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Potential Hazards Posed by Plants to Retail Consumers and Livestock

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Executive Summary

This report was prepared to fulfill the 2007 Legislative directive that: "...the commissioner of agriculture in consultation with the commissioner of Health shall evaluate the potential hazards posed by plants to retail consumers and livestock, and report the findings to the standing committees of the Senate and House of Representatives with jurisdiction over agriculture policy."

After consideration and evaluation, the MDA believes a regulatory approach to address human or animal exposure to potentially hazardous plants would be difficult given the tremendous variability in toxicities, situations, species susceptibility and the large number of native and agronomic plants that could be characterized as having some level of toxicity.

Rather than a regulatory approach, the MDA recommends improving outreach and education to the general public, and targeted education for livestock producers, to help ensure the implementation of appropriate precautions and management techniques.

Many potential poisonous plants (PHC) are native to Minnesota and cannot, nor should be, eliminated from the environment. Many PHC-containing plants are widely planted to produce valuable cash crops. Restricting the sale of plants and/or seed would have a significant economic impact.

In the absence of any formal regulation of PHC-containing plants by the federal government and other states, Minnesota would stand alone should it enact regulation. Based on the available information, such regulation would be incomplete, subject to ongoing debate, be unenforceable and perhaps be subject to restraint of trade charges (by impacting interstate commerce). However, even if the threat posed by PHC is not amenable to effective regulation, it should not be ignored.

In the preparation of this report, MDA consulted with the Minnesota Department of Health (MDH). MDH has concluded the report provides useful information about potential hazards posed by plants; however, this information is insufficient to draw conclusions regarding adverse human health effects from specific plant hazards. This is based, in part, on the fact that adverse human health effects (e.g., poisonings) are influenced by several complex factors, such as the plant species, type of exposure/contact, amount of exposure, and individual variables, such as age and health status. Herbal medicines/supplements are excluded from this report.

Summary of Findings

1. In 2006, Hennepin County recorded 1,455 poisoning incidents involving plants or 2.63% of the total poisonings that year.

2. Of the four types of plant poisoning accounting for 60% of the total reports, nearly 86% of the incidents required no follow-up and were rated either non toxic exposure or only minimal toxicity.

3. Plant species with potential levels of toxicity are numerous and widespread.

4. Plant species with toxic chemical potential include nursery stock (trees, shrubs and perennials), indoor ornamental plants, cut flowers and annual plants, native plants (oak and maple trees, ferns, black, choke and wild cherries), agricultural crops (clovers, sorghum, potatos, rhubarb).

5. Phytotoxicity may occur in many types of plant material including mulch used in landscape improvements.

6. The number one cause of cattle poisoning in Minnesota is due to nitrate poisoning. Sorghum-sudangrass hybrids are the species most commonly involved.

7. Other causes of cattle poisoning are due to exposure to oak species, sorghum species, nightshade and cocklebur plants, buckwheat, St. Johnswort, water hemlock and poison hemlock.

8. The number one poisoning problem in horses is due to consumption of maple leaves.

9. Due to wide range of response to phytotoxins by humans and animals and the prevalence of these chemicals in plants, it is not feasible to accurately identify and label plants identifying their toxicity.

10. Plant toxicity cannot be eliminated.

11. Public awareness about the poisonous potential of plants is low as indicated by the number of plant-related poisoning incidents.

12. A more educated and aware public may reduce the number of incidents.

Introduction

MDA staff consulted a variety of sources to assemble a report to evaluate the hazards posed by plants to retail consumers and livestock. Many plants found in the natural environment, sold in the nursery trade, and even raised as agronomic crops can be hazardous to humans or animals under various circumstances. The degree of toxicity that a specific plant may exhibit can vary dramatically depending on environmental conditions, stage of growth, plant part encountered, sensitivity of the individual person, and sensitivity or tolerance of the animal species. This report attempts to summarize those hazards and also to quantify those hazards as reported in Minnesota.

The number of plants containing PHC is large and includes many plants commonly encountered by domesticated animals and humans. The examples presented are not inclusive but meant to be representative of the types of plants and negative affects such plants may have on humans and animals. Many plants are native to Minnesota, planted in large agriculture acreages for commerce, or commonly sold by nurseries. It is not reasonable or possible to enforce removal of these plants from the landscape. From the data, there is no practical method of protecting animals and humans from PHC-containing plants in the environment.

Background

Human Exposure

The Minnesota Poison Control System (MPCS) provides Nationally Certified Specialists in Poison Information who provide poison exposure information to the general public and health care professionals 24 hours a day, 365 days a year. In the MPCS 2006 Annual Report, 82,517 calls were placed to the Hennepin Regional Poison Center which is designated by the MDH to provide poison information and toxicology consultative services to Minnesota. Human exposures due to plants occurred 1,399 times which accounted for 2.57% of total reported poisonings from all causes. Children 5 years of age and younger accounted for 54% of the exposure calls.

Additional 2006 data compiled in the American Association of Poison Control Centers (AAPCC), Toxic Exposure Surveillance System involving plants indicated the following categories accounted for approximately 60% of the incidents: dermatitis, 182 times; oxalate-related, 259 times; gastrointestinal irritant, 174 times; and non-toxic, 260 times. Perhaps more importantly, in 85.8% of the cases no follow-up was needed and either nontoxic exposure or minimal toxicity was expected from the incident.

The 2005 Annual Report of the AAPCC National Database mirrors the local findings for human exposures. Substances involving plants accounted for 2.8% of human exposures (68,847 incidents). However, nationally only 4% of incidents involved children under six years of age.

Of interest in the national report is the list of plants involved in the human poisoning incidents. Poinsettia was third on the list. Some commonly encountered ornamental plants were also present (caladium, Christmas cactus, English ivy and chrysanthemum). Poison ivy would not be a surprise to be on a plant list of poisonous plants. However, dandelion, strawberry and apple/crabapple are not uncommon plants in the landscape and made the list of the 20 plants most commonly involved with reported human poisoning.

Animal Exposure

The Northwest Research & Outreach Center (NWROC) report issued in July 2005 identified nitrate poisoning as the number one cause of cattle poisoning. Nitrates accumulate in some plants grown under drought stress and/or when nitrogen used as fertilizer. The crops sorghum-sudangrass and corn are the agricultural crops reported

most often; sorghum-sudangrass hybrids have been the number one cause of nitrate poisoning in Minnesota.

The report cites gallotannins in oak species, cyanide poisoning caused by sorghum and chokecherry, glycoside poisoning from nightshades and cocklebur, photosensitive skin reactions from St. Johnswort and buckwheat, cicutoxin poisoning from water hemlock and alkaloid poisoning from poison hemlock as the other main causes for cattle poisoning in Minnesota.

The two most common causes of sheep poisoning are nitrate poisoning and photosensitive reactions. In horses, the number one poisoning problem has been from maple leaves, followed by hoary alyssum and white snakeroot.

Plant Exposure

A review of readily available literature pertaining to poisonous plants indicated that the number of plant species containing hazardous/potentially poisonous chemicals (PHC) was much larger than anticipated and included species in all categories (i.e.. forest, florist, agriculture, ornamental and general nursery trade).

Plants with PHC can be encountered wherever plants occur. In the home, cut flowers may include the PHC-containing stems of foxglove, calla lily, Easter lily or baby's breath. In the urban setting many plants commonly used for yard beautification contain PHC. Examples include aster, azalea, begonia, bleeding heart, burning bush, chrysanthemum and iris. Furthermore, many trees and shrubs both in the manicured landscape, urban forests and natural settings have toxic potential. Some examples are: arborvitae, ash, birch, balsam fir, elm, ginkgo, juniper, maple, oak and yew.

Fruit trees contain PHC. The fleshy fruits are generally safe while seeds often are hazardous. Fruit with PHC include apple, apricot, and cherry,

Some nuts contain PHC such as almonds.

Indoor ornamental plants including dieffenbachia, poinsettia, and schefflera may contain PHC.

Garden plants (cultivated and weed species) include some with PHC. Rhubarb, tomato, potato and the nightshade weeds common in gardens and yards all carry risk.

Plants associated with agriculture also possess PHC. Alsike clover, red clover, white clover, rapeseed, alfalfa, buckwheat, oats, cultivated onion, potato, reed canary grass, sorghum, sudan grass, and sunflower contain PHC.

The fact that a plant may contain a PHC does not correlate well with its health impact and is why we use the term "potentially hazardous chemical." Human and/or animal response to PHC may be different depending on part of plant ingested, quantity consumed, manner

of exposure, plant maturity and even status of plant material when ingested (i.e.. raw, cooked, mature, dry, etc.).

Some examples presented in detail below may more clearly show this variation within a plant species and the complexity of the "poisonous plant" issue. This information was obtained from the Government of Canada, Canadian Biodiversity Information Facility, Poisonous Plant Information System.

Alfalfa can cause a variety of toxic problems depending on a number of variables. Ingesting rapidly growing alfalfa at the vegetative to mid-bud stage can cause bloat in cattle and sheep. Alfalfa contains phytoestrogens which cause infertility in cattle and sheep. These compounds may also be in some types of supplement pills available at health food stores and may cause problems. Alfalfa contains saponins that can interfere with poultry growth thereby reducing egg-laying.

Aloe is the common "Aloe vera" found in extracts used in cosmetics and medicinal products. The latex from under the skin can cause a cathartic reaction because it irritates the large intestine. Contact dermatitis, in some cases causing local swelling, has been documented to result from contact with this plant.

Avacado has a seed easily germinated to produce a houseplant of interest. The leaves of some cultivars can be very toxic to pets. There is a warning that leaves should not be allowed to fall accidentally into fish tanks.

Black cherry is found in both woods and in landscape plantings. The plant contains chemicals that can release hydrogen cyanide in animals. All types of animals can be poisoned by ingesting leaves and twigs.

Humans can be sensitized to dust from buckwheat flour after long exposure. Asthma is the usual response, although rare individuals may exhibit reactions to foods containing buckwheat flour.

Canada yew, which is a shrub native to Minnesota and Japanese yew, commonly sold in nurseries, contain the toxin taxine. In one documented case in British Columbia, several cattle became ill and some died after ingesting the leaves and twigs of a Canada yew that had been planted for ornamental purposes. Several cattle died after gaining access to shrubs around houses or after being fed hedge trimmings. A similar situation occurred in Minnesota involving ornamental Japanese yew.

Garden chives have poisoned horses that ingested the leaves in early spring.

Some humans develop contact dermatitis after extended exposure to garden chrysanthemums. This is an occupational hazard of florists, nursery workers and gardeners.

Common milkweed has poisoned sheep in the eastern United States. The plant contains cardiac glycosides, toxic to animals.

Humans have been poisoned after ingesting daffodil bulbs mistaken for onions, as have cattle fed bulbs instead of feed in times of scarcity. Family pets may be at risk if they ingest daffodils.

Horseradish contains glucosinolates, which can cause toxicity in livestock.

Hydrangea, a very common ornamental plant has poisoned humans after they ingested the flower buds. There are older reports of horse and cattle poisonings after eating hydrangea.

Lamb's-quarters, a common weed, can cause sickness and death in livestock if large quantities are ingested. The plants can accumulate both nitrates and soluble oxalates.

Lily-of-the-valley is a perennial plant long used in urban landscapes. The plant contains glycosides as well as saponins. Animals that have access to the plant material may be poisoned. Certainly, ingesting large quantities of lily-of-the-valley can cause problems to family pets such as cats and dogs.

Oat stubble can cause nitrate toxicity in livestock, swine and turkeys.

Cultivated onion has caused hemolytic anemia in horses and cattle. Death can occur in severe cases. The formation of Heinz bodies in the red blood cells is a common occurrence.

Pin cherry is a native tree. The leaves have an average nitrogen rate of 91 mg/100grams which as much as 143 mg/100 grams recorded. These levels are potentially lethal to livestock if ingested.

The entire potato plant contains toxic glycoalkaloids but usually in harmless quantities in the edible tubers. However, in the presence of light, the tubers photosynthesize, turn green and increase the amount of toxins. A dog became comatose after ingesting green potato tubers.

Red clover is a common clover widely used in both cultivation for forage and food for animals. This plant is also involved in a condition called congenital joint laxity and dwarfism. This disorder results in teratogenic problems in beef calves when their dams have over wintered exclusively on clover and grass silage. Red clover can also develop phytoestrogens, which affect fertility in livestock.

Red maple is a native tree. Leaves of this plant have poisoned horses in New England states and Georgia.

Red oak is a native tree containing tannins that have caused poisoning and death in cattle and horses. Sheep may have also been poisoned by this oak. Poisoning can lead to depression, anorexia, loss of condition and kidney damage.

Rhubarb is a perennial cultivated plant. The plant contains oxalate crystals, which have been reported to cause poisoning when large quantities of raw or cooked leaves are ingested. Humans, goats and swine have been poisoned after eating the leaves.

Sudan grass is cultivated forage that is planted as a late-season emergency forage crop and is either pastured or cut for green feed. Sudan grass can have a hydrogen cyanide potential after damage to the plant. It can also accumulate toxic quantities of nitrates.

Tulip contains an allergen, tulip side A, which causes dermatitis in sensitive individuals. Poisoning of humans and dogs has also been reported when tulip bulbs mistaken for onions were ingested.

White clover is widely cultivated. Under certain conditions it can cause bloat in livestock. It has caused laminitis in horses and cattle. After they are ingested, some varieties can liberate hydrogen cyanide, poisoning animals.

Poinsettia is a popular Christmas plant grown for its red leafy bracts. It has been listed as a known toxic plant that has caused loss of human life. Case studies show that some humans develop sensitivity to the latex, resulting in dermatitis. Short exposures to poinsettia in a few cases have led to bouts of vomiting, but no cause of death can be found in the literature. Poinsettia may not be a severely toxic plant, although it appears to have some toxic affects.

Only recently have there been public service-type announcements in the media cautioning the public about the PHC contained by poinsettias and possible impact on pets. Poinsettia may by the paradigm of the PHC debate. While the public hears the public service announcements about PHC potential and it was the third most common plant involved with human incidents in 2005, at least one website contends that poinsettia is safe and without risk. Whether poinsettia does or does not contain PHC, historically, there have been no labels in poinsettia pots identifying a PHC threat to humans or pets.

Plant products used in landscape work may contain PHC. Cocoa mulch is one example. It contains theobromine, the PHC contained in chocolate which is hazardous to the point of fatality to animals.

A September 1998 report on Prussic Acid Poisoning from North Dakota State University documents the variation of PHC during plant growth. Prussic acid levels in sorghums. Johnson grass, sudangrass and sorghum-sudangrass hybrids is generally high in young, rapidly growing plants. Higher concentrations of cyanide are found in young leaves than in old leaves and stems. New forage growth following drought or frost is dangerously high in cyanide. Plants grown in soils high in nitrogen but low in phosphorus and potassium tend to have high cyanide concentrations.

Weather conditions can even influence prussic acid levels. Poisoning is commonly associated with plant regrowth following a drought ending rain or the first autumn frost. The authors recommend that livestock owners wait at least seven days after a killing frost before grazing to allow hydrogen cyanide to dissipate.

Conclusion

It is inevitable that individuals and animals will be exposed to PHC plants. Most encounters are harmless or minimally poisonous. Significant variation in PHC activity within species also accounts for much inherent non-poisonous activity.

A regulatory approach to address human or animal exposure to potentially hazardous plants would be difficult given the tremendous variability in toxicities, situations, species susceptibility and the large number of native and agronomic plants that could be characterized as having some level of toxicity. Some level of outreach and education for the general public and perhaps targeted education for livestock producers would likely help ensure that appropriate precautions and management techniques are implemented.

There exists in a variety of sources a tremendous amount of information about hazardous plants to both people and livestock. This information is readily available on a number of web sites (listed below) and there are numerous books and journal articles on the subject.

The Minnesota Poison Control system (MPCS) provides 24-hour referral and consultation services to the public for the proper recommendations about treatment and management of poisoning incidents, including exposures to toxic plants, pharmaceuticals and many common chemicals. MPCS also develops educational materials and conducts outreach to increase public awareness to prevent poisonings-including efforts aimed to protect children who are especially vulnerable. For more information about MPCS services and outreach (including their guide to toxic plants) see http://www.mnpoison.org/.

Web Resources
Plant Guide, Minnesota Poison Control System
http://www.mnpoison.org/mnpoison/pdfs/Plant_guideJan04.pdf

2006 Annual Report, Minnesota Poison Control System
http://www.mnpoison.org/mnpoison/pdfs/Final%202006%20Annual%20Report.pdf

Poisonous Plants Informational Database, Cornell University
http://www.ansci.cornell.edu/plants/index.html

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Bibliography

Hansen, H.Trammell, E. Dunayer, S. Gwaltney, D. Farbman, and S. Khan, Cocoa Bean Mulch as a Cause of Methylxanthine Toxicosis in Dogs, ASPCA 2007

Lai, Melisa W., M.D., W.K-Schwartz, et al., 2005 Annual Report of the American Association of Poison Control Centers' National Poisoning and Exposure Database, in *Clinical Toxicology*, 44: 803-932, 2006

Minnesota Poison Control System, 2006 Annual Report
www.mnpoison.org

Munro, Derek., Canadian Poisonous Plants Information System, Website
http://www.cbif.gc.ca/pls/pp

Stoltenow, Charlie and Greg Lardy, Prussic Acid Poisoning, North Dakota State University, Veterinary Diagnostic Laboratory, Publication V-1150, September 1998

Minnesota Plant Exposures 2006 – AAPCC Toxic Exposure Surveillance System

Human Plant Exposures – Minnesota 2006

Toxic Plants – Alphabetical by common name – UC Davis

List of Plants by Common Name – Veterinary Medicine Library UIUC

List of Poisonous Plants by the Animals Affected – Purdue

Minnesota Poison Control System, 2006 Annual Report
www.mnpoison.org