Zinc Nutrient Initiative

Zinc Fact Sheet: wheat

Introduction

Zinc deficiency is a critical constraint to wheat production. Soil zinc deficiency is the most commonly occurring micronutrient deficiency in cereal-cultivated soils, resulting in severe decreases in growth and grain yield.

Nearly 50% of the cultivated soils for wheat production globally are low in plant available zinc. Widespread zinc deficiency in soils causes great economic losses for farmers and significant decreases in nutritional quality of grain.

Wheat:

- most common crop worldwide
- grown on over 240 million hectares
- most important food crop for humans
- more than 50% of the daily calorie intake in most Asian countries
- sensitive to zinc deficiency

Soil Tests for Zinc Deficiency

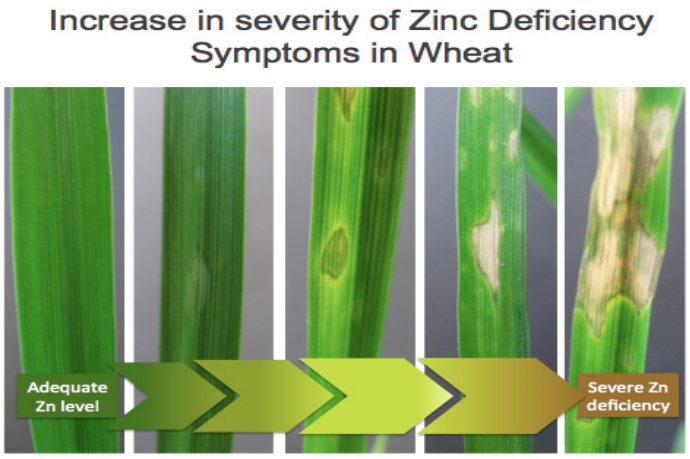
Measurement of DTPA-extractable zinc is the most widely used soil test method to determine zinc status of the soils. Generally, soils containing less than 0.5 ppm DTPA-extractable zinc are classified as potentially zinc-deficient. Increases in wheat grain yield (more than 20%) as a result of zinc fertilization have been obtained on soils containing less than 0.25 ppm DTPA-extractable zinc.

Various field tests conducted in India indicate that wheat grown on soils containing less than 0.6 ppm DTPA-extractable zinc respond positively to zinc fertilization at a rate of 5 kg Zn/ha (e.g., around 25 kg $ZnSO_4.7H_2O$/ha).

Plant Tests and Diagnosis of Zinc Deficiency

The most characteristic reactions of wheat plants to zinc deficiency are reductions in plant height and leaf size. These symptoms are followed by the development of whitish-brown necrotic spots on middle-aged leaves. As the severity of zinc deficiency intensifies, the necrotic spots spread on the leaves, and the middle parts of the leaves are often collapsed, showing a “scorched” appearance (see Figure 1). In most cases, the zinc concentration of such zinc-deficient leaves is below 10-12 ppm. In wheat, despite presence of some genotypic variation, the critical zinc concentrations of leaves or whole shoot at the vegetative growth stage are generally around 15-17 ppm. In zinc-deficient

locations, wheat grain zinc concentrations are found to be below 15-20 ppm. Among the wheat species, durum wheat is extremely sensitive to zinc deficiency and could be a good indicator for the existence of zinc deficiency in a region. Zinc deficiency symptoms on plants appear earlier and more severe under water-deficient soil conditions.



Correction of Zinc Deficiency

Zinc deficiency can be easily corrected by soil application of ZnSO4.7H2O or ZnO. ZnSO4 is the most commonly applied source of zinc to correct the zinc deficiency problem in crop plants. Due to its cheaper price, ZnO can also be used as an effective source for zinc fertilization. The rate of soil zinc application varies between 10 to 100 kg ZnSO4.7H20 per hectare. Foliar zinc application is also very effective in addressing zinc deficiency. However, in increasing grain yield, soil zinc applications are more effective than the foliar zinc applications. The commonly applied rates of foliar zinc application vary between 2.5 to 10 kg ZnSO4.7H20 per hectare. In the case of increases in grain zinc concentrations, foliar zinc applications are more effective than the soil zinc applications.

Examples of the Effects of Zinc Fertilizer on Wheat Crops

In field trials on four varieties of wheat grown under irrigated conditions in Turkey, the increases in yield by zinc fertilizers ranged from 29% to 355%, with an average increase in wheat yield of 58%. The average increase in value per hectare of the four wheat varieties was $477. If calculated at a 20% yield increase, which may be a more realistic long-term yield benefit of using zinc fertilizer, the farmer could expect to make an additional $123 per hectare (Phillips, 2006).

In 2011 and 2012, IZA conducted 8 field trials in China evaluating Zn fertilizer effect on wheat yield and grain Zn concentration. The results showed that application of 10 kg and 20 kg ZnSO4.H2O/ha increased wheat yields by 9.5% and 10.5%, respectively. Zinc fertilizer brought high economic returns to farmers with the average 22 to 1 for 10 kg ZnSO4.H2O/ha and 7.5 to 1 for 20 kg. Zinc fertilizer also increased Zn concentration in wheat grain by an average of 30%, increased grain nitrogen content (uptake) by 5 to 16 kg/ha, and increased nitrogen efficiency by 2.8 -8.8%.

Conclusion

Currently, increasing grain zinc concentration is an important global challenge in order to minimize zinc deficiency-related health problems for over a billion people. Since wheat is inherently very low in grain zinc concentration and growing wheat on zinc deficient soils reduces further grain zinc concentrations, application of soil and/or foliar zinc fertilizers to wheat is fundamentally important for both better crop production and better human health.

Zinc ...essential for life

The Zinc Nutrient Initiative was launched by The International Zinc Association (IZA) in response to the critical issue of zinc deficiency in soils, crops and humans. To learn more, visit: www.zinc.org/crops.