

ZINC DEFICIENCY OF TEA IN CEYLON

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Publication of this paper will precede the 1963 Biennial Conference by several months. During that period, data from experiments, supplemented by information from estate experience, will still be coming in. Therefore I intend in this publication to introduce the subject and to give basic information which will help in the more detailed discussion at the Conference itself.

Zinc is one of the group of elements which are accepted as being essential plant foods, without which plants cannot live. Zinc is thus comparable biologically to nitrogen, with the difference that a healthy plant usually requires about one thousand times as much nitrogen as it needs of zinc. This is the reason for zinc being sometimes referred to as one of the "minor elements". I prefer the terms "trace element" or "micro-nutrient" as these terms are less liable to give the impression that "minor" refers to the importance of the elements. Indeed from the 1930's to the present day, more and more systems of agriculture in widely separated parts of the world have had reason to realise that a lack of zinc can cause a major economic failure, and zinc has had to be included in their routine manuring programmes. More frequent detection of zinc deficiency has doubtless been helped by a more intensive search for visible symptoms of the trouble, which often bear a family resemblance from one crop to another. It is also possible, and justifiable, to assume that such a deficiency really is becoming more prevalent, since zinc reserves of many soil types are limited and little is done to replace the loss of zinc in crop removal. A third factor in this sketch of the position of zinc in agriculture, is introduced by the possibility that the efficiency of utilization of zinc by the crop may be impaired by imbalance in the availability of other plant foods. This is a complex subject, but physiological research seems to be producing evidence to suggest that, once again, the balance of plant foods is a vital feature of manuring programmes.

Zinc deficiency usually shows itself by prominent discolouration and distortion of leaf and shoot development. It has now, for the first time, been recorded that tea can suffer from this deficiency and often shows characteristic symptoms in the mature leaf (Fig. 1).

The first symptom which attracted my attention was the sickle-shaped leaf, distorted sideways by the unequal growth of the two halves of the blade. It was soon seen that there exist a series of distortions until the extreme case is reached, where both edges of the leaf have grown more rapidly than the rest of the blade, giving an upfolded, wavy-edge pattern. A rather vague, greenish-yellow chlorosis is often present, starting from the edges of the leaf and diffusing inwards. Chlorosis appears to be commoner in the hotter and drier districts; possibly the sickle-leaf variant may also be commoner than the wavy-edge in the same districts. Affected leaves are usually hard and dull and, except for chlorotic areas, often darker than normal. The plucking table of affected bushes often shows crater-like hollows, in the depths of which can be seen dormant shoots topped by distorted leaves. Such shoots occasionally develop many small leaves rather close together, but extreme smallness and bunching of the leaf is not a common characteristic of this particular disorder. The symptoms described are doubtless affected by variations in climatic conditions, and possibly by the general nutritional status of the bush,

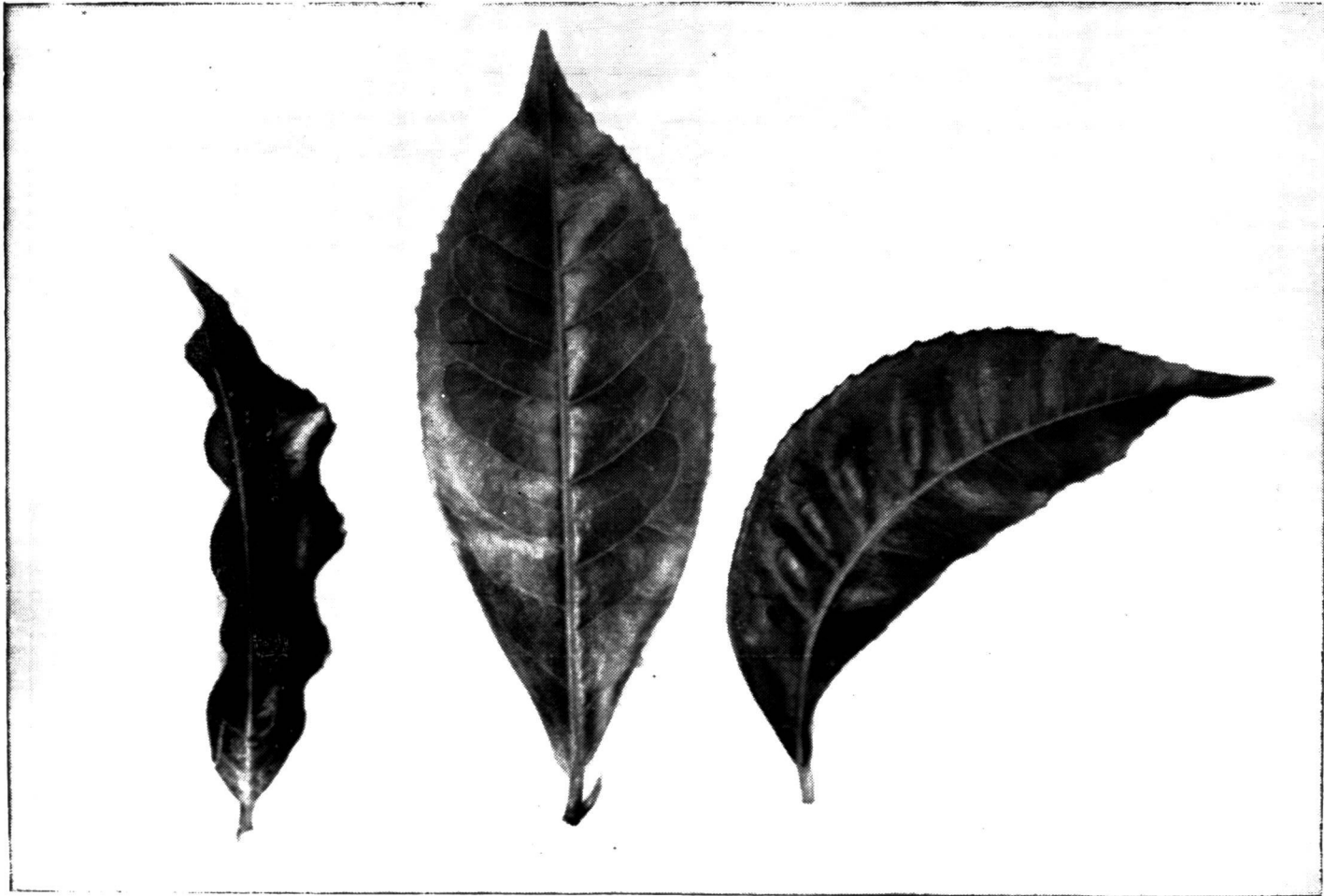


Figure 1. Zinc deficiency of tea. *Left*: wavy-edge variant. *Centre*: healthy leaf. *Right*: sickle-leaf variant.

Well-marked symptoms were first seen near Lunugalla and Ratnapura. Results of chemical analysis of the leaf did not show any startling features, judged by standards often taken, of necessity, from work on other crops. Other reasons delayed further investigations and it was not until early 1961, when symptoms appeared in an experimental area on St Coombs, that intensive work began. It is of importance to note that this area had been under close observation for some years past, and that there was only a short time interval between the appearance of the symptoms and their detection. Diagnosis of the cause of the symptoms was by means of foliar spraying. Chlorotic leaves regained a more normal colour when sprayed with a solution of zinc sulphate, but the most interesting reaction was the rapid and profuse development of new and normal leaves from largely dormant plucking tables.

Some crops are decidedly sensitive to the concentration of zinc sulphate foliar sprays, but during the above diagnosis it was found that tea is surprisingly tolerant, as it is towards several other chemical sprays. A heavy spraying with a 4% solution of zinc sulphate caused only slight scorching of the youngest leaves, while mist-blower application of a 5% solution caused no damage unless a bush was sprayed to the point where the droplets coalesced. No wetting agent or other additive was used in the many small trials carried out to determine these limits, and it was found that spraying could safely be done in the strongest sunshine (St Coombs, dry season). This meant that the diagnostic sprays had pointed at once to a practicable cure, and that research could be concentrated on the relation between the rate of zinc sulphate and the frequency and volume of spraying.

Soil application of zinc fertilisers could be expected to be slower in action and, in the initial outlay, more expensive than foliar application. As the requirement for zinc is so small even when a bush is suffering from a severe lack of zinc, foliar spraying with its obvious advantages of evenness and flexibility of distribution, seems to warrant the major share of the research. Soil treatments are in existence, in very simple trials, and it is intended to pay rather more attention to this method of application in nurseries. Zinc sulphate, at rates varying from 50 to 300 lb per acre, has been applied to a high-organic soil on St Coombs, and after more than a year no adverse effects have been seen in the tea (mature). It would appear that fear of zinc toxicity need not be listed among our present problems. It will always be borne in mind as a future, possible, problem.

The decision to emphasise foliar spraying was not made without first considering the relation to manufacture. The first point to be settled concerned the residue of zinc on the flush. All foods contain zinc, but most of the organisations which keep a watch on health hazards set a limit to the amount of zinc which is permissible, unless it can be shown that a given food is inherently very high in zinc. Black tea samples of various types, and dried untreated flush, gave "natural" zinc contents of about 20 parts per million (dry matter). Dried flush from zinc-sprayed plots did not exceed 33 p.p.m. even when plucked one day after spraying and in spite of the inclusion of some high concentrations. As the official limits, at present, are either 40 or 50 p.p.m., depending on the country concerned, and since tea is not a normal 'foodstuff' and could if necessary plead a special category (as was done when copper spraying became routine), I think we have nothing to fear.

The second point, concerning any effect on the quality of the final black tea, is more difficult to determine. An impression from preliminary manufactures is that there is no obvious effect, and that zinc spraying need not prevent the manufacture of excellent tea. At the time of writing (July) it is anticipated that several estates, particularly in Uva, will be able to carry out comparable manufactures on a large scale from sprayed and unsprayed areas during the 1962 dry season. It

may be noted in passing that there is no reason to assume, as is too often done, that chemical sprays will inevitably tend to harm the manufactured tea.

I will give only a brief report of two trials which are in progress, and which illustrate the three types of foliar application which could be considered in practice.

Plot 8Z. St Coombs

A drenching spray, with the addition of a wetting agent was applied; most of the leaves on mature bushes were uniformly wetted.

Twenty bushes, representing different clones of widely different jat, were first sprayed in mid-February 1962. Twenty adjoining bushes of the same clones have throughout been left untreated. All bushes have received heavy applications of the major nutrients.

The first spray applied zinc sulphate at the rate of 30 lb per acre. Yield increases were recorded two plucks later, and became more pronounced throughout a drought which was more severe than usual on St Coombs. For the twelve plucking rounds from February to mid-May the yield totals can be expressed in this manner:

20 control bushes:	100
20 sprayed bushes:	130

A second spray was applied after the twelfth pluck, giving only 5 lb zinc sulphate per acre. The yield totals from the thirteenth to the eighteenth pluck were:

Controls:	100
Sprayed:	132

Both these increases in yield from the sprayed bushes are statistically significant ($P=0.05$).

New Manures Trial; St Coombs

Seedling tea, in the third year of its cycle, had been marked out for the comparison of three forms of nitrogen at two rates. These six treatments were replicated in four blocks, and it was decided to apply varying zinc treatments to these blocks.

The first group of sprays went on in July-August 1961, at a time when the yield potential of these areas was not known, but was expected to be reasonably good. Sprays were given so that each application represented 5.4 lb of zinc sulphate in 100 gallons of water per acre. No wetting agent was used. One block received two sprays, one received four sprays and two were left untreated. Intervals of two or three weeks separated the sprays.

The more heavily sprayed block, allowing for initial differences in yield between the four blocks, showed a steady yield increase of approximately 15% over the following few months. The less heavily sprayed block, previously the lowest yielding, also showed a yield increase, but of a less steady pattern.

By March 1962 these differences had lessened, and it was then apparent that the tea was potentially high-yielding, 2,000 lb per acre being the estimate for the

completed third year. It was then decided to examine the effect of frequent low-volume sprays, applying 1 lb of zinc sulphate per week in 12 gallons of water per acre (no wetting agent). Four such sprays were put out during the latter part of the drought, March-April. In this phase of the trial, the highest-yielding block (previously 22 lb zinc sulphate rate in 1961), and the lower-yielding of the two former control blocks were chosen for identical zinc treatment. April yields showed approximately 20% and 12% increases respectively. Regular weekly spraying at the same rate was started from late-May and to-date the above yield trends have persisted.

This summary will serve to show the way in which our research is developing. Detailed presentation of the data with discussion of their full implications will be made at the conference, together with reports on other trials.

The use of a drenching spray, as in the 8Z Plot Trial, seems to be a practicable technique for nurseries where the economic implications are negligible. Three or four repetitions of a solution of 1 or 2 lb of zinc sulphate in 10 gallons of water, plus 3 to 4 fluid ounces of 'Teepol' might offer a practicable answer to the problem of zinc deficiency in nurseries. Observations suggest that many nurseries do suffer from this trouble. For mature tea, such sprays could probably only be contemplated for small, demonstration or diagnostic plots. I would stress that this should not be dismissed lightly, but that such sprayings could well be tried in many areas of an estate.

Since frequent small doses of zinc sulphate in low-volume sprays can prove beneficial on zinc-deficient mature tea, there would seem to be no need to look for other methods of application when a long season of copper-spraying is routine practice. The 10 to 15 lb annual dose of zinc sulphate, per acre, which is becoming familiar to many superintendents will, of course, be subject to change as and when experimental data warrant. Where copper spraying is infrequent or not done at all, we have to consider the cost of making separate spray-applications. Trials with zinc have the advantage of giving early results, and it is hoped that this particular problem will soon be answerable.

One further point needs to be introduced before leaving this outline of possible methods of applying zinc. When zinc sulphate is dissolved in a suspension of any of the commoner red-oxide fungicides, the mixture remains apparently unchanged in the tank (even for a few weeks) but after drying on the leaf, the deposit usually turns blue. Large drops may dry to a red centre with a blue fringe. At the time of writing, a detailed trial is in progress to determine the effect, if any, on the fungicidal efficiency of this blue product. There appear to be no reports in the literature of such a reaction, and it is therefore unwise to say more at present, except that I do not fear any decrease in the efficiency of the control of Blister Blight.

Reasons for the occurrence and the detection of zinc deficiency in agriculture have been suggested in the opening paragraphs, and it will be seen that I am of the opinion that the deficiency is widespread in Ceylon tea, and of comparatively recent incidence. Whether in view of the relative ease of control this aspect is of interest rather than of importance remains to be seen. Also for future consideration is the choice of methods of routine manuring with zinc. Attention now tends to be focused on curing an actual deficiency. It is unlikely that routine manuring would need to continue with high doses of zinc and we must be careful to remember this. As a last word before the Conference, I will emphasise yet again that zinc is a plant food which, as far as we are concerned, appears to be required now or in the near future as part of the balanced mixture of nutrients which forms what we call "manure".