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### **The Myth of Foliar Feeding**

*“Fertilizers sprayed on the leaves of trees and shrubs are more effective than soil applications”*

#### **The Myth**

Recently, I received an email from a professional colleague whose clients often ask about foliar feeding as a method of fertilizing plants. As he says, “All the water soluble fertilizer companies advertise the practice all the time.” What, he wondered, was my opinion of the practice?

Foliar feeding involves spraying the foliage of target plants with water-based fertilizers. The logic for the practice is based on scientific research from the 1950’s, which demonstrated that leaves can take up minerals through their stomata, and in some cases through their cuticles. This research is consistently cited in the argument that foliar feeding is 8, 10, or even 20 times more effective than traditional soil application.

In assessing the advertised claims for foliar feeding of shrubs and trees, I had particular questions that are answered in bulleted lists below (all bullets are directly from marketing media):

- (1) What are the advantages of foliar feeding over soil application?
  - Immediate results
  - Prolong bloom
  - Increase crop yields
  - Increase storage life of food crops
  - Boost growth during dry spells
  - Increase cold and heat tolerance
  - Increase pest and disease resistance
  - Maximize plant health and quality
  - Help the internal circulation of the plant
  
- (2) When should one use foliar nutrients sprays?
  - When the soil is too cold for conversion of nutrient elements into usable forms
  - When it is at least 72°F
  - Any time except when it is too hot or too cold
  - Transplant time
  - Bloom time
  - When a quick growth response is desired
  - After fruit set
  - Every 2-3 weeks
  - Any time of stress
  - As long as the plant has leaves that aren’t dormant
  - When the soil is deficient in nutrients
  
- (3) What time of the day, and in what quantity, should you apply foliar fertilizers?
  - Early morning
  - Until it drips from the leaves
  - There is no improper way

- (4) How long will material last on the leaves?
- 24 hours
  - 1-2 days
  - Four weeks
- (5) What nutrients are critical components of foliar feed fertilizers?
- Nitrogen
  - Phosphorus
  - Micronutrients
- (6) Apart from commercial formulas, what should homemade mixtures contain?
- Seaweed
  - Compost tea
  - Natural apple cider vinegar
  - Blackstrap molasses
  - Fish emulsion
  - Baking soda

As one company states, “In our opinion, foliar feeding is by far the best approach to use to insure maximum growth, yields, and quality by overcoming limitations of the soil and its ability to transfer nutrients into the plant.”

### **The Reality**

If these laundry lists look more like a multiple choice test rather than solid information, it's not surprising. Foliar feeding is yet another agricultural practice best suited to intensive crop production under specific soil limitations rather than as a landscape management tool. Thus, advertisers take great liberties with the facts, often resulting in contradictory messages (note especially the recommended temperature conditions!). Rather than individually refute the numerous errors in the claims, I'll explain when foliar feeding might actually be beneficial.

The original 1950's research came from Michigan State University and was particularly useful in understanding how nutrients move within plant tissues. As explained by Dr. Tukey in his testimony to the Joint Committee on Atomic Energy, use of radiolabelled nutrients allowed his team to discover "...that a leaf is a very efficient organ of absorption. The amounts may at first seem relatively small, but to offset this handicap, the efficiency is high." From this advertisers claim that foliar feeding is 8, 10 or 20 times more effective than soil application. This is not accurate for several reasons.

Obviously, materials applied directly to a leaf are more likely to enter the leaf in large quantity than the same materials applied to the soil. Leaching, chemical reactions, microbial activity, etc. can decrease what actually reaches the roots and is taken up into the plant. But materials applied to the leaf do not necessarily travel throughout the entire plant as effectively as they do through root uptake. They often remain in the same or adjoining tissues but travel no further. This is especially true of those elements recognized as "immobile" within plant tissues (apart from root uptake and xylem transport).

Research over many decades has explored the mineral uptake and transport of many species of fruit trees, conifers including pine and spruce species, and some hardwoods of ornamental or commercial value. Results have been mixed in many cases, with some species responding well to treatment and others remaining unaffected. Generally, the results suggest that foliar application of particular nutrients can be useful in crop production situations where soil conditions limit nutrient availability. For instance,

alkaline soils do not readily release many metallic nutrients, especially iron and manganese. Zinc, copper, magnesium, molybdenum, boron, and calcium are other micronutrients required in small quantities that have been applied to foliage in an effort to relieve deficiencies and combat fruit disorders. Fruit, as adjacent tissue, can benefit from foliar spray. But this is a localized application that does not affect the trunk or roots – and therefore is not a solution to soil imbalances. In fact, researchers consistently state that foliar treatments are a specialized, temporary solution to leaf and fruit deficiencies in tree fruit production but will not solve larger soil management issues.

On the other hand, macronutrients, such as nitrogen, phosphorus and potassium, are needed in larger quantities. While many of these are mobile in the plant, it is pointless to apply them to foliage as leaves cannot take up enough material to supply the entire plant's demands. Furthermore, foliar application of high concentrations of such nutrients often results in leaf burn as water evaporates and the fertilizer salts remain behind. Substituting numerous, lower concentration applications would not be cost effective.

Species differ widely in their ability to take up nutrients through their leaves. Differences in cuticle thickness, stomatal resistance, and other genetic factors will influence uptake, as will environmental conditions. Plants in a protected situation (like a greenhouse) have thinner and more porous cuticles than plants in the field and take up foliar sprays much more readily. Likewise, plants adapted to arid environments naturally have thicker, less penetrable cuticles than those from more moderate locations.

A better management solution to the problem of nutrient availability is to choose plants that can adapt to the existing soil conditions. If you have alkaline or calcareous soils, for heaven's sake don't install acid loving plants! Poor plant selection in terms of mineral nutrition will be a management problem for the lifetime of the plant – which may be pretty short. Choose cultivars of species that are more resistant to alkaline soils – they are able to acidify the root environment so that micronutrients are remobilized from the soil and available for uptake.

The existing research does not justify foliar fertilization of landscape plants as a general method of mineral nutrition. It can be useful for diagnosing deficiencies; for instance, spraying leaves with iron chelate can help determine if interveinal chlorosis is from iron deficiency. It would obviously have benefit for those landowners with landscape fruit trees that perpetually have flower or fruit disorders associated with micronutrient deficiencies. Applying fertilizers to leaves (or the soil) without regard to actual mineral needs wastes time and money, can injure plant roots and soil organisms, and contributes to the increasing problem of environmental pollution.

### **The Bottom Line**

- Tree and shrub species differ dramatically in their ability to absorb foliar fertilizers.
- Proper plant selection relative to soil type is crucial to appropriate mineral nutrition.
- Foliar spraying is best accomplished on overcast, cool days to reduce leaf burn.
- In landscape plants, foliar spraying can test for nutrient deficiencies, but not solve them.
- Micronutrients are the only minerals that are effectively applied through foliar application.
- Foliar application will not alleviate mineral deficiencies in roots or subsequent crown growth.
- Foliar spraying is only a temporary solution to the larger problem of soil nutrient availability.
- Minerals (especially micronutrients) applied in amounts that exceed a plant's needs can injure or kill the plant and contribute to environmental pollution.
- Any benefit from foliar spraying of landscape trees and shrubs is minor considering the cost and labor required.

For more information, please visit Dr. Chalker-Scott's web page at <http://www.theinformedgardener.com>.