Technology 8: Extent of micro- and secondary nutrient deficiencies in Indian soils and their correction

(i) Zinc

Survey of Indian soils revealed that about 49% of 2.52 lakh soil samples analyzed were found deficient in available Zn distributed over 20 states. Zinc deficiency is wide spread in all agro-ecological zones (AEZ). Soils of AEZ 6 and 10 had maximum Zn deficiency extended, up to 60 percent (Map 1). Whereas, soils of agro-eco zones 3, 4, 7, 8, 13, and 14 had 50-60 per cent Zn deficiency. The magnitude of Zn deficiency is declining in the states like Punjab, Haryana, Uttar Pradesh, Andhra Pradesh, Bihar and Madhya Pradesh.

Analysis of 90419 surface soil samples of Indo-Gangatic alluvial plains covering AEZ 4, 9,13, 16 indicated the extent of zinc deficiency was 55, 47, 36 per cent in Trans-northern, Central and Eastern parts of IGP alluvial plains while reverse trend was recorded for boron having 8, 37, 68 per cent deficient soils, respectively.

Iron deficiency was found to be the largest in AEZ-8 where about 36% of shallow black soils of Karnataka and alluvium derived soils of AEZ 9 and 13 were deficient. The Fe deficiency spread over 20-27% in soils of Haryana (AEZ 4), 14-17% in soils of AEZ 8; and 3-9% soils of AEZ 4 and 5. Iron chlorosis in groundnut and other crops is serious problem in calcareous soils of AEZ 2 of Saurashtra and Kutch.

Fig. 1 Extent of zinc deficient soils in diffrent agro-ecological zones of India

IPNS favours cost efficient amelioration of micronutrient deficiencies

FYM 8 t/ha without Zn

Zn 6 kg/ha without FYM

(ii) Manganese

Extent of Deficiency

Manganese (Mn) deficiency is not a common problem in Indian soils and crops except in some areas. Its deficiency is fast emerging in areas under oilseeds and pulses due to higher removal of manganese by these crops.

Visible symptoms of manganese deficiency in rice, soybean and other crops have been catalogued. The symptoms first appears on young foliage in the form of pale chlorotic leaves, chlorotic strips on leaves, poor branching and stunted growth.

Manganese deficiency in Indian soils ranges from traces to 22 percent with an over all average of 4%. Its deficiency is widespread in coarse textured alluvial, leached and deep black clayey soils. The deficiency of manganese is emerging fast in wheat in sandy soils of Punjab where the introduction of rice–wheat cropping system led to leaching of soluble manganese during rainy season and following wheat crop suffered more with acute manganese deficiency. Its deficiency is found more in alkaline, coarse textured soils having low organic matter content.

Technologies for correction of deficiency

Among sources, manganese sulphate is the common inorganic fertilizer that can be used for soil application or for foliar sprays. Teprosyn Mn containing 55% Mn as slurry was found useful for seed treatment.

Basal application of 40 kg Mn/ha through manganese sulphate controlled efficiently its deficiency in wheat, berseem, soybean, sorghum crops in Mn deficient soils. Two to 3 foliar sprays of 0.5-1.0% solution were found more efficient or equal to 40 kg Mn /ha. Thus, foliar sprays were better than soil application due to higher use efficiency and better economics.

Incorporation of a green manure every year before transplanting rice seedlings markedly reduces the occurrence of manganese deficiency in following crop. One foliar spray of manganese sulphate solution prior to first irrigation and second after first irrigation in wheat were found more beneficial.

Manganese deficiency symptoms on flag leaf o

Response of wheat to manganese

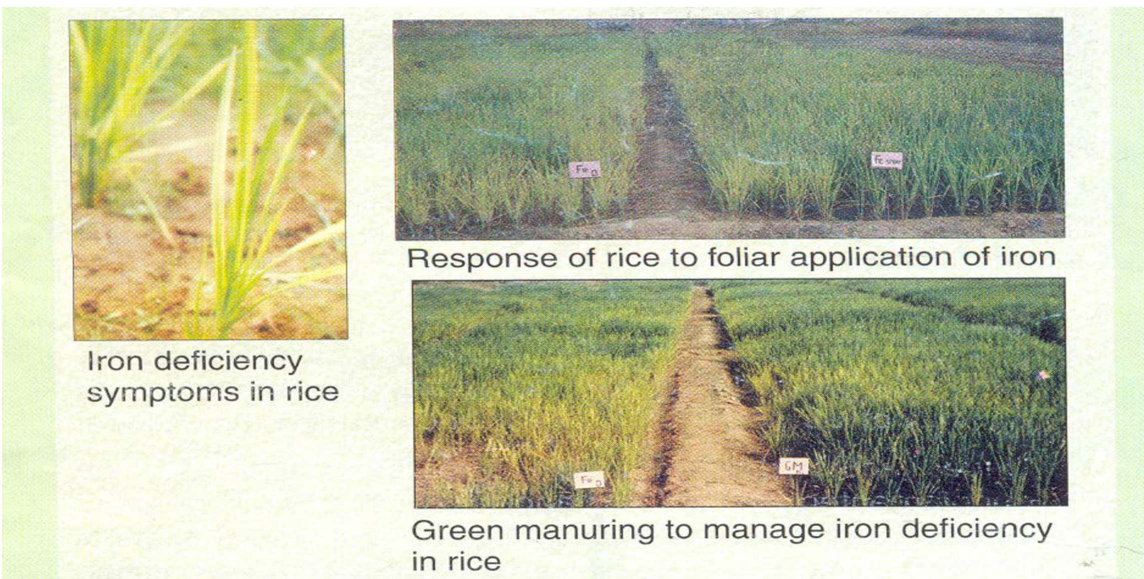
Manganese deficiency in wheat

(iii) Iron

Extent of deficiency

Iron is an important micronutrient element involved in the several metabolic and enzymatic activities in plants. It is essential for the synthesis of chlorophyll and oxidation-reduction activities in green plans. Iron deficiency is commonly observed in horticultural and vegetable crops like citrus, and field crops such as pulses, groundnut, rice nurseries etc**.**

Deficiency of iron is manifested as interveinal chlorosis of young new leaves. Soon after the veins also lose green colour and the whole leaf turns yellow. In case of acute deficiency, the affected leaves undergo bleaching and the newly emerging leaves also look bleached. Sometimes reddish lesions also develop in the bleached area.



Iron deficiency symptoms in rice

Response of rice to foliar application of iron

Green manuring to manage iron deficiency in rice

Iron deficiency was observed in several crops grown in alkaline soils with high pH, soils with high calcium carbonate, highly permeable coarse textured soils, and soils low in organic carbon content. The iron chlorosis was also frequently observed in soils irrigated with water containing bicarbonates. In Punjab, this problem results from the inability of the soil to pond water for a longer time because of high permeable nature of the coarse textured soil. Such soils are not necessarily be deficient in iron but the iron present in them is not converted into ferrous from (the form in which it is taken up by rice plants) because of the absence of reduced conditions within the root zone of the crop.

Technologies for correction of Fe deficiency

- Make small plots so as to ensure prolonged ponding of irrigation water in the soil.
- Spray the deficient crop with 1% solution of ferrous sulphate. For this purpose, dissolve 1 kg ferrous sulphate in 100 litre of water and carry out the sprays at weekly intervals. Though 3-4 sprays may suffice, yet the number of sprays can be increased depending upon the severity of the deficiency.
- Incorporation of a healthy 40-50-day-old green manure crop of sesbania *(dhaincha*) every year before transplanting rice seedlings markedly reduces the occurrence of iron deficiency.

Following precautions may be followed for higher use efficiency of iron fertilizer application.

- Do not apply ferrous sulphate to soil.
- Prepare ferrous sulphate solution just before carrying out spray.

(iv) Sulphur

Extent of deficiency

Sulphur (S) is involved in amino acid and protein synthesis, enzymatic and metabolic activities in plants. Its deficiency is fast emerging in areas under oilseeds and pulses due to higher removal of S by crops.

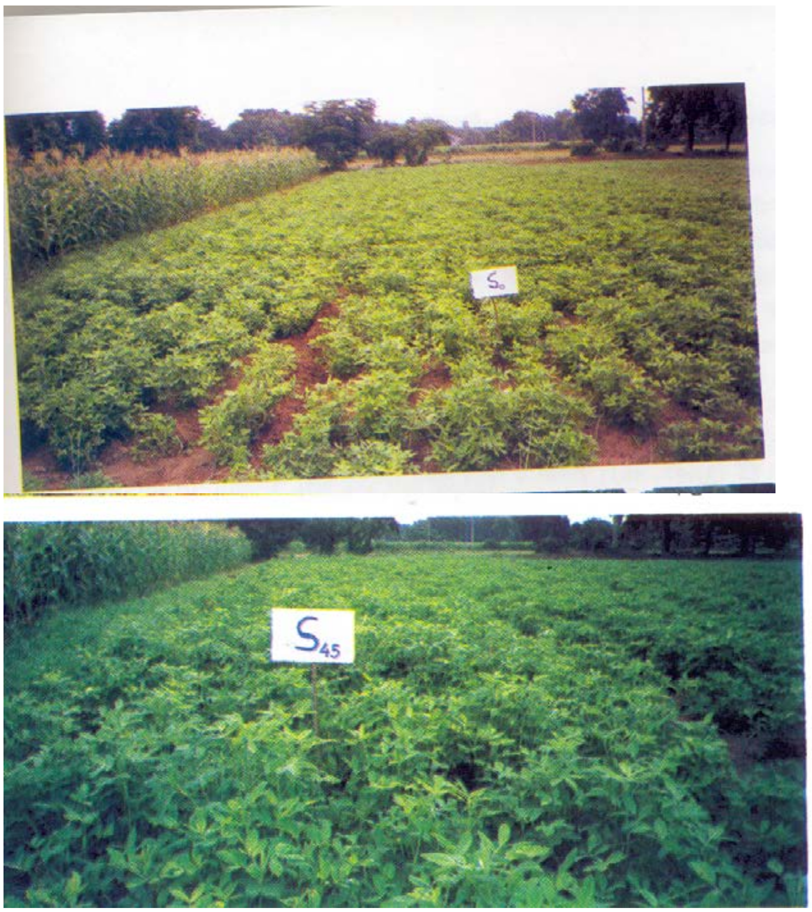
Visible symptoms of sulphur deficiency in most of the oilseed and pulse crops appear on young foliage in the form of pale chlorotic leaves, thin slender stem, stunted growth, poor branching, and busy appearance.

On an average, 41 per cent of Indian soils are deficient in S and it is widespread in coarse textured alluvial, red and lateritic, leached acidic and hill soils and black clayey soils. The deficiency of sulphur is emerging fast in areas where continuously sulphur free fertilizers like DAP, urea etc are being used. Sulphur deficiency is also found more in alkaline, coarse textured, low organic matter soils.

Technologies for correction of S deficiency

Among different sources, single super phosphate, gypsum, phospho- gypsum, pyrites, ammonium sulphate, bentonite S pastilles were found better for S fertilzation. Basal application of S was found beneficial but in oilseed its application can be made in at 25-3o days of crop growth. Pyrite should be applied in moist soil through surface broadcast. Application of 8-10 t /ha organic manure efficiently correct sulphur deficiency and gave equal yield as that of inorganic sources. Sulphur should be preferably applied to oilseed and pulses to achieve higher benefits in oilseed/pulse based cropping systems.

Among pulses, chickpea, field pea, pigeon pea require 40 kg S ha^{-1}, while lentil, green gram, black gram and cluster bean need 20 kg S ha^{-1} to produce optimum crop yields. Regular use of 40 kg S ha^{-1} to soybean, groundnut, mustard, gobi sarson, raya, safflower, castor, and 20 kg S ha^{-1} to sesame, linseed, niger was found optimum. Application of 20-40 kg S ha^{-1} gave economic seed response of 204 to 640 kg ha^{-1} in oilseed crops, and 176 to 592 kg ha^{-1} in pulse crops amounting to Rs.9/- to 82/- benefit for each rupee spent on sulphur.



Effect of sulphur application on groundnut crop under front line demonstrations