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EPSOM SALT USE IN HOME GARDENS AND LANDSCAPES

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Abstract

Epsom salt is a popular soil amendment for home gardeners with anecdotally-reported value as a fertilizer and pesticide. However, it is not registered as a pesticide, nor should it ever be used as a pesticide. This publication will review the scientific evidence behind the use of Epsom salt in home gardens and provide readers with a set of guidelines designed to improve soil nutrient conditions and promote plant health.

What is Epsom Salt?

Magnesium sulfate, or Epsom salt, is a naturally occurring mineral consisting of magnesium and sulfur (MgSO_4 , Figure 1). It readily dissolves in water, releasing positively charged magnesium ions (Mg^{+2} cations) and negatively charged sulfate ions (SO_4^{-2} anions).



Figure 1. Magnesium sulfate, sometimes sold as Epsom salt. Photo: Rich Guggenheim.

Epsom salt is named after Epsom, England, where water that is naturally high in magnesium sulfate is used in the region's historic spas.

What role does magnesium play?

Magnesium is an essential plant nutrient, and small amounts are required for chlorophyll formation. When deficient, leaves will have a characteristic interveinal chlorosis pattern where the veins remain green but tissues between the veins turn yellow (Figure 2).

Magnesium is an exchangeable cation and behaves similarly to calcium and potassium in the soil. In short, exchangeable cations are bound and released from the clay components of soils and from organic material. Cation exchange capacity (CEC) is important in both reducing soil nutrient leaching and in providing nutrients for plant growth.

What role does sulfate play?

As discussed in our publication on gypsum (Chalker-Scott and Guggenheim 2018), elemental sulfur (S) can acidify soils when it reacts with soil water to form sulfuric acid (H_2SO_4). The sulfate ion in Epsom salt, however, does not form sulfuric acid in the soil and has no effect on soil pH.

Sulfur has an important role in plant nutrition, as it is an essential component of proteins.

History of Epsom Salt Use in Agriculture

In the middle of the last century, agricultural researchers began to see "leaf blotch" in commercial orchards, where leaves would change color from green to yellow, or to red or even purple. They would then die and drop from the tree prematurely. Of course, this meant that fruit production was reduced, because there were fewer leaves to feed the developing fruits. Wallace (1939) and other researchers identified the problem as magnesium deficiency in the leaves, and for several decades magnesium sulfate was applied to the soil, leaves, and even injected into the branches to solve the problem.



Figure 2. Magnesium deficiency occurs first in oldest leaves. Photograph courtesy of Wikimedia.

There was no consistent success with this approach. The scientific literature is full of studies that contradict each other. Researchers warned of damage to plants from the overuse of magnesium sulfate (Boynton 1943; Boynton et al. 1943; Nagai et al. 1966). Unfortunately, because foliar sprays have a quick and obvious effect on leaf color, frequent applications of foliar magnesium sulfate became the popular way for tree fruit growers and others in production agriculture to temporarily alleviate the problem. This approach does nothing to alleviate the nutrient imbalances in the soil.

Interactions Between Epsom Salt and Other Fertilizers

Agricultural researchers have long known that misuse or overuse of fertilizer can induce plant nutrient deficiencies and they soon discovered that magnesium and calcium cations could interfere with one another both in the soil and in root uptake (Bir et al. 1988; Finér 1992; Fuksman et al. 1998). Likewise, excessive soil potassium may lead to magnesium deficiencies in plants (Boynton and Erickson 1954; Constable 1954; Drosdoff and Kenworthy 1944; Weber 1955; Williams et al. 1945).

We now know that many cations compete with each other for binding space on clay particles in the soil, and for uptake sites on roots. Too much of one

cation means other cations are lost from the soil and are less likely to be taken up by roots.

Benefits of Epsom Salt Amendment Documented Benefits

A plant suffering from magnesium deficiency cannot manufacture chlorophyll and leaves begin to lose their normal, green color. Under certain circumstances, magnesium might need to be added:

- Magnesium deficiency is most common on sandy, acidic soils (Heymann-Herschberg 1951; Wallace 1939).
- Many scientific articles have demonstrated improved growth and production of magnesium-deficient plants once a usable source of magnesium is supplied.

Unsubstantiated Benefits

Most of the purported benefits of Epsom salt, especially for home gardens, are not based on scientific evidence. Here are some of the Epsom Salt Council's unsubstantiated claims regarding Epsom salt use in home gardens and landscapes. These uses are not recommended.

- “Helps seeds germinate.” Non-dormant seeds only need water and oxygen to germinate. Magnesium sulfate will not increase germination time or success.
- “Makes plants grow bushier...produces more flowers...increases chlorophyll production.” All of these claims are missing the comparative treatment—what are treated plants being compared to? It's nearly impossible to have soils that are devoid of either magnesium or sulfate, especially in home gardens, and, in any case, there is zero evidence that treated plants have more leaves, flowers, or chlorophyll than those grown under normal conditions.
- “Produces more flowers.” Neither additional magnesium nor sulfate will increase flower production. Optimal temperatures and water availability are much more relevant to flower production.

- “Increases chlorophyll production.” Light availability plays a significant role in chlorophyll production. Magnesium provided at excessive levels does not.
- “Deters pests, such as slugs and voles.” This claim is absolutely without merit. In fact, the literature on magnesium sulfate use demonstrates that magnesium-deficient plants tend to be more resistant to pests than those with sufficient magnesium (Bravenboer 1965; Thompson 1942). In addition to false merit, there are legal issues here: there are no magnesium sulfate products registered as pesticides in Washington State.
- “Reduces the total amounts of fertilizers needed.” Since Epsom salt contains no nitrogen, potassium, phosphorus, or other essential nutrients, its use has no effect on the need for other nutrient sources.
- “Epsom Salt is not persistent so you can’t overuse it.” This is simply untrue. As outlined below, there are decades of research documenting the damage done to both plants and soil with overuse and misuse of magnesium sulfate.
- Excessive use of magnesium sulfate can cause plant deficiencies of boron (Hunter et al. 1986), iron and manganese (Finér 1992), potassium (Bull and Chapas 1956), and calcium (Azizi et al. 2011; Vafaie et al. 2013; Weber-Blaschke and Rehfuss 2002).
- Overuse of magnesium sulfate has been linked to reduced root colonization of beneficial microbes such as nitrogen-fixing bacteria (Mazher et al. 2006) and mycorrhizal fungi (Gharineh et al. 2009).
- Excessive amounts of soil magnesium can release aluminum from the soil, making this toxic metal available to plants and aquatic systems (Bigelow and Canham 2010; Weber-Blaschke and Rehfuss 2002).

Recommendations for Epsom Salt Use in Home Gardens and Landscapes

Among the diverse plant materials that have been studied under treatment with Epsom salt, there are two commonalities: all are intensively produced crops and all were suffering from magnesium deficiency. There are no scientific articles relevant to Epsom salt use in home gardens and landscapes. We do know, however, that urban soils—including those in home gardens and landscapes—are rarely deficient in magnesium. A soil test is absolutely required before using this chemical.

There are many online recipes for using Epsom salt as a fertilizer, to treat physiological problems, such as blossom end rot (Figure 3), and to prevent transplant shock; some of these are discussed elsewhere (Chalker-Scott 2007). None of these recipes are based on science, and their use could create soil nutrient imbalances and cause substantial injury to plants.

Drawbacks of Epsom Salt Amendment

Without a professional soil test, it is impossible to know the amount of available magnesium and other cations in the soil, the CEC, or pH. These are important variables in determining what effects an Epsom salt addition will have on plants or the environment. Excessive addition or misuse of Epsom salt can create an imbalance of soil minerals with unwanted results:

- Magnesium sulfate is a salt, and excessive levels can cause salt injury to plants (Abid et al. 2008; Ashutosh and Kukadia 2003; Kant et al. 2008; Ramoliya et al. 2004; Velichkova et al. 2011).
- Unnecessary applications of magnesium will not increase plant growth (Babu et al. 2007) and might even make growth worse (Ford 1968; Kolukunde et al. 2014).



Figure 3. Blossom end rot on tomato is not related to magnesium deficiency. Photograph courtesy of Cami Cannon, Utah State University.

Action Items for Gardeners

- Consult your local [Extension Master Gardener](#) group for help in identifying and managing garden pests.
- Collect soil samples for professional testing before ever applying Epsom salt (Cogger 2010; Fery and Murphy 2013). Be sure to ask for pH and nutrient levels (Figure 4).
- Use a coarse, woody mulch (Figure 5) to reduce compaction, improve aeration, conserve soil water, and provide nutrients naturally (Chalker-Scott 2015).
- If salinity levels are high in your soils, you should not use Epsom salt, as this will increase soil salinity.

- Do not add any fertilizer, including Epsom salt, to planting holes. If fertilizer is needed, it should be applied to the top of the soil after planting.

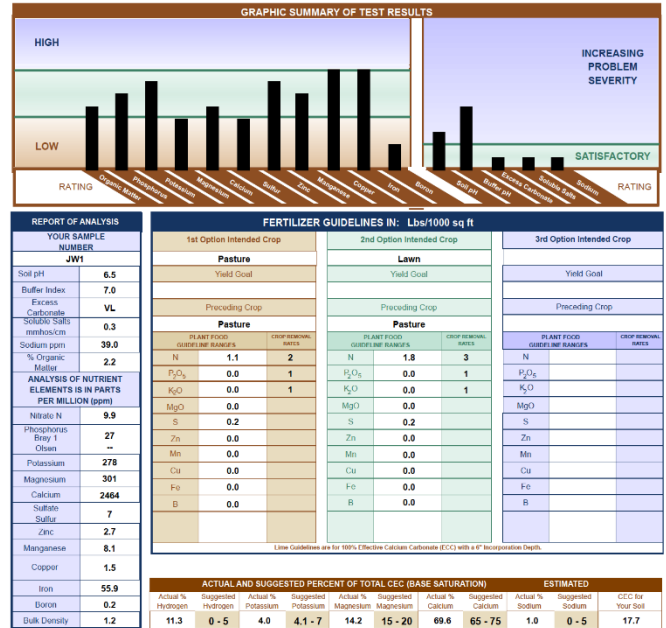


Figure 4. A soil test with pH and nutrient information. Image: Rich Guggenheim.



Figure 5. Arborist wood chips are an ideal mulch for soil improvement. Photo: Rich Guggenheim.

- Unless magnesium is deficient, don't add Epsom salt. If sulfur is needed, use ammonium sulfate instead.
- Maintain sufficient soil moisture levels during periods of active plant growth.

Adapted from Chalker-Scott, L. 2007. Epsom Salts. *MasterGardener Magazine* 1(2):17–19.

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