



HOW TO CORRECT ZINC DEFICIENCIES ZINC IN CACAO (*Theobroma Cacao* L.)

Description of symptoms:

Zinc deficiency of cacao produces symptoms in both the leaves and the bean pods.

Leaves develop in a deformed rosette shape, with chlorosis of the interveinal areas, which are coloured pale green or yellowish. The leaves are smaller than normal, and often fall prematurely.

Trees with zinc deficiency show delayed maturity, with few leaves and branches, which together with the abnormal development of small pods and flat beans results in low yields.

If the zinc deficiency is acute, the yield may be almost nil. Should multiple nutrient deficiencies occur, diagnosis through symptoms can be confirmed by soil and plant tissue analysis.

Moreover, certain diseases of cacao such as VSD (vascular streak die-back) have symptoms similar to those of zinc deficiency. Branches should be split and checked for a "brown streak" to see whether the problem is zinc deficiency or VSD.

Climatic conditions likely to produce zinc deficiency:

Zinc uptake and availability for plants is considered normal between temperatures of 15° C and 40° C.

Zinc deficiency because of reduced plant uptake may occur if temperatures are lower than 15° C, with very limited uptake at temperatures below 5° C. Hence, zinc deficiencies are common during cool periods or wet seasons.

Soil conditions likely to produce zinc deficiency:

Zinc in soil exists in a number of different forms as part of the mineral structure, as a salt: as soluble and insoluble organic complexes etc. Nevertheless zinc deficiency can be induced by soil pH conditions (lower than pH 4.5 and higher than 7.5). Zinc deficiency is found both in soils with a very high organic matter content (peat and muck soils) and soils with low level of organic matter.

Zinc deficiency is also common in sandy soils, soils with very high native phosphate or excessively fertilised with phosphate fertilisers, and in poorly drained soils.

Diagnosis by soil analysis:

The total level of zinc in soils ranges from less than 10 to 200 mg/kg.

However, the following guide could serve as a reference for DPTA-extractable zinc. A level of less than 0.2 mg/kg zinc is very low, and cacao crops are almost certainly deficient. A level of 0.2-0.5 mg/kg zinc is low, and crops are likely to be deficient; 0.2-0.5 mg/kg zinc is moderate, and crops may be slightly deficient; 0.6-2 mg/kg is high, and crops have a very adequate supply of zinc. More than 2 mg/kg zinc is excessive, and crops may suffer from zinc toxicity !

Diagnosis by plant analysis:

Plant tissue analysis should be of samples taken from the second or third leaf (from the apical shoot) of the recently mature flush. Normally, levels of zinc in cacao leaves are 80-170 mg/kg. Levels of 20-30 mg/kg are mildly deficient, and less than 15 mg/kg is severely deficient.

Several factors should be considered in the interpretation of results. Younger leaves contain higher levels of zinc than older ones. Furthermore, the zinc concentration decreases with the age of the tree.

Interaction with other elements:

High levels of phosphorus (soil or fertiliser application) reduce the levels of zinc in the leaves.

Likewise, excessive levels of calcium, iron and manganese tend to depress the leaf zinc concentration.

Excessive aluminium is likely to have an antagonistic effect on zinc in highly acidic soils.



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HOW TO CORRECT ZINC DEFICIENCY?

For seedlings, young trees and mature trees, a foliar spray of **1% zinc sulphate** (ZnSO_4) (23% Zn) or **zinc oxide** (ZnO) is applied repeatedly until the deficiency is corrected.

For larger areas, it may be easier to broadcast zinc fertiliser (10-20 kg/ha zinc sulphate) and incorporate it into the soil. Fertiliser zinc should be mixed with the topsoil to reach the feeding roots, as it is not transferred far from the point of application.

Zinc chelates (see our **SICOHEL/CHELASTAR/ATTACK/PROCHEL/LIQUISTAR** ranges) applied in a band are an alternative method of Zn deficiency correction. They include $\text{Na}_2\text{Zn-EDTA}$ (synthetic), applied at a rate of 0.5-1 kg/ha and zinc lignopolycarboxylic acid (natural), applied at a rate of 0.5-4 kg/ha.

We recommend the use of our "**Attack DF High Zinc**" Chelated Micronutrient Mix containing:

Zn*:	8%	Fe:	5%
Cu:	1%	Mn:	4%
B:	1.5%	MgO:	3%
Mo:	0.05%		

Some organic fertilisers such as NATURACTIV/SICORGAN chicken manure NPK 4.3.3 + 1MgO + TE contain 200-1500 mg/kg of zinc. Applications of chicken manure thus not only improve the humus content and physical and biological conditions of the soil, but enrich the level of zinc.

According to experience in the field (Mindanao, Philippines), mature cacao trees exhibiting low levels of leaf zinc (less than 50 mg/kg, dry matter) recovered with the application of 25 g tree of zinc sulphate (SICO- ZINC 33% or 35% Zn, granular).

The production of normal cacao pods and beans was sustained. In fact, the application of zinc sulphate seemed to reduce the number of trees affected with VSD, as well as the number of trees with "VSD-like symptoms" which were in fact zinc-deficient.