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USDA-ARS Poisonous Plant Research Laboratory: History and Current Research on Western North American Rangelands

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On the Ground

- Poisonous plants on western North American rangelands have historically been troublesome to livestock producers.
- Research on toxic plants was initiated by the United States Department of Agriculture in the late 1890s to solve problems for the livestock industry.
- The United States Department of Agriculture Agricultural Resource Service Poisonous Plant Research Laboratory in Logan, Utah continues to provide research-based solutions to poisonous plant problems besetting livestock producers, hobby farmers and small holders, veterinarians, and extension personnel.
- Principal plants of current research interest include larkspur, lupine, locoweed, selenium accumulating plants, pyrrolizidine alkaloid-containing plants, and ponderosa pine.

Keywords: poisonous plants, cattle, sheep, livestock, toxic, plant secondary compounds.

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The colonization of western North America brought domestic livestock to this continent in the early 1500s, when cattle were introduced into Mexico by Gregorio Villalobos in 1521. Cattle, sheep, and horses were introduced into the western United States by Coronado in 1540. However, the real beginning of the range livestock industry in the western United States is attributed to the movement of settlers and livestock into the Mississippi Valley, and these herds merged with livestock moving from Texas northward to other states. From about 1865 to 1895, 5 million head of cattle were moved north out of Texas. Forage on rangelands was considered to be limitless, and predators and thieves were the major worries for livestock producers. Poisonous plants were not a major concern given the extensive animal husbandry practices during that era.

Settlers in the Midwest had some experience with plant toxicity in humans and livestock from milk cows eating white snakeroot (*Ageratina altissima*), but large-scale losses of livestock to poisonous plants were rare on eastern rangelands. The range livestock industry in the United States boomed after the Civil War as large numbers of cattle and sheep were trailed onto expansive western rangelands. Soon thereafter, large losses of livestock from poisonous plants were reported as ranchers encountered unknown plants such as locoweeds (*Astragalus* and *Oxytropis* spp.) and larkspurs (*Delphinium* spp.), among others (Fig. 1.).

History of the Poisonous Plant Research Laboratory, Logan, Utah[i]

Spurred on by numerous accounts of field losses, United States Department of Agriculture (USDA) officials decided to act. V. K. Chesnut, assistant botanist for the USDA, was assigned to begin field investigations in 1895 in the western US, including Utah. Chesnut and his associate, E.O. Wilcox, made field investigations in Utah and other states focusing on locoweeds and larkspurs (Figs. 2 and 3). In 1901, six different divisions (Botany,

[i] The 70th Annual Society of Range Management Annual Meeting will be held in St. George, Utah 29 January–2 February 2017. This article highlights Utah range science and management. For more information on SRM Red Rock & Rangelands 2017 see http://rangelands.org/srm17/.

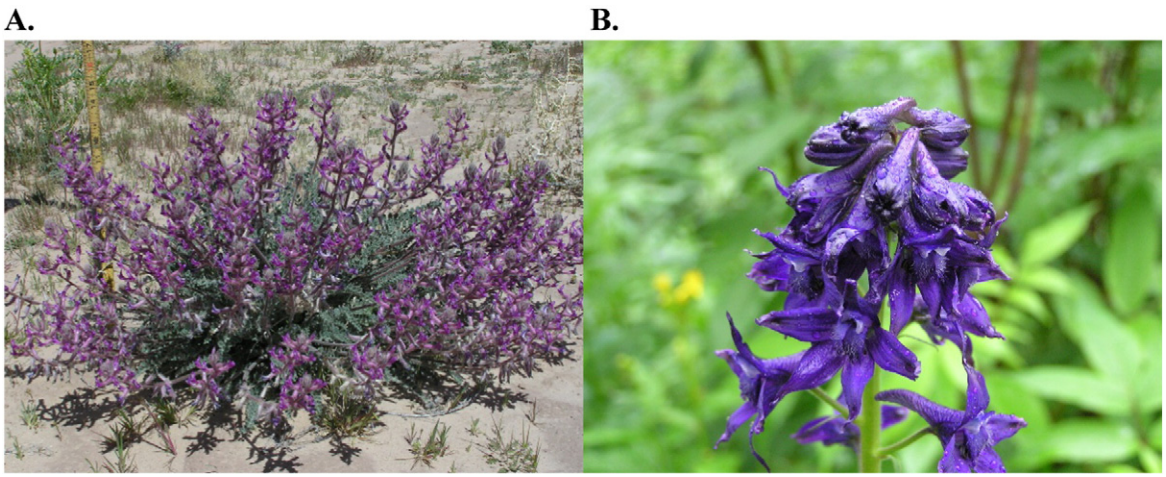

Figure 1. A, *Astragalus mollissimus*. **B,** *Delphinium barbeyi*. Photos courtesy of Al Schneider©, www.swcoloradowildflowers.com.

Pomology, Vegetable Physiology and Pathology, Agrostology, Gardens and Grounds, and Seeds) within the USDA were consolidated into the Bureau of Plant Industry (BPI). One initial emphasis of the BPI was investigations in systematic botany, including the development of a herbarium for reference and research. An outgrowth of the herbarium effort was the collection of information by BPI botanists on the distribution of poisonous plants, including "their identity and harmful characteristics." The renowned animal physiologist Dr C. D. Marsh was hired in 1905 as 'Animal Physiologist in Charge' of Poisonous Plant research, where Marsh and coworkers initially worked at field stations in Hugo, Colorado and Imperial, Nebraska. In 1908 these temporary stations were closed and moved to Gunnison, Colorado, and then again to Greycliff, Montana until 1914. These early research stations were temporary locations tasked with the study of site-specific toxic plant problems, such as locoweed and larkspur.

In 1915 the investigation of poisonous plants was transferred from the BPI to the Division of Pathology in the Bureau of Animal Industry, and also moved to a more permanent research facility, the Salina Experiment Station, in Fish Lake National Forest near Salina, Utah (Fig. 4). At the Salina Experiment Station research continued on locoweed, larkspur, lupine, and other toxic plants under the direction of Dr Marsh. Additional studies were conducted on big head poisoning in sheep, oak brush poisoning in cattle, and sneezeweed and milkweed poisoning in sheep (Fig. 5). The harsh winters precluded winter occupancy of the Salina Experiment Station, and the researchers decamped to Washington, DC during each winter. Dr C. D. Marsh was head of the poisonous plant investigations in the western United States (including Salina, Utah) from 1905 to 1930, and was eventually replaced as director at Salina by Mr A. B. Clawson (animal physiologist).

The pioneering efforts of C. D. Marsh and his coworkers over the years led directly to the formal creation in 1955 of the Poisonous Plant Research Laboratory (PPRL[ii]) within the Agricultural Research Service (ARS). The Salina Experiment Station was closed in 1955. Its permanent replacement was established in Logan, Utah on the campus of Utah State University (USU) with Dr Wayne Binns, DVM as the first research leader. Dr Binns, then head of the Department of Veterinary Science at USU, was hired as the first Director of the USDA-ARS Poisonous Plant Research Laboratory and was provided office space at USU. Dr Binns initiated research on halogeton, larkspur, and field studies of ewes giving birth to cyclopic or "monkey-face" lambs. He further initiated studies into "crooked calf syndrome." In 1957 Mr Lynn F. James (Animal Scientist) was hired to assist Dr Binns' research efforts. L. F. James completed his PhD degree in 1966 on halogeton poisoning in sheep, and was appointed research leader in 1972 after Binns stepped down due to health problems. PPRL buildings adjacent to the main USU campus were constructed in the late 1950s, and were intended to be temporary research facilities. These "temporary" facilities were finally replaced in 2004 by a new, state-of-the-art facility, under the direction of Dr James. Dr Kip Panter (Reproductive Toxicologist) replaced Dr James as research leader in 2007.

Economic Impact of Poisonous Plants

Losses to the livestock industry from poisonous plants in western North America and across the world come in many forms. These include death losses from acute and chronic intoxication, reduced weight gains, reduced reproductive efficiency (lack of conception, embryo loss, abortion, male infertility, lack of mother-infant bonding and suckling, uterine infections), and animals which fail to thrive. Exposure to some toxic plants such as locoweeds, may predispose animals to other health problems, such as right heart failure in brisket disease. Further, exposure to poisonous plants may reduce the effectiveness of vaccines and other routine veterinary management practices, leading to subtle losses later in the production cycle. Other insidious costs include increased costs for fencing and for range riders, veterinary fees, loss of forage on pastures and rangelands due to changes in management, forced changes in grazing and livestock management, and reductions in land values. In expansive

[ii] Visit the PPRL website at http://www.ars.usda.gov/pacific-west-area/logan-ut/poisonous-plant-research/.