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## Zinc Deficiency and Its Corrective Measures in Fruit Crops

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### Abstract

Zinc is essential for human health and it is necessary for the immune system. Zinc sufficient plants contain 25 to 150 ppm of Zn in mature tissue. Zinc (Zn) deficiency is widespread throughout the world causing economic losses on fruit crops. It commonly affects banana, custard apple and mangoes. Problems often appear in spring when crops are growing quickly but have difficulty in absorbing nutrients from cold soil. Zinc is required for the synthesis of tryptophan a precursor of auxin thus helps in reducing fruit drop. Plants absorb zinc as Zn<sup>2+</sup>. Zinc deficiency leads to fruit loss of 25 percent to no yield. To correct zinc deficiency, zinc has to be applied by soil application as enriched manures, through drip fertigation as water-soluble fertilizers and foliar application when there is deficiency symptom occurs or whenever necessary to achieve the maximum benefit.

### Introduction

Zinc is an essential element whose significance to health is increasingly appreciated. In 1961 essentiality of zinc for humans was recognized. Ensuring adequate levels of zinc intake should be a key component in efforts to reduce illness (Dheshpande *et al.*, 2012). It ensured that plants have to be supplied sufficient zinc to avoid poor zinc concentration in food stuff which will ultimately reflect in human health. Zinc is the precursor of auxin thus helps in reducing fruit drop. Plants absorb zinc as Zn<sup>2+</sup> but many times zinc found to be unavailable due to unfavourable soil properties. Zinc deficiency symptoms appear mostly in limed soils or soils with high pH and sandy in texture. Despite the fact that much information was generated during the last 20 years on Zn soil chemistry and its inorganic phase equilibrium, the mechanism controlling the amount of free Zn<sup>2+</sup> present in the soil solution is not yet completely understood (Swietlik, 2001).

### Role of Zn in Plants

- Zinc is a constituent of three enzymes *viz.*, Alcoholic dehydrogenase, carbonic anhydrase and superoxide dismutase.
- Zn is required in the synthesis of tryptophan, which in turn is necessary for the formation of growth hormones like Auxin (IAA) in plants.
- Zn is involved in the metabolism of gibberellic acid and synthesis of RNA.
- Because of preferential binding to sulfhydryl group, zinc plays an important role in the stabilization and structural orientation of the membrane proteins.
- Zn plays an important role in starch formation.

- Zn influences translocation and transport of P in plants. Under Zn deficiency, excessive translocation of P occurs resulting in P toxicity.

### Deficiency Symptoms

- Zn deficiency symptoms show wide variation in different plant species. The common symptoms are chlorosis between the veins, reduction in the size of the young leaves, which are often clustered, bronzing, purple, violet, reddish brown or brown coloration of the foliage.
- Shortening of the stem or internode-bushy, rosette appearance of leaves. Small, narrow, thickened leaves-malformed leaves and sickle shaped leaves.
- White discoloration near the midrib at the base of leaves.
- Reduced flowering and delayed maturity.

### Specific Symptoms in Fruit Crops

- **Mottle leaf or Frenching of citrus:** The young emerging leaves remain smaller, chlorotic and shoots die back.
- **Little leaf of mango:** Reduced leaf size and shortening of internodes in mango.
- **Rosette in Fruit trees:** Zinc deficiency of apple, commonly called ‘rosette’, is characterized by a dense cluster of small narrow leaves that terminate a branch which is usually leafless.

### Zinc Toxicity Symptoms

**T**oxicity will appear when Zn leaf concentration exceeds 400 ppm. High soil zinc levels may occur on extremely acid soils (pH < 5.0) or in areas where municipal sewage sludge or industrial waste containing high levels of zinc as been applied as a soil amendment to cropland.

- Older leaf appears dull.
- Root elongation may be decreased.
- Peanuts may be stunted with split stalks.

Crops vary in the zinc level they can tolerate. Dry edible beans are a zinc- sensitive crop and can tolerate only zinc levels below 40-50 ppm in leaf tissue.

The yield loss in fruit crops due to zinc deficiency:

- Mild Deficiency: Fruit loss upto 25%
- Moderate Deficiency: Fruit loss of 40-50%
- Severe Deficiency: No fruits are obtained

### Mango

**T**he leaves become smaller and numerous pointed leaves leading to an abnormal growth called resetting. Yellow necrotic patches develop on older leaves with drying

of leaves. Zn deficiency also causes mango flower cluster and fruit malformation. In acute conditions the branches start drying from the top.



Figure 1: Zinc deficiency in mango

### Banana

**N**arrow pointed and chlorotic young leaves, bunch top crowns are the symptoms of zinc deficiency. These symptoms start on younger leaves of the banana plants. In severe deficiency, the fruit development is slow and the fingers are twisted, shorter, thinner and lighter green in colour than those of normal plants.



Figure 2: Zinc deficiency in banana

### Guava

**Z**inc deficiency results in significant reduction in the size of leaves with interveinal chlorosis. In acute deficiency, the branches start drying from the top, resulting in poor growth which leads to reduction in flowering and fruiting. Deficiency in fruits normally with spots and cracks.



### Citrus

Zinc deficiency is common in citrus orchards but less understood. Mostly due to the poor supply of Zn by soils. Appearance of small specks of yellow between the veins of the leaves are common and in severe case entire leaf become yellow. The leaves also become very small and narrow, with pointed tips and the twigs may start dying back. The fruits on severely deficient trees generally have a smooth, light coloured thin rind.



Figure 3: Zinc deficiency in citrus

### Grapes

In grapes, growth of the vine is checked causing yellowing, drying and dropping of leaves mostly during summer, when secondary growth starts. First leaves show a light green, mosaic-like chlorosis in the interveinal areas. Later interveinal fields turn pale. A dark green border remains along the veins. Upper leaves exhibit these symptoms earlier than those are other parts. With severe zinc deficiency, the bunches of grapes are small. Only a few berries set. Most of them are small and seedless.



Figure 4: Zinc deficiency in grapes

### Papaya

Zinc deficiency results in poor growth and leaf blade size is reduced. Interveinal areas of young and middle leaves are chlorotic later become purple spots. Low zinc levels also reduces flower formation, fruit number per tree and to a lesser extent the fruit size, resulting in decreased yields.



Figure 5: Zinc deficiency in papaya

### Pineapple

Young leaves are usually the most affected and are small, narrow, chlorotic and often rosette due to failure of the shoot to elongate. Bloom spikes are small, deformed and drooping. In young pine apple plants, zinc deficiency is indicated by the young heart leaves bunching together and then tilting horizontally. This condition is commonly called crook neck in pine apple.



Figure 6: Zinc deficiency in pineapple

### Corrective Measures of Zinc Deficiency in Fruit Crops

Metal ammonium complexes such as ammoniated Zn Sulphate decompose easily in soil and increase the agronomic effectiveness. Application of organic manures along with micronutrient fertilizers will act as natural chelates and increases the use efficiency of the crops.

#### Soil Application

Table 1: Quantity of Zinc sulphate recommended for soil application

Fruit crop	Quantity of Zinc Sulphate recommended per hectare
Banana	25 kg ZnSO <sub>4</sub>
Grapes	25 kg ZnSO <sub>4</sub>

Table 2: Recommended dose of foliar spray for fruit crops

Fruit crop	Concentration (%)	Stage of the crops
Mango	1.0	One at the time of flowering and the other at one month after the first spray.
Banana	0.5	Foliar spray at 3 <sup>rd</sup> , 5 <sup>th</sup> and 7 <sup>th</sup> month after planting to increase yield and quality of banana.
Guava	0.5	Foliar spray at twice a year during March and October.
Citrus	0.125	Foliar spray, 3 to 4 times in a year mainly during April, July & September.
Grapes	0.2	Foliar spray twice before flowering and 10 days after first spray.
Papaya	0.5	Foliar spray during 4 <sup>th</sup> and 8 <sup>th</sup> month after planting to improve growth and yield.
Pine apple	0.5-1.0	Foliar spray at 15 days interval to overcome the deficiencies in the early crop phase.

### Foliar Application

Foliar application can be used as a supplement to soil application especially during the critical growth stages of the crop.

### Conclusion

Zinc is essential for human health. Maintenance of soil fertility is essential to produce zinc rich food. Plants require the zinc in smaller quantity but it is highly essential for synthesis of tryptophan and it is a precursor of auxin which is essential for terminal bud. Timely supply of zinc to the crops may avoid the yield loss, maintain the quality of fruit and can avoid zinc malnutrition in human beings.

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