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Full Length Research Paper

Usefulness of Zn, Mg, Fe and fertilizer on seed germination characters of barley (*Hordeum vulgare*)

Amoon S. Afsaneh, Ramah G. Hatima and Radmehr P. R Arsham

Department of Plant and Crop Science, Faculty of Agriculture, University of Tabriz, East Azarbaijan Province, Iran.

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In order to study the effect of interaction of micro and macro elements on soil chemical properties, grain yield and yield components in barley, an experiment was conducted as split plot design on randomized complete block design with three replications in research field of Zabol University, 2008. Different proportions of manure and chemical fertilizer treatment were composed of: 100% manure (F_1), 100% chemical fertilizer (F_2), 50% manure + 50% chemical fertilizer (F_3) and control as the main plot; and use of micro nutrient elements were composed of: iron sulfate (N_1), zinc sulfate (N_2), magnesium sulfate (N_3) and control (N_4) as sub plot in this experiment. Results of this research showed that fertilizer proportions and nutrition elements, with the exception of grain number in ear and germination percentage had the significant effect on yield and yield components, and other germination characteristics of barley. The highest amounts of grain yield, 1000 grain weight and biological yield was obtained in F_2N_3 (100% fertilizer and $FeSO_4$), and the highest amount of forage yield was found in F_3N_1 (50% manure + 50% fertilizer and $FeSO_4$). Among nutrition elements, use of $FeSO_4$ had more influence on yield and yield components of barley.

Key words: Barley, fertilizer, germination, manure, yield.

INTRODUCTION

Barley (*Hordeum vulgare*) is a fast growing, cool season, annual grain crop that can be used as forage or as a cover crop to improve soil quality. This Old World plant has many valuable features. Agricultural consultants still have difficulty in deciding appropriate fertilizers and application rates to use with seed to minimize the risk of germination damage. This is not new, as early as 1928 fertilizer effects on germination were examined on brassica green feed crops (Hudson et al., 1937). Their work showed that traditional turnip fertilizers which contained small amounts of ammonium sulphate and potassium chloride added to superphosphate caused more germination damage to turnips than superphosphate, particularly when premixed for prolonged periods with seed. As well as the type and rate of fertilizer, there are other factors that influence the germination risk. These include the proximity (or placement) of seed relative to fertilizer, the soil moisture conditions, the soil texture and pH, and the plant species (Carter, 1967, 1969). Mineral nutrition alone has contributed significantly to increased crop yields during the 20th century. Borlaug and Dowswell (1994) reported that 50% of the increase in crop yields worldwide during the 20th century was due to application of chemical fertilizers. Stewart et al. (2005) reported that average percentage of yield attributable to fertilizer generally ranged from about 40 to 60% in the USA and England, and tended to be much higher in the tropics. Although, micronutrient elements are needed in relatively very small quantities for adequate plant growth and production, their deficiencies cause a great disturbance in the physiological and metabolic processes in the plant (Bacha et al., 1997).

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). Abd El-Wahab (2008) stated that micro-

*Corresponding author. E-mail: Amoon2020@yahoo.com.

Table 1. Chemical analysis of soil of experiment.

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

nutrients such as iron, manganese and zinc have important roles in plant growth and yield of aromatic and medicinal plants. Havlin et al. (1999) reported that iron is critical for chlorophyll formation and photosynthesis, and is important in the enzyme systems and respiration of plants; manganese is involved in the enzyme systems related to carbohydrate and nitrogen fixation in legumes; while zinc is essential for sugar regulation and enzymes that control plant growth. Zn is a vital element for wheat growth and it activates some enzymes such as carbonic anhydrase, dehydrogenase, proteins and peptidase. Hemantaranjan and Gray (1994) indicated that using Zn led to increases in leaf chlorophyll and indol acetic acid, so photosynthesis will be improved and then dry mater will be increased. 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). 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-Hady, 2007). Recently, Wang et al. (2001) reported that organic and inorganic fertilizers showed great benefits not only for the increase in the N uptake by the plant but also the improvement of the fodder yield. Materechera and Salagae (2002) used partially decomposed cattle and chicken manure amended with wood ash and reported that higher plant yield of fodder maize was obtained by the use of chicken manure. Manure can supply nutrients required by crops and replenish nutrients removed from soil by crop harvest.

Therefore, the present investigation was carried out to evaluate the effects of farmyard manure, and chemical fertilizer on yield and seed germination characters of barley grown in Sistan region of Iran.

MATERIALS AND METHODS

This experiment was conducted in 2009 cropping at Agriculture Research Center of Zabol. University. The site lies at longitude 61°29′, and latitude 31°2′ 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 29°C, 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 is shown in Table 1). The experimental design was split plot, using randomized complete block design with tree replication. Different proportion of manure and chemical fertilizer were F_1= 100% of manure (60 ton per hectare), F_2 = 100% chemical fertilizer (urea 250 kg/ha, super phosphate triple 200 kg/ha and oxide potassium 100 kg/ha), F_3 = 50% of manure + 50% of chemical fertilizer, F_4 = control as main plot and use of elements were composed of: N_1 = iron sulfate, N_2 = zinc sulfate, N_3 = manganese sulfate, and N_4 = control as sub plot in this experiment. All treatments were 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 and some soil characteristic such as EC and soil nutrient content. Electrical conductivity (EC) was measured with a 1:10 (soil: water) ratio.

The data were analyzed using MSTATC software; mean comparison was done using Duncan Multiple Comparison at 5% probability level.

RESULTS AND DISCUSSION

Grain yield

Proportions of manure and chemical fertilizer, use of nutrient and interaction with them had significant effect on barely grain yield ($P < 5\%$) (Table 2). Results showed that all proportions of manures and chemical fertilizer treatments significantly increased barley grain yield as compared to control (F_4) and the highest grain yield was obtained in the F_3 (50% manure + 50% chemical fertilizer) and F_2 (100% chemical fertilizer) treatments with mean of 2758.2 and 2713.5 kg/ha respectively as shown in Table 3. The increase in maize growth with the use of organic materials has also been observed by Silva et al. (2004).

This study confirms the role of manure and chemical fertilizer in increasing grain yield of barley, and the results showed that manure and chemical fertilizer can increase grain yield of barley but combination of them has more effect on increase in grain yield. In a recent evaluation of the direct effects of cattle manure on corn, it was verified (Silva et al., 2004) that manure increased green ear yield and grain yield in two corn cultivars. Cattle manure also increased water retention and availability, and phosphorus, potassium, and sodium contents in the soil layer from 0 to 20 cm (Silva et al., 2004). The residual effect of organic fertilizers on yield, including cattle manure, has been found to be positive in sorghum (Partidar and Mali, 2002), corn (Ramamurthy and

Table 2. Analysis of variance for yield and yield components, grain nutrient concentration.

S.O.V	df	Grain yield	Germination %	Coleoptile length	Radical length	Coleoptile dry weight	Radical dry weight
Replication	2	24756.40^{ns}	0.39^{ns}	79.72^{ns}	1.52^{ns}	0.0005^{ns}	0.0003^{ns}
Proportions of manure and fertilizer	3	42471.29**	0.11^{ns}	9.39*	7.10*	0.008*	0.03**
Error a	6	12225.65	0.84	20-May	02-Feb	0.004	0.004
Nutrient	3	6460.78*	1^{ns}	5.44*	44-May	0.004^{ns}	0.0084*
Interaction	9	5606.07**	0.33^{ns}	6.85^{ns}	6.85^{ns}	0.005^{ns}	0.0038^{ns}
Error b	12	2173.99	0.47^{sn}	Feb-67	Feb-67	0.03	0.05
CV	-	20.17	0.72	22-Mar	23-Oct	21.39	28.23

*, ** Significantly at the 5 and 1% levels of probability respectively and ns (non significant).

Table 3. Mean comparison of interaction effects yield and yield components.

Treatment	Grain yield	Germination percentage	Coleoptile length	Coleoptile dry weight
Proportions of manure and chemical fertilizer				
100% manure	229.77^{b}	5.13^{b}	6.80^{b}	0.141^{b}
100% chemical fertilizer	271.35^{a}	6.85^{a}	8.32^{a}	0.184^{a}
50% manure + 50% chemical fertilizer	275.82^{a}	5.84^{ab}	7.54^{ab}	0.184^{a}
Control	147.56^{c}	4.87^{b}	6.64^{b}	0.076^{c}
Nutrient				
Fe	253.96^{a}	5.98^{ab}	7.45^{ab}	0.17^{a}
Zn	245.62^{ab}	5.28^{ab}	7.12^{ab}	0.15^{a}
Mg	221.98^{Bb}	6.99^{a}	8.17^{a}	0.14^{ab}
Control	202.84^{c}	4.44^{b}	6.56^{b}	0.10^{c}

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

Shivashankar, 1996) and *Brassica juncea* (L.) (Rao and Shaktawat, 2002). Therefore, there was a direct effect of cattle manure on green ear yield and grain yield (Silva et al., 2004).

Nutrient treatments, N_1 (Fe^{2+}), N_2 (Zn^{2+}) and N_3 (Mg^{2+}), increased barley grain yield by 20, 17.5 and 8.6%, respectively, as compared to control (N_4), and the highest grain yield (2539.6 kg/ha) was measured in N_1 (Fe^{2+}) as compared to other treatments, as shown in Table 2.

REFERENCES

Abd E-Hady BA (2007). Effect of Zinc Application on Growth and Nutrient Uptake of Barley Plant Irrigated with Saline Water. J. Appl. Sci. Res. 3(6):431-436.

Abd El, Wahab MA (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.

Bacha MA, Sabbah AM, Hamady MA (1997). Effect of foliar application of iron, zinc and manganese on yield, berry quality and leaf mineral composition of Thompson seedless and roomy red grape cultivars. J. King Saud Univ, Agric. Sci. 9(1):127-140.

Borlaug NE, Dowswell CR (1994). Feeding a human population that increasingly crowds a fragile planet. Paper presented at the 15th World Congress of Soil Science, 10-16 July 1994, Acapulco, Mexico.

Carter OG (1967). The effect of chemical fertilisers on seedling establishment. Aust. J. Exp. Agric. Anim. Husb. 7:174-180.

Carter OG (1969). The effect of fertilizers on germination and establishment of pastures and fodder crops. Wool Technol. Breed. Aust. 16(1):69-75.

Havlin JL, Beaton JD, Tisdale SL, Nelson WL (1999). Soil Fertility and Fertilizers – An introduction to nutrient management 6th Ed. Prentice Hall, New Jersey. pp. 79-95.

Hemantaranjan A, Gray (1994). Physiology and biochemical significance of zinc in plants. In: Advancement in Micronutrient Research, pp 151-178.

Hudson AW, Woodcock JW, Doak BW (1937). The effect of some phosphatic fertilizers and superphosphate-lime mixtures on turnip seed germination. pp. 159-180.

Materechera SA, Salagae AM (2002). Use of partially decomposed cattle and chicken manures amended with wood-ask in two South

African arable soils with contrasting texture effect on nutrient uptake, early growth and dry matter yield of maize. Commun. Soil Sci. Plant Anal. 33(1/2):179-200.

Nahed AG, 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.

Partidar M, Mali AL (2002). Residual effect of farmyard manure, fertilizer and biofertilizer on succeeding wheat (*Triticum aestivum*). Indian J. Agron. 47:26-32.

Ramamurthy V, Shivashankar SW (1996). Residual effect of organic matter and phosphorus on growth, yield and quality of maize (*Zea mays*). Indian J. Agron. 41:247-251.

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.

Silva J, Silva PSL, Oliveria M, Silva KMB (2004). Effect of cattle manure on green ear yield and corn grain. 22:326-331.

Stewart WM, Dibb DW, Johnston AE, Smyth TJ (2005). The contribution of commercial fertilizer nutrients to food production. Agron. J. 97:1-6.

Wang XB, Cia DX, Hang JZZ (2001). Land application of organic and inorganic fertilizers for corn in dry land farming in a region of north China sustaining global farm. D.E Ston. R.I.I.I. Montar and G.C. Steinhardt (Eds.). pp. 419-422.