

Review of Foliar Feeding in Various Vegetables and Cereal Crops Boosting Growth and Yield Attributes

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Abstract: Due to large scale cultivation of vegetables and cereal crops, depletion of nutrients occur from the soil. In Pakistan deficiency of nutrients greatly affect the crop production, if this situation is not handled on time it may lead to severe depletion of plant mineral nutrients from the soil of Pakistan. The alternative approach to these problems plant mineral nutrients is used through foliar spray form which is more effective and less costly. In the last decades foliar feeding was used to increase the yield of the various crops and this procedure improves nutrients utilization. The literatures regarding plant mineral nutrition through foliar form and related studies

Key words: Plant physiology • Nutrient • Foliar feeding • Vegetables • Growth • Yield

INTRODUCTION

History of Plant Mineral Nutrients: Seventeen (17) elements are required by plants for normal growth. C, H and O are taken from water and air. Other nutrients are obtained from soil. Primary nutrients are used by plants in comparatively large quantity and often complemented as fertilizers (Nitrogen, Phosphorus and Potassium). On the other hand, secondary nutrients like Ca, Mg and S are also utilized in large quantity but sufficiently supplied and are normally readily available. Micronutrients (trace elements) are required in minute quantity. Micronutrients nutrients are Fe, Zn, Mo, Mn, B, Cu, Co and Cl [1]. Glimpses of early history for research starting on essential nutrients for plant growth emerged in literature, which demonstrate that crop nutrition experiments were carried out by a Greek Philosopher Theophrastus during 287-372 BC. Later on several scientists performed a long chain of experiments to be familiar with the significance of mineral nutrients for normal growth of plants. Thus it appears that plant nutrition is possibly one of the earliest phases of quantitative study of plant physiology [2].

The question of mineral nutrients nature remain unrealized since plants ashes composition does not illustrate whether a certain element found is essentially needed for survival or whether it is just roughage. The complexity was clarified by the rediscovery of

hydroponics technique by plant physiologist J. V Sachs. It allows them to make precisely defined nutrient solution and to determine the effect of anion and cation on plants growth. Experiments of J. Woodward shows that in rain water, plant growth is improved as compared to river water and that after the water had taken up solutes from soil growth was promoted. J. V Sachs and a chemist A Stockhardt together make the first usable synthetic nutrient solution. While performing experiments with iron free nutrient solutions, the importance of iron was also recognized by him. The importance of root hairs nutrients uptake was also determined by Sachs. At the same time very often used nutrient solution was also developed by J.A.L.W Knop (1861). The experiments determine that the cation (K^+ , Mg^{2+} , Ca^{2+}) and small quantity of Fe^{2+} and Fe^{3+} and also anions (SO_4^{2-} , $H_2PO_4^{4-}$, NO_3^-) are important for plants survival and normal growth. From 1860's to 1940's, plants mineral nutrition was also studied by different other scientists [2].

When in 20th century the requirements to the chemical purity increased. The fact comes in front that a number of other additional elements are also required by plants. These elements required in much smaller quantity by plants for their growth were called trace elements. At the time nutrient recipes for best possible growth of plants were developed by different plant nutritionists including [3]. A most detailed review elaborating

methodology for finding essential minerals were discussed by [4] in the book of water and sand culture methods while studying plants nutrition. Other basic concepts about plants nutrition were explained in another book “Mineral Nutrition of Plants: Principles and Perspectives” by [5]. Another book “Mineral Nutrition in Higher Plants” published by Horst Marscherin in 1989 and 1996 fully describes about essential minerals of plants [2].

Importance of Foliar Mineral Nutrition: In agriculture practices fertilizer is an important source to increase crop yields. Among fertilizer application methods, one of the most important methods of application is foliar nutrition because foliar nutrients facilitate easy and quick consumption of nutrients by penetrating the stomata or leaf cuticle and enters the cells [6]. Due to several compensations of foliar application methods like quick and proficient response to needs of plants, less needed products and soil conditions independency, the concentration towards foliar fertilizers is arising day by day. It is also determined that during crop growth supplementary foliar fertilization increase plants mineral status and improve crop yields [7].

The function of nutrients is one of the chief importance in improving quality and productivity of vegetables which require mineral nutrients in large amount and continuous inorganic fertilizers consumption which results in micronutrients deficiency, disproportion in physiochemical properties of soil and low production of crops. For that reason these minerals are practiced in foliar form [8]. Foliar application is most effective when roots are incapable of absorbing required amount of nutrients from soil due to some reasons like high degree of fixation, lack of soil moisture, losses from leaching and low soil temperature [9]. The mineral nutrients assimilation rate by plants aerial parts is not only different among plant species but also among many different varieties of the same plant species [10].

Nutrients foliar application at proper growth phases is essential for their consumption and improved crop performance [11]. As fertilizers application is complicated to apply through top dressing or placement. Therefore the scope of foliar fertilization is best suited for Rabi pulses [12]. Foliage applied micro and macronutrients at critical stages of crops were efficiently absorbed and translocated to the developing pods, which generate much filled and more number of pods in soybean [13]. The presence of nutrients like Nitrogen, Phosphorus, Potassium, Sulfur and Magnesium are essential in balanced form for major processes of development of

plants and production of yield [14]. Plants also require the trace elements (B, Cu, Mn, Zn and Mo) for their normal growth and development [15].

Effect of Foliar Mineral Nutrients on Various Plants:

Foliar application of Urea also confirmed advantageous effects like better yield and enhanced crop quality as stated in many species of vegetables i.e. Onion, Squash, Cabbage, Cucumber [16, 7]. Micronutrients foliar application is one of the safest and most efficient techniques for plants growth [17]. Foliar application of Fe, Mn and Zn considerably boost the growth and yield parameters of Mung bean plants [18]. Ramesh and Thirumurugan [19] determined that different results of foliar applications of 2percent DAP and 1 percent KCl along with benzyladenine 25 ppm had significantly increased the plant height in soybean. Azarpour *et al.* [20] reported that the effect of foliar spray on cowpea plants with humic acid at the concentration of 50mg/L in presence of the N fertilizer (45kg/ha) produced the highest values of seed yield, number of pods/plant, number of seeds/pod, pod length, seed length and seed width.

Eman and Mogied [21] as they noticed that foliar application of urea increase the grain yield. Narang *et al.* [22] observed that foliar application spray of potassium increase grain yield. Zafer and Muhammad [23] reported that foliar as well as soil applied treatments of nitrogen increased yield of wheat. Thiyageswari and Ranganathan [24] as they found effect of foliar application of nutrients along with the recommended dose of nutrients on the dry matter production and yield of soybean. They also reported that foliar application of NPK with MnSO₄, ZnSO₄, Sodium molybdate and boron yielded the highest seed yield of 1832 kg ha⁻¹ followed by foliar application of boron (1398 kg ha⁻¹) as against the recommended NPK (1225 kg ha⁻¹). Anitha *et al.* [25] found that combined spraying of 0.5 per cent FeSO₄ and 0.5 per cent ZnSO₄ at 45 DAS proved most effective and increased the seed yield by 43.1per cent when compared to control.

Sarkar and Mukhopadhyay [26] recorded that foliar spray of 0.5 per cent KNO₃ solution at 50 per cent flowering stage significantly increased the grain yield of high yielding and traditional cultivars by 49.1 and 19.3 per cent, respectively over control in rice. According to Manivannan *et al.* [27] investigated that foliar application of N, P and K with chelated micronutrients has increased the grain yield of blackgram. Pothiraj *et al.* [28] revealed that foliar spray of NAA 40 ppm at 45, 60 and 75 days after sowing with di-ammonium phosphate (3 %) increased the seed cotton yield compared to water spray.

CONCLUSION

Recently the work related to plant nutrition reported by various scientist has come to conclusion that foliar application of macro and micro nutrients play an important role in the production of good crop and higher yield.

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