Defensive Strategy for Poisonous Introduced Plants

M. Coburn Williams

The United States has for many years introduced desirable species from abroad for use as cultivated crops, forage, fiber, or ornamentals. Some germplasm was introduced for specific genetic characteristics to increase resistance to disease, insects, or drought, or to increase yields, palatability, or nutritive value. Nearly all of these species have served their intended use, and our country has benefited from the introduction.

Unfortunately, a few purposefully introduced species have escaped to become troublesome pests, and yearly these species cost the agricultural industry millions of dollars in decreased yields of crops and livestock plus millions more in control costs. Examples include hydrilla, introduced for the aquarium trade, and waterhyacinth, introduced as an ornamental. Both are now costly pests in lakes, waterways, and canals. Bouncing bet, buckthorn, chinaberry, Dalmatian toadflax, hemp (marijuana), jimsonweed, Macartney rose, multiflora rose, and musk thistle are examples of introductions that have invaded pastures and rangelands. At least 35 purposefully introduced species are now considered weeds. Half of these are objectionable because they are poisonous to livestock. The list of such plants grows every year despite clean seed laws, plant quarantines, and regulations against indiscriminate introduction of exotic plants.

What can be done to prevent the introduction into the United States of species that might some day become serious problems? Is there any practical way to screen an introduction for possible undesirable characteristics before its release?

Personnel at the Poisonous Plant Research Laboratory, Science and Education Administration, U.S. Department of Agriculture, Logan, Utah, are now studying one area of this problem. This research is concerned with preventing the introduction of potentially poisonous species on pastures and rangelands in the western United States.

Foreign species have heretofore been introduced on pastures and range to restore overgrazed areas, improve productivity, and provide hardy, nutritious vegetation compatible with sustained production of livestock.

Today, the energy crisis has turned the attention of the nation to the reserves of coal, oil and gas found in the West. Many of the areas being disturbed by searchers for energy are arid or semiarid and are quite ecologically fragile. Huge areas are being strip mined for coal—and by law these areas must be revegetated. Species must be found which will grow on mine tailings, reproduce quickly to hide the scars of strip mining, and control erosion. Consequently, these new revegetation needs, added to the general requirement for restoring and improving grazing lands, have created increased interest in plant introductions.

Several methods must be used to insure that poisonous plants are not introduced onto western pastures and ranges. First, potentially poisonous species can be identified and banned before they are brought into this country as seeds or plants. Second, the seed inventories and nurseries of plant introduction stations can be examined for poisonous species. Third, species near release can be subjected to toxicological examination. The emphasis of this Laboratory will be to intercept harmful species no later than the nursery evaluation stage. A maximum number of genera and species can thus be covered in minimum time, and plant introduction personnel can be saved considerable time and expense in needless collections and evaluations.

Should we ban all introduced species in which a poisonous compound is detected, is a frequently asked question.

Certainly not! If we banned every food found at the supermarket that contains a poisonous compound, no matter how small the amount, we would soon starve, for virtually every food would have to be removed from the shelves. Introduced species in which some poisonous compound is detected will be evaluated on an individual basis as to intended use, type of poison present, potency of the poison, and concentration in the plant. The concentration or toxicity of the poison may be so low that the plant would not be considered harmful to livestock.

If a species is poisonous to livestock and its intended use is for grazing—or if it might be grazed even though seeded for another use—then certainly this species should not be released. A nonpoisonous species that is seeded for firebreaks, mine reclamation, or even ornamental purposes and that might have weedy characteristics that would make it an undesirable pest if it invaded croplands, pastures, or range, also should not be released. Plant introductions that become well established are virtually impossible to eradicate. When purposeful introductions turn into pests, they become just another burden on the farmer and rancher in time, expense, labor, and reduced yields of crops and livestock.

A discussion of cooperative research now in progress between Soil Conservation Service and SEA plant introduction stations and the Poisonous Plant Research Laboratory will illustrate the problems and progress associated with the interception of poisonous introduced species.

The author is with the Poisonous Plant Research Laboratory, Agricultural Research, Science and Education Administration, U.S. Department of Agriculture, Logan, Utah.

Astragalus

Approximately 1,500 species of *Astragalus* are found outside of North America. Many of these species have been introduced for evaluation as forage species. Since half of the North American *Astragalus* contain poisonous nitro compounds, such compounds would likely be present in a sizable number of Old World and South American *Astragalus*. The introduction of such species as forage crops would not be desirable, since nitro compounds are highly toxic to livestock. If these nitro-bearing species could be intercepted before the evaluation process began, the resulting savings in time, money, and labor would be considerable. Several procedures are used to intercept nitro-bearing *Astragalus*. All employ a rapid, accurate analysis that detects and measures nitro compounds in small plant samples. First, we have a continuing arrangement with plant introduction stations to test for nitro compounds in *Astragalus* species that are being grown for seed increase in their nurseries. Second, we obtain *Astragalus* seeds from plant introduction inventories and grow our own plants for analysis. Third, we examine small leaflet samples from herbarium specimens. Nitro compounds are so stable that they can be detected in herbarium specimens collected 100 years ago. Only 10 mg of leaflet is required for the qualitative test.

To date, 25 nitro-bearing species have been found in plant introduction nurseries or in plants grown at our station. Thirty other nitro-bearing species have been discovered through analysis of herbarium specimens. Eventually, we hope to analyze for nitro compounds most of the remaining *Astragalus* species by collecting leaf samples from major herbaria throughout the world.

Coronilla and Indigofera

Species in two other introduced genera. *Coronilla* and *Indigofera,* also synthesize nitro compounds. Crownvetch (*Coronilla varia*) is widely planted east of the Rockies and has not caused any problems in sheep and cattle under field conditions, although experimentally the plant has been shown to be toxic to swine, chicks, and meadow voles. Two species of *Indigofera* are known to be poisonous, and most of the species examined have contained nitro compounds. Seven species of *Coronilla* and 28 species of *Indigofera* are being grown at Logan for toxicological studies.

Chenopodiaceae

Many genera of the Chenopodiaceae contain species that synthesize soluble oxalates. When certain of these species are rooted in saline soils high in sodium chloride (NaCl), they may synthesize high concentrations of toxic sodium oxalates and thus become toxic to livestock. Halogeton (*Halogeton glomeratus*), a fairly recent (1930's) inadvertent introduction, is the most familiar of such species. Oxalate-synthesizing species are grown for 8 weeks in nutrient cultures that contain 0.05 M NaCl. An analysis of the foliage then indicates the potential soluble oxalate levels that the species might attain under optimum field conditions on saline soils.

Ruby sheepbush (*Enchylaena tomentosa*), introduced from Australia but not yet released in this country, contained a modest 5 to 6% oxalate in its native land. Grown in nutrient solutions that contained NaCl, ruby sheepbush, synthesized 14% soluble oxalates. Fivehook bassia (*Bassia hyssopifolia*), another introduced species, also synthesizes more soluble oxalates in nutrient solutions that contain NaCl. *Bassia* is poisonous to sheep.

Kleingrass

Unforeseen problems often arise with plant introductions. Kleingrass (*Panicum coloratum*) introduced from South Africa, was tested extensively with no problems before it was released. In western Texas, particularly near San Angelo, kleingrass has caused numerous outbreaks of bighead in sheep and goats. The syndrome is characterized by liver damage accompanied by photosensitization. Cooperative investigations to isolate the causal agent are in progress with investigators in Georgia and Texas.

Galenia

Galenia (*Galenia pubescens*), a member of the Aizoaceae family from South Africa, is a succulent that shows promise for use as firebreaks and roadside plantings in California. Unfortunately, galenia contains low to moderate amounts of soluble oxalates that can be increased to 11% or more under optimum growing conditions. Moreover, galenia fertilized with ammonium nitrate accumulated up to 3% nitrate nitrogen, or over 21% potassium nitrate (KNO_3). A KNO_3 level in plants of 1.5% is considered toxic to ruminants. Sheep and chicks fed galenia died from nitrate and oxalate poisoning. Galenia must be considered a poisonous plant and cannot be recommended for release.

Goatsrue

Goatsrue (*Galega officinalis*), introduced as a potential forage crop into northern Utah in the 1890's proved to be unpalatable and low in protein. Although the plant was not further evaluated, neither was it eradicated, and it eventually escaped from the experimental farm and now covers 60 square miles of Cache County, Utah. Goatsrue contains an alkaloid that makes it moderately toxic. An occasional sheep or horse is lost to this species. This pest costs $16,000 per year in control costs and probably an equal amount in lost pasture productivity.

These are but a few of the problems encountered in the search for desirable introductions for ranges and pastures of the western United States. The cooperative research between the Poisonous Plant Research Laboratory and the plant introduction agencies should make all aware of the problem and be instrumental in preventing the introduction of poisonous or weedy species.