

Foliar nutrition of plants

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It has been known for many years that plants are able to absorb essential elements through their leaves. The absorption takes place through the stomata of the leaves and also through the epidermis. Movement of elements is usually faster through the stomata, but the total absorption may be as great through the epidermis. Plants are also able to absorb nutrients through their bark.

The following elements have been successfully used to supply nutrients for plant growth by applying them as foliar sprays to the leaves:

Primary nutrients	Secondary nutrients	Micronutrients
Nitrogen	Magnesium	Iron
Phosphorus	Calcium	Zinc
Potassium	Sulfur	Boron
		Copper
		Molybdenum
		Manganese
		Chlorine

One difficulty in using foliar sprays to supply essential elements to crops is that translocation of the applied element may not be rapid enough for increasing crop yields. With some plants this problem is more difficult than with others. For example, the relative mobility of essential nutrients in bean plants when applied as a foliar spray in order of decreasing mobility, was as follows:

Mobile	Partially mobile	Immobile
Potassium	Zinc	Boron
Phosphorus	Copper	Calcium
Chlorine	Manganese	Sulfur
Nitrogen	Molybdenum	Iron
	Magnesium	

Role of foliar nutrition in plants : The predominant route for nutrients to enter plant tissue is via uptake through the roots. However, there are many situations where nutrition through leaves, fruit or shoots can be a very effective complementary delivery system. Leaves are not ideal for water and nutrient uptake, because their architecture is to protect crops against water loss as well as fungi and pest attack. The cuticle, (the outer cell layer on leaves sealed with wax) works as a barrier to the entrance of nutrients into the plant. However, nutrients in the ionic form can penetrate either through the cuticle via

small cracks or through the stomata, the pores in leaves for gas exchange.

Foliar applications can be done either with aqueous solutions or suspension of nutrients. Application rates are low, 0.5 to 10 kilograms of foliar fertilizer per hectare, dissolved in 50 – 2500 liters of water. The water rate depends on canopy size and density. Foliar fertilizers are often used to supplement micronutrients (Mn, Fe, Zn, Cu, B, Mo) and occasionally the secondary (Ca, Mg, S) and Primary nutrients (N, P, K).

Foliar application to treat absolute deficiency : All nutrients play an essential role for growth and development of crops. The shortage of a single nutrient becomes a bottleneck of production since vital metabolic pathways are impaired. As a consequence, shape and colour of crops deviates from those fully nourished. Visual symptoms can tell an experienced grower which nutrient is lacking. Foliar application of the nutrient concerned will provide an immediate relief of the problem and a normal crop yield can be achieved. Sometimes there are no visible symptoms, but foliar sprays are applied to treat latent deficiencies (hidden hunger). The need for such treatments is determined by a chemical analysis of the crop. For almost all crops critical nutrient values are available which indicate the adequate nutrient content in the tissue. If the analysis for a particular nutrient is below its critical value, foliar nutrition can be made to prevent the problem. Yield responses to foliar nutrition can be substantial.

Foliar nutrition to prevent deficiencies in fruits: Nutrient availability is not the only bottleneck for adequate nutrient supply to crops. Limited nutrient transport to different plant parts can also cause localized deficiencies. In particular the transport of boron and calcium in the plant relies on the transpiration flow, which means that tissue with low transpiration rates. Ex: Fruit, can easily become deficient in calcium and boron.

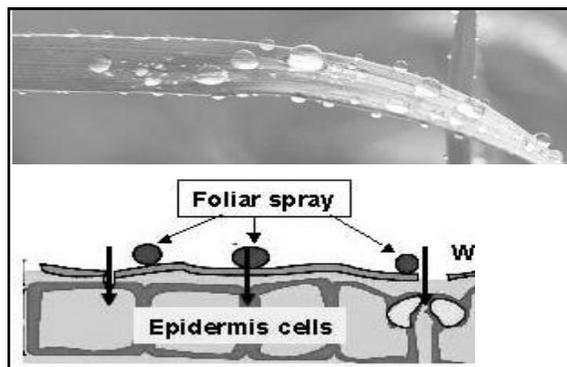
Efficient foliar fertilizers : Efficiency of foliar applications depends on crop type, leaf coverage, weather conditions and product quality. It is estimated that foliar treated crops will absorb about 15 – 40 per cent of nutrients applied. Efficiency of the foliar fertilizer is improved when the formulation contains additives like wetting agents to enhance the coverage of leaves or stickers that prevent nutrients being washed off by rainfall.

Proper timing of foliar applications :

Proper growth stage: This is one of the most critical aspects of a foliar feeding programme. Foliar applications should be timed to provide needed nutrients during the yield potential determining time frame of plant development, which will in turn favourably influence the post reproductive and development stages. Multiple, low rate applications may show the most favourable responses within these time frames whether a crop is nutritionally

sound or not. Careful crop growth stage monitoring on a weekly and sometimes a daily basis, is essential. A comprehensive plant tissue analysis programme taken just prior to the desired application is also essential to establish levels of plant nutrients most limiting to crop growth. DRIS (Diagnosis and Recommendation Integrated System) analysis of tissue tests is the best method of relating tissue nutrient levels to desired plant needs by ranking plant nutrients in order of most limiting to least limiting.

Proper crop condition: Generally speaking, crops that are nutritionally sound will be most likely to respond to foliar feeding. This is due to better tissue quality (allowing for maximum absorption of nutrients into leaf and stem) and better growth vigour (allowing for translocatable nutrients to be rapidly moved to the rest of the plant).



Crops under heat or moisture stress show less response to foliar applications due to lower leaf and stem absorption rates and/or poor vigour. However, foliar feeding does benefit crop performance and yield if an application was made prior to heat or moisture stress. Recovery from cold growing conditions and herbicide stress can be hastened with proper foliar applications. Good recovery of corn suffering from light to moderate hail damage has been shown where nitrogen-sulfur solutions were foliar applied.

Under most conditions, however, due to the practical and economic limitations on the amount of nutrients that can be foliar applied to give a favourable growth response, foliar feeding has a limited rescue capability.

Proper meteorological conditions: Environmental influences, such as time of day, temperature, humidity and wind speed influence the physical and

biological aspects of foliar applications. Plant tissue permeability is an important factor in absorption of nutrients into the plant: warm, moist and calm conditions favour highest tissue permeability, conditions found most often in the late evening hours, and occasionally in the early morning hours.....

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