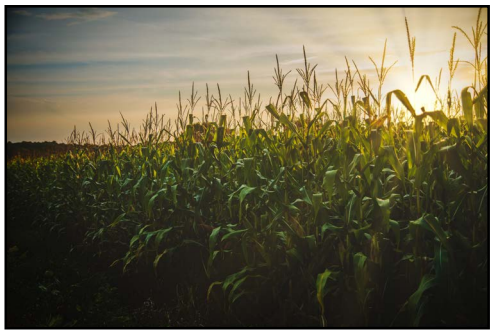
# ATRAZINE
## FACT SHEET

### What is atrazine?

Atrazine is in a group of man-made systemic herbicides called triazines. Specifically, atrazine is a chlorotriazine herbicide.[1] It is used for broadleaf weeds both before and after they sprout. It is also used on some grassy weeds.[1,2] It was first registered for use in 1958.[1]



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### What are some products that contain atrazine?

There are over 300 products that contain atrazine.[3] Many of these can only be used by professionals. Some are available for residential use. Products with atrazine may be labeled for use on soil, roadsides, lawns, and athletic fields. Some products can be used on corn, sorghum, sugarcane, macadamia nuts, guava, or wheat stubble after harvest.[2,3] Products containing atrazine may be granules, liquids, concentrates, or ready-to-use sprays. Always remember to read the label for your product's use sites and instructions. See the text box about **technical grade atrazine**.

**Technical Grade Atrazine: This fact sheet refers to the technical grade, or "pure" atrazine only. Products you buy from the store include other ingredients as well. While many of the chemicals used as other ingredients may not pose health or environmental risks, some of them can be toxic. In some cases, the other ingredients can pose greater risks than the active ingredient itself.**

### How does atrazine work?

Atrazine interferes with photosynthesis in some broadleaf plants and grasses.[2,4] It is taken up by roots and leaves and moves upward in the plant to areas of new growth.[2] The plant dries out and dies. Older leaves on plants may be affected more than new leaves. Root growth is not affected by atrazine.[4]

### How might I be exposed to atrazine?

You could be exposed to atrazine while using a product or being too close to an application. You could get atrazine on your skin, eyes, or breathe it in. Very low levels of atrazine may be found in food and drinking water.[5,6] Pesticides used on crops have tolerances. Tolerances are legal limits set by the U.S. Environmental Protection Agency (EPA) to help ensure food safety. See the text box about **tolerances**.

Always follow label instructions and take steps to minimize exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 800-222-1222. If you wish to discuss a pesticide problem, please call NPIC at 800-858-7378.

**What is a tolerance?**
**The EPA sets legal limits for how much pesticide is allowed in food and drinking water. In food, those limits are called "tolerances." Every pesticide has its own tolerance for each crop it can be used on. In water, those limits may be called Maximum Contaminant Levels (MCLs), health advisories (HA), or other names. The amount allowed in water is specifically regulated for some pesticides. Health advisories are issued for others.**

## What are some signs and symptoms from a brief exposure to atrazine?

Atrazine is very low in toxicity if breathed in.[5] Symptoms may include a runny nose.[7] It is not considered an eye irritant but swelling or redness may occur if it gets in the eyes.[1,8]

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Skin exposure to atrazine may cause mild irritation, redness, or swelling.[7,8] Atrazine is low in toxicity if it touches the skin. It is not considered a skin sensitizer. This means that allergic reactions after multiple exposures are not likely.[1]

If atrazine is eaten, it is low in toxicity.[1] People who accidentally ate atrazine had nose bleeds, swelling of the face, salivation, and drooping eyelids.[7,8] They also had goosebumps, muscle weakness, fatigue, tremors, and difficulty breathing.[7]

When rats ate enough atrazine to almost kill them, they had increased activity followed by slowing, incoordination, and muscle spasms.[9] Systemic toxicity from atrazine is not expected unless a large amount is eaten.[10]

**TOXICITY CLASSIFICATION - ATRAZINE[1]** (see the text box about **mg/kg**)

| | High Toxicity | Moderate Toxicity | Low Toxicity | Very Low Toxicity |
|---|---|---|---|---|
| Acute Oral $LD_{50}$ | ≤ 50 mg/kg | > 50 – 500 mg/kg | **> 500 – 5000 mg/kg** | > 5000 mg/kg |
| Inhalation $LC_{50}$ | ≤ 0.05 mg/L | > 0.05 – 0.5 mg/L | > 0.05 – 2.0 mg/L | **> 2.0 mg/L** |
| Dermal $LD_{50}$ | ≤ 200 mg/kg | > 200 - 2000 mg/kg | **> 2000 – 5000 mg/kg** | > 5000 mg/kg |
| Primary Eye Irritation | Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days | Corneal involvement or other eye irritation clearing in 8 - 21 days | Corneal involvement or other eye irritation clearing in 7 days or less | **Minimal effects clearing in less than 24 hours** |
| Primary Skin Irritation | Corrosive (tissue destruction into the dermis and/or scarring) | Severe irritation at 72 hours (severe erythema or edema) | Moderate irritation at 72 hours (moderate erythema) | **Mild or slight irritation at 72 hours (no irritation or erythema)** |

The shaded boxes reflect the signs and symptoms from a brief exposure discussed in this fact sheet. Modeled after the U.S. Environmental Protection Agency, Office of Pesticide Programs, Label Review Manual, Chapter 7: Precautionary Statements. https://www.epa.gov/sites/default/files/2018-04/documents/chap-07-mar-2018.pdf.

You may be wondering why the "High Toxicity" column has smaller numbers than the "Low Toxicity" column. This is because if a smaller amount of the pesticide caused a health effect, it's more toxic. If it takes a larger amount of the pesticide to cause a health effect, it's less toxic.

**What is a mg/kg?**
**"Mg/kg" is a way to measure a chemical dose. This can tell us how toxic a chemical is. "Mg" means milligrams of a chemical. "Kg" means one kilogram of an animal's body weight. Something that is highly toxic may kill a person with a very small amount of chemical. If something is very low in toxicity, it may take much more for that same person to become very sick or die.**

## What happens to atrazine when it enters the body?

Atrazine does not easily pass through the skin. After it was left on human skin for 24 hours, about 6% of the dose was absorbed.[5] It is not likely to build up in the body.[7,11] As it moves through the body, it may be found in the liver, ovary, kidney, red blood cells, and fat.[5,9]

In a study with monkeys, atrazine was highest in blood plasma within 1 hour. The plasma half-life was 4 hours. Metabolites of atrazine had half-lives of 2.8 and 17.8 hours.[5]

It is excreted in the urine and feces. Urinary excretion of atrazine peaked 1-2 days after exposure.[5,9] Fecal elimination peaked around 2-4 days. After rats ate atrazine, about 95% of the dose was gone from their bodies within 7 days.[5]

## Is atrazine likely to contribute to the development of cancer?

Atrazine does not alter or damage genes in humans and animals.[5,12,13,14] Female rats exposed to atrazine developed breast tumors. However, these tumors were not considered relevant to humans by a scientific advisory panel. This was because of differences in rat and human female reproductive systems.[5] EPA classified atrazine as "not likely to be carcinogenic to humans".[1,5]

The World Health Organization's (WHO) International Agency for Research on Cancer considers atrazine to be "not classifiable as to its carcinogenicity to humans".[15] However, the Food and Agriculture Organization of the United Nations and WHO concluded that atrazine is "not likely to pose a carcinogenic risk to humans".[14]

## Has anyone studied non-cancer effects from long-term exposure to atrazine?

Atrazine affected liver cells in rats after they were given 400 mg/kg per day for 14 days. They also lost weight and had difficulty moving.[16] Dogs fed atrazine at 34 mg/kg per day for one year had increased and irregular heart rates. They also had enlarged hearts with fluid inside the heart's membrane.[11]

Rats drank water with either 30 or 300 µg/kg of atrazine added for five months. This started when they were 8 weeks old. After 3 months, half the rats in each group were then fed a high-fat diet instead of regular rat chow. Rats who drank the treated water used less energy when they were sitting still. They also gained weight and became insulin resistant. This happened even though their food intake and activity level did not change. The high-fat diet made the weight gain and insulin resistance worse.[17]

Pregnant rabbits that were given 75 mg/kg per day of atrazine for 12 days after the first week of pregnancy. They lost more pregnancies than rabbits who did not get atrazine. The rabbit litters had fewer and smaller babies. They also showed slower bone formation.[7]

Rats fed low doses of 25 mg/kg per day did not have reproductive effects. However, the mothers and pups weighed less.[7]

Pregnant rats ate moderate doses of 100 mg/kg of atrazine for seven days during the third week of pregnancy. More infant rats died than when their mothers were not fed atrazine.[18]

Female rats ate moderate doses of 100 mg/kg per day of atrazine for at least five days during the last week of pregnancy. Their daughters reached puberty later than expected. This did not happen at doses of 20 mg/kg per day. Reproductive cycles were disrupted in female rats after eating low doses of 3.12 mg/kg per day for four days. It also happened in rats fed 3.65 mg/kg per day for six months. However, this did not harm pregnancies or change the female rats' fertility. Puberty was delayed in young male rats fed low doses of at least 12.5 mg/kg per day for 20 days.[5]

The EPA uses a benchmark dose to set a limit of 2.42 mg/kg per day for four days for estimating risks to humans. This was based on atrazine's effects on luteinizing hormone. This hormone normally affects embryo development. It also affects fertility by leading to the release of eggs from ovaries.[5] See the text box about **benchmark dose**.

A reference dose of 0.1 mg/kg per day over a lifetime is not expected to have adverse health effects.[5] At expected levels of exposure through use and diet, EPA determined atrazine is not likely to affect hormone function in humans.[19]

**Benchmark Dose: The benchmark dose is based on the benchmark response. The benchmark response represents some set percent change from baseline or controls. Scientists look at two factors to decide how much change is of concern. They look at both the pesticide's potential negative effect and the strength of evidence. They consider both short-term and long-term exposures. The threshold is set at the lowest dose that led to a negative effect in tested animals. EPA does not expect any harm to come from exposures below the benchmark dose.[5,20]**

Epidemiology looks at what has happened to people and what health problems they have to see if the two are related. A number of epidemiology studies have looked at possible human health effects from exposure to atrazine. Some studies found effects on human health, but others have not. These studies help guide more research. They may also provide information about possible risk. They do not prove that exposure leads to harm.

A study in Texas found that mothers who lived in areas where more atrazine was used had a greater chance of giving birth to children with birth defects in their faces and skulls than mothers who did not. The more atrazine used in the county, the greater the chance of birth defects.[21]

Researchers collected urine from pregnant women in France. They tested the urine for atrazine or its metabolites to estimate exposure to atrazine. Babies whose mothers were exposed to atrazine during pregnancy grew more slowly. The babies had smaller head circumference than babies whose mothers were not exposed to atrazine during pregnancy.[22]

Women living in areas in Illinois where atrazine is heavily used had more irregular menstrual periods than women living in agricultural areas in Vermont, where less atrazine is used. Atrazine measured in the residential water was 0.4 µg/L in Vermont but 0.7 µg/L in Illinois. The more water women in Illinois drank, the more likely they were to have delayed periods.[23]

Farmers have reported information on their health and use of pesticides in the Agricultural Health Study. Farmers who used atrazine were more likely to have both allergic and non-allergic wheezing. The chance of reporting wheezing increased with how often the farmers reported using atrazine.[24]

Researchers using Agricultural Health Study data found that people who had been exposed to more atrazine had a higher risk of end-stage renal disease (kidney failure) compared to people who had not been exposed. As atrazine use increased, risk of end-stage renal disease also increased.[25]

Farmers in the Agricultural Health Study who used more atrazine also had a greater increase in body-mass index (BMI) than other farmers as they got older.[26]

## Are children more sensitive to atrazine than adults?

Research shows that children are not more sensitive to atrazine than adults.[5] However, children may act in ways that put them at greater risk of being exposed. For example, they may spend more time on the ground. They may also be more likely to place their hands in their mouths after touching treated areas.

## What happens to atrazine in the environment?

Atrazine is broken down slowly by water, sunlight, and microorganisms.[5] Without oxygen, atrazine has a half-life of around 578 days in water.[1] Atrazine has a half-life of 168 days in water exposed to sunlight.[27] Once applied, atrazine is not expected to come back up into the air as vapor.[1,4] If in the air, atrazine degrades quickly, with an estimated half-life of 14 hours.[11]

Atrazine has a low to moderate solubility in water.[1,28] Atrazine does not bind well to soil and can easily move in it.[27] It has an average half-life in soil of around 60-75 days.[4,29] It breaks down more slowly in less acidic soil, and under cool, dry conditions.[4,30] Atrazine may be more persistent in colder climates.[1]

Atrazine has a high potential to reach ground and surface water.[31] Atrazine can be found in low levels in some community water systems. Contact your local water provider for more information.

Atrazine is absorbed through leaves or roots and moves throughout the plant.[4] Atrazine is not expected to bind to foliage and may wash off from treated plants. Atrazine was found to have a half-life of around 13 days in living foliage, and 66 days in leaf litter. When applied to turf, atrazine had a half-life of 5-9 days, depending on the formulation.[1] Atrazine collects in the growing points of plants.[2] It remains highly toxic to plants as they grow from seedlings to mature plants.[27]

## Can atrazine affect fish or other wildlife?

Atrazine is slightly to moderately toxic to fish, including guppies and rainbow trout, following exposures of four days or less.[27,30]

Atrazine exposure for two days is highly toxic to freshwater invertebrates and very highly toxic to marine invertebrates, including midges and marine shrimp.[27] It is slightly toxic to water fleas.[30]

Atrazine is practically non-toxic to honeybees through short-term contact or ingestion.[27,30] It is very low in toxicity to earthworms.[30,32]

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Atrazine is practically non-toxic to slightly toxic to ducks and quail if eaten in the short term.[27,30] Atrazine exposure in the diet at 225 mg/kg over a longer time period in ducks caused changes in egg production and the number of live chicks.[27]

Amphibians are at risk from long-term (chronic) exposure. Across several studies, there were effects on mortality, development, growth, and reproduction. These effects were seen at amounts either measured in the environment or estimated based on field data. Effects varied by species.[27]

In fish, amphibians, aquatic plants, and aquatic invertebrates, the breakdown products of atrazine were less toxic than atrazine. Breakdown products of atrazine were found to be equally or slightly more toxic to birds and mammals.[27]

The EPA modeled risks to wildlife based on atrazine's toxicity and on how it is currently used. The risk assessment found that non-target plants and animals might be harmed depending on the application.[27]

The EPA concluded that 52 out of 59 species of birds would raise fewer young if they were exposed to atrazine. Five bird species often found in cornfields might produce fewer broods of nestlings per year. The EPA's models suggested that small mammals were at long-term risk near fields sprayed with atrazine. Small mammals could be harmed at up to 250 feet away from the crop.[27]

Plant communities could be harmed by runoff and spray drift even if less atrazine was sprayed than usual. The EPA found that aquatic vegetation that was not intended to be controlled by atrazine was likely to be harmed. This was the case even when less atrazine was used and most of it bound to soil. Injuring the non-target plants may have effects on the aquatic ecosystem.[27]

EPA scientists modeled what would happen to fish from long-term exposure to atrazine from runoff and spray drift. The models suggested that the fish might be harmed at all application rates. They also suggested that amphibians living in water may also be at risk. This was based on what other scientists had found, results from surface water testing, and models.[27]

Atrazine is not expected to accumulate in animals.[33]

## Where can I get more information?

For more detailed information about atrazine please visit the list of referenced resources, call the National Pesticide Information Center, Monday - Friday, between 8:00am - 12:00pm PT (11:00am - 3:00pm ET) at 800-858-7378 or visit us on the web at npic.orst.edu. NPIC provides objective, science-based answers to questions about pesticides.

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