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WASHINGTON, D.C. 20460

OFFICE OF  
PREVENTION, PESTICIDES, AND  
TOXIC SUBSTANCES

April 8, 1996

Memorandum

SUBJECT: Transmittal of EFED RED for the List C Chemical Strychnine  
Case #3133, Chemical #076901

FROM: Mary Powell *Mary Powell*  
Science Analysis and Coordination Staff  
Environmental Fate and Effects Division

THRU: Kathy Monk, Acting Chief *Kathy Monk*  
Science Integration Staff  
Environmental Fate and Effects Division

TO: Kathryn Davis, PM 52  
Special Review and Reregistration Division

Attached please find the following documents for the completed RED for strychnine:

1. SACS summary report
2. EEB science chapter
3. EFGWB science chapter

There are no data gaps for the below-ground uses of this chemical. If you have any questions about this case, please call Mary Powell on 305-7384.

cc (with SACS summary report attached):

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List C File

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## SACS RED Summary Report

In 1989, all above-ground uses of strychnine were "temporarily canceled" by court order. Use of strychnine was restricted to underground rodent burrows; food and feed crop uses were canceled and some data waivers were granted. Strychnine registrants, many of which are small companies, formed the Strychnine Consortium to jointly fund EPA-required studies.

### I. Exceedance of Levels of Concern

The Agency believes that the risk from the below-ground uses of strychnine is minimal when used as directed. When the precautions recommended are taken, it does not constitute a threat to nontarget or endangered species.

### II. Data Gaps

There are no data gaps for the below-ground uses of strychnine.

### III. Endangered Species

Studies have demonstrated that the above-ground use of strychnine poses a threat to nontarget animals and may cause jeopardy to members of endangered or threatened species. However, we believe that the risk from below-ground uses of strychnine is minimal when used as directed. When the precautions recommended are taken, it does not constitute a risk to nontarget or endangered species.

### IV. Labeling

USE RESTRICTIONS: "Do not place bait on or above the ground surface."

The label contains the ENVIRONMENTAL HAZARD WARNING:

"This product is toxic to fish, birds, and other wildlife. Baits exposed on soil surface may be hazardous to birds and other wildlife. Do not contaminate water in lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes."

This last sentence should be changed to: "Do not contaminate water when disposing of equipment washwater or rinsate" if the court order permits such a change.

ENDANGERED SPECIES CONSIDERATIONS:

"The killing of a member of an endangered species during strychnine baiting operations may result in a fine under the Endangered Species Act. Before baiting, the user is advised to contact the Regional U.S. Fish and Wildlife

Service (Endangered Species Specialist) of the local Fish and Game Office for specific information on endangered species."

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## 1. ECOLOGICAL TOXICITY DATA

### a. Toxicity to Terrestrial Animals

#### i. Birds, acute and subacute

The acute oral toxicity study (71-1) was waived because strychnine is sufficiently well known to assume that a bird receiving an acute dose would die. It will be assumed that it is very highly toxic to birds on an acute basis.

Two subacute dietary studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to birds. The preferred test species are mallard duck (a waterfowl) and bobwhite quail (an upland gamebird). Results of these tests are tabulated below.

Table . Avian subacute dietary toxicity.

Species	% ai	LC50 (ppm)	Toxicity Category	MRID Author/Year	Study Classification
Northern bobwhite quail ( <i>Colinus virginianus</i> )	100	3536 NOEC 1250	Slightly Toxic	41322602 Pedersen/1989	Core
Mallard duck ( <i>Anas platyrhynchos</i> )	99	212 NOEC 78	Highly Toxic	41322601 Pedersen/1989	Core
Black-billed magpie ( <i>Pica pica</i> )	100	99 (65-130)	Highly Toxic	File no. 56228-16	Supplemental
American kestrel ( <i>Falco sparverius</i> )	100	234	Highly Toxic	File no. 56228-16	Supplemental

These results indicate that strychnine is slightly to highly toxic to avian species on a subacute dietary basis. The guideline requirement (71-2) is fulfilled (MRID 41322601 and 41322602).

#### ii. Birds, chronic

Avian reproduction studies using the technical grade of strychnine were required because birds may be subject to repeated or continuous exposure to the pesticide and because strychnine is stable in the environment to the extent that potentially toxic amounts may persist in the food of wild birds. The tests were done with the preferred species, the mallard duck and bobwhite quail. Results of these tests are tabulated below.

**Table . Avian reproduction.**

Species	% ai	NOEC/LOEC (ppm)	Endpoints Affected	MRID Author/Year	Study Classification
Northern bobwhite quail ( <i>Colinus virginianus</i> )	100	1,114/1,200	None	42716801 Pedersen/1993	Core
Mallard duck ( <i>Anas platyrhynchos</i> )	100	not reported/33	testes	42716802 Pedersen/1993	Core

There were no treatment related effects to the Bobwhite quail. In the Mallard duck, testes were smaller at the LOEC (33 ppm). Also, chick body weights were reduced on day 1 (in the 68.9 ppm group) and day 14 (in the 140.9 ppm group). Egg production and adult female body weight were also reduced at 140.9 ppm.

The guideline requirement (71-4) is fulfilled (MRID 42716801 and 42716802).

### iii. Mammals, acute and chronic

Wild mammal testing was required because of the potential exposure of wild mammals during baiting with strychnine. Rat toxicity values were obtained from the Agency's Health Effects Division (HED). The toxicity values and test results are reported in the table below.

**Table . Mammalian toxicity.**

Species	% ai	Test Type	Endpoint	MRID No. Author/Date	Study Classification
Laboratory rat ( <i>Rattus norvegicus</i> )	99 unknown	Acute oral Acute oral	LD50 ♀ = 2.2 mg/kg LD50 ♂ = 6.4 mg/kg	40908901 41210701	Supplemental Supplemental
Striped skunk ( <i>Mephitis mephitis</i> )	99	Acute, mg per egg bait	LD100 = 31 mg/egg/skunk	40296501 Record/1987	Supplemental
European ferret ( <i>Mustella putorius</i> )	99	Dietary 5-day	LC50 = 198 ppm	40296502 Record/1987	Supplemental
Red fox ( <i>Vulpes fulva</i> )	99	Dietary 5-day	LC50 = 70 ppm (52-96)	40296503 Record/1987	Supplemental

Based on a comparison to HED's rat toxicity values, these results indicate that strychnine is very highly toxic to small mammals on both an acute oral basis and dietary basis. The signs of toxicity, including death, occurred within one hour. This is considered typical of strychnine.

The guideline requirement (71-3) is fulfilled (MRID 40296501, 40296502 and 40296503).

#### iv. Terrestrial field testing

##### *Pocket gopher (Thomomys bottae) control.*

In one study, strychnine bait was applied with a burrow builder, a device that creates an artificial burrow, puts the poisoned baits underground, and seals the burrow. The strychnine bait partially controlled a population of gophers.

A 0.5% bait produced an 8% reduction in population, 1.15% bait produced a 10% reduction, and 1.8% baits produced a 19% reduction. Strychnine residues were found in the muscle tissue. The mean residue was approximately 0.5 ppm, and residues ranged as high as 5.4 ppm. It was also found in the gastro-intestinal tract at a mean of approximately 5 ppm and as high as 35.8 ppm.

Three nontarget species were found dead: Horned lark (*Eremophila alpestris*), Brewer's blackbird (*Euphagus cyanocephalus*), and Striped skunk (*Mephitis mephitis*). Residues in the lark were 0.35 ppm in the muscles and 1.61 ppm in the gastro-intestinal tract. Residues in the Blackbird were 0.56 ppm in the muscle and 23.3 ppm in the gastro-intestinal tract. Tissues samples from the skunk were not analyzed.

The results of this study show that:

- Based on burrow census data and pocket gopher population data, no treatment level was efficacious. The greatest decrease in the pocket gopher population was estimated to be only 18 percent. Generally, at least 85% population reduction in the pest species is needed to get efficacy.
- Hazards to nontarget avian species (and possibly mammals) occur when using the burrow builder because of spillage of the poisoned baits when the builder is removed from the ground or goes around a corner (e.g., at the end of a row). These results are similar to those reported in previous studies (Hegdal and Gatz, 1978; Fagerstone *et al.*, 1980; Matschke *et al.*, 1991; and Evans and Campbell, 1989).
- Residues of strychnine in the gastro-intestinal tract of pocket gophers exceed the Agency's unacceptable risk criteria for nontarget organisms. Residues at those levels could kill secondary consumers.
- There are sufficient data to presume that the proposed use poses a "may effect" situation to endangered species, and exposure to endangered species is expected if the baiting operation is conducted in their currently occupied habitats.

However, recent instructions for the burrow builder say that the operators should pick up spilled bait; therefore, the underground use of strychnine to control pocket gophers does not pose an unacceptable risk to nontarget wildlife (MRID 42488601).

In another study, hand baiting of burrows was used to control gophers. The baiting controlled the gophers, but there was nontarget mortality that would be of concern in areas inhabited by endangered species (MRID 41478501).

**b. Toxicity to Freshwater Aquatic Animals**

**i. Freshwater fish, acute**

Two freshwater fish toxicity studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). Results of these tests are tabulated below.

**Table . Freshwater fish acute toxicity.**

Species	% ai	LC50 (ppm)	Toxicity Category	MRID Author/Year	Study Classification
Rainbow trout ( <i>Oncorhynchus mykiss</i> )	99.9	2.3 (1.7-3.2)	Moderately Toxic	41126502 Bowman/1989	Core
Bluegill sunfish ( <i>Lepomis macrochirus</i> )	99.9	0.76 (0.61-0.96)	Highly Toxic	41126501 Bowman/1989	Core

These results indicate that strychnine is moderately to highly toxic to freshwater fish on an acute basis. The guideline requirement (72-1) is fulfilled (MRID 41126501 and 41126502).

**ii. Freshwater invertebrates, acute**

A freshwater aquatic invertebrate toxicity test using the technical grade of the active ingredient is required to establish the toxicity of a pesticide to invertebrates. The preferred test species is *Daphnia magna*. Results of this test are tabulated below.

**Table . Freshwater invertebrate toxicity.**

Species	% ai	LC50/ EC50 (ppm)	Toxicity Category	MRID Author/Year	Study Classification
Waterflea ( <i>Daphnia magna</i> )	99.9	10 (8-12)	Moderately Toxic	41126503 Forbis/1989	Core

The results indicate that strychnine is moderately toxic to aquatic invertebrates on an acute basis. The guideline requirement (72-2) is fulfilled (MRID 41126503).

## 2. ENVIRONMENTAL FATE ASSESSMENT

### a. General Issues

Only a very limited amount of environmental fate data are available at this time, and therefore a full-scale environmental fate assessment is not appropriate. The majority of data indicate that strychnine is persistent, but not mobile. The acceptable hydrolysis and soil photolysis studies reveal that neither process produces a significant transformation of parent. Aerobic soil metabolism data, which are not acceptable, suggest that metabolism can sometimes not occur, or can occur rapidly under as yet undefined conditions which include a significant lag period. The applicant believes a specific microorganism or an adaptive enzyme system may be responsible. Metabolism may also be very slow, and this process may not be a consistent and dependable means of breakdown. The acceptable batch adsorption/desorption study demonstrates strong binding to a number of soils.

With the present below-ground use pattern, strychnine is not likely to reach ground or surface water. The material is incorporated into baits, which are largely, if not exclusively, applied as a below-ground spot treatment to specific burrows occupied by pocket gophers, and not as a broadcast or general treatment.

For these reasons, the Agency's concerns are minimal, in that soil and ground or surface water do not seem likely to be materially affected by below-ground use of strychnine.

### b. Status of Data Requirements

According to the 1989 Strychnine Settlement Agreement, the following studies are required for below-ground registration of strychnine, mainly to control pocket gophers: Hydrolysis (161-1), photolysis on soil (161-3), aerobic soil metabolism (162-1), mobility-ads/des (163-1), and terrestrial field dissipation (164-1).

The Agency does not require aerobic soil metabolism studies for below-ground uses. Waivers were granted for photolysis in water (161-2) and anaerobic soil metabolism (162-2). Bioaccumulation in fish (165-4) and terrestrial field dissipation were reserved.

Available data satisfy the requirements for underground uses. In the event that above-ground uses are restored by court order, all above-ground reregistration data will be required.

#### **i. Hydrolysis**

Parent does not hydrolyze at pH 5, 7, and 9. Acceptable hydrolysis data indicate that this process does not significantly degrade the parent (MRID #411223-01).

#### **ii. Photolysis on Soil**

Parent was stable to soil photolysis. Acceptable photolysis data indicate that this process does not significantly degrade the parent. The projected half-life is ca. 180 days based on first-order kinetics, which may not apply. The actual kinetic model could not be determined with confidence, since only a minimal amount of strychnine is transformed within the experimental period. No products of the transformation could be detected (MRID #429734-01).

#### **iii. Mobility**

The data indicate that strychnine is immobile; the parent is adsorbed to organic matter and clay. Using batch equilibrium techniques, strychnine had Freundlich  $K_{oc}$  in loamy sand, sandy loam, loam, and sandy clay loam soils of 39.79, 94.65, 118.87, and 168.97, respectively. Adsorption increased with increasing CEC.  $K_{oc}$  values were 55.0 for the loamy sand, 89.4 for the sandy loam, 114.6 for the loam, and 146.1 for the sandy clay loam soils. Mobility of unaged parent was satisfied (MRID #42366501).

The data requirement for aged parent is reserved.

#### **iv. Aerobic Soil Metabolism**

EFGWB does not require aerobic soil metabolism for below-ground uses, but one unacceptable study was submitted. The study did not provide a half-life for strychnine, and there was no accounting for material balance. Aerobic soil metabolism may be limited to microorganisms capable of adaptive enzyme formation; some soils do not appear to have the specific microbes necessary for metabolism. There is a considerable lag period preceding metabolism in those soils that metabolize parent (MRID #422342-01).

#### **v. Ground Water and Surface Water Assessment**

Neither ground water nor surface water seem to be at risk under the current use pattern because the active ingredient is incorporated into baits that are applied as spot treatments to specific burrows (below-ground) and not as a broadcast application. Also, the parent is essentially immobile.

**3. EXPOSURE AND RISK CHARACTERIZATION**

The data are insufficient to calculate risk quotients for above-ground baiting with strychnine. However, the studies have demonstrated that the use of strychnine above ground poses a threat to nontarget animals and may cause jeopardy to members of endangered or threatened species.

The Agency believes that the risk from the below-ground uses of strychnine is minimal when used as directed. When the precautions recommended are taken, it does not constitute a risk to nontarget or endangered species.

**USE RESTRICTIONS:** "Do not place bait on or above the ground surface."

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