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Foliar Feeding: How Plants Get Nutrition through Leaves

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Foliar feeding is a technique in plant nutrition where essential diluted nutrient solution is applied directly to the leaves of plants. Foliar feeding has been found to be the most efficient way to increase yield and improve plant health. Several studies have shown that foliar feeding can increase yields from 12% to 25% when compared to conventional fertilization. This technique is effective especially on horticulture crops for supplying secondary nutrients (Calcium, magnesium, and sulphur) and micro-nutrients (zinc, manganese, iron, copper, boron, and molybdenum). Unlike traditional soil fertilization, which relies on nutrients being absorbed through the roots, foliar feeding allows plants to obtain nutrients through their foliage. However, it's important to note that foliar feeding is not a replacement for soil fertilization. While it can supplement plant nutrition, it should be used in conjunction with a comprehensive soil fertility management program.

What are the benefits of foliar feeding?

The farmers are looking for ideal techniques to use nutrients effectively and also ecologically safe, and therefore foliar feeding is an attractive and preferred choice. The technique offers several advantages/benefits. Firstly, it provides a rapid and efficient method of delivering nutrients to plants, as the absorption process through leaves is often faster compared to root uptake. This can be particularly beneficial when plants are experiencing nutrient deficiencies or when immediate nutrient supplementation is needed. Additionally, foliar feeding allows for targeted nutrient application, enabling specific plants or plant parts to receive the required nutrients without affecting the entire soil ecosystem. It stimulates root developments which helps in better growth and development of plants along with improving quality of crop yield.

How do plants get nutrition through leaves?

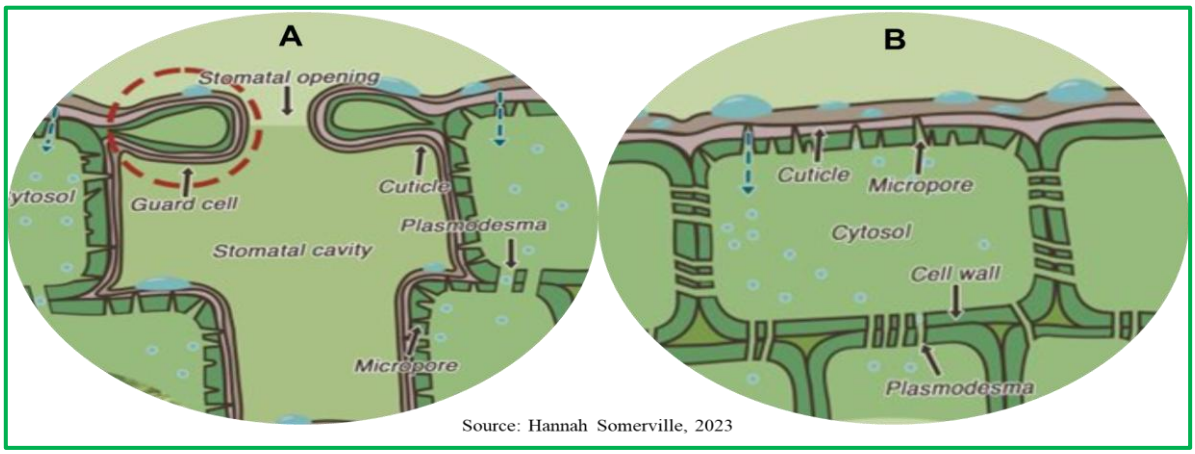
The applied spray droplets enter cells of the leaves through two pathways i.e., through small, cuticular micropores (A) and through the stomata (B).

A. Cuticular microspores: are very minute pores which line the leaf with a density of about ten billion pores per cm^3 of leaf surface. These pores are negatively charged, making uptake of negatively charged nutrients difficult (like HPO_4^{-2} phosphorus and NO_3^{-1} nitrate). But, uptake of positively charged nutrients like Ca^{2+}, K+, Mg^{2+}, and Z^{2+} are preferred.

B. Stomata: are specialized plant parts that open and close through the action of guard cells to allow gas and liquid entry deeper into the leaf. The cuticle is extremely thin over and within the stoma, allowing uptake to occur easily within the stomatal cavity.

Once the absorbed nutrients from the spray have moved through the microspores and stomata, past the cuticle, they enter the cell at the leaf surface. From here, nutrients can move deeper into the leaf via plasmodesmata (channels which connect the cytosol between individual cells). Nutrients can be utilized in the leaf, or moved to other parts of the plant. The absorbed nutrients move from the plant cells into transport tissues in the midrib and leaf

vein through plasmodesma connections. From here, they can be moved to the shoot, roots, or fruit for further utilization.



Source: Hannah Somerville, 2023

Key points for maximizing nutrient absorption through leaves

- Use adjuvants or surfactants in the nutrient solution to enhance penetration and spreading of nutrients on leaf surfaces. Adjuvants help to reduce surface tension and improve nutrient absorption.
- Foliar nutrients are recommended to apply early in the morning or late in the afternoon to avoid extreme temperatures and to allow sufficient time for nutrient absorption before the leaves dry.
- Choose appropriate chemical nutrients made with chelated nutrients and nutrient formulations based on the specific need of the plant which are easily absorbed by the leaves.
- Also, care should be taken in mixing different nutrients. Because, a few nutrients may compete for uptake or form insoluble precipitates when mixed together in a foliar spray solution.
- Use appropriate sprayer equipment, such as fine nozzles, that produce a fine mist or minute droplets size to ensure even distribution across the leaf surface.
- Avoid spraying of nutrients on stressed plants. Instead maintain proper irrigation for the plants and for better absorption capacity spray nutrients on healthy and actively growing leaves.
- Avoid spraying of nutrients during heavy rain, high winds, or extreme temperatures, as these conditions can affect the efficiency of nutrient absorption and may cause runoff.

However, it's worth noting that foliar feeding should not be the sole method of nutrient supply for plants. Excess application of nutrients may lead to burning of leaves and phytotoxicity. Hence, it is essential to maintain a balanced soil fertility for long-term plant health and enhance quality of crop yield.

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