Review on Agriculture and Rural Development 2014. vol. 3 (1) ISSN 2063-4803

THE EFFECT OF BORON FOLIAR FERTILIZER ON SOME MORPHOLOGICAL PARAMETERS OF WHEAT AT DIFFERENT GROWTH STAGES

HAMZEH RAWASHDEH[1], 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]Banats University of Agricultural Sciences and Veterinary Medicine, "Regele Mihai I al României", Faculty of Agricultural Sciences, Department of Soil Sciences and Plant Nutrition, Aradului Street, no. 119, RO-300645, Romania

florin_sala@usab-tm.ro; hamz_rawashdeh@yahoo.com

ABSTRACT

This field research was carried out to study the effect of boron foliar application at different growth stages on morphological parameters of wheat Alex variety at Didactic Station, Timisoara, Romania during the year 2012-2013. The trial was laid out in a randomized complete block design (RCBD), consisted of three replications with the following treatments: T1 control (only received distilled water spray), T2 (B 0.3% at ZGS22), T3 (B 0.3% at ZGS41) and T4 (T2+T3) as form boric acid. Foliar solution of B was sprayed with a hand held pump sprayer at the rate of 400 L ha^{-1} on plant foliage. Experimental results revealed that the foliar application of 0.3% boron as a H_3BO_3 at different growth stages at ZGS22 and ZGS41 significantly increased plant height, spike length (cm), number of spikes m^{-2} and number of spikelets per spike which were over the control. Best results were obtained when B was applied at 0.3% at ZGS22 and ZGS41 (T4), which gave significant increase in plant height, spike length (cm), number of spikes m^{-2}, and number of spikelets per spike as compared with the control treatment. These parameters were increased by 11.11%, 15.38%, 12.81% and 17.30%, respectively.

Keywords: Boron, foliar spray application, growth stages, morphological parameters, wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an essential cereal crop, source of staple food and thus the most important crop in food security potential. More of the earth's surface is wrapped by wheat than by any additional food crop. Wheat production is the third major cereal production in the world, following maize and rice. In conditions of nutritional eating, however, wheat comes second to rice as a major food crop, known the more general use of maize as animal feed (FAO, 2013). Wheat is the second important cereal crop in Romania. It was grown on an area of 1988 thousand ha in 2012/2013 with the total production 5215 thousand metric tons with an average yield of 2.623 t ha^{-1} (INS, 2013).

Boron (B) is an important micronutrient required for plant growth, development and plays a significant role in physiological and biochemical processes. Plant needs B in small quantity. B affects not only yield but also quality of several crops. There is a wide variation in B requirement between plant species (GOLDBACH ET AL., 2001).

In several plant functions, B is disturbed directly and indirectly as it involves in cell wall formation, membrane integrity, cell wall syntheses, carbohydrate metabolism, calcium uptake, sugar transportation, flowering and fruiting, nitrogen metabolism and disease resistance (PARR AND LOUGHMAN, 1983; BONILLA ET.AL., 2009; PANDEY AND GUPTA 2013), fruit development, seed setting and grain yield is significantly responsive to B deficiency than vegetative growth (ZHANG ET AL., 1994). B deficiency is a wide-spread problem in agricultural areas world-wide, and management of B nutrition is challenged by

Review on Agriculture and Rural Development 2014. vol. 3 (1) ISSN 2063-4803

sudden occurrences of B deficiency or inconsistent effects of foliar B application (WIMMER AND EICHERT, 2013). Wheat plant is not sensitive to B deficiency but several studies have shown that B fertilizers both as soil application as well as foliar spraying single or shared with other micronutrients significantly improved growth, grain yield and yield components in wheat plant (AHMAD AND IRSHAD, 2011; MOEINIAN ET AL., 2011; REHMAN, 2012).

In Romania very few studies and information about the affect of foliar application of B on growth and yield productivity of wheat and is not enough documented and investigated till now.

The present investigation was carried out with a view to pursue the influence of foliar application of B on some morphological parameters of wheat at two growth stages.

MATERIAL AND METHOD

Field experiments were carried out at the Didactic Station, University of Agricultural Sciences and Veterinary Medicine "Regele Mihai I al României" din Timişoara (USAMV) during the growing season 2012-2013.

A composite soil sample was taken before beginning of the experiment from the soil surface 0-25 cm depth, air dried, ground, passed through 2 mm sieve, analysed for chemical and physical properties by using standard methods at laboratory of Physical-Chemical analysis "OSPA – USAMVB" according to (SR-ISO, 1998). Soil texture was clay having the following characteristics; sand 27%, silt 28.3%, clay 44.7%, pH 6.80, EC 0.40 dS m^{-1}, humus 3.18%, total N 2.1%, P 9.5 ppm, K 108 ppm.

The experiments was laid out in randomized complete block design (RCBD) having three replications and four foliar treatments. Seeds were sown through drills at a 15 cm distance between rows. A seed rate 270 kg ha-1 of "Alex" wheat variety was used. The unit plot size was 10.0 m x 3.0 m. A buffer zone of 2.0 m spacing was given between plots. Nitrogen was applied in two doses. First dose of nitrogen along with full dose of phosphorus and potassium were applied for all treatments at 4 weeks after sowing in the form of complex 150:100:100, respectively at the rate of 360 kg ha^{-1}. Second dose of the nitrogen in the form of urea was applied at the stem elongation stage (ZGS 30/31) at the rate 100 kg ha^{-1}. Weeds and insects associated with wheat were controlled by using a tractor - mounted boom sprayer. The B solution was applied as foliar spray to the plant leaves in form boric acid (0.3% boron w/v) at the rate of 400 L ha^{-1} with a hand pump sprayer at two growth stages of wheat. The foliar application times of B included: T1 control (distilled water spray), T2 sprayed at beginning tillering stage (ZGS22), T3 sprayed at early booting stage (ZGS41) and T4 sprayed at beginning tillering stage and early booting stage (ZGS22+ ZGS41) according to the Zadoks growth stage scales of wheat plant as described by (ZADOKS ET AL., 1974). At maturity stage, one meter square area selected randomly, selected at three locations in each plot. Plants were harvested manually and the following parameters were measured:

Plant height

The height of plants from ground level to the tip of the plant exclude spike was measured. The average height of these plants was calculated and expressed as mean plant height (cm).

Spike length

Spike length was measured from the base of first spikelets to the tip of terminal spikelets excluding awn and then average was calculated and expressed as mean spike length (cm).

Number of spikes
The number of spike was counted and then average was converted as number of spikes per square meter.

Number of spikelets per spike
The culm from the base was counted. Total number of spikelets was counted and average was recorded as number of spikelets per spike.

Data analysis
Morphological parameters were recorded and the data was analysed statistically by using the analysis of variance (ANOVA) through MSTAT-C (1991) software package. The significance of treatment means were compared by using Least Significant Difference (LSD) test at 0.05 level (STEEL AND TORRIE, 1997).

RESULTS AND DISCUSSION

Plant height (cm)
Results showed that the effect of foliar fertilizer of B on plant height was highly significant at level of 5% (*Figure 1*). The tallest plant was obtained by T4 (87.33cm) and the shortest plant was obtained by T1 (78.60cm). B plays an important role in the physiological process of plants, such as, cell elongation, cell maturation, meristematic tissue development and protein synthesis. Which in turn, maybe leads to an increase in plant height of wheat (UDDIN ET AL., 2008; AHMAD AND IRSHAD, 2011; REHMAN ET AL., 2012).

Spike length (cm)
Data regarding to spikes length are shown in (*Figure 2*). Analysis of the data showed that foliar application of B significantly affected spike length. Tallest spike length was obtained by the foliar application of B 9.15 cm (T4) and the shortest spike length was 7.93 cm (T1). Foliar application of B at ZGS22 and ZGS41 (T4) gave 15.38% increase in spike length compared to the control. This result is in agreement with KHAN ET AL., 2006, UDDIN ET AL., 2008 and REHMAN ET AL., 2012, who reported that B application significantly increase spike length.

Number of spikes per square meter
Results of this study indicated that foliar application of B significantly affected number of spike m^{-2} (Figure 3). The highest number of spike m^{-2} 405 was obtained by foliar application of B at ZGS41 (T4) and the lowest number of spike per square meter 359 was obtained from the control (T1). Number of spike per square meter increased 12.81% with ZGS22+ZGS41 as compared with control. There was no significant difference between T3, T2, and T1 treatment in number of spike per square meter. The same results have been obtained by (GUENIS ET AL., 2003; SOYLU ET AL., 2005; KHAN ET AL; 2006; ALI ET AL, 2009) who reported significant variations for number of spikes per square meter for foliar application of B.

Number of spikelets per spike
Statistical analysis of the data showed that the foliar application of B significantly increased number of spikelets per spike (*Figure 4*). Maximum number of spikelets per spike (12.00) were recorded when B was sprayed at ZGS22 + ZGS41 (T4). The minimum

number of spikelets per spike (10.23) was obtained when B was not sprayed (T1). Number of spikelets per spike increased by 17.30% as compared with control. The increase in number of spikelets per spike may be due to the reason that B plays a vital role in flowering and grain setting of wheat. These results are in agreement with the finding of UDDIN ET AL. (2008) and REHMAN ET AL. (2012) who reported that B application increased number of spikelets per spike in wheat.

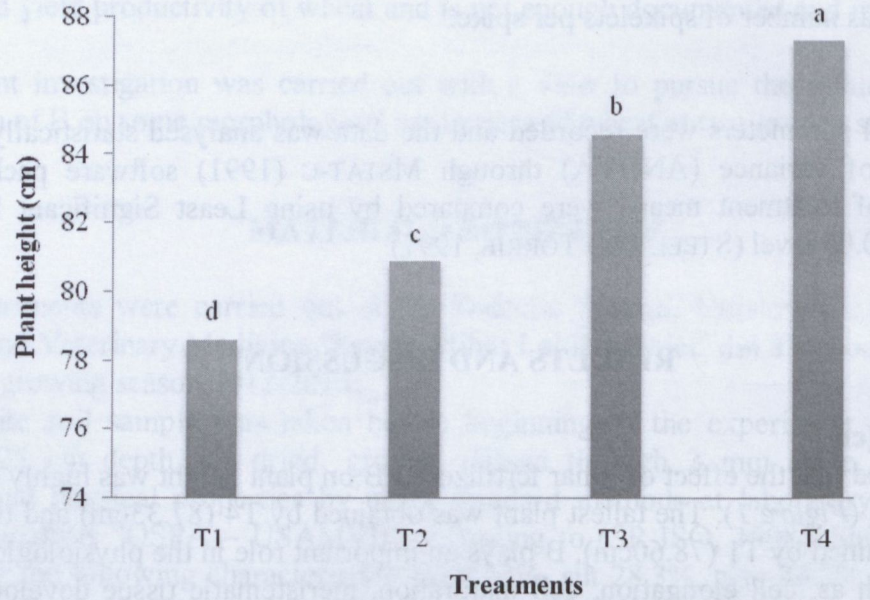

Figure 1. Effect of foliar fertilizer of Boron at different growth stages on wheat plant height.

The columns sharing the same letter are not significantly different at level of P = 0.05

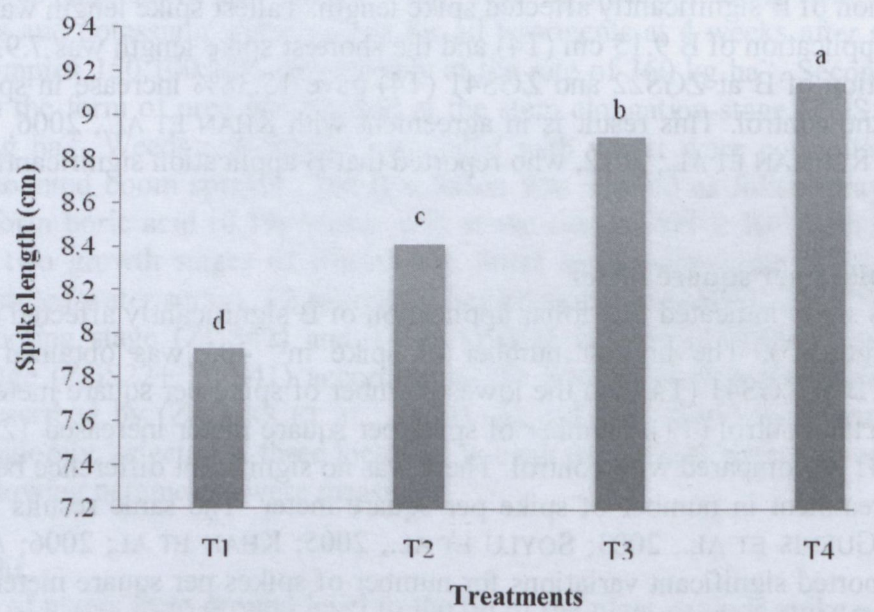

Figure 2. Effect of foliar fertilizer of Boron at different growth stages on spike length of wheat plant.

The columns sharing the same letter are not significantly different at level of P = 0.05

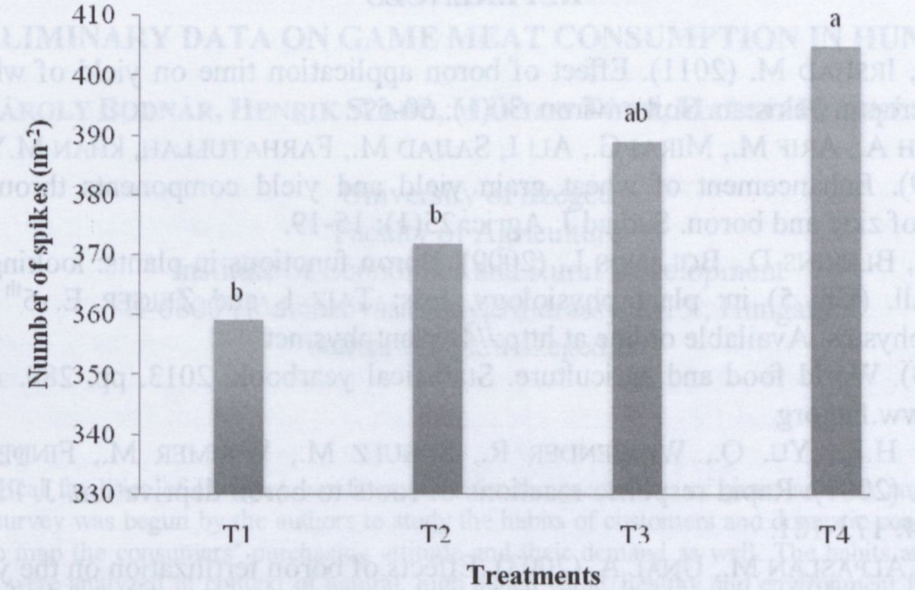

Figure 3. Effect of foliar fertilizer of Boron at different growth stages on number of spike m^{-2} of wheat plant.

The columns sharing the same letter are not significantly different at level of P = 0.05

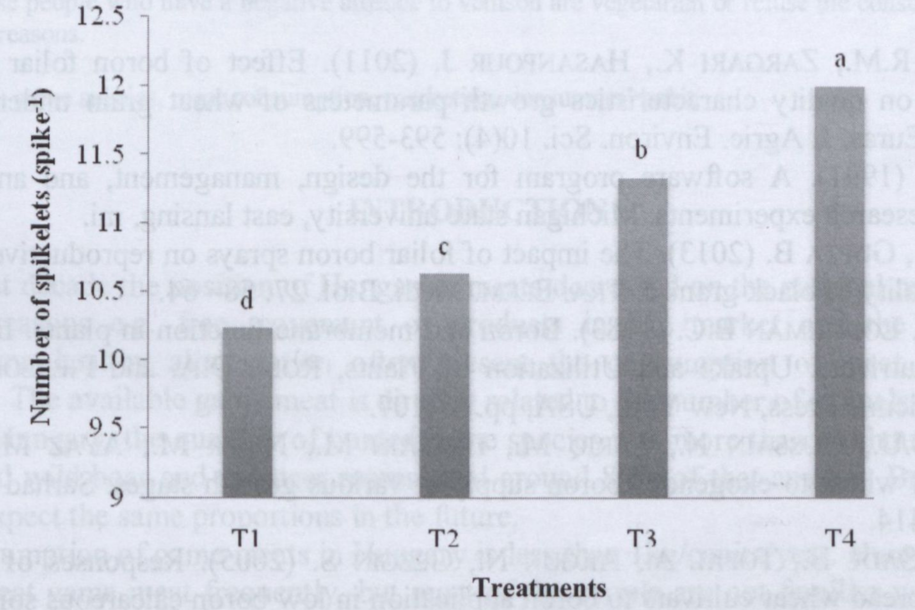

Figure 4. Effect of foliar fertilizer of Boron at different growth stages on number of spikelets per spike of wheat plant.

The columns sharing the same letter are not significantly different at level of P = 0.05

CONCLUSIONS

The current study showed that foliar application of Boron (0.3%) at different growth stage at ZGS22 and ZGS41 significantly increased wheat plant height, spike length (cm), number of spikes m^{-2}, and number of spikelets per spike. The highest values of all studied parameters were obtained from T4 treatment. The control (T1) gave the lowest values of all studied parameters. For getting more general results, it is recommended to repeat the experiment in other locations.

REFERENCES

AHMAD, R., IRSHAD M. (2011). Effect of boron application time on yield of wheat, rice and cotton crop in Pakistan. Soil environ. 30(1): 50-57.

ALI S., SHAH A., ARIF M., MIRAJ G., ALI I, SAJJAD M., FARHATULLAH, KHAN M.Y., KHAN N.M. (2009). Enhancement of wheat grain yield and yield components through foliar application of zinc and boron. Sarhad J. Agric. 25(1): 15-19.

BONILLA, I., BLEVINS D., BOLANOS L. (2009). Boron functions in plants: looking beyond the cell wall. (Ch. 5) in: plant physiology. Eds: TAIZ L and ZEIGER E. 5th ed. IOP publishing physics. Available online at http://4e.plantphys.net.

FAO. (2013). World food and agriculture. Statistical yearbook. 2013. pp. 289. Available online at www.fao.org

GOLDBACH, H.E., YU. Q., WINGENDER R., SCHULZ M., WIMMER M., FINDEKLEE P., BALUSKA F. (2001). Rapid response reactions of roots to boron deprivation. J. Plant Nutr. Soil Sci. 164: 173-181.

GUENIS, A., ALPASLAN M., UNAL A. (2003) .Effects of boron fertilization on the yield and some yield components of bread and durum wheat. Turk J. Agric. 27: 329-335.

INS. (2013) Institutul naţional de statistică, comunicat de presă nr. 71 din 29 martie 2013. pp. 5

KHAN, R., GURMANI A.H., GURMANI A.R. ZIA M.S. (2006). Effect of boron application on rice yield under wheat rice system. International Journal of Agriculture and Biology 8 (6): 805-808.

MOEINIAN, R.M., 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(4): 593-599.

MSTAT-C. (1991). A software program for the design, management, and analysis of agronomicresearch experiments. Michigan state university, east lansing, mi.

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, A. J., LOUGHMAN B.C. (1983). Boron and membrane function in plants. In: Metals and Micronutrients: Uptake and Utilization by Plants, ROBB D.A. and PIERPOINT W.S. (Eds.). Academic Press, New York, USA, pp. 87-107.

REHMAN, S.U., 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(3): 411-414.

SOYLU, S. SADE B., TOPAL A., AKGUN N., GEZGIN S. (2005). Responses of irrigated durum and bread wheat cultivars to boron application in low boron calcareous soil. Turk J. Agric. For. 29: 275-286.

STEEL, R., TORRIE J.H., DICKEY D.A. (1997). Principles and procedures of statistics. A biometrical approach, 3rd Ed. McGraw Hill Book Co., New York, pp. 172-177.

UDDIN, M.N., ISLAM M.S., ISLAM A.B.M.S. (2008). Effect of boron on wheat at different boron application methods. J. Subtrop. Agric. Res. Dev. 6(2): 483-486.

WIMMER, M.A., EICHERT T. (2013). Review: mechanisms for boron deficiency-mediated changes in plant water relations. Plant Sci. 203–204: 25–32.

ZADOKS, J.C., CHANG T.T., KONZAK C.F. (1974). A decimal code for the growth stages of cereals. Weed Res. 14: 415-421.

ZHANG, X., SHEN Z., SHEN K. (1994). The effect of boron on the development of floral organs and seed yield of rape (In Chinese). Acta Ped. Sin. 31: 146-151.