

### What is sulfur?

Sulfur is an element that exists in nature and can be found in soil, plants, foods, and water.<sup>2</sup> Some proteins contain sulfur in the form of amino acids.<sup>3</sup> Sulfur is an essential nutrient for plants.<sup>4</sup> Sulfur can kill [insects](#), mites, [fungi](#), and [rodents](#). Sulfur has been registered for use in pesticide products in the United States since the 1920s.<sup>5</sup>

### What are some products that contain sulfur?

[Products](#) containing sulfur can be dusts, wettable powders, liquids, or fumigant gas cartridges.<sup>4</sup> They are used in field crops, root crops, tree fruits, nuts, berries, vegetables, ornamentals, and turf. They are also used in outdoor residential areas and on food and non-food crops. Non-food use sites include pets, livestock, and livestock quarters.<sup>4</sup>



photo credit: Ben Mills, Wikimedia Commons

There are over 200 active products containing sulfur on the market in the United States.<sup>5</sup> Some have been approved for use in organic gardening.<sup>6</sup> Non-pesticide products containing sulfur are used as soil amendments or fertilizers.<sup>7</sup>

Always [follow label instructions](#) and take steps to minimize exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to [discuss a pesticide problem](#), please call 1-800-858-7378.

### How does sulfur work?

Sulfur kills fungi on contact.<sup>8</sup> The way sulfur works is not completely understood yet. Some researchers believe sulfur may react with plants or fungi to produce a toxic agent.<sup>9</sup> However, the main theory is that sulfur enters fungi cells and affects cell respiration.<sup>10</sup>

Sulfur can kill insects if they touch it or eat it.<sup>6</sup> It disrupts their normal body function, altering their ability to produce energy.<sup>11</sup> Sulfur in gas cartridges, after ignited and placed in a burrow, releases toxic gases that suffocate burrowing animals.<sup>4</sup>

### How might I be exposed to sulfur?

Sulfur is present in food and we may be exposed to it in our regular diet.<sup>12</sup> You can also be exposed if you are applying sulfur dusts or sprays and you get it on your skin, in your eyes, or breathe it in. This can also happen if you get some on your hands and eat or smoke without washing your hands first.

You can [limit your exposure](#) to sulfur by [following all label directions](#) carefully.

### What are some signs and symptoms from a brief exposure to sulfur?

Sulfur is low in toxicity to people. However, ingesting too much sulfur may cause a burning sensation or diarrhea. Breathing in sulfur dust can irritate the airways or cause coughing. It can also be irritating to the skin and eyes. Blurred vision has also been reported.<sup>13</sup>

If animals eat too much sulfur, it may be toxic and can be fatal. Signs of poisoning in animals include problems to the stomach and intestines, effects on the lungs, and neurologic disorders.<sup>14</sup> Sulfur in excess can cause brain cell death, resulting in brain damage. Signs associated with brain damage can include blindness, incoordination, seizures, death, and others.<sup>15</sup> See the fact sheet on [pets and pesticide use](#) for more information about reducing risks to pets.



photo credit: Cade Martin, Dawn Arlotta, USDCDP

Burning sulfur creates sulfur dioxide, a gas. If inhaled, coughing, shortness of breath, sore throat, and labored breathing, has been reported. Eye irritation has also been reported.<sup>16</sup>

### What happens to sulfur when it enters the body?

Sulfur is essential for humans, animals, and plants. When it enters our body, it can be incorporated into tissues like skin and cartilage. It is also found in some proteins and vitamins.<sup>17</sup>

When sulfur gets on intact skin, most of it does not get into the bloodstream. However, it can be absorbed into skin itself. In one study, sulfur was applied to the skin and was detectable from 2 to 8 hours afterwards. It was undetectable after 24 hours. In another study, sulfur was applied for 8 hours to the skin of four volunteers. Sulfur was found in urine 2 hours later and after 6 hours it reached its maximum. Researchers found that 1% of sulfur was taken into the body after 20 hours. About half of this was removed from the body in urine.<sup>18</sup>

### Is sulfur likely to contribute to the development of cancer?

Sulfur is common in water and soil and daily exposure to sulfur is expected. The US Environmental Protection Agency (US EPA) concluded that there are no known cancer risks related to sulfur. Sulfur is not known to alter or damage genes.<sup>12</sup>

### Has anyone studied non-cancer effects from long-term exposure to sulfur?

Prolonged or repeated skin contact may cause rashes or calluses.<sup>12</sup> Breathing sulfur over the long-term may irritate the nose and the respiratory tract, resulting in chronic bronchitis.<sup>13</sup>

The EPA has concluded that there are no known risks to reproduction or child development from sulfur.<sup>12</sup>

### Are children more sensitive to sulfur than adults?

While [children may be especially sensitive to pesticides](#) compared to adults, there are currently no data to conclude that children have increased sensitivity specifically to sulfur. However, young children may act in ways that put them at greater risk of being exposed.<sup>12</sup> For example, they may spend more time near the ground. They may also be more likely to place their hands in their mouths after touching treated plants or surfaces.

### What happens to sulfur in the environment?

Sulfur naturally occurs in the environment. Elemental sulfur applied to the soil will be incorporated into the natural sulfur cycle.<sup>7</sup>

Sulfur doesn't dissolve well in water. Therefore, drift or runoff to water bodies is not expected to impact aquatic life. Sulfur drift to areas close to a treated field can injure sulfur-sensitive plants.<sup>7</sup>



photo credit: Scot Nelson, flickr

### Can sulfur affect birds, fish, or other wildlife?

Sulfur has shown to be practically non-toxic to bobwhite quail, bluegill sunfish, rainbow trout, water fleas, and mysid shrimp. It is also practically non-toxic to the honeybee.<sup>7</sup>

### Where can I get more information?

For more detailed information about sulfur please visit the list of [referenced resources](#) or call the National Pesticide Information Center, between 8:00 AM and 12:00 PM Pacific Time (11:00 AM to 3:00 PM Eastern Time), Monday - Friday, at 1-800-858-7378 or visit us on the web at [npic.orst.edu](http://npic.orst.edu). NPIC provides objective, science-based answers to questions about pesticides.

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### References

1. Institute of Medicine of the National Academies. *Chapter 7: Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*; National Academies Press: Washington, DC, 2005.
2. Institute of Medicine of the National Academies. *Chapter 10: Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*; National Academies Press. Washington, DC, 2005.
3. Norton B. R.; Mikkelsen R.; Jensen T. Better Crops with Plant Food : Sulfur for plant nutrition. *Int. Plant Nutr. Inst.* 2013, 97, 2, 10-12.

4. *Interim Registration Review Decision for Sulfur*; U.S. Environmental Protection Agency, Office of Pesticide Programs, Pesticide Re-evaluation Division, U.S. Government Printing Office: Washington, DC, 2015.
5. *NPIC Product Research Online (NPRO): Sulfur*; National Pesticide Information Center: Corvallis, OR, 2017.
6. National Organic Program: USDA Organic Regulations. *Fed. Regist.* 2017, 82, 53, 14420-14421.
7. *Preliminary Environmental Fate and Ecological Risk Assessment for the Registration Review of Sulfur*; U. S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division, U.S. Government Printing Office: Washington, DC, 2013.
8. Turner, J. A. *The Pesticide Manual, A World Compendium, 17th ed.*; British Crop Protection Council: Hampshire, UK, 2015; pp 1048-1049.
9. McCallan, S. E. A. The Nature of the Fungicidal Action of Copper and Sulfur. *Bot. Rev.* 1949, 15, 9, 629-643.
10. Williams J. S.; Cooper R. M. The oldest fungicide and newest phytoalexin—a reappraisal of the fungitoxicity of elemental sulphur. *Plant Pathol.* 2004, 53, 3, 263-279.
11. Sparks T. C. Toxicology of insecticides and acaricides. *Cotton Insects and Mites: Characterization and Management*; Cotton Foundation: Memphis, TN, 1996; pp 286.
12. *Summary of Human Health Risk Assessments to Support Registration Review*; U. S. Environmental Protection Agency, Office of Pesticide Programs, Health Effects Division, U.S. Government Printing Office: Washington, DC, 2013.
13. *International Chemical Safety Cards: Sulfur*; Centers for Disease Control and Prevention; National Institute for Occupational Safety and Health: Atlanta, GA, 2000.
14. Gupta, P. K.; Aggarwal, M. Toxicity of Fungicides. *Veterinary Toxicology, Basic and Clinical Principles*; Gupta, R. C. Ed.; Academic Press: Oxford, England, 2007; pp 653-670.
15. Niles, G. A. Toxicoses of the Ruminant Nervous System. *Vet. Clin. N. Am.-Food Anim Prac.* 2017, 33, 1, 111-138.
16. *International Chemical Safety Cards: Sulphur Dioxide*; Centers for Disease Control and Prevention; National Institute for Occupational Safety and Health: Atlanta, GA, 2006.
17. Komarnisky, L. A; Christopherson, R. J.; Basu, T. K. Sulfur: its clinical and toxicologic aspects. *Nutrition*, 2003, 19, 1, 54-61.
18. *Hazardous Substances Data Bank: Sulfur, Elemental*; National Library of Medicine's Toxicology Data Network; National Institutes of Health, Health & Human Services: Bethesda, MD, 2017.

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