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TIP ANALYSIS AS A METHOD FOR CURRENT EVALUATION OF THE EFFECT OF MICRO-NUTRIENTS ON PLANTS

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NOTE: *The following article is based on research on crops other than avocados, but field experience indicates that they respond to micro-nutrient foliage sprays in much the same manner as the crops used.*

After many years of field testing to determine the responses of plants to applications of zinc, manganese, phosphorus and so forth, quite a few questions remain unanswered. It is generally known and a well substantiated fact that zinc, manganese and phosphorus do not move to any extent in alkaline western soils. In most cases, when a tree does not respond to soil applications of these elements, it is simply due to the fact that the micro nutrients have been locked up in the surface area and do not reach the root zone. In order to get around this dilemma a logical approach is to use a foliage spray.

In the last few years many colleges are using radio-active materials to study the problems of the absorption and translocation of elements by leaves. Foliar sprays of P 32 labeled phosphoric acid applied to apples and cherries during bud swell and green tip stages supplied 8-13% of phosphorus utilized by shoot growth and immature fruits. Also evidence has indicated that foliar absorption of micro nutrients is a metabolic process (Jyung & Whittwer, Michigan State University 1963). Mechanisms on ion uptake by leaves are similar to those for roots (Epsteins, Raines and Schmid, 1962). Thus foliar absorption is temperature, light and oxygen dependent.

Around 1950 the Leffingwell Chemical Company decided that the use of visual appearance of the leaves was not giving all the information, that was desirable to have to justify the use of foliar nutrients. As a result, yield records and growth measurements were taken on crops like cotton, citrus and grapes. It soon became apparent that these methods did not explain certain types of responses—and some years the response was different from others. After much consideration of the various possible methods for evaluation it was decided to use the growing point or the one-inch tip for analysis for the following reasons:

1. It made possible the analysis of uncontaminated tissue 10 days to two weeks after spraying to be compared with the unsprayed tips in a replicated experiment. It was possible to obtain proof of the absorption and translocation of certain elements as well as the factors that influenced the absorption.
2. The zinc ion cannot be cleaned satisfactorily from the sprayed surface of leaves so it was not desirable to use the older leaves in this type of research.

3. Knowing whether an element was absorbed was not the final answer. It was necessary to know if it was being utilized and translocated by the plant. This method also made it possible to study the period of time during which each foliage spray was effective.

By following the growth as it is elongated it was soon demonstrated that the material applied was absorbed and gave responses lasting up to two to three months for trees and vines. The use of grape tips, due to the long continuous growth period, has been excellent for this purpose and the grape has been one of the main crops used for research purposes.

The study of the annual crops, cotton, sugar beets, corn and tomatoes has indicated that the effective period for these crops is shorter than that for perennial tree crops.

When comparing the results of many treatments with the un-sprayed areas it became apparent that there was a correlation between the zinc and the phosphorus in relationship to the yield and the growth of the plant.

The following types of responses have been noted for zinc plus phosphate sprays when zinc alone has little or no effect.

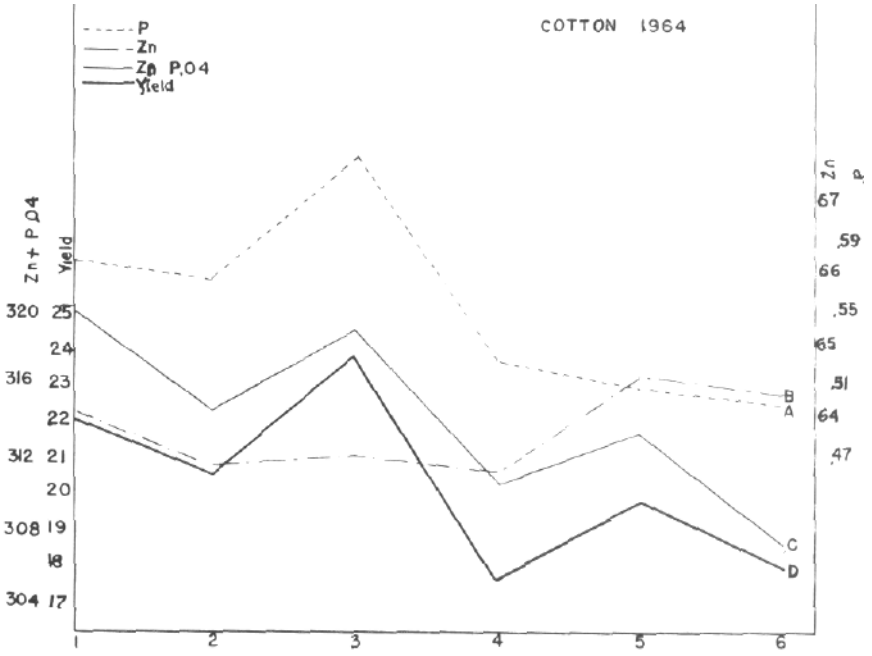
(a) Citrus trees with a Nutra-Phos spray would have less leaf drop following a hot, dry wind in the fall.

(b) It is possible to reduce the amount of blossom shattering in grapes by a foliage spray of zinc and phosphorus. Zinc sprays alone did riot help.

(c) A heavier set in numbers of fruit has occurred for many crops, annuals as well as trees.

(d) Zinc sprays alone applied over young fruit will reduce the sugar development while zinc-phosphorus combination sprays tend to raise the sugar percentages. This is especially true of zinc, potassium and phosphorus combinations.

It is possible with reasonable accuracy, when comparing the results of an experiment with several combinations of materials containing zinc and phosphorus, to tell whether the response was due to one or another of the several materials used or to both. The following graph comparing the levels of zinc and phosphorus with yield of cotton illustrates the comparisons.



In the above graph the zinc line B or the phosphate line A does not correspond as closely to the yield line C as does the composite zinc-phosphate line D. In making these comparisons, the other elements like nitrogen, potassium and manganese must he at adequate levels. In the experiment covered by the graph there were eight replications.

At the start of the study phosphorus was used at roughly a hundred times the level of zinc. This is the approximate percentage in the plants that were used; however, it was soon observed that due to its catalytic action the zinc was much more effective and to determine correct balance it was necessary to use phosphorus at 1/25 of its actual percentage in the plant. When these were added together, it was possible, when comparing with an unsprayed area, to determine whether a favorable response was indicated.

(**EDITOR'S NOTE:** *Mr. Kessler was graduated from the University of California at Berkeley in 1923 with a B.S. degree in Agriculture. He has been employed by the Leffingwell Chemical Company as Director of Field Service since 1948. Before joining Leffingwell, Mr. Kessler had several years of farm experience including row crops, vegetables, citrus and avocados. He has a wide experience in micronutrients and foliar feeding and his primary interest at Leffingwell is the development and testing of micronutrients for foliar application.*)