Integrated Research to Reduce Poisoning from *Oxytropis* and *Astragalus* spp in U.S.A.

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Livestock poisoning from *Astragalus* and *Oxytropis* species is the most wide-spread poisonous plant problem in the western USA . There are over 400 species of *Astragalus* and 22 species of *Oxytropis* in North America , but only 24 species have been shown to contain the toxic alkaloid swainsonine , or have been implicated in poisoning (Ralphs et al . , 2002) .

Locoweed chemistry The locoweed toxic alkaloid , swainsonine , was first discovered in *Swainsona* species of Australia (Colgate et al . ,1979) , and later in both *Astragalus* and *Oxytropis* species in North America (Molyneux and James 1982) . Gardner et al . (2001) reported on the current quantitative assay for swainsonine using GC and LC/MS . The concentration of swainsonine ranges from 0 .001-0 .2% of the plant's dry weight . The flowers and seeds appear to have the highest concentration , but all parts of the plant contain swainsonine , even the dry dead plant material . Enzyme-linked immunosorbent assays (ELISA) and other biomarkers are being developed as sensitive and specific assays for the detection and measurement of swainsonine in plant and animal tissues .

Endophyte Recently , the endophytic fungus *Embellisia* was found in *Astragalus* and *Oxytropis* species and was shown to synthesize swainsonine (Braun et al . , 2003 , Creamer et al . ,2007) . The endophyte is passed to the next generation through the seed coat . *Oxytropis sereicea* has the ability to sustain a symbiosis with the endophyte and dinitrogen fixing bacteria , thus increasing levels of swainsonine when soil nitrogen is limited (Valdez Barillas et al . , 2007) .

Pathology of locoweed poisoning Swainsonine inhibits essential glycosidase enzymes : lysosomal α-mannosidase (which alters glycoprotein processing) , and mannosidase II (which impairs cell to cell communication , cell movement , cellular adhesion and intracellular trafficking) . Swainsonine intoxication results in various physiologic changes , including growth inhibition , impaired cardiovascular function , compromised immunity to infectious disease , decreased feed efficiency , and neurologic damage (Stegelmeier et al . ,1999) . Locoweed dramatically increases the incidence of high mountain disease or congestive right-heart failure in cattle grazing locoweed at high elevations (James et al . , 1991) .

Effects of locoweed on reproduction Locoweeds inhibit all reproductive processes in livestock : spermatogenesis and oogenesis , ovarian function and estrous behavior , delays placentation , reduces placental and uterine vascular development resulting in abnormal cotyledonary development . This results in embryonic death , birth defects , induces abortion and hydrops amnii (Panter et al . , 1999) . Neonates are born small and weak , prone to secondary infection , have difficulty nursing and have difficulty bonding with mothers (Pfister et al . , 2006) .

Grazing management to reduce risk of poisoning Consumption and subsequent poisoning generally occurs when locoweed is green and growing and associated grasses are dormant , or in short supply (Ralphs , 1999) . Grazing management strategies have been developed to prevent livestock from grazing locoweeds during critical periods when they are relatively more palatable than associated forages (Ralphs et al . , 2002) : restrict access to locoweeds by fencing locoweed-infested areas or herd them away ; don t overstock locoweed-infested range-ensure animals have adequate desirable forage ; watch livestock closely and remove them if they start eating locoweed to prevent poisoning and prevent them from influencing others to start ; conditioned food aversion can be used to train cattle and horses to avoid grazing locoweed .

Locoweed population cycles and control Many locoweeds experience extreme population cycles , and outbreaks are followed by catastrophic livestock loss (Ralphs et al . , 2003) . *Astragalus* and *Oxytropis* species can be controlled using common rangeland herbicides picloram (0 .42 kg/ha) , clopyralid (0 .28 kg/ha) , and metsulfuron (0 .012 kg/ha) (McDaniel et al . , 2007) . However , their seed remain viable for many years and germinate whenever environmental conditions are favorable .

References

Braun K , Romero J , Liddell C , Creamer R . 2003 . Production of swainsonine by fungal endophytes of locoweed . *Mycol . Res .* 107 :980-988 .

Colgate SM , Dorling PR , Huxtable CR . 1979 . A spectroscopic investigation of swainsonine : an α-mannosidase inhibitor isolated from *Swainsona canescens* . *Aust . J . Chem .* 32 :2257-2264 .

Creamer R , McLain-Romero J , Oldrup E . 2007 . Fungal endophytes of locoweed : an overview , pp . 338-344 . *in* : K .E . Panter and J .A . Pfister (eds) . *Poisonous Plants : Global Research and Solutions* . CABI , Wallingford , UK .