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INFLUENCE OF FOLIAR APPLICATION OF BORON AND TIMES OF SPRAYING ON YIELD OF MAIZE (*ZEA MAYS* L.)

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Abstract

To study the effect of mineral and nanoparticles boron (T0 control, T1 mineral boron 1ml.L^{-1}, T2 mineral boron 2 ml.L^{-1}, T3 nanoparticles boron 1ml.L^{-1}, T4 nanoparticles boron 2ml.L^{-1}) and spraying time (45 days and 60 days spraying after planting) to find out the effect on yield of maize. An experiment was done using split plot with randomized complete block design in three replications in spring season 2018. The maximum Number of grains per cob, cob length (cm), 500 grain weight (g), grain yield tons. ha^{-1} and biological yield tons.ha^{-1} (674, 19.03, 188, 8,11.31 and 42.36) respectively were recorded @ interaction between mineral boron 1ml.L^{-1} with spraying time at 60 days after planting.

***Key words*:** Maize (*Zea mays* L.), boron, spraying time, grain yield and biological yield.

Introduction

Maize (*Zea mays* L.) ranks third after wheat and rice in the world grain production. Maize as a major source of carbohydrate is used as food, in livestock diet, in the textile industry and also in the pharmaceutical industry. The essentiality of boron as it affected the growth of maize or corn. Deficiency of boron can cause reductions in crop yield. Boron deficiency rapidly inhibits the elongation and growth of roots, Root elongation is the result of cell elongation and cell division, and evidence suggests that boron is required for both processes (Shelp, 1993). Boron is thought to have a direct effect on sugar synthesis, Boron regulates auxin supply in plants by protecting the indole acetic acid, The role of boron in seed production is so important .Feeding nutrients, whether sprinkled on leaves, is of great importance to plants (Alwan *et al*., 2009; Almosawy *et al*. 2014; Alamery *et al*., 2018; Alamery *et al*., 2019). B is essential to transport of photosynthetic sugars, adequate B increases flower production and retention and seed development (John *et al*., 2011).

Both Zn and B play an important role in the basic plant functions like photosynthesis, protein and chlorophyll synthesis (Cakmak, 2008; Almosawy *et al*., 2018a). These nutrients (Zn and B) are also involved in root growth, synthesis of proteins and carbohydrates, increase flower setting (Moeinian *et al*., 2011). The nanoparticles boron play an important role in increasing crop yield in maize where gave significantly effected on number of grains per cob (Almosawy *et al.,* 2018a; Almosawy *et al.,* 2018b). Muhammad *et al*. (2012) observed that, application of boron at the rate of 0.30kg ha^{-1} significantly increased plant height, leaf area, stem diameter, cob weight, number of grain per cob, protein and oil content of maize. Gazala *et al*. (2016) observed that the application of boron at different rates in different crops have shown a positive influence on yield and other agronomical attributes in different crops thereby proving the vital role boron plays in improving yield of different crops.

Materials and Methods

The experiment was carried out at the field of Ibn Al-Bitar Vocational Preparatory during the spring Season in 2018 to study the effect of different concentrations of nanoparticles and mineral boron and times of spraying on yield components of maize. The experiment was laid out according to randomized complete block design with split plot with three replicates. The experiment consisted of two factors: the first factor, five concentrations of nanoparticles and mineral boron (T0 control, T1 mineral boron 1ml.L^{-1}, T2 mineral boron 2 ml.L^{-1}, T3 nanoparticles boron 1ml.L^{-1}, T4 nanoparticles boron 2ml.L^{-1}).The second factor. spraying times (45 days and 60 days spraying after planting).

Results

Number of Grains per cob

Data in Table (1) indicated that Number of grains per cob was significantly increased with boron spraying, where the highest Number of grains per cob was recorded with the T1 mineral boron 1ml.L^{-1} which was recorded (639).The minimum Number of grains per cob was noticed with control (455). Results show that Number of grains per cob was not significantly affected due to spraying time. Boron spraying interaction with spraying time had significant influence on Number of grains per cob, where superior interaction (mineral boron 1ml.L^{-1} with spraying time at 60 days after planting) on other interaction which was recorded (674) while interaction between control + spraying time at 45 days after planting gave lowest minimum Number of grains per cob which was recorded (349).

Cob Length (cm)

The cob length under B treatments were significantly influenced as presented Table (2). The highest cob length was (18.27 and 17.08) cm respectively in treatments T1 and T3 of mineral and nanoparticles boron 1ml.L^{-1} respectively. cob length was not significantly affected by spraying time. Interaction between mineral and nanoparticles Boron spraying and spraying time played significantly affected on cob length, where superior interaction (mineral boron 1ml.L^{-1} with spraying time at 45 days after planting) on other interaction which was recorded (19.03) cm. control with spraying time at 45 days after planting gave minimum value which was recorded (12.89) cm.

Weight of 500 Grain (g)

B application had a significant effect on weight of 500 grain Table (3), The maximum value recorded @

nanoparticles and mineral boron, where gave 1ml.L^{-1} nanoparticles and 2ml.L^{-1} of mineral boron heighest weight of 500 grain which was recorded (178.1 and 167.7)g respectively, superior over other concentrations. The minimum value was noticed with control which was recorded (135.4) g. weight of 500 grain was not significantly affected by spraying time. B interaction with spraying time had a significant influence on weight of 500 grain, where superior interaction (nanoparticles boron with spraying time at 45 days after planting) on other interaction which was recorded (188.8) g. The minimum value noticed with control + with spraying time at 45 days after planting (117.1) g.

Grain Yield (tons. ha^{-1})

According to the analysis of variance Table (4). The effect of mineral and nanoparticles boron treatments was significant on grain yield. The maximum grain yield (10.80 and 10.25) tons. ha^{-1} was obtained with mineral and nanoparticles boron 1ml.L^{-1} respectively, while the lowest value was produced under control which was recorded (6.79) tons.ha^{-1}. grain yield was not significantly affected by spraying time. Interaction between B and spraying time played significantly affected on grain yield, where superior interaction (mineral boron 1ml.L^{-1} with spraying time at 60 days after planting) on other interaction which was recorded (11.31) tons.ha^{-1}. The minimum grain yield was noticed with (control + spraying time at 45 days after planting) which was recorded (4.39) tons.ha^{-1}

Biological Yield (tons.ha^{-1})

Results revealed that the effect of boron on biological yield was statistically significant Table (5), where mineral and nanoparticles boron 1ml.L^{-1} gave highest biological yield (41.26 and 38.37) tons.ha^{-1} respectively superior to other concentrations. The minimum biological yield was noticed with control which was recorded (28.02) tons.ha^{-1}. The result showed that the spraying time was not play a significant role in affecting biological yield. B interaction with spraying time played significant role in affecting biological yield, where superior interaction mineral boron (1ml.L^{-1}) with spraying time at 60 days after planting on other interaction which was recorded (42.36) tons.ha^{-1}. The minimum biological yield was noticed with control with spraying time at 45 days after planting (20.64) tons.ha^{-1}.

Table 1 : Effect of Foliar Application of Boron and times of spraying on Number of grains per cob

Mean	Concentrations					Spraying time
	T4	T3	T2	T1	control	
521	551	552	548	604	349	F1
562	472	529	574	674	561	F2
LSD spraying time ns	114.5					LSD interaction
	511	540	561	639	455	Mean
	88.5					LSD concentrations

Table 2 : Effect of Foliar Application of Boron and times of spraying on cob length (cm).

Mean	Concentrations					Spraying time
	T4	T3	T2	T1	Control	
16.59	17.54	16.99	16.53	19.03	12.89	F1
17.10	16.00	17.18	17.53	17.52	17.30	F2
LSD spraying time ns	2.43					LSD interaction
	16.77	17.08	17.03	18.27	15.09	Mean
	1.88					LSD concentrations

Table 3 : Effect of Foliar Application of Boron and times of spraying on weight of 500 grain (gm).

Mean	Concentrations					Spraying time
	T4	T3	T2	T1	Control	
157.6	162.3	188.8	159.7	160.1	117.1	F1
162.3	157.1	167.4	175.7	157.6	153.7	F2
LSD Spraying time ns	30.45					LSD interaction
	159.7	178.1	167.7	158.9	135.4	Mean
	18.04					LSD concentrations

Table 4 : Effect of Foliar Application of Boron and times of spraying on grain yield (tons. ha^{-1}).

Mean	Concentrations					Spraying time
	T4	T3	T2	T1	control	
8.93	9.54	11.05	9.38	10.28	4.39	F1
9.71	7.84	9.45	10.74	11.31	9.19	F2
LSD Spraying time ns	2.29					LSD interaction
	8.69	10.25	10.06	10.80	6.79	Mean
	1.71					LSD concentrations

Table 5 : Effect of Foliar Application of Boron and times of spraying on biological yield (tons.ha^{-1}).

Mean	Concentrations					Spraying time
	T4	T3	T2	T1	Control	
34.39	35.03	40.87	35.25	40.16	20.64	F1
36.10	27.56	35.87	39.32	42.36	35.39	F2
LSD Spraying time ns	8.45					LSD interaction
	31.29	38.37	37.48	41.26	28.02	mean
	6.23					LSD concentrations

Discussion

Application of Boron and appropriate time to spray in this experiment significantly improved yield parameters of Maize plants as compared with control plant. The Number of grains per cob, cob length, weight of 500 grain, grain yield and biological yield were statistically higher than control .application of B is essential to transport of photosynthetic sugars, adequate B increases flower production, retention and seed development (John L. Havlin *et al*., 2011). Root elongation is the result of cell elongation and cell division, and evidence suggests that boron is required for both processes (Cakmak, 2008). Boron is thought to have a direct effect on sugar synthesis , Boron regulates auxin supply in plants by protecting the indole acetic acid, The role of boron in seed production is so important (handbook plant nutrition). application of Boron nutrition With the appropriate time to spray which might have accelerate the vigorous growth increase of increase Number of grains per cob and weight of 500 grain that lead to increase total yield and biological yield.

Conclusion

The results showed that foliar application of boron with the appropriate time to spray on maize yield had positive effects on The Number of grains per cob, cob length, weight of 500 grain, grain yield and biological yield. However, application of mineral boron 1ml.L^{-1} with spraying time at 60 days after planting increased increase total yield and biological yield.

References

Alamery, A.A.; Lateef, S.M.; Almosawy, A.N.; Alhassaany, M.H. and Almosawy, M.M. (2019). Effect of Phosphate Bio Fertilizers on Increasing the Efficiency of the Use of Phosphate Mineral Fertilizers and its Effect on some growth Properties of Broccoli (*Brassica oleracea var. italica*).

Almosawy, A.N.; Alamery, A.A.; Al-Kinany, F.S.; Mohammed, H.M.; Alkinani, L.Q. and Jawad, N.N. (2018b). Effect of optimus nanoparticles on growth and yield of some broad bean cultivars (*Vicia faba* L.). Int. J. Agricult. Stat. Sci., 14(2).

Al-Mosawy, A.N.; Al-Farttoosl, H.A.; Al-Amery, A.A. and Attiya, R.L. (2014). Role of nutrient solution magnetizer of manganese sulphate in growth and yield in wheat which Grown in the fields of holy Karbala (*Triticum aestivum* L.). Karbala Heritage Quarterly Authorized Journal Specialized in Karbala Heritage, 1(2): 311-330.

Alwan, A.H.; Al-Anbari, M.A.; Al-Aamry, A.A.H. and Abd-Alrada, H.A. (2009). Effect of sowing date and phosphorus fertilizer on growth and yield of wheat (*Triticum aestivum* L.). Scientific Journal of Karbala University, 7(3): Scientific.

Almosawy, A.N.; Alamery, A.A.; Al-Kinany, F.S.; Mohammed, H.M.; Alyasiri, N.A. and Alhusani, A.H. (2018a). Effect of proteck calbor nanoparticle on growth and yield of some wheat cultivars (*Triticum aestivum* L.). Biochem. Cell. Arch, 18(2): 1773-1178.

Alamery, A.A.; Almosawy, A.N.; AlRubaei S.M.; Mohammed, H.M.; Al-Kinanai, L.Q. and Alkrati, H.G. (2018). Effect of potassium and g power calcium nanoparticle spray on growth and yield of some broad bean cultivars (*Vicia faba* L.). Biochem. Cell. Arch, 18(2): 2003-2007.

Shelp, B.J. (1993). Physiology and biochemistry of boron in plants. In: U.C. Gupta, ed. Boron and Its Role in Crop Production. Boca Raton, FL: CRC Press, 53–85.

John, L.H.; James, D.B.; Samuel, L.T. and Werner, L.N. (2011). Soil Fertility and Fertilizers Book.

Cakmak, I. (2008). Enrichment of cereal grains with zinc: agronomic or genetic biofortification. Plant Soil. 302: 1–17.

Moeinian, M.R.; Zargari, K. and Hasanpour, J. (2011). Effect of boron foliar spraying application on quality characteristics and growth parameters of wheat grain under drought stress. Amer. Eur. J. Agric. Environ. Sci, 10: 593-599.

Muhammad, T.; Asghar, A.; Farkhan, K.; Muhammad, N.; Naeem, F. and Muhammad, W. (2012). Effect of foliar Applied Boron Application on Growth, Yield and Quqlity of Maize (*Zea mays* L.) PK Journal Sci Ind Res. Ser. B: bio. Sci, 55(3): 117-121.

Gazala, N.; Upinder, S. and Pardeep, K. (2016). Boron Its important in crop production, Status in Indian Soils and Crop Responses to its application. International journal of advanced Research, 4(5): 654-660.

Wahid, M.; Ahmad, W.; Cheema, M.; Saleem, M. and Sattar, A. (2011). Impact of foliar applied boron on yield and yield components of spring maize (*Zea mays* L.) under drought condition. Soil and Crop Environ, Sci., 382-383.