Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses

DELTAMETHRIN

Deltamethrin was first registered for use in Canada in 1982 under the trade name of Decis. Deltamethrin is used to control Colorado potato beetles, leaf hoppers, cutworms, tentiform leaf miners, bertha army worms, flea beetles, diamond-back moths, grasshoppers, and tarnished plant bugs (Agriculture Canada and Environment Canada 1995).

The average half-life of deltamethrin in soil is between 5 and 6 weeks and depends on the nature of the soil as well as the temperature (Elliott 1989). Deltamethrin undergoes photolysis, hydrolysis, and oxidation. The photodegradation of deltamethrin includes isomerization, ester cleavage, dehalogenation, and decarboxylation. Photoinduced isomerization of deltamethrin involves the cyclopropane ring and oxidation to carbon dioxide (NRCC 1986).

Although deltamethrin is less susceptible to microbial degradation than other pyrethroids, it does occur. Under aerobic conditions, deltamethrin is subjected to the hydrolysis of the ester linkage with half-life values ranging from 11 to 72 d (WHO 1990). Under anaerobic conditions, deltamethrin is reduced to various carboxylic acids.

Deltamethrin is lipophilic and has a low mobility in soils. The formulated product and its metabolites are more mobile, but they do not accumulate in soils (Kaufman and Kayser 1979a, 1979b). It was also reported that deltamethrin does not persist in treated crops (Roussel-Uclaf 1982).

For more information on the use, environmental concentrations, and chemical properties of deltamethrin, see the fact sheet on deltamethrin in Chapter 4 of *Canadian Environmental Quality Guidelines*.

Water Quality Guideline Derivation

The Canadian water quality guideline for deltamethrin for the protection of livestock water was developed based on the CCME protocol (CCME 1993).

Livestock Water

Acute toxicity (LD_{50}) values in mammals ranged in rats from 1.8 $mg \cdot kg^{-1}$ (intravenous) (Kavlock et al. 1979) to 5000 $mg \cdot kg^{-1}$ (oral) (Audegond et al. 1981). Chronic toxicity ranged from 1.0 $mg \cdot kg^{-1}$ for retardation of fetus development in mice (Vannier and Glomot 1982) to 50 $mg \cdot kg^{-1}$ for reduction in growth and offspring weight in rats (Wrenn et al. 1980). The NOELs (reproduction) for rats and mice were 2.1 and 12 $mg \cdot kg^{-1}$, respectively (Worthing 1983).

The WHO assigned a NOEL of 2.1 $mg \cdot kg^{-1}$ per day for rats, 13 $mg \cdot kg^{-1}$ per day for male mice, and 17 $mg \cdot kg^{-1}$ per day for female mice (WHO 1990). A reproductive NOEL for rats was 2.5 $mg \cdot kg^{-1}$ per day (USEPA 1992). The most sensitive animal was the dog, with a NOEL (moribundity, mortality, body weight, food consumption, and hemato- and neurotoxicity) of 1.0 $mg \cdot kg^{-1}$ per day (IRDC 1980). Kavlock et al. (1979) reported that female rats receiving deltamethrin orally at 1.25 $mg \cdot kg^{-1}$ experienced a 20% reduction in weight gain. Mice exposed to 4.36 $mg \cdot kg^{-1}$ of deltamethrin for 91 d experienced 50% mortality (Gupta and Kumar 1991).

Deltamethrin was administered to male and female beagle dogs at dose concentrations between 1.0 and 40 $mg \cdot kg^{-1}$ for 2 years. Dogs were observed for toxicity, moribundity, mortality, changes in body weight and food consumption, and hemato- and neurotoxicity. No compound-related effects were observed, and the NOEL was set at 40 $mg \cdot kg^{-1}$ (IRDC 1980).

Estimates of direct toxicity (LD_{50}s) of deltamethrin to birds ranged from 1.0 $g \cdot kg^{-1}$ oral for chickens *(Gallus*

Table 1. Water quality guidelines for deltamethrin for the protection of agricultural water uses (CCME 1997).

Use	Guideline value ($\mu g \cdot L^{-1}$)
Irrigation water	NRG*
Livestock water	2.5

*No recommended guideline.

domestica) (Grandadam 1976) to 18 $g \cdot kg^{-1}$ oral for partridges *(Perdix perdix)* (Grolleau and Griban 1976).

The geometric means of the LOELs and NOELs for each species for which acceptable toxicological data were available were divided by an uncertainty factor of 10 to determine the TDI. The lowest calculated TDI was 0.0062 $mg \cdot kg^{-1}$ per day for mice (Gupta and Kumar 1991). Multiplying the TDI by the ratio of body weight to water intake rate resulted in an RC of 0.0124 $mg \cdot L^{-1}$. To account for exposure to deltamethrin from sources other than water, the lowest RC is multiplied by an apportionment factor of 0.2 to give a water quality guideline of 2.5 $\mu g \cdot L^{-1}$ for the protection of livestock (CCME 1997).

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