



Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses

ALDICARB

In Canada, aldicarb was registered and used as a systemic pesticide, primarily for the control of insects, acarids, and nematodes affecting potato and sugar beet production from 1975 to 1996. The registration of aldicarb for all uses in Canada was discontinued in 1996 (PMRA 1998). Due to the toxicity of the two major aldicarb transformation products, aldicarb sulfoxide (ASO) and aldicarb sulfone (ASO₂), concentrations of aldicarb in the environment are generally reported as total aldicarb residues (TAR). The rate of oxidation of aldicarb and subsequent hydrolysis is affected by such factors as pH, temperature, soil moisture, and microbial activity. Photodegradation and volatilization are relatively minor routes of aldicarb dissipation in water and soil. In general, aldicarb is considered to be moderately persistent with DT₅₀ (time for 50% dissipation) <8 weeks in agricultural soils, but may persist longer under some circumstances.

Aldicarb is highly soluble in water (6 g·L⁻¹), has a low affinity for most soil types (log K_d < 4 L·kg⁻¹) (Hough et al. 1975; Cohen et al. 1984), and has been demonstrated to have a high potential to leach through agricultural soils. Use of aldicarb in agriculture and noncrop areas may result in contamination of surface water or groundwater systems. Aldicarb may represent a hazard to nontarget crop species if these water sources are subsequently used to irrigate sensitive crop species.

In addition to its pesticide capabilities, aldicarb and its two oxidation metabolites are toxic to mammals. Since aldicarb was marketed only in the granular form in Canada, significant exposures of mammals are likely to be associated with ingestion of contaminated feeds and water. Aldicarb acts as a systemic and soil pesticide, and contamination of pastures near treated fields may result in the ingestion of contaminated plants by grazing livestock.

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

Water Quality Guideline Derivation

The Canadian water quality guidelines for aldicarb for the protection agricultural water uses were developed based on the CCME protocol (CCME 1993a).

Irrigation Water

The water quality guidelines for aldicarb for two groups of nontarget crop species are as follows: 67.5 µg·L⁻¹ for legumes and 54.9 µg·L⁻¹ for other crops. There is no recommended guideline for tame hay and cereals since no studies with adverse effects were found. The lowest of the two water quality guidelines developed, 54.9 µg·L⁻¹, is the Canadian water quality guideline for TAR in irrigation waters. In areas dominated by legume production, water quality guidelines for this family (Leguminosae) may be used to evaluate the quality of potential sources of irrigation water and assess the significance of contamination by total aldicarb residues.

SMATCs were calculated for each crop species for which adequate data were available. The lowest SMATC for each group (tame hay and cereals, legumes, and other crops) was adopted as the water quality guideline for that group. Aldicarb phytotoxicity was assessed for 18 nontarget plant species (4 cereals, 4 legumes, and 10 other crops) representing three groups of crops cultured in Canada. The most sensitive SMATCs were calculated from the decreased growth indices of young tobacco plants (*Nicotiana tabacum*) (NOEAR = 4.48 kg·ha⁻¹, LOEAR = 6.72 kg·ha⁻¹) (Barker and Powell 1988) and alfalfa (*Medicago sativa*) (up to 48% reduced seedling growth at 13.5 kg·ha⁻¹) (Lin et al. 1972).

The acceptable application rate (AAR) was calculated as the geometric mean of the LOEAR and NOEAR divided by an uncertainty factor of 10. The SMATC is calculated by dividing the AAR by the irrigation rate (10⁷ L·ha⁻¹·a⁻¹). The most sensitive SMATC values calculated were 67.5 µg·L⁻¹ for legumes and 54.9 µg·L⁻¹ for other crops; 54.9 µg·L⁻¹ was adopted as the Canadian water quality guideline for irrigation water.

Table 1. Water quality guidelines for aldicarb for the protection of agricultural water uses (CCME 1993b).

| Use | Guideline value (µg·L ⁻¹) |
|------------------|---------------------------------------|
| Irrigation water | 54.9* |
| Livestock water | 11* |

*Applies to the concentration of total aldicarb residues (comprising aldicarb, ASO, and ASO₂).

Livestock Water

A water quality guideline of 11 µg·L⁻¹ in livestock water is recommended for the protection of livestock. Data were available for nine avian species. Toxicity data ranged from 0.2 mg·kg⁻¹ for 7 d, reducing growth rates in chickens posttreatment (Farage-Elawar 1989), to an LD₅₀ of 12 mg·kg⁻¹·d⁻¹ in ring-necked pheasants (*Phasianus colchicus*) (Hudson et al. 1984). Of the 12 mammalian species tested, Nubian goats were found to be the most sensitive, with a lethal dose of 5 mg·kg⁻¹ (Mohamed and Adam 1990).

The water quality guideline was determined using data from the most sensitive livestock species (Nubian goats). The TDI was calculated by dividing the arithmetic mean of the NOED and the LOED by an uncertainty factor of 10 (CCME 1993a). The TDI was multiplied by the ratio of the animal body weight to water intake rate to yield the RC. The water quality guideline was calculated by multiplying the RC by the percentage of daily exposure assumed to be contributed through the ingestion of drinking water (20%) (USEPA 1988) to give the recommended water quality guideline for the protection of livestock of 11 µg·kg⁻¹.

The guideline was based on available data and derived using the protocol (CCME 1993a) developed to protect the most sensitive livestock water use (i.e., Nubian goats); it is therefore considered appropriate for other livestock.

References

- Barker, K.R., and N.T. Powell. 1988. Influence of aldicarb on the growth and yield of tobacco. *J. Nematol.* 20(3):432–438.
- CCME (Canadian Council of Ministers of the Environment). 1993a. Appendix XV—Protocols for deriving water quality guidelines for the protection of agricultural water uses (October 1993). In: Canadian water quality guidelines, Canadian Council of Resource and Environment Ministers, 1987. Prepared by the Task Force on Water Quality Guidelines. [Updated and reprinted with minor revisions and editorial changes in Canadian environmental quality guidelines, Chapter 5, Canadian Council of Ministers of the Environment, 1999, Winnipeg.]
- . 1993b. Appendix XIV—Canadian water quality guidelines: Updates (October 1993), aldicarb and dimethoate. In: Canadian water quality guidelines, Canadian Council of Resource and Environment Ministers. 1987. Prepared by the Task Force on Water Quality Guidelines.
- Cohen, S.Z., S.M. Creeger, R.F. Carsel, and C.G. Enfield. 1984. Potential pesticide contamination of ground water from agricultural uses. In: Treatment and disposal of pesticide wastes, R.F. Krueger and J.N. Seiber, eds. ACS Symposium Series 259. American Chemical Society, Washington, DC.
- Farage-Elawar, M. 1989. Toxicity of aldicarb to young chicks. *Neurotoxicol. Teratol.* 10:549–554.
- Hough, A., I.J. Thomason, and W.J. Farmer. 1975. Behavior of aldicarb in soil relative to control of *Heterodera schachtii*. *J. Nematol.* 7(3):214–221.
- Hudson, R.H., R.K. Tucker, and M.A. Haegele. 1984. Handbook of toxicity of pesticides to wildlife. U.S. Fish Wildl. Serv. Resour. Publ. 153. 2d ed. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC.
- Lin, S.-C., B.R. Funke, and J.T. Schulz. 1972. Effects of some organophosphate and carbamate insecticides on nitrification and legume growth. *Plant Soil* 37(3):489–496.
- Mohamed, O.S.A., and S.E.I. Adam. 1990. The toxicity of temik (aldicarb) in Nubian goats. *Br. Vet. J.* 146(4):358–363.
- PMRA (Pest Management Regulatory Agency). 1998. Pesticide Hotline. 24 September 1998. Janet Thornton (613) 736-3761 (or -3799)/1-800-267-6315.
- USEPA (U.S. Environmental Protection Agency). 1988. Health advisories for 50 pesticides. PB88-245931. Office of Drinking Water, Washington, DC.

Reference listing:

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of agricultural water uses: Aldicarb. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

For further scientific information, contact:

Environment Canada
Guidelines and Standards Division
351 St. Joseph Blvd.
Hull, QC K1A 0H3
Phone: (819) 953-1550
Facsimile: (819) 953-0461
E-mail: ceqg-rcqe@ec.gc.ca
Internet: <http://www.ec.gc.ca>

For additional copies, contact:

CCME Documents
c/o Manitoba Statutory Publications
200 Vaughan St.
Winnipeg, MB R3C 1T5
Phone: (204) 945-4664
Facsimile: (204) 945-7172
E-mail: sppcme@chc.gov.mb.ca