academicresearchJournals

Vol. 2(7), pp. 97-101, December 2014
DOI: 10.14662/ARJASR2014.033

ISSN: 2360-7874©2014 Academic Research Journals
http://www.academicresearchjournals.org/ARJASR/Index.htm

Academic Research Journal of Agricultural Science and Research

Full Length Research

Foliar Application of Boron on Some Yield Components and Grain Yield of Wheat

Hamzeh Mohmmed Rawashdeh[1, 2*] and Florin Sala[2]

[1]Water Management and Environment Research Department, National Center for Agricultural Research and Extension, P.O. Box 639, Baqa 19381, Jordan
[2]Banat's University of Agricultural Sciences and Veterinary Medicine, "king Michael I of Romania", Faculty of Agricultural Sciences, Department of Soil Sciences and Plant Nutrition, Aradului Street, no. 119, RO-300645, Romania
[*]Corresponding author**:** Mobile: +40730184687/ +962777260163, Fax: +40256 277 126, E-mail address: hamz_rawashdeh@yahoo.com (M.R. Hamzeh)

Accepted 11 November 2014

Foliar fertilization or foliar feeding is one of the most important methods of fertilizer application In agriculture practices fertilizer because foliar nutrients facilitate easy and quick consumption of nutrients by penetrating the stomata or leaf cuticle and enters the cells. Foliar application of Boron single or shared with other micronutrients had positive effect on growth, yield and yield parameters of wheat crop. In optimizing fertilization strategies, addition of foliar application develops fertilizer use efficiency and reduces soil pollution. Foliar application of Boron single or shared with other micronutrients at different growth stages have been shown to be effective in efficient consumption of Boron by wheat and thus increase grain sitting and increase the grain yield, number of grains per spike, number of spiklet per spike and thousand grain weight. Preservation this in outlook, the literatures on foliar application of Boron on the yield and yield components of wheat are reviewed in this paper.

Keywords: Wheat, foliar fertilization, foliar feeding, yield components, Boron, micronutrients

Cite this article as: Hamzeh MR, Florin S (2014). Foliar Application of Boron On Some Yield Components and Grain Yield of Wheat. Acad. Res. J. Agric. Sci. Res. Vol. 2(7) pp. 97-101.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important cereal crop, source of staple food and as a result the most important crop in food security potential. Supplementary of the earth's surface is wrapped by wheat more than any additional food crop. Wheat produce is the third major cereal production in the world, following maize and rice. (FAO, 2013).

The average total Boron concentration in soils in the range of 20-200 ppm dry weight, most of which is unreachable to plants (Mengel and Kirkby, 2001). The available concentrations also vary greatly from soil to soil. Most soils have less than 10 ppm B and many areas of land are poor in B (Woods, 1994). Furthermore, the preponderance of this Boron is immobilized in rocks and not ready available for plants.

Plant needs 17 elements for regular growth. O, C and H are taken from air and water. Supplementary nutrients are achieved from soil. Primary nutrients are used by plants in comparatively large quantity and often complemented as fertilizers (N, P and K). On the other hand secondary nutrients like Ca, Mg and S are also consumed in large quantity but adequately supplied and are normally readily available. Micronutrients take place in very small amounts in both soils and plants, but their role is frequently as important as the primary or secondary nutrients. Micronutrients consist of 6 essential elements: Fe, Mn, Zn, Cu, B and Mo (Steven, 2000). Macro and micro nutrients are playing an important

function in growth, development improving quality and productivity of cereals (Raun and Jhonson, 1999)

Boron is, of all the micronutrients, the least understood. Boron is neither an enzyme constituent nor does it affect enzyme activities in the plant. Boron, however, is involved in or plays a major role in a number of plant functions, some of which are not clearly understood, but in the absence of Boron, these processes are greatly affected (Cheng and Rerkasem, 1993; Dell and Huang, 1997; Rerkasem and Jamjod, 2004).

Boron affects at least 16 functions in plants. These functions include: cell wall structure, membrane stability (Brown et al., 2002), sugar transportation, and phenol, carbohydrate, nucleic acid and IAA (indole acetic acid) metabolism (Parr and Loughman, 1983; Marschner, 1995). pollen germination (Wang et al., 2003) flowering, seed development (Brown et al., 2002) and grain sitting in wheat (Taher et al., 2009).

Wheat plant has generally been considered to have a low requirement for Boron (Marten and Westermann, 1991). A number of studies have showed that applying Boron as single or associated with other micronutrients to soil and/or foliar application significantly improved growth, yield and yield components.

Foliar sprays of Boron is most useful when roots of plants are not able to absorbing required amount of Boron from soil due to the soil chemical and physical properties such as pH, organic matter, calcium carbonate, soil texture, soil moisture temperature, cultivation, microbial action and losses from leaching, Therefore foliar applications of micronutrients are recommended to be applied for enhanced crop nutrition and increased crop growth, which will assure higher yields and improve grain quality.

RESULTS

Effect of Foliar Application of Boron on Some Yield Components

Number of grain per spike is an important yield participating parameter and has a direct consequence on the grain yield of wheat (Tahir et al., 2009). Gunnes et al. (2003). They reported that 1000-grain weight was significantly increased when Boron was sprayed on wheat at proper stage.

Wongmo et al. (2004) explored that Boron insufficiencies caused reduction in grain setting in form of decreased number of grain per spike and grains per spikelet at the same time as in barley, low Boron significantly inferior the number of spikelet per spike by 23 to 75 percentages in addition enthused terminal spikelet worsening.

Khan et al. (2006) found that Boron application at rate one kg B ha^{-1} significantly increased 1000 grain weight as compared to control.

Tahir et al. (2009) showed that, Foliar application of Boron in wheat at four different growth stages i.e at tillering, jointing, booting and anthesis increased number of grain per spike over control. The maximum number of grain per spike was obtained in treatment where Boron was sprayed at booting growth stage. Number of grain per spike increased 11.73 percent as compared to control. While Mitra and Jana (1991) who reported that Boron application significantly increased the number of grains per spike.

Ali et al. (2009) observed that foliar application of Zinc and Boron at 20 g L^{-1} and 30 g L^{-1}, respectively significantly increased number of spikes per square meter, grains per spike, 1000- grain weight, biological yield and grain yield as compared to control., during both growing seasons. Highest number of grains per spike was produced by combined application of both Zinc and Boron

Tahir et al. (2009) expressed thousand grain weight has a straight effect on final grain yield of wheat crop. More the weight of grains, better will be the grain yield also he found that 1000- grain weight increased when Boron was applied at jointing stage which was at par with the treatments where Boron was applied at tillering, booting and anthesis stage.

Nadim et al. (2011) found that application of Boron at 2 kg ha^{-1} with basal dose of NPK significantly improved the number of grains per spike.

Rehman et al. (2012) reported that foliar application of Boron at 1250 mL ha^{-1} in booting stage increased number of grain per spike. The number of grain per spike increased 16.65% over control and also found that application of Boron at booting stage increased thousand grain weight (22.50%) over the control.

Nadim et al. (2012) found that soil and foliar spray application of Boron at 2 kg ha^{-1} increased thousand grain weight in wheat plant and increased number of grain per spike (54.25) as compared to side dressing and soil application.

Moghadam et al. (2012). reported that foliar application of Boron no significant effect on 1000 grain weight. Ali et al. (2009) found that Combined foliar application of both Zinc and Boron significant increase thousand grains weight. Thousand grains weight increased 4.88% over control treatment.

Hussain et al. (2005) found that foliar application of Boron at three growth stages of wheat i.e. at tillering, booting and milking significant improvement in number of grains per spike and 1000-grain weight.

Foliar application of micronutrients mixture ‘Shelter’ containing (Fe = 1%, Mn = 2%, Zn = 2%, Cu = 1%, B = 1%) at various growth stages improved 1000- grain weight in wheat (Kahn et al., 2010).

Tahir et al. (2009) articulated the more harvest index will be for the reason of the physiological potential for

converting dry matter into grain yield. Effects of Boron application on harvest index were claimed the most effect of Boron application on harvest index was reported at anthesis stage in wheat.

Pandey and Gupta (2013) reported that foliar application of Boron at all stages increased the yield parameters like number of pods, pod size and number of seeds formed per plant, also improved the seed yield and seed quality in terms of storage seed proteins and carbohydrates in black gram. Krudnak et al. (2013) found that B application at planting date could increase pollen viability and percent seed set of sunflower.

Effect of Foliar Application of Boron on Grain Yield

Grain yield of wheat crop is the result of combined effect of various yield contributing components (Tahir et al., 2009). Different experiments have been conducted to evaluate the response of wheat to Boron application and a wide range of genotypic variation in response to Boron absence and toxicity (Rerkasem and Jamjod, 1997; Paull et al., 1991).

Li and Ling (1997); Shaaban et al. (2001) reported that improved growth and high-quality yields were attained when crops were supplied with Boron.

Helder et al. (2007) found that appliation 2 kg Boron ha^{-1} produced significantly highest yield in both the years of study.

(Chaudhry et al. 2007) stated that micronutrients (Zn, Fe, and B) significantly increased the wheat yield over control when applied single or in combination with each other.

The ten winter wheat cultivars tested differed significantly in their nutritional demands for Boron. At the same concentration of Boron in soil, four out of ten wheat cultivars responded to foliar Boron application with 8.6-15.2% grain yield increase while the other six cultivars did not respond to the treatments (Korzeniowska, 2008).

Foliar application of Boron at reproductive stage enhanced grain yield and different yield components of wheat (Wroble, 2009; Ahmad and Irshad, 2011).

Application of Boron in wheat at tillering, jointing, booting and anthesis stage significantly increased grain yield when Boron was applied (Tahir et al., 2009).

Moeinian et al. (2011) found that foliar 1% Boron increased grain yield of wheat under drought stress. Also found that the proline content of grain and gluten percentage of the grain was significantly affected with Boron foliar spraying and irrigation treatments.

Soil application of Boron fertilizer has positive impact on the yield and different yield components of wheat, rice and cotton crop. Thirty one field experiments were conducted to evaluate the response of wheat, rice and cotton to Boron application the results showed that the soil application of Boron fertilizer has positive impact on the yield and different yield components of wheat, rice and cotton crop. Soil application not only considerably raises yield of these crops but it is as well inexpensive and effortless to utilize for the farmers. (Ahmad and Irshad, 2011).

Soylu et al. (2004) who concluded that grain yields in all genotypes of wheat crop were increased significantly by the application of fertilizer Boron as compared to control.

Moghadam et al. (2012) found that foliar application of Boron and Zinc had positive effect on yield and yield components of wheat.

Chaudhry et al. (2007) stated that micronutrients (Zn, Fe, and B) significantly increased the wheat yield over control when applied single or in combination with each other.

A field experiment was conducted to evaluate the response of wheat to market available micronutrient application (Fe = 1%, Mn = 2%, Zn = 2%, Cu = 1%, B = 1%). The results showed that application of micronutrient significantly enhanced the number of grains per spike, 1000-grain weight, grain yield, straw yield, biological yield and harvest index at different growth stages of wheat. In conclusion, commercially obtainable foliar application may be useful to get better the wheat crop (Khan et al., 2010).

Nadim (2011) study the physiology and yield attributes of wheat using different levels of Zn, Cu, Fe, Mn and B alone and in different combinations, he found that the use of micronutrients significantly affected wheat yield. Among micronutrients, the application of Boron at 2 kg ha^{-1} and Copper at 8 kg ha^{-1} had significantly positive effect on most of yield contributing parameters of wheat.

Wrobel (2009) and Uddin et al. (2008) found that the foliar fertilization with Boron has a positive effect on the main wheat yield components, significantly improving grain yield.

Raza et al. (2014) reported that foliar application of Boron was significant affected on grain yield, number of grains spike-1and 1000 grain weight. The highest grain yield of wheat (6.5 ton h^{-1}) was observed when 20 mg L^{-1} Boron was applied.

Zahoor et al. (2011) A field experiment as carried out to determine the effect of different application rates of B on yield and quality of cotton. The results showed that B application at any stage improved plant growth and photosynthetic rate, leaf nitrogen, achene oil, seed yield and protein contents of sunflower plant.

Kandi et al. (2012) found that B foliar application on safflower plant had the highest positive effect on plant biological yield, harvest index and seed Boron content.

CONCLUSION

In respect of the above review it can be concluded and suggested that the foliar application of Boron single or in combination with other micronutrients improves the yield

attributes and grain yield of wheat in evaluation with the soil applied Boron. It is besides very useful when roots are unable to absorb the Boron from soil due to the several factors including; Soil reaction (pH), organic matter, low soil temperature, rainy weather, high of soil moisture and loss of Boron by leaching. So, foliar application of Boron can be considered as the helpful apply for the production of wheat.

REFERENCES

Ahmad R, Irshad M (2011). Effect of Boron application time on yield of wheat, rice and cotton crop in Pakistan. Soil Environ. 30:50-57.

Ali S, Shah A, Arif M, Miraj G, Ali I, Sajjad M, Farhatullah, Khan MY, Khan NM (2009). Enhancement of wheat grain yield and yield components through foliar application of Zinc and Boron. Sarhad J. Agric. 25:15-19.

Brown PH, Bellaloui N, Wimmer MA, Bassil ES, Ruiz J, Hu H, Pfeffer H, Dannel D, Romheld V (2002). Boron in plant biology. Plant Biol. 4:205–223.

Bonilla I, Blevins D, Bolanos L (2009). Boron Functions in Plants: Looking Beyond the Cell Wall. (Ch. 5) In: Taiz L and Zeiger E (eds). Plant Physiology. IOP publishing physics. retrieved from web. http://4e.plantphys.net.

Cheng C, Rerkasem B (1993). Effects of Boron on pollen viability in wheat. In: Barrow NJ (eds) Plant nutritionfrom genetic engineering to field practice. Dordrecht: Kluwer Academic Publishers, pp: 405-407.

Chaudhry EH, Timmer V, Javed AS, Siddique MT (2007). Wheat response to micronutrients in rainfed areas of Punjab. Soil and Environ. 26:97-101.

Dell B, Huang LB (1997). Physiological response of plants to low Boron. Plant Soil. 193:103-120.

FAO. 2013. FAO Statistical Yearbook. 2013: World Food and Agriculture. Food and Agriculture Organization of the United Nations . Rome, pp 289.

Gunnes A, Alpaslan M, Inal A, Adak MS, Eraslan F, Cicek N (2003) .Effects of Boron fertilization on the yield and some yield components of bread and durum wheat. Turkish J. Agric. Forestry, 27:329-335.

Halder NK, Hossain MA, Siddiky MA, Nasreen N, Ullah MH (2007). Response of Wheat Varieties to Boron Application in Calcareous Brown Floodplain Soil at Southern Region of Bangladesh. J. Agron. 6:21-24.

Hussain N, Khan MA, Javed MA (2005). Effect of foliar application of plant micronutrient mixture on growth and yield of wheat (*Triticum aestivum* L.). Pak. J. Bio. Sci. 8:1096-1099.

Kandi MAS, Khodadadi A, Heydari F(2012). Evaluation of Boron foliar application and irrigation withholding on qualitative traits of safflower. Intl. J. Farm. and Alli. Sci. 1: 16-19.

Khan H, Hassan ZU, Maitlo AA (2006). Yield and micronutrients content of bread wheat (*Triticum aestivum* L.) under a multi-nutrient fertilizer Hal-Tonic. Intl. J. Agric. Biol. 8:366-370.

Khan MB, Farooq M, Hussain M, Shahnawaz, Shabir G (2010). Foliar application of micronutrients improves the wheat yield and net economic return. Int. J. Agric. Biol. 12:953–956.

Korzeniowska J (2008). Response of ten winter wheat cultivars to Boron foliar application in a temperate climate (South-West Poland). Agron. Res. 6:471-476.

Krudnak A, Wonprasaid S, Machikowa T (2013). Boron affects pollen viability and seed set in sunflowers. Afr. J. Agric. Res. 8:162-166.

Li Y, Liang H (1997). Soil Boron content and the effect of Boron application on yield of maize, soybean, rice and sugarbeet in Heilonjiang province, PR China. In: Bell RW, Rerkasem B (eds) Boron in soils and plants. Kluwer, Dordrecht, the Netherlands, pp 17–21.

Marschner H (1995). Mineral nutrition of higher plants (2^{nd} eds). Acad. Press. London, pp 889.

Marten JM, Westermann DT (1991). Fertilizer applications for correcting micronutrient deficiencies. In: Mortvedt JJ, Cox FR, Shuman LM, Welch RM (eds) Micronutrients in agriculture, SSSA Book Series No. 4. Soil Science Society of America, Wisconsin, pp 549–592.

Mengel K, Kirkby EA (2001). Principles of Plant Nutrition. (5^{th} eds), Kluwer Academic Publishers, Dordrecht. pp 621-638.

Mitra AK, Jana PK (1991). Effect of doses and method of Boron application on wheat in acid Terai soils of North Bengal. Indian J. Agron. 36:72-74.

Moeinian RM, Zargari K, Hasanpour J (2011). Effect of Boron foliar spraying application on quality characteristics growth parameters of wheat grain under drought stress. Am-Euras. J. Agric.Environ. Sci. 10:593-599.

Moghadam MJ, Sharifabad HH, Noormohamadi G, Sadeghian motahar Y, Siadat SA (2012). The Effect of Zinc, Boron and Copper Foliar Application, on Yield and Yield Components in Wheat (*Triticum aestivum* L.). Ann. Biolo. Res. 3:3875-3884.

Nadim MA, Awan IU, Baloch MS, Khan EA, Naveed K, Khan MA, Zubair M, Hussain N (2011). Effect of micronutrients on the growth and yield of wheat. Pak. J. Agri. Sci. 48:191-196.

Nadim MA, Awan IU, Baloch MS, Khan EA, Naveed K (2012). Response of wheat (*Triticum aestivum* L.) to different micronutrients and their application methods. J. Anim. Plant Sci. 22:113-119.

Pandey N, Gupta B (2013). The impact of foliar Boron sprays on reproductive biology and seed quality of black gram. J. Tra. Elem. Medi. Biol. 27:58– 64.

Parr AJ, Loughman BC (1983). Boron and membrane function in plants. In: Metals and Micronutrients, Uptake and Utilisation by Plants. Robb DS, Pierpoint WS (Ed.).

Academic Press, New York. pp. 87-107.
Paull JG, Rathjen AJ, Cartwright B (1991). Major gene control of tolerance of wheat (*Triticum aestivum* L.) to high concentrations of soil Boron. Euphytica, 55**:**217-228.
Raun WR, Jhonson GV (1999). Improving nitrogen use efficiency for cereal production. Agron. J. 91:357-363.
Raza SA, Ali S, Chahill ZS, Iqbal RM (2014). Response of foliar application of Boron on wheat (*Triricum aestivum. L*) crop in calcareous soils of Pakistan. Acad. J. Agric. Res. 2:106-109.
Rehman SU, Hussain N, Tariq M, Hussain M, Nasir M, Ayaz M (2012). Response of wheat to exogenous Boron supply at various growth stages. Sarhad J. Agric. 28:411-414.
Rerkasem B, Jamjod S (1997). Genotypic variation in plant response to low Boron and implications for plant breeding. Plant and Soil, 193:169-180.
Rerkasem B, Jamjod S (2004). Boron deficiency in wheat: a review. Field Crop Res. 89:173–186.
Shaaban MM, El-Fouly MM (2001). Boron foliar application improves Zinc and other nutrient status in cotton plants growth under low or high calcium carbonate level in the soil. Proc. Of the Intl. Workshop Boron 2001 Boron Germany, June, 23-28.
Soylu S, Topal A, Sade B, Akgun N, Gezgin S, Babaoglu M (2004). Yield and yield attributes of durum wheat genotypes as affected by Boron application in Boron-deficient calcareous soils: an evaluation of major Turkish genotypes for Boron efficiency. J. Plant. Nutr. 27:1077-1106.
Steven CH (2000). Soil Fertility Basics, Soil Science Extension, North Carolina State University, certified crop advisor training, pp. 75.
Tahir M, Tanveer A, Shah TH, Fiaz N, Wasaya A (2009). Yield Response of Wheat (*Triticum aestivum* L.) to Boron Application at Different Growth Stages. Pak. J. Life Soc. Sci. 7:39-42.
Wang Q, Lu L, Wu X, Li Y, Lin J (2003). Boron influences pollen germination and pollen tube growth in Picea meyeri, Tree Physiol. 23:345-351.
Wongmo J, Jamjod S, Rerkasem B (2004). Contrasting responses to Boron deficiency in barley and wheat. Plant Soil, 259:103–110.
Woods WG (1994). An introduction to Boron: History, sources and chemistry. Environmental health perspectives 102:5-11.
Wrobel S (2009). Response of spring wheat to foliar fertilization with Boron under reduced Boron availability. J. Elementol. 14:395-404.
Uddin MN, Islam MS, Islam ABMS (2008). Effect of Boron on wheat at different Boron application methods. J. Subtrop. Agric. Res. Dev. 6:483 - 486.
Zahoor R, Basra SMA, Munir H, Nadeem MA. Yousaf S (2011). Role of Boron in improving assimilate partitioning and achene yield in sunflower. J. Agri. Soc. Sci. 7:49–55.