Nutri-Facts

IPNI

Agronomic fact sheets on crop nutrients

Selenium

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Selenium (Se) is not essential for plants, but is required for many physiological functions in humans and animals. Since Se is obtained primarily from food, it's accumulation by plants impacts human health.

Selenium in Plants

Selenium is not involved in any essential functions for plants and is not classified as an essential element for growth. However, it is essential in more than 20 human proteins, where it is involved in diverse roles such as cancer protection, anti-oxidants, maintaining defenses against infection, and regulating proper growth and development[1].

Selenium behaves very similarly to sulfur (S) and plants do not distinguish between these two elements. Selenium can be substituted for S in many plant proteins and enzymes. Plant species that have a high S requirement also have a tendency to accumulate larger amounts of Se. At very high Se concentrations, this substitution causes metabolic problems for plants. However, there are no reports of naturally occurring Se causing damage to agricultural plants in the field.

High Se-accumulating crops include those within the *Brassica* genus. Other high-Se foods include Brazil nuts, whole grains, and edible seeds.

A number of non-agricultural plants are able to accumulate Se to concentrations where it is toxic when consumed by livestock. Accumulator plants may accumulate up to 3,000 parts per million (ppm) Se, compared to less than 1 ppm in most food crops.

Selenium in Soils

Selenium is found in both organic and inorganic forms in soil (**Figure 1**). However, plants only utilize Se from the soil in the inorganic form. Soil organic matter is an important reserve of Se that will become available for plant uptake over time.

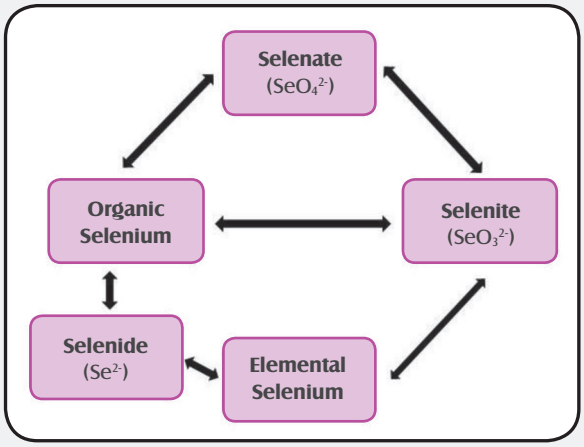

Figure 1. Selenium cycle in soil.

The inorganic forms of Se include:

Selenate (Se^{6+}): This form (SeO_4^{2-}) is most readily taken up by plants. It is very soluble and behaves quite similar to sulfate (SO_4^{2-}). Selenate is most likely to be found in well-aerated, neutral pH soils. Selenate is translocated directly from the roots to the leaves and stored in the cell chloroplasts before being converted to organic compounds such as selenomethionine. An abundance of SO_4^{2-} in the soil inhibits the uptake of SeO_4^{2-} since they both compete for uptake at the same transport sites of roots.

Selenite (Se^{4+}): This form (SeO_3^{2-}) is more typically found in aerated soils with acid to neutral pH. Selenite is much more reactive with various soil minerals than selenate, making it less soluble in the soil solution. When plants take up selenite, much of it is converted to organic compounds (such as selenomethionine) before being translocated in the xylem.

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High Se-accumulating crops include those within the Brassica genus. Other high-Se foods include Brazil nuts, whole grains, and edible seeds. A useful resource to determine the nutrient content of food (including selenium) can be found at http://ndb.nal.usda.gov/ndb/nutrients/index

Elemental Selenium (Se^{o}): Metallic, insoluble, and not available for plant uptake.

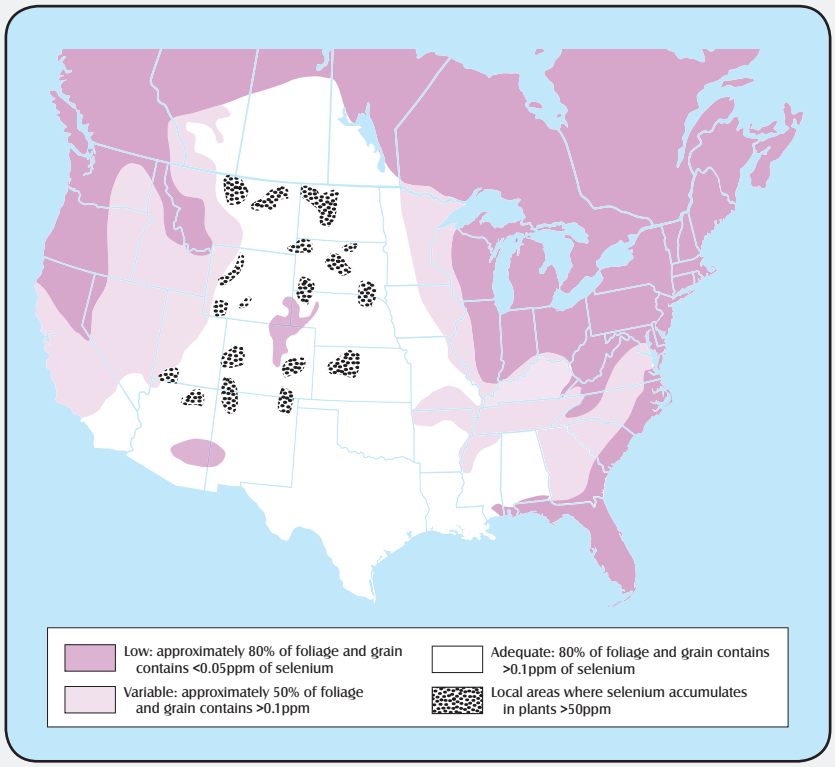
Selenide (Se^{2-}): This form is primarily found in flooded soils. It may be present in combination with a variety of minerals and organic compounds. It is mostly unavailable for plant uptake.

Fertilizing Soils with Selenium

Plants are never fertilized with Se to boost yields, but to supplement the Se concentration in the harvested or grazed crop[2]. Some soils support crops that contain Se at concentrations too low to meet human and animal nutritional requirements. This can only be determined through chemical analysis, since there are no plant Se deficiency symptoms. In these locations (such as in Finland and New Zealand), efforts have been made to increase plant Se concentrations through fertilization. Because of the high uptake of selenate and the risk of toxicity to humans from excessively high Se concentrations, many farmers prefer to use the less soluble selenite fertilizer where supplementation is needed.

Selenate fertilizer is the most readily available form of Se for plant uptake. Selenite is not as soluble in soil and less available for plant uptake. Selenate sources of fertilizer increase plant Se concentrations 20 to 50 times more than selenite sources. Elemental Se requires microbial oxidation before becoming available for plant uptake and is not used as a fertilizer source.

Soil properties influence plant uptake of Se from soil. Selenium uptake generally decreases with increasing amounts of clay, iron oxide and organic matter in the soil. To avoid soil factors that make Se supplementation difficult, foliar and seed applications of supplemental Se are successfully used to boost plant Se concentrations.



Selenium availability to plants varies across the US and Canada. Even if your area is considered low or adequate, pockets of high-selenium soils may exist.[3, 4]

References

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