

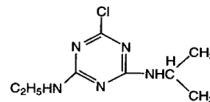


## Case study: Does Atrazine Cause Developmental Abnormalities at Low Levels?



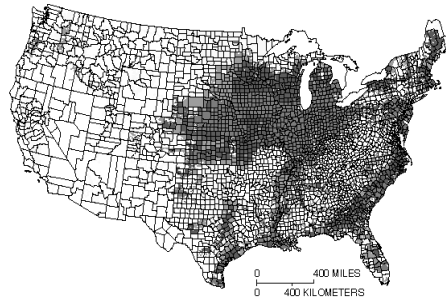
## Introduction/Background

- **Atrazine (2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine) is the most widely used herbicide in the US**
- **Controls broad leaf weeds.**
- **Used on corn, soybeans, sugarcane and others.**

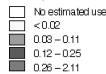


## Introduction/Background

- Emerged in the late 1950's – early 1960's.
- The Midwest applies the highest amounts of atrazine on corn crops.
- Nearly 77 million lbs are applied each year in the U.S.
- Atrazine is banned in several European countries.



EXPLANATION  
Amount of atrazine applied annually to cropland and pasture (in pounds, active ingredient)



Crops	Total Amount Applied (in pounds, active ingredient)	National Use (in percent)
corn	53,796,206	84.13
sorghum	7,339,963	11.48
sugar cane, sugar & seed	1,711,322	2.68
pasture	518,074	0.81
sweet corn	444,523	0.70
sod	119,182	0.19
proso millet	11,937	0.02
field and grass seed	6,305	0.01

## Atrazine in Michigan

There is virtually no atrazine free environment in the U.S.

In Michigan:

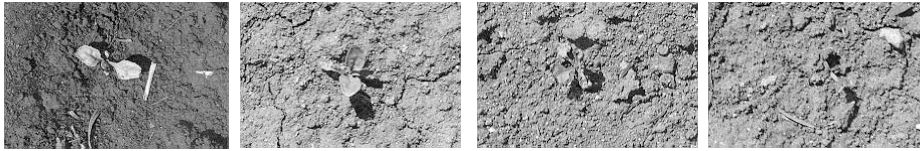
- over 95,000 people drink atrazine impacted water.

- Over 30,000 of these people drink water contaminated with more than 3 ppb atrazine.



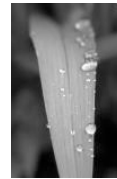
## Introduction/Background

- **Atrazine is a photosynthesis inhibitor that acts through root absorption.**
- **Rapid death of plant occurs.**



## Is Atrazine Harmful?

- **Classified as a type III chemical (I is most and IV is least toxic).**
- **Atrazine is highly mobile and can travel with water through soil into groundwater and is not easily degraded.**
- **Atrazine enters surface waters through runoff.**
- **Results in drinking water contamination.**



## Is Atrazine Harmful?

- High levels of atrazine caused mammary tumors in some laboratory animals.
- Link suspected between Atrazine and breast cancer, ovarian cancer, stomach cancer, and non-Hodgkin's lymphoma.
- No strong evidence that atrazine causes tumors in humans (EPA).
- Atrazine is an endocrine disruptor at lower doses.



## Is Atrazine Harmful?

- Humans are typically exposed to atrazine by:
  1. Inhalation (rural areas where atrazine is applied).
  2. Handling treated crops.
  3. Drinking contaminated water.
- Atrazine is readily absorbed through the gastrointestinal tract.



## Is Atrazine Harmful?

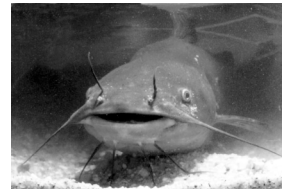
- The maximum allowable amount of Atrazine in drinking water is 3 ppb.
- Estimated that humans drinking Atrazine contaminated water will drink 1000 ppb in a lifetime.
- Chronic exposure to atrazine in humans and mammals may be linked to: muscular degeneration, cardiovascular damage, and cancer.



## Atrazine and Wildlife

- Atrazine has been shown to alter the development of:

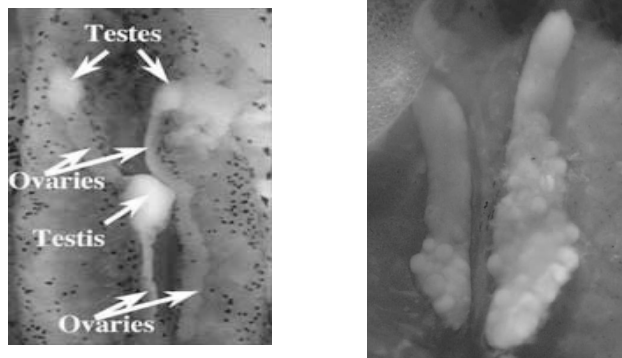
- Alligators
- Fish
- Amphibians



However, at what concentrations?

## Part I. Hayes Study

- Hayes et al. (2002) studied the effects of low levels of atrazine on *Xenopus leavis* (African Clawed Frog).
- Results showed frogs exposed to as low as 0.01 ppb had multiple gonads or both male and female sex organs.



## Part II. EcoRisk Study

- EcoRisk, a group funded by Syngenta, the sole manufacturer of atrazine, repeated the Hayes et al. (2002) study.
- Unable to replicate Hayes' results (Carr et al. 2003)
  - No hermaphrodites at less than 10 ppb.
  - Frogs in control group were hermaphroditic or had multiple gonads.
  - Could not conclude atrazine caused multiple gonads or hermaphroditic frogs.

## Part III. Hayes Summary

**Assignment (due Wed. 3/12)**

**Answer questions to Part 3.**

**Use Hayes (2004) to help answer.**

**Read the article and pay specific attention to material relating to Figs. 5, 6 and 7 and Table 1.**

**Assignment must be typed (double spaced).**