# Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses

# METOLACHLOR

Metolachlor ($C_{15}H_{22}ClNO_2$) is used for weed control in corn, soybeans, potatoes, snap beans, dry beans, lima beans, sorghum, sugar beets and rutabagas (Chesters et al. 1989; OMAF 1989). Weeds controlled by metolachlor include crab grass, goosegrass, witch grass, barnyard grass, pigweed, fall panicum, foxtails, yellow nutsedge, and eastern black nightshade (OMAF 1988).

The primary factor affecting metolachlor degradation in soil is microbial activity (WSSA 1983). Organic matter, clay content, and cation exchange capacity are the most important soil characteristics with regard to the adsorption of metolachlor (Jordan 1978; Peter and Weber 1985).

Metolachlor is relatively nonvolatile (vapour pressure of $1.7 \times 10^{-3}$ Pa at 20ºC); volatilization loss ranged from 0.6 to 1.4% within the first 24 h in field studies (Burkhard 1977). The hydrolysis half-life was reported to be >200 d at 20ºC over a pH range from 1 to 9 (Worthing and Walker 1987). Loss of metolachlor by photodegradation is considered to be insignificant (LeBaron et al. 1988).

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

## Water Quality Guideline Derivation

The derivation of the interim Canadian water quality guideline for metolachlor for the protection of irrigation water differs slightly from the CCME protocol (CCME 1993) as it was based on a LOEL value for sorghum. The interim Canadian water quality guideline for metolachlor for the protection of livestock water was developed based on the CCME protocol (CCME 1993).

## Irrigation Water

Metolachlor was found to inhibit the gibberellic acid synthesis for cell-free extracts of sorghum in a phosphate buffer at concentrations as low as 28 $\mu g \cdot L^{-1}$ (Wilkinson 1981). A NOEL of 0.28 $mg \cdot L^{-1}$ was derived for the germination of seven crop species (Pillai et al. 1979). These studies used nutrient solutions, moist filter paper, or sand as the substrate in which germination and growth of various plant species were examined during exposure to metolachlor. Thus, the absence of soil organic matter, specifically the humic matter, prevented the reduction of metolachlor activity due to adsorption (Weber et al. 1987).

By contrast, early post-emergence spraying of metolachlor on field plots at 3000 and 12 000 $mg \cdot L^{-1}$ did not have a significant effect on the growth of cauliflower, cabbage, or broccoli (Sieczka et al. 1986). Other field studies revealed that 9570 $mg \cdot L^{-1}$ had only a slight effect on Chinese cabbage (Grenoble and Ferretti 1986).

In the absence of sufficient information, an interim Canadian water quality guideline for metolachlor in irrigation water of 28 $\mu g \cdot L^{-1}$ (CCME 1991) is proposed based on the LOEL of 28.4 $\mu g \cdot L^{-1}$ for sorghum (Wilkinson 1981). Since this exposure did not have added soil material to adsorb or degrade metolachlor, this guideline should be protective of crop species growing under more natural conditions.

## Livestock Water

The available information indicates that metolachlor is not very toxic to mammals and birds. Oral $LD_{50}$s for metolachlor range from 2000 to 5000 $mg \cdot kg^{-1}$ bw for rats. For mallard ducks and bobwhite quail, 8-d $LC_{50}$s for technical metolachlor are >10 000 $mg \cdot kg^{-1}$ in the diet (WSSA 1983). A 6-month chronic feeding study with dogs reported a NOEL of 100 $mg \cdot kg^{-1}$ (3 $mg \cdot kg^{-1}$ per day) based on weight gain and failure of the serum alkaline phosphatase enzyme system to decrease with increasing age (USEPA 1987). A NOAEL of 1.5 $mg \cdot kg^{-1}$ per day was reported for a 2-year feeding study in rats (USEPA 1987). Although the metabolic pathway is incompletely known, metolachlor appears to be rapidly and completely

**Table 1. Water quality guidelines for metolachlor for the protection of agricultural water uses (CCME 1991).**

| Use | Guideline value ($\mu g \cdot L^{-1}$) |
|---|---|
| Irrigation water | 28* |
| Livestock water | 50* |

*Interim guideline.

absorbed from the mammalian gastrointestinal tract and quickly metabolized and excreted. In rats, approximately 70–90% of single oral doses are excreted as metabolites in the urine and feces within 48 h (Hamböck 1974a, 1974b, 1974c). Metolachlor is rapidly metabolized in mammals via dechlorination, *o*-methylation, *N*-dealkylation, and side chain oxidation (Hamböck 1974a, 1974b).

Data are not sufficient to derive a guideline; therefore, the guideline value for human drinking water supplies (Health Canada 1996) is adopted as an interim Canadian water quality guideline for livestock water (CCME 1993). This results in a recommended interim livestock watering guideline of 50 $\mu g \cdot L^{-1}$ for metolachlor (CCME 1991).

### References

Burkhard, N. 1977. Volatilization of CGA-24705 from soil under laboratory conditions. Ciba-Geigy Limited, Basel, Switzerland. Unpub. (Cited in LeBaron et al. 1988.)

CCME (Canadian Council of Ministers of the Environment). 1991. Appendix VIII— Canadian water quality guidelines: Updates (April 1991), metolachlor, simazine, and captan. In: Canadian water quality guidelines, Canadian Council of Resource and Environment Ministers. 1987. Prepared by the Task Force on Water Quality Guidelines.

———. 1993. 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.]

Chesters, G., G.V. Simsiman, J. Levy, B.J. Alhajjar, R.N. Fathulla, and J.M. Harkin. 1989. Environmental fate of alachlor and metolachlor. Rev. Environ. Contam. Toxicol. 110:1–74.

Grenoble, D.W., and P.A. Ferretti. 1986. Herbicides for Chinese cabbage. Proc. Northeast. Weed Sci. Soc. 40:145–147.

Hamböck, H. 1974a. Project 7/74: Metabolism of CGA 24705 in the rat: (Status of results gathered up until June 10, 1974): AC 2.52. Prepared by Ciba-Geigy Ltd., Basel, Switzerland. Unpub. (Cited in USEPA 1987.)

———. 1974b. Project 12/74: Addendum to Project 7/74: Metabolism of CGA 24705 in the rat: AC 2.52. Prepared by Ciba-Geigy Ltd. Basel, Switzerland. Unpub. (Cited in USEPA 1987.)

———. 1974c. Project 1/74: Distribution, degradation and excretion of CGA 24705 in the rat: AC 2.52. Prepared by Ciba-Geigy Ltd., Basel, Switzerland. Unpub. (Cited in USEPA 1987.)

Health Canada. 1996. Guidelines for Canadian drinking water quality. 6th ed. Prepared by the Federal–Provincial Subcommittee on Drinking Water of the Federal–Provincial Committee on Environmental and Occupational Health.

Jordan, G.L. 1978. Environmental factors and soil relationships influencing the activity of acetanilide herbicides. Ph.D. Thesis. Univ. of Wisconsin, Madison (Diss. Abstr. 78-23069). (Cited in LeBaron et al. 1988.)

LeBaron, H.M., J.E. McFarland, B.J. Simoneaux, and E. Ebert. 1988. Metolachlor. In: Herbicides: Chemistry, degradation and mode of action, Vol. 3, P.C. Kearney and D.D. Kaufman, eds. Marcel Dekker Inc., New York.

OMAF (Ontario Ministry of Agriculture and Food). 1988. 1989 Guide to weed control. Publication 75. Queen's Printer for Ontario, Toronto.

Peter, J.C., and J. Weber. 1985. Adsorption, mobility, and efficacy of alachlor and metolachlor as influenced by soil properties. Weed Sci. 33:874–881.

Pillai, P., D.E. Davis, and B. Truelove. 1979. Effects of metolachlor on germination, growth, leucine uptake and protein synthesis. Weed Sci. 27(6):634–637.

Sieczka, J.B., A.F. Senesac, and J.F. Creighton. 1986. Weed control programs in transplanted crucifers. Proc. Northeast. Weed Sci. Soc. 40:139–143.

USEPA (U.S. Environmental Protection Agency). 1987. Metolachlor. Health advisory. USEPA, Office of Drinking Water, Washington, DC. Draft.

Weber, J.B., M.R. Tucker, and R.A. Isaac. 1987. Making herbicide rate recommendations based on soil tests. Weed Technol. 1:41–45.

Wilkinson, R.E. 1981. Metolachlor (2-chloro-*N*-(2-ethyl-6-methyl-phenyl)-*N*-(2-methoxy-1-methylethyl)acetamide) inhibition of gibberellin precursor biosynthesis. Pestic. Biochem. Physiol. 16:199–205.

Worthing, C.R., and S.B. Walker (eds.). 1987. The pesticide manual: A world compendium. 8th ed. British Crop Protection Council, Thornton Heath, UK.

WSSA (Weed Science Society of America). 1983. Herbicide handbook. 5th ed. WSSA, Champaign, IL.

Reference listing:

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of agricultural water uses: Metolachlor. 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: spccme@chc.gov.mb.ca


Excerpt from Publication No. 1299; ISBN 1-896997-34-1

Aussi disponible en français.