



Proposed Acceptability for Continuing Registration

PACR2005-08

Re-evaluation of Strychnine

The purpose of this document is to inform registrants, pesticide regulatory officials and the Canadian public that Health Canada's Pest Management Regulatory Agency (PMRA) has re-evaluated the available data on strychnine. Health Canada is proposing that the use of strychnine to control Northern pocket gophers, skunks, pigeons, wolves, coyotes and black bears be maintained as it does not raise concerns for human health or the environment.

The current use of strychnine to control ground squirrels (i.e., Richardson's, Columbian, Franklin and thirteen-lined) is a concern from an environmental perspective. This Proposed Acceptability for Continuing Registration (PACR) document outlines a proposed interim decision for strychnine pending implementation of a Richardson's ground squirrel pest management strategy.

Health Canada will accept written comments on this proposal up to 60 days from the date of publication of this document. Please forward all comments to Publications at the address below.

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**Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6605C
Ottawa, Ontario
K1A 0K9**

Internet: pmra_publications@hc-sc.gc.ca
www.pmra-arla.gc.ca

**Information Service:
1 800 267-6315 or (613) 736-3799
Facsimile: (613) 736-3798**



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Foreword

Health Canada's Pest Management Regulatory Agency has re-evaluated the available data on strychnine and proposes that the use of strychnine to control Northern pocket gophers, skunks, pigeons, wolves, coyotes and black bears does not represent an unacceptable risk to human health or the environment.

The current use of strychnine to control ground squirrels (i.e., Richardson's, Columbian, Franklin and thirteen-lined) is a concern from an environmental perspective. Producers and the governments of Alberta and Saskatchewan consider Richardson's ground squirrels to be the major mammalian pest impacting croplands, pastures and rangelands over the past several decades, for which the control option of choice has remained strychnine-treated food baits. In consideration of the ongoing work by a national expert group to develop and promote a pest management strategy for the control of Richardson's ground squirrel, the lack of practical alternatives at this time and the additional mitigative measures proposed in this document, it is proposed that the use of strychnine to control ground squirrels be maintained for the short term. This proposed interim decision will be reviewed in three years in light of progress made towards the implementation of the Richardson's ground squirrel pest management strategy.

This PACR document provides a rationale for the proposed interim decision for strychnine. The PMRA will accept written comments on this proposal up to 60 days from the date of publication of this document.

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1.0 Background

Health Canada's Pest Management Regulatory Agency (PMRA) is re-evaluating all pesticides, both active ingredients and end-use products, that were registered prior to 31 December 1994 to ensure that their continued acceptability is examined using current scientific approaches. Regulatory Directive [DIR2001-03](#), *PMRA Re-evaluation Program*, presents the re-evaluation activities and program structure.

Based on the outcome of the United States Environmental Protection Agency (USEPA) review, other international reviews, Canadian field studies and the published literature, the PMRA is proposing a regulatory decision and appropriate mitigation measures for Canadian uses of strychnine.

The USEPA conducted a re-evaluation of the safety of strychnine and concluded, on the basis of health and environmental risk assessments, that it was eligible for reregistration with implementation of mitigation measures. The PMRA health assessment was based on the 1996 USEPA Reregistration Eligibility Decision (RED) document for strychnine, taking into account the Canadian use pattern and Canadian issues (e.g., the federal Toxic Substances Management Policy [TSMP]). As the American and Canadian use patterns are not identical, the PMRA environmental assessment was based on information from the USEPA RED as well as from other international reviews, Canadian field studies and the published literature. A review of the chemistry of Canadian products was also conducted.

2.0 Re-evaluation of Strychnine

Strychnine was first registered in Canada in 1928. It is currently registered for use as a rodenticide/predacide to control Northern pocket gophers, ground squirrels (Richardson's, Columbian, Franklin and thirteen-lined), skunks, pigeons, wolves, coyotes and black bears. There are 2 technical, 2 manufacturing and 12 end-use products registered in Canada. These products are listed in Appendix I. All end-use products are classified as "Restricted".

2.1 Chemical Identification

Active substance: strychnine

Function: rodenticide/predacide

Chemical names:

IUPAC: *L*-strychnine

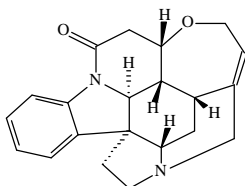
CAS: strychnidin-10-one

Chemical class: alkaloid

CAS number: 57-24-9

Molecular formula: $C_{21}H_{22}N_2O_2$

Structural formula:



2.2 Description of Uses

Products used for the control of Northern pocket gophers and ground squirrels are formulated as ready-to-use (RTU) baits, pellets, particulates or freshly mixed baits. For control of pocket gophers, products are applied below ground using hand probes, burrow builders, or by hand placement in burrows. For ground squirrel control, products are applied by hand placement in burrows or in tamper-resistant bait stations.

One product is registered for control of pigeons and is formulated as RTU 0.4% impregnated cracked corn. The bait is placed in areas where pigeons frequent, such as feeding areas, or in tamper-resistant bait stations. Treatment areas should be inaccessible to children, pets, wildlife and domestic animals. Bait is maintained or changed as required.

The above mentioned products are only for sale to licensed pest control operators, farmers or to persons authorized in government approved pest control programs wherein the vendor has to maintain a record of sales.

For control of coyotes, wolves and black bears, one product is registered for use and handling by authorized employees of the Alberta Department of Sustainable Resource Development. Tablets containing 50% strychnine are mixed with meat, tallow or fish and covered with snow or loose dirt. Baits must be placed 1 km away from a building, can remain in place for 30 to 90 days and should be checked every 7 days. Warning signs are to be posted at each bait site and each main access point to the bait site. A complete record must be maintained. Upon the termination of the pest control program, baits are collected and disposed.

One product is formulated as a 3.5% solution for injection into eggs and is currently registered for the control of skunks. It is restricted for use and handling only by persons authorized under the *Alberta Agricultural Pests Act* to control rabies.

2.3 Effects Having Relevance to Human Health

The primary health concern with any strychnine formulation is its acute toxicity to humans. The risk of acute toxicity to applicators should be adequately mitigated with a requirement to wear chemical-resistant gloves, long pants and a long-sleeved shirt during application of all formulations, in addition to wearing a dust mask during mixing/loading and application of products formulated as grain baits.

Based on the current restrictions on Canadian end-use product labels as described previously, bystander exposure is considered to be minimal. Canadian registrants are required to amend their labels to include a requirement for storing end-use products away from children and under lock and key.

There are no feed or food uses for strychnine. Dietary exposure through food or drinking water is expected to be minimal.

2.4 Environmental Assessment

The PMRA expects the use patterns for pocket gopher, predator and skunk control to result in limited exposure to non-target organisms and, therefore, to constitute an acceptable risk. Pocket gophers rarely exit their burrows; thus, the likelihood that treated bait and/or poisoned pocket gophers will become available to non-target species on the surface is greatly reduced. The use patterns for predator and skunk control are severely restricted and are only for use by trained provincial or municipal employees in the province of Alberta; these control measures are used very infrequently. For both the pigeon and ground squirrel use patterns, treated grain containing the same concentration of strychnine is used and can result in treated grain and poisoned carcasses being available to non-target organisms. As such, the detailed risk assessment that follows applies to the use patterns for ground squirrel and pigeon control.

2.4.1 Environmental Fate

Strychnine is soluble in water. Strychnine has negligible vapour pressure, indicating that this compound is not likely to volatilize into the air. The *n*-octanol–water partition coefficients indicate that strychnine has the potential for bioaccumulation ($\log K_{ow} = 4$ at pH 7).

Based on the results of laboratory studies, strychnine is expected to be persistent and immobile in soil. Hydrolysis is not an important route for the transformation of strychnine at environmentally relevant pH levels. Phototransformation in soil is also not an important route of transformation. Under aerobic soil conditions, strychnine is expected to be persistent except where specialized microbial populations are present. In four soils tested, adsorption K_{ads} ranged from 39 to 1680, which indicates that strychnine is not expected to be mobile in soils. However, sorption to entrained soil particles could facilitate movement in the environment during runoff events. No data on the environmental fate of strychnine under terrestrial field conditions were available for review.

No studies on the fate and behaviour of strychnine in aquatic environments were available for review. However, as strychnine is used in baits that are applied in localized areas, it is unlikely that substantial quantities of this chemical will enter surface waters either by movement of treated seeds or from runoff of soil-bound strychnine residues.

2.4.2 Environmental Toxicology

Strychnine is moderately to very highly toxic to birds and mammals on an acute oral basis ($LD_{50} = 2\text{--}112$ mg a.i./kg bw). It is slightly to highly toxic to birds on a dietary basis ($LC_{50} = 99\text{--}3536$ mg a.i./ kg diet). The lowest observed effect concentration (LOEC) for chronic exposure of birds to strychnine is 33 ppm based on reduced size of the testes. Strychnine is expected to be highly toxic to mammals on a dietary basis based on studies with the European ferret and the red fox ($LC_{50} = 70\text{--}198$ mg a.i./kg diet).

No studies on the toxicity of strychnine to terrestrial plants and invertebrates were reviewed; however, exposure is expected to be minimal due to the narrow use pattern of strychnine.

Studies with freshwater fish and invertebrates were evaluated. These studies indicate that strychnine is moderately to highly toxic to these freshwater organisms. As strychnine is used as a bait in localized areas, it is unlikely that aquatic organisms will be exposed to substantial quantities of strychnine when these products are used according to the label directions.

2.4.3 Terrestrial Assessment

In characterizing the environmental risk of strychnine, the PMRA used a deterministic approach that characterizes the risk by the quotient method. A risk quotient (RQ) is calculated as the ratio of the estimated environmental concentration (EEC) to the effects endpoint of concern. Risk quotients less than one are considered to be a low risk to non-target organisms, whereas RQs greater than one indicate some degree of risk.

The focus of this assessment is on terrestrial habitats as exposure to aquatic habitats is expected to be minimal. The EECs used for determining the risk of primary poisoning were based on the amount of strychnine in the bait according to the product guarantee (0.4% or 4000 mg/kg bait). For estimating the risk of secondary poisoning, measured tissue concentrations (muscle and intestinal) in pocket gophers that were reported in the USEPA RED were used. These data were considered acceptable as a surrogate for tissue concentrations in ground squirrels. Toxicity endpoints (acute and/or chronic) were chosen for the most sensitive species and used as surrogates for the range of species that can potentially be exposed following treatment with this product.

Birds

Assessments were conducted for acute, short-term dietary and chronic exposure to strychnine from birds consuming treated seeds directly (primary poisoning) and from the consumption of poisoned carcasses or prey items by scavenger or predator species (secondary poisoning).

The acute risk assessment estimated that a small songbird would exceed the LD₅₀ value by consuming less than one grain of treated wheat. This indicates that there is a substantial acute risk to birds that consume the treated baits.

For a predator or scavenger, it was determined that it would take one and eight days of feeding on intestinal and muscle tissues, respectively, to consume a dose of strychnine equivalent to the LD₅₀. To reach the no observed effect level (NOEL), carnivorous birds would need to consume contaminated intestinal tissues for 0.1 day and contaminated muscle for 0.8 day. As the number of feeding days required for an adverse effect is less than one, there is an acute risk to carnivorous birds consuming contaminated carcasses or prey items.

A short-term dietary assessment was conducted for primary poisoning of birds that consume treated seeds and for secondary poisoning resulting from the consumption of poisoned carcasses or prey items. For birds feeding directly on treated bait, a dietary RQ of approximately 36 was obtained, indicating a high risk to birds when treated grain is part of the diet. For secondary poisoning from predation or scavenging, dietary RQs of 0.5 and 3.6 were calculated, indicating a low to moderate dietary risk from the consumption of contaminated muscle and intestinal tissues, respectively.

On a chronic basis, the most sensitive endpoint in birds was the testes size. The RQs (EEC/NOEC) could not be calculated as a NOEC was not reported. However, on the basis of the LOEC, the RQ would be approximately 85, which indicates a high chronic risk resulting from dietary exposure to strychnine.

Mammals

Assessments were conducted for acute and short-term dietary exposure to strychnine of mammals consuming treated seeds directly (primary poisoning) and from the consumption of poisoned carcasses or prey items by scavenger or predator species (secondary poisoning).

The acute risk assessment estimated that a small mammal would exceed the LD₅₀ value by consuming approximately three grains of treated wheat. The NOEL (NOEL = 0.1 LD₅₀) would be exceeded by consuming less than one grain of treated wheat. This indicates that small non-target mammals are at substantial risk of mortality from consuming a few seeds treated with strychnine.

For predators or scavengers feeding on poisoned animals or food sources, it was determined that it would take approximately 1.0 and 0.15 days of feeding on muscle and intestinal tissues, respectively, to reach the LD₅₀. In order to reach the NOEL, a predator/scavenger would need to consume contaminated intestinal tissues for 0.015 day and contaminated muscle for 0.1 day. As the number of feeding days required for an adverse effect is less than one, there is an acute risk to mammalian predators or scavengers consuming contaminated carcasses or prey items.

No dietary studies with seed eating mammals could be located for this review.

A dietary assessment was conducted for mammalian predators or scavengers feeding on poisoned animals or food sources items. RQs of 0.7 and 5.1 were calculated, indicating a low to moderate dietary risk from consuming contaminated muscle and intestinal tissues, respectively.

2.4.4 Aquatic Assessment

Based on the current use patterns for strychnine products in Canada, exposure to freshwater and marine organisms is expected to be minimal.

2.4.5 Canadian Field Studies

During the 2001 growing season, several field studies were conducted by the provinces of Alberta and Saskatchewan in collaboration with Environment Canada's Canadian Wildlife Service in order to address certain outstanding questions with regards to strychnine use for ground squirrel control. The findings of these studies are summarized below.

A study was conducted to compare the efficacy of a strychnine RTU bait (0.4% strychnine) to freshly mixed bait of similar nominal concentration of strychnine. Results indicated that the freshly mixed bait was more effective than the RTU products as evidenced by higher mortality counts when compared to the RTU. However, both the freshly mixed bait and the RTU bait resulted in significantly higher visual counts of dead ground squirrels in comparison to the untreated control areas. Of significance to this environmental review is the fact that the treatment of 60 hectares during this study resulted in 221 ground squirrel carcasses being observed on the surface and, thus, available to scavengers. It should be noted that these numbers were not corrected for scavenging or search efficiency and, therefore, are likely underestimated.

A second study was conducted in Saskatchewan that examined the potential for non-target primary poisonings. To reduce the potential for non-target poisoning, current product labels require that entrances to ground squirrel burrows be covered after treatment. This study documented the number of treated kernels of wheat reaching the surface when entrances were blocked after strychnine was placed into the burrow and compared this number with the number of kernels reaching the surface when burrow entrances were left uncovered after treatment. Results indicated that collapsing the burrow entrance did not result in a significant reduction in the amount of treated kernels of wheat reaching the soil surface. Both scenarios would result in a significant number of small concentrated areas of strychnine-treated grain on the soil surface. The study estimated that, at a minimum, 108 000 to 324 000 small concentrated areas of strychnine-treated grain were exposed and available to songbirds and small mammals during the 2001 season in southern Saskatchewan. Each of these areas contained an average of 39 kernels of wheat if burrows were covered after treatment, compared to an average of 22 kernels when burrows were left uncovered. Since, for sensitive bird species, a fraction of a treated kernel represents the LD₅₀, this equates to a potential 7 128 000 to 12 636 000 doses of strychnine equivalent to the LD₅₀ being available to songbirds. This figure does not account for strychnine use in other areas such as Manitoba and Alberta. The results of this study clearly indicate that there is considerable potential for primary poisoning of non-target birds and mammals. One of the conclusions of the study was that alternate types of baits that are less attractive to non-target species need to be considered to replace currently used baits.

A third study examined the potential for secondary non-target poisonings as a result of scavengers feeding on the carcasses of poisoned animals. On the basis of carcass counts, the study estimated that use of strychnine-treated bait in Saskatchewan potentially resulted in 4680–4980 strychnine-poisoned ground squirrel carcasses being available to scavengers on the soil surface. Similarly, it was estimated that 1800 (95% C.I. = 300–3600) to 1950 (95% C.I. = 450–3750) songbirds may have been poisoned and available to scavengers. Carcass counts had to be corrected because the authors were able to determine that a significant amount of scavenging was occurring (43 of 50 planted ground squirrel carcasses were scavenged within 3 days, and 31 of 50 planted ring-necked pheasants scavenged within 3 days). A correction was also used for search efficiency,

which was estimated to be about 89%. The potential impact on scavengers could not be estimated as the amount and distribution of strychnine within the tissues of the carcasses was not determined. The results of this study clearly indicate that primary poisoning of non-target birds does occur when using strychnine baits for ground squirrel control, which can also result in a considerable potential for secondary poisonings. As with the previous study, the authors recommend that the current baits be altered so that they are less attractive to non-target species.

2.4.6 Incident Reports

Canadian incident reports of strychnine poisoning are not available. However, the PMRA requested incident reports of strychnine poisonings from the USEPA. The American incident reports span from 1966 to 2001 and they are divided into categories according to the legality of the use. Incidents that were clear cases of intentional misuse are not considered here.

Over the 20 year period spanning from 1968 to 1988, when above ground uses (which include the use pattern for ground squirrel control) were permitted, the USEPA reported a total of 39 incidents. During the 12 year period spanning from 1989 to 2001, when above ground uses were banned, a total of 17 incidents were reported. The majority of reported incidents involved birds and included a large number of incidents involving predatory species. For non-predatory species, the number of individuals killed per incident ranged from as low as one individual to an incident involving thousands of starlings, and includes small species (e.g., songbirds) as well as larger species (e.g., geese). Incidents involving predatory species, such as eagles and other raptors, usually involved only a few individuals per report. Of particular interest is the observation that after above ground uses of strychnine were banned in the United States, the number of reported incidents involving predatory bird species fell to zero.

Incident reports are not necessarily predictive of the magnitude of non-target mortality resulting from strychnine use because the number of unreported incidents is unknown. However, these reports do support the conclusions of this risk assessment as they indicate that the use of strychnine does result in primary and secondary poisoning of non-target species.

2.4.7 Environmental Assessment Conclusions

Strychnine is expected to be persistent in soil but it is immobile and should not leach. The current use pattern of strychnine is unlikely to result in contamination of aquatic ecosystems and drinking water. As a result, exposure to aquatic organisms is expected to be minimal. In the terrestrial environment, strychnine use for the control of pocket gophers, predators and skunks is expected to result in limited exposure to non-target species due to the confined/restricted nature of these uses.

The risk assessment of the use of strychnine to control pigeons and ground squirrels indicates that strychnine poses a high to very high acute risk to birds and mammals that consume the bait directly as well as to species that prey on or scavenge animals that have been poisoned by strychnine. Risks from short-term dietary and chronic exposure were also identified but, because of the high toxicity of strychnine and its rapid mode of action, acute primary poisonings of birds and mammals are of the greatest concern.

The use of wheat seeds and cracked corn for strychnine-treated baits are a significant factor in this assessment as these are desirable types of food for seed-eating animals, particularly birds. The method of application of strychnine for ground squirrel and pigeon control creates small concentrated areas of the treated seed that may attract non-target species. Subsequently, the poisoned carcasses in these areas will then attract predators and scavengers, creating the possibility of secondary poisoning. If small birds and mammals are attracted to areas where treated seeds are available, the likelihood of mortality is high as only one seed may be needed to deliver a lethal dose. Unlike other formulation types or application methods, a relatively accurate estimate of the dose that an organism receives from ingesting treated seeds can be determined using mixing rates and the product guarantee.

Canadian field studies have demonstrated that the current use pattern for the control of ground squirrels does result in appreciable amounts of bait being available to non-target organisms. This was evident by the significant number of kernels of wheat that were found outside of burrow entrances in the study area. Based on carcass counts, it was estimated that up to 1950 songbirds were poisoned in southern Saskatchewan during the 2001 season. This estimate does not include strychnine use in other areas. Similarly, large numbers of dead ground squirrels, counted above ground in areas where burrows were treated, would be available to predators and scavengers. Species of concern, including the endangered swift fox and the endangered burrowing owl, are found in the same areas and type of habitat where strychnine is used for ground squirrel control. Additionally, incident reports from the United States clearly indicate that above ground strychnine use resulted in primary and secondary poisoning of non-target species. This information, coupled with the fact that additional mitigative measures for ground squirrel control may reduce, but not prevent, primary and secondary poisoning by strychnine, has led to the conclusion that the current use of strychnine for ground squirrel control is of concern. Other measures, such as new forms of bait that are less palatable to non-target organisms and/or ways to reduce users' reliance on strychnine, need to be explored.

The potential for primary and secondary poisoning as a result of pigeon control with strychnine-treated corn is a concern. Currently, the label of the pigeon control product containing strychnine does not restrict the areas where the product may be applied beyond a statement to place bait in feeding areas and other areas where pigeons frequent. More specific statements are required concerning the placement of bait near/in feeding stations and on buildings where pigeons frequent.

2.5 Other Assessment Considerations

During the re-evaluation of strychnine, the PMRA has taken into account the federal TSMP and has followed its Regulatory Directive [DIR99-03](#). It has been determined that this product does not meet TSMP Track 1 criteria because strychnine does not meet the criterion for bioaccumulation (log K_{ow} of 4 at pH 7). Furthermore, strychnine is reported to be rapidly metabolized and excreted.

Strychnine is a plant extract and it is not likely to contain any by-products or micro-contaminants that meet the TSMP Track 1 criteria. Impurities of toxicological concern are not expected to be present in this product.

3.0 Integrated Pest Management (IPM) for Richardson's Ground Squirrels

Richardson's ground squirrels are considered by producers and the governments of Alberta and Saskatchewan as the major mammalian pest impacting agriculture, and strychnine has remained the control option of choice. A national expert group on Richardson's ground squirrels formed a committee to promote and develop alternative methods for the control of Richardson's ground squirrels. This stakeholder group is composed of producers, environmentalists, registrants, academics and representatives from all levels of government, including the following:

- Alberta Agriculture, Food and Rural Development (Chair)
- Nu-Gro Corp.
- Saskatchewan Association of Rural Municipalities
- Saskatchewan Agriculture, Food and Rural Revitalization
- Pest Management Regulatory Agency
- Alberta Research Council
- Environment Canada
- University of Lethbridge
- Maxim Chemical
- Alberta Agricultural Fieldmen
- Alberta Beef Producers
- Alberta Environment

The Richardson's ground squirrel pest management strategy is the outcome of a series of stakeholder meetings held from 2002 to 2004. Initial meetings explored the scope of the problem, and subsequent meetings determined the knowledge gaps that prevent sustainable management. Responsibilities and timelines were established for a number of projects designed to fill these gaps. Below is a summary of the action items that make up the pest management strategy. It is expected that aspects of the Richardson's ground squirrel pest management strategy will be applicable to other ground squirrel species.

3.1 Assessment of the Economic Impact of Richardson's Ground Squirrel

Measures of the economic costs of infestations and the corresponding treatment have never been established for Richardson's ground squirrels and need to be researched. The group identified three different systems, each with its impact level: urban setting, field crop and pastures. In a first attempt, only the pasture system will be investigated. A project will be initiated to assess the economic impacts of Richardson's ground squirrel on pastureland used for grazing. It is anticipated that the work will begin in 2005, with completion within two years.

3.2 The Role of Environmental Factors in Population Regulation

Environmental factors such as precipitation (especially in the spring) are known to drastically affect ground squirrel populations. A study will attempt to show correlations between 40 environmental factors for ground squirrels and their population levels. Sales data on gopher control products containing strychnine will serve as a proxy for ground squirrel population levels for a period of at least ten years. This data will be analysed to show any correlations with environmental factors. If environmental factors contribute significantly to the population dynamics of Richardson's ground squirrels, a predictive model may then be developed to enable producers to initiate timely control actions if and when required. Difficulties in assembling the necessary data have delayed this project, although it is hoped to have an analysis completed for the spring of 2006.

3.3 Behaviour and Biology of Richardson's Ground Squirrels

Information on the spatial distribution of ground squirrels on a macro-scale (regional distribution) and a micro-scale (within field distributions) will provide producers with regional information on population levels, thus guiding producers to make more informed decisions on when and where to treat. Data collected in previous years and that from a 2004 survey conducted in Alberta will be analyzed to determine both the regional and the field differences in population levels. These data will eventually show how spatial distributions on a regional scale change over time as well as the overall trends in population densities. It is anticipated that the 2004 Alberta survey will continue for several years. The work done in Alberta will also provide a large-scale test of a novel census technique that may be implemented as part of the overall integrated pest management program providing an indicator of the need to treat.

3.4 Toxicant Evaluation and Optimization (Part 1)

Producers have traditionally relied on the use of toxicants for the control of ground squirrels in the Prairies. With the implementation of an integrated pest management program, it is expected that the use of toxicants will eventually decrease. However, the use of toxicants will still remain an important part of the producers' toolbox. As part of the pest management strategy, evaluation of currently available tools for ground squirrel control will continue. Moreover, novel control techniques using new chemistries will be investigated. If proven to be of benefit, these chemistries will be submitted to the PMRA for registration.

As new techniques are being developed to enhance existing control measures, these will be immediately promoted through provincial agriculture websites and through the municipal Agriculture Fieldmen. For 2004, data collected will be analyzed to determine whether the shelf life of the current fresh-mixed baits can be extended by refrigeration without losing efficacy. The results of this study are under review.

3.5 Toxicant Evaluation and Optimization (Part 2)

There is considerable anecdotal evidence from both producers and academics that the current practice of covering the burrow entrance after the application of strychnine would likely result in a greater chance of non-target poisoning, as the ground squirrels will often, during the process of clearing out the burrow entrance, throw the bait onto the surface of the prairie. A study will be undertaken to determine if significantly more seed is deposited on the above ground area around the ground squirrel burrow when the burrow opening is left undisturbed versus when the opening is closed. The results of this study are currently under review. If label changes to mitigate the non-target exposure are indicated, these will be implemented.

This proposed pest management strategy will address field crop, pasture and urban uses separately. Growers will then have access to a wider spectrum of pest control tools as part of an IPM-based decision system. The long-term goal of the committee is to manage Richardson's ground squirrels in a sustainable manner, especially addressing the environmental risk associated with today's practices.

4.0 Proposed Re-evaluation Decision

The PMRA proposes that the use of strychnine to control Northern pocket gophers, skunks, pigeons, wolves, coyotes and black bears does not represent an unacceptable risk to human health or the environment provided that the proposed mitigation measures are adopted.

The current use of strychnine to control ground squirrels is a concern from an environmental perspective. However, in consideration of the ongoing work by a national expert group to promote and develop a pest management strategy for the control of Richardson's ground squirrel, a major agricultural pest, the lack of practical alternatives at this time, and the additional mitigative measures being proposed in this document, it is proposed that the use of strychnine to control ground squirrels be maintained for the short term. If implemented, this interim decision will be reviewed in three years in light the progress made towards the implementation of the Richardson's ground squirrel pest management strategy.

The PMRA will accept written comments on this proposal up to 60 days from the date of publication of this document to allow interested parties an opportunity to provide input into the proposed re-evaluation decision. Registrants of products containing strychnine should not apply for label amendments or submit the additional data described in Section 6.0 during this comment period; they will be informed by letter of the specific instructions for addressing label changes and data requirements once the re-evaluation decision has been finalized.

5.0 Proposed Regulatory Action

5.1 Proposed Regulatory Action Having Relevance to Human Health

Based on the acute toxicity of strychnine and the USEPA's conclusions, registrants are required to amend the "Precaution" section of end-use product labels and must include the following statements:

- 1) For all products,
 - "This product should be stored away from children under lock and key."
 - "Do not apply this product in a way that will contact workers, other persons, pets or domestic animals."
- 2) For products formulated as a grain-based bait,
 - "Wear chemical-resistant gloves, a dust mask, long pants and a long-sleeved shirt during mixing/loading, application, clean-up and other handling activities."
- 3) For products formulated as a solution or tablets,
 - "Wear chemical-resistant gloves, long pants and a long-sleeved shirt during mixing/loading, application, clean-up and other handling activities."

5.2 Proposed Regulatory Action Having Relevance to Environment

Current risk mitigation measures used when controlling ground squirrels and pigeons include covering ground squirrel burrows after treatment, removing dead carcasses post treatment and using covered bait stations. These measures can help reduce, but not prevent, non-target poisonings. Therefore, the PMRA proposes the following label improvements to mitigate the risks to non-target organisms associated in the control of pigeons and ground squirrels.

- 1) For Registration Number 24510 (Strychnine Predacide Skunk Control),
 - In the “**Nature of Restriction**” section, the following statement must be removed:

“This product is for storage, use and handling only by persons authorized under the *Alberta Agricultural Pests Act*”,

and must be replaced with the following:

“This product is for storage, use and handling only by designated employees of the Alberta Department of Agriculture, Food and Rural Development, or by municipal employees, authorized under the *Alberta Agricultural Pests Act*, provided that such designated or authorized persons are trained and certified by the Department in the use of this product in accordance with Section 14(2) of the Pest and Nuisance Control Regulations of the *Agricultural Pests Act* (2001).”
- 2) For all end-use products registered for the control of pocket gophers and ground squirrels,
 - In the “**Directions for Use**” section, the following statements must be included:

“Care must be taken to avoid spilling bait on soil surface. All spilled bait must be collected and disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent non-target poisonings. Toxic to all forms of life.”

- A section entitled “**Monitoring**” must be added to the label and must include the following text:

“All areas where the bait has been used must be monitored on a regular basis for dead animals. In the case of ground squirrels, monitoring must be done on a daily basis for the first week and on a weekly basis for several weeks thereafter. All carcasses must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep to prevent scavengers from unearthing carcasses.”
- A section entitled “**Environmental Precautions**” must be added to the label and must contain the following text:

“This product is toxic to wildlife. Treated grain exposed on soil surface and poisoned carcasses may be hazardous to birds and other wildlife. All treated grain and poisoned carcasses exposed on soil surface must be collected and disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent non-target poisonings. Toxic to all forms of life.”
- The following statements, which will help to mitigate the risks to non-target organisms including species at risk, must appear on the product label under the section entitled “**Environmental Precautions**”:

“Species at risk, including the burrowing owl (*Athene cunicularia*) and the swift fox (*Vulpes velox*), are known to frequent habitat occupied by ground squirrels. **DO NOT APPLY THIS PRODUCT IF THESE OR OTHER SPECIES AT RISK THAT MAY FEED ON STRYCHNINE BAIT OR GROUND SQUIRRELS ARE PRESENT IN YOUR AREA.** For information on species at risk in your area, contact your local provincial or federal wildlife officials.”
- The “**DISPOSAL**” section must be rewritten as follows:

“Dispose of the container in accordance with provincial requirements. For more information on the disposal of unused product, contact the provincial regulatory agency or the manufacturer.”

“Carcasses Disposal (Target and Non-target Species): All carcasses must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent scavengers from unearthing carcasses.”

- 3) For all end-use products registered for the control of pigeons,
- In the “**Primary Display**” panel, the following text must be removed:

“A PREPARED BAIT CONTAINING STRYCHNINE FOR THE CONTROL OF PIGEONS”

and must be replaced with the following:

“A PREPARED BAIT CONTAINING STRYCHNINE FOR THE CONTROL OF FERAL PIGEONS IN OR WITHIN 100-METRES OF BUILDINGS, NESTING SITES AND ROOSTING SITES”
 - Under the section entitled “**PIGEONS**”, the following text must be removed:

“Place POISON CORN Ready-to-Use Bait in feeding areas and other areas where pigeons frequent. Change or maintain bait as required.”

and must be replaced with the following:

“For the control of feral pigeons on farms, place POISON CORN Ready-to-Use Bait in and around buildings where pigeons are known to congregate or in feeding stations. Treatment area must be checked daily for dead carcasses and spilled bait until the control program is completed. Dead carcasses, uneaten bait and collected spilled bait must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent scavengers from unearthing carcasses.”

“For the control of feral pigeons in urban areas, place POISON CORN Ready-to-Use Bait on buildings or ledges where pigeons are known to congregate at least 2 metres (approximately 6 feet) off the ground. Treatment area must be checked daily for dead carcasses and spilled bait until the control program is completed. Dead carcasses, uneaten bait and collected spilled bait must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent scavengers from unearthing carcasses.”

- A section entitled “**ENVIRONMENTAL PRECAUTIONS**” must be added to the label and must contain the following text:

“This product is toxic to wildlife. Exposed treated grain is hazardous to non-target birds and other wildlife. All carcasses and uneaten bait must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep enough to prevent scavengers from unearthing carcasses. Toxic to all forms of life. **DO NOT USE IN AREAS WHERE PEREGRINE FALCONS ARE KNOWN TO NEST OR HUNT.**”
- The “**DISPOSAL**” section must be rewritten as follows:

“Dispose of the container in accordance with provincial requirements. For more information on the disposal of unused product contact the provincial regulatory agency or the manufacturer.”

“Carcasses Disposal (Pigeons and Non-target species): All carcasses must be disposed of by incineration or burial in a pit no less than 46 cm (approximately 18 inches) deep and then covered to prevent scavengers from unearthing carcasses.”

A submission to request label revisions will be required within 90 days of the finalization of the re-evaluation decision.

6.0 Data Requirements

The technical registrants of strychnine will be required to submit the following data within 24 months of the finalization of the re-evaluation decision:

- all data (as they relate to Canadian use pattern) submitted to the USEPA in response to the data call-in prior to reregistration in the United States, and the USEPA Data Evaluation Reports (DERs); and
- all data (as they relate to Canadian use pattern) that were required by the USEPA as a condition of reregistration of strychnine.

7.0 Supporting Documentation

PMRA documents, such as DIR2001-03 and data codes (DACO) tables can be found on our website at www.pmra-arla.gc.ca. PMRA documents are also available through the Pest Management Information Service. Phone: 1 800 267-6315 within Canada or 1 (613) 736-3799 outside Canada (long distance charges apply); Fax: (613) 736-3798; E-mail: pmra_infoserv@hc-sc.gc.ca.

The federal TSMP is available through Environment Canada's website at www.ec.gc.ca/toxics.

The USEPA RED document (*Strychnine*) is available on the Office of Pesticide Programs' website at www.epa.gov/pesticides/reregistration under Chemical Status.

List of Abbreviations

a.i.	active ingredient
bw	body weight
C.I.	confidence interval
DACO	data codes
DER	Data Evaluation Report
EEC	expected environmental concentration
K_{ads}	adsorption coefficient
kg	kilogram(s)
K_{ow}	<i>n</i> -octanol–water partition coefficient
LC ₅₀	lethal concentration to 50%
LD ₅₀	lethal dose to 50%
LOEC	lowest observed effect concentration
mg	milligram(s)
NOEC	no observed effect concentration
NOEL	no observed effect level
pH	-log ₁₀ acid dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RED	Reregistration Eligibility Document
RQ	risk quotient
RTU	ready-to-use
TSMP	Toxic Substances Management Policy
USEPA	United States Environmental Protection Agency

Appendix I Canadian Strychnine Products Currently Registered (17 April 2005)

Registrant	Registration Number	Guarantee	Product Name	Class
Nu-Gro IP Inc.	14109	0.4%	Wilson Poison Corn	Restricted
Alberta Sustainable Resource Development, Fish and Wildlife Division	20410	50%	Strychnine Wolf, Coyote & Black Bear Control Predacide	Restricted
K-9 Cattle Co.	21557	0.4%	K-9 Pocket Gopher Bait	Restricted
Nu-Gro IP Inc.	22913	0.4%	Wilson Strychnine Gopher-Kil Bait	Restricted
Maxim Chemical International Ltd.	22956	0.4%	Fairview Gopher Cop R.T.U.	Restricted
Saskatchewan Association of Rural Municipalities	23236	0.4%	S.A.R.M. Gopher Poison R.T.U.	Restricted
BCN Chemicals Inc.	23499	99.0%	Strychnine Technical	Technical active
Elston Manufacturing Inc.	24988	0.4%	Elston Gopher Getter Bait II	Restricted
Elston Manufacturing Inc.	24989	0.4%	Elston Gopher Getter Bait I	Restricted
Noris Chemical Corp.	25471	98.4%	Strychnine Alkaloid NFX Powder Technical	Technical active
Wilco Distributors, Inc.	25472	0.4%	Wilco Gopher Ground Squirrel Bait	Restricted
Alberta Department of Agriculture	24510	3.5%	Strychnine Predacide Skunk Control	Restricted
Nu-Gro IP Inc.	27651	0.4%	Wilson Richardson's Ground Squirrel Strychnine Bait	Restricted
Maxim Chemical International Ltd.	24619	10%	Fairview Gopher-Cop 10	Manufacturing concentrate
Maxim Chemical International Ltd.	27757	2%	Fairview Gopher Cop 2	Manufacturing concentrate
Maxim Chemical International Ltd.	27758	0.4%	Fairview Gopher Cop R.T.U.W.	Restricted

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