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Foliar Application of Micronutrients in Vegetable Crops

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Abstract: -

Foliar nutrition, the application of nutrients directly to plant leaves, plays a pivotal role in enhancing the growth, yield, and quality of vegetable crops. Unlike soil fertilization, foliar feeding provides rapid nutrient uptake, bypassing root-related limitations. It is particularly beneficial under stress conditions such as drought, salinity, and nutrient lock-up in the soil. Foliar applications can correct micronutrient deficiencies more efficiently due to direct absorption through the leaf cuticle and stomata. Vegetables, being high nutrient-demanding crops, respond well to timely foliar sprays, especially during critical growth stages. This method ensures uniform nutrient distribution and minimizes losses due to leaching or fixation. Foliar nutrition enhances chlorophyll content, photosynthetic efficiency, and enzyme activity, leading to vigorous plant growth. It also improves flowering, fruit set, and the nutritional quality of produce. Crop-specific formulations and application timings are key for maximizing effectiveness. Research shows that foliar application of micronutrients like zinc, boron, and iron significantly boost vegetable productivity. Moreover, it helps in minimizing nutrient loss through leaching and volatilization. The synergistic use of bio-stimulants or plant growth regulators can amplify their effectiveness. In conclusion, foliar nutrition is a valuable tool for sustainable vegetable production and addressing hidden hunger in crops.

Keywords: Foliar nutrition, micronutrients, hidden hunger, bio stimulant, synergistic effect

Introduction:

Micronutrients, though required in minute quantities, are essential for the optimal growth, development, and productivity of vegetable crops. These elements—including zinc (Zn), boron (B), iron (Fe), manganese (Mn), copper (Cu), molybdenum (Mo), and others—play crucial roles in enzymatic activities, chlorophyll synthesis, hormonal regulation, and reproductive development in

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plants. However, due to factors like intensive cropping, imbalanced fertilization, soil pH extremes, and nutrient interactions, micronutrient deficiencies are becoming increasingly common in vegetable-growing areas. Such deficiencies often go unnoticed until significant yield losses occur, a phenomenon known as "hidden hunger." In vegetable crops, which are highly sensitive to nutrient imbalances and have short growing cycles, foliar application offers an efficient means of enhancing crop performance, yield quality, and resistance to abiotic stresses. Generally leaves uptake nutrient faster than the soil. Leaf is the place where photosynthesis occurs and produces different compounds which are necessary for plant growth. Foliar nutrient application is now getting more popular as it optimizes crop yield by encouraging crop growth at certain stages of growth, correcting nutrient deficiencies and enhancing tolerance to adverse crop growth condition. Foliar feeding do not have limitations like insoluble fertilizer run off, nutrient leaching loss, antagonism between certain nutrients, low dose etc. as in case of soil application.

Currently micronutrients are getting more popular among vegetable crops due to their beneficial nutritional support and also ensuring good yield and return per unit area. Due to the heavy utilization of chemical fertilizers like urea to increase the productivity is reducing the availability of micronutrients which leads to show micronutrients deficiency in plant. As micronutrients are required in low quantity so micronutrients are most suitable for foliar application.

Situation Favouring Foliar Nutrition:

Nutrient deficiencies during key growth stages of a crop can harm both the yield and quality of the produce. In such cases, spraying nutrients directly on the leaves (foliar feeding) can quickly fix the problem. Nutrients added to the soil often depend on many soil conditions to be effective, while foliar nutrients enter the leaves directly and are quickly used by the plant. In soils with high nutrient fixation or sandy soils that lose nutrients easily through leaching, nutrients applied to the soil may not be available to the plant when needed. Extreme soil temperatures—too low or too high—also reduce nutrient uptake. Without enough soil moisture, nutrients applied to the soil go to waste, and the plant may even wilt. In later stages of plant growth, the developing fruits demand most of the plant's energy, leaving less for the roots to take up nutrients. This slows down overall plant growth and yield. Applying nutrients to the leaves at these stages can help support the plant.

Factors Affecting the Efficiency of Foliar Nutrition:

The effectiveness of foliar fertilizers depends on factors like the type of crop, amount of leaf surface, weather conditions, and the quality of the fertilizer used. Their efficiency can be improved by adding wetting agents and stickers where wetting agents help the spray spread better on the leaves, while stickers help nutrients stay on the leaves even during rain (Shabnam and Kuruwanshi, 2015). It's important to apply nutrients at the right stage of plant growth so they can be properly absorbed and used. Applying smaller amounts multiple times during the right period often gives the best results. The size and shape of leaves affect how much spray is captured by the plant. The structure of the leaf surface, including the cuticle and wax layers, influences how easily nutrients can reach the plant cells. Leaf hairs can trap droplets on the surface, but too many hairs can reduce contact between the spray and the leaf. Environmental conditions like temperature, humidity, and wind speed also affect how well foliar feeding works. Fertilizers for foliar use must be fully water-soluble and should not leave any residue on the leaves. The spray concentration should be safe for the leaves while still allowing good nutrient absorption.

Advantages of Foliar Nutrition:

Foliar feeding of nutrients is a way of rapid correction of nutrient deficiencies and physiological disorders of crop plants. It is an effective means of reducing soil and ground water pollution (Fageria et al., 2009). Plants typically show a response to soil-applied nutrients within five to six days, while foliar feeding produces visible results in just three to four days. Foliar nutrition works efficiently regardless of soil conditions, allowing quick nutrient absorption through the leaves and even enhancing the roots' ability to take up nutrients from the soil (Kannan, 2010). Compared to soil application, foliar feeding is more environmentally friendly because it reduces the risk of nutrient buildup in the soil that could become harmful (Haytova, 2013).Foliar fertilization can be adopted throughout the growing season of crop which facilitates application of adequate amount of nutrients at the right time. Fertilizers can be mixed with compatible pesticides, which reduce plant protection costs.

Conclusion:

Micronutrients play a major role in growth and development of vegetable crops. Foliar application has a great role to sustain soil health and crop productivity besides maintaining nutritional quality of vegetable crops. It offers maximum benefits when it is applied in right concentration, right quantity and at right crop growth stage. Thus it can be concluded that foliar nutrition of micro nutrients is beneficial for increasing growth, yield and quality attributes of vegetable crops.

Effect of Foliar Application of Micronutrients in Vegetables:		
Micronutrient	**Crop**	**Effect**
Zn	Onion	When applied with 2,4-D(3ppm) as foliar spray increased the bulb weight, bulb yield
	Chilli	Zn @4ml/l is optimum for obtaining economical fruit yield
	Tomato	Zn @250ppm results maximum plant height, total dry weight, number and fresh weight of fruits/plant and yield
	Potato	Zn @30ppm increased the number of tuber, tuber yield/plot and tuber yield/ha
B	Broccoli	Borax @0.3% at 30 and 45 DAT gave maximum yield of 13.37t/ha
	Carrot	B @3Kg/ha gave the highest seed yield(1769.11kg/ha) whereas the lowest seed yield(1371.93kg/ha) without B
	Tomato	B @2kg/ha, enhanced number of flower clusters/plant, fruit set percentage, total yield, TSS
	Sugar beet	B @120 and 150 ppm improved root yield and percentage of white sugar content
Cu	Potato	$CuSO_4$ resulted increase in tuber yield
	Tomato	Cu @100ppm increases number of fruits/plant
Mo	Cauliflower	Mo @30 and 45µg/l improved curd yield
Ni	Tomato	Ni @15, 30, 45, 60ppm promote N, P, K content in fruits
Fe	Chilli	Fe @20kg/ha significantly increases the yield
		Fe @0.6 mg/l increases the fresh and dry weight, total uptake of Mn, chlorophyll content and total iron uptake

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