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Foliar Application of Plant Mineral Nutrients on Wheat: A Review.

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ABSTRACT

In agriculture practices fertilizer is an important source to increase wheat yield. 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. It is determined that during crop growth supplementary foliar fertilization increase plants mineral status and improve crop yields. Foliar feeding of mineral nutrients at tillering, jointing, booting and various stages of wheat crop in utilization of nutrients has been shown much effective and increase the yield. Keeping these facts in view, the literatures on foliar application of plant mineral nutrients on growth and yield of wheat are reviewed in this paper.

INTRODUCTION

In Pakistan, wheat (*Triticum aestivum* L.) member of Poaceae family is known as the “king of cereal crops” and is an essential food used in Pakistan, India and all over the world. Wheat grain products are one of the main constituents of our daily diet. Wheat is number one food grain crop which is directly consumed by the human beings and also leading other cereals like maize, rice, oat, barley, millet and sorghum in production all over the world. Wheat is a chief food for the inhabitants of Pakistan, and provides protein and calories necessities more than 60% in everyday diet. Niacin and thiamine daily needs are provided by wheat and also can meet the total day to day needs of riboflavin and iron. About 70% of the total produced wheat is used in unleavened flat bread form known as chapatti in Pakistan while especially in Khyber Pakhtunkhwa leavened form bread is prepared from it which is known as (Khamiri roti) by the local inhabitants. The rest 30% is utilized other bakery foodstuffs like pastries, bread, Cakes and cookies etc. The study of how plants obtain and use mineral nutrients is called mineral nutrition. This area of research is central to modern agriculture and environmental protection. High agricultural yields depend strongly on fertilization with mineral nutrients. In fact, yields of most crop plants increase linearly with the amount of fertilizer that they absorb. 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. The function of nutrients is one of the chief importance in improving quality and productivity of cereals which require mineral nutrients in large amount and continuous inorganic fertilizers consumption which results in micronutrients deficiency, disproportion in physiochemical properties of soil, low production of crops and in Pakistan deficiency of nutrients greatly affect the crop production, if this situation is not handled on time it may lead to severe deletion of nutrients from the soil of Pakistan For that reasons these minerals are practiced in foliar form. Foliar form of 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.

Effect of foliar macronutrients on growth and yield attributes

A field trial in the ecological conditions of Tokat-Kazova to investigate the efficiency of TSP and DAP as phosphorus sources effects on the grain yield and attributes of winter wheat Bezostaja-I and Kirkpınar-79

cultivars [9]. Effects of the treatments applied on appearance period, number of plants m^{-2} and grain yield in the 1st year found significant, while all attributes were significantly affected in the 2nd year.

Field experiments were conducted at different locations to investigate the effect of foliar treatment of nitrogen and potassium on wheat plant under at Punjab [13]. The foliar treatment of KCl along with N results in maximum biological yield 10938. Among different applications, effect of foliar K was significant on wheat (Chakwal-86). The investigation revealed that both potassium sources i.e. KCl and KNO_3 are similar efficient in maximizing the wheat yield.

Mosali *et al.* [14] carried out three field experiments to study the response of winter wheat grains yield, phosphorous uptake and use efficiency to foliar P 12 different amounts. P foliar treatment at Feekes seven commonly the grains yield higher and phosphorous uptake against non-foliar phosphorous. While phosphorous applied at Feekes 10.54 use efficiency was maximum. Obtained findings of the investigation suggested that mid-season P deficiency in winter wheat might be recovered through low amounts of foliar applied P.

Jamal *et al.* [11] planned an experiment to determine the effect of foliar and soil applications in various NPK concentrations which were: KH_2PO_4 , K_2HPO_4 and NH_4NO_3 on the yield attributes of wheat plant. When treatment applied collectively through foliar and soil the grain yield improved. In wheat the soil treatment yields good results than foliage NPK.

A set of experiments were designed to investigate the response of wheat plant to different foliar nutrients and soil application. Various concentrations of NPK (KH_2PO_4 , NH_4NO_3 and K_2HPO_4) were applied. The findings showed that vegetative and yield characters increased when application was used either through foliage or soil and both together, whereas it was lowered when applied individually through foliar. It was concluded that the application applied collective through foliar and soil yield improved results [10].

Amal *et al.* [3] carried out two field experiments to study the response of two wheat cultivars to foliar fertilizers of urea and potassium on growth and productivity at Egypt. Foliar fertilizer of urea and potassium caused significant stimulatory effect on growth parameters, however, foliar feeding with urea 2% + 2 K O 2% gave the highest significant values for all growth characters at 65, 90 and 115 days after sowing and also for yield and its components i.e. plant height, number of spikes $/m^2$, weight of spikes $/m^2$ as well as grain, straw and biological yields / feddan.

A field trial was investigated to determine the effect of foliar application of 1% K on various growth phases of wheat cultivars (Lasani-2008, Auqab-2000) under limited conditions of H_2O at Faisalabad [4]. Foliage treatment of potassium at all 3 main growth phases enhanced the drought tolerance of plants and increased the growth and yield attributes, whereas stage of grain filling was more responsive to the drought stress.

An experiment was conducted in (RCBD) setup with 4 replicates to examine the response of wheat varieties to foliar and soil treatment of N and S at KP, Agricultural University Peshawar. N and S treatment significantly increased the number of spike m^{-2} , number of grains spike⁻¹, (1000) grain weight and grain yield. The result concluded that foliar nitrogen and sulphur at the amount of 10 to 15% would increase the grain yield and yield attributes of wheat during various growth phases in the investigation area and contributed significantly to maximum outcome [16].

Effect of foliar micronutrients on growth and yield attributes

Two field experiments were conducted at Egypt to determine the results of foliar micronutrients and FYM at amounts of 0 and 20 $Mg\ ha^{-1}$ on growth and yield of wheat [8]. The summaries of obtained results are as under: Quantitative yield characteristics increased significantly by FYM in all as compared to control. Foliar micronutrients (Boron, Molybdenum and Zinc) gave the maximum mean values of all investigated yield parameters. There significant findings were achieved by the interaction between micronutrients spray, FYM addition and the application of FYM adding with foliar application of micronutrients (Boron, Molybdenum and Zinc) was the superior.

To evaluate the effect of foliar application of zinc and boron on yield and yield components of wheat, the present experiment was conducted at Agricultural Research Farm of NWFP Agricultural University Peshawar [2]. Solutions of zinc, boron and zinc plus boron were used as foliar spray, each applied at tillering, jointing and boot stage. Significant increase was recorded in number of spikes m^{-2} , grains spike⁻¹, thousand grain weight, biological yield and grain yield for foliar application of zinc and boron as compared to both control treatments.

Yassen *et al.* [17] carried out experiments to investigate the response of wheat, its yield and growth to foliar spraying with (1%) urea and various applications of micronutrients (Iron, Zinc, Mn) on growth and yield at Egypt. The results revealed that foliar spray of 1% urea gave higher significant 1000-grain weight. Whereas the interaction

effect of micronutrients spraying and 1% urea showed optimistic results on all the attributes and also showed significant increase in grain and straw yields.

Field experiments were carried out to study the response of wheat crop cultivar (AS-2002) to Zn as Zinc sulphate at Adaptive Research Farm and Farmer's fields of Thal desert, district Layyah. The results indicated that maximum grain yield was observed with each incremental zinc dose reaching the threshold level of zinc sulphate at 22.5 kg per ha ^[1].

Khan *et al.* ^[12] carried out a field experiment to check the response of wheat to market available micronutrient application "Shelter" (Zinc = 2%, Iron = 1%, Manganese = 2%, Copper = 1%, Boron = 1%). Shelter treatment significantly enhanced the number of grains spike⁻¹, weight of 1000 grains, straw yield, grain yield, biological yield and harvest index at different growth stages of wheat. In conclusion, commercially available foliar application may be useful to improve the wheat crop.

Nadim *et al.* ^[15] studied the physiological and yield parameters of wheat variety Gomal-8 using various levels of micronutrients singly and in different combined forms. The findings revealed that treatment of B @ 2kg /ha improved crop wheat growth rate (33.40g /m² per day) and grain yield (3.67tonnes/ha). Though, the application of Cu @ 8kg /ha produced the highest number of tillers (249 /m) and statistically grain yield (3.62 tonnes /ha). The observations showed that B treatment increase the wheat grains yield whereas the application of Cu and Mn also showed optimistic results on wheat production.

El-Fouly *et al.* ^[7] conducted a pot experiment to study the foliar micronutrients application effect on wheat variety Gemiza 3 improving for NaCl tolerance. Experimental findings revealed that increasing concentration of salt reduced the nutrients and uptake growth. N, P, K, Ca, K/Na, Mg/Na ratios, Fe, Mn, Zn and Cu were lowered as NaCl levels raised, while sodium was increased. Obtained findings of this investigation suggest that for increasing tolerance in wheat against salt stress foliar application of micronutrient may have a potential role.

Bameri *et al.* ^[5] conducted a field trial to investigate the response of growth and yield of wheat to foliage micronutrient treatment at Iran during 2010. The findings revealed that foliar micronutrient significantly improved height of plant, number of spike plant⁻¹, number of grain spike⁻¹, grain yield, 1000 grain weight, biological yield and harvest index (%). Mn+Fe treatment had the maximum optimistic effect on yield characters and grain yield. The study results suggested that foliar micronutrient had better effect on growth and yield of wheat.

An experiment was proposed to determine the effect of foliar and soil application of zinc on wheat. The results revealed that the combine effect of soil treatment and foliar treatment showed dominancy for all the parameters and also showed 80% improvement in Zn content of grain ^[6].

CONCLUSION

In respect of the above review it can be concluded and suggested that the foliar plant mineral nutrients improves the vegetative and yield components of wheat in comparison with the soil applied nutrients. It is also very beneficial when roots are unable to absorb the nutrients from soil due to the interference of various edaphic factors such as; low soil temperature, lack of soil moisture and loss of nutrients due to leaching. So, foliar application can be considered as the beneficial practice for the production of wheat.

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