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RESEARCH ARTICLE

FOLIAR FEEDING AND ITS ROLE IN VEGETABLES- A REVIEW

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Abstract

Foliar feeding is characterized by a technique of feeding plants by applying liquid fertilizer directly to their leaves, its ability in uptake of nutrients which has been known for many years. Observed effects of foliar fertilization have included in yield increase, resistance to diseases and insect pests, improved drought tolerance and enhanced crop quality. Plant response is dependent upon the species, fertilizer form, concentration and frequency of application as well as the stage of plant growth. Foliar application is often timed to coincide with specific vegetative or fruiting stages of growth and the fertilizer formula is adjusted accordingly. In terms of nutrient absorption, foliar fertilization can be from 8 to 20 times as efficient as ground application. Foliar fertilization can efficiently supply nutrients during stages of high nutrient demand in crop and upsurge the nutrient content in crop foliage when the physiological efficiency of plant to take nutrients from soil is plummeted. Moreover, used to supplement soil fertilization, foliar fertilization has a great potential to give higher yield under intensive cropping system and also side-by-side enhance the quality, economic aspect, crop tolerance to diseases and drought conditions.

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Introduction:-

Foliar feeding is the process whereby liquid fertilizers are introduced to plant leaves. The ability of plants to take the essential nutrients is through the leaves, where the plant stomata of these leaves are typically quicker in their intake of nutrients compared to soil (Smolen, 2012). The leaves are green factories where the complex chemical processes of photosynthesis generate the compounds, plants required for growth. Fertilizers are absorbed right where they are used as acting quite quickly, whereas many soil fertilizers can never be used by plants. Nowadays, foliar feeding is a widely adopted strategy in modern crop management, where it is used to ensure higher or optimal crop performance by enhancing crop growth at certain stages of growth, correcting crop nutrient deficiencies and improving crop tolerance to adverse crop growth conditions. Foliar application overcomes soil

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fertilization limitations such as leaching, insoluble fertilizer runoff, antagonism between certain nutrients, low-dose heterogeneous soils and fixation / absorption reactions such as phosphorus and potassium.

Foliar fertilization feeds the plants not the soils. This statement, as stated by Justus von Liebig in the 19th century, considered one of the most effective approaches for plant mineral nutrition through foliar application. Approximately three centuries ago, plant leaves were recognized as able to absorb water and nutrients. In the early 19th century the application of nutrient solutions to plant foliage as an alternative means of fertilizing grapevines was noted (Pace, 1982). Recently, foliar fertilization, like horticultural crops, has been widely used and accepted as an essential part of crop production.

Reasons for foliar feeding

Nitrogen is the most energy-intensive element, and with it specific losses in the form of denitrification, volatilization, leaching, and fixation are more frequent than any other nutrient. Those problems can be eliminated by foliar nutrition with water soluble fertilizers. In addition, foliar applications of dilute nutrient solutions to complement the basal applications can also reduce nutrient wastage. The foliar fertilizers applied in the sandy loam are up to 20 times more efficient compared to the fertilizers applied in soil. When foliar fertilizers are applied, the plant uses more than 90 per cent of the fertilizer. Only 10 per cent of it is used when a similar amount is applied to the soil. The most effective way to improve yield and plant safety is by foliar fertilization. Tests have shown that when compared to traditional fertilization, foliar feeding can increase yields from 12 to 25 per cent.

Foliar application could be considered as one of the most common methods of supplying plants with the necessary nutrients in adequate concentrations and improving plant nutritional status, as well as increasing crop yield and quality. However, the management of fertilizers is very important due to its roles in plant growth and development or plant physiology and biochemistry, as well as plant disease control (Roy et al., 2006).

Typical concentration of nutrients in plant dry matter differs according to macronutrients i.e., Nitrogen 1.5%, Phosphorous 0.1-0.4%, Potassium 1-5%, Sulphur 0.1-0.4%, Calcium 0.2-1.0%, Magnesium 0.1-0.4% and micronutrients i.e., Boron 6-60 µg/g, Iron 50-250µg/g, Manganese 20-500µg/g, Copper 5-20µg/g, Zinc 21-150µg/g, Molybdenum <1µg/g, Chlorine 0.2-2%, Nickel 10-100mg/kg.

One of the most important factors in the absorption of nutrients by plant leaves, rainfall will reduce the effectiveness of application within 24 to 48 hours of a foliar application, as not all nutrient materials are instantly absorbed into the plant tissue. N (for urea) 30minutes-2 hours, P 5-10 days, K 10-24 hours, Ca 1-2 days, Mg 2-5 hours, S 8 days, Zn 1-2 days, Mn 1-2 days, Fe 10-20 days, Mo 10-20 days.

Not all fertilizers may be used as a foliar spray. A foliar application's primary objective is to allow maximum nutrient absorption into the plant tissue; therefore, foliar fertilizer formulations should meet certain standards to minimize the damage to the foliage. Fertilizers should have low salt index, high purity and high solubility. All in all, there are water soluble NPK fertilizers which are synthetic fertilizers (Polyfeed, Mono-ammonium phosphate, Mono potassium phosphate, Sulphate of potash, Multi K etc) and organic liquid fertilizers (Vermiwash, Panchagavya, Liquid fish, Cow urine, Sea weed extract, Compost tea, Water hyacinth, Pig weed red-root) which are available in the market sector.

Factors affecting effectiveness

The effectiveness of foliar feeding may be subjected to several factors. These factors can be divided into four major groups viz, spray solution, environmental conditions, leaf characteristics and plant state.

Table 1:- Environmental condition for better foliar application.

Time of day	Early morning; before 9:00 A.M Late evening; after 6:00 P.M.
Temperature	65-85°F, Ideal 21°C
Humidity	greater than 70% relative humidity
Temperature/Humidity Index	140-160
Wind speed	less than 5 mph

Environmental influences, such as time of day, temperature, humidity and wind speed influence the physical and biological aspects of foliar applications.

Equipment for spraying

The use of spraying equipment, i.e. low pressure or high pressure equipment is the most efficient form of foliar application. Spray equipment provides better placement for most, less loss by dripping, and more effective foliage coverage compared to other application methods. Commonly used are spray pumps, sprinkler system, hose end applicator and electrostatic sprayer, which is used in commercial farms imparts a charge to the spray particles and cause them to adhere more readily to plant.

Case studies

The application of 66 % recommended dose of fertilizer + 2.5 % foliar spray on cabbage showed positive impact on its growth (plant height, loose leaves/plant, leaf length & breadth), yield, quality (total soluble solids, fiber content, dry matter of head, chlorophyll content, ascorbic acid) parameters and highest B:C ratio. All in all, 33-50% of fertilizers requirement of crop could be meet-out by foliar spray which can positively abate the cost for purchase of fertilizers and obtain higher yield with acceptable quality head (Ganiger et al., 2017).

The impact of foliar application of water soluble fertilizers on growth, yield and quality attributes of Garlic was impressive. 100% recommended dose of fertilizer application with three sprays of polyfeed (19:19:19) at 30, 45 and 70 days increased growth, yield, quality and economical attributes and proved as a better technique (Mehta et al., 2017).

In potato, split up application was beneficial for maximum tuber yield and quality as controlled nitrogen application rate and better synchronization between applied nitrogen and potato nitrogen uptake was identified. Moreover, the nitrogen management (basal + top dressed + foliar) found more beneficial to the crop as compared to recommended dose of fertilizer (basal + top dressing) and control. It not only saves valuable nitrogen but also enhances the availability of it to the crop. 50% basal nitrogen + 25% top dressing at 25 days after planting + one foliar spray@ 2% urea at 40 days after planting) produced maximum tuber yield as well as maximum B: C ratio and is more suitable to improve most of the quality characters (Kumar et al., 2017).

The consequence of foliar application of a commercial aminochelate fertilizer (a commercial liquid fertilizer light brown in color, consisting of 2% N-amino acid, 2.5% Zn, 2% Fe, 1.5% Mn, 0.4% Mg, and 0.4% Cu) with respect to soil application of aminochelate and soil application of nitrogen, phosphorus and potassium fertilizer (NPK) on growth and yield production in three vegetable crops, i.e., tomato, cucumber, and green bean, in lime soil were significantly superior. Foliar application was performed six times during the growing season at a constant concentration of 0.2% for all three vegetable crops. Plants were foliar sprayed at 6-7am using a portable sprayer, with the upper and lower leaf surfaces were sprayed. The initial spraying was performed at the four-leaf stage for bean and at transplanting for tomato and cucumber plants. The remaining foliar applications were performed at one-week intervals for all three vegetable crops. The foliar application improved the plant growth, fruit yield/plant characteristics and L-ascorbic acid and total soluble solids in all three vegetable

resulted in a significant upsurge. In nut-shell, amino acids which increase nutrient bioavailability are considered precursors for protein synthesis, indicating their importance in stimulating cell growth. Aminochelates also provide a superior nitrogen source for plant uptake and use (Souri et al., 2017).

Growth, a plant's progressive development occupies an important place in a farming enterprise's profitability. By having adequate vegetative growth and maximum yield attribute, the reproductive efficiency and economic yield can be maximized. Here are some more vegetable with its beneficial aspects.

Crop	Fertilizers		References
Chilli	100 % N and K, 3 sprays= polyfeed (45, 60 and 75 DAS) & 2 sprays =multi K (75 & 120 DAS)	Highest number of fruits/ plant, dry fruit yield, higher net income and benefit cost ratio	(Palaniappan et al., 1999)
	50 % RDF + 50 % nitrogen through neem cake	Plant height, fruits, less diseases and pests	(Vitkar et al., 2007)
Cucumber	1% urea, 1.5% DAP and 1.5% KCl + 3/4 th of NPK RDF	Yield	(Karuppaiah et al., 2001)
Brinjal	Normal RDF + NPK 19:19:19	Highest dry matter production	(Karpagam et al., 2004)
Onion	polyfeed 19:19:19 one per cent at 15, 30 and 45 DAP and multi K 1% at 60, 75 and 90 DAP	Bulb yield and maximum net return	(Anon., 2005)
Cabbage	urea 0.8 % and 1.0 %	large and weighty heads	(Yildirim et al., 2007)
Cauliflower	N 1.5 % & 40 ppm zinc	Plant height, plant spread, number of leaves/plant, fresh weight diameter, dry weight, TSS, compactness, color and yield of curd q/ha and earliness in complete maturity of curd	(Yadav et al., 2014)
Broccoli	RDF 50% NPK + one foliar spray of amino magical	plant height, leaves number, fresh and dry weight of leaves, stems and apical heads	(Abou El-Magd et al., 2015)
Tomato	0.2% FeSO ₄ , Calcium nitrate, ZnSO ₄ and Boron 0.1%	Plant height ,girth, Days to first flowering, fruiting, Days to maturity, No. of fruits/plant, Fruit length, Fruit diameter, Fruit weight, Yield/plant and Yield/ha	(Dixit et al., 2018)

Table 2:- Some attributes shown by vegetables with different water soluble fertilizer foliar nutrition concentrations.

It can be concluded that foliar fertilization has a zenith place in vegetable production and the essential nutrients which are supplied via foliage plays vital role in plant life right from seedling stage to matured, post-harvest stage. Thus, foliar nutrient spray can be used widely, seen as an utmost impressive technique in coming days, for sure.

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