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Effect of Zn, Mn, and organic manures applications on yield, yield components and chemical constituents of barley (Hordeum *vulgare L.*) grown in newly sandy soil

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Abstract : Two field experiments were conducted in the Research and Production Station of National Research Centre (NRC), Al-Nubaria , El-Behiera Governorate, Egypt during the two successive winter seasons of 2010/2011 and 2011/2012 to investigate the effect of organic manure and foliar applications with some micronutrients on yield, yield components and chemical constituents of barley cv. Giza 123 variety. A split plot layout within randomized complete block design with four replications was used. Main plots were four levels of chicken manure (0, 5, 10 and 15 ton/fed), and sub-plots were four foliar application treatments with micronutrients (O, Zn, Mn and Z + Mn). The results indicated that addition of organic manure significantly increased barley yield and its components compared with control treatment (without organic manures). Moreover, higher grain and straw yields, 1000 grain weight and harvest index was obtained with the application of 15 ton/fed of chicken manure. Increasing organic manure from 0 to 15 ton/fed significantly increased N, P, K and protein content of the grains. Also, application of micronutrients (Zn, Mn) significantly increased yield and yield components as well as chemical composition of barley grains over control treatment (spray with tape water), when applied single or in combination. Foliar application by Zn produced the tallest plants and spikes and spike weight (gm). The mixed foliar treatment (Zn + Mn) gave the highest values of all studied yield characteristics. Best results of chemical parameters of barley grains were obtained by foliar application with micronutrients with superiority to combined treatment. Generally, barley plants fertilized by 15 ton/fed organic manure and spraying with (Zn + Mn) recorded the highest values of 1000-grains, and the highest grain, straw and biological yields.
Key words: barley, chicken manure, Zn, Mn, yield components, crude protein.

Introduction

Barley (*Hordeum rulgareL.*) is considered one of the most important cereal crops, it ranks fourth among field crops in grain production in the world after wheat, maize and rice (1). In recent years, about two-thirds of barley crop has been used for seed, one – third for malting and about 2% directly for food (2). In Egypt, barley is qualified to be cultivated in wide areas, especially in the north coast region and in the new cultivated because of its tolerance characteristics to salt and drought stresses. Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals (3). The application of manures to soil provides potential benefits including improving the fertility, structure, water holding capacity of soil, increasing soil organic matter and reducing the amount of synthetic fertilizer needed

for crop production (4,5). Manures are the main sources of nitrogen (N) supply in organic crop production. Nitrogen availability from applied manure includes the inorganic N (No_3-N and NH_4-N) in manure plus the amount of organic N mineralized following application (6). Sial et al., (7) stated that addition of organic manure to sandy soil enhance microbial activity and increasing its fertility and consequently the majority of soil physical properties i.e.moisture constants, hydraulic conductivity, water consumptive use and water use efficiency. Ofosu-Anim and Leitch (8) study the effect of 6 organic manures on spring barley, they found that organic manure application had potential of increasing plant height, chlorophyll content of leaves and spring barley yield. Cerny et al., (9) found that the manure fertilized plot produced 22% average yield of barley, while application of sewage sludge resulted in 26% barley yield over control treatment. Application organic manure sources are among the most important fertilizer because they improve soil physical and chemical conditions and increased quality parameter of crops (10-12). Also, Ayalew and Dejene (13) revealed that application of inorganic and organic fertilizer (FYM) is a better approach to increase barley yield than application of either inorganic or organic fertilizers alone. Micronutrients play many complex roles in plant nutrition and plant production so balanced and efficient use of micronutrients fertilizer can improve agricultural production and quality (14). For example, zinc and Manganese function in many plant enzyme sestems as bridges to connect the enzyme with the substrate upon which it is mean to act (15). El-Ghamry et al., (16) reported that the mixed foliar application treatment (B, Mo, and Zn) gave the highest quantitative yield characteristics of wheat. Zinc is essential element for crop production and required in the carbonic enzyme which present in all photosynthetic tissues and chlorophyll biosynthesis (17,18). Zn have main role in synthesis of proteins, oxidation and revival reaction and metabolism of carbohydrates (14,19,20). Also, Mousavi et al.,(21) showed that Zn has an important metabolically role in plant growth and development and there is chemical and biological interaction between it and some other elements such as phosphours, Iron and nitrogen in plants. Manganese is akey component in arginase enzymatic system and phosphotransferase. Manganese is important in electron transport reactions and chlorophyll synthesis. Majority of manganese is in leaves and stem and only atrace amount can be found in seeds. Barley is classified to be moderately sensitive to manganese deficiency (22). Seyedin, (23) suggested that, soil fertilizing and solution spraying of manganese sulfat may enhance growth and improve wheat yield compared to the control and also increases level of manganese in seed and straw. Moreover, manganese in part of an important antioxidant (superoxide dismutase) structure that protects plant cells by deactivating free radicals which can destroy plant tissue. It also serves as electron storage and delivery to the chlorophyll reaction centers (24). Manganese also plays positive effect on No. of fertile tillers, soluble carbohydrates especially in roots and photosynthesis of wheat plants (25). In order to increase yield components, number of tillers and number of fertile tillers in barley plants it is better to use soil fertilizing with Fe, Zn, Cu and Mn while for rising of grain protein percentage and improvement of grain yield qualitatively the method of solution spraying is recommended (26). This study was conducted to fulfill the information about the effective of organic manure and foliar application with Zn and Mn on yield, yield components and grain chemical composition of barely CV. Giza 123 grown in new cultiva

Material & Methods

Two field experiments were conducted in the Research and Production Station, National Research Centre (NRC), El-Nubaria Province, El-Behiera Governorate, Egypt during the two successive winter seasons of 2010/2011 and 2011/2012 (latitude 30^o $30^\backslash$ $1.4^{\backslash\backslash}$ N, and longitude $30^o19^\backslash$ $10.9^{\backslash\backslash}$E, and mean altitude 21 m above sea level). The objective of this study was to evaluate the effect of organic manures and foliar application with some micronutrients on yield, yield components and chemical constituents of barley plant cv. Giza123 variety. Soil sample was taken at depth of 0- 30 cm for mechanical and chemical analyses as described by Chapman and Pratt, (27) (Table 1).

Table (1): Mechanical and chemical analyses of the experimental soil

2011/2012	2010/2011	**Mechanical analysis:**
90.1	88.0	Sand %
4.30	5.50	Silt %
5.50	6.50	Clay %
		Chemical analysis:
7.40	7.45	pH (1: 2.5)
0.81	0.89	EC
0.35	0.30	Organic matter %

1.80	1.78	$CaCO_3$ %
		Soluble anions Meq./L
-	-	CO_3
2.30	2.35	HCO_3
2.00	2.01	Cl^-
3.81	3.98	SO_4^-
		Soluble cations Meq./L
4.45	4.50	Ca^{++}
1.00	1.00	Mg^{++}
2.73	2.77	Na^+
0.07	0.07	K^+
		Available macronutrients mg/Kg soil
52.20	50.00	N
9.35	9.50	P
64.75	63.45	K
		Available micronutrients mg/Kg soil
3.20	3.12	Fe
0.68	0.61	Mn
0.48	0.48	Zn
0.96	0.92	Cu

The experiment was laid out in split plot design with four replications in rows 3.5 meter long, 15 cm apart and 20 rows with total area 10.5 m^2. Every experiment included 16 treatments, four organic manures fertilization in combination with four foliar application with micronutrients. Organic manure as the source of chicken manure were distributed in the main plots at the rate of (unfertilized , 5 , 10 and 15 ton /fed.) ,mean while foliar application with micronutrients were allocated in sub plots as follow : (Tap water ,260 ppm Zn, 260 ppm Mn and 260 ppm Zn + 260 ppm Mn) .Chicken manure mixed with the soil surface layer before sowing , it had the following chemical composition : organic mater 49.8 – 51.6 % , organic carbon 29.0 – 29.4 % , C / N ratio 14.7 – 14.9 ,PH 7.5 -7.8 , EC 2.2 – 2.2 mmhos / cm^2 ,Total N 2.0 -2.2% , Available P 116 – 128 ppm , Available K 105 -111 ppm in both seasons . Seeds of barley (*Hardeum vulgare L*) cv. Giza 123 were sown at the rate of 50 kg / fed. at 1 st December and 28th November in the first and second seasons, respectively. Calcium super phosphate (15.5 % P_2O_5) and potassium sulfate (48.5 % k_2O) were broadcasted during tillage operation before sowing at the rate of 100 and 48 kg / fed., respectively. Ammonium sulfate (20.5 % N) at the rate of 80 kg / fed., was applied in two equal doses the 1st was applied after 21 days from sowing and the another was added three weeks later in both seasons. Foliar fertilizer with micronutrients was sprayed twice , the first at tillering stage and the second at shooting stage. The other cultural practices were done as in the province.

Barley Yield and Yield Components:

At harvest time,1 m^2 was taken from the center of each sub - plot of the trial to estimate the No. of tillers /m2 and No. of spikes / m2 .Sub samples of ten barley plants were taken randomly to determine the yield components i.e. Plant height (cm) ,Spike length (cm) ,No. of grains / spike , Dry weight of spike (gm) , Dry weight of grain /spike (gm) and 1000 – grain weight (gm). All barely plants for each plot were harvested to determine: (i) Grain yield (kg / fed.), (ii) Straw yield (kg / fed.), (iii) Biological yield (kg / fed.) and (iv) Harvest index % = grain yield / biological yield x 100.

Chemical Composition of Barley Grains:

Samples of barley grains were taken from the grain yield of each sub plot, cleaned, dried, digestion and determination of chemical analysis: Total N, P, and K contents according to Cottenie et al., (28). Crude protein percentage was calculated by multiplying N% by 5.75.

Statistical Analysis:

All data were statistically analyzed according to Snedecor & Cochran, (29) where treatment means was compared using L.S.D.test at 0.05 probability level.

Results and Discussion

1. Effect of organic fertilization treatments:

1.1. Yield and Yield components:

It is revealed from data in table 2 that the differences between organic fertilization rates were significant for all studied characters except for No. of grains/ spike and 1000-grain weight in the first season and No. of grains/ spike on the second season. Treatment of 15 ton/ fed produced the tallest plants and spikes, the highest No. of tillers/ m^2 and No. of spikes / m^2 and the heaviest spikes and 1000- grain. It is evident that each increase in the rate of organic manure rates from zero to 15 ton/ fed. was accompanied by a significant increase in each of grain, straw, biological yield/ fed., as well as harvest index during the two growing seasons. Obtained results might be due to the stimulation effect of organic manure on improving the physical properties of the soil, increasing soil fertility and increasing the availability of many nutrients to plant uptake, which in turn improves the growth of barley plants and positively affect the yield and yield components. The same results obtained by Sadur et al., (30), Ofosu – Anin and Leitch (8) and Cerny et al., (9) Moreover, Ayalew and Dejenl (13) reported that application of organic fertilizers (FYM) with inorganic fertilizers is a better approach to increase barley yield then application of either organic or inorganic fertilizers alone.

1.2 Chemical Contents of Barley Grains:

Data in Table 3 show significant differences between organic manure rates on percentage of N,P,K and crude protein % in barley grains. Increasing chicken manure fertilization levels increased significantly contents of N, P, K and crude protein. However, the superiority was achieved as a result of addition 15 ton/ fed., as compared to the other treatments.The increase in chemical contents of grains may be due to the fact that chicken manure is an excellent organic fertilizer , as it contains high nitrogen, phosphorus, potassium and essential nutrients. These results are in harmony with those obtained by Miller et al., (31) Jacinta and Gordon, (10), Sancar et al., (11) and Woldesenbet et al., (12).

2. Effect of Foliar Application with Zn and Mn:

2.1 Yield and yield components:

Results recorded in Table 4 revealed that all studied characters significantly affected by foliar spraying with Zn or Mn and Zn + Mn compared with the control treatment (without spraying) in both growing seasons, except No. of grains/ spike. Data also showed that the highest values of plant height (cm), No. of tillers and spike/ m^2, spike length and weight, 1000-grain weight (gm), yields of grain, straw and biological yield kg/ fed as well as harvest index were recorded with spray in solution of (Zn + Mn) followed by spraying with Zn alone without significant difference. These results may be due to zinc is activator of many enzymes involved in photosynthesis, cell elongation and cell division as well as it has essential role in plant metabolism. The same results reported by Alloway, (15), ;Ali et al., (19), El-Ghamry et al., (16) and Sayed et al., (20). Also, Boorboorie et al., (26) showed that application of Zn in form of solution spray increased grain yield and quality of barley significantly. Eleiwa et al., (32) showed that the highest values of spik lenth, tillers and leaves number per plant, 1000-grain weigh and yields of grain and straw as well as the physiological parameters of barley were attained by using the concentration of 150 ppm zinc.

2.2. Chemical contents of Barley grains:

Result analysis in Table 5 showed that foliar application of either Zn or Mn or Zn + Mn significantly increased concentrations of N,P,K and total nitrogen in barley grains as compared with control treatment .The mixed foliar application treatment (Zn + Mn) gave the highest percentages of N,P,K and croud protein in grains of barley followed by spraying with Zn alone. Such effect being dependent on the influence of Zn on basic plant life processes such as nitrogen metabolism, protein quality, photosynthesis and carbon anhydrase activity (18).This results are in agreement with those obtained by Alloway, (15), Cakmak, (33), Cuma et al., (34),

Graham et al., (35) and Mona et al.,(36). In this regards, Eleiwa et al., (32) indicated that the highest values of chemical parameters of barley i.e. N, P, K and total nitrogen were attained by using the concentration of 150 ppm zinc followed by 100 and 50 ppm in descending order.

3. Interaction Effect between organic Manure and Micronutrient:

3.1. Yield and yield components:

Data in Table 6 show the effect of interaction between organic manures and foliar application with Zn and Mn on yield and yield components of barley plants. It is clear that there were significant differences between interaction in all previous characters except harvest index. Interaction between 15 ton/ fed organic manure and spraying with (Zn + Mn) produced the tallest plants, the greatest No. of tillers/ m^2, No. of spikes/ m^2, No. of grains/ spike, grain, straw and biological yields (Kg/fed.), but interaction between 15 ton/fed organic manure and spraying with Zn recorded the highest value of spike weight (gm) and 1000-grain weight (gm).These results are in according to with those obtained by Sanjay and Megh, (37), Petal et al., (38) and El-Ghamry et al., (16). In this concern, Shelley and Kalpana (39) reported that application of Zinc and organic measures significantly increased the crop yield. Moreover, Ghanbari et al, (40) studied the effect of the interaction of manure and micronutrients on yield and yield components of barley. They showed that the effect of different proportions of manure and nutrient treatments on grain yield and yield components were significant.

3.2 Chemical contents of Barley Grains:

It is clear from data in Table 7 that the difference between interactions were significant in percentage of N,P,K and crude protein in grains. Interaction between fertilized by 15 ton/fed manure and foliar application with (Zn + Mn) produced the highest contents of N,P,K and crude protein, while untreated plants (control) and sprayed with tap water produced the lowest values. Similar results were obtained by Kandel, (41), Babaeian et al., (42), Ahmed et al., (43) and Ramah et al., (44). In this concern, Mousavi et al., (21) showed that zinc is an active element in biochemical processes and there is chemical and biological interaction between it and some other elements such as phosphorus, Iron and nitrogen in plant.

It could be concluded that all chicken manure treatments and foliar spraying with micronutrients positively affected all studied yield and yield components characters of barley CV. Giza 123 under newly reclaimed sandy soil. The combined treatment (Zn + Mn) recorded the best effect on yield and chemical contents of barley grains.Generally, plants fertilized by 15 ton/ fed. Organic manure and sprayed with (Zn+ Mn) recorded the highest values for grain, straw and biological yield/ fed and produced the highest protein, P and K contents in grains.

Table 2: Effect of organic fertilization treatments on yield and yield components of barley at 2010 – 2011 and 2011 – 2012 seasons

Characters / Treatment	Plant height cm	No. of tillers/ m^2	No. of Spikes/ m^2	No. of grains/ spike	Spike length (cm)	Spike weight gm	Grain Weight/ spike gm	1000 grain weight gm	Grain yield Kg/fed.	Straw yield kg/fed.	Biological Yield kg/ fed.	Harvet index %
First Season												
Zero	88.95	468.15	245.29	55.72	9.96	2.92	1.94	48.16	1987	4173	6160	32.27
5 ton/fed.	96.29	490.42	273.32	57.25	10.22	3.10	2.08	49.37	2200	4410	6610	33.28
10 ton/fed.	98.14	506.89	298.18	58.90	10.61	3.22	2.20	49.68	2378	4573	6951	34.21
15 ton/fed.	103.10	537.10	303.74	59.74	11.03	3.27	2.29	49.82	2630	4784	7014	37.50
L.S.D at 5%	7.11	17.32	4.70	N.S	0.50	0.10	0.08	N.S	63	87	101	0.70
First Season												
Zero	91.9	472.30	264.85	56.10	10.06	2.96	1.94	47.62	2003	4256	6259	32.00
5 ton/fed.	98.10	496.18	288.00	56.80	10.42	3.16	2.14	49.10	2090	4389	6479	32.26
10 ton/fed.	101.40	517.25	305.10	58.77	10.88	3.22	2.25	50.08	2240	4551	6791	32.98
15 ton/fed.	103.88	537.95	316.70	59.75	11.90	3.35	2.25	50.23	2530	4677	7207	35.10
L.S.D at 5%	5.34	19.70	5.10	N.S	0.32	0.12	0.09	1.98	57	98	113	0.53

Table 3: Effect of organic fertilization treatments on chemical contents of barley grains

(Combined analysis of 2010/2011 and 2011/2012 seasons)

Treatments	Nitrogen %	Phosphorus %	Potassium %	Crude Protein %
Zero (Control)	1.660	0.177	0.376	9.545
5 ton/fed	1.781	0.191	0.394	10.241
10 ton/ fed	1.891	0.194	0.394	10.873
15 ton/ fed	1.899	0.205	0.412	10.919
L.S.D at 5%	0.100	0.013	0.016	0.370

Table 4: Effect of foliar fertilization with Zn and Mn yield and yield components of barley at 2010-2011 and 2011-2012 seasons

Characters / Treatment	Plant height cm	No. of tillers/ m^2	No. of Spikes/ m^2	No. of grains/ spike	Spike length (cm)	Spike weight Gm	Grain Weight/ spike gm	1000 grain weight gm	Grain yield Kg/fed.	Straw yield kg/fed.	Biological Yield kg/ fed.	Harvet index %
First Season												
Tap water	90.35	488.67	267.88	55.50	9.89	2.89	1.98	47.40	1932	4057	5989	32.26
Zn	97.98	514.99	281.35	57.00	10.81	3.13	2.10	50.33	2380	4650	7030	33.85
Mn	94.90	503.75	276.16	56.75	10.34	3.00	2.07	49.62	2188	4615	6803	32.16
Z + Mn	99.14	522.16	293.91	59.00	11.10	3.17	2.18	50.45	2459	4760	7219	34.06
L.S.D at 5%	4.01	11.06	5.30	N.S	0.45	0.10	0.09	1.78	76	93	99	0.50
Second Season												
Tap water	88.51	491.67	273.40	54.10	9.98	2.95	1.96	47.75	1994	4127	6121	32.58
Zn	99.00	518.70	289.90	57.66	11.00	3.18	2.13	50.88	2410	4680	7090	33.99
Mn	97.29	509.88	278.35	54.35	10.60	3.03	2.06	50.30	2240	4565	6805	32.92
Zn + Mn	98.87	536.0	299.20	59.00	11.50	3.19	2.18	51.33	2485	4690	7175	34.63
L.S.D at 5%	5.16	13.50	6.20	N.S	0.53	0.11	0.08	2.40	66	105	77	0.55

Table 5: Effect of foliar fertilization with Zn and Mn on chemical contents of barley grains (Combined analysis of 2010/2011 and 2011/2012 seasons)

Treatments	Nitrogen %	Phosphorus %	Potassium %	Crude Protein %
Tape water (Control)	1.632	0.176	0.365	9.384
Zn	1.809	0.197	0.398	10.402
Mn	1.781	0.193	0.395	10.241
Zn+Mn	1.940	0.212	0.416	11.155
L.S.D at 5%	0.129	0.017	0.025	0.801

Table 6: Effect of interaction between organic and micronutrients fertilization on yield and yield components of barley (Combined analysis of 2010-2011 and 2011-2012 seasons)

Organic Fertil. Ton/ fed.	Foilar Fertili.	No. of tillers m^2	No. of spikes m^2	No. of grains/ spike	Spike length cm	Spike weight gm	Grain weight/ spike gm	1000 grains weight (g)	Grain yield kg/fed.	Straw yield kg/fed.	Biological yield kg/fed.	Harvest index %	Plant height cm
Zero	Tap water	468.9	237.2	53.0	9.8	2.90	2.45	45.8	2088	4510	6598	31.65	89.5
	Zn	487.2	288.6	58.0	9.8	2.98	2.71	47.6	2270	4940	7210	31.48	95.0
	Mn	479.3	274.5	55.6	9.8	2.96	2.60	47.0	2245	4680	6925	32.42	90.9
	Zn + Mn	496.9	293.9	57.9	10.0	2.98	2.76	48.3	2376	4998	7374	32.22	94.6
5	Tap water	498.3	278.3	55.3	9.8	3.07	2.83	47.3	2195	4917	7112	30.86	92.3
	Zn	519.9	318.2	57.2	11.0	3.23	2.99	48.5	2399	5130	7529	31.86	98.3
	Mn	510.3	302.5	56.4	10.2	3.15	2.86	48.1	2249	4989	7238	31.07	94.2
	Zn + Mn	521.8	330.1	59.7	11.8	3.18	3.05	49.9	2459	5246	7705	31.91	99.7
10	Tap water	503.8	306.3	56.7	9.9	3.17	2.93	48.7	2260	4992	7252	31.16	96.0
	Zn	545.10	330.9	60.6	11.9	3.46	3.09	51.3	2550	5343	7893	32.31	99.5
	Mn	519.8	307.6	58.3	11.3	3.36	3.02	50.9	2343	5039	7382	31.74	96.6
	Zn + Mn	547.9	370.0	61.8	12.7	3.38	3.24	51.8	2629	5435	8064	32.60	103.3
15	Tap water	506.3	327.5	57.0	11.2	3.29	2.96	50.2	2341	5115	7456	31.40	96.7
	Zn	545.7	380.1	62.4	12.6	3.51	3.25	54.9	2579	5435	8014	32.18	96.7
	Mn	539.7	352.8	60.5	12.0	3.47	3.12	51.7	2469	5264	7733	31.93	99.8
	Zn + Mn	562.4	405.1	65.3	13.1	3.48	3.34	53.5	2682	5560	8242	32.54	106.1
L.S.D at 5%		40.71	13.50	4.24	0.23	0.16	0.23	2.53	98	143	130	N.S	6.05

Table7: Effect of interaction between organic and micronutrients fertilization on chemical contents of barley grains (Combined analysis of 2010-2011 and 2011-2012 seasons)

Treatments		Nitrogen %	Phosphorus %	Potassium %	Crude protein %
Organic fertilization	Foliar fertilization				
Zero	Tap water	1.690	0.172	0.365	9.718
	Zn	1.809	0.182	0.386	10.402
	Mn	1.808	0.186	0..385	10.396
	Zn + Mn	1.848	0.192	0.396	10.626
5	Tap water	1.719	0.184	0.370	9.884
	Zn	1.863	0.193	0.411	10.712
	Mn	1.820	0.196	0.405	10.465
	Zn + Mn	1.965	0.200	0.408	11.299
10	Tap water	1.808	0.192	0.370	10.396
	Zn	1.987	0.201	0.406	11.425
	Mn	1.935	0.205	0.406	11.126
	Zn + Mn	2.011	0.216	0.417	11.563
15	Tap water	1.849	0.200	0.388	10.632
	Zn	2.022	0.206	0.401	11.627
	Mn	1.968	0.206	0.408	11.316
	Zn + Mn	2.080	0.216	0.430	11.960
L.S.D at 5%		0.110	0.050	0.026	0.621

References

1- FAO, 2008. http //: www. Fao. Org.

2- Baik, B. K. and S. E. Ullrich, 2008. Barley for Food: Characteristics, Improvement and Renewed Interest. J. Cereal Sci., 48: 233- 242.

3- Samman, S., Chow, J.W.Y., Foster, M.J., Ahmad, Z.I., Phuyal, J.L. and Petocz, P.(2008). Fatty acid composition of edible oils derived from certified organic and conventional methods. Food Chemistry, 109: 670-674.

4- Phan, T. C.; Roel, M; Cong , S. S. and Nguyen,Q. 2002. Beneficial effects of organic amendment on improving phosphorus availability and decreasing aluminum toxicity in two upland soils. Symposium No. 13 paper No. 1226 17th,W. C.SS. 14- 21, Thailand.

5- Blay, E. T.; Danquah, E. Y.; J. Ofosu-Anim and Ntumy, J. K. 2002. Effect of poultry manure on the yield of shallot.Adv. Hort. Sci. 16: 13-16.

6- Jae-Hoom, S.; Jong-Chul, Y.; Du-Hoi, C. and Han-Myeong, K. 2006. Difference in Nitrogen Mineralization Properties of Various Organic Inputs in Korean Paddy Soil. 18th World Congress of Soil Science.July 9-15, 2006- Philadelphia, Pennsylvania, USA.

7- Sial, R.A.,· Chaudhary, E.H.,· Hussain, S. and Naveed,M. (2007). Effect of organic manures and chemical fertilizers on grain yield of maize in rain- fed area. Soil Environ., 26: 130-133.

8- Ofosu- Anim, J. and Leitch,M. (2009). relative efficacy of organic manures in spring barley (Hordeum vulgare L) production. Australian J. of Crop Science.3 (1):13-19.

9- Cerny,J.,· Balik, J.,· Kulhanek, M.,· Casova, K and Nedved, V. (2010): Mineral and organic fertilization efficiency in long-term stationary experiments plant Soil Environ., 56(1): 28-36.

10- Jacinta, M. K. and Gordon, A.M. (2013). Mulch Inoculation and Placement Influenced Barley (*Hordeum Vulgare*) Growth and Soil Nitrate Levels. Greener Journal of Agricultural Sciences, 3 (5): 332-340.

11- Sancar, B.; Ali, O.; Mehmet, M.K. and Nesrin, Y. (2013). Effect of organic manures and nonchernical weed cantrol on wheat II. Grain quality. Turk. J., Agric. 37 : 271-280.

12- Woldesenbet, M., Tana, T., TN, S. and Mekonnen, T. (2014).Effect of Integrated Nutrient Management on Yield and Yield Components of Food Barley (*Hordeum vulgare* L.) in Kaffa Zone, Southwestern Ethiopia. Sci. Technol. Arts Res. J., 3 (2): 34-42.

13- Ayalew, A. and Dejene, T. (2012). Combined Application of Organic and Inorganic Fertilizers to Increase Yield of Barley and Improve Soil Properties at Fereze, In Southern Ethiopia. Innovative Systems Design and Engineering. 3 (1): 25-23.

14- Mousavi, S. R. (2011). Zinc in crop production and interaction with phosphorus. Australian Journal of Basic and Applied Sciences. 5: 1503-1509.

15- Alloway, B.J. (2008). Zinc in Soils and Crop Nutrition. Second edition, published by IZA and IFA Brussels, Belgium and Paris, France, pp: 135.

16- El-Ghamry, A.M., Abd El-Hamid, A.M. and Mosa, A.A.(2009).Effect of Farmyard Manure and Foliar Application of Micronutrients on Yield Characteristics of Wheat Grown on Salt Affected Soil. American-Eurasian J. Agric. & Environ. Sci., 5 (4): 460-465.

17- Abd E-Hady, B. A. (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.

18- Potarzycki, J., and Grzebisz, W. (2009). Effect of zinc foliar application on grain yield of maize and its yielding components. Plant Soil Environ, 55(12): 519-527.

19- Ali, S., Riaz, K.A., Mairaj, G., Arif, M., Fida, M. and Bibi, S. (2008). Assessment of different crop nutrient management practices for yield improvement. Australian Journal of Crop Science, 2(3):150-157.

20- Sayed, R.M.; Mohamed, G. and Maryan, R. (2013). Zinc (Zn) importance for crop production a Review. International J. of Agro. And plant production. Vol., 4(1): 64-68.

21- Mousavi, S.R., Galavi, M. and Rezaei, M. (2013). Zinc (Zn) Importance for Crop Production – A Review. International journal of Agronomy and Plant Production, 4 (1): 64-68.

22- Malakooti, M.J. and Keshavarz, P. (2006). A view on Iran soil ferltility (identification and exploitation), Sana publication, pp: 503

23- Seyedin, K., 2006. Effect of microelement on wheat production. Maine Agricultural Research Institute. Final report.

24- Millaleo, R., Reyes, D.M. Ivanov, A.G, Mora, M.L. and Iberdi, M. A. (2010). Mamganese as essential and toxic element for plants transport, accumulation and resistance mechanisms. Journal of Soil Science and Plant Nutrition, 10(4):470-481.

25- Rennan, G.O., Dias, A.F.S., Macedo, S.M., Santos, W.N.L. and Ferreira,S.L.C. (2007). Method development for the determination of manganese in wheat flour by slurry sampling flame atomic absorption spectrometry. Food Chem., 101: 397-400.

26- Boorboori, M.R., Asli, D.E. and Tehrani, M.M. (2012). Effect of micronutrient application by different methods on yield, morphological traits and grain protein percentage of barley (*Hordeum vulgare* L.) in greenhouse conditions. Revista Científica UDO Agrícola, 12 (1): 127-134.

27- Chapman, H.D and Pratt, P.F. 1978. Methods of Analysis for Soils, Plants and Water. Univ. California, Div. Agric. Sci. Prical Publication 4030, pp:12-19.

28- Cottenie, A.; Verloo, M.; Kekens, L.; Velghe, G. and Camberlynch, R. 1982. Chemical analysis of plants and soils. Lab. Agroch.State Univ.Ghent., pp:12-19.

29- Snedecor, G.W. and Cochran, W.G. (1990). Statistical Methods 8 th Ed, Iowa State Univ., Press, Ames, Iowa, USA.

30- Sadur, R; Khalil, S. K.; Rehman, A. and Saljoqi, A.U. R. (2008). Organic and inorganic fertilizers increase wheat yield components and biomass under rainfed condition. Sarhad J. Agric. 24 (1): 11- 20.

31- Miller, J.J., Beasley, B.W., Drury, C.F. and Zebarth, B.J. (2009). Barley Yield and Nutrient Uptake for Soil Amended with Fresh and Composted Cattle Manure. Agron J. 101:1047–1059.

32- Eleiwa, M. E., Kord, M.A. and Ibrahim, S.A. (2013): Response of barley plants to foliar application of growth regulators mixture of indole acetic acid, naphthalene acetic acid and zinc. Afr. J. Biotechnol., 12(23): 3653-3661.

33- Cakmak, I., 2008. Enrichment of cereal grains with zinc: Agronomic of genetic biofortification. Plant Soil , 302: 1- 17.

34- Cuma,A., Ilhan,D., Mehmet, Y. and Ismail, G.(2008).Effects of different zinc doses on zinc and protein contents of barley. Asian J. of Chemistry V. 20 No.(3). 2293-2301.

35- Graham, R.; Welch, R.M.; Grunes, D.L.; Cary, E.E. and Norvell,W.A. (2012). Effect of zinc deficiency on the ccumulation of boron and other mineral nutrients in barley. Soil, Sci., society of America J., vol. 51 No. 3, p, 652-657.

36- Mona, E.E.; Maymona, A.K. and Ibrahim, S.A. (2013). Response of barley plants to foliar application of growth regulators mixture of indole acetic acid, naphthalene acetic acid and zinc. African J., of Biotechnology Vol., 12 (23), pp. 3653-3661.

37- Sanjay, A. and Megh, S. (2004). Interaction Effect of Zinc and Nitrogen on Growth and Yield of Barley (*Hordeum vulgare L.*) on Typic Ustipsamments. Asian Journal of Plant Sciences, 3: 101-103.

38- Petal, B. T.,· Petal, J.J.,· Petal, V.B. and Petal, A.M. (2008). Zinc management in presence and absences of FYM in kharif maize (*Zea mays* L.). Crop Res. Hisar 35: 186-189.

39- Shelley, G. and Kalpana, H. (2009). Direct and residual effect of zinc and zinc amended organic manures on the zinc nutrition of field crop. International J. of Agriculture Sci., V. (1) pp: 26-29.

40- Ghanbari, G.,· Babaeian, M.,· Esmaeilian, Y.,· Tavassoli, A. and Asgharzade, A. (2012). The effect of cattle manure and chemical fertilizer on yield and yield component of barley (*Hordeum vulgare*). African Journal of Agricultural Research, 7(3): 504-508.

41- Kandel, N.Kh. (2003). Effect of soil amendments and micronutrients fertilization on barley plant grown on calcareous soil and its chemical composition. Egypt. J. Appl. Sci.,18 (4B).

42- Babaeian ,M.,· Esmaeilian, Y.,· Tavassoli, A. and Javaheri, M. (2011). Interaction of micro and macro elements with manure on barley feed yield and soil nutrient content in Sistan region African Journal of Microbiology Research, 10(75): 17175-17179.

43- Ahmad G.,·Mahdi, B.,· Yasser, E.,· Abolfazl, T. and Ahmad, A.(2012). The effect of cattle manure and chemical fertilizer on yield and yield component of barley (Hordeum vulgare).African J.of Agri. Res. Vol.7(3), pp. 504-508.

44- Ramah, T.M., Shahram, G.H. and Radmehr, P.R.A.(2014).The effect of chemical and cattle fertilizer on yield and yield constituent of barley (*Hordeum vulgare*). Afr. J. Crop Sci., 2(4):94-97.

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