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تأثير نقع الحبوب في العناصر الصغري مع الرش بحامض الهيوميك علي إنتاجية و جودة محصول الشعير تحت ظروف الأراضي الملحية

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الملخص العربي

أجريت تجربتان حقليتان خلال الموسم الشتوي ٢٠١٠/٢٠١١& ٢٠١١/٢٠١٢ في قرية جلبانة– منطقة سهل الطينة– شمال سيناء وتهدف هذة الدراسة إلي إستبيان مدي تأثير إضافة العناصر الصغري عن طريق نقع الحبوب بالإضافة الي الرش بحامض الهيوميك علي نبات الشعير صنف جيزة ١٢٣. تم نقع حبوب الشعير في محاليل الزنك والمنجنيز والحديد والنحاس في صورة مخلبية بمعدل ٣٠٠ جزء في المليون لكل عنصر(بمعدل لتر لكل كيلو جرام حبوب) في صورة منفردة أو متحدين لمدة ٢٤ ساعة وأيضا رش النباتات بحامض الهيوميك بتركيز ٣٠٠ جزء في المليون مرتين. بعد ٣٥ و ٧٥ يوم من تاريخ الزراعة بمعدل ٤٠٠ لتر/ فدان. وقد أظهرت النتائج فاعلية الغناصر الصغري في تحسين الصفات السيئة التي يحدثها وجود ظروف قاسية في وسط النمو. وفي هذا المضمار سجل مخلوط الزنك والمنجنيز والحديد والنحاس كفاءة عالية في إحداث إستجابة معنوية لمحصول الشعير ومفرداتة حيث وصلت النسبة المئوية لمحصول الحبوب ٤٥,٤٤&٤٥,٥٤ لكل الموسم الأول والثاني علي التوالي. زيادة إحصائية لمحتوي الحبوب من العناصر الكبري (نيتروجين– فوسفور– بوتاسيوم) والعناصر الصغري (زنك– منجنيز– حديد– نحاس) بالإضافة الي البروتين الخام. وهذة الزيادة صاحبتها نقص محتوي القش من هذة العناصر. كما إرتفعت نسبةالإنبات إحصائيا بالإضافة إلي طول الريشة والجذير والوزن الخضري والجاف للبادرة في كل من موسمي الزراعة. أظهرت النتائج أيضا فاعلية الرش بحامض الهيوميك في مقاومة الظروف السيئة الناتجة عن الملوحة وإحداث تأثيرا فعالا في إظهار النتائج المرجوة في كل التقديرات السابقة في كل موسمي الزراعة. وأوضحت النتائج أيضا أنة نتيجة إتحاد حامض الهيوميك مع العناصر الصغري أحدث زيادة معنوية في كل الصفات السابق ذكرها وكانت معامل الدمج المكونة من زنك+ منجنيز+ حديد+ نحاس+ حامض الهيوميك هي المثلي في معاملات الدمج حيث أحدثت أعلي زيادة إحصائية ليس فقط في محصول الشعير ومكوناتة وتر كيز العناصر المغذية ولكن أيضا في البروتين الخام بالإضافة الي نسبة الإنبات وطول الريشة والجذير وأيضا الوزن الخضري والجاف للبادرة في كل من موسمي الزراعة لنبات الشعير صنف جيزة ١٢٣ .

EFFECT OF GRAINS SOAKING WITH MICRONUTRIENTS AND FOLIAR NUTRITION WITH HUMIC ACID ON THE PRODUCTIVITY AND QUALITY OF BARLEY PLANT UNDER SALINE SOIL CONDITIONS

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ABSTRACT: *Two field experiments were carried out during two successive seasons in 2010-2011 and 2011- 2012 at Gelbana Village Sahl- El Tina Plane (North Sinai). The study aimed to identify the integrated effect of micronutrients applied as soaking treatments, likewise foliar spray with humic acid at either individually or together on Egyptian barley variety Giza 123. Barley grains were soaked with micronutrients in the form of EDTA compounds i-e Zn- EDTA (14%), Mn- EDTA (12%), Fe- EDTA (6%) and Cu-EDTA (4%) at a rate of 300 mg/ l for each nutrient (at a rate of liter/kg grains) either singly or in combination for 24 hour before planting. Also plants were sprayed with humic acid at a rate of 300 mg/l two times, after 35 days and 75 days form sowing at a rate of 400 l/fed.. The obtained results showed the effective action of Zn, Mn, Fe and Cu in minimized the salt- induced nutrient deficiency and give high response to such plants grown under stress conditions. In this respect, the efficiency of Zn, Mn, Fe and Cu combination was more effective in increasing significantly yield and its components, since the percentage of increases in grains yield reached 45.44 and 45.54% for the first and second seasons, respectively as comparing with the control treatment. Corresponding increases significantly in macronutrients (nitrogen, phosphorus and potassium) and micronutrients (zinc, manganese, iron and copper) concentrations and uptake as well as crude protein % and protein yield in grains and straw. Such increases were accompanied by corresponding significant decreases concentration and crude protein % in straw throughout the two seasons. Significant increases were found in germination percent shoot length, radical length, as well as fresh and dry weights of seedlings for two growing seasons. The obtained data also indicated that foliar nutrition with humic acid alleviates the adverse effect of salinity and induced significant improvements all studied parameters throughout the development stages of growth. Data illustrated that joint addition of humid acid with micronutrients gave high increases significantly in all prior studied parameters. The combined treatment of Zn+ Mn+ Fe+ Cu+ humic acid gave the highest significant increases not only yield and its attributes and nutrients concentrations and uptake but also on crude protein %, protein yield in grains in addition on percentage of germination, shoot and radical length, also fresh and dry weights of seedlings for the two growing seasons of barley plants, Giza 123 cultivar.*

Key words: *Barley plants, Micronutrients (Zn, Mn, Fe and Cu), Humic acid and Soil salinity.*

INTRODUCTION

Barley (*Hordum Vulgare L*.) is one of the most important cereal crops in the world, being used for many purposes such as molting, brewing industry, animal feeding, bread making as it is or by mixing with wheat flour in some places, some food and beverages.

Salinity is one of the most important a biotic factors in limiting plant productivity (Munns, 1993). So, environmental stress such as salinity induce several physiological, bio-chemical and molecular responses in several crop plants, which would help them to adopt to such limiting environmental conditions (Arora *et al.* 2002).

In Egypt, most of barley production areas are located where the adverse conditions exist such as micronutrients deficiency. The micronutrients application in the form of coating or foliar spray is undoubtedly of great importance to improve barley production (Anton *et al*, 1999). Ghaly *et al*. (1992) found that coating method for wheat grains with Zn+ Mn+ Fe elements at the rate of 0.3+ 0.15+ 0.3 gm/kg seeds, respectively resulted in increasing straw and grains yield in sandy soil. Mohamed *et al*. (2001) found that application of Fe+ Mn+ Zn+ Cu combinations at rate of 1000 mg/l Fe- EDTA (6%), 500 mg/l Mn- EDTA (12%), 500 mg/l Zn- EDTA (14%) and 250 mg/l Cu- EDTA (4%) significantly increased 1000 grain weight, grin yield, straw yield, protein content and K content in grains of wheat. Pandya *et al*. (2004) showed that supplemental Mn in salt stress barley plants found increase in relative growth rate and net assimilations rate. Mohammad *et al*., (2009) induced that application of zinc, ferrous and manganese increases significantly number of grains in each spike, weight of 1000-grains and grains yield of wheat as well as zinc, ferrous and manganese concentrations in grains. Seadh *et al*. (2009) found that application of micronutrients mixture of Zn+ Mn+ Fe+ Cu at rate of 500 mg/l for each nutrients produced the highest values of plant height, number of spike/m^2, spike length, 1000 grain weight, grain yield, straw yield, N, P, K, germination percent, Shoot length and root length of wheat followed by Zn, Mn, Fe and Cu added as individual treatments at rate of 500 mg/l.

Furthermore, humic acid play prominent role in various physiological and bio-chemical processes related to environmental stresses. For most crops, the greatest plant response to humic acid and fulvic acid runs any where from 10 to 300 ppm (Hakan, 2008). Ragab *et al*. (2010) found that interaction of humic acid with salinity resulted in significant increases in 1000-grains weights, grains and straw yield, likewise N, P, K, Fe, Mn and Zn uptake in grains. Celik *et al*., (2011) reported that foliar application of humic acid had significant positive effect on dry weight and copper, zinc, and manganese uptake of maize plants.

Seed quality has direct influences on success of crop and significantly contribution to productivity levels (Bewley and Black, 1994). Loana *et al*. (2004) found that copper micronutrient significantly inhibit germination compared to the untreated control, the toxicity of copper is higher if concentration increases. The most important symptoms of copper toxicity are chlorosis, modifications in root morphology and development, decreased of stem development and eventual, perturbation in plant development (Mehra and Farago, 1994).The positive influence of organic on crop yield and quality has been demonstrated in the works of many researchers (Stefanescu,2002; Hoffman ,2001; Sttar and Hossain 2001).

This work aimed to study soaking treatment of grains with zinc, manganese, iron and copper solution with subsequent spraying of the plants with humic acid on yield and yield components, nutrients concentrations and uptake, crude protein % and protein yield inside barley plant as well as seed vigor test in such saline conditions and which of them enables the plants to tolerate and survive not only by completing its life cycle but also by appropriating to be marketing.

MATERIALS AND METHODS

Two field experiments were conducted during two successive grown winter seasons 2010-2011 and 2011-2012 at Gelbana Village Sahl-El Teina (North Sinai Governorate) to study the response of

Egyptian barley variety Giza 123 (*Hordium vulgar L*.) to micronutrients (Zn, Mn, Fe and Cu in the form of EDTA compounds) which applied as soaking treatment at a rate of 300 mg/l for each nutrient (at a rate of liter/ kg grains) either singly or in combination as well as foliar fertilization with humic acid at a rate of 300 mg/l either individually or in associated with micronutrients.

Representative surface soil sample (0-30cm) was taken before the performance of the experiment for physical and chemical analysis according to Black (1965) and Page *et al*., (1982). The obtained data were recorded in Table (1).

Table (1): Physical and chemical properties of the experimental soil.

Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture	O.M (%)	CaCO3 (%)	pH (1:2.75 soil: water susp.)
10.89	59.1	13.01	16.8	Loamy sand	0.60	7.30	7.9
EC (dS/m)	cation (mg/l) Soluble				Soluble anion(mg/l)		
7.0	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	Cl^{-}	SO^{-4}
	41.25	17.41	21.45	2.11	2.84	22.23	55.19
Available macronutrients (mg/kg)			micronutrients Available (mg/kg)				
N	P	K	Fe	Mn	Zn	Cu	
10.21	5.15	120.32	4.35	3.66	1.42	0.091	

Barley grains were planted at 15th and 19th of November during the first and second seasons, respectively at a rate of 60 kg /fed. in rows.20 cm apart. The used experimental design was a complete randomized with four replicates. The area unit was (3x3.5) = $10.5m^{2.}$

The studied treatments were which may be listed as follow.

1-Control (without micronutrients and humic acid). (0.0)
2-Zn-EDTA.
3-Mn-EDTA.
4-Fe-EDTA.
5-Cu-EDTA.
6-Zn+ Mn+ Fe+ Cu- EDTA.
7-Humic acid.
8-Zn+ humic acid.
9-Mn+ humic acid.
10- Fe+ humic acid.
11- Cu+ humic acid.
12- Zn+ Mn+ Fe+ Cu+ humic acid.

All plots received recommended doses of nitrogen fertilizer at a rate of 33.5 kg N/fed. as ammonium nitrate (33.5%) which applied in four equal doses at sowing, and after 20, 45 and 60 days from sowing date. Phosphorus fertilizer was applied at rate of 30 kg P_2O_5 /fed. as calcium super phosphate (15% P_2 O_5),which applied during soil tillage before barley sowing. Potassium fertilizer was used at a rate of 48 kg K_2O/fed. as potassium sulphate (48% K_2 O) after 20 days from sowing.

The micronutrients treatments such as Zn, Mn, Fe, and Cu were applied as soaking treatment directly before planting. Before soaking, barley grains were surface sterilized in 5% sodium hypochloride for 5 minutes and rinsed will with water (Anonymous, 1985). Grains were soaked in solutions of Zn, Mn, Fe and Cu at rates of 300 mg/l for each element (at a rate of liter/ kg grains) for 24 hour before sowing in the form of EDTA compounds (Zn-EDTA) (14%Zn), (Mn-EDTA) (12%Mn), (Fe-EDTA) (6% Fe) and (Cu-EDTA) (4%Cu).

Humic acid (obtained from commercial company) was added as foliar spray method at a rate of 300 mg/l. Plants were sprayed after 35 and 75 days from sowing at a rate of 400 l/ fed. The chemical composition of the used humic acid was determined by using $BaCl_2$ precipitation methods as described by Fataftah *et al*. (2001) as shown in Table (2).

Other field practices were followed in the usual manner for barley cultivation. Plants were grown till maturity and harvest. Harvest took place on 20 and 25 May in the first and second seasons, respectively. The area of each sample was $1m^2$. At harvest, agronomic traits were recorded i-e, plant height (cm), number of spike/m^2, spike length (cm), number of kernel/spike, weight of kernel/spike (g), 1000-grains weights, as well as grains and straw yield (ton/fed.).

Table (2): Main characteristic of the used humic acid.

Compounds and units	Values	Properties unites	Values
Organic matter/total Solid (%)	42.81	Total nitrogen (N, %)*	7.55
Total humic acid/total solid(g/l)	175.11	C/N ratio	2.98
Organic carbon (%)	24.13	Total phosphorus (P_2O_5, %)*	5.14
pH	8.40	Available potassium (K_2O, %)*	9.33
EC	5.8	Total calcium (Ca, %)**	0.09
		Total magnesium(Mg, %)*	0.07
		Total boron(B, mg/l)*	73.15
		Total manganese (Mn, mg/l)**	91.62
		Total zinc (Zn, mg/l)**	89.51
		Total iron (Fe, mg/l)**	895.14
		Total copper (Cu, mg/l)**	92.16

* Soluble in distilled water ** Digest by H_2SO_4..

A laboratory tests were carried out at Seed Technology Research Dep. ARC as follow

Vigor testing: Percent of germination, grains were incubated in moist filter paper at 20^{o}C for 8 days. Normal seedlings were count and expressed as germination percentage at the final count according to International Rules I.S.T.A. (1993) and measuring radical, shoot length and its fresh and dry matter according to Kirshnasamy and Seshu (1990). Before planting, the initial germination after soaking in Zn, Mn, Fe ,Cu alone and mixture micronutrients in the laboratory were 70, 72, 60, 65and 75% for treatments compared with control(53%) respectively.

For chemical determinations, the harvested and oven-dried plant material were fine powdered, wet digestion for dry material was carried out according to Chapman and Pratt (1961). Nitrogen content was determined in grains and straw digest by microkjeldhal methods as described by A.O.A.C. (1990). Crude protein percent was estimated in prior organs by multiplying N% by 5.7% as described by A.O.A.C. (1990). Phosphorus and potassium content in grains and straw were estimated using the procedure described by A.O.A.C. (1990). The atomic absorption spectrophotometer was used determine Zn, Mn, Fe and Cu concentrations according to the methods recommended by A.O.A.C. (1990). Least significant differences test was used for comparing treatments effects as described Sendecor and Cochran (1982) .

RESULTS AND DISCUSSIONS

Yield and Yield Components.

The obtained results in Table (3) clearly indicate that supplementary of Zn, Mn, Fe and Cu individually as priming method for barley plant were found to have the alleviating effect on deterious effect caused by salinity, resulting significant increases in yield and its components for barley plant. For example, the plant height and number of spike /m^2 were increased from 91.25 to 99.60 and from 227 to 274, respectively, in the first season, and from 92.05 to 100.75 and from 230 to 278 at the respective order in the second season at control treatment and in the individual Zn treatment. Fageria *et al*., (2008) found that cereal crops had higher Zn use efficiency. Soleimani (2006) reported that zinc is a vital element for wheat growth and it activates some enzymes such as carbonic anhydrass, dehydrogenase, protein and peptidase. Pandya *et al*. (2004) pronounced that supplemental Mn improved the growth of salt stressed plant to a limited extent, but did not improve the growth of the control plant. Khurana and Chatterjee (2000) found that copper has been to be essential for growth and viability of pollens and also in the filling of endosperm cells of the maturing seeds.

Table 3

Garg (1987) found that applying micronutrients delayed the senescence of wheat plant through increases in the level of IAA (indol acetic acid) and chlorophyll content and consequently increased the total dry matter accumulation and yield components. Similar trend had been seen by Kandel (2003), Courtney and Mullen (2008), Behera and Singh (2010), Bhupinder and Singh (2011) and Ahmad *et al*. (2012).

It is evident from the obtained data in Table (3) that there was progressive improvement on either yield or yield components for barley plants by combined treatment of Zn+ Mn+ Fe+ Cu in the two growing seasons compared with the untreated plants. Where the increases in spike length and number of kernel /plant in this treatment rose to 7.88 and 65, respectively in the first season and were 7.95 and 68, at a respective order in the second season. The effect of micronutrients on yield components could be explained by their improving role in the biosynthesis of natural hormone, organic nutrients as well as both cell division and enlargement, which are reflected in increasing the nutrient status of plants (Valley and Wacher, 1970). EL-Aggory *et al*. (2000) recorded increase in wheat grains yield (1.37 ardab /fed.) as a result of micronutrients implication with NPK to such soil with high pH and with deficient in micronutrients. Coincidence results were obtained by Salem and Mohamed (2000) on wheat plant.

Treatment of foliar spray with humic acid only resulted in substantial promotion of the studied growth parameters in the two grown seasons compared to the control treatment, since increases in weight of kernel /spike and 1000- grains weight amounted to 1.13 and 43.12, respectively for the first season and 1.16 and 44.5, respectively for the second season, where these two parameters were 0.89 and 40.56,respectively in the first season and 0.91 and 40.69,respectively in the second season in the unfertilized plants by both micronutrients and humic acid. Morard *et al*. (2011) gained the similar results. They declared that the humic-like substance induced a biostimulating effect on plant growth. Treated plants presents a faster development and reach reproductive stage days earlier than control.

Data in Table (3) show that combination treatment of both humic acid with micronutrients induced high significant increases in the aforementioned yield components and yield. The combined treatment of humic acid + Zn+ Mn+ Fe+ Cu surpassed the other combination treatments for the two seasons. In this treatment the yield of grains and straw were increases and reached 1.77 and 1.95, respectively in the first season, also data were 1.82 and 2.04, in the order stated in the second season. Similar results were obtained by Sadek and Sallam (2011).

Nutrients Concentrations and Uptake.

Macronutrients concentrations.

Data in Table (4) reveal that treatment with different micronutrients as individual owing to significant increases in macronutrients concentrations in barley grains, throughout the experimental period. For example, treatment with Zn-EDTA exceeded the other micronutrients in ameliorating the deleterious effect of salinity on the concentrations of essential nutrients inside barley tissues grown under such server conditions. Where the nitrogen concentration (%) in this treatment change from 1.63 and 1.70% in control treatments to 1.9 and 1.99% in Zn treatments in the first and second seasons, respectively. In this connection, Khoshgoftar *et al*. (2006) reported that Zn application had a positive effect on salt tolerance of wheat plants. Pandya *et al*. (2004) found that supplemental Mn did not improve N and P content for control. Amberger (1974) reported that Mn ions are necessary for the final reduction step of nitrate to ammonium. Evans and Sorger (1966) stated that Mn required in the biological system for the activity of several enzymes. Similar results were obtained by Abd EL_Magid *et al*. (2000).

Table 4

In currently work, dealing with micronutrients associations, more significant increases in N, P and K concentrations in barley grains under saline conditions as recorded in Table (4), where the increases in phosphorus concentrations reached 0.39 and 0.410 in the first and second seasons, at a respective order which were 0.323 and 0.339% in the plant unfertilized by either of micronutrients or humic acid. Those results are in agreement with Negm and Zahran (2001).

Dealing with humic acid as foliar application, it led to significant increases in potassium concentrations in barley grains under such conditions whereas reached to 0.564 and 0.586 in the first and second seasons in the order stated (Table, 4). Similar trends were found for nitrogen and phosphorus concentrations in such organ for the two seasons. Several studies shown that humic acid increased branched roots and proliferate root hair development, so increased root growth resulted in greater absorption of water and nutrients (Tan and Nopamornbodim 1979 and Matlikarajunarao *et al*. 1987)

With regard to interaction between humic acid and micronutrients, statistical analysis clarified high increases significantly for macronutrients concentrations (%) in grains for both seasons. The combined treatment of humic acid plus micronutrients mixture produced the highest significant improvements in those concentrations, where potassium concentrations rose from 0.481 to 0.61 in the first season and from 0.503 to 0.639 in the second season at control and Zn+ Mn+ Fe+ Cu+ humic acid, respectively. Those results are in agreement with Sadek, and Sallam, (2011). On the other hand, micronutrients and humic acid addition either singly or together decreases significantly macronutrients concentrations in straw. This was true for the two growing seasons, indicating more nutrients translocations to the grains. Such trend might emphasize the increase in grains yield occurred under the above mentioned treatments (Table, 3).

Macronutrients uptake.

Data illustrated in Table (5) showed that implication of micronutrients as single treatments increased significantly nitrogen, phosphorus and potassium (kg/fed.) uptake in grains and straw of barley as compared to the control treatment in the two grown seasons. Zinc treatment seemed more effective than other micronutrients throughout the two grown seasons. Since nitrogen uptake reached to 26.79 and 13.02 (kg/fed.), respectively in the first season, and were 28.66 and 13.69 (kg/fed.), at a respective order in the second season.

Present data reveal that soaking combination between Zn+ Mn+ Fe+ Cu applications increased significantly macronutrients uptake in grains and straw for two grown seasons except for phosphorus uptake in straw at second season. The increase in nitrogen uptake rose to 28.28 and 13.53 (kg/fed.), respectively in the first season as well as 29.84 and 13.86 (kg/fed.), in the order stated in the second season for grains and straw, respectively. This is due to that the effective role of micronutrients on the dry weights accumulation. Similar results were obtained by Shaban *et al*. (2010).

In addition, foliar addition of humic acid had a significant positive effect on those nutrients uptake in grains and somewhat slightly increases in the straw and nonsignificant for the two seasons. Where phosphorus uptake increases in grains reached 4.52 and 4.85 (kg/fed.) for the first and second seasons, in the order stated.

Similar results were obtained before by Ragab *et al*. (2010).

Concerning interaction effect of the studied treatments, statistical analysis revealed that combination between micronutrients and humic acid had a significant effect for increasing N, P and K uptake by straw and grains of barley plant with some exception for phosphorus uptake in straw for the second season. The highest significant increases attained due to Zn+ Mn+ Fe+ Cu+ humic acid application. The highest increases in potassium uptake in

Table 5

grains and straw were 10.80 and 25.16 (kg/fed.), respectively for the first season and were 11.63 and 26 32 (kg/fed.), at a respective order for the second season.

Micronutrients concentrations.

The obtained data in Table (6) show that addition of Zn, Mn, Fe and Cu as individual increases significantly their concentrations in grains. This was true for the two seasons. Wang *et al*. (2010) reported that Zn applications increased the contents of water-soluble plus exchangeable (WSEXC Zn)), Carbonate bound Zn (CA Zn) and iron – manganese oxide-bound Zn (Fe Mn OX Zn) in soil. Alhendawi *et al*. (2008) found that Fe supply, NH_4 nutrition approximately double Fe, Zn, Cu and Mn concentrations and uptake.

Results in Table (6) declared the superiority of micronutrients mixture in enhancing significantly the concentrations of micronutrients in grains of barley plants. Where the zinc and manganese concentrations reached 79.13 and 93.11 (mg/kg), respectively in the first season and 81.69 and 95.49 (mg/kg) in the order stated in the second season. The obtained results are in a agreement with those obtained by Salem and Mohamed (2000).

Table (6) showed that foliar fertilizer with humic acid increased significantly micronutrients concentrations in grains in the grown seasons. Since ferrous concentrations rose to 150.96 and 153.62 (mg/kg) in the first and second seasons, respectively. Coincidence results obtained such conclusion confirm those of Celik *et al*., (2011).

In combination treatment of microelements with humic acid, results showed that the combined treatment of Zn+ Mn+ Fe+ Cu+ humic acid induced the highest significant increases in the concentrations of micronutrients in grains in both grown seasons. For example copper concentrations of grains reached 13.14 and 13.88 (mg/kg) in the first and second seasons, at a respective order. On the other hand, addition of microelements and humic acid either singly or in associations decreased significantly micronutrients concentrations in straw of barley in the two grown seasons as compared with the untreated plants (control), indicating more nutrients translocation to the valuable sites in barley and consequently increases nutrients % in those sites i-e grains as found by Zandonadi *et al*. (2007).

Micronutrients uptake.

Data recorded in Table (7) indicate that barley grains pro-soaking with Zn, Mn, Fe and Cu alone or in combination significantly enhanced uptake (mg/kg) of those nutrients in grains and straw with some exceptions in the two grown seasons. The combined treatment was the most effective one in this respect comparing with the untreated plants. The results take similar trend in both seasons. Since the increase in zinc uptake in grains and straw as much as 114.74 and 19.77 (g/kg), respectively for the first season, likewise 120.10 and 20.63 (g/kg), at a respective order for the second season. The increases in the content of Zn, Mn, Fe and Cu as well as the increases in dry weights of grains and straw due to the application of micronutrients surely reflected on increasing their uptake by grains and straw. Similar results were obtained by Salem and Mohamed (2000).

From the same Table, it could be noted that foliar nutrition with humic acid improved significantly those uptake in grains except for Cu uptake throughout the two grown seasons. Such treatment could not any significant improvement in those uptakes in straw. This was true in grown seasons except for 5% level in the first season and Mn uptake and Fe uptake at the same level in the second season. Whereas the increases in manganese uptake in grains reached to 80.00 and 83.75 (g/fed.), in the first and second season, respectively. These results are in harmony with those obtained by Ragab *et al*. (2010).

Examining further significant effect (Table, 7), it could be noted that the positive effect of all combined treatments were more

Table 6

pronounced and highly significant. The application of humic acid with micronutrients

Table 7

mixture produced the highest increases significantly in those uptakes of the determined micronutrients in grains and straw in both seasons as compared with the unfertilized plants. The increases in Fe uptake amounted to 417.56 and 181.80 (g/fed.), respectively in the first season and 435 and 190.15 (g/fed.), in the order stated the second season. Such treatment increases copper-uptake by about 23.26 and 3.92 (g/fed.), at a respective order in the first season as well as 25.26 and 4.2 (g/fed.), respectively in the second season. Sanchez *et al*., (2006) found that the joint addition of Fe-EDTA and humic acid improved Fe uptake.

Crude protein percent and protein yield.

Data in Table (8) clearly show that priming the grains with Zn, Mn, Fe and Cu either alone or together significantly improved the crude protein percent in grains and protein yield (kg/fed.) in grains and straw in both seasons. The efficiency of micronutrients mixture was more positive and significant than individual nutrients. Where crude protein content increases reached 11.12 and 11.57 (%) in the first and second seasons, respectively. Anton *et al*. (1999) and Salem and Mohamed (2000), have been obtained similar results.

Similarly, humic acid application as foliar fertilizer produced significant increase in the crude protein percent, whereas 10.83 and 11.34 (%) in the first and second seasons at a respective order. Wang *et al*. (2001) reported that organic and inorganic fertilizers showed great benefits not for the increase in the N uptake by the plant but also in the improvement of the maize plant.

Concerning the combination treatments of micronutrients and humic acid under study, data showed that motivation of humic acid was highly pronounced when combined with the micronutrients either individual or together, the joint application of humic acid and mixture of microelements gave the highly significant increases in protein yield in grains and straw over the control treatment by about 208.86 and 91.07 (kg/fed.), respectively in the first season. In case of second season the values were 224.04 and 96.49 (kg/fed.) in the same order.

On the other hand application of micronutrients and humic acid either separately or in associations decreased significantly crude protein percent in straw, indicating more nitrogen translocation to the valuable sites of barley plants and consequently increased protein content in those sites i-e, grains. This was true for both growing seasons. Abd El- Wahab (2008) stated that micronutrients such as iron, mangnes 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 was impotent functions in plant metabolism, such as activating catalase enzymes.

Seed Vigor Test.

The fact that pre-soaking treatments of grains increases the potential of seedlings to extract more moisture from the atmosphere due to change in lipophilic colloids (Chinoy *et al*., 1970 and Narendra and Srivastava 2001). Results of Table (9) show that germination percentage, shoot, radical length likewise, fresh and dry weights of seedlings (cm) were increases significantly for the two seasons. Humic acid with mixture of micronutrients were improve the germination percentage and other characters. David *et al*., (1994) reported that humic acid promote seed germination, increase nutrients uptake and stimulate plant growth by its effect on ion transfer at root level by activating the oxidation reduction state of plant growth medium and so increased absorption of micronutrients.

In first season, the highest values in germination percentage (75% and 80%) were obtained by mixed of microelements

Table 8

alone and humic acid with mixed of micronutrients, followed by (68% and 74%) when Zn was used alone and with humic acid. While increased germination %

Table 9

reached (56% and 60%) when copper was used alone and with humic acid, respectively compared with control (50% and 55%. Loana *et al*. (2004) found that copper microelement significantly inhibit germination compared to the untreated control. The toxicity of copper is higher of concentration increases. Zinc microelement also inhibits germination however its effect highly depends on the micronutrients concentration. The increases in Shoot, radical length and both of fresh and dry weights of seedlings reached to 14.70, 8.30, 3.07 and 0.202 when mixed microelements was used while increases the values 19.30, 10.10, 3.77 and 0.284 when mixed microelements was used with humic acid respectively compared with control 11.4, 14.10, 5.10, 6.91, 2.38 2.92 and 0.113, 0.172, respectively.

In second season, the increase in germination percentage, shoot, radical length, fresh and dry weights of seedling reached to (76%, 83%, 15.02, 19.62, 8.83, 10.80 and 3.12 and 3.82 cm) when used mixed micronutrients alone and humic acid with mixed microelements followed by (64%, 77%, 14.11, 18.97, 8.01, 10.50, 3.01, 3.61 and 0.198, 0.285) when Zn was used alone and Zn with humic acid compared by control (52% 57%, 11.55, 14.38, 5.42, 7.36, 2.40, 2.97 and 0.115, 0.177), respectively. Balanced fertilization program with macro and micronutrients in plant nutrition is very important in the production of high yield and high quality products (Swan *et al*., 2001).

CONCLUSION.

Because of the loamy sand nature of the North Sinai associated with high of pH, EC and high in soluble cation and anion. Most of nutrients negligible availability in this soil. These conditions may lead to some nutritional disorders that go along with the deficiency of such nutrients. The observation that the disorder can be alleviated by priming treatments with micronutrients at 0.3g/l for Zn, Mn, Fe and Cu, proved to be the best in alleviating this disorder caused by salinity stress resulting high percentage of yield and yield components This due to the fact that pre-soaking treatments of grains increases the potential of seedlings to extract more moisture from the atmosphere due to change in lipophilic colloids. In addition, many other attempts have been made to overcome this disorder, including foliar application of humic acid; barley plants appear able to regulate the uptake and accumulations of nutrients. Wide fluctuation occurs in response of internal mineral elements to the exogenous treatments; Zn, Mn, Fe, Cu and humic acid was observed. It was possible to watch a regular trend for the association between internal element concentrations and those treatments. This indicates that the balance between the internal mineral ions was affected by such exogenous treatments combinations.

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تأثير نقع الحبوب في العناصر الصغري مع الرش بحامض الهيوميك علي إنتاجية و جودة محصول الشعير تحت ظروف الأراضي الملحية

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الملخص العربي

أجريت تجربتان حقليتان خلال الموسم الشتوي ٢٠١٠/٢٠١١& ٢٠١١/٢٠١٢ في قرية جلبانة- منطقة سهل الطينة- شمال سيناء وتهدف هذة الدراسة إلي إستبيان مدي تأثير إضافة العناصر الصغري عن طريق نقع الحبوب بالإضافة الي الرش بحامض الهيوميك علي نبات الشعير صنف جيزة ١٢٣. تم نقع حبوب الشعير في محاليل الزنك والمنجنيز والحديد والنحاس في صورة مخلبية بمعدل ٣٠٠ جزء في المليون لكل عنصر(بمعدل لتر لكل كيلو جرام حبوب) في صورة منفردة أو متحدين لمدة ٢٤ ساعة وأيضا رش النباتات بحامض الهيوميك بتركيز ٣٠٠ جزء في المليون مرتين. بعد ٣٥ و ٧٥ يوم من تاريخ الزراعة بمعدل ٤٠٠ لتر/ فدان. وقد أظهرت النتائج فاعلية الغناصر الصغري في تحسين الصفات السيئة التي يحدثها وجود ظروف قاسية في وسط النمو. وفي هذا المضمار سجل مخلوط الزنك والمنجنيز والحديد والنحاس كفاءة عالية في إحداث إستجابة معنوية لمحصول الشعير ومفرداتة حيث وصلت النسبة المئوية لمحصول الحبوب ٤٥,٤٤&٤٥,٥٤ لكل الموسم الأول والثاني علي التوالي. زيادة إحصائية لمحتوي الحبوب من العناصر الكبري (نيتروجين- فوسفور- بوتاسيوم) والعناصر الصغري (زنك- منجنيز- حديد- نحاس) بالإضافة الي البروتين الخام. وهذة الزيادة صاحبتها نقص محتوي القش من هذة العناصر. كما إرتفعت نسبةالإنبات إحصائيا بالإضافة إلي طول الريشة والجذير والوزن الخضري والجاف للبادرة في كل من موسمي الزراعة. أظهرت النتائج أيضا فاعلية الرش بحامض الهيوميك في مقاومة الظروف السيئة الناتجة عن الملوحة وإحداث تأثيرا فعالا في إظهار النتائج المرجوة في كل التقديرات السابقة في كل موسمي الزراعة. وأوضحت النتائج أيضا أنة نتيجة إتحاد حامض الهيوميك مع العناصر الصغري أحدث زيادة معنوية في كل الصفات السابق ذكرها وكانت معامل الدمج المكونة من زنك+ منجنيز+ حديد+ نحاس+ حامض الهيوميك هي المثلي في معاملات الدمج حيث أحدثت أعلي زيادة إحصائية ليس فقط في محصول الشعير ومكوناتة وتر كيز

العناصر المغذية ولكن أيضا في البروتين الخام بالإضافة الي نسبة الإنبات وطول الريشة والجذير وأيضا الوزن الخضري والجاف للبادرة في كل من موسمي الزراعة لنبات الشعير صنف جيزة ١٢٣ .

Table (3): Effect of micronutrients and humic acid fertilization either separately or in association on yield and yield components of barley plants for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011							
Humic acid (mg/l)	Micronutrients (300 mg/ l)	Plant height (cm)	No of spike $/m^2$	Spike lengh (cm)	No of kernel /spike	Weight of kernel /spike	1000-grains weight(g)	Grains yield (ton/fed.)	Straw Yield (ton/fed.)
0.0	0.0	91.25	227	7.25	44	0.89	40.56	0.997	1.11
	Zn	99.60	274	7.60	60	1.16	43.20	1.41	1.55
	Mn	97.34	257	7.50	58	1.11	42.70	1.36	1.52
	Fe	96.43	244	7.43	55	1.08	42.27	1.34	1.49
	Cu	94.41	240	7.40	52	1.05	41.20	1.31	1.45
	Zn+Mn+Fe+Cu	101.67	284	7.88	65	1.25	44.54	1.45	1.63
300	0.0	100.91	261	8.45	53	1.13	43.12	1.18	1.32
	Zn	109.25	311	8.74	69	1.44	50.99	1.68	1.88
	Mn	106.51	306	8.70	67	1.40	48.81	1.59	1.78
	Fe	104.65	303	8.61	63	1.35	46.62	1.51	1.67
	Cu	102.71	295	8.52	60	1.30	45.11	1.48	1.63
	Zn+Mn+Fe+Cu	111.15	319	8.85	72	1.50	52.12	1.77	1.95
L.S.D. * 5%		2.11	8.47	0.09	5.49	0.1	0.35	0.20	0.22
1%		3.12	12.51	0.14	8.11	0.15	0.51	0.29	0.33
C.V. **		10.13	12.44	10.44	10.22	10.21	11.44	11.66	10.12
Treatments		2011/2012							
Humic acid (mg/l)	Micronutrients (300 mg/l)	Plant height (cm)	No of spike $/m^2$	Spike Lengh (cm)	No of kernel /spike	Weight of kernel /spike	1000-grains weight(g)	Grains yield (ton/fed.)	Straw yield (ton/fed.)
0.0	0.0	92.05	230	7.31	46	0.91	40.69	1.01	1.15
	Zn	100.75	278	7.68	64	1.19	43.47	1.44	1.61
	Mn	98.32	261	7.60	59	1.14	43.01	1.39	1.59
	Fe	97.31	248	7.54	57	1.11	42.45	1.36	1.54
	Cu	95.28	243	7.49	55	1.08	41.51	1.34	1.50
	Zn+Mn+FE+Cu	102.89	286	7.95	68	1.26	44.72	1.47	1.69
300	0.0	102.10	265	8.56	56	1.16	44.5	1.20	1.39
	Zn	110.56	318	8.84	73	1.48	51.52	1.71	1.94
	Mn	107.90	311	8.79	71	1.46	49.83	1.62	1.85
	Fe	105.85	304	8.69	66	1.38	47.11	1.53	1.75
	Cu	104.31	301	8,6	63	1.34	45.35	1.50	1.68
	Zn+Mn+Fe+Cu	112.11	321	8.94	76	1.65	53.35	1.82	2.04
L.S.D. * 5%		2.17	8.61	0.12	5.89	0.11	0.54	0.21	0.23
1%		3.21	12.71	0.17	8.69	0.16	0.79	0.31	0.34
C.V. **		11.13	12.71	11.22	12.15	11.44	12.61	11.91	11.33

*: Treatments. **: Coefficient of variation.

Table (4): Effect of micronutrients and humic acid fertilization either separately or in association on macronutrients Concentrations (%) in grains and straw of barley for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011					
		Grains			Straw		
Humic acid (mg/l)	Micronutrients (300 mg/l)	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
0.0	0.0	1.63	0.323	0.481	0.86	0.06	1.32
	Zn	1.90	0.382	0.552	0.84	0.05	1.30
	Mn	1.86	0.378	0.541	0.85	0.05	1.30
	Fe	1.77	0.360	0.528	0.83	0.05	1.31
	Cu	1.72	0.354	0.522	0.84	0.05	1.30
	Zn+Mn+Fe+Cu	1.95	0.390	0.588	0.83	0.05	1.29
300	0.0	1.90	0.383	0.564	0.85	0.05	1.31
	Mn	2.05	0.425	0.590	0.83	0.048	1.30
	Fe	2.01	0.418	0.584	0.82	0.049	1.30
	Cu	1.98	0.411	0.574	0.83	0.049	1.30
	Zn+Mn+Fe+Cu	1.95	0.401	0.567	0.84	0.048	1.29
		2.07	0.440	0.610	0.82	0.044	1.29
L.S.D. * 5%		0.07	0.03	0.04	0.09	0.05	
1%		0.1	0.04	0.06	0.13	0.07	
C.V. **		8.13	7.22	8.44	9.22	8.41	
Treatments		2011/2012					
		Grains			Straw		
Humic acid (mg/l)	Micronutrients (300 mg/l)	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
0.0	0.0	1.70	0.339	0.503	0.87	0.07	1.34
	Zn	1.99	0.404	0.577	0.85	0.06	1.32
	Mn	1.95	0.397	0.569	0.86	0.05	1.32
	Fe	1.85	0.379	0.553	0.84	0.06	1.32
	Cu	1.79	0.375	0.550	0.84	0.06	1.33
	Zn+Mn+Fe+Cu	2.03	0.410	0.618	0.82	0.05	1.30
300	0.0	1.99	0.404	0.586	0.86	0.06	1.33
	Zn	2.14	0.447	0.617	0.83	0.06	1.32
	Mn	2.09	0.439	0.612	0.84	0.05	1.31
	Fe	2.06	0.434	0.601	0.83	0.05	1.31
	Cu	2.03	0.422	0.593	0.85	0.05	1.32
	Zn+Mn+Fe+Cu	2.16	0.463	0.639	0.83	0.04	1.29
L.S.D. * 5%		0.06	0.02	0.05	0.11	0.08	0.10
1%		0.09	0.03	0.07	0.16	0.12	0.15
C.V. **		9.22	9.14	9.52	8.49	9.71	8.26

*: Treatments. **: Coefficient of variation.

Table (5): Effect of micronutrients and humic acid fertilization either separately or in association on macronutrients uptake (kg/fed.) in grains and straw of barley for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011					
		Grains			Straw		
Humic acid (mg/l)	Micronutrients (300 mg/l)	N uptake (kg/fed.)	P uptake (kg/fed.)	K uptake (kg/fed.)	N uptake (kg/fed.)	P uptake (kg/fed.)	K uptake (kg/fed.)
0.0	0.0	16.25	3.22	4.80	9.55	0.67	14.65
	Zn	26.79	5.39	7.78	13.02	0.78	20.15
	Mn	25.30	5.14	7.36	12.92	0.76	19.76
	Fe	23.72	4.82	6.08	12.37	0.75	19.52
	Cu	22.53	4.64	6.84	12.18	0.73	18.85
	Zn+Mn=Fe+Cu	28.28	5.66	8.53	13.53	0.82	21.03
300	0.0	22.42	4.52	6.66	11.22	0.66	17.29
	Zn	34.44	7.14	9.91	15.60	0.90	24.44
	Mn	31.96	6.65	9.29	14.60	0.87	23.14
	Fe	29.90	6.21	8.67	13.86	0.81	21.17
	Cu	28.86	5.93	8.39	13.69	0.78	21.03
	Zn+Mn+Fe+Cu	36.64	7.79	10.80	15.99	0.86	25.16
L.S.D. * 5%		3.65	0.90	1.28	1.46	0.07	2.48
1%		5.39	1.33	1.89	2.16	0.11	3.66
C.V. **		9.11	9.41	9.71	9.44	9.51	9.61
Treatments		2011/2012					
		Grains			Straw		
Humic acid (mg/l)	Micronutrients (300 mg/l)	N uptake (kg/fed.)	P uptake (kg/fed.)	K uptake (kg/fed.)	N uptake (kg/fed.)	P uptake (kg/fed.)	K uptake (kg/fed.)
0.0	0.0	17.17	3.42	5.08	10.01	0.81	15.41
	Zn	28.66	5.82	8.31	13.69	0.97	21.25
	Mn	27.11	5.52	7.91	13.67	0.80	20.99
	Fe	25.16	5.15	7.52	12.94	0.92	20.33
	Cu	23.99	5.03	7,37	12.60	0.90	19.95
	Zn+Mn+Fe+Cu	29.84	6.03	9.08	13.86	0.85	21.97
300	0.0	23.88	4.85	7.03	11.95	0.83	18.49
	Zn	36.59	7.64	10.55	16.10	1.16	25.61
	Mn	33.86	7.11	9.91	15.54	0.93	24.24
	Fe	31.52	6.64	9.20	14.53	0.88	22.93
	Cu	30.45	6.33	8.90	14.28	0.84	22.18
	Zn+Mn+Fe+Cu	39.31	8.43	11.63	16.93	0.82	26.32
L.S.D. * 5%		4.14	1.01	1.44	1.60	0.09	2.68
1%		6.11	1.49	2.12	2.36	0.13	3.93
C.V. **		9.44	8.71	9.14	9.61	9.18	8.66

*: Treatments. **: Coefficient of variation.

Table (6): Effect of micronutrients and humic acid fertilization either separately or in association on micronutrients Concentrations (mg/kg) in grains and straw of barley for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011							
		Grains				Straw			
Humic acid (mg/l)	Micronutrients (300 mg/l)	Zn (mg/kg)	Mn (mg/lg)	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)
0.0	0.0	41.22	55.32	128.40	7.16	12.33	25.10	94.61	2.50
	Zn	75.11	73.84	159.59	9.22	12.10	23.27	93.22	2.10
	Mn	62.42	82.16	140/67	9.12	11.33	24.51	93.14	2.33
	Fe	58.16	63.81	182.61	8.81	12.21	24.33	93.55	2.31
	Cu	47.49	60.68	135.75	11.33	11,69	24.61	94.21	2.41
	Zn+Mn+Fe+Cu	79.13	93.11	193.16	12.24	12.13	23.11	92.16	2.11
300	0.0	49.01	67.80	150.96	8.71	12.30	24.71	94.44	2.47
	Zn	80.19	88.01	185.49	11.33	12.26	22.16	92.33	2.05
	Mn	66.24	95.94	164.94	11.26	11.20	24.14	93.10	2.30
	Fe	61.20	72.92	218.49	11.10	11.66	23.44	93.41	2.21
	Cu	50.49	70.88	155.45	12.22	11.41	24.22	94.24	2.35
	Zn+Mn+Fe+cu	82.16	96.15	235.91	13.14	11.98	22.13	93.23	2.01
L.S.D. * 5%		3.24	2.28	4.61	2.15	1.65	2.47	1.87	1.12
1%		4.78	3.36	6.81	3.17	2.44	3.65	2.74	1.66
C.V. **		7.22	8.61	8.14	9.12	8.41	8.39		9.44
Treatments		2011/2012							
		Grains				Straw			
Humic acid (mg/l)	Micronutrients (300 mg/l)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)
0.0	0.0	42.55	56.62	130.21	7.56	15.22	25.66	95.51	2.7
	Zn	77.64	75.84	162.94	10.11	13.24	23.61	93.39	2.11
	Mn	64.59	84.51	143.37	10.13	13.42	24.75	93.20	2.38
	Fe	60.54	65.81	186.34	9.22	13.44	24.71	94.11	2.33
	Cu	49.28	61.26	138.75	12.33	12.41	24.80	94.28	2.45
	Zn+Mn+Fe+Cu	81.69	95.49	197.20	13.42	12.21	23.15	92.22	2.10
300	0.0	51.05	69.79	153.62	9.24	13.22	24.78	94.50	2.48
	Zn	83.18	91.26	187.31	11.96	12.81	22.10	93.30	2.06
	Mn	68.77	98.91	170.10	11.88	11.44	24.61	93.16	2.34
	Fe	64.03	75.10	223.90	11.72	12.61	23.51	94.10	2.22
	Cu	52.70	71.60	159.40	12.91	12.10	24.66	94.25	2.41
	Zn+Mn+Fe+Cu	84.86	98.98	239.44	13.88	12.16	23.10	93.21	2.06
L.S.D. * 5%		3.88	2.78	5.11	2.42	2.14	2.63	1.97	1.19
1%		5.73	4.11	7.54	3.57	3.16	3.88	2.91	1.75
C.V. **		10.10	8.44	9.11	9.81	8.64	7.91	9.44	8.11

*: Treatments. **: Coefficient of variation

Table (7): Effect of micronutrients and humic acid fertilization either separately or in association on micronutrients uptake (g/fed.) in grains and straw of barley plants for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011							
		Grains				2011/2012			
Humic acid (mg/l)	Micronutrients (300 mg/l)	Zn uptake (g/fed.)	Mn uptake (g/fed.)	Fe uptake (g/fed.)	Cu uptake (g/fed.)	Zn uptake (g/fed.)	Mn uptake (g/fed)	Fe uptake (g/fed.)	Cu uptake (g/fed.)
0.0	0.0	41.10	55.15	128.01	7.14	13.69	27.86	105.02	2.78
	Zn	105.91	104.11	225.02	13.00	18.76	36.07	144.49	3.26
	Mn	84.89	111.74	191.31	12.40	17.22	37.26	141.57	3.54
	Fe	77.93	85.51	277.70	11.81	18.19	36.25	139.39	3.44
	Cu	62.21	79.49	177.83	14.84	16.95	35.68	136.60	3.49
	Zn+Mn+Fe+Cu	114.74	135.01	280.10	17.75	19.77	37.67	150.22	3.44
300	0.0	57.83	80.00	178.13	10.28	16.24	32.62	124.66	3.26
	Zn	134.72	147.86	311.62	19.03	23.05	41.66	173.58	3.85
	Mn	105.32	152.54	262.25	17.90	19.94	42.97	165.72	4.09
	Fe	92.41	110.11	329.45	16.76	19.47	39.14	155.99	3.69
	Cu	74.73	104.90	230.07	18.09	18.60	39.48	153.61	3.83
	Zn+Mn+Fe+Cu	145.42	170.19	417.56	23.26	23.36	43.15	181.80	3.92
L.S.D. *	5%	10.44	13.42	22.81	4.40	1.80	4.67	14.60	0.51
	1%	15.41	19.81	33.67	6.49	2.65	6.89	21.55	0.75
C.V. **		8.71	8.65	9.34	9.51	8.81	8.13	9.42	
Treatments		2011/201							
		Grains				Straw			
Humic acid (mg/l)	Micronutrients (300 mg/l)	Zn uptake (g/fed.)	Mn uptake (g/fed.)	Fe uptake (g/fed.)	Cu uptake (g/fed.)	Zn uptake (g/fed.)	Mn uptake (g/fed.)	Fe uptake (g/fed.)	Cu uptake (g/fed.)
0.0	0.0	42.98	57.19	131.51	7.64	17.50	29.51	109.84	3.11
	Zn	111.80	109.21	234.63	14.56	21.32	38.01	150.36	3.40
	Mn	89.78	117.47	199.28	14.10	21.34	39.35	148.19	3.78
	Fe	82.33	89.50	253.42	12.54	20.70	38.05	144.93	3.59
	Cu	66.04	82.10	185.93	16.52	18.62	37.20	141.42	3.68
	Zn+Mn+Fe+Cu	120.10	140.37	289.88	19.73	20.63	39.12	155.85	3.55
300	0.0	61.26	83.75	184.34	11.10	18.38	34.44	131.36	3.45
	Zn	142.24	156.05	320.30	20.45	24.85	42.87	181.00	4.00
	Mn	111.41	160.23	275.56	19.25	21.16	45.53	172.35	4.33
	Fe	97.97	114.90	342.57	17.93	22.07	41.14	164.68	3.89
	Cu	79.05	107.40	239.10	19.37	20.33	41.43	158.34	4.05
	Zn+Mn+Fe+Cu	154.45	180.14	435.78	25.26	24.81	47.12	190.15	4.20
L.S.D. *	5%	12.61	14.02	27.92	5.03	1.06	4.89	18.50	0.55
	1%	18.61	20.69	41.22	7.43	1.56	7.22	27.31	0.81
C.V. **		9.34	8.33	9.18	7.66	8.44	9.14	7.53	0.71

*: Treatments. **: Coefficient of variation.

Table (8): Effect of micronutrients and humic acid fertilization either separately or in association on crude protein and protein yield in grains and straw of barley plants for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011				2011/2012			
Humic acid (mg/l)	Micronutrients (300mg/l)	Crude protein (%)		Protein yield (kg.fed.)		Crude protein (%)		Protein yield (kg/fed.)	
		Grains	Straw	Grains	Straw	Grains	Straw	Grains	Straw
0.0	0.0	9.29	4.90	92.62	54.39	9.69	4.96	97.87	57.04
	Zn	10.83	4.79	152.70	74.25	11.34	4.85	163.30	78.09
	Mn	10.60	4.85	144.16	73.72	11.12	4.9	154.57	77.91
	Fe	10.09	4.73	135.21	70.48	10.55	4.79	143.48	73.77
	Cu	9.80	4.79	128.38	69.46	10.20	4.79	136.68	71.85
	Zn+Mn+Fe+Cu	11.12	4.73	161.24	77.10	11.57	4.67	170.08	78.92
300	0.0	10.83	4.85	127.79	64.02	11.34	4.90	136.08	68.11
	Zn	11.69	4.73	196.39	88.92	12.20	4.73	208.62	91.76
	Mn	11.46	4.67	182.21	83.13	11.91	4.79	192.94	88.62
	Fe	11.29	4.73	170.48	78.99	11.74	4.73	179.62	82.78
	Cu	11.12	4.79	164.58	78.08	11.57	4.85	173.55	81.48
	Zn+Mn+Fe+Cu	11.80	4.67	208.86	91.07	12.31	4.73	224.04	96.49
L.S.D. *	5%	0.33	1.16	22.89	5.53	0.34	1.25	23.79	6.35
	1%	0.48	1.71	33.79	8.16	0.50	1.85	35.39	9.38
C.V. **		8.44	8.16	8.71	8.44	9.44	9.15	7.66	9.18

*: Treatments. **: Coefficient of variation.

Table (9): Effect of micronutrients and humic acid fertilization either separately or in associations on seed vigor test of barley plant for 2010/2011 and 2011/2012 seasons.

Treatments		2010/2011					2011/2012				
Humic Acid (mg/l)	Micronutrients (300 mg/l)	Germination (%)	Shoot length (cm)	Radical length (cm)	Fresh weight of seedling (g)	Dry weight of seedling (g)	Germination (%)	Shoot Length (cm)	Radical length (cm)	Fresh weight of seedling (g)	Dry weights of seedling (g)
0.0	0.0	50	11.40	5.10	2.38	0.113	52	11.55	5.42	2.40	0.115
	Zn	68	13.90	7.50	2.97	0.194	64	14.11	8.01	3.01	0.198
	Mn	67	13.26	7.10	2.89	0.189	60	13.58	7.58	2.99	0.193
	Fe	54	12.50	6.80	2.84	0.146	56	12.74	7.25	2.89	0.185
	Cu	56	12.10	6.20	2.68	0.150	54	12.41	6.62	2.72	0.151
	Zn+Mn+Fe+Cu	75	14.70	8.30	3.07	0.202	76	15.o2	8.83	3.12	0.207
300	0.0	55	14.10	6.91	2.92	0.172	57	14.38	7.36	2.97	0.177
	Zn	74	18.66	9.88	3.55	0.279	77	18.97	10.50	3.61	0.285
	Mn	70	17.91	9.31	3.48	0.268	72	18.30	9.92	3.53	0.274
	Fe	67	16.90	8.71	3.34	0.258	69	17.21	9.26	3.39	0.263
	Cu	60	15.22	8.50	3.30	0.236	62	15.54	9.04	3.34	0.240
	Zn+Mn+Fe+Cu	80	19.30	10.10	3.77	0.284	83	19.62	10.80	3.82	0.290
L.S.D. *	5%	1.77	0.75	0.70	0.20	0.07	2.20	0.81	0.79	0.21	0.09
	1%	2.61	1.11	1.04	0.29	0.10	3.25	1.20	1.16	0.31	0.13
C.V. **		10.44	11.35	10.22	9.91	10.11	10.81	11.66	11.34	9.85	10.53

*: Treatments. **: Coefficient of variation.