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Full Length Research Paper

Efficacy of different iron, zinc and magnesium fertilizers on yield and yield components of barley

Mahdi Babaeian[1*], Yasser Esmaeilian[1], Abolfazl Tavassoli[1] and Ahmad Asgharzade[2]

[1]Department of Agriculture, Bojnourd Branch, Islamic Azad University, Bojnourd Iran.
[2]Department of Agriculture, Shirvan Branch, Islamic Azad University, Shirvan Iran.

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In order to study the effect of micro and macro nutrients on yield of barley, an experiment was conducted as randomized complete block design with three replications in research field of Zahedan, 2008. Use of micro nutrient elements were composed of: Iron sulfate (F_1), zinc sulfate (F_2), magnesium sulfate (F_3) and control (F_4) as sub plot in this experiment. Results showed that nutrient treatments had significant effect on grain yield, 1000 grain weight, spike weight and biological yield in barley and among this nutrient, Fe fertilizer had maximum effect on grain component of barley and lowest amount of all measured parameters observed in control treatment.

Key words: Barley, iron, zinc, magnesium, yield components.

INTRODUCTION

Evidence of greater nutritional value in crops is currently a subject of intense debate (Murphy et al., 2008). Micronutrients are as important as macronutrients for adequate plant nutrition and a deficiency of just one nutrient can greatly reduce yield. Micronutrients play a vital role in growth and development of plant and occupy an important portion by virtue of their essentiality in increasing crop yields. In fact, their essential role in plant nutrition and increasing soil productivity makes their importance ever greater. Micronutrient deficiencies in soils are also a critical problem for cereals productions causing severe reductions in yield and nutritional quality of the grains. A balanced fertilization program with macro and micronutrients in plant nutrition is very important in the production of high yield with high quality products (Sawan et al., 2001). Six micronutrients, that is, Mn, Fe, Cu, Zn, B and Mo are known to be required for all higher plants (Welch et al., 1991).

Singh and Ram (2005) initiated a 25-year-long fertilizer experiment in 1971 to evaluate the nutrient and micronutrient uptake of the rice and Wheat. Abd El-Wahab and Mohamed (2008) stated that micronutrients such as iron, manganese and zinc have important roles in plant growth and yield of aromatic and medicinal plants. He reported micronutrients, especially Fe and Zn which act as metal components of various enzymes and are also associated with photosynthesis and protein synthesis and Iron has important functions in plant metabolism, such as activating catalase enzymes. Iron is mainly present in the form of insoluble Fe (III), therefore, unavailable to higher plants, particularly in neutral and alkaline soils (Shao et al., 2007). Zinc is one of the eight essential trace elements which is necessary for the normal healthy growth and reproduction of crop plants (Parker and Thomason, 1992). Zn is a vital element for wheat growth and it activates some enzymes such as carbonic anhydrase, dehydrogenase, proteins and peptidase. Soleimani (2006) reported increase in biological yield for foliar application of zinc. Another study showed that use of zinc in blue sage (*Salvia farinacea L.*) enhanced the length of peduncle, length of main inflorescence, number of inflorescence and florets, and fresh and dry weight of inflorescences/ plant (Nahed and Balbaa, 2007). A similar effect of Zn supply on this parameter was also reported on *M. chamomilla* (Grejtovský et al., 2006). The positive effects of Fe and Zn on plant may be due to their effects as a metal component of some enzymes or regulatory for the others. Moreover, they have essential roles in plant metabolism (Abd El-Wahab and Mohamed 2008).

*Corresponding author. E-mail: mahdi_bbn@yahoo.com.

Table 1. Chemical analysis of soil of experiment.

Mn	Zn	Fe	Ca	P	K	N	EC	pH
Mg l^{-1}	Mg l^{-1}	Mg l^{-1}	Meq l^{-1}	Meq l^{-1}	Meq l^{-1}	Meq l^{-1}	Ds m^{-1}	-
0.32	1.615	0.03	12.1	1.56	317	0.027	1.8	7.2

Table 2. Mean comparison of interaction effects yield and yield components.

Treatment	Grain yield	1000-grain weight	spike weight	Grains per spike	Biological yield
Nutrient fertilizer	Kg/ha	g	g	-	Kg/ha
Fe	2539.6 a	37.62 a	1.44 a	31.67 a	8344.8 a
Zn	2456.2 ab	35.76 b	1.44 a	30.25 a	7011.7 b
Mg	2219.8 b	35.73 b	1.31 b	30.03 a	6712.8 b
Control	2028.4 c	35.01 b	1.25 c	29.61 a	6542.5 b

Mean fallowed by similar letters in each column, are not significantly at the 5% level of probability.

Present study was carried out to evaluate the effects of nutrient (Fe, Zn and Mg) on yield and yield component of barley grown in Zahedan of Iran.

MATERIALS AND METHODS

This experiment was conducted in 2009 cropping at Agriculture Research Center of Payame Noor University of Zahedan. The site lies at longitude 61º29′, and latitude 31º2′ and the altitude of the area is 487 m above sea level. It has a warm dry climate with the mean minimum, mean maximum, and average air temperatures of 16, 30, and 29ºC, respectively. The soil characteristics of Agriculture Research Center is sandy-loam in texture, pH = 7.4 and EC = 1.8 $ds.m^{-1}$ (The soil properties prior to the experiment has been shown in Table 1). The experimental design was randomized complete block design with tree replication. Micro elements were composed of: F_1: iron sulfate, F_2: zinc sulfate, F_3: magnesium sulfate and F_4: control in this experiment. All treatments exerted before sowing. Barley was planted manually in October 2008. Experiment plots were seeded with Sistan cultivar with 25 cm row to row distance and 2 cm between plants. Seeds were sown 4 cm deep. Weeds were removed by hand. After planting, irrigation was applied as required during the growing season. The barley was harvested in April 2009. For measurement of plant characteristics, two edge rows eliminated as margin effects and one square meter of each plot was used for sampling.

Data collected (obtained by combining the four center rows at each experiment unit) included: grain yield, 1000-grain weight, weight of ear, number of grain per ear. The data were analyzed using MSTATC software; mean comparison was done using Duncan Multiple Comparison at 5% probability level.

RESULTS

Grain yield

The data regarding grain yield of barley is affected by different nutrient are presented in Table 2. Our data showed that yield of barley significantly affected with nutrient element fertilizer treatment. Mean comparison data showed that highest amount of grain yield was obtained in F_1 (Fe^{2++}) with average of 2539.6 Kg/ha and minimum amount of grain yield was measured in control treatment (F_4) with average of 2028.4 Kg/ha. Our data shows all nutrient treatment increased grain yield of barley in compare to control and this treatments F_1 (Fe^{2++}), F_2 (Zn^{2++}) and F_3 (Mg^{2++}) increased barley grain yield 20, 17.5 and 8.6%, respectively, as comparison to control as shown in Table 1. Similar results were obtained by Ziaeian and Malakouti (2002) who conducted 25 field experiments in order to study the effects of micronutrients on wheat production in calcareous soils. The results showed that Fe fertilization caused significant increase in grain yield. With the application of Fe, their concentration and total uptake in grain and flag leaves and the grain protein content increased significantly.

1000-grain weight

Micro nutrient treatment had significant effect on 1000 grain weight. Among nutrient treatments consuming Fe had severity effect on 1000 grain weight and highest amount of 1000-grain weight was recorded in this treatment with average of 37.62 g. Consuming Fe cased to increase 1000-grain weight in compare to control about 7.64%. Consuming Zn and Mg were in second and third level with average of 35.76 and 35.73 g [there was not significant different among F_2 (Zn) and F_3 (Mg)] and lowest amount of 1000-grain weight was obtained in control treatment (F_4) with average of 34.1 g as shown in Table 2. These results are in line with the findings of Ziaeian and Malakouti (2002) who stated that Fe consumption fertilizer increased 1000-grain wheat.

Spike weight

Obtained results in Table 2 showed that ear weight of barley significantly affected by nutrient treatments and

highest amount of ear weight was obtained in F_1 and F_2 with average 1.44 and 1.42 g, respectively and there was not significant different among Fe and Zn. Result in this part showed that consumption of Fe^{2++} increase ear weight about 15% as compared to control treatment.

Ear weight of barley under effect by Mg was 1.31 g and this treatment was in third level among all nutrient treatment and lowest ear weight was recorded in control (F_4) with average of 1.25 g. This result corroborated the earlier findings of Mentler et al. (2002) on corn. In another study Soleimani (2006) showed that use of zinc in blue sage (*Salvia farinacea L.*) enhanced the length of peduncle, length of main inflorescence, number of inflorescence and florets, and fresh and dry weight of inflorescences/ plant (Nahed and Balbaa, 2007).

Biological yield

Regarding the effect of nutrient fertilizer on biological yield of barley obtained results showed that chemical fertilizer had significant effect on biological yield of barley. Mean comparison data showed that highest amount of biological yield was recorded in F_1 (Fe^{2++}) treatment with average of 8344.8 Kg/ha, F_2 and F_3 were in second and third level with average 7011.7 and 6712.8, respectively, and minimum amount of biological yield was measured in control treatment (F_4) with average of 6542.5 Kg/ha. All nutrient treatment increased biological yield of barley in comparison to control and this treatments, F_1 (Fe^{2++}), F_2 (Zn^{2++}) and F_3 (Mg^{2++}) increased biological yield by 21.59, 6.69 and 2.57%, respectively, as comparison to control as shown in Table 2.

Conclusion

Applications of iron and zinc affected all the growth and yield parameters of barley at all the rates. As regard growth and yield parameters, application of Fe and Zn significantly increased the grain yield, spike weight, 1000 grain weight and biological yield of barley. In general, it can be concluded that consumption of iron and zinc fertilizer considerably improved yield and yield component of barley.

REFERENCES

Abd El-Wahab, Mohamed A (2008). Effect of some trace elements on growth, yield and chemical constituents of *Trachyspermum ammi* L. (AJOWAN) plants under Sinai conditions. Res. J. Agric. Biol. Sci., 4(6): 717-724.

Grejtovský A, Markušová K, Eliašová A (2006). The response of chamomile (*Matricaria chamomilla* L.) Plants to soil zinc supply. Plant Soil Environ., 52(1): 1–7.

Mentler A, Partaj T, Strauss P, Soumah H, Blum WE (2002). Effect of locally available organic manure on maize yield in Guinea, West Africa. Research paper, 17th WCSS, 14-21 August, Thailand, 16 -20.

Murphy K, Hoagland L, Reeves P, Jones S (2008). Effect of cultivar and soil characteristics on nutritional value in organic and conventional wheat. 16th IFOAM Organic World Conference in Cooperation with the International Federation of Organic Agriculture Movements (IFOAM) and the Consorzio Modena Bio., Modena, Italy, 18–20 June, 2008; pp. 614-617.

Nahed Abd El-Aziz G, Balbaa LK (2007). Influence of tyrosine and zinc on growth, flowering and chemical constituents of *Salvia farinacea* plants. J. Appl. Sci. Res., 3(11): 1479-1489.

Parker DR, Aguilera JJ, Thomason DN (1992). Zinc-phosphorus interactions in two cultivars of tomato (*Lycipersicon esculentum L.*) grown in chelator-buffered nutrient solutions. Plant Soil, 143: 163-177.

Sawan ZM, Hafez SA, Basyony AE (2001). Effect of phosphorus fertilization and foliar application of chelated zinc and calcium on seed, protein and oil yields and oil properties of cotton. J. Agric. Sci., 136:191-198.

Shao G, Chen M, Wang W, Mou R, Zhang G (2007). Iron nutrition affects cadmium accumulation and toxicity in rice plants. Plant Growth Reg., 53: 33–42.

Singh V, Ram N (2005). Effect of 25 years of continuous fertilizer use on response to applied nutrients and uptake of micronutrients by rice-wheat-cowpea system. Cereal Res. Comm., 33: 589-594.

Soleimani R (2006). The effects of integrated application of micronutrient on wheat in low organic carbon conditions of alkaline soils of western Iran. 18th World Congress of Soil Science.

Welch RM, Allaway WH, House WA, Kubota J (1991). Geographic distribution of trace element problems. In: Mortvedt J.J., ed. Micronutrients in agriculture, 2nd Ed. Madison, Wisconsin: SSSA Book Ser. 4. SSSA, pp. 31-57.

Ziaeian AH, Malakouti MJ (2002). Effects of Fe, Mn, Zn and Cu fertilization on the yield and grain quality of wheat in the calcareous soils of Iran. Plant Nutrition. Food Security and Sustainability Agro-ecosystems, 92: 840-841.