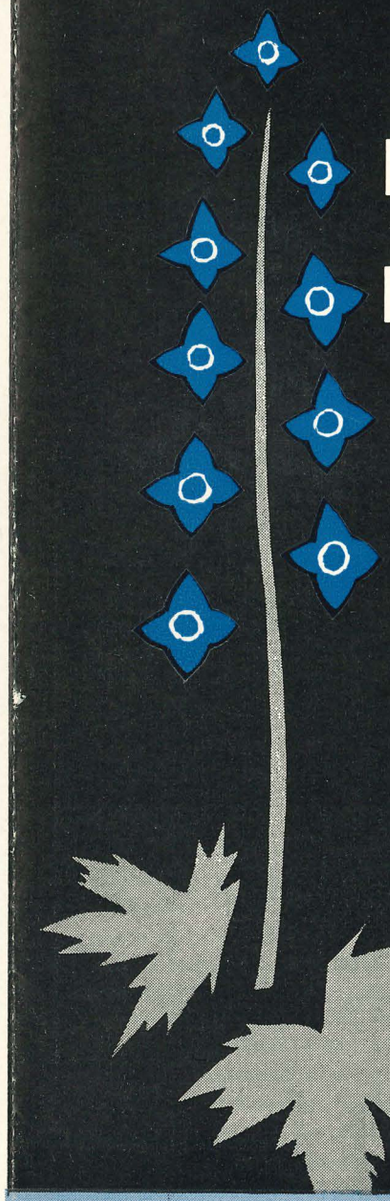

POISONOUS LARKSPURS

Identification and Control

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HOW TO RECOGNIZE LARKSPURS

Larkspurs have long been known as plants poisonous to livestock. Early studies of poison plants in the West singled them out as among the worst offenders. Studies at the University of California, reported in 1935, indicated that larkspurs probably cause more cattle losses in California than does any other group of plants. Without doubt, they still represent a serious menace to livestock on California rangelands.

Larkspurs (*Delphinium*), also known as "poison weed" or "cow poison," belong to the buttercup or crowfoot family (*Ranunculaceae*). Native California larkspurs are all perennials. They are of two general sorts: (1) the tall larkspurs—robust plants with coarse, erect, hollow stems, usually between 3 and 6 feet tall; and (2) the low larkspurs—smaller plants with more slender stems usually about 1 to 2 feet tall. The flowers are usually some shade of blue or blue-violet. A few species have red flowers. One of the most distinctive features is the spur that projects from the back of the flower (see illustration). After the outer flower parts wither and drop off, seed pods form, usually in groups of three (see illustration). These split open when ripe, and shed the numerous seeds.

When larkspurs are in bloom they can be readily distinguished from other range plants by the characteristic spurs on the flowers. Since livestock poisoning often occurs before flowering, however, it is frequently necessary to identify suspected plants at earlier stages of growth. The leaves of all the larkspurs are palmately lobed, toothed, or divided—that is, the leaf has lobes or divisions radiating out from the center much as wide-spread fingers extend from the palm of a hand. Many features of the larkspur leaf may vary from one species to another—the size, the width of the lobes, the sharpness or bluntness of the lobes, and so forth—but all leaves show this palmate pattern of lobing. At stages before flowering, however, several other groups of native range plants may be confused with larkspurs. The perennial buttercups, the wild geraniums, certain wild mallows (for example, species of *Sidalcea*), and a few plants in the parsley family (*Umbelliferae*), such as Pacific sanicle (*Sanicula crassicaulis*), also have leaves that are palmately lobed or divided, and thus are similar to certain low larkspurs (see illustration). For the most part, these other plants are nontoxic, although a few of the buttercups may be acrid and more or less irritating.

Left: part of flower cluster of larkspur. Note distinctive spurs. Right: seed pods of larkspur. Note arrangement in groups of three.

Western monkshood (*Aconitum columbianum*) is very similar to the tall larkspurs, particularly mountain larkspur (*Delphinium glaucum*). Monkshood is also a poisonous plant, and is often found growing with mountain larkspur. The two may be distinguished from one another by the following differences: (1) the stems of tall larkspurs are hollow; those of monkshood have a solid core of pith; and (2) the leafstalks of monkshood become progressively shorter toward the top of the stem, the stalks of the upper leaves being extremely short, or lacking. In the tall larkspurs, on the other hand, the

upper leaves have definite stalks, although they may be shorter than those of the lower leaves. Once the plants are in flower, larkspurs and monkshood may be readily distinguished, for the flowers of monkshood do not have the spur so characteristic of the larkspurs. Instead, the upper sepal somewhat resembles a small hood, hence the name, monkshood.

WHERE LARKSPURS GROW

The tall larkspurs are most common at higher elevations in the northern part of the state and in the Sierra Nevada. One species (*Delphinium californicum*), however, occurs in the hills of the Coast Range of central California, often near the coast. Tall larkspurs prefer moist situations, such as damp meadows or the margins of streams and ponds.

The low larkspurs are most abundant at lower elevations, on open hillsides and in openings in chaparral, particularly in the Coast ranges. One species (*Delphinium parishii*) occurs in desert areas in southern California.

POISONOUS PROPERTIES

Several poisonous alkaloids have been isolated from different species of larkspur, one of the most powerful being delphinine. It seems likely that all our native species are poisonous, although they probably vary in their degree of toxicity, and some species, even though poisonous, are not found in sufficient abundance to be dangerous.

The greatest stock losses occur early in the season before the plants bloom, while the young stems and leaves are actively growing. The young leaves are the most poisonous; as the plant matures, potency decreases. One investigator found that leaves from fruiting plants were only one-sixteenth as poisonous as were leaves from young plants. Fully mature plants are generally reputed to be relatively harmless, but livestock losses from tall larkspurs have been reported in Utah as late as September and October. Therefore it would seem best to regard larkspurs as dangerous at all times. The seeds are even more poisonous than the leaves, but are probably rarely eaten in sufficient quantity to cause trouble. The low larkspurs are reportedly poisonous during the whole life of the plant, but since the tops have usually dried up and died by early summer, they are dangerous mainly in early spring.

Larkspurs cause heaviest losses in cattle. Under range conditions, very few horses are lost, and sheep, with their greater tolerance, are probably only very rarely poisoned. However, it seems likely that large quantities or unusually potent plant material will poison most domestic animals. One report from New Zealand records the death of 15 sheep that had eaten withered stalks, bearing seed pods, of *Delphinium consolida*, a European species grown as an ornamental, that had been thrown out as garden refuse.

SYMPTOMS OF LARKSPUR POISONING

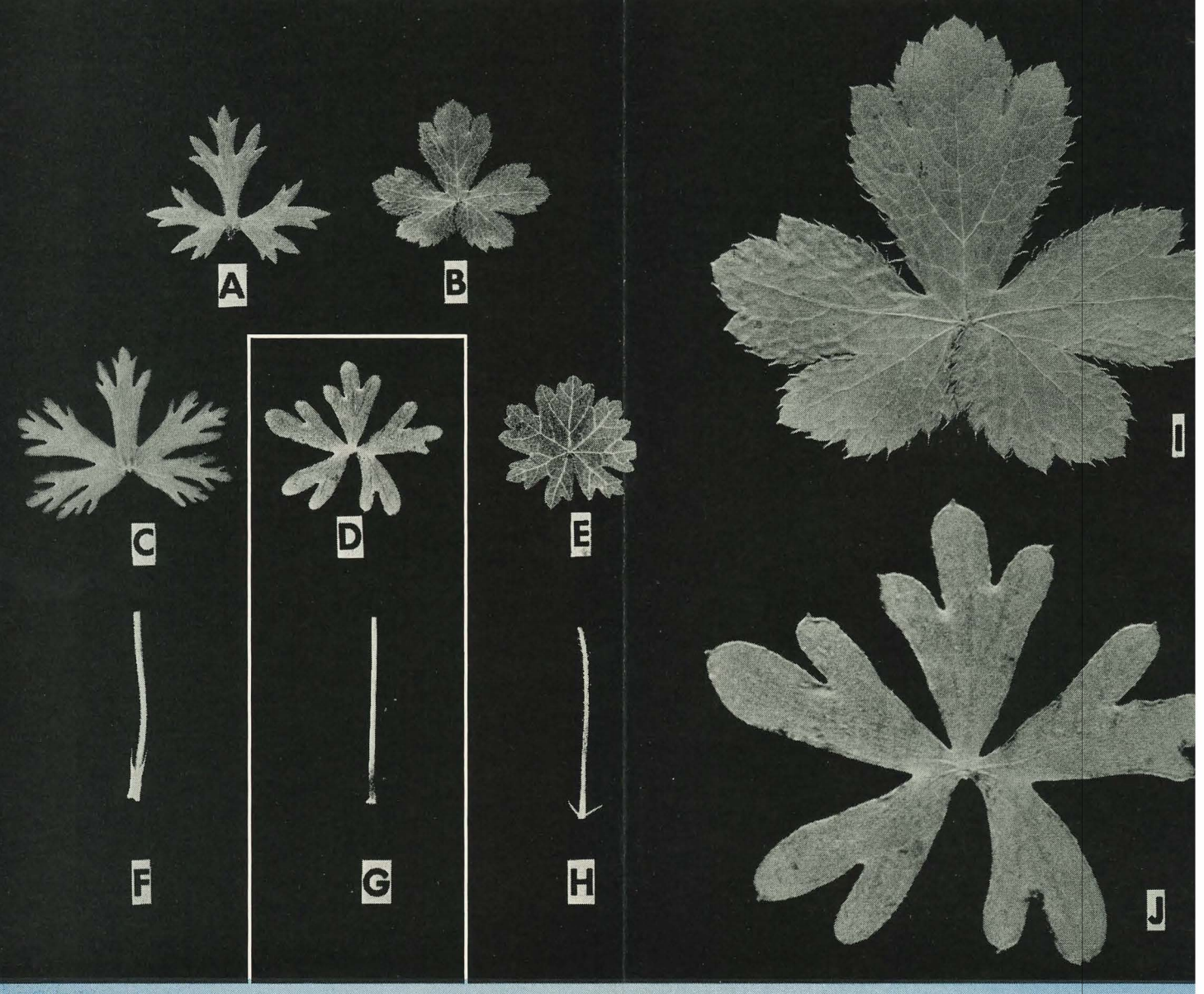
The symptoms of poisoning are the same for all larkspurs. The alkaloids act on the nervous system, and affect heart action, respiration, and muscular activity. Muscular twitching and a staggering gait may be observed, but more commonly the animal simply falls suddenly. After some struggling, it may rise to its feet, walk away, and show no further symptoms. More severely poisoned cases may fall repeatedly, and finally be unable to rise. Colicky pains and bloating may sometimes occur. Retching efforts to relieve paunch pressure may lead to vomiting, with the added danger of inhaling paunch contents. Increased salivation and swallowing are observed in some animals. Finally the prostrated, but conscious, animal dies of respiratory failure. Death or recovery usually occurs within 24 hours. No diagnostic changes are found at autopsy.

PREVENTION OF LARKSPUR POISONING

There is no simple effective treatment for larkspur poisoning. Management practices designed to keep the animals from eating sufficient quantities to cause damage are much more effective than treatment of affected animals. Veterinary service is recommended when valuable animals are found in early stages of the disease.

In general, poisonous plants do not grow in large numbers when the range is in good condition and supports an abundance of good forage species. Likewise, poisonous plants are apparently less palatable than most common forage species, and are seldom eaten when other plants are abundant. Improper use of range, therefore, may result in an increase in the percentage of poisonous plants present, and increase the opportunity for those plants to be eaten by the grazing animals.

Animals that are in a good state of nutrition seldom select poisonous plants for grazing. The provision of supplemental feed early in the grazing season, when the growth of range grasses is short, or later when the forage has become less palatable or has deteriorated following early rainfall, will help prevent losses from poisonous plants.



HOW TO DISTINGUISH POISONOUS LOW LARKSPURS FROM SIMILAR, BUT NONTOXIC, PLANTS

Leaves, leafstalks, and roots provide clues for distinguishing larkspurs from other plants when no flowers are present. Note the similar palmate pattern of lobing in the leaves of smooth larkspur (*Delphinium patens*), D, and in those of other plants shown around it: A, western buttercup (*Ranunculus occidentalis*); B, Pacific sanicle (*Sanicula crassicaulis*); C, wild geranium (*Geranium carolinianum*); and E, wild mallow (*Sidalcea*).

NONTOXIC PLANTS

In wild geranium, F, and mallow, H, base of the leaf stalk bears a pair of small appendages, called stipules, on either side.

In Pacific sanicle, I, teeth of the leaf margins are tipped with short, fine hairs.

In buttercup, below, K, the root system consists of numerous slender, fibrous roots.

LOW LARKSPURS

No stipules at base of the leaf stalk, G.

No fine hairs on the tips of leaf margins, J.

The root is dark-colored, thickened, and tuberlike, below, L, or a cluster of coarse, woody roots, below, M.