

Fact Sheet

Health Effects of Atrazine



Atrazine is a popular herbicide used extensively on corn and sorghum in the Midwest. In fact, it's the second most used pesticide in the U.S., with more 75 million pounds used each year.¹ It's also the most commonly detected pesticide in drinking water, showing up in 94% of samples tested by the USDA.²

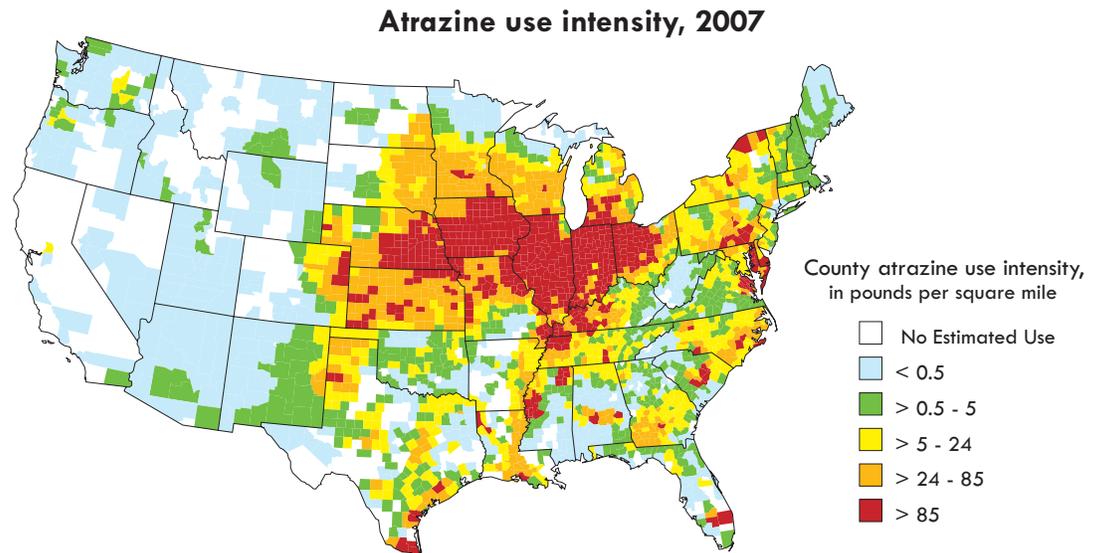
It caused pervasive water contamination in Europe, and therefore was banned there in 2004.

Atrazine is an endocrine disruptor that can affect reproduction and development.

Atrazine is an endocrine disruptor,³ meaning that it can interfere with the balance of hormones in an organism. Endocrine disruptors can have profound effects on animals at low doses, and timing of exposure can be just as important as the dose itself.⁴

Laboratory tests have shown that pregnant rats fed atrazine-laced diets give birth to deformed pups,⁵ and that puberty is delayed in atrazine-exposed males.⁵ Other studies have found detrimental effects on sperm production^{6,7} and sex hormone levels.^{5,8,9} Rats that are exposed to low levels over long periods of time have an increased rate of mammary (breast) tumors and enlarged prostates.⁵ In mice exposed to low doses of atrazine around the time of birth, learning is affected and males display more feminine behavior.¹⁰

Effects on frogs are particularly startling: At extremely low concentrations, atrazine caused male frogs to develop eggs in their testes¹¹ or to become hermaphrodites.^{12,13} A more recent study



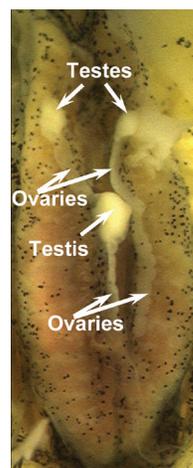
Map courtesy of USGS³⁵

found that 10% of genetically male frog eggs developed into adults with female bodies and female behaviors when raised in water spiked with tiny amounts of atrazine.¹⁴

Whether the effects seen in animals are relevant to humans is disputed, but a few recent epidemiological studies have found associations between atrazine levels in drinking water and

increased levels of birth defects. In one study, researchers found that babies conceived in the months with the highest atrazine levels in drinking water are the most likely to suffer from birth defects.^{15,16} Another study found that pregnant women who lived in areas of high atrazine use had an increased chance of having a baby with gastroschisis, a condition in which part of the intestines protrudes from the abdomen.¹⁷ Other studies have found that atrazine exposure increases the chance of having an underweight,¹⁸ small,^{18,19,20} or premature^{19,21} baby and the risk of miscarriage.²²

Looking at adults, one study found that men with detectable levels of atrazine in their urine were much more likely to have low semen quality (defined as low sperm concentration, low percentage of sperm with normal morphology, and low percentage of motile sperm) when compared to men with no detectable atrazine in their urine.²³



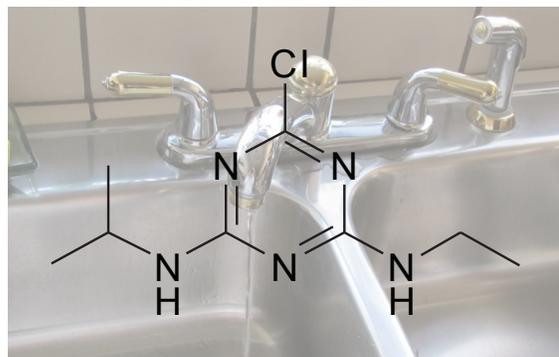
Testes of a North American Leopard frog exposed to 1.0 ppb atrazine.

There is concern that atrazine may cause cancer.

Atrazine causes cancer in rats,^{5,24,25} but whether it can cause cancer in people is debated. Workers in Syngenta's atrazine factory were found to have elevated rates of prostate cancer,⁵ and a study of Midwest farmers found a slight increase in non-Hodgkin's lymphoma among those who reported using the herbicide.²⁶ A study in Kentucky found a slight increase in breast cancer prevalence among women who lived in counties with elevated levels of atrazine in drinking water,²⁷ and a Canadian study found that stomach cancer incidence was associated with atrazine in drinking water.²⁸ But other studies have looked for and failed to find associations between atrazine exposure and cancer in people.²⁹

The U.S. EPA has concluded that "atrazine is not likely to cause cancer in humans." Nonetheless, the Agency is

sponsoring additional cancer studies and in 2011 will formally reevaluate its cancer risk.³⁰ The International Agency for Research on Cancer concluded that atrazine causes cancer in animals, but found "inadequate evidence in humans for the carcinogenicity of atrazine."²⁵



The legal limit for atrazine in water is too permissive.

The legal limit for atrazine in drinking water is 3 ppb. This limit is set by the EPA, and it applies to all public and private water systems serving more than 25 people. (Private wells serving individual homes are not regulated.) The levels of atrazine breakdown products like desethyl atrazine (DEA) and desisopropyl atrazine (DIA) are not regulated in systems of any size.

The 3 ppb limit is a federal standard, but states can set more restrictive limits. For example in California, the legal limit is just 1 ppb, and the state's non-enforceable public health goal is 0.15 ppb.³¹ Minnesota has set a "Health Risk Limit" of 3 ppb for the total of atrazine, DEA, and DIA in drinking water,³² and Illinois has a non-enforceable "action level" of 0.3 ppb for atrazine contamination in ground water.³³

We strongly suspect that the federal standard of 3 ppb is too permissive and that regular exposure to lower levels may cause harm to people, especially infants and fetuses. This is because atrazine has been shown to have developmental and reproductive effects on animals at levels lower than 3 ppb, and because many epidemiological studies have detected effects in people exposed to lower levels.

Some examples:

Sexual development (in frogs)

Frogs raised in tanks with just 0.1 ppb atrazine suffered from a range of sexual abnormalities including hermaphroditism.^{12,13} A recent study found that genetically male frogs that spent their entire lives in tanks containing 2.5 ppb atrazine showed varying degrees of feminization. Ten percent were completely feminized with fully female bodies and behaviors.¹⁴ While there is a huge evolutionary distance between frogs and humans, these results beg the question: If atrazine can have such a dramatic effect on a frog's development, what might it do a baby developing a mother's womb?

Small babies

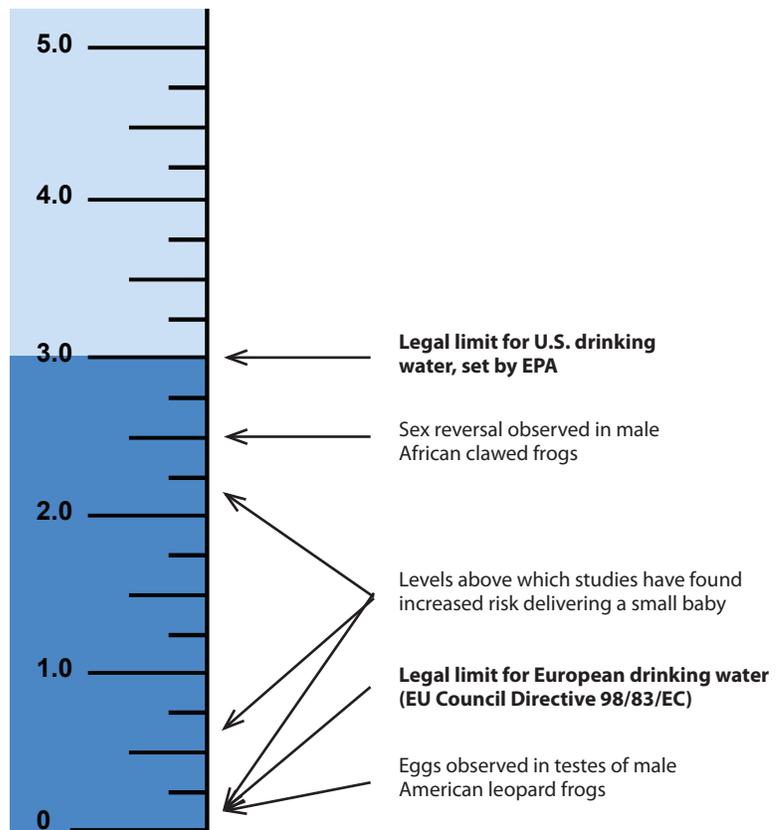
As discussed in the previous section, a number of epidemiological studies have examined the relationship between women's exposure to atrazine during pregnancy and the chance of having a small or underweight baby.

- One study looked at women whose average level in drinking water was 0.015 ppb versus those with an average of 0.033 ppb, and found a 37% increase in risk of delivering a small baby for that

later group. The risk of delivering prematurely was also increased.¹⁹

- Another found a 17–19% increased risk for having a small baby for those whose drinking water during the third trimester had greater than 0.1 ppb atrazine versus those with less than 0.1 ppb. This study also found that women drinking water with greater than 0.64 ppb for their entire pregnancy were more likely to have a small baby than those exposed to less than 0.18 ppb.¹⁸
- A third study looked at women with greater overall exposure, and divided them into one group with an average atrazine level in water of 2.2 ppb versus those with an average 0.7 ppb. The rate of delivering a small baby was 80% higher in the more exposed group.²⁰

Legal limit of atrazine in U.S. drinking water versus levels found to cause harm



Cancer

The study of breast cancer incidence in Kentucky mentioned above found a 20% increase in breast cancer among the women most exposed to atrazine. Only 0.3% of the drinking water samples examined in the study exceeded the federal standard of 3 ppb.²⁷ (It should be noted that a similar study in Wisconsin found no correlation between atrazine exposure in drinking water and breast cancer.³⁴) The Canadian study found that for men, each 0.1 ppb increase in atrazine contamination of drinking water resulted in an increase of stomach cancer incidence of 0.6 cases per 100,000 people per year. For women, a 0.05 ppb increase corresponded to 1.0 extra case per 100,000 people per year.²⁸

Other studies have found associations between atrazine exposure and various health effects, but rather than looking at atrazine levels in drinking water, they used other measures of exposure. For example, some studies

used surveys to estimate how often farmers worked with atrazine, and then correlated these estimates with rates of disease. While these studies are very useful for determining what health problems might be associated with atrazine exposure, they don't provide much information upon which to judge whether EPA's 3 ppb standard is protective enough.

In summary, there are a number of animal studies as well as epidemiological studies that have found health harms associated with atrazine levels less than 3 ppb. Many questions still remain, but with the evidence at hand we conclude that the legal limit of 3 ppb is too permissive and does not adequately protect human health.

For more information about atrazine, visit www.panna.org/atrazine.

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