



ChemicalWatch Factsheet

A Beyond Pesticides/ NCAMP Factsheet

Pendimethalin

While the systemic herbicide pendimethalin is plagued by extensive data gaps, including most data on chronic toxicity and animal and plant metabolism, existing studies indicate that it is extremely toxic to fish and aquatic organisms, and its use may put several endangered species at risk. At least one formulation, Prowl™, contains a large percentage of the highly toxic “inert” ingredient monochlorobenzene (MCB).

Pendimethalin was registered in 1972 for preemergent and postemergent control of broadleaf and grassy weeds on many crops, including: cotton, corn, sorghum, peanuts, rice, beans, peas, wheat, potatoes, soybeans, sunflowers, tobacco, ornamentals, non-bearing fruit and nut crops and vineyards. A systemic dinitroaniline herbicide, like oryzalin and trifluralin, the chemical inhibits germination and seedling development. Available as a granular or an emulsifiable concentrate, American Cyanamid trade names include: Prowl™, Stomp™, Herbadox™, and Pay-off™.

The pesticide is highly toxic to fish and aquatic invertebrates, LD₅₀ = 0.138-280 ppm. As a result, pendimethalin labels bear the following

warning: “This pesticide is toxic to fish and aquatic organisms. Fish may be killed at application rates recommended on the label. Drift and runoff from treated areas may be hazardous to fish (and aquatic organisms) in neighboring areas.” In addition, the Slackwater darter and certain freshwater mussels are endangered species at risk from the use of pendimethalin on cotton. EPA

is an animal oncogen, mutagen, and teratogen (causes birth defects), is toxic to the liver, kidney and blood, and can suppress the immune system. Animals given MCB developed lymphoid or myeloid depletion of the bone marrow, spleen, or thymus in a 90-day subchronic study. Male rats given 120 mg/kg MCB daily for five days a week for 103 weeks had neoplastic nodules (benign tumors) of the liver. MCB-exposed rabbit fetuses had birth defects and visceral (organ) malformations. MCB is weakly mutagenic in adult rat liver epithelial cells.¹

Pendimethalin is not highly acutely toxic. Interestingly, it is many times more acutely toxic by inhalation, LD₅₀ = 320 mg/l, than by the oral or dermal routes, oral LD₅₀ = 1250 mg/kg.²

In a chronic study, dogs ingesting 50 mg/kg or higher, developed

liver damage, with increased liver weights. Tested rats developed similar effects.³

Pendimethalin causes central nervous system depression in mice and rats.³ In addition, the herbicide potentiates hypnosis caused by other drugs such as pentobarbitone, barbitone or ether, and lengthened recovery from drug effects.

According to EPA, pendimethalin

chemicalWATCH Stats:

CAS Registry Number: 40487-42-1

Chemical Class: 2,6-Dinitroaniline herbicide

Use: Broadleaf weeds and grassy weed species, residential lawns and ornamentals

Toxicity Rating: Slightly toxic

Signal Word: Caution, Warning

Health Effects: Group C-possible human carcinogen. Suspected endocrine disruptor.

Environmental Effects: Highly toxic to fish and aquatic invertebrates on an acute basis. Slightly toxic to avian species and small mammals. It is immobile and slightly to moderately persistent in soil.

notes that the “conventional labeling approach may be inadequate to properly inform the users on how to protect the endangered species:”⁴

Prowl™ contains nearly 50% of the toxic secret ingredient, or “inert,” MCB.¹ American Cyanamid notes that the toxicity of MCB is of greater significance than that of pendimethalin. MCB, a potent central nervous system depressant,

liver damage, with increased liver weights. Tested rats developed similar effects.³

Pendimethalin causes central nervous system depression in mice and rats.³ In addition, the herbicide potentiates hypnosis caused by other drugs such as pentobarbitone, barbitone or ether, and lengthened recovery from drug effects.

According to EPA, pendimethalin

in does not cause birth defects in rats and rabbits. In a rat reproduction study there were slightly fewer offspring.⁴

Chronic toxicity cannot be assessed because there are no valid mutagenicity or chronic toxicity rat studies and no carcinogenicity data. EPA personnel state that some of the animal data have been submitted as of July 2, 1991, but have not been reviewed.⁵

Because of inadequate data, the tolerance may be suspect. The ADI (Acceptable Daily Intake) was originally based on a 2-year rat feeding study which was subsequently declared invalid. The provisional ADI was calculated using the 90-day portion of the same invalid study. Tolerances are currently established for the combined residues of pendimethalin and one of its metabolites, between 0.05 - 0.1 ppm on raw agricultural commodities.⁴

"The metabolism of pendimethalin in animals and plants

is not fully understood."⁴ EPA is requiring data on metabolism and related metabolite(s) in crops and animals and on storage stability. Pendimethalin in contact with nitrite could form N-nitroso chemicals which most likely would be carcinogenic. The formation of such chemicals could occur during treatment of water with granulated activated charcoal.⁶ There is one acknowledged carcinogenic nitrosamine impurity; however, EPA has no toxicity data on it. "The Agency required that levels of N-nitrosopendimethalin contaminant not exceed 60 ppm in the technical product and that the technical product be analyzed for other impurities."⁴ The existence of other contaminants is unknown.

Pendimethalin is strongly adsorbed by soil organic matter and clay and said to not readily leach through the soil. The agency contends that "pendimethalin should not cause a water contamination

problem," and has therefore waived groundwater data requirements.⁴ However, it has been found in groundwater in IA⁷ and FL.⁸ The chemical is absorbed and taken up by the roots and shoots from the soil in limited amounts by monocotyledonous plants and in moderate amounts by dicotyledonous plants. It inhibits plant cell division and elongation.⁴ It is principally degraded by oxidation of the benzene ring and the N-1-ethyl propyl group. Soil microorganisms do not appear to play a significant role in degradation. In one study, the half-life of pendimethalin was 11 days.⁹

Pendimethalin has a low acute toxicity to birds, with an acute oral $LD_{50} = 1421 \text{ mg/kg}$.²

Update, November 2007:

Pendimethalin has many uses, on food crops, feed crops, non-food crops, and residential applications. All uses of pendimethalin were reregistered with the signing of the Reregistration Eligibility Decision (RED) in April 1997.¹⁰ Pendimethalin causes thyroid follicular cell adenomas in male and female rats,¹¹ and is classified as a possible human carcinogen (Group C) and is also a suspected endocrine disruptor. While no developmental effects were reported in the RED at the doses administered orally to rats and rabbits, maternal toxicity was observed at the highest doses tested (125, 250, 500 mg/kg/day) in rabbits, evidenced by increased mortality. Reproductive effects were found in rats at the highest dose tested (5000 ppm), based on pup body weight gain and possible decreased pups born alive and pup survival. Also, the percentage of apoptosis increased in mouse embryos exposed to low doses of pendimethalin, suggesting that at levels considered to be safe in humans pendimethalin has adverse effects very early in development.¹²

Dietary exposure to pendimethalin and the cancer risk to the general population are low. Exposures to applicators, either commercial or residential, and occupational handlers are higher than for the general population, and are at a level of risk that is of concern. Pesticide applicators exposed to pendimethalin showed an exposure response for lung cancer.¹³ A later study found no clear association of lifetime pendimethalin exposure with cancer incidence, but observed evidence of an elevated risk of lung cancer at the highest levels of exposure and an increased risk of rectal cancer in pendimethalin-exposed pesticide applicators compared to nonpendimethalin-exposed applicators.¹⁴

EPA has recommended some measures to reduce occupational exposure to pendimethalin, which are described in the RED. These include the use of chemical-resistant gloves in addition to the baseline attire (long-sleeve shirt, long pants, shoes and socks). The required restricted-entry intervals (REIs) was raised from 12 to 24 hours for all allowed occupational uses of pendimethalin. The maximum application rate has been decreased from 3 lbs. ai./acre to 2 lbs. ai./acre for application to residential and recreational turf grass.

Pendimethalin *chemicalWATCH* Factsheet Bibliography

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