

## **EARLY EXPERIMENTAL DEVELOPMENT OF FOLIAR FEEDING**

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### **OBJECTIVE:**

To monitor and test FOLIAR APPLICATIONS ( with the radio-isotope technique, provided by the U.S. Atomic Energy Comm.) of nutrients in an attempt to evaluate the relative efficiency of FOLIAR APPLICATIONS of nutrients and SOIL APPLICATIONS of nutrients.

### **INTRODUCTION:**

I appreciate the opportunity to tell you something about what I think is one of the most exciting new developments in agriculture, namely, that not only can plants absorb nutrients through the roots, but also through the foliage, the fruit, the twigs, the trunk, and even the flowers. Most people believe that plants can get their food only from the soil. This has long been the classical belief, "the law of nature". Today, it is known that this is not the only way! It has been demonstrated that by spraying mineral nutrients on the leaves, fruit, or any above-ground parts of the plant, the plant can be fed! It is now known that non-root absorption of mineral nutrients can take place through above-ground parts of the plant.

### **METHOD**

A tool was needed which would distinguish what was absorbed by the leaf from that which was taken up by the roots; one that would prove whether absorption took place, where it was absorbed, and whether the nutrient traveled through the plant. The radio-isotope was the tool. Michigan State University began investigating above ground absorption of mineral nutrients by plants, using radio-active phosphorus. Their experiment was to find out if absorption could take place, if radio-phosphorus was transported to other parts of the plant, the areas of active growth, etc.

### **EXPERIMENT**

Bean seedlings were started in coarse sand, then they were transferred to aerated solution cultures, so as to control their growth closely, and obtain soil-free roots for radio-chemical analysis. With a supply of uniform plants for experiments using the isotope technique, radio-active phosphorus was applied to the upper surface of each of the primary leaves. After treatment, plants were harvested at intervals, separated into "treated" and "untreated" pots, and dried in an oven. By determining the total radio-activity applied, and the amount in each plant part, it was possible to calculate the percentage of "tag" nutrients absorbed. A standard scale gave an account of the radio-activity in the roots, stems, and leaves of the various plants tested. The results were encouraging. Nitrogen, for example, may be applied in the form of urea. The rate of nitrogen absorption from urea usually corresponds to its rate of enzymatic-hydrolysis. Several plants were tested with interesting results. By plotting the tolerance in grams per liter of concentration of urea by plants, against the relative rate of utilization. The plants which tolerate the least concentration of urea, the cucumber, tomato, the corn, utilize urea most rapidly. The peach, potato and cherry, which tolerate the greatest concentration of urea, utilize it more

slowly. The apple is somewhere between. Other elements of importance to plant nutrition which were studied in relation to foliar absorption and sodium, magnesium, sulfur, chlorine, potassium, calcium, manganese, iron, copper, zinc, lobydium, strontium, molybdenum, and barium. Using radio-isotopes of these elements as tracers, and using techniques such as those used in investigation of radio-active phosphorus (Michigan State University), more information was accumulated on absorption of above-ground parts.

Potassium, sodium, and lobydium, were found to be rapidly absorbed, and highly mobile. Phosphorus, sulphur, and chlorine, were absorbed at a slower rate, but were also mobile and were transported at a rapid rate. Manganese, zinc, copper, and molybdenum were found to be slightly mobile. Calcium, strontium, barium, iron, and magnesium were readily absorbed but did not move out of the leaf to which they were applied. The radio-isotope technique had revealed a great deal about absorption of nutrient by above-ground parts, that non-root absorption was a fact, and the distribution pattern of the most significant elements in plant nutrition had been determined.

## **EXPERIMENT #2**

To evaluate the relative efficiency of FOLIAR-APPLICATIONS of nutrients and SOIL-APPLICATIONS of nutrients three kinds of soil were used: sandy loam, clay loam, and an organic soil. Uniform tomato plants were used as test specimens. The treatments were replicated and randomized. Radio-active phosphorus was used again as the "tag" nutrient. Soil application versus foliar application were used to determine which was the most efficient? Three weeks after initial foliar and soil applications, the fruit was again harvested, and assayed for both radio- activity and total phosphorus to determine the percentage (%) contribution from the two methods of application (foliar-soil). Analysis of the harvested fruit revealed that the foliar application was more efficient than the soil application in the three soil types. CLAY LOAM and organic: Foliar application were six (6) times more efficiently utilized than the soil application. SANDY LOAM: Foliar application was utilized twenty (20) times more efficiently than in the soil application. Like foliar applications were applied to the skin of developing tomato fruit, and were found later to have been absorbed into the flesh of the fruit. Dormant fruit trees were sprayed utilizing the radio-active "tag" nutrient method, and in later developing buds, the leaves, the flowers, and fruit were measured. Dormant sprays were found to supply nutrients when natural conditions hinder or prevent root absorption. Foliar sprays on crops such as tomatoes, beans, corn, and potatoes, contributed significantly to mineral nutrient requirements, and increased yields.

## **SUMMARY:**

Many modern agricultural practices, overhead irrigation, misting, spraying for pest control, already utilize the application of foliar nutrients, pesticides, herbicides, to above-ground plant parts. By foliar applications, control over nutritional needs can be exercised in a degree never before thought possible. Black-heart in celery is prevented by calcium sprays; rosette of peaches is prevented by applying foliar zinc solutions. Urea nitrogen sprays improve the fruit set of apples. Magnesium in nitrogen spray supplement root absorption in tomatoes during the critical stages in flowering, or in fruit development, when demands are high and root uptake is inadequate. Nutrients can be applied to the branches of winter injured fruit trees to promote recovery where it is impossible for the above-ground part to be adequately supplied with

minerals from the roots. It is entirely possible to extend the area of crop protection into those regions where growth is limited by low temperatures, which limit the uptake of nutrients by the roots alone, and to increase significantly the productivity in those areas. In fact, experiments have been conducted in which crops such as beans, have grown to maturity with no nutrients supplied to the roots whatsoever, all being supplied through foliar application.

#### CONCLUSION:

We have seen that materials are absorbed by the plant and move rather freely in the plant. The amounts may at first seem relatively small, but to offset this handicap, the efficiency rate is high! In fact, this is the most efficient method of applying fertilizer to plants that we have yet discovered. If we apply these materials to the leaves in soluble forms, as much as 95% of what is applied may be used by the plant. If we apply a similar amount to the soil, we find that only about 10% of it is used. This is a very dramatic finding!