FOLIAR FEEDING OF PLANT NUTRIENTS

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At the SE Strawberry Expo at Greenville, NC and the Carolina Farm Stewardship Association Conference at Boone, NC this past November, many growers expressed interest in nutritional plant health products new to this region. I am excited about such unique supplemental plant health products. Some, for soil application, contain enzymes that will cause a great increase in soil's natural population of bacteria to improve soil structure, water and air permeability and help unlock bound-up currently unavailable soil nutrients. Some, for drip irrigation to roots, improve plants without applying more nitrogen. Some, formulated for foliar application, provide fastest plant response. All are designed to supplement your soil improving fertility program. Several are OMRI certified for organic growers, some now are formulated with food-grade nutrients for sustainable, non-toxic use. With improvements in plant absorption technology, use of food-grade nutrients prevents plant absorption of heavy metals or other impurities that may be contained in non-food grade nutrients, and/or toxins that could become part of the fruits or vegetables that we would consume. Look for this information on the product labels!

For many years, horticulturists and agronomists have largely subscribed to the belief that foliar feeding of plant nutrients is an idea of dubious merit. A commonly held opinion is that foliar nutrients feeding is best employed only where a specific minor element deficiency may exist as determined by tissue test of plant foliage or leaf petioles.

Dramatic and fast correction of such nutrient deficiencies are generally always seen from such foliar applications.

Dr. H.B. Tukey, renowned plant researcher and Head of Michigan State University's Department of Horticulture back in the 1950's, working with research colleague S.H. Wittwer at MSU, first proved conclusively that foliar feeding of plant nutrients really works. Researching possible peaceful uses of atomic energy in agriculture, they used radio-active phosphorous and radio-potassium to spray plants, then measured with a Geiger counter, the absorption, movement and utilization of these and many other nutrients within plants. They found plant nutrients moved at the rate of about one foot per hour to all parts of the plants. Comparing efficiency of plant use of foliar-fed nutrients versus soil-applied nutrients near roots, they found foliar feeding provided about 95 percent efficiency of use compared to about 10 percent of use from soil applications! Likewise, speed of absorption and use by foliar applications was immediate, whereas from soil applications absorption and plant use both were very

slow, thus providing a major benefit of foliar feeding where a specific plant nutrient deficiency may exist, be it major or minor plant nutrient.

You'll note from references of these researchers' work cited at the end of this article, that this very important finding was published, but only in research journals and symposia proceedings. These findings rarely found their way into the ranks of Extension educators or their grower-focused publications and other teaching materials or programs.

I am living proof of that, nor was this information taught in my academic class's way back in the late 1950[1]s and early 1960's. Now, a half-century later, I believe it is important to bring these science-based findings to light and publicize this work to benefit growers and their crops.

Armed with this knowledge they dug out of the research journals, commercial agricultural chemists began developing foliar feeding formulations. Their continuous product improvement research has resulted in products containing not only specific plant nutrients, but also natural plant sugars that aid rapid entry and movement into and through plants, plus cytokinins: natural plant growth hormones extracted from seaweed, now stabilized for several years of shelf life. Together with nutrients, they aid natural plant defense mechanisms to resist many plant diseases and insect pests. We know that healthier plants, like humans, are better able to resist many pests compared to those in stressed, poor condition. Also, growers know and observe that the weakest plants are the ones most often attacked by many insect, disease and mite pests. I believe such products can help improve your soil and your plants' health for higher yields with lower pest control inputs and plant nutrients costs, based on my tests over the past year and ongoing at our farm. Remember, a relatively small amount of plant nutrients, foliar-applied, can replace a much greater amount that is soil-applied, and is immediately available to plants.

The development of a low-cost, natural soybean oil-based adjuvant for use with such foliar-applied nutrients and crop protectants further improves leaf and stem coverage and retention for about $2.50/acre per application. An example, combined with foliar (or even to twigs and stems after leaf drop) potassium to benefit berry, grape and tree fruits plants in late fall/early winter, or during winter in milder areas when applied anytime temperatures are above freezing: To toughen/harden plant cells, apply one gallon per acre of foliar-formulated potassium. In two weeks apply a second spray of two gallons of foliar K per acre. Add 1 pint/acre of the soybean oil adjuvant first to the tank, then a small amount of water while agitator is running, then add the potassium product and fill tank with water with agitator running, then spray. 1 gallon of the potassium per acre plus 1 pint of adjuvant oil per acre costs about $18.50 per acre per application for materials, is rain-fast in 15 minutes and is great insurance at very low cost for high-value horticultural crops. Note: Use only 50 mesh screens at the spray tips so the cytokinins will pass through to your plants. With clean spray water, I also can remove my tip screens and can also use larger spray tips to insure no clogging.

For smaller areas foliar applications for 4 gallon back pack sprayer, use 1 ounce of the spray oil in 1 quart of water, stir, then add 16 oz. of the foliar potassium, stir, then fill tank with water while stirring. Shake tank from side to side while applying to maintain agitation to prevent settling. Do NOT apply this

program through drip irrigation systems, as this product is formulated for foliar use only. Seaweed extracts may clog some drip irrigation filters. A clear potassium solution is available for drip irrigation, and also supplies no plant-tenderizing nitrogen in the fall or winter.

References cited for further reading:
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3. Witter, S.H., Teubner, F.G. and McCall, W.W. 1956. Comparative absorption and utilization by beans and tomatoes of phosphorus applied to the soil and foliage. Proceedings, American Society for Horticultural Science. (needs vol and pp numbers from Barden).

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!