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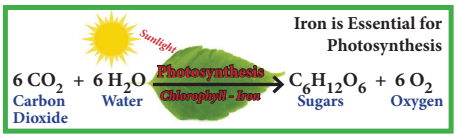
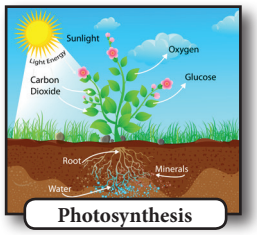


Iron Issues For Utah Soils



Plants need nutrients from the soil to make chlorophyll; the green pigment in leaves which fosters photosynthesis. Nitrogen, magnesium and iron are the main nutrients a plant needs to make chlorophyll. Plants obtain iron from the soil, through their roots. There is often plenty of iron in our soil; the beautiful red color in many soils is evidence of abundant iron. However, soil in Utah is generally alkaline. In alkaline soils, iron is often only available in forms that plants can't absorb.

When plants cannot absorb enough iron, they become 'Chlorotic'. "Chlorosis" means 'lack of chlorophyll'.

Iron chlorosis causes a leaf to become yellow, while the veins of the leaf remain green. The green veins are very narrow; they look like they were drawn with a pencil. The newest leaves on ends of branches are the most affected by this condition, although in severe cases, all the plant's leaves may be affected. In advanced stages, iron chlorosis causes plant tissue to die, which appears as brown, scorched areas of the leaf.

Magnesium chlorosis is very similar to iron chlorosis. The leaves turn yellow, while the veins remain green. However, the green veins are wide; they look like they were drawn with a crayon.

In either case, chlorosis has a very detrimental effect on the plant. While iron is absolutely necessary for plant survival, too much iron is toxic, deadly, and is often harder to correct than not enough available iron.

Iron - It *is essential for many plant functions.*

1. Chlorophyll development and function.
2. It plays a role in energy transfer within the plant.
3. It is a part of certain enzymes and proteins.
4. Iron functions in plant respiration, and plant metabolism.
5. It is involved in nitrogen fixation.

Iron chlorosis is a common ailment in Utah because our soil has a high pH. It is not that the soil lacks iron; it often has adequate quantities of this nutrient. The problem is that the iron is locked up in chemical compounds, in the soil, that makes it unavailable for some plants. Often, iron deficiencies can be seen, even when sufficient iron is available.

Some plants can tolerate a wider range of soil pH than others, and utilize the available iron. However, many plants that are sensitive to iron chlorosis are planted without regard to their adaptability to the existing soil conditions. Examples are Blueberries, Japanese Maples, many species of Acer rubrum (red maples), Silver Maples, and other acid loving plants.

In general, High soil pH reduces Iron availability, while acid soils increases Iron availability.

The iron deficiency in high pH soils can be made worse by too much phosphorous in the soil, too much clay, waterlogged soil, compacted soil conditions, or other poorly aerated soils.

Chelated Iron

There are forms of iron that are more readily available to plants than other forms. These types of iron are chelated. Chelates are organic molecules that envelop the iron, and protect it from interacting with other chemicals in the soil.

There are many chelating molecules available, but only three are commonly used in horticulture: EDTA, DTPA and EDDHA. The most common iron chelate in Utah is EDDHA,

Between a soil pH of 4.0 to 5.5, any form of iron will work (including iron sulfate) at supplying iron to the plant. However, as the soil pH increases, the type of iron applied should be changed. If iron is applied in a form that is not soluble, because of high soil pH, then most of the nutrient will not be available to plants until soil pH is lowered.

Iron-EDTA is not stable above pH 6.5 where nearly 50% of the iron is rendered unavailable for plant uptake. It is therefore ineffective in alkaline soils.

Iron-DTPA is stable in up to pH 7.0.

Iron-EDDHA is stable at levels as high as pH 11.0 and is the preferred choice for controlling iron deficiency in difficult soil conditions. This is the best type of iron chelate that should be used in Utah.

Research has shown that the ranking of iron forms from most effective, to least effective, at supplying iron in high soil pH is: Iron-EDDHA > Iron-DTPA > Iron-EDTA > Iron sulfate.

Correcting Iron Chlorosis

A. Acidify the soil. Altering soil pH, by making it more acidic, usually gives the best long-term results. Spreading elemental sulfur evenly on the soil surface, over the root zone can be effective. However, the application of too much sulfur can be detrimental to plant growth: be careful.

"If a little is good, a lot is better" does not apply in this case. Follow label recommendations. It is best to apply a little sulfur - often - rather than a lot of sulfur - all at once. Apply sulfur in the spring and fall for best results.

Avoid heavy applications of sulfur to poorly drained soils to prevent formation of toxic hydrogen sulfide.

Acidifying soil is much easier when you do it before you plant acid-loving plants, such as azalea and rhododendron. Remember, acidifying only the soil in the planting hole is not enough for most plants. Roots will grow far beyond the original hole. You need to make sure the entire root system has the targeted pH.

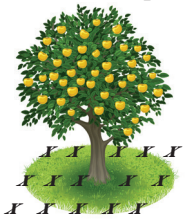
B. Apply additional iron. Another method to help correct chlorosis is to apply extra iron. Always use iron in the EDDHA chelated form in a soil that has a high pH. Several brands are available: Growmore EDDHA Iron; Miller's Ferri Plus Iron; and Sequestrene 138 iron.

Iron chlorosis: Dark green veins look like they are drawn with a Sharp Pencil.

Magnesium chlorosis: Dark green veins look like they are drawn with a Crayon.

Iron sulfate is of little value in our soil pH, except for short term results in shallow rooted plants. For example, Encap Iron and Ironite, work nicely in lawns or vegetable gardens, but they are not very effective for long-term help on shrubs or trees. Be careful broadcasting some types of iron on lawns; sweep the sidewalks and driveway before applying any water, or you will have little red dots all over the cement (Encap Iron is non-staining, so it is not as big of a concern as other brands of iron.)

1. Chelated iron can be placed in a series of holes punched in the ground four to six inches deep, throughout the root zone of the tree, but at least two feet from the tree trunk. One easy way is to push a shovel into the soil as far as possible. Push the shovel forward and drop 1 tablespoon of iron down the hole. Repeat the process every 1 to 3 feet throughout the entire dripline of the tree, and then water the tree thoroughly, to dissolve the iron.



You can apply iron to the soil of the root zone either dry, or in solution, any time during spring or summer. Follow label directions for the amount to use. Chlorotic foliage should start to turn green within a month, and the treatment may last several months, or even a few years.

Results, however, may be inconsistent depending on the actual soil pH, the type of soil, and the water content in the soil. Both clay soil, and soggy soil conditions, prevent all types of iron from being as effective.

2. Iron can also be applied directly to the plant in the form of a spray. This method is a short term fix, but it may be quick and beneficial, until the other methods can be implemented.

Sprays should be applied during cool periods of the mornings or evenings, not during the heat of a hot summer day. Spray once a week, for two or three weeks, for best results. Iron sprays can stain sidewalks, and other surfaces, so use them cautiously.

The greening of foliage should start to appear fairly quickly, but may only last a few weeks. You must spray all the leaves, on the entire tree, for best results. It may be difficult for homeowners to spray all the foliage on a very large tree.

3. Iron can be implanted directly in the tree trunk. Medicap implants, capsules containing iron citrate, are sometimes very helpful, especially in severely chlorotic trees. The normal green color may start to be restored in a few weeks, and may last a year or two. Although implanting iron does give short-term benefits, long-term results are not always possible because of the soil conditions, and tree roots can still remain a problem.

C. Watch The Water. Excessive irrigation, or poor drainage, magnifies iron chlorosis problems. Home gardeners need to carefully control the amount of water being applied to susceptible plants. Plants in low lying, or poorly drained areas, are especially susceptible to iron chlorosis because of saturated soil conditions.

When there is too much water (water-logging), the air is pushed out of the soil. Roots need oxygen to be able to absorb nutrients. If starved of oxygen too long, the root system dies. Therefore, it is critical to provide the right amount of water at all times.

This is especially important in the spring of the year, when cold temperatures also decrease the availability of iron to growing plants. As the soil dries, and the temperatures rise, microorganism activity increases, releasing natural iron that may be available to growing plants. Therefore, more iron is available because of increased root activity.

D. Choose The Right Plant Alkaline soil pH makes certain plants, that are valued in the East and West Coasts, such as flowering dogwood, rhododendron, blueberries, and pin oak, difficult to grow in our area. Adding sulfur to the soil may help to lower soil pH temporarily, but it is not always effective, in many cases, as a long term fix. Local water sources are usually alkaline. So, just by watering regularly, you may partially negate your attempts to reduce the soil pH.

If you don't want to worry about iron problems, choose plants that are more tolerant of high pH soil, and are less likely to be chlorotic. Example; if you want a large, fast growing tree, plant a sycamore tree, instead of a silver maple tree; instead of planting a pink rhododendron, plant a pink hydrangea.

E. Long-Term, Preventative Maintenance. If your plants have a history of chlorosis, you may need to develop a long-term, consistent, iron maintenance program; to help keep your plants healthy, and keep them looking the way you want. Plan ahead and do preventative measures, rather than waiting to try to cure a problem. 'Prevention Is The Best Cure.'

Pay special attention to problem areas, and to soil near buildings or masonry walls. The soil pH in these areas may be higher than the soil in other locations, because lime can leach from the concrete and mortar, into the soil.

Too Much Iron?

Iron toxicity is not common, but some plants do secrete acids from their roots, which lowers soil pH. These plants can then take up too much iron, leading to toxicity. The symptoms of iron toxicity include bronzing and stippling of leaves. The leaf discoloration is caused by the plant creating enzymes to control free radicals that are present in high levels of iron. (Free radicals are molecules with broken bonds, so they are highly reactive, and will react with anything that they come into contact with.)

Iron toxicity also can occur when too much chelated iron is added to soil. Chelates help increase nutrient uptake, and solubility of metal micronutrients. Use iron chelates carefully.

Some plants that are prone to iron toxicity include tomatoes, basil, phlox and impatiens.

More Resources:

http://forestry.usu.edu/htm/city-and-town/tree-care/preventing-and-treating-iron-chlorosis-in-trees-and-shrubs
https://www.cals.uidaho.edu/edcomm/pdf/CIS/CIS1042.pdf
http://www.soils.wisc.edu/extension/pubs/A3554.pdf
http://www.ars.usda.gov/sp2UserFiles/Place/36071000/Posters/Frantz180082_2006_HealthyPlant.pdf
http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/iron-chlorosis/