



## Cornell University Program on Breast Cancer and Environmental Risk Factors in New York State (BCERF)

### Pesticides and Breast Cancer Risk, An Evaluation of Atrazine

*The BCERF Program strives to provide information on environmental risk factors and the risk of breast cancer. This fact sheet\* is an evaluation of atrazine, a chemical used to control weeds in agricultural crops. In this fact sheet, we have reviewed the scientific evidence of whether atrazine may affect breast cancer risk, as well as other types of cancers. We also provide information on atrazine's use, its regulation by federal agencies, where atrazine is found in the environment, ways to minimize exposure and where more studies are needed.*

#### **Why is there concern about atrazine and the risk of breast cancer?**

BCERF chose to review atrazine because of its widespread use in agriculture, history of water contamination, and evidence of causing tumors in laboratory animal studies.

#### **What is atrazine and how is it used?**

Atrazine is an herbicide used to control weeds on agricultural crops, especially corn. It is the most used agricultural herbicide in the United States (U.S.) and New York State. It is usually applied to the soil once a year in the spring before the young corn plants emerge from the ground. It is also used on other agricultural crops including sorghum, sugar cane, guava and macadamia nuts. Atrazine may be applied alone or in combination with other herbicides. Non-agricultural uses include control of weeds on Christmas tree farms. In the southern U.S., atrazine is used to control weeds on sod farms and residential lawns. See the "Chemical Information" box (on page two) for more details on the usage and some common trade names of atrazine.

#### **Does atrazine cause breast cancer in humans?**

It is difficult to evaluate whether atrazine causes breast cancer in humans, because there are no published studies that have specifically looked at the rate of breast cancer in women with and without exposure to atrazine. Nearly all of the studies on agricultural workers exposed to atrazine and cancer risk have been done on men. A survey of women farmers in the U.S. did not find a higher rate of death from breast cancer in these women. However, this study was based on information from death certificates and no information was available on the women's exposure to specific pesticides.

#### **Does atrazine cause other types of cancer in humans?**

A higher risk of cancer of the ovaries was observed in one study of Italian women farm workers exposed to atrazine. Atrazine exposure has also been associated with a higher risk of developing a type of cancer called non-Hodgkin's lymphoma. A higher risk of non-Hodgkin's lymphoma was observed in several studies of male agricultural workers in the midwestern U.S. who mixed or applied atrazine. However, a more recent re-analysis of these studies found that when exposure to other pesticides was taken into consideration, there was little association between exposure to atrazine and the risk of developing non-Hodgkin's lymphoma. Studies in humans have not shown an increased risk of developing leukemia, colon cancer or a type of cancer called myeloma in white men who were exposed to atrazine.

#### **Does atrazine cause breast cancer in laboratory animals?**

What we call the breast in humans is called the mammary gland in laboratory animals. Feeding high levels of atrazine to mice or one type of female rat did not result in a higher number of mammary gland tumors in these animals. However, when tested in another type of rat, several studies found either a higher number or earlier appearance of mammary gland tumors in the female rats fed a moderate to high level of atrazine over long periods of time. These rat studies suggest that atrazine could be a possible breast cancer causing agent.

The reason why atrazine caused mammary tumors in one type of rat is currently being debated and studied. Some researchers believe that atrazine may cause changes in the

\*This fact sheet was based on the technical document, "Critical Evaluation of Atrazine's Breast Cancer Risk," by Suzanne Snedeker, Ph.D., and Heather Clark, M.S.



levels of substances carried in the blood called hormones. These hormonal changes may play a role in the development of the mammary tumors in rats fed atrazine. Other researchers have not been able to show that atrazine causes hormonal changes that would explain the higher number of mammary tumors in these rats. More studies will be needed to determine how atrazine causes mammary tumors in some laboratory animals.

### **Chemical Information, Usage and Trade Names for Atrazine**

**Type of pesticide:** Herbicide (weed killer)  
**Herbicide family:** s-triazine

**Some breakdown products:** deethylatrazine, deisopropylatrazine, diaminoatrazine, hydroxyatrazine

#### **Agricultural Usage**

U.S.: 68 to 73 million pounds per year  
NY State: 1.4 million pounds per year

#### **Some common trade names\*\*:**

AAtrex®, Atrachem®, Atranex®, Atrasul®, Atrataf®, Atratyfone®, Atrazin®, Azinotox®-500, Callizine®, Cat L Siapa®, Crisazina®, Drexel®Atrazine, Flotrazine®, Gesaprim®, Fezprim 500®, Herbitrin®, Limpiaamiz®, Maizine®, Sanazine®, Trac®, Weed Pro®Atrazine, Woprazine®.

\*\*Note: Trade names are used herein for convenience and for informational purposes only. No endorsement of products is intended and no criticism of unnamed products is implied.

### **Does atrazine cause other types of cancer in laboratory animals?**

Tumors of the pituitary (a small gland at the base of the brain) have been observed occasionally in studies where atrazine was fed to female rats for long periods of time. Male mice injected with atrazine developed a higher number of lymphomas than untreated animals. A higher number of cancers of the uterus, and of lymphomas and leukemia (leukemia is a type of cancer in the blood) were observed in one study of female rats that were fed high levels of atrazine. More recently, similar studies did not find a higher number of lymphomas, leukemia or uterine tumors in female rats fed atrazine for long periods of time.

### **Are there other ways atrazine can affect breast cancer risk?**

The hormone estrogen has been implicated in breast cancer risk. It has been suggested that exposure to synthetic chemicals that act like the hormone estrogen could

potentially increase breast cancer risk. A variety of laboratory tests have shown that atrazine does not act like estrogen.

Some researchers have suggested that a certain breakdown product of estrogen, called 16-alpha hydroxyestrone, may increase the risk of breast cancer. One group of researchers found that human breast cancer cells grown in the laboratory that were exposed to atrazine made more of this estrogen breakdown product, while another group of researchers did not see this effect. More research is being conducted to determine the significance of these findings.

Chemicals that cause mutations or other changes in a cell's genetic code can increase cancer risk. Most tests have shown that atrazine does not cause genetic changes or damage.

### **What is the current regulatory status of atrazine?**

Only certified pesticide applicators may apply this pesticide. Products containing atrazine have information on the label that state the maximum amount that can be put on a field during a growing season. This level has been reduced several times during the 1990s. The label also recommends farming practices that help to reduce the run-off of atrazine from fields into streams and rivers.

Atrazine was placed under Special Review by the U.S. Environmental Protection Agency (EPA) in 1994. This was in response to studies which showed that atrazine caused cancer in laboratory animals, and hence is a possible cancer causing agent in humans. The EPA expressed concern about cancer risks to humans exposed to atrazine through water and food, and in workers who handled or applied atrazine-containing products. The primary manufacturers of atrazine are required to submit additional research studies that address the concerns of the EPA during the Special Review period. A regulatory decision on atrazine by the EPA is expected by summer of 1999.

### **Are the levels of atrazine in drinking water and in food regulated?**

Because of possible health concerns, the EPA sets limits on the amounts of atrazine allowed in public drinking water supplies. This amount is called the "maximum contaminant level." The maximum contaminant level for atrazine has been set at no more than three micrograms per liter of water (one microgram is one-millionth of a gram, one liter is approximately one quart). The EPA also sets limits on the maximum level of atrazine and breakdown products allowed in food for human consumption and animal feed. These maximum levels are called "tolerances." The Food and



Drug Administration (FDA) and the U.S. Department of Agriculture are federal agencies that monitor the levels of atrazine and its breakdown products in domestic and imported foods. Foods that exceed the tolerances can be seized or destroyed by local or federal government officials. In a recent report, the FDA did not find atrazine residues in either imported food or food produced in the U.S.

### **Does atrazine in food pose a cancer risk?**

The risk of cancer from atrazine in food is being evaluated as part of EPA's Special Review. In 1994, EPA evaluated whether residues of atrazine and its breakdown products found in treated crops or in animal products (eggs, red meat, poultry and milk) posed a dietary cancer risk. They estimated that the maximum cancer risk from consuming these foods was low, up to about 4.4 in 100,000. More studies are anticipated to be submitted to EPA to reassess the cancer risk from eating foods with residues of atrazine and its breakdown products during the Special Review period.

### **Who might be exposed to atrazine and its breakdown products?**

People most likely to be exposed to these chemicals are:

- Farmers and agricultural workers who mix or apply mixtures containing atrazine to fields
- People in the southern U.S. who apply atrazine to turf or lawns
- People involved in the manufacturing of atrazine
- People who consume water contaminated with atrazine or atrazine breakdown products
- People who handle or launder atrazine-contaminated worker clothing

### **Is atrazine present in soil?**

Atrazine stays on the surface of the soil for several weeks, but in deeper layers of soil it can remain for months and even several years. Atrazine can also break down in the soil. Some of these breakdown products do not bind to the soil, but can move through the soil and contaminate wells. Atrazine and some of its breakdown products can be carried from the soil in the fields into rivers or streams after a heavy rain storm. We need to know more about the levels of these atrazine breakdown products, including how long they remain in the soil and water and whether they can cause any health problems.

### **Is atrazine present in water or in rain?**

Small amounts of atrazine have been widely detected in streams, rivers, reservoirs and wells in the U.S., especially in the corn-producing Midwestern states. Levels of atrazine in streams and rivers were highest in the spring after heavy rainfalls. During the 1980s, the levels of atrazine in these

water supplies frequently exceeded the maximum contaminant level set by the EPA. Atrazine is still frequently detected in public water supplies, especially in agricultural regions that use atrazine extensively. However, in the mid-1990s, the levels of atrazine in waterways were usually lower than the maximum contaminant level allowed in public water supplies.

Research studies are starting to test water samples for both the levels of atrazine and several of its breakdown products. Some scientists have expressed concern because the levels of atrazine breakdown products are sometimes as high as the level of atrazine in the water samples of rivers and rural wells. When the amounts of atrazine breakdown products and atrazine were added together, they sometimes were close to or exceeded the maximum contaminant level for atrazine. For this reason, more information is needed to determine if atrazine breakdown products have any adverse health effects.

There is some information on the level of atrazine in rain. Atrazine has been detected in rain samples throughout the state of Iowa. Iowa is a corn producing state and uses atrazine heavily. Low levels of atrazine were detected in about a quarter of the rain samples collected. Concern has been expressed by the authors of this study that atrazine could be carried by rainfall to other sites, including organic farms.

### **Are there ways to minimize my exposure to atrazine?**

- Agricultural workers should always follow label directions on how to mix and apply atrazine-containing products. The label provides information on personal protective clothing that should be worn when handling and using the products. Additional label information specifies agricultural practices to be followed that minimize atrazine run-off into waterways.
- Work clothes and boots soiled with atrazine should not be worn in living or eating areas. Work clothing should be laundered separately from all other clothing. Always wash work clothes before wearing them again.
- If you have a private well and live in areas where atrazine is in use, have your water tested on a regular basis. Refer to BCERF Fact Sheet #7B on: *Reducing Potential Cancer Risks from Drinking Water; Part II: Home Water Treatment Options*, for information on water treatment systems that are available to remove pesticides from drinking water.



## Conclusions:

- The potential for atrazine to affect breast cancer risk in women could not be adequately evaluated because studies evaluating breast cancer rates in women exposed to atrazine have not been published.
- There is evidence from several studies that atrazine can cause a higher number or earlier appearance of mammary gland tumors in one type of laboratory rat. This suggests that atrazine could be a possible breast cancer causing agent in humans.
- Atrazine is not estrogenic and most studies have found that it does not cause mutations or other genetic damage.
- People with the highest potential for exposure to atrazine are agricultural and manufacturing workers.
- Low levels of atrazine are widely found in wells and waterways near agricultural areas that use atrazine. However, these levels are usually below the maximum contaminant levels for atrazine in public drinking water supplies set by the EPA.
- Low levels of several atrazine breakdown products have also been detected in wells and waterways near areas that use atrazine.

An extensive bibliography on *Atrazine and Breast Cancer Risk* is available on the BCERF web site:  
<http://www.cfe.cornell.edu/bcerf/>

## Where are more studies needed?

- Studies are needed to better characterize the exposure of women to atrazine in the workplace.
- Studies are needed which will monitor the level of cancers of the breast, ovaries and uterus in women known to have been exposed to atrazine in the workplace. A study currently in progress, called the Agricultural Health Study, is determining the risk of breast and other cancers to farm women in Iowa and North Carolina exposed to atrazine and other farm chemicals.
- Further studies are needed to determine how atrazine causes mammary tumors in certain types of female rats and the relevance of these findings to human breast cancer risk.
- Further studies are needed to determine how long atrazine breakdown products remain in soil, wells and waterways.
- Atrazine breakdown products which remain in soil or are found in water should be tested for their potential to affect cancer risk and for other health effects.

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