

IRON FACTSHEET

December 2003

IRON IN SOILS

Iron (Fe) is ranked fourth in abundance after oxygen, silicon and aluminium in the earth's crust. Of all the elements plants derive from the soil, iron is the most abundant, total iron concentrations often being around 2.5%. Yet, as far as plant nutrition is concerned, it is classified as a micronutrient, or trace element, as it is only required in small amounts. Any problem with iron supply to plants is therefore one of availability in the soil. Factors which affect the availability of iron as the ferrous iron [Fe^{2+} or Fe (II)], the form taken up by plant roots, include :-

pH - In common with copper, manganese and zinc, iron is less available in alkaline (high pH) soils, in which iron in ionic forms, e.g. Fe (II), is changed to less soluble or insoluble hydroxides or oxides. "Lime induced chlorosis" (iron deficiency) in plants is mainly attributed to the effect bicarbonate (HCO_3^-), which is found in higher concentrations in calcareous and recently limed soils, has within plants following its uptake from the soil. Bicarbonate immobilises iron in plants and prevent its translocation to young leaves.

Water – logging has a different effect in acid and alkaline soils. In acid soils, anaerobic bacteria reduce iron to Fe (II), which may result in iron toxicity, e.g. in paddy rice. This reduction process is depressed where the soil pH_w is above 7. In addition, bicarbonate can accumulate in alkaline soils when water - logged, particularly if the soil is poorly structured. Consequently, temporary iron deficiency may occur following irrigation on alkaline or calcareous soils, e.g. the heavy clay soils used for cotton production in northern NSW and Queensland.

Interactions with Other Elements - High concentrations of other cations, e.g. copper, manganese, zinc, calcium, magnesium and potassium may interfere with the uptake of iron due to competitive effects at the root surface. In particular, high manganese (often associated with low pH) may induce iron deficiency on acid soils, where this would not normally be expected, e.g. in pineapples.

IRON IN PLANTS

Iron uptake occurs at the root tips, so there is a restricted zone between the plant and the soil from which uptake can occur. Anything that affects the health of the root tips, e.g. calcium deficiency, can affect iron uptake, and result in iron deficiency.

Iron is essential for the formation of chlorophyll, the green pigment or colouring found in leaves. It is not readily mobile within plants, i.e. it is not easily moved from old to young tissue.

DEFICIENCY SYMPTOMS

Iron deficiency is most likely to occur in :-

- recently limed soils;
- alkaline soils where levels of plant available iron are low, particularly if water logged;
- acid soils (even though iron is most available at low pH) where excessively high levels of soluble manganese, zinc, or copper depress the uptake of iron by plants;
- sandy soils low in total iron;
- peat and muck soils where organic matter ties up iron;
- situations where normal root development is impaired, e.g. root damage from disease, insects or nematodes; calcium deficiency, and low soil temperatures;
- hydroponic crops, e.g. strawberries;



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- potted plants.

The most notable symptom of iron deficiency is chlorosis or yellowing between the veins of the youngest leaves, while older leaves remain green. This allows iron deficiency to be distinguished from magnesium deficiency, which is also characterised by a failure in chlorophyll production.

There is usually a sharp distinction between the yellow chlorotic tissue and the green veins (distinguishing iron deficiency from zinc and manganese deficiencies in which there is a gradual colour change from the green veins to the chlorotic interveinal tissue). In severe cases, the yellowing runs into the veins and the whole leaf turns yellow or even white.

TOXICITY SYMPTOMS

Toxicity is most likely to occur in acid water-logged soils. In rice, the first leaf symptoms are tiny brown spots which develop into a uniform brown colour, a condition known as “bronzing”.

IRON FERTILIZERS

The only solid iron fertilizer marketed by Incitec Pivot Limited is **Iron Granules**, an iron oxysulfate fertilizer containing 25 % iron, for dry application to the soil. This product is not fully soluble, and can not be applied in solution.

Iron sulfate and iron chelate can be used if iron is to be sprayed onto the soil or foliage. Chelates have wider compatibility with other fertilizers when applied in solution (dissolved in water), and are not fixed as quickly on application to the soil, but cost more.

APPLICATION

Foliar sprays are the preferred way to apply iron. As iron is immobile in plants, and does not move readily from old to young leaves, the effect of foliar sprays is short lived. In perennial crops, three or four repeat sprays may be required, commencing with the onset of the vegetative period. In annual field crops, foliar applications should commence when there is sufficient foliage to absorb the spray and be repeated at 2 to 3 week intervals.

Soil applications are generally not recommended, and may be ineffective, particularly if factors such as water-logging in alkaline soils, or high manganese in acid soils, are restricting uptake of iron from the soil or its translocation in plants. Iron applied to soils in which iron deficiency occurs in crops is likely to be fixed quickly, particularly on alkaline (high pH) soils.

FURTHER READING - An Agritopic on Iron is available if more detailed information is required.

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