Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses

METRIBUZIN

Metribuzin ($C_8H_{14}N_4OS$) is a selective herbicide used for broadleaf and grass weed control in various crops, including potatoes, tomatoes, soybeans, rapeseed, citrus, corn, carrots, lentils, lucerne, dryfield beans, established cereals, alfalfa, asparagus, and peas, and some range and pasture grasses (OMAF 1988).

The persistence of metribuzin in Canadian soils ranges from 0 to 20% of the initial application (Smith 1982, 1985). Half-life values range from 6 to 1007 d (Hance and Haynes 1981). The half-life increases with decreasing soil moisture content, depth, temperature, and pH (Ladlie et al. 1976a; Smith and Walker 1989).

Although some nonbiological degradation occurs, (Webster et al. 1978), microbial metabolism is the major pathway for the removal of metribuzin from soil (Ladlie et al. 1976b). Metribuzin degradation rate constants are closely related to microbial activity and significantly correlated with the amount of the herbicide available in the soil solution, the Freundlich adsorption coefficient, the clay, sand, and organic matter content of the soil, and the available potassium (Allen and Walker 1987).

The optimal pH for maximum adsorption of metribuzin to soil colloids was suggested to be between pH 4.0 and 5.0 (Ladlie et al. 1976a). The phytotoxicity of metribuzin is positively correlated with soil pH (Warnes et al. 1977; Peek and Appleby 1989).

Metribuzin was found to be more mobile in coarse soils and the adsorption coefficients for various soils were negatively correlated with the mobility. The only soil property significantly correlated with herbicide behaviour was sand content, with mobility being increased and phytotoxicity being diminished by increased sand content (Peek and Appleby 1989).

Photodegradation and volatilization influence the loss of metribuzin (Jensen et al. 1989). Volatilization losses from soil surfaces approached 10–12% of that initially applied for the first few hours. Half-life values of 4–5 d were calculated for metribuzin on the soil surface when exposed to "warm" temperatures and intense irradiation (Savage 1980). Photochemical degradation was found to proceed only in the presence of moisture (Bartl and Korte 1975).

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

Water Quality Guideline Derivation

The interim Canadian water quality guideline for metribuzin for the protection of irrigation water was adopted from the Ontario Ministry of the Environment's water quality guideline (OMOE 1984). The interim Canadian water quality guideline for metribuzin for the protection of livestock water was developed based on the CCME protocol (CCME 1993).

Irrigation Water

Ratsch et al. (1986) determined the toxicity of metribuzin to *Arabidopsis thaliana* using a plant life cycle bioassay. Metribuzin significantly suppressed plant vegetative dry weight and mature seed weight. Chemical sensitivity, as determined by the concentration that suppressed growth by 50%, was as low as 7.0 $\mu g \cdot L^{-1}$. The effect threshold concentration for metribuzin was 5.0 $\mu g \cdot L^{-1}$. Harrison et al. (1987) found that a metribuzin concentration of 300 $\mu g \cdot L^{-1}$ severely injured susceptible sweet potato clones. The OMOE (1984) noted that concentrations of triazine herbicides (including metribuzin) as low as 0.5 $\mu g \cdot L^{-1}$ might injure seedling crops. In the absence of sufficient information, an interim Canadian water quality guideline for metribuzin in irrigation water of 0.5 $\mu g \cdot L^{-1}$ (CCME 1990) is recommended by choosing the lowest value at which toxic effects may occur (OMOE 1984).

Table 1. Water quality guidelines for metribuzin for the protection of agricultural water uses (CCME 1990).

Use	Guideline value ($\mu g \cdot L^{-1}$)
Irrigation water	0.5*
Livestock water	80*

*Interim guideline.

Livestock Water

The acute oral LD_{50} toxicities for metribuzin range from 164 $mg \cdot kg^{-1}$ for bobwhite quail to 2345 $mg \cdot kg^{-1}$ for rats (Worthing and Walker 1987; from Löser and Kimmerle 1972). The NOEL ranged from 15 $mg \cdot kg^{-1}$ for rabbits to 300 $mg \cdot kg^{-1}$ for rats (Wnuk et al.1987).

Insufficient data are available for deriving a guideline. In the interim, the procedure recommended in the protocol (CCME 1993) of adopting the guideline value for human drinking water supplies (80 $\mu g \cdot L^{-1}$) (Health Canada 1996) is followed to develop an interim Canadian water quality guideline for livestock water. This results in an interim water quality guideline for metribuzin of 80 $\mu g \cdot L^{-1}$ for the protection of livestock (CCME 1990) (adoption updated 1998).

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