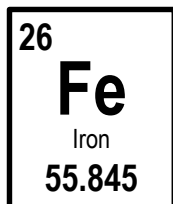




## Iron Fertility in Crop Production

### Function in Plants

- Iron (Fe) plays an important role in the production and movement of energy in the plant, involving the formation of chlorophyll, proteins, and enzymes needed during respiration.
- A 200 bu/acre corn crop takes up 2.5 lbs/acre of iron. A 75 bu/acre soybean crop takes up 1.7 lbs/acre of iron.



### Availability in Soil

- Iron is abundant in most soils, but most of it exists in forms unavailable for plant uptake.
- Iron exists in the soil solution as ferrous ( $Fe^{2+}$ ) and ferric ions ( $Fe^{3+}$ ).
  - Soybeans are only able to take in  $Fe^{2+}$  and must excrete acids from their roots to convert  $Fe^{3+}$  in the soil to  $Fe^{2+}$ .
  - Corn is able to take in both forms of Fe, and converts  $Fe^{3+}$  to  $Fe^{2+}$  inside of the plant.
- Soluble forms of iron are more abundant in acidic soils. At pH levels above 7.5, iron deficiencies are more common, particularly in poorly drained calcareous soils.

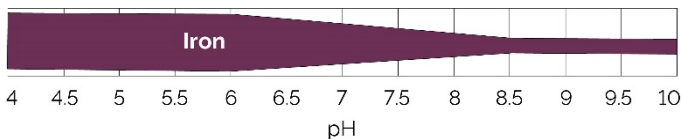


Figure 1. Relative availability of iron by soil pH.

### Factors Associated With Iron Deficiency

#### High pH Soils

- Iron deficiency chlorosis (IDC) is a complex plant disorder associated with high pH soils and soils containing soluble salts where chemical conditions reduce the availability of iron.
- High pH soils above 8.0 contain much more  $Fe^{3+}$  than  $Fe^{2+}$ . Soybeans will begin showing a deficiency before corn, as soybeans will be unable to take up  $Fe^{3+}$ .
- Soils with calcium carbonate and bicarbonate neutralize acids and make it hard for plants to convert Fe into a usable form.

#### Soil Temperature and Moisture

- Wet soils trap carbon dioxide, which turns into bicarbonate and raises the pH of the soil.
- Compaction and low soil temperatures contribute to iron chlorosis.

#### Other Nutrients

- High levels of sodium and excess salts restrict the uptake of iron in corn.
- As nitrate is taken into a soybean plant, the plant must release a bicarbonate molecule. This raises the pH of the surrounding soil which makes iron uptake difficult.



Figure 2. Green veins and light green/yellow tissue between veins indicates iron deficiency chlorosis in corn and soybeans.

### Symptoms

- Iron deficiency symptoms are similar across plant species and appear as yellowing and stunting of younger leaves. Because iron does not translocate in the plant, new growth is most affected.
- Deficiency symptoms in soybeans can appear a few weeks after emergence as interveinal chlorosis on the first trifoliate leaves.
- Leaves may turn yellow with dark green veins and the plants may be stunted. Under severe iron deficiency, leaf edges become necrotic (turn brown) and the necrosis may progress until entire leaves or even plants are dead.
- Corn leaves will have light green and yellow stripes between veins.
- The symptoms tend to show up in irregularly shaped spots randomly distributed across a field.
- Fe deficiency looks similar to a manganese and magnesium deficiencies. Manganese deficiency is not particularly common in corn and magnesium deficiency occurs on the oldest leaves of the plant rather than the newest.

### Managing Iron Deficiency

- Inorganic iron sources added to soil are rapidly converted to insoluble forms and provide little crop benefit.
- Organic chelate fertilizers such as Fe-EDDHA can benefit plants but are often cost-prohibitive.
- Several management practices can be used to address iron deficiency chlorosis, including variety selection, delayed planting, and avoidance of herbicides that slow growth or cause leaf area loss.

Authors: Samantha Reicks and Mark Jeschke November 2017

IPNI. 2014. Iron. Nutriacts No. 12. International Plant Nutrition Institute. Sawyer, J. 2012. Nutrient deficiencies and application injuries in field crops. IPM42. Iowa State Univ. Extension.

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