



Deficiency and Amelioration of Micro-Nutrients in Rice-Wheat Cropping System

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Among essential *micro* nutrients the deficiency of zinc, iron and manganese has been seen on different crops in Punjab. Deficiency of zinc is widespread and encountered under varying soils and crop situations, while the deficiency of iron and manganese is location and crop specific. Rice-wheat is the major cropping system in Punjab, and is very exhaustive in nature. Therefore, the *micro* nutrients deficiencies which affect these crops are discussed below.

Introduction

Plants require about 17 nutrients for normal growth and to complete their life cycle. They are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, boron, molybdenum, chlorine, zinc, copper, iron, manganese and nickel. Among them carbon, hydrogen and oxygen are absorbed by plants from air and water, while all other nutrients are absorbed by plants from soil. Nitrogen, phosphorus and potassium are required by plants in large amounts, therefore they are referred as *major* nutrients. Sulphur, calcium and magnesium are referred as *secondary* nutrients. The remaining (boron, molybdenum, chlorine, zinc, copper, iron and manganese) nutrients are referred as *micro* nutrients. They are *micro* in the sense that they are required by plants in very small amounts in comparison to *major* nutrients, but not in the sense of their minor importance in plant life. Although they are present in minute quantities in soil, but they are as important for plants as the *macro* nutrients are. Their deficiency in plants may leads to reduction in crop yields to greater extent.

Intensive cropping (cropping intensity 188%) coupled with the use high analysis *macro* nutrient fertilizers over the last few decades has resulted in the deficiency of several essential *micro* nutrients in Punjab soils. According to the recent reports about 25, 10, 3 and 2 per cent soils of the state are deficient in available zinc, iron, manganese and copper, respectively. Among these essential *micro* nutrients the deficiency of zinc, iron and manganese has been seen on different crops in Punjab. Deficiency of zinc is widespread and encountered under varying soils and crop situations, while the deficiency of iron and manganese is location and crop specific. Rice-wheat is the major cropping system in Punjab, and is very exhaustive in nature. Therefore, the *micro* nutrients deficiencies which affect these crops are discussed below.

Soils Prone To Micro Nutrient Deficiencies

Zinc: Zinc deficiency is generally encountered in fields with coarse textured soils, low organic matter, high pH, high calcium carbonate. Use of irrigation water containing high amounts of bicarbonates and excessive use of phosphatic fertilizers can also leads to zinc deficiency in soils. The soils of floodplain areas and recently leveled soils are also prone to zinc deficiency. Soils testing less than 0.6 kg zinc/kg soil are rated as zinc deficient soils.

Iron: Iron deficiency is common in soils with coarse texture, low organic matter, high pH, high calcium carbonate content. Soils testing less than 4.5 mg iron/ kg soil are rated as iron deficient soils. Iron deficiency is conspicuous in rice grown on sandy soils which are unable to pond water for longer period due to very high permeability.

Manganese: Manganese deficiency is common in soils with coarse texture, low organic matter, high pH. Sandy soils under rice-wheat cropping sequence for last 6-7 years show manganese deficiency. Owing to flooding conditions developed during rice season, a part of manganese gets leached to the lower soil layers. As a consequence of that, the content of available manganese in the surface layer of soil reaches a level that is inadequate to meet the manganese requirement of wheat crop following rice. Soils testing less than 3.5 mg manganese/kg soil are rated as manganese deficient soils.

Visual Deficiency Symptoms and Amelioration**Rice**

Zinc deficiency symptoms: Zinc deficiency in rice plants first appears on lower (old) leaves at about two-three weeks after transplanting the crop. Deficiency appears as light yellowish brown spots scattered in the interveinal areas imparting pale yellowish-brown color to the affected leaves. With the passage of time these spots enlarge, join together and become reddish brown or rusty in color. Under acute zinc deficient conditions, the plants give rusty look. The affected leaves finally dry up and fall or float on water. The growth of plants under deficient situations is reduced and they give bushy appearance. Tillers fail to develop panicles and results in reduction in grain yield. Under acute deficient conditions, earing and maturity are delayed.

Amelioration: Zinc deficiency can be corrected by applying 25 kg zinc sulphate heptahydrate (21% Zn) or 16 kg zinc sulphate monohydrate (33% Zn) per acre by broadcast method at the time of crop transplanting.

Iron deficiency symptoms: Iron deficiency symptoms are exhibited as interveinal chlorosis of the younger or newly emerging leaves. Soon after, the veins also lose green color and whole leaf turns yellow in color. Under acute iron deficient conditions, there is a bleaching of the affected leaves and the newly emerging leaves also look white or bleached.

Amelioration: Iron deficiency can be ameliorated by foliar application of 1.0% ferrous sulphate solution, 2-3 times at weekly interval.

Wheat

Manganese deficiency symptoms: In wheat deficiency of manganese may appear at two stages i.e. at initial growth stage just after the first irrigation to crop and later at ear emergence stage. Manganese deficiency symptoms during the early growth stage of wheat appears immediately after first irrigation to crop. Deficiency symptoms are

manifested as interveinal chlorosis on the middle leaves, with light grayish yellow to pinkish brown or buff colored specks of variable size confined largely to 2/3 lower portion of the leaf. With the passage of time, these spots enlarge and join together to form streaks or band in between the veins which remain green. In case of acute manganese deficiency, whole plant may become dry and crop gives a burning look. At head emergence stage, these symptoms appear prominently on the flag leaf. Wheat crop in such deficient situations also experience a great difficulty at the time of ear emergence. The emerged ears remained week and deformed.

Amelioration: Manganese deficiency can be corrected through foliar application of manganese sulphate solution. In manganese deficient soils, give one spray of 0.5% manganese sulphate solution (1.0 kg manganese sulphate in 200 liters of water) 2-4 days before first irrigation to the crop and three sprays thereafter, at weekly interval on sunny days. Do not apply manganese sulphate to soil as it is not profitable. Durum wheat varieties *viz.* PDW-274, PDW-291 and PDW-233 etc. are more prone to manganese deficiency; therefore these varieties should be avoided in deficient soils.

Zinc deficiency symptoms: The deficiency symptoms of zinc in wheat are observed at tillering stage on second/third leaf from the top of plant. Zinc deficiency is manifested as light yellowish white tissue between the mid-rib and margins in the middle or lower half of the affected leaf. Minute reddish brown spots are seen in the affected area. With the passage of time, these spots join together and form reddish-brown lesions leading to the necrosis and drooping of the leaf.

Amelioration: As soon as the deficiency symptoms appears on the wheat crop, top dress 25 kg zinc sulphate heptahydrate (21% Zn) per acre. Under severe deficient situations, soil application may be supplemented by foliar application of 0.5% solution of zinc sulphate. The solution can be prepared by dissolving 1.0 kg zinc sulphate and 0.5 kg un-slaked lime in 200 liters of water. This solution is sufficient for spraying an acre of wheat crop. Two-three such sprays at 15 days interval are needed.

Since rice is more susceptible to zinc deficiency, it is desirable to apply zinc sulphate to rice in rice-wheat cropping system. Zinc sulphate applied to rice may suffice for the subsequent 3-4 crops owing to its residual effect and as such its repeat application may not be needed to every crop/year provided the required dose has been applied. However, if zinc sulphate has not been applied to rice and deficiency appears on wheat, the recommended dose of zinc sulphate should be applied.

Since by the time the deficiency symptoms of a *micro* nutrient deficiency appear on the plant, the crop may have undergone considerable damage in respect of its ultimate yield. It is therefore, desirable to test soils for their available *micro* nutrient status before sowing/transplanting a crop in order to ensure timely corrective measures.