Journal Home: www.biospub.com

Popular Article

Article: RT1126

Biotica Research Today Vol 4:10 2022

717/719

How to cite this article?

Sainath *et al.*, 2022. Role of Zinc in Plants - Deficiency and Corrective Measures. Biotica Research Today 4(10):717-719.

Role of Zinc in Plants - Deficiency and Corrective Measures

N. Sainath*, S. Sridevi, A. Saritha, D. Swetha, E. Umarani and A. Sathish

Agricultural Research Station (PJTSAU), Tornala, Siddipet, Telangana (502 114), India

Open Access

Corresponding Author

N. Sainath

e-mail: sainathnagula134@gmail.com

Keywords

Corrective measures, Deficiency, Micronutrient, Zinc

Abstract

Zinc is the micronutrient involved in metabolism of auxins like tryptophan synthesis and has particular physiological functions in all living systems. Inadequate supply of zinc reduces crop production. Zinc has main role in enzyme activation, synthesis of proteins, and carbohydrate metabolism. Performance and quality of crop can be improved by utilizing fertilizer containing zinc and other micronutrients. Deficiency of zinc causes decline in plant photosynthesis and destroy RNA, amount of solution carbohydrates and synthesis of protein and thereby quality and performance of crop will be decreased.

Introduction

To improve the quality and quantity of plant products, a proper plant nutrition is required. Zinc is deficient in majority of the Indian soils and its content varies from less than 1 ppm to few ppm. Inadequate supply of zinc reduces crop production. There is biological and chemical interaction between zinc and other elements like iron, nitrogen in plants. Phosphorus and copper have an antagonistic impact on zinc (Yuvaraj and Subramanian, 2020).

Gene expression which is required for the tolerance of environmental stresses are regulated and maintained by zinc. So that it's deficiency causes abnormalities in plants such as stunted growth, chlorosis, spikelet sterility. Zn deficiency can also adversely affect the quality of plant products; plants susceptibility to injury by high light or temperature intensity and to infection by fungal diseases. Soil and foliar application of zinc fertilizer is recommended for correcting deficiencies. It prevents oxidative damage.

Functions of Zinc

• Plants absorb zinc as Zn^{2+}. Zinc sufficient plants contain 20 to 150 ppm Zn in mature tissue.

• Zinc is a major constituent of three enzymes they are alcoholic dehydrogenase, carbonic anhydrase, superoxide dismutase (SOD).

• Zinc is involved in the synthesis of indole acetic acid, metabolism of gibberellic acid and synthesis of RNA.

• Zinc plays an important role in the stabilization and structural orientation of the membrane proteins.

• Zinc influences transport and translocation of phosphorous in plants.

• Zinc is major constituent of carbohydrate metabolism.

Deficiency Symptoms of Zn in Plants

The content of zinc below 20 ppm is considered as deficiency. When the concentration is above 400 ppm is considered as toxic. Different plants exhibit different

Article History

Received on: 20th October 2022

Revised on: 24th October 2022

Accepted on: 25th October 2022

E-mail: *bioticapublications@gmail.com*

kinds of symptoms with the deficiency of zinc in their plant tissue a few are discussed below.

Khaira Disease in Rice

The first symptom of zinc deficiency appears in 3 to 4 week old seedlings when the young leaves develop reddish brown pigmentation. The pigmentation appears first in the middle of the leaves, then intensifies and spreads over the entire lamina. The affected tissue becomes papery and necrotic and under conditions of severe deficiency, the entire mass of leaves collapses and further growth of the plant is arrested (Figure 1). Soil application of Zn at 1.0 kg ha^{-1} as Zn-EDTA recorded highest rice grain yield of 5.42 t ha^{-1}, filled grain percentage of 90.2%, test weight of 25.41 g and number of panicles m^{-2} of 452 (Naik and Das, 2007).

White Bud of Maize

Soon after the emergence of seedlings, areas between the veins of old leaves become light yellow and develop white necrotic spots, which later develop dark brown necrotic areas that enlarge and coalesce, resulting in the necrosis (death of the entire leaf). Leaves that emerge and unroll subsequently appear yellow and white (Figure 2). Zinc concentration in soils, in leaves and total uptake by maize significantly increased with applied zinc (Tariq *et al*., 2002).

Mottle Leaf or Frenching of Citrus

Metabolically, Zn-deficiency induces many morphological, cytological and anatomical changes that lead to low flowering intensity and fruit set in addition to affecting the quality of citrus produced on sustained basis. Global occurrence of Zn-deficiency known by various names like rosette, little leaf, frenching, mottle leaf, *etc*., is basically characterized by interveinal chlorosis which may or may not be coupled with rosetting or smalling of leaves (Figure 3). Zinc deficiency is also suggested to appear due to competition from P, Fe, Mn, Ca and up to some extent K, besides a number of soil properties influencing the Zn-availability.

Fern Leaf of Potato

Deficiency results usually on alkaline soils or in the presence of excessive phosphorus. Symptoms include stunting, brown spots on stems and petioles, and leaf malformation. Young leaves roll up as with leaf roll virus and have a tip burn. The leaf roll is called “fern leaf” and is upward and cupping; leaves are also thick, brittle and puckered (Figure 4). Older leaves have gray-brown areas and bronzing along margins.

Corrective Measures

Three are three different compounds of zinc fertilizers and the zinc content vary in these. These sources of zinc include:

• Inorganic compounds like zinc oxide (ZnO - 36%), zinc

Figure 1: Khaira disease in rice

Figure 2: White bud of maize

Figure 3: Mottle leaf or frenching of citrus

Figure 4: Fern leaf of potato

carbonate ($ZnCO_3$ - 50-56%), Zinc sulphate monohydrate ($ZnSO_4.H_2O$ - 36%), zinc sulphate ($ZnSO_4.7H_2O$ - 22%) and zinc nitrate [$Zn(NO_3)_2$ - 23%].

• Synthetic chelates, Disodium EDTA (8-14%), Sodium zinc EDTA (9-13%), Sodium zinc HEDTA (6-10%) *etc*.

• Natural organic complexes such as lignosulphonates, phenols and polyflavonoids.

Method and Dose of Application

• In rice after final puddling and before transplanting zinc sulphate @ 50 kg ha^{-1} can be broadcasted and incase of irrigated dry crops at the time of land preparation.

• In case of alkali soils, the dose of zinc sulphate for soil applicationneeds to be doubled to 100 kg ha^{-1}.

• Zinc is also available as zinc chelate (mostly Zn-EDTA form). In case of highly alkaline soils (pH > 8.0) than zinc sulphate the zinc chelate is better source.

• In calcareous soils, Zn-HEDTA (Hydroxy Ethylene Diamine Tetra Acetic acid) form is efficient for soil application.

• To correct the deficiency on a standing crop foliar application of zinc sulphate @ 2 g $litre^{-1}$ of water twice should be adopted at 5 days interval.

Conclusion

Zinc is an important micronutrient element to increase crop yield. Wide spread deficiency of zinc throughout the world is arising as a big threat to crop production. Zinc deficiency causes several physiological disorders and ultimately decrease in yield in major field crops. So the judicious application of zinc by zinc containing fertilizers, increases economic yield.

References

Naik, S.K., Das, D.K., 2007. Effect of split application of zinc on yield of rice (*Oryza sativa* L.) in an inceptisol. *Archives of Agronomy and Soil Science* 53(3), 305-313.

Tariq, M., Khan, M.A., Perveen, S., 2002. Response of maize to applied soil zinc. *Asian Journal of Plant Sciences* 39(1), 245-247.

Yuvaraj, M., Subramanian, K.S., 2020. Significance of zinc in plant nutrition. *Biotica Research Today* 2(8), 823-825.