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MINI REVIEW

Foliar Nutrition: A Key to Utilize Production Potential of Horticultural Crops

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ABSTRACT

Agricultural scientists are day night busy; to evolve high yielding crop varieties and introduce most easy and economical crop production technology, for fulfillment of the food requirements of the population, growing up very fast. They have conducted various studies world over and reveals that soil analysis, land preparation, sowing time and methodologies, irrigation, interculturing, thinning, fertilizer application and crop protection techniques are basic principles and necessities. Among these, fertilizers play a vital role, because regular cultivation results nutritional deficient soils and the cultivation in nutritionally poor soils not only result slow growth process but weak plants easily hit by insect pests and diseases also. Therefore, fertilizer application become compulsory similar to food supplements and multivitamin and mineral supplements as are necessary for human being.

Traditionally only organic and or some inorganic fertilizers are used to enrich soils with basic macro nutrients such as nitrogen, phosphorous and potassium (NPK). Gypsum is also now frequently used to improve saline soils or zinc is applied in zinc deficient soils in case of rice cultivation. The micro nutrients are totally ignored by near about all illiterate and the growers having refusal or very less interest in cropping. Whereas, all 17 macro and micro nutrients are equally important for all crops (living plants and trees), for normal growth, development and production. Otherwise, the crop may initially produce the symptoms of such deficiency and in case of ignorance; the pests and diseases may easily hit the poorly developing plants and trees due to less resistance or more susceptibility in nutrition deficit plants or trees.

However, the yield of our crops is not satisfactory in all over country as well as many other countries of the world due to many constraints. Among those, fertilizer management plays an important role for obtaining satisfactory yield. In order to increase crop productively nutrient management may be achieved by the involvement of organic sources, biofertilizers and micronutrients (Singh and Kalloo, 2000). Modern crop fertility programs are complex in nature, resulting from the interactions of many factors. One important factor is fertilizer cost, which is a large portion of the crop production expenses.

Application of unrequired nutrients contributes to farming inefficiency and ground water pollution (Hochmuth, *et al.*, 2005). The balanced nutrients have been paid little attention in agriculture areas of developing world. The deficiencies of micronutrients have emerged in the farmer's field and are recognized as symptoms on foliage and reduction in the quality and yield of the crop. The benefit of micronutrients is not limited solely to the replenishment of the micronutrient itself but in addition micronutrient acts as catalyst in the uptake and use of certain macronutrients (Phillips, 2004). Recently, foliar fertilizers are widely used in vegetable and fruit crops, that contain various macro and micronutrients, which are essential for the proper growth and yield. Foliar fertilizer technology came into use early in this century, but did not become more common practice. After 1980s, the application of foliar fertilizers is the quickest way to deliver nutrients to the tissues and organs of the crop, and is proved that application of these micronutrients is beneficial to correct certain nutrient deficiencies (Anonymous, 2001).

What, How and Why?

Foliar feeding is the practice of applying liquid fertilizers to plant leaves. The leaves are green factories where the complex chemical processes of photosynthesis produce the compounds, plants needed for growth. Foliar fertilizers are absorbed right at the site where they are used as quite fast acting, whereas, much of the soil fertilizers may never get used by plants. For instance, 80% of the phosphorus applied through conventional fertilizers may get fixed up in the soil, but, up to 80% of foliar-added phosphorus directly absorbed by the plants (Donelon, 2005). Silberbush (2002) stated that foliar fertilization is widely used practice to correct nutritional deficiencies in plants caused by improper supply of nutrients to roots. Ca and B which are immobile in the plant should be applied in small amounts at high frequency rather than in one application for correcting temporary deficiencies in vegetables (Maynard and Hochmuth, 1996). Bhonde, *et al.,* 1995 evaluated the effect of zinc, copper and boron on onion crop. Bulb size and yield as well as quality of bulb enhanced when micronutrients were applied in combination instead of alone. The foliar application of zinc 3 ppm, copper 1 ppm and boron 0.5 ppm were found to give maximum net return to the growers. Naruka and Singh, 1998 applied two concentrations of urea

sprays (1 and 2%) and three concentrations of gibberellic acid (GA3) spray (50, 100 and 150 ppm); both urea and gibberellic acid application enhanced the growth and fruit yield of okra significantly. Tumbare, et al. (1999) applied NPK at recommended rate as solid fertilizer and as liquid fertilizer; the yield and yield component values increased with increasing fertilizer rate by liquid as compared to conventional application. Whereas, Palaniappan, *et al.,* 1999 applied N and K fertilizers (100 and 75% of recommended rate), Multi-K and Polyfeed (Both at 1%) foliar fertilizers and the combination of these two fertilizer sets on tomato. The application of 100% NK + 2 sprays of Polyfeed (30 and 45 days after sowing, DAS) + 3 sprays of Multi-K (60, 75 and 90 DAS) gave the highest tomato fruit yield, marketable yield, net income and benefit cost ratio. Similarly for chili, the treatment of 100% NK +3 sprays of Polyfeed + 2 sprays of Multi-K produced the highest number of fruits per plant, dry fruit yield, net income and benefit cost ratio. Increasing the frequency of Polyfeed spraying from 3 to 4 times do not increased the number of chili fruits per plant. Souza, *et al*., 1999 applied kumulus (containing sulfur) at 4 kg/ha to see the effect on cotton crop. Treatments with increased sulfur produced 11.5% more cottonseed then the untreated control. Naruka, *et al*., 2000 studied the effect of foliar application of zinc and molybdenum through foliar spray at 0.2, 0.4 and 0.6% and 30, 60 and 90 ppm, respectively. Increasing zinc and molybdenum levels resulted in increasing plant height, number of fruits, fruit diameter and fruit yield. However, increasing levels resulted increasing in growth and height fruit yield in okra. Selvi and Rani, 2000 reported that okra plants were treated with NPK (40: 50: 30 kg/ha) alone, NPK + micronutrients (MNS; soil application of FeSO4 at 50 kg/ha and Zn SO4 at 25 kg/ha, or foliar spraying of FeSO4 at 1.0% and ZnSO4 at 0.5%) or foliar and soil application of Microfood (SMF, 750 and 25 kg/ha, respectively). The highest yield, income and benefit cost ratio were recorded from NPK+SMF and MNS foliar treatment; whereas, lowest yield among the treated plants was recorded from the single NPK treatment. Barge, 2001 used the foliar fertilizers, ElamMax (27% Mn) at 0.5 pints/acre, Folizyme (12% N, 3% K, 3% Ca and 3% Mn) at 2q/acre, Keylate (5% Mn) at 2 pints/acre, White Label (6% Mn) at 2 pints/acre and Harvest More Urea Mate (N, P, K, Ca, Mg, B, Co, Cu, Mn, Mo and Zn) at 5 ponds/acre. All treatments resulted in higher yields of soybean than the control. Bajapai and Chauhan, 2001 worked on effect of zinc, boron and manganese and reported that all treatments significantly improved the performance of okra in terms of number of fruits per plant, fresh and dry fruit weight, seed per fruit and seed weight. Singh, *et al.,* 2002 reported that bulb diameter, bulb size index, total soluble solids, dry matter weight 20 bulbs, and gross and marketable yield of onion were highest with basal application of NPK and foliar application of 1% Multi-K 30, 45 and 60 days after planting.

Naresh and Singh, 2002 conducted study on the effect of zinc (0.2, 0.4 and 0.6 %), copper (0.1, 0.2 and 0.3%) and boron (0.1. 0.2 and 0.3%) on the yield components of litchi plants and observed significant improvement in fruit set, normal fruit, cracked fruits and fruit maturity in the treated plants over control. Mishra, *et al.,* 2003 also observed significant improvement in chlorophyll content and fresh weight of kinnow treated with zinc, iron and boron. Chattopadhyay, *et al.,* 2003 applied B at 0.28, 0.56 and 1.12 kg/ha and Mo at 0.1, 0.2 and 0.4 kg/ha alone or in combination (as single or double) to okra cv. *Pusa Sawani* in field experiment. Mo at 0.4 kg/ha resulted in the highest yield of 223.18 q/ha, while B at 0.56 kg/ha produced the highest yield of 222.71 q/ha. B at 1.12 kg/ha + Mo at 0.2 kg/ha produced the highest yield of 229.37 q/ha. Alkaff and Hassan, 2003 determined the effect of foliar application 0, 2, 4, 6g of power 4 on the growth and yield of okra plants. Foliar application of 4g of power 4/litre had the highest value for fresh and dry weight, number of pods per plant, average yield, average pod weight and early yield. Sharaf and El-Naggar, (2003) conducted field experiment to record the response of Carnation plant to phosphorus and boron foliar fertilization. The results showed that foliar application of P_2O_5 alone or in combination with different levels of B stimulated the length, diameter and dry weight of stem, number and dry weight of leaves per branch as well as enhanced flowering time, number, size and dry weight of flower per plant. The best results of vegetative growth and flowering characteristics were obtained at 200 mg P2O5 per liter plus 50mg B per liter.

Tuncay, *et al.,* 2004 investigated the effects of Superalg, NZN, Croptec and Polyfeed foliar fertilizers on yield and quality related characters of sunflower. They had significant effects on seed yield, seed height, seed/husk ratio, oil content, plant height, seed dry matter and stem yield ($P<0.01$). The best results were obtained from Croptec and Polyfeed fertilizers. However, according to economic analysis, NZN application had the highest gross margin per hectare. Alexander, *et al.* (2004) applied Boron (B) through Disodium Octaborate Tetrahydrate (DOT) in the form of Solubor as foliar spray @ 1.5g/l twice at 15 days interval and calcium (Ca) through Calcium Nitrate (CN) as Hydro Calcium Nitrate as soil application to supply top dressed N, twice @ 30 kg/acre. Among the various treatments, foliar spray of DOT with soil application of CN gave maximum yield of 20.93 t/acre and had a long shelf life of 12 days in comparison to control where yield of 16.63 t/ac and a shelf life of 4 days were recorded. However, many other experiments have been carried out on the effect of commercial foliar fertilizers alone and in combination with recommended NPK levels, on growth and yield potential of different crops. The results showed significant differences with reference to the data recorded on days taken to flowering, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit weight per plant, fruit yield per hectare, fruit quality and cost benefit ratio. Shekhar, *et al.,* 2010 reported significant increase in plant growth, yield and fruit quality characters *viz.* plant height,

plant girth, fruiting height, fruiting depth, number of fruit per plant, fruit yield (kg/plant and Q/ha), fruit size (fruit length and width), T.S.S., total sugars and ascorbic acid content with the foliar application of Copper sulphate 0.25 per cent+Manganese sulphate 0.25 per cent alongwith Borax 0.1 per cent Significant reduction in days taken to first flowering and acidity were recorded with same.

Foliar fertilizers are fast acting because these are absorbed right at the site where they are used. Foliar feeding of these fertilizers not only replenishment of micronutrients but, also act as catalyst in the uptake and use of certain macronutrients. Hence, where the crop is going to be sown in low fertile soils, these foliar applications must be applied.

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