Grazing Risk on Tall Larkspur-infested Ranges

James A. Pfister, Dale R. Gardner, and Kermit W. Price

Tall larkspur is responsible for more cattle death losses on mountain ranges in the West than any other poisonous plant. In areas with abundant tall larkspur (*Delphinium barbeyi* or *D. occidentale*) populations, many cattle producers lose about 5% of their herds each year, and some losses exceed 15% per year. This is a heavy economic burden. The presence of tall larkspur often dictates summer grazing management of cattle on mountain rangelands. Nearly a century ago, researchers suggested that producers avoid tall larkspur-infested ranges until larkspur matured (Glover 1906). In this paper we provide suggestions for grazing tall larkspur ranges during the early summer period.

Tall larkspur exacts other costs from ranchers besides dead cattle and management headaches. There are large losses of grazeable nutrients when cattle producers defer grazing of tall larkspur-infested pastures until late summer or early fall when forages undergo a substantial decrease in nutrient content. Other producers avoid grazing infested pastures with cattle entirely, or substitute sheep grazing for cattle. They reason that the potential poisoning of cattle is not worth the risk of grazing. These adjustments have caused some ranches to relinquish their cattle grazing permits and leases on public lands, with diminished ranch values.

Tall larkspur contains numerous alkaloids, several of which are very toxic. As tall larkspur matures, the amount of these toxins typically decreases, except in maturing pods. Cattle generally begin eating tall larkspur during the flower stage, and consumption usually peaks during late flower or pod stage. The relationship between declining, but still substantial, tall larkspur toxicity and increasing consumption by cattle after flowering results in a toxic window when most cattle deaths can be predicted (Fig. 1). Depending on weather conditions, this toxic window may be about 4 to 5 weeks long in a typical season. What about the period before larkspur flowers (i.e., before larkspur stems elongate flowering racemes)? Can cattle be safely grazed during this time period (called early grazing in this paper), or is the risk of poisoning too high since tall larkspur is very toxic? A study was conducted to provide an additional test of early grazing, adding to studies that were done over a 9–year period (Pfister et al. 1997).

1996 Study, Yampa, Colo.

Sixteen mature cows grazed a 4,000 acre Forest Service allotment from 21 June to 10 July, 1996 near Yampa, Colo. The allotment covers an elevation gradient from 8,200 ft. to nearly 11,000 ft. Due to unseasonably warm weather and rapid snowmelt, early summer forage growth occurred very

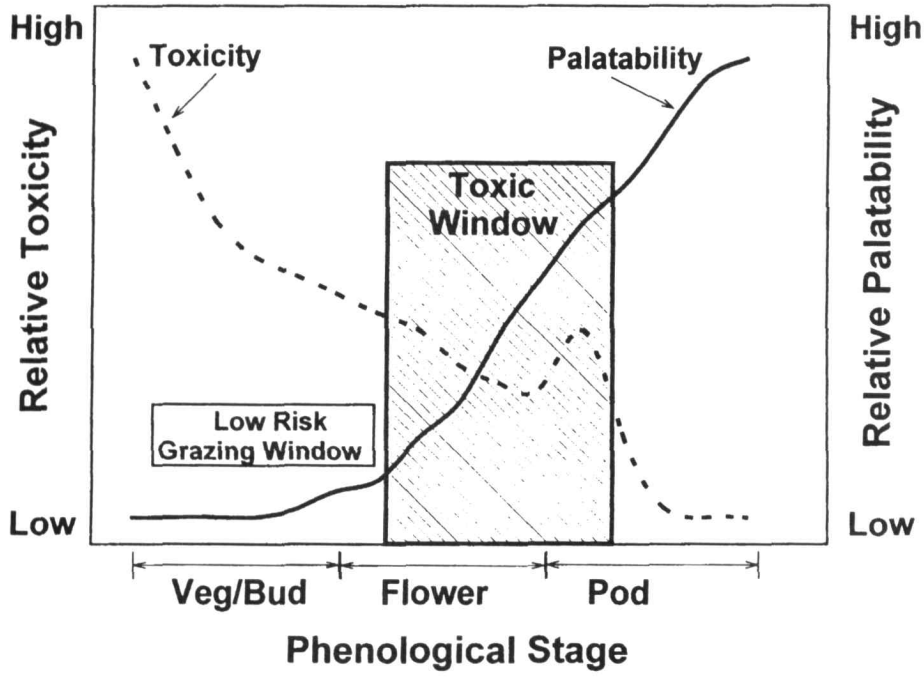

Fig. 1. *General relationship between tall larkspur toxicity and palatability to cattle (no units). The shaded area defines a primary toxic window when toxicity and palatability are both sufficiently high that most cattle deaths occur during this time. There is also a grazing window, during early growth stages before tall larkspur flowers, when cattle may be grazed with low risk even though tall larkspur toxicity is usually very high. Adapted from Pfister et al. (1988).*

rapidly, and in our opinion cattle could have been introduced into the allotment at least 7 days earlier. Twenty tall larkspur plants were inspected weekly to determine stage of growth in a typical patch located partially under an aspen canopy at 9,400 ft. elevation. Other tall larkspur plants in the same patch were harvested weekly to determine tall larkspur consumption. Bite counts taken daily from horseback were used to determine tall larkspur consumption. We collected data on all 16 cows during 6 hours of daily observations that encompassed their peak grazing periods. The period before larkspur stems elongated was termed the **preflower** period, and the time between stem elongation and opening of the flowers was termed the **early flower** period.

Risk is defined as the chance of loss, and in the context of this paper, risk is the perceived threat of losing cattle to tall larkspur poisoning. The dose response of cattle to tall larkspur (and related risk) was quantified by relating tall larkspur toxicity (i.e., amount of toxic alkaloid) and consumption (% of diet as tall larkspur) for a 1,200 lb. cow (Fig. 2) The larkspur dose (and the resultant likelihood of poisoning) was categorized as either high, medium, or low.

Cattle ate no tall larkspur during the preflower stage before larkspur elongated flowering stems. Cattle began eating tall larkspur during the early flower period, and ate an average of < 0.5% of bites on 1 July, 2.5% on 2 July, 2% on 4 July, and nearly 6% on 5 July. All tall larkspur consumption occurred near a riparian area at 8,200 ft. elevation on these dates, and cows were not observed to eat larkspur on the other days of the study. When eating tall larkspur, cows consumed primarily leaves, but occasionally they ate a small amount of flowering parts and stem material. None of the animals showed any symptoms of poisoning after eating tall larkspur. The risk of losing cattle was low before flowering stems began to elongate, and risk remained generally low during the early flower period when cattle began to eat some tall larkspur (Fig. 2).

Tall larkspur grew rapidly during the study, as temperatures were above normal. Stems on the marked plants were either vegetative or had buds on 21 June, but by 5 July many stems had begun to elongate, and were in full flower within a week. The marked tall larkspur plants (growing at 9,400 ft.) elongated flowering stems about 7 days later than those tall larkspur plants (not marked) growing at a lower elevation (8,200 ft.) where cattle were grazing.

The amount of toxic alkaloid (mg/g dry weight) in tall larkspur decreased only slightly as the larkspur matured, with average concentrations in leaves at 7.9 mg/g on 21 June, 6.9 mg/g on 28 June, 5.7 mg/g on July 5, and 5.6 mg/g on 12 July. In general, we categorize toxic alkaloid concentrations as follows: less than 3 mg/g – low toxicity; 3 to 6 mg/g – moderately toxic; greater than 6 mg/g – highly toxic. Most tall larkspur samples from Colorado, Utah, and Idaho have toxic alkaloid concentrations between 2 and 15 mg/g.

Conclusions and Recommendations

The risk of losing cattle to tall larkspur is low if plants have not elongated flowering stems. In this study and others (Pfister et al. 1997), cattle ate little or no tall larkspur before flowering, thus providing a low risk grazing period (Fig. 1). Even though amounts of toxic alkaloid are usually high in immature larkspur, cattle are unlikely to eat tall larkspur in sufficient amounts for poisoning to occur. We grazed the cows in this study for about 3 weeks before tall larkspur began to flower, but we were late in getting into the allotment, and there was sufficient forage growth for grazing at least 1 week earlier. In most cases, ranchers can gain about 4 weeks of grazing on tall larkspur-infested ranges during this early grazing period (Pfister et al. 1997). Early season grazing may benefit range plants if done properly (Lacey et al. 1994).

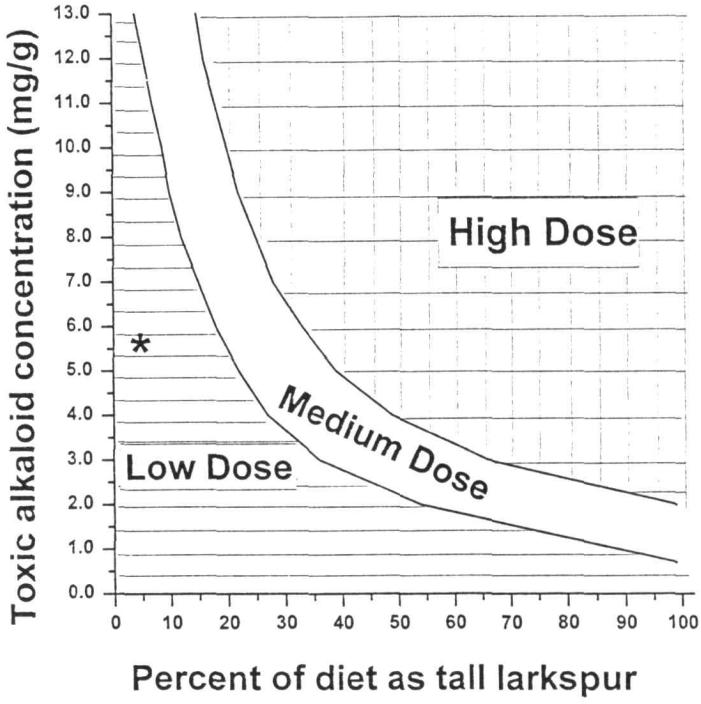

Fig. 2. *Dose response of cattle to tall larkspur. The y-axis shows the toxic alkaloid concentration (mg/g dry wt.) in larkspur and the x-axis shows the amount of tall larkspur in cattle diets (% of dry wt.). The risk of poisoning cattle increases as the toxicity of the plant increases and as consumption by cattle increases. The star indicates the approximate amount of tall larkspur eaten by cattle at Yampa, Colo. and the toxicity of larkspur samples in early July; the average dose (and risk) to grazing cattle was low. Ranchers interested in alkaloid analysis of tall larkspur samples should contact the authors.*

Even though cattle may eat little or no tall larkspur during the early flower stage, this does not necessarily mean that cattle will not eat tall larkspur later in the grazing season. Cattle may begin to eat larkspur suddenly at any time during or after flowering, therefore, the amount of tall larkspur eaten before flowering should not be used to predict post-flower consumption.

Growth of tall larkspur is influenced by environmental conditions (e.g., snow cover, temperature, precipitation), but there are general patterns that ranchers can observe.

Newly emergent tall larkspur shoots grow for several weeks in the vegetative stage. Visible bud clusters then develop for about 2 or 3 weeks, followed by rapid elongation of flowering stems. The transition in tall larkspur growth from preflower to flowering can be easily distinguished by observing if many stems have elongated. Fully developed tall larkspur buds often "nod" or droop to one side when stem elongation begins, and this is another visual clue that the transition is occurring. Flowers on newly-elongated stems generally require one to several weeks to open fully after stems have reached about 90% of their mature height. The toxic window shown in Fig. 1 begins in the early flower or full flower growth stage, depending upon when cattle begin to eat larkspur, and continues until tall larkspur pods begin to dry out.

When (or sometimes if) cattle begin to consume increasing amounts of tall larkspur, knowing the toxic alkaloid concentration may be critical in making grazing management decisions. Grazing management decisions can be improved if information on tall larkspur toxicity and possible dose response are considered in conjunction with the possibility that cattle will eat dangerous amounts of tall larkspur at a particular growth stage (Fig. 1). If tall larkspur toxicity is high, and cattle are likely to eat larkspur, ranchers may wish to defer or discontinue grazing to avoid losses. Figure 2 can provide general guidelines to help producers determine the toxic alkaloid dose that will poison cattle.

We recommend that management of tall larkspur-infested ranges be evaluated to determine if it is feasible to take advantage of this early low-risk period. When it is feasible, cattle should be grazed on these high elevation ranges as soon as sufficient forage is available. Generally, larkspur will still be vegetative when there is about 400 to 500 lb./acre of forage on these high-elevation ranges. Reduced grazing of lower elevation ranges during early summer through timely removal of cattle to higher elevation ranges may ease some constraints (e.g., riparian management; lack of forage) that can limit overall carrying capacity. Livestock producers should also consider removing cattle or reducing cattle numbers on high elevation ranges when tall larkspur flowers to

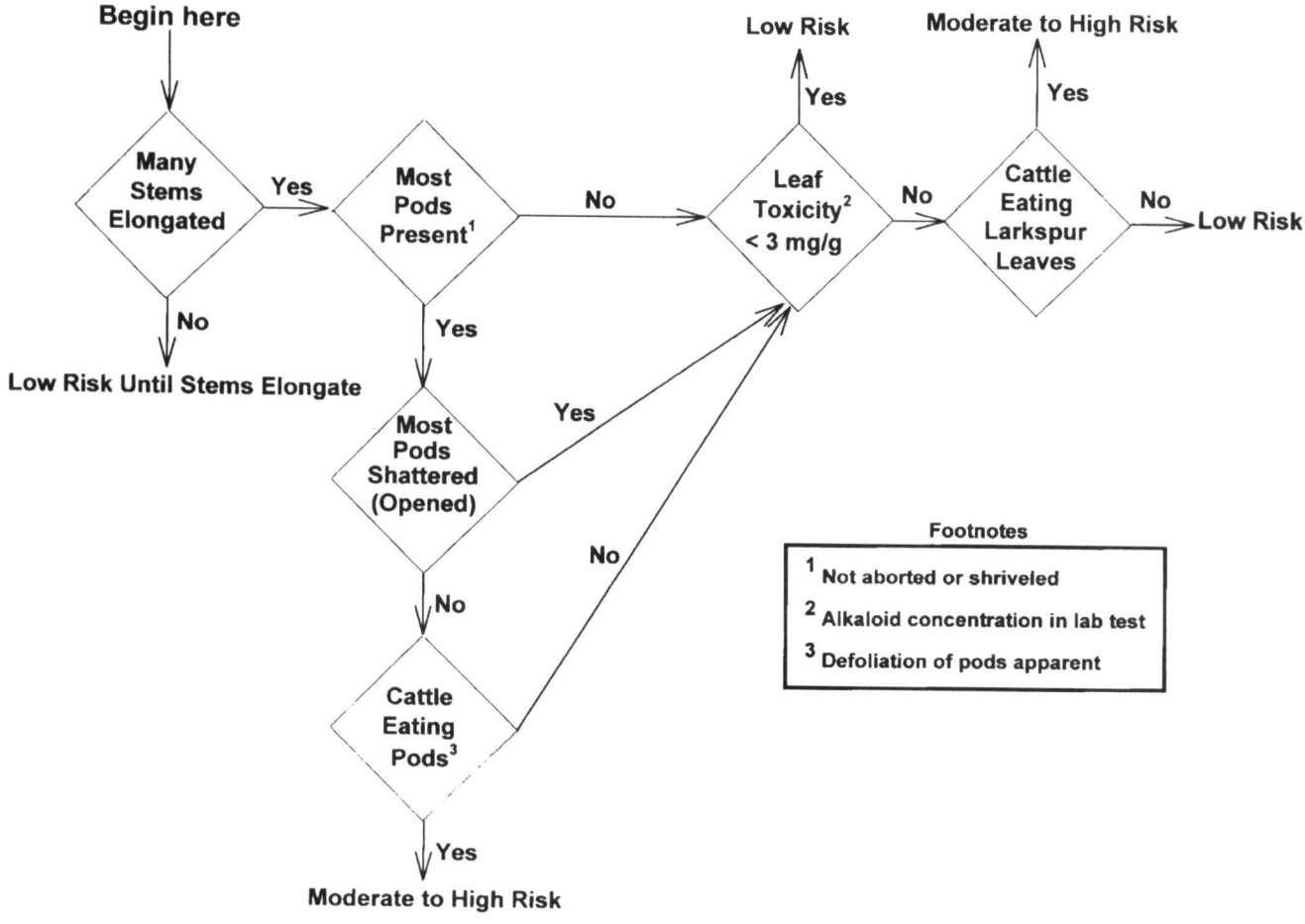

Fig. 3. *Decision-making flow chart indicating the relative risk of grazing tall larkspur ranges depending upon tall larkspur growth stage, toxicity, and actual or potential consumption by cattle.*

reduce risk of cattle losses, particularly if cattle are eating tall larkspur. For a crude indication of tall larkspur consumption, livestock producers can quickly note defoliation of flowers (perhaps even leaves) without observing cattle actually eating tall larkspur. We suggest that ranchers get out into the field and directly observe what cattle are actually eating one or two days each week when cattle begin to graze troublesome pastures. If cattle remain on tall-larkspur infested ranges after larkspur has flowered, and cattle eat large quantities of larkspur, relative risk of losing cattle may be high until tall larkspur toxicity decreases with maturity. Producers can generally graze larkspur ranges with little risk once seed pods have shattered.

We have provided a simple flow chart (Fig. 3) that livestock producers can use to help determine if cattle should be placed on a larkspur-infested range, or alternatively removed at some point during the grazing season. Ranchers should consult with the authors about alkaloid analysis of tall larkspur samples. Our results do not apply to low larkspurs (e.g., *D. nuttallianum*) or to plains larkspur (*D. geyeri*), as they grow in different habitats, and specific grazing recommendations are being developed for these species.

Literature Cited

Glover, G.H. 1906. Larkspur and other poisonous plants. Colo. Agric. Expt. Sta. Bull. 113.

Lacey, J., S. Studiner, and R. Hecker. 1994. Early spring grazing on native range. Rangelands 16:231–233.

Pfister, J.A., G.D. Manners, M.H. Ralphs, Z.X. Hong, and M.A. Lane. 1988. Effects of phenology, site and rumen fill on tall larkspur consumption by cattle. J. Range Manage. 41:509–514.

Pfister, J.A., M.H. Ralphs, G.D. Manners, D.R. Gardner, K.W. Price, and L.F. James. 1997. Early season grazing by cattle of tall larkspur- (*Delphinium* spp.) infested rangeland. J. Range Manage. 50:391–398.

Authors are with the USDA-ARS Poisonous Plant Research Laboratory, 1150 E. 1400 N., Logan, Ut. 84341.

The authors thank Bob and Ann McKune, who graciously assisted in research on their grazing allotment, and also thank Dirk and Jeff Salmon for assistance with the study. We thank John Walker for providing stimulating reading and constructive thoughts on the topic.