

Zinc deficiency in apples

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Zinc is a trace element that is required by plants for healthy growth. Trace elements such as zinc are only needed in small quantities from the soil, but when they are in short supply, serious problems can occur.

Role of zinc

Zinc is important in the formation of the growth hormone auxin. Auxin is produced by shoot tips, and controls cell division, leaf and shoot growth and fruit development.

Zinc is also needed by leaf cells to form the green leaf pigment chlorophyll. Chlorophyll is needed for leaves to make sugars (photosynthesis).

Cause

Zinc deficiency is now a common problem in most commercial orchard districts in NSW, on all soil types.

Traditionally, zinc deficiency is most common on alkaline (high pH) soils that contain high natural levels of calcium carbonate.

However, it is also a problem in soils with high levels of iron, and those with high levels of phosphorus. Most apple orchards planted on acidic (low pH), red coloured, volcanic and granite based soils are naturally high in iron.

Symptoms

Symptoms are most dramatic in spring. Shoot growth is delayed, and affected leaves are short and abnormally narrow. Leaves at the top of affected shoots appear tufted or in a rosette formation, with smaller (sometimes chlorotic) leaves below. This symptom is often referred to as 'little leaf'.

The abnormal leaf growth can easily be confused with herbicide damage. In affected blocks, leaf

growth often looks sparse when compared with healthy trees nearby, and it is easy to see through the canopy to nearby rows.

If the deficiency is not corrected, blind patches of wood may develop, dieback and fungal attack can become a problem on weak branches, and further growth will be restricted.

As zinc deficiency affects the formation of chlorophyll, yellowing (chlorosis) of the leaves can also occur, although this is not always seen in apples. When present, the space between the leaf veins becomes mottled green (figure 1). Leaves with low amounts of chlorophyll produce less of the plant sugars needed for growth and fruit development.

Severely affected trees develop small, misshapen fruits of poor quality. This is due to poor cell division early in fruit development, and fruits not getting enough sugars from photosynthesis during the growth period.

Prevention

Regular testing of soil and leaf nutrient levels will help to identify deficiencies that are likely to occur in the future.



Figure 1. Leaf chlorosis – normal leaf (left), leaf with chlorosis (centre) and leaf with chlorosis and deformed growth (right).

Leaf tests are usually carried out mid-summer, and give a snapshot of the tree's nutritional status at that point in time. If testing indicates a low zinc level, this should be corrected before the next season, as more zinc will be removed from the trees with the harvested crop. Most orchardists consider the monitoring of zinc levels to be an important component of their nutrition program.

The use of zinc-based fungicides such as Zineb and Ziram will cause high leaf-test results, and should be avoided early in the season if leaf testing for zinc levels is planned. Although significant in leaf tests, such products do not add enough zinc to the tree to correct a deficiency, and problems may go undetected until leaf symptoms are displayed.

Zinc levels are reported in either milligrams per kilogram (mg/kg) or parts per million.

Table 1: Leaf analysis standard for zinc in apples (mg/kg) From Weir and Cresswell (1993)

| Deficient | Low | Normal | High | Excessive |
|--------------|---------|---------|---------|---------------|
| Less than 10 | 10 - 15 | 16 - 50 | 51- 100 | More than 100 |

Correcting zinc deficiency

Where zinc deficiency has been diagnosed through tests and/or visible symptoms, either (not both) of the following forms of zinc can be applied according to label directions.

Zinc sulfate (heptahydrate)

Apply to the soil when plants are fully dormant, before pruning. This form of zinc will damage fruit and leaves if applied to foliage, or applied before the tree is fully dormant (figure 2).

Chelated or complexed zinc

Apply to foliage soon after harvest, before leaves start to fall or at green tip. Chelates are usually applied as a foliar spray for a rapid response, but can also be applied to the soil.

If symptoms are discovered during spring, zinc chelates may be applied to correct the problem.

Although developed to be applied to leaves, foliar fertilisers can cause fruit russet, especially in susceptible varieties such as Fuji and Granny Smith.

Any new foliar fertiliser should first be tested on a small number of trees and monitored for undesirable effects before widespread use in the orchard. Do not apply more than the recommended rate of trace element fertilisers – damage may occur.



Figure 2. Fruit damage from an incorrectly applied zinc sulfate spray.

Further reading

Weir, RG & Cresswell, GC 1993, *Plant nutrient disorders 1: temperate and subtropical fruit and nut crops*, NSW Agriculture, Inkata Press.

Acknowledgements

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