American-Eurasian J. Agric. & Environ. Sci., 5 (4): 460-465, 2009
ISSN 1818-6769


# Effect of Farmyard Manure and Foliar Application of Micronutrients on Yield Characteristics of Wheat Grown on Salt Affected Soil

*[1]A.M. El-Ghamry, [2]A.M. Abd El-Hamid and [1]A.A. Mosa*

[1]Department of Soils, Faculty of Agriculture, Mansoura University, Egypt
[2]Plant Nutrition, Soil, Water and Environment, Res. Inst., Agric. Res.Center, Giza, Egypt

**Abstract:** Two field experiments were carried out in 2006/2007 and 2007/2008 seasons at the experimental farm, Tag El-Ezz Research Station, Dakhlia Governorate, Egypt, (+7 m altitude, 31° 36\ latitude and 30° 57\ longitude) to study the effect of adding FYM at rates of 0 and 20 Mg ha$^{-1}$ and some micronutrients as foliar application on growth, yield and nutrients content of wheat. The most important finding could be summarized as follows: Application of FYM gave a significant increase in all quantitative yield characteristics as compared with the control treatment. The mixed foliar application treatment (B, Mo and Zn) gave the highest mean values of all studied yield characteristics, whereas, Mo-treatment gave the lowest mean values in all studied characteristics. The interaction effect between FYM addition and foliar application of micronutrients on quantitative yield characteristics of wheat plants recorded a significant increase in all studied yield parameters as compared with control treatment. The concentrations of macro and micronutrients in grain and straw yield of wheat were affected by FYM and foliar application of micro nutrients and this effect was significant. There was significant effect of the interaction between FYM addition and foliar application of micronutrients and the treatment of adding FYM with foliar application of the mixed micronutrients (B, Mo and Zn) was the superior.

**Key words:** Farmyard manure % Micronutrients % Wheat % Salt affected soil

## INTRODUCTION

Wheat is the dominant grain crop of the world commerce. It is occupying an important part of the daily diet of millions of people. In Egypt, increasing productivity of wheat becomes a most to overcome unusual increase in population.

Nitrogen application is considered one of the key factors for obtaining higher grain yield. The shortage of locally produced nitrogen fertilizers, high cost of the nitrogen unit and low nitrogen use efficiency encourage investigators to develop more agronomic practices to improve the efficiency of nitrogen fertilizers. Using farmyard manure considered one of many ways to reduce the applied quantities of mineral nitrogen fertilizers.

In literatures several workers showed the importance of farmyard manure on increasing cereal grain yield. Application of either chemical nitrogen or organic manure significantly increased grain yield compared with the control [1, 2]. Also, grain yield of wheat were significantly increased as the organic manure increased up to 30 ton/ha, while 20 ton/ha was adequate for the highest values of panicle length, number of panicles/m$^2$ and number of grains/panicle [3]. Addition of 5 tons crop residues/ha significantly increased number of panicles/m$^2$, panicle length, number of grains/panicle and grain and straw yields [4]. Addition of 50 m$^3$ farmyard manure/ha significantly increased flag leaf area, plant height, number of panicles/m$^2$, panicle length, panicle weight number of filled grains/panicle, 1000-grain weight and grain and straw yields [5].

Micronutrient deficiency is widespread in plants, animals and humans, especially in many arid countries, due to the calcareous nature of soils, high pH, low organic matter, salt stress, continual drought, high bicarbonate content in irrigation water and imbalanced application of fertilizers [6].

Boron (B), molybdenum (Mo) and zinc (Zn) are three essential micronutrients required for the growth and development of higher plants. Born plays important roles in cell wall synthesis and structure and possibly membrane stability [7-11].

**Corresponding Author:** Dr. Ayman M. El-Ghamry, Department of Soils, Faculty of Agriculture Mansoura University, Egypt

Table 1: Some physical and chemical properties of the experimental soil

| Ec dSmG¹ (soil Paste) | PH (1:2.5) | Available nutrients (mg/ L) N | P | K | Fe | Mn | Zn | B | Mo | ESP % | Soil type | Texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.1 | 8.2 | 30 | 11 | 300 | 5.8 | 4.7 | 0.9 | 0.3 | 0.06 | 10.1 | Saline | Clayey |

Table 2: Some chemical analyses of farmyard manure

| pH | EC | C% | N% | C/N ratio | Total P% | Total K% | OM% |
|---|---|---|---|---|---|---|---|
| 6.90 | 4.30 | 17.60 | 1.18 | 14.92 | 0.41 | 1.07 | 26.38 |

Boron deficiency causes abnormal development of reproductive organs [12, 13] and reduces plant yield [14, 15]. Molybdenum deficiency decreases the activity of nitrogenase and nitrate reductase, damages chloroplast structure and reduces carbohydrate synthesis, which can lead to impaired pollen development in plant [16, 17]. Zinc is a structural component of several enzymes and it is required for enzyme activation; thus, Zn deficiency also affects carbohydrate metabolism, damages pollen structure and decreases the yield [18-21].

The objective of this study was to investigate the effect of foliar application of some micronutrients with or without farmyard manure application on quantitative and qualitative yield characteristics of wheat under salt affected soils.

## MATERIALS AND METHODS

Two successive field experiments were established in winter seasons of 2006/2007 and 2007/2008 at the experimental farm, Tag El-Ezz Research Station, Dakhlia Governorate, Egypt, (+7 m altitude, 31° 36\ latitude and 30° 57\ longitude). Wheat (*Triticum aestivum* L.) "Sakha 93" was obtained from the Agric. Res. Center. The sowing dates were 20th and 25th of November in the 1st and 2nd seasons, respectively.

The experimental design was split plot with 4 replicates. Main treatments were assigned to FYM application which added at rates of 0 and 20 Mg haG¹. Foliar application of micronutrients treatments were presented in subplots which were:

- C Distilled water (as the control treatment).
- C Boron (50 mg LG¹) in form of borax.
- C Molybdenum (25 mg LG¹) in form of sodium molybdate.
- C Boron and molybdenum (50 and 25 mg LG¹, respectively).
- C Zinc (250 mg LG¹) in form of zinc sulfate.
- C Boron a nd molybdenum and zinc (50, 25 and 250 mg LG¹, respectively)

At the beginning of the experiment, surface soil samples were collected and analyzed according to Black [22]. Some physical and chemical characteristics of the experimental soil are shown in Table 1. Chemical analysis of FYM were carried out according to Black [22] and listed in Table 2.

Foliar application treatments were applied at three times using 600 L haG¹. The 1st one was after 45 days from sowing (before tillering stage), the 2nd and the third times were sprayed separately after 15 days for each. Agricultural practices such as mineral fertilization, irrigation, hilling, weed, pest and disease control on all plots were done following the guidelines given by Ministry of Agriculture.

Wheat plants were harvested after 6 months from sowing. Plant samples were collected from each plot using a frame of 1 $m^2$ and the yield for each grain and straw were calculated as Mg haG¹. Plant samples were oven dried at 70°C, grounded and 0.4 g from each sample was wet-digested using the mixture of $H_2SO_4$-$HClO_4$ according to Peterburgsiki [23]. Contents of macro and micronutrient (N, P, K, Fe, Mn and Zn) were determined in grain and straw yields according to Black [22].

The statistical analysis was done according to the methods described by CoStat [24] using the technique of variance analysis [25]. Duncan's Multiple Range Test was used to compare the treatment means [26].

## RESULTS AND DISCUSSION

**Effect of FYM and Foliar Application of Micronutrients on Growth and Yield Characteristics in Wheat Grains:** Data in Table 3 show main treatments effect on quantitative yield characteristics of wheat. It is clear that FYM application gave a significant increase in all quantitative yield characteristics as compared with the control treatment.

Concerning the effect of foliar application of micronutrients, it is obvious that the mixed foliar application treatment (B, Mo and Zn) gave the highest

Table 3: Effect of FYM and foliar application of micronutrients on growth and yield characteristics in wheat grains

| Treatments | | Plant height (cm) | Leaf area ($cm^2$) | Spike length (cm) | Yield (Mg / ha) Grain | Yield (Mg / ha) Straw |
|---|---|---|---|---|---|---|
| FYM treatments | | | | | | |
| Without FYM | | 93.44 | 20.75 | 11.65 | 5.28 | 5.14 |
| With FYM | | 102.84 | 25.23 | 13.58 | 5.31 | 6.24 |
| F Test | | * | * | * | * | * |
| Foliar application of micronutrients | | | | | | |
| Control | | 93.14f | 20.29f | 10.06e | 4.38e | 4.55e |
| B | | 97.58d | 22.64d | 11.92d | 4.68c | 5.71c |
| Mo | | 96.78e | 21.79e | 11.75d | 4.44d | 4.95d |
| B+Mo | | 99.67b | 24.53b | 13.16c | 4.91b | 6.10b |
| Zn | | 98.50c | 23.53c | 13.52b | 4.69c | 5.95bc |
| B + Mo+Zn | | 103.15a | 25.15a | 15.29a | 5.69a | 6.93a |
| Interaction effect | | | | | | |
| Without FYM | Control | 90.11e | 18.30i | 9.24g | 3.91h | 3.88g |
| | B | 93.02fg | 20.78gh | 10.90f | 4.31f | 5.02ef |
| | Mo | 92.43g | 20.18h | 10.79f | 3.95g | 4.95f |
| | B+Mo | 94.01f | 21.76fg | 11.28e | 4.36f | 5.40d |
| | Zn | 93.94f | 21.36g | 12.99d | 3.96g | 5.24de |
| | B + Mo+Zn | 97.11e | 22.11f | 14.67bc | 5.19cd | 6.36c |
| With FYM application | Control | 96.17e | 22.27f | 10.87f | 4.85e | 5.19e |
| | B | 102.14cd | 24.50d | 12.94d | 5.04de | 6.38c |
| | Mo | 101.12d | 23.40e | 12.70d | 4.94e | 4.95f |
| | B+Mo | 105.33b | 27.30b | 15.04b | 5.46b | 6.79b |
| | Zn | 103.06c | 25.70c | 14.04c | 5.40bc | 6.67bc |
| | B + Mo+Zn | 109.19a | 28.19a | 15.91a | 6.19a | 7.50a |

Mean values followed by the same letter within the treatments are not significantly different ( $p < 0.05$) according to Duncan's multiple range test

Table 4: Effect of FYM and foliar application of micronutrients on N, P, K, Fe, Mn and Zn concentration in wheat grain yield

| Treatments | | Macronutrients (%) N | P | K | Micronutrients (mg / Kg) Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|
| FYM treatments | | | | | | | |
| Without FYM | | 1.65 | 0.35 | 0.22 | 88.70 | 37.93 | 34.64 |
| With FYM | | 1.99 | 0.41 | 0.26 | 101.10 | 45.08 | 45.20 |
| F test | | * | * | * | * | * | * |
| Foliar application of micronutrients | | | | | | | |
| Control | | 1.64d | 0.31e | 0.23d | 80.90c | 37.50b | 36b |
| B | | 1.78c | 0.36d | 0.24cd | 89.15b | 41.20ab | 39b |
| Mo | | 1.75c | 0.33e | 0.27b | 88.35b | 45.89a | 37.81b |
| B+Mo | | 1.84b | 0.43b | 0.25c | 103.80a | 38.00b | 42.13a |
| Zn | | 1.78c | 0.39c | 0.25c | 100.99a | 38.95b | 47.03a |
| B + Mo+Zn | | 2.14a | 0.46a | 0.29a | 106.20a | 47.50a | 44.28a |
| Interaction effect | | | | | | | |
| Without FYM | Control | 1.46e | 0.27f | 0.26c | 71.40e | 40.80b | 32.18e |
| | B | 1.55f | 0.32e | 0.22f | 82.70d | 37.80c | 31.63e |
| | Mo | 1.56f | 0.31e | 0.24e | 83.90d | 42.80b | 31.42e |
| | B+Mo | 1.68d | 0.39c | 0.22f | 98.20b | 34.00c | 36.15d |
| | Zn | 1.62d | 0.36d | 0.19g | 95.97b | 35.00c | 48.03a |
| | B + Mo+Zn | 2.02b | 0.43b | 0.25ce | 100.00b | 34.20c | 40.43c |
| With FYM application | Control | 1.81c | 0.36d | 0.26c | 90.40c | 43.80b | 42.60c |
| | B | 2.00b | 0.39c | 0.31ab | 95.60b | 44.60ab | 44.17b |
| | Mo | 1.94bc | 0.34 | 0.30b | 92.80bc | 48.97a | 44.19b |
| | B+Mo | 1.99b | 0.47a | 0.27c | 109.40a | 42.00b | 44.03b |
| | Zn | 1.93bc | 0.42b | 0.32a | 106.00ab | 42.90b | 48.10a |
| | B + Mo+Zn | 2.25a | 0.49a | 0.20 g | 112.40a | 51.20a | 46.12a |

Mean values followed by the same letter within the treatments are not significantly different ( $p < 0.05$) according to Duncan's multiple range test

Table 5: Effect of FYM and foliar application of micronutrients on N, P, K, Fe, Mn and Zn concentration in wheat straw yield

| | | Macronutrients (%) | | | Micronutrients (mg / Kg) | | |
|---|---|---|---|---|---|---|---|
| Treatments | | N | P | K | Fe | Mn | Zn |
| FYM treatments | | | | | | | |
| Without FYM | | 0.44 | 0.21 | 0.99 | 5.07 | 13.66 | 114.88 |
| With FYM | | 0.51 | 0.26 | 1.24 | 5.95 | 17.20 | 145.39 |
| F test | | * | * | * | * | * | * |
| Foliar application of micronutrients | | | | | | | |
| Control | | 0.42d | 0.17e | 0.90d | 4.05e | 13.45d | 112.19d |
| B | | 0.46c | 0.22c | 1.19bc | 5.29c | 15.99b | 126.42c |
| Mo | | 0.42d | 0.20d | 1.33a | 5.13d | 15.00c | 124.29c |
| B+Mo | | 0.52b | 0.29a | 1.23b | 6.23a | 15.20c | 133.59b |
| Zn | | 0.50b | 0.26b | 1.06c | 5.99b | 15.58bc | 144.82a |
| B + Mo+Zn | | 0.54a | 0.29a | 1.35a | 6.37a | 17.36a | 139.51b |
| Interaction effect | | | | | | | |
| Without FYM | Control | 0.38f | 0.15g | 0.76j | 3.29e | 11.41i | 95.72i |
| | B | 0.41e | 0.18ed | 0.84i | 4.83d | 14.12g | 107.55h |
| | Mo | 0.40e | 0.17f | 1.12e | 4.80d | 15.12f | 106.82h |
| | B+Mo | 0.49c | 0.26c | 1.07 fg | 5.89b | 13.60h | 126.09f |
| | Zn | 0.46d | 0.24d | 0.92h | 5.59c | 14.00gh | 119.03g |
| | B + Mo+Zn | 0.50c | 0.28b | 1.20c | 6.00b | 13.68h | 134.09e |
| With FYM application | Control | 0.45d | 0.19e | 1.04g | 4.81d | 15.48ef | 128.65f |
| | B | 0.50c | 0.26c | 1.31b | 5.74b | 17.86b | 145.29cd |
| | Mo | 0.44d | 0.22 | 1.34b | 5.45a | 16.31de | 141.76d |
| | B+Mo | 0.55ab | 0.30a | 1.07f | 6.56a | 16.80cd | 148.15bc |
| | Zn | 0.53b | 0.28b | 1.19d | 6.39 | 17.16bc | 155.54a |
| | B + Mo+Zn | 0.57a | 0.31a | 1.46a | 6.74a | 19.60a | 152.92ab |

Mean values followed by the same letter within the treatments are not significantly different ( $p < 0.05$) according to Duncan's multiple range test

values of all studied yield characteristics. Meanwhile, Mo-treatment gave the lowest mean values in all studied characteristics. These results are in agreement with Mei *et al*., [27] who found that the effect of B fertilizer on the seed yield was attributed to the increase in the number of seeds per plant. The combined application of B, Mo and Zn resulted in the highest seed yield compared with the application of B, Mo or Zn alone.

The interaction effect between FYM addition and foliar application of micronutrients on quantitative yield characteristics of wheat plants recorded a significant increase in all studied yield parameters as compared with the control treatment.

This could be due to the favorite effect of adding FYM as a good source of plant nutrients. Furthermore, FYM acts as a natural soil conditioner which improved soil properties and consequently soil productivity. These results are in accordance with those obtained by More [28].

**Effect of FYM and Foliar Application of Micronutrients on N, P, K, Fe, Mn and Zn Concentration in Grain and Straw Yield of Wheat Plant:** Data in Tables 4 and 5 illustrated that concentrations of macro and micronutrients in grain and straw yield of wheat were affected significantly by FYM and foliar application of micronutrients.

A glance on Table 4, it is clear that the mixed foliar application treatment (B, Mo and Zn) jointly with FYM application gave the highest values of all studied nutrients except for K% and Zn (mg $kg^{-1}$) in grain wheat as compared to the check treatment. Meanwhile, data in Table 5 reveal that the highest values of the aforementioned nutrients except for Zn (mg $kg^{-1}$) in straw occurred with the mixed foliar application treatment (B, Mo and Zn) in combination with FYM application as compared to the check treatment. It is well known that, during the decomposition of organic matter, macro and micronutrients are incorporated into the soil matrix, allowing the soil to act as a reservoir of these nutrients. These nutrients will be released, to become available for uptake by plants. Otherwise, humus which is the final component of organic matter decomposition, accumulate in the environmental systems to increase moisture retention and nutrient supply potentials of soils [29].

The obtained data are confirmed with the results found by Tolba *et al*., [30] and Khater *et al*., [31], who mentioned that FYM plays an important role for supplying plants by some required nutrients.

Foliar application of micronutrients led to an increase in concentrations of macro and micronutrients in both of grain and straw yield and this is mainly due to the vital physiological roles in plant cells which promote the uptake of plant nutrients [32, 33].

## CONCLUSIONS

Application of FYM in combination with foliar application of micronutrients had the highest effect on all quantitative yield characteristics. Foliar application treatment (B, Mo and Zn) with FYM gave the highest values, whereas, Mo-treatment without FYM gave the lowest values in all studied yield characteristics compared with the other micronutrients. Foliar application of micronutrients led to an increase in concentrations of macro and micronutrients in both of wheat grain and straw yield and this effect may be attributed mainly to the vital physiological roles in plant cells which promote the uptake of plant nutrients.

## REFERENCES


1. Nour, M.A., 1998. Effect of farmyard manure and water regime on production of rice. Egypt, J. Agric. Res., 76: 1533-1547.
2. El-Kholy, M.H., Y.M.Y. Abido and K.E. Nassar, 1999. Effect of organic manure and nitrogen fertilization on efficiency of blue green algae inoculation in paddy fields. Proc. of the International Symposium on Biological Nitrogen Fixation and Crop Production, Cairo, Egypt, pp: 169-179.
3. Ebaid, R.A., 2000. Rice productivity as affected by integration of organic and inorganic nitrogen fertilizers.J. Agric. Sci. Mansoura Univ., 25: 7357- 7365.
4. Das, K., D. Medki and B. Guha, 2001. Recycling effect of crop residues with chemical fertilizers on physico-chemical properties of soil and rice (*Oryza sativa*) yield. Ind. J. Agron., 46: 648-653.
5. Bassal, S.A.A. and F.A. Zahran, 2002. Effect of farmyard manure, bio and mineral nitrogen fertilizer and hillspaces on rice crop productivity. J. Agric. Sci. Mansoura Univ., 27: 1975-1988.
6. Malakouti, M.J., 2008. The effect of micronutrients in ensuring efficient use of macronutrients. Tur. J. Agric. For., 32: 215-220.
7. Cakmak, I. and V. R¨omheld, 1997. Boron deficiency-induced impairments of cellular functions in plants. Plant Soil. 193: 71-83.
8. Matoh, T., 1997. Boron in plant cell walls. Plant Soil. 193: 59-70.
9. Goldbach, H.E., Q. Yu, R. Wingender, M. Schulz, M. Wimmer, P. Findeklee and F. Baluska, 2001. Rapid response reaction of roots to boron deprivation. J. Plant Nutr. Soil Sci., 164: 173-181.
10. Brown, P.H., N. Bellaloui, M.A. Wimmer, E.S. Bassil, J. Ruiz, H. Hu, H. Pfeffer, F. Dannel and V. R¨omheld, 2002. Boron in plant biology. Plant Biology, 4: 205-223.
11. Iwai, H., A. Hokura, M. Oishi, H. Chida, T. Ishii, S. Sakai and S. Satoh, 2006. The gene responsible for borate cross-linking of pectin rhamnogalacturonan-II is required for plant reproductive tissue development and fertilization. P. Natl. Acad. Sci. USA. 103: 16 592-16 597.
12. Dell, B. and L.B. Huang, 1997. Physiological response of plants to low boron. Plant Soil. 193: 103-120.
13. Huang, L.B., J. Pant, B. Dell and R.W. Bell, 2000. Effects of boron deficiency on anther development and floret fertility in wheat (*Triticum aestivum* L. 'Wilgoyne'). Ann. Bot., 85: 493-500.
14. Chen, G., F.Z. Nian, F.S. Xu and Y.H. Wang, 2005. Effect of boron and molybdenum on yield and quality of two rapeseed cultivars. Plant Nutr. Fert. Sci. (in Chinese). 11: 243-247.
15. Nabi, G., E. Rafique and M. Salim, 2006. Boron nutrition of four sweet pepper cultivars grown in boron-deficient soil. J. Plant Nutr., 29: 717-725.
16. Kaiser, B.N., K.L. Gridley, B.J. Ngaire, T. Phillips and S.D. Tyerman, 2005. The role of molybdenum in agricultural plant production. Ann. Bot., 96: 745-754.
17. Schwarz, G. and R.R. Mendel, 2006. Molybdenum cafactor biosynthesis and molybdenum enzymes. Annu. Rev. Plant Biol., 57: 623-647.
18. Cakmak, I., H. Ekiz, A. Yilmaz, B. Torun, N. K¨oleli, N.L. G¨ultekin, A. Alkan and S. Eker, 1997. Differential response of rye, triticale, bread and durum wheat to zinc deficiency in calcareous soils. Plant Soil. 188: 1-10.
19. Das, K., R. Dang, T.N. Shivananda and P. Sur, 2005. Interaction between phosphorus and zinc on the biomass yield and yield attributes of the medicinal plant stevia (*Stevia rebaudiana*). Sci. World J., 5: 390-395.
20. Pandey, N., G.C. Pathak and C.P. Sharma, 2006. Zinc is critically required for pollen function and fertilization in lentil. J. Trace Elem. Med. Bio., 20: 89-96.

21. Fang, Y., L. Wang, Z. Xin, L. Zhao, X. An and Q. Hu, 2008. Effect of foliar application of zinc, selenium and iron fertilizers on nutrients concentration and yield of rice grain in China. J. Agric. Food Chem., 56: 2 079-2 084.
22. Black, C.A., 1982. Methods of Soil Analysis, Part2 American Society of Agronomy. Inc. Publisher, Madison, Wisconsin, USA.
23. Peterburgsiki, A.V., 1968. Hand Book of Agronomic Chemistry, Kolos Publication House, Moscow. (In Russian) pp: 25-90.
24. CoStat Statistical Software, 2004. CoStat. Manual Revision, 4.2: 271.
25. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for the Agricultural Research. John Wiley and Sons, Inc., New York.
26. Duncan, D.B., 1955. Multiple Range and Multiple F Test, Biometric, 11: (11-44).
27. Mei, Y., S. Lei1, X.F. Sen1, L.J. Wei1 and W.Y. Hua1, 2009. Effects of B, Mo, Zn and Their Interactions on Seed Yield of Rapeseed (*Brassica napus* L.). Pedosphere, 19(1): 53-59.
28. More, S.D., 1994. Effect of farm wastes and organic manure on soil properties, nutrient availability and yields of rice and wheat grown on sodic Vertsoils. J. Ind. Soc. Sci., 46: 253.
29. Suganya, S. and R. Sivasamy, 2006. Moisture Retention and Cation Exchange Capacity of Sandy Soil as Influenced by Soil Additives. J. Appl. Sci. Res., 2: 949-951.
30. Tolba, M.H., G.A. Baddour and A.M. El-Ghamry, 2003. Effect of different sources of organic manures on eggplant (*Solanum melongena*, L.) and some soil properties. J. Agric. Sci. Mansoura Unive., Special Issue, Scientific Symposium on "problems of soils and water in Dakohlia and Domietta Governorayes" March, 18: 127-135.
31. khater, E.A., S.B. Ibrahim and A.A. Awadalla, 2004. Utilization of some form organic wastes for improving soil productivity af the newly reclaimed areas at El-Fayoum governorate Egypt. Egypt. J. Soil Sci., 44(3): 333-354.
32. Ishag, H.M., 1992. Effects of Foliar Micronutrient Fertilizers on the Yield of Irrigated Cotton on the Vertisols of the Sudan Gezira. Experimental Agriculture, 28: 265-271.
33. Abd El-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.