4. Micromax has worked especially well when used with Osmocote at high rates.

FOLIAR NUTRITION OF LANDSCAPE PLANTS

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Above-ground part plants — leaves, stems, branches and flowers — can absorb nutrients, pesticides and growth regulators from sprays. For almost seventy years, growers of commercial crops have used foliar sprays of nutrients to control minor element deficiencies in fruit plantings. Today, there is renewed interest in foliar nutrition due to increased cost of fertilizer, environmental concerns about nutrient applications to soil which may be carried into ground water supplies, and better knowledge of the plants that we grow. The main advantages of foliar nutrition, as compared to root applications, are (a) more rapid and (b) more efficient absorption of nutrients (3). To utilize these advantages, we must know the growth patterns of plants and when to apply nutrients for best effect

Several environmental factors affect foliar absorption. For example, an increase in temperature increases foliar uptake due, in part, to an effect on processes of penetration. In addition, there is a great influence of temperature on the structure of the plant which in turn greatly affects foliar absorption (4). The outermost layer of the cuticle on the leaves of most plants is composed of epicuticular waxes. These waxes, such as the bluish bloom on cabbage leaves, grapes, and apples, are exuded onto the surface of leaves in regular patterns. In tests where plants were grown at warm temperatures at relatively high light intensities, factors which favor foliar absorption, the epicuticular waxes were arranged in an upright fashion and did not cover the leaf surface completely, leaving small openings to the leaf surface below. In contrast, in plants grown at low temperatures and relatively low light intensities, the waxes were arranged as smaller or densely packed platelets which did not allow contact with the cell surface beneath. Thus, it would seem that the effect of light and temperature is indirect, affecting epicuticular waxes which, in turn, influences contact between the treating solution and the cell surfaces beneath.

The pH of the nutrient solution applied to plants also influences foliar uptake (3); pH affects the form of the nutrient and its ability to hold water which allows a longer time period

for absorption to take place For example, in the case of potassium phosphate, a common form of phosphorus to apply to foliage, at pH 3 to 6, monobasic phosphate ($H_2PO_4^-$) predominates which does not hold water well and is not easily absorbed. In contrast, at pH 7 and above, dibasic phosphate ($HPO_4^=$) predominates, which holds water and is easily absorbed. Thus, the effect of pH is an indirect one and, except at very low pH, such as 2 or 3, which causes severe injury to leaves, does not influence penetration itself.

As the relative humidity increases, foliar absorption also increases due in great part to improved retention of water, allowing nutrients to remain in solution. Although the cuticle is the primary barrier to penetration of foliar-applied substances, the thickness of the cuticle is not a good measure of the ability of a plant to absorb nutrients. Rather, it is the nature of substances in the cuticle and environmental factors which affect the development of the epicuticular waxes. Thus, the effect of most environmental factors such as pH, light, temperature, and relative humidity is indirect, affecting the plant and the substances in solution rather than the processes of absorption.

A great number of horticultural plants can absorb nutrients from foliar sprays with improved growth. For example, during propagation, herbaceous and softwood cuttings, which grow during propagation, absorb large amounts of foliar applied nutrients and make greater amounts of growth both during and after propagation than cuttings which have not received nutrients (5). In contrast, hardwood cuttings which do not grow during propagation may absorb nutrients, but there is little effect of the nutrients on growth Foliar applied nutrients to ground covers such as pacysandra and English ivy produced much heavier plants three months following propagation than plants that had received no nutrients or slow-release nutrients in the root medium (2). For continued growth, a combination of root-applied and foliar-applied nutrients produced the largest, heaviest plants. Similar results were obtained with other rapidly growing plants such as privet and some floriculture crops.

However, some plants do not respond favorably to foliar nutrition. Surprisingly, some species of juniper are injured by foliar applications (2). Despite the injury, nutrients were absorbed and, after treatment, plants recovered quickly and grew well. Azaleas are very sensitive to nutrition and require only small amounts of nutrients during growth. A diversity of azalea cultivars was badly injured by even small quantities of

nutrients in foliar sprays, which caused defoliation and greatly suppressed rooting (1).

Today, there is much research directed toward finding the pathway by which foliar-applied substances move through the cuticle into the leaves beneath. Use of specific strains and electronmicroscopy has demonstrated the presence of structures which extend from epidermal cells up into the cuticle. The nature of these strands has not been determined conclusively, but it has been suggested that they are pectinatious materials which could offer a pathway by which substances in solution could pass from the outer leaf surface into the interior of leaves.

These results demonstrate that horticultural plants can absorb nutrients from sprays to the foliage. Foliar nutrition is an effective method of getting nutrients into plants and offers another management technique for progressive producers of plants. Today, foliar nutrition has been or is being investigated for use with fruit and vegetable crops, forestry plantings, agronomic crops such as soybeans and corn, as well as nursery and floriculture crops Although all the nutrient requirements for plant growth can be met by nutrient sprays, it is common practice to combine foliar and root applications for best growth The effective use of foliar nutrition depends upon the plant and the production system It may be that for rapidly growing crops that are making primarily vegetative growth, root applications would offer the most convenient methods. However, in plants which are being grown intensively with good environmental control, and with improved knowledge of growth patterns, foliar applications could allow a better control of nutrition.

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