

# chemicalWATCH Factsheet

## ATRAZINE

*Atrazine, a widely used herbicide on crops, golf courses and residential lawns, is linked with endocrine disruption, neuropathy and cancer. This toxic chemical persists in the environment for long periods of time.*

### What is Atrazine?

The most widely used group of herbicides since their discovery in the 1950's, common triazines include atrazine, simazine, cyanazine, ametryn, prometryn, and zine are used annually, making it the number one pesticide by volume in the U.S.

The Environmental Protection Agency (EPA) classifies atrazine in toxicity class III (on a scale of I to IV, I being the highest toxicity class). Absorbed by plants, the triazines act systemically to inhibit photosynthesis. Crop plants are able to partially metabolize or otherwise detoxify the triazines, resulting in the compounds' somewhat selective effect. Thus, the atrazine is used for broad-leaf and grassy weed control in a variety of crops, including corn, sorghum, sugarcane, pineapple, Christmas trees, as well as in conifer restoration plantings.<sup>1</sup> Annually, 75% of all corn, 58.5% of all sorghum, and 76% of sugarcane grown are treated with atrazine, mostly as a pre-emergent.<sup>2</sup> It is also used as a non-selective herbicide on turf, including golf courses and residential lawns. Due to the nature of atrazine, its use on lawns is usually limited to the SE, specifically Florida. There are no public health uses.<sup>3</sup>

In 1990, EPA classified atrazine as a Restricted Use Pesticide (RUP), which included label amendments that reduced application rates for agricultural uses and limited the maximum annual application rate for indus-

trial weed control. It also restricts the sale and use to certified applicators or persons under their direct control. However, even as an RUP, atrazine contained in lawn care products can still be purchased over the counter for unsupervised residential use. Home use cannot be monitored for safe use or handling, and leaves open a dangerous route of exposure. Children are put at risk for post-application dermal exposures with ordinary play on the lawn. Alarming, the common hand-to-mouth behavior of children puts

several published scientific studies documenting adverse effects on amphibians linked with atrazine exposure. In November 2003 Natural Resource Defense Council (NRDC) issued a lawsuit charging EPA, the White House Office of Management and Budget (OMB), and the White House Council on Environmental Quality with violating the law by refusing to disclose documents regarding the nature of industry involvement in EPA's assessment of atrazine's safety.

### Atrazine has been linked with

- √ **Cancer**
- √ **Birth Defects**
- √ **Reproductive Effects**
- √ **Neurotoxicity**
- √ **Kidney/Liver Damage**
- √ **Sensitizer/Irritant**
- √ **Groundwater Contamination**
- √ **Toxic to Fish**

them at risk for oral exposure as well. Adults can also be exposed dermally, especially when conducting higher contact activities such as heavy yard work. Inhalation, oral and dermal exposures are also concerns for adults during application. In January 2003, the label for home application formulations was changed to somewhat limit, but not ban, residential uses of atrazine, leaving the route of exposure open.

In October 2003, which was the settled deadline to incorporate threats to amphibians in its atrazine risk assessment, EPA announced that it had negotiated a deal with industry that would not require any new restrictions on atrazine use. The decision came despite

### Acute Toxicity

Most triazines have moderately low acute oral toxicity, with rat LD50's ranging from 1.4-5.0 gm/kg. Atrazine falls in the middle of this range, with a rat LD50 = 3.08 gm/kg. However, fatigue, dizziness, nausea, abdominal pain, diarrhea, vomiting, and irritation of the eye, skin and respiratory tract, allergic eczema, or asthma may follow exposure.<sup>4</sup> Rashes have also been reported with exposure.<sup>5</sup> Triazines are known to be skin sensitizers and photosensitizers for both humans and

other animals.

In animals, triazines are not retained for extended periods. Atrazine rat metabolism studies found 65% was eliminated in the urine and 15% was retained in body tissues, mainly in the liver, kidneys, and lungs.<sup>6</sup> The most common metabolic reactions are amine dealkylation and side chain oxidation.

### Chronic Toxicity

Animals given an oral dosage of atrazine for 6 months showed respiratory distress, paralysis of the limbs, structural and chemical changes in the brain, heart, liver, lungs, kidney, ovaries, and endocrine organs, as well as growth retardation. In a 2-year study with

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dogs, 7.5 mg/kg/day caused decreased food intake and increased heart and liver weights, increased adrenal weight, lowered blood cell counts, and occasional tremors or stiffness in the rear limbs.<sup>7</sup>

Atrazine has also been implicated in the development of sensory motor polyneuropathy in a farmer whose skin was exposed over several days.<sup>8</sup>

### **Carcinogenicity**

EPA states atrazine is “not likely to be carcinogenic to humans” despite numerous studies that suggest otherwise. The chemical has been shown to cause cancer in the mammary glands of rats.<sup>9</sup> One study showed women workers exposed to atrazine were nearly three times more likely to suffer ovarian cancer.<sup>10</sup> A study conducted by Syngenta found a statistically significant increase in prostate cancer among longtime workers at its St. Gabriel, LA atrazine production facility. Epidemiological studies have linked triazine exposure to increased risk of non-Hodgkin’s lymphoma.<sup>11</sup> In 2002, research by the National Lymphoma Foundation of America showed an increase in lymphoma in populations with higher exposures to pesticides. Atrazine was among the herbicides most frequently associated with the increased incidence and/or with mortality.<sup>12</sup>

### **Endocrine Disruption**

Atrazine at low concentrations interferes with the production and activity of sex hormones in salmon, causing decreases in the production of sperm.<sup>13</sup> Synergistic effects were detected in mice exposed to aldicarb, atrazine and nitrate at levels of contamination within the range often encountered in U.S. water supplies.<sup>14</sup> A U.S. Geological Survey Na-

tional Water Quality Assessment study found alterations in sex steroid hormones (estrogen and testosterone) and vitellogenin (egg protein produced by females) in blood of wild carp that appear to be related to certain chemical groups including atrazine dissolved in water.<sup>15</sup> Later research began detecting effects in humans. A 2003 study found elevated levels of pesticide metabolites, including atrazine, in men’s urine samples, correlated with poor semen quality.<sup>16</sup>

### **Frogs As Indicators of Toxicity**

A 2002 study found that male Leopard Frogs dosed with > .1 part per billion (ppb) of atrazine in water developed dramatic female sexual characteristics, including retarded gonadal development (gonadal dysgenesis) and testicular oogenesis (hermaphroditism).<sup>17</sup> In addition, Joseph Kiesecker of Pennsylvania State University tested the role that pesticides, including atrazine, play in frog deformities. His findings suggest that pesticides severely weaken the immune system, making frogs much more susceptible to parasitic infection and deformities.<sup>18</sup> Scientists emphasize the importance of these findings when the threat is translated to human health. Environmentalists also hold concerns for other wildlife facing risks from atrazine exposure such as sea turtles in the Chesapeake Bay; salamanders in Austin, Texas; freshwater mussels in Alabama; and fish in the Midwest.

### **Environmental Fate**

#### **Soil**

Atrazine is highly persistent in soil, and can persist for longer than 1 year under dry or cold conditions.<sup>19</sup> Its half-life is between 60 and 100 days.<sup>20</sup>

### **Plants**

Plants can absorb atrazine through the roots and sometimes through the foliage. Once absorbed, it accumulates in the growing tips and the new leaves of the plant, inhibiting photosynthesis in susceptible plant species. In tolerant plants, it is metabolized.<sup>21</sup> Atrazine increases the uptake of arsenic by treated plants.<sup>22</sup>

### **Water Contamination**

As the second most common pesticidal water contaminant<sup>23</sup>, atrazine shares characteristics with other triazines which make them serious threats to groundwater: high leaching potential, persistence in soils, slow hydrolysis, low vapor pressure, moderate solubility in water, and moderate adsorption to matter and clay. Hydrolysis of atrazine in water, important for the disappearance of the chemical if it is followed by biodegradation, is slowed in water of neutral pHs.<sup>24</sup> Atrazine has been detected in each of 146 water samples collected at 8 locations from the Mississippi, Ohio and Missouri Rivers and their tributaries. 27% of these samples contained atrazine concentrations above the EPA’s maximum contaminant level (MCL).<sup>25</sup>

Despite the problematic nature of atrazine as a water contaminant, EPA announced a deal in October 2003 to allow atrazine manufacturer Syngenta to be responsible for testing U.S. waterways for contamination of the very chemical they produce. The program will begin in March 2004, and at its peak will only cover 3.4% of the 1172 highest-risk watersheds. The approach was developed by EPA, atrazine manufacturers, the US Department of Agriculture and grower groups, barring environmentalists from the negotiation.<sup>26</sup>

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<sup>2</sup>“Interim Reregistration Eligibility Decision for Atrazine” Case No. 0062. U.S. Environmental Protec-

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<sup>3</sup>“Interim Reregistration Eligibility Decision for Atrazine” Case No. 0062. U.S. Environmental Protection Agency Office of Prevention, Pesticides and Toxic Substances.

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<sup>4</sup> Ellenhorn, M.J., S. Schonwald, G. Ordog, J. Wasserberger. *Ellenhorn’s Medical Toxicology: Diagnosis and Treatment of Human Poisoning*. 2nd ed. Baltimore, MD: Williams and Wilkins, 1997. 1643

<sup>5</sup>“Atrazine” Pesticide Information Profile,

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