



# Breast Cancer and Environmental Risk Factors

March 1998

FACT SHEET #16

**Q & A's from the Cornell University Program on Breast Cancer  
and Environmental Risk Factors in New York State**

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

### **What is simazine?**

Simazine (2-chloro-4,6-bis(ethylamino)-*s*-triazine) is a synthetic chemical that is widely used as an herbicide to control the growth of weeds. Simazine is in the family of *s*-triazine herbicides. Some of the common trade names of simazine include: Simazina Atanor, Gesatop, Princep, Caliber 90, Drexel Simazine, Simanex, Sim-Trol, and Nezitec. Simazine is also available commercially in combination with other pesticides including paraquat, diuron, glyphosate, metolachlor, ametryn, amitrole, terbutryn, diquat dibromide and another *s*-triazine herbicide called atrazine.

### **What is the history of simazine's use?**

Simazine was first registered for use as an herbicide in 1957 by Ciba Plant Protection (now Novartis Crop Protection, Inc.). Its primary agricultural use is to control broad-leaf and grassy weeds in corn fields, citrus crops, alfalfa and grapes. It is also used to control weeds in strawberries, apples, pears, nuts, olives, pineapples, asparagus, sugar cane, tea and coffee. It is often used as a *pre-emergent herbicide* to control weeds before the new seedlings emerge from the soil. Its non-agricultural uses have included weed control on vacant lots and right-of-ways, on ornamental trees and shrubs, and in the Southern U.S. on golf fairways, sod farms, and turf. Although simazine was once used to control algae in swimming pools and hot tubs, the U.S. Environmental Protection Agency (EPA) no longer allows it to be used for these purposes.

### **What is the current usage of simazine?**

Simazine use on croplands in the U.S. during 1990-93 has been estimated to be 4 million pounds of active ingredient

(AI) annually. It's the 20th most used agricultural herbicide in the U.S. Use for non-agricultural purposes has been estimated to be 2.0 to 3.3 million pounds of AI per year. Use on New York State (NYS) crops has been estimated to be 90 thousand pounds per year, making it the 9th most used agricultural herbicide in NYS. Information on non-agricultural usage of simazine in NYS was unavailable.

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

Simazine is currently classified by the EPA as a *General Use Pesticide*. The use of simazine to control algae in swimming pools, hot tubs and whirlpools was canceled by the EPA in 1994 because exposure from these uses represented unacceptable health risks to children and adults. Simazine, along with other *s*-triazine herbicides including atrazine and cyanazine, was placed under Special Review by the EPA in 1994. These triazines were placed under Special Review because their cancer causing potential had been demonstrated in experimental animal studies, because of potential exposures through food and water, and risks from occupational exposures to this herbicide. The manufacturers/registrants of simazine are required to submit additional studies to address the concerns of the EPA during the Special Review period. A preliminary regulatory decision by the EPA is not expected until sometime in 1998, with a final decision anticipated in 1999.

### **How do our federal agencies regulate simazine to protect the consumer?**

The EPA sets the maximum level of simazine that is allowed in public drinking water supplies. This *maximum contaminant level* (MCL) for simazine has been set at no more than 4 micrograms per liter of water (one microgram is one-millionth of a gram, one liter is approximately one quart of water). The EPA also sets limits on the maximum levels of residues allowed



in food for human consumption and in animal feed. These maximum residue levels are called *tolerances*. The Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA) are the federal agencies that monitor the levels of simazine 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.

### Who might be exposed to simazine?

People most likely to be exposed to simazine include:

- Farmers and agricultural workers who have handled or applied simazine, or herbicide mixtures containing simazine to fields or orchards
- Family members that have lived on farms or orchards that have used simazine
- Pesticide applicators who have used simazine to control weeds on vacant lots, right-of-ways, turf, golf fairways or on ornamental shrubs
- People who have handled or laundered simazine-contaminated clothing
- People who have worked in simazine manufacturing facilities
- People who have consumed water contaminated with simazine
- People who have consumed food products with residues of simazine or its breakdown products

### Is simazine present in water?

Low levels of simazine have been detected in well water in California, and in surface water in Florida where its major use is on citrus crops. Studies have also detected simazine in the ground and surface water in the Midwest, where it is primarily used as a corn herbicide. In the waterways or wells that had detectable levels of simazine, most of the residues were below the MCL set by the EPA for drinking water. In a national survey of pesticide residues in well water, 7% of the wells with detectable levels of simazine exceeded the MCL. There is little information available on simazine residues in NYS waterways. A recent study of pesticide residues in the Hudson River basin was conducted by the U.S. Geological Survey. They reported that simazine was detected in 28% of the samples taken. However, the levels in the water were very low. Median levels were over

300 times lower than the MCL for simazine, and none of the samples had simazine levels higher than the MCL.

### Does simazine stay in the soil?

There is some evidence that simazine persists in soil. About half of the simazine is still present in soil 12 days to two years after its application. Over time, some of the simazine is broken down by bacteria in the soil. More information is needed on the persistency of these simazine breakdown products in soil, and their potential to leach into ground and surface water.

### Are residues of simazine in food a concern?

The EPA is currently evaluating whether the residues of simazine and its breakdown products in treated crops (corn, certain fruits, nuts) and in eggs, milk, poultry or red meat, pose a cancer risk. Preliminary studies evaluated by the EPA have estimated that the maximum risk of cancer from simazine residues in food products is low, at about one in 100,000. More studies are anticipated to be submitted to EPA during the Special Review Period to reassess the cancer risk from eating foods with residues of simazine and its breakdown products.

### Does simazine cause cancer in experimental animals?

Simazine fed at high levels over long periods of time to experimental animals caused an increased incidence in the tumors of the liver in male rats and of the pituitary gland in female rats. In contrast, mice treated with simazine did not develop tumors.

### Does simazine cause cancer in humans?

There is a concern that simazine and other *s*-triazine herbicides may affect the risk of ovarian cancer. One study reported an increased incidence of ovarian cancer in female farm workers in Italy who were exposed to the herbicides atrazine (predominant exposure) and simazine. There are other ongoing studies being conducted by Novartis Crop Protection that are evaluating whether women employed in simazine manufacturing plants have adverse health effects.

Some researchers have suggested that simazine can react with other chemicals to form a chemical called nitrosamine. Nitrosamines are substances known to increase the risk of stomach cancer. To what extent simazine and substances in



soil or water can react to form nitrosamines is not known and needs to be studied.

### **Does simazine cause breast cancer?**

Studies were not available that evaluate the risk of breast cancer in women exposed to simazine. There is some evidence that simazine may be a breast carcinogen (substance that causes cancer) in experimental animals. Simazine does not cause breast tumors in mice. One study has reported a significant increase in the incidence of malignant and benign breast tumors in one strain of female rats fed high levels of simazine for long periods of time, compared to rats that did not receive a diet that contained simazine. It should be noted that the high levels of simazine used in this study are much higher than levels that people would be exposed to from food, water, soil, or through occupational exposures to this herbicide.

Researchers are investigating whether simazine changes the levels of hormones in experimental animals in a way that may affect breast tumor formation. Hormones are chemical messengers in the body. Some researchers have suggested that exposure to the hormone estrogen can affect breast cancer risk. Simazine-treated animals did not have elevated levels of estrogen in their blood. However, they did have elevated levels of another hormone called prolactin, and this hormone is known to play a role in the development of breast tumors in laboratory animals. Most researchers believe that prolactin does not play a significant role in human breast cancer.

### **Are there other ways by which simazine may affect breast cancer risk?**

There is currently no evidence that simazine can affect breast cancer risk in other ways.

- Tests have shown that simazine does not appear to act like the hormone estrogen.
- Most tests have shown that simazine is not a mutagen. Mutagens are substances that can cause changes in a cell's genetic material that can sometimes lead to the development of cancer.

### **Conclusions**

We could not adequately evaluate the breast cancer risk of simazine in humans because studies have not been published that have looked at breast cancer incidences in women with past exposures to simazine. There is limited evidence from

one experimental animal study that simazine, when fed at high levels over long periods of time, can cause an increased incidence of breast tumors in female rats. More studies are needed to determine the way simazine induces breast cancer in experimental animals and if these mechanisms are relevant to humans. Because the evidence of simazine's potential to affect breast cancer risk is limited to one animal study, we conclude that there is inadequate evidence at the present time to show that simazine is a human breast carcinogen.

### **Where are more studies needed?**

- More studies are needed to develop ways to accurately assess exposure to simazine.
- Studies are needed to determine if there is a higher incidence of cancers of the breast or ovaries in women occupationally exposed to simazine. This includes women who have been exposed to simazine while working as pesticide applicators, farm workers, or in simazine-manufacturing plants. Women who have lived on farms or orchards that have used simazine should also be followed for the development of breast cancer. A study sponsored by the National Cancer Institute, the Agricultural Health Study, is currently evaluating the health effects of exposure to simazine and other agricultural chemicals in 58,000 male farm workers and pesticide applicators, and 35,000 women who are spouses of farm workers, or are farmers or pesticide applicators themselves. Risk of cancer, including breast cancer, as well as other health effects will be evaluated in this 10-year long study being conducted in Iowa and North Carolina.
- More studies are needed to find out how simazine causes breast tumors in experimental animals and the relevance of these mechanisms to humans.
- Further research is needed to determine how persistent simazine breakdown products are in soil, and if these breakdown products do, or do not have any adverse health effects.

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

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