NPTN General Fact Sheets are designed to answer questions that are commonly asked by the general public about pesticides that are regulated by the U.S. Environmental Protection Agency (U.S. EPA). This document is intended to be helpful to professionals and to the general public for making decisions about pesticide use.

National
Pesticide
Telecommunications
Network

BORIC ACID

(General Fact Sheet)

For less general information, please refer to the Technical Fact Sheet.

The Pesticide Label: Labels provide directions for the proper use of a pesticide product. *Be sure to read the entire label before using any product.* A signal word on each product label indicates the product's potential hazard.

CAUTION - low toxicity **WARNING - moderate toxicity** **DANGER - high toxicity**

What is boric acid?

- Boric acid and salts of boric acid are active ingredients of pesticide products used against insects, spiders, mites, algae, molds, fungi, and weeds. They were first registered in the United States in 1948 and reregistered in 1993 (1). *Use of the term "boric acid" in this fact sheet refers to boric acid and boric acid salts.*

- Boric acid is derived from boron, a naturally occurring substance found in rocks, soil, and water. Boron is common in the environment (2, 3, 4).

- Boric acid is generally a white solid, but it may be clear to murky. It is odorless and generally stable under normal conditions (1).

- Signal words for products containing boric acid range from Caution to Danger (5). The signal word reflects the combined toxicity of boric acid and other ingredients in each product. See the **Pesticide Label** box above.

- Applicators use boric acid products on a variety of sites including sewage systems and food and non-food crops. It is also used inside and outside homes, hospitals, and businesses (1). Boric acid pesticides exist in various forms including aerosols, liquids, granules, wettable powders, dusts, pellets/tablets, and impregnated materials (baits, stakes, etc.) (5).

How does boric acid work?

- Insects are killed by eating boric acid and its salts. The salts of boric acid are abrasive to the exterior of the insect (1).

- Boron is an essential plant nutrient, and some boric acid products are used to aid plant growth (1, 3). Plants need small amounts of boron but high levels are toxic (3). Boric acid kills weeds by disrupting normal plant functions and causing water loss (1).

- Boric acid interferes with reproduction of molds and fungi (1).

- The toxic action in animals is not known (6).

What are some products that contain boric acid?

- BORA-CARE®
- JECTA®
- NIBAN®
- NIBOR®
- Tim-Bor®

How toxic is boric acid?

Animals

- Boric acid is very low to low in toxicity when eaten (2). See boxes on **Laboratory Testing**, **LD50/LC50,** and **Toxicity Category**.

- *Boron* compounds are low to very low in toxicity when inhaled (2). The U.S. Environmental Protection Agency (EPA) has not required inhalation toxicity studies for boric acid (1).

- Boric acid is low in toxicity when applied to the skin (1). It is poorly absorbed in rabbits across intact skin, but damaged skin experiences increased penetration (7).

- The U.S. EPA classifies boric acid as low to very low in toxicity for skin irritation (1).

- Data are not available regarding the ability of boric acid to affect skin sensitivity (1).

- Boric acid is generally low in toxicity for eye irritation. An exception is a specific boric acid salt, which is highly toxic to the eye (1).

Exposure: Effects of boric acid on human health and the environment depend on how much boric acid is present and the length and frequency of exposure. Effects also depend on the health of a person and/or certain environmental factors.

Laboratory Testing: Before pesticides are registered by the U.S. EPA, they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure. When pesticide products are used according to the label directions, toxic effects are not likely to occur because the amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

- In a 90-day study, investigators fed dogs boric acid. At the highest dose, they noted altered blood chemistry, a buildup of fat in select tissues, and toxicity to the testes (1).

- Researchers fed dogs boric acid in the diet for 2 years and detected no adverse health effects(1).

- Signs of toxicity in laboratory animals poisoned with boric acid include depression, impaired muscle movement, vomiting, purple-red skin color, and lowered body temperature (6).

Humans

- Two siblings, one 24 days old and the other 14 months, were inadvertently fed boric acid in their formula. Symptoms included irritability, diarrhea, and redness in the groin area. Neither child developed severe toxicity nor had symptoms 1 month after the incident (8).

Toxicity Category (*Signal Word*) (10)

	High Toxicity (*Danger*)	Moderate Toxicity (*Warning*)	Low Toxicity (*Caution*)	Very Low Toxicity (*Caution*)
Oral LD50	Less than 50 mg/kg	50 - 500 mg/kg	500 - 5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200 - 2000 mg/kg	2000 - 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05 - 0.5 mg/l	0.5 - 2 mg/l	Greater than 2 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible within 7 days	Minimal effects, gone within 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

LD50/LC50: A common measure of acute toxicity is the lethal dose (LD50) or lethal concentration (LC50) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD50 is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC50 is often expressed as mg of chemical per volume (e.g., liter (L)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD50/LC50 is small and practically non-toxic when the value is large. However, the LD50/LC50 does not reflect any effects from long-term exposure (i.e., cancer, birth defects, or reproductive toxicity) that may occur at levels below those that cause death.

- Investigators evaluated cases of people who ate boric acid. No patients experienced severe toxicity, and the majority did not have symptoms. In patients experiencing symptoms, the most common complaints were vomiting, stomach pain, and diarrhea. Sluggishness, lightheadedness, and rashes were less common symptoms (9).

Does boric acid break down and leave the body?

Animals

- After being eaten, boric acid is rapidly and completely absorbed. Break down of the chemical is limited in the body, and it leaves the body primarily in urine as boric acid (2, 11).

- Boric acid fed to rats did not accumulate in soft tissues. Boric acid was found in bone in the form of boron (11).

Humans

- Six male volunteers who ate a single dose of boric acid excreted the majority of the chemical over a 4-day period (12).

- In a study of nine patients who ingested boric acid, the elimination half-life ranged from 4-28 hours (9). See box on **Half-life**.

Half-life is the time required for half of the compound to degrade.

1 half-life = 50% degraded
2 half-lives = 75% degraded
3 half-lives = 88% degraded
4 half-lives = 94% degraded
5 half-lives = 97% degraded

Remember that the amount of chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

- Investigators evaluated infants that had talcum powder containing boric acid applied to the skin for diaper rash. Only small amounts of boric acid penetrated the skin (2).

Does boric acid cause reproductive or birth defects?

Animals

- Researchers fed rats boric acid for three generations. At the highest dose, the rats did not reproduce, and researchers noted lower body weight gains in both sexes, decreased food efficiency in females, and toxicity to testes in males. They noted no effects at the lowest doses tested (1).

- In a two-generation reproductive study with mice, scientists noted that at the highest dose, the animals did not produce litters, and the males had decreased sperm levels and mobility. At the second highest dose, they detected an increase in days between litters and a decrease in the number of females producing litters. Scientists detected no effects at the lowest tested dose (1).

- Pregnant rats fed boric acid had offspring with lower body weights at all doses tested. At the three highest doses, investigators detected more rib and brain changes (13).

- In a developmental study, scientists exposed pregnant mice to boric acid and noted kidney effects in mothers at all tested doses. At the two highest doses, offspring had lower body weights and body structure changes at the highest dose (13).

- Laboratory workers fed boric acid to pregnant rabbits by stomach tube and at the highest doses, observed more offspring deaths and heart defects. At the same dose, they also found lower food consumption by mothers and vaginal bleeding associated with pregnancy loss. Workers did not detect effects at lower doses (14).

Humans
- Investigators evaluated reproductive effects of boric acid to men employed at a mining and production facility. They did not detect any effects to male fertility (15).

- Data are not available from work-related exposures, accidental poisonings, or other human studies regarding the potential of boric acid to cause birth defects.

Does boric acid cause cancer?

Animals
- Laboratory workers fed mice boric acid for 2 years and noted no evidence of cancer or signs of toxicity. Workers observed increased numbers of some cell types and decreased size of the testes (1).

- Researchers fed rats boric acid for 2 years and noted no evidence of cancer. Researchers detected that rats that received the highest doses had lower body weights and effects to the testes. No effects occurred at lower doses (1).

- Researchers often test chemicals for their ability to change the genetic material of an organism as an indication of their potential to cause cancer. Evidence exists that boric acid does not pose a hazard to genetic material (1, 2)

Cancer: The U.S. EPA has strict guidelines that require testing of pesticides for their potential to cause cancer. These studies involve feeding laboratory animals large *daily* doses of the pesticide over most of the lifetime of the animal. Based on these tests, and any other available information, EPA gives the pesticide a rating for its potential to cause cancer in humans. For example, if a pesticide does not cause cancer in animal tests at large doses, then the EPA considers it unlikely the pesticide will cause cancer in humans. Testing for cancer is not done on human subjects.

Humans
- The U.S. EPA currently classifies boric acid as a group E carcinogen (16). This means that boric acid is not considered to cause cancer based on results from animal studies. See box on **Cancer**.

- Data are not available from work-related exposures, accidental poisonings, or other human studies regarding the potential of boric acid to cause cancer.

What happens to boric acid in the environment?

- Most boron compounds convert to boric acid in the environment (4).
- Boric acid naturally occurs in air, water (surface and ground water), soil, and plants, including food crops. It enters the environment through break down of rocks, loss from seawater, and volcanic eruptions (2).
- Products and human activities that contribute to boric acid in the environment include agricultural chemicals, laundry products, irrigation drainwater, mining and processing, and coal burning (2, 4).
- Boric acid readily dissolves in water and results in the chemical reaching lakes, rivers, and wetlands (4).
- Boric acid binds to soil and minerals (4). Binding can be either reversible or irreversible, depending on soil properties (2). Boric acid is mobile in soil (1).

What effects does boric acid have on wildlife?

- Boric acid is practically nontoxic to fish and other water organisms. Boric acid has a low potential to buildup in organisms (1).
- Boric acid is practically nontoxic to birds (1). Boric acid may adversely affect development of young birds. In studies with ducks, the highest tested doses in ducklings caused increased mortality, altered behavior, and decreased growth and hatching success (17-19). The U.S. EPA does not anticipate adverse effects to birds from the use of boric acid (1).
- Boric acid is relatively nontoxic to bees (1).

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