Zinc Deficiency of Tomatoes

corrective applications of zinc-supplying chemicals to soil tested in trials with transplanted and direct-seeded plants

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Canning tomatoes suffering from zinc deficiency were observed during the 1956 growing season near Linden, San Joaquin County, and in southern Sacramento County in addition to the known zinc deficient areas near Clarksburg in Yolo County. Apparently the disorder has a wider geographical distribution than was supposed.

Previous research in California indicated that the disorder in tomatoes grown in zinc deficient soils in the greenhouse was quite similar to little leaf of deciduous fruit trees. However, field observations of tomatoes growing on soils known to be deficient indicated no little leaf symptoms but the zinc deficiency symptoms found were quite different.

The first sign of zinc deficiency in direct-seeded tomatoes is an acute stunting of the seedling, which may reach a height of only 2″ after two months of growth. Accompanying this stunting is a gross thickening of the leaves and a development of a marked yellowing around the margins and between the veins of the leaves. Usually in areas of severe deficiency these plants fail to survive after the onset of the hot weather of June and July. Under less severe conditions the plants may begin to grow normally late in season.

When tomatoes are transplanted into zinc deficient soils, the development of symptoms is usually delayed for about three weeks. This is probably due to the supply of zinc in the plant obtained from the seedbed. Again, the first symptom observed is an acute stunting of the plant accompanied by an extreme reflexing or bending back of the petioles and leaves of the plant. As in the case of direct-seeded tomatoes, the leaves become very much thickened and brittle. The new leaves take on a decidedly dusty appearance. As the deficiency develops, the older leaves begin to have an orange or bronze color frequently accompanied by the appearance of small necrotic spots along the leaf margins.

A zinc deficient tomato plant. Note extreme backward curling of the leaves.

In an attempt to correct zinc deficiency two trials were conducted in 1956 on direct-seeded tomatoes suffering from the disorder. Zinc sprays were applied at 10–14 day intervals shortly after the stunting was observed. Zinc sulfate and zinc EDTA were used at the rate of four pounds of material per 100 gallons of water. The plants were thoroughly wet with the spray. Neither material provided any marked improvement in the growth of the plants. Apparently the leaf area was so small that sprays did not apply enough zinc to correct the trouble.

Three tests were carried out on tomatoes transplanted into zinc deficient soils. In the first test, zinc was applied in the transplant water at the rate of two pounds of zinc sulfate per 100 gallons of water. Five hundred gallons of water were used per acre.

The plants treated with zinc started growth rapidly and did not appear to be deficient at any time during the season. However, those which received only water in the transplanting operation soon became stunted and produced a small unsatisfactory crop.

In another test, zinc sulfate foliar sprays were compared to different zinc materials applied to the soil at the time of planting. The material applied in the transplant water produced the greatest yield. The plants grew quite rapidly and

Yields of Tomatoes as Influenced by Zinc Sulfate Applications to the Transplant Water

Treatment	Yields—tons/acre	
	1st harvest	Total
Zinc sulfate in transplant water	12.6	28.0
Check	2.8	6.4
LSD (05)	3.1	2.5

did not appear to suffer any deficiencies throughout the season.

When zinc sulfate or zinc EDTA was side dressed at the time of planting, very little stunting occurred indicating that the plants were able to use the zinc from these two materials shortly after transplanting.

In the fourth treatment, zinc sulfate spray partially corrected the deficiency, but by the beginning of the harvest season slight deficiency symptoms were becoming apparent, indicating that the sprays had not supplied the plant with sufficient zinc. The yields of the check plots in this test were somewhat larger than in the first test, probably because the deficiency was not so severe.

Yields of Tomatoes as Influenced by Different Zinc Carriers and Methods of Application Applied at Planting Time

Treatment	Total yields tons/acre
Zinc sulfate in transplant water	24.4
Zinc EDTA side dressed	22.3
Zinc sulfate side dressed	21.7
Zinc sulfate sprays	18.6
Check	9.9
LSD (05)	5.7

In a third trial the corrective measures were applied after the plants were observed to be suffering from an acute zinc deficiency. Foliar applications of different zinc carriers were compared to a side dressing of zinc sulfate applied on July 7. The sprays were applied on June 27 and July 11. The yields indicate that the best response was obtained by the use of zinc sulfate sprays.

The next most effective treatment was zinc EDTA and zinc sulfate as a side dressed application, with zinc oxide dust providing the least amount of correction.

According to visible symptoms, the plots receiving the zinc sulfate sprays responded more quickly than did the other treatments. Visible differences in growth from this treatment were apparent at the end of two weeks and held up throughout the season. The plots receiving zinc sulfate as a side dressing responded more slowly than where it was used as a spray application but by harvest season this material had become more effective. All the plots receiving the spray applications appeared to be suffering mild zinc deficiency by the middle of the harvest season. Further sprays of zinc sulfate to these plants would probably have been of benefit.

On the basis of the 1956 experiments, tomatoes should not be direct-seeded on known zinc deficient soils. Also, because young tomato seedlings appear to be very sensitive to zinc deficiency, it seems desirable to transplant tomatoes on these soils.

In the process of applying transplant water to the plants, zinc sulfate should be included—at a rate not exceeding two pounds per 100 gallons of water and the transplant water applied at a rate of at least 500 gallons per acre.

Broadcast applications of larger amounts of zinc prior to planting show promise but the value of this practice is dubious because some zinc deficient soils can apparently fix large quantities of zinc. Applications of the cheaper more soluble zinc salts such as zinc sulfate can be fixed so that some crops may show slight zinc deficiency symptoms even after 50 pounds of zinc sulfate have been applied to the soil. Several materials such as zinc EDTA are not fixed to any great degree, but at the present time the price makes them too expensive for general use.

Zinc materials may be side dressed on the plants shortly after transplanting, but in this case response will be somewhat slower due to the time lag required for the roots to grow into the treated zone of soil.

If zinc deficiency is observed after the crop is growing the best method to correct the disorder appears to be by foliar sprays. Zinc sulfate seems to be the best material to use for this purpose, because it is the most soluble compound tested and is one of the most economical zinc carriers available. Zinc oxide dust could be used, but here the response appears to be materially slower than with zinc sulfate sprays. Zinc EDTA could be used as a foliar application, but this material is much more expensive than either of the other two materials tested.

If a deficiency is observed in a direct-seeded field and plant growth is extremely stunted, replanting the field or the affected spot with transplants and applying zinc in the transplant water will produce a much more satisfactory growth.

Yields of Tomatoes as Influenced by Various Treatments Applied after Deficiency Developed

Treatment	Yields—tons/acre	
	1st harvest	Total
Zinc sulfate sprays	7.1	13.5
Zinc EDTA sprays	6.3	12.7
Zinc oxide dust	4.3	11.7
Zinc sulfate side dress	3.7	12.1
Check	3.1	8.0
LSD (05)	0.85	1.4

Experimental work is continuing on the problem of zinc deficiency to establish the geographic distribution of the disorder, and to further evaluate the various methods and materials which can be used to correct the disorder.

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