

*chemical*WATCH Factsheet

Boric Acid

Boric acid is a low-toxicity, non-volatile mineral with insecticidal, fungicidal, and herbicidal properties. It has long been embraced as a safer alternative to highly volatile, synthetic chemical pesticides. Boric acid is especially effective when used as part of an ongoing integrated pest management (IPM) program that incorporates sanitation, cultural, mechanical, and biological practices.(3)

Boric acid and its sodium salts, all boron-related compounds, generally refers to seven active ingredients, including boric acid, sodium tetraborate decahydrate (borax decahydrate), sodium tetraborate pentahydrate (borax pentahydrate), sodium tetraborate (anhydrous borax), disodium octaborate tetrahydrate, disodium octaborate (anhydrous), and sodium metaborate. No registered pesticide products contain boric oxide as an active ingredient.(6)

Boric acid was originally registered as a pesticide in the U.S. in 1948; there are currently 189 registered pesticide products on the market containing boric acid or one of its sodium salts as an active ingredient.(5)

While exposure to boric acid has been linked to adverse health effects, experts agree that careful application offers a less hazardous, more effective alternative to many pesticides, without the indoor air problems commonly associated with pesticide sprays.

Use and Mode of Action

Boric acid and its salts, borates, have been used in medicine as a bactericide, a fungicide, and an antiseptic since the 1860s.(3) It is used as a wettable powder, liquid (applied as a spray or aerosol), emulsifiable concentrate, granule, powders, dusts, pellets, tablets, paste, bait or

crystalline rod depending upon the circumstances and target pest.(6)

As an insecticide, boric acid acts as a "stomach poison" for ants, cockroaches, silverfish and termites, and is most commonly used in a bait formulation containing a feeding attractant or as a dry powder. The powder can be injected into cracks and crevices, where it forms a fine layer of dust. Insects travel through the powder, which adheres to their legs. When the insects groom themselves, they ingest the poison, which causes death due to starvation and dehydration 3-10 days later. Boric acid can also abrade the exoskeletons of insects.(5) As long as the material is not allowed to become wet, its continuous presence ensures that hatching insects, which sprays commonly spare, are exposed and die as well. Many insecticidal formulations contain a desiccant to protect the boric acid from airborne moisture. These formulations can be effective for more than a year.(3)

When used as an herbicide, boric acid desiccates and/or interrupts photosynthesis in plants, or suppresses algae in swimming pools and sewage systems. As a fungicide, boric acid can be used as a wood preservative that controls decay-producing fungi in lumber and timber products.(5)

In agriculture, boric acid is used as an insecticide, herbicide and fungicide in food crops and orchards (6), and borates have also been utilized as a nutritional supplement for boron-loving crops, such as sugar beets and cabbage.(4)

Boric Acid Toxicity

Boric acid occurs naturally in water, fruits, vegetables and forage crops. It is an essential nutrient for plants and an

essential element for many organisms.(5) The acute toxicity of boric acid in rats is less than that of table salt.(2) It is generally of moderate acute toxicity, and has been placed in Toxicity Category III by the EPA for most acute effects, including oral and dermal toxicity, and eye and skin irritation.(5) Sodium tetraborate (anhydrous borax) products are categorized as Toxicity Category I because of high acute toxicity for eye irritation effects.

There are few allergic responses from skin applications of boric acid. Absorption through skin is negligible unless the skin is broken or burned. Respiratory irritation can occur from chronic inhalation of airborne boric acid or borates. Workers show eye irritation, dryness of the mouth, nose, or throat, sore throat, and cough at mean exposures of 4.1 mg/m³.(2)

The oral LD₅₀ in rats ranges between 3160 and 4080 mg/kg body weight depending on the species and sex, with males being more susceptible than females. (For comparison, an alternative termite treatment, chlorpyrifos (Dursban®), is about 20 times more acutely toxic at 163mg/kg).(2) Large chronic daily doses of boric acid (about 1g in 1kg food) shrink testicles in dogs and rats, and interfere with reproduction.(2) High doses are selectively toxic to the testes, causing histopathological changes and even sterility in both male rats and dogs.

Workers exposed to large amounts of boric acid in manufacturing plants were also found to have reduced sperm count and motility in one study with a small sample size.(7) EPA says the study results "are of limited value for risk assessment due to sparse details and small sample size." No effect on fertility was found in a much larger study of U.S. borate production workers (Whorton et al., 1994a,b, 1992),

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but exposure concentrations were much lower (approximately 2.23 mg/m³ sodium borate or 0.31 mg B/m³) in this study.(7)

Boric acid is not mutagenic. In chronic oncogenicity studies using mice, rats and beagle dogs, boric acid and borax were found not to be carcinogenic. The EPA has classified boric acid as a "Group E" carcinogen, indicating "evidence of noncarcinogenicity" for humans. Reproductive and developmental toxicity studies using rats, mice and rabbits found maternal liver and kidney effects and decreased weight gain, as well as decreased fetal body weights. Two studies found that no litters were produced at the highest dose levels. Prenatal mortality occurred at the highest dose levels in the rabbit study.(5)

Boric acid is toxic to all living cells, partially due to enzyme inhibition. Rats fed complex organic salts or boric acid had their serum cholesterol levels lowered due to liver enzyme inhibition. Boric acid was also found to antagonize riboflavin metabolism in chickens.

The greatest danger of boric acid to humans results from chronic unprotected exposure to aerosols, or accidental acute ingestion of large amounts. It is extremely rare that an accidental poisoning of boric acid is lethal.

Ecological Effects

Boric acid is practically nontoxic to birds, fish, aquatic invertebrates, and relatively

nontoxic to beneficial insects. However, its noncrop herbicidal use along rights-of-way may harm endangered or threatened plants and pose a potential threat to aquatic invertebrates, as a result of runoff into aquatic environments.(5) EPA concludes that boric acid's limited outdoor use patterns, low toxicity and natural presence in terrestrial and aquatic environments reduces concerns about its impact on nontarget organisms.(5)

Effectiveness

An EPA assessment of a boric acid pilot pest control program conducted at the U.S. Army's Aberdeen Proving Ground in Maryland found that boric acid was both more economical and more effective than monthly spray treatments. (1) At least one study has shown that the combination of heat at 110 degree F for two hours with boric acid will increase the speed at which the German cockroach is killed. (1)

A study comparing crack and crevice treatments in conjunction with a full IPM program for cockroaches in school cafeterias found that one crack and crevice application of boric acid reduced roach numbers from 40 per trap to less than three per trap within three months. The low average was maintained for two years by the single boric acid treatment. The same level of control with Dursban® required two full applications followed by a spot treatment. The need for multiple treatments combined with the higher unit cost of Dursban® made boric acid much more

cost-effective.(1)

Regulatory Information

EPA is requiring three phytotoxicity studies to assess the risks of non-target plants and endangered plant species. These studies are not part of the target database and do not affect reregistration eligibility of boric acid and related active ingredients. EPA has requested product-specific data including product chemistry, acute toxicity, and efficacy studies, revised Confidential Statements of Formula and revised product labeling for reregistration. EPA has reregistered all 43 boric acid products covered by the General Registration Standard. For these products, only current labeling and Confidential Statements of Formula must be submitted to ensure that they still meet the criteria set forth in that document.(5)

EPA has issued a general exemption for tolerance (acceptable residues) of boric acid in raw agricultural commodities, but is setting limits for the chemical in food and feed additives in the unlikely event that is use in food establishments results in food residues.

Under its worker protection standard, EPA is requiring personal protective equipment (PPE) and a 12-hour reentry time for nonresidential uses of boric acid and its salts because it believes that use patterns present a potential for dermal and inhalation exposure among applicators and people reentering treated areas.(5)

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