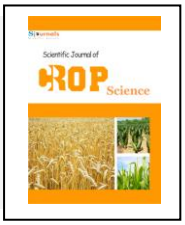
Sjournals
Scientific Journal of Crop Science (2014) 3(2) 9-16
ISSN 2322-1690
doi: 10.14196/sjcs.v3i1.1178

Contents lists available at Sjournals
Scientific Journal of CROP Science
Journal homepage: www.Sjournals.com



Original article

Effect of iron nano chelated fertilizers foliar application on three wheat cultivars in Khorramabad climatic conditions

M. Rezaeei[a,*], M. Daneshvar[b], A.H. Shirani[c]

[a]*MSc of student of Agronomy Department, Khoramabad branch, Islamic Azad University, Khoramabad.*
[v]*Assistante Professor of Agronomy Department, Faculty of Agriculture Sciences, Lorestan University, Khoramabad.*
[c]*Assistante Professor of Agronomy Department, Khoramabad branch, Islamic AzadUniversity, Khoramabad.*

*Corresponding author; MSc of student of Agronomy Department, Khoramabad branch, Islamic Azad University, Khoramabad.

ARTICLE INFO

Article history,
Received 07 February 2014
Accepted 19 February 2014
Available online 28 February 2014

Keywords,
Fertilizers
Foliar spraying
Iron
Wheat
Yield

ABSTRACT

In order to investigate the effect of iron nano chelated fertilizers foliar application on three wheat cultivars, an experiment was arranged based on randomize complete block designe in three replications during the 2011-2012 cropping seasons in research farm of faculty of agriculture, university of Lorestan, Iran. The first factor included breeded cultivars Zagros (c1) Koohdasht (c2) and Azar2 (c3) and second factor included iron nano chelated foliar application in four levels, F1, control, F2, 1.5kg iron nano chelated fertilizers foliar application per 1000 liter water, F3; 2.5 kg iron nano chelated fertilizers foliar application per 1000 liter water and F4, 3.5 kg iron nano chelated fertilizers foliar application per 1000 liter water. In this study spike number, grain number per spike, 1000 grain weight, biological yield, grain yield and harvest index of wheat were evaluated. Results showed that effect of iron nano chelate foliar application, wheat cultivars and interaction of them had signigicant effects on spike number, grain per spike, 1000 grain weight, biological yield and harvest index ($p \leq 0.01$ and $p \leq 0.05$). Zagros cultivar with 2.5 kg iron nano chelated fertilizers foliar application (C1F3 treatment) had the highest values at most of evaluated characters and with regard to this regional climatic condition is recommended as prevalent treatment.

1. Introduction

Wheat is one of the first plants that had been cultivated by human and is one of the most important plants among the crops. Its cultivation is simple and is adapted to different climate conditions. Wheat is the main food of most people of the world and is cultiveded more than others (Karimi, 1992). Suitable and usuful usage of different kind of fertilizers are the main way for reformation and maintaing of soil fertility and inceasing of crops yield (Hossein Talaei, 2012). Each plant needs to certain fertilizers according to its needs and soil analyze results. Also macroelements is the critical elements for plants, however, microelements play the important role in crop productivity where it is used in low rate. Optimum plant nutration and maximum yield is achieved when nutrient elements are availble for plant during the growing season (Malakouti et al., 2001). Mental syntetic chelates are recommending according to their stability in soil, solubility in water, absorption capability by plant root or according to soli pH and plant type (Vanluit et.al.1981). In about iron fertilizers and its relative shotage problems, Soil couldn't be reform by controlling of chemical variations even by using of iron fertilizers useage (Havling et.al, 1999). The best way for application of microelements in alkaline soils of Iran is foliar application because application of this nutrient to soil couldn't resolve the absorption problem completely. Khazra iron nano chelate had the strong and stable complex with 3<pH<11 range which is higher than Iran national standards rate (pH=8.3), and make 9% of solved iron in water available for plant. Zinc and manganese supplements had the specifice role in this fertilizer (Khalaj et al., 2009). Seven elements of available nutrients in natural environment have low necessity for plant growth. Some of them are absorbed in cation form such as iron, manganese, copper and zinc and some of them are absorbed in inione form such as bor, molybdenum and chlorine (Khajepoor, 1999). Iron plays the important role in biological activites and in some cases its shortage disturbs the plant. It will prevent the absorption of excess phosphate in acidic soils. Iron amounts in soil are between 40-50 ppm and are in mineral form. If the soluble iron content in soil be more than 200 mg\l it caused to poisoning effects in plants and in the alkaline soils its solvent is reduced (Koolivand 1987). Probably all the soils have enough iron, however, its solubilty which controle by soil pH, in the plants and cultivars with unefficiency absorption is low. By increasing of per unit change in pH, solubility may be reduced to a thousand times (Lindsay, 1992). In limestone soils usage of Fe-EDDHA and montmorillonite ferruginous clay is more effective than Fe-HEDTA (Sarmadnia and Koucheki, 1997). The advantage of leaf feeding or foliar nutrients is that when its fast effect is need it is available for branches, leaves or fruit. Some parts of plant such as fruit, needs more food such as the calcium. In early spring when soil temperature is low the roots couldn't absorb nutrients so, elements such as bor and zinc are need for plant. In some cases such as when incompatibly phenomenon by addition of some material occurred in plant root or microorganisms leaf feeding gets more important (Malakooti and Tabatabaei 1998) showed that by using of zinc sulphate, copper sulphate besides the increasing of grain yield, iron, zinc and copper concentration in grain increased and protein rate increased from 6-10% to 14 percentage.

Khalily mahhaleh et al. (2002) indicated that foliar application of micro elements such as iron, zinc, manganese in both shooting and a little before the flowering stages increased the yield and yield components of corn cilage. The main difference between nano technology and other technologies is in material and structures which are used in this technology. Nono powders are mixture of particles with dimensions between 1 to 10 nm. One of the most important applications of nanotechnology in agriculture and trends in water and soil science is using nano fertilizers for plant nutrition (Rezaei et al., 2008). Uses of chelated forms which are stabilized by reaction of the metal salts with natural and synthetic complexes are the most important ways to protect of iron from the mineralization resulted of increasing of soil pH. Reported that iron chelated fertilizers significantly increased plant yield compared with other iron fertilizers (Chohura et.al 2007). Nazaran et al. (2009) in order to study the effect of Khazra iron nano chelated fertilizer application time on quantitive and quality of dryland wheat an experiment was arranged and results showed that Khazra iron nano chelated fertilizer foliar application at shooting stage let to 99% increasing of grain yield and 32.4% increasing of grain iron compared with controle treatment. Pahlavan rad and Kolli (2009) indicated that microelements such as iron and zinc increased the grain number per spike and 1000 grain weight, in addition this elements concentration were increased in grain. Today,

due to the low concentration of micronutrients in wheat grain that is the main food of the people of Iran many diseases, such as kidney stones, anemia, fatigue and gastrointestinal disorders are common (Malakooti and Lotf Allahi 1998). Mohamad et al (2006) reported that foliar application of microelements fertilizers at emergencing, shooting and ripening stages significantly increased spike number per m2, grain number per spike, 1000 grain wheight, biological yield and grain yield of wheat.

2. Material and methods

An experiment was conducted during 2011-2012 in Agricultural Research Station located in Khorramabad, Lorestan University, Iran. In this semi-arid climatic condition average annual rainfall is 520.6 mm and the average temperature is 17.3 ° C. In order to determining of chemical and physical properties of farm soil samples were prepared from 0-30 cm depth. Samples were sieved and were analyzed at laboratory. Soil analysis results showed in table 1.

Table 1
Soil analysis of physical and chemical properties.

Ec mmos/cm	pH	Cu ppm	Zn ppm	Mn ppm	Fe ppm	N ppm	K ppm	P ppm	O.C (%)	Deep (cm)
0.61	7.7	0.68	0.8	6.6	7.6	80	230	8	0.79	0-30

This experiment was arranged in factorial based on randomize complete block designe in three replications. First factor included wheat breeded cultivars, Zagros, Koohdasht and Azar2 (c1,c2 and c3 respectively) which were prepared from Lorestan research center and second factor was Khazra iron nano chelated fertilizer foliar application in 4 levels , f1 controle, f2 iron nano chelated fertilizer foliar application in 1.5 kg per 1000 liter water, f3 iron nano chelated fertilizer foliar application in 2.5 kg per 1000 liter water and f4 iron nano chelated fertilizer foliar application in 3.5 kg per 1000 liter water. Khazra iron nano chelated fertilizer included different microelements such as iron (8.9%), zinc (0.92%), manganesium (0.96%) sodium (9.9%) and brimstone (9.5%) were prepare and mixed at 1.5, 2.5, 3.5 kg per 1000 liter water and sprayed at shooting and generation stages on leaf and branch of studied cultivars. Triple super phosphate added as a phosphate resource at the sowing time and urea as a nitrogen resource at sowing and tillering stages. Each plot consists of 8 sowing rows with 20 cm between rows and 1-2 cm on rows spaces. For sowing 135 kg\ha wheat grain was used. Weeds were controlled by 2,4-D herbicides and for evaluating of grain number per spike, 10 plants at physiologic ripining were selected randomizly and after the removing of spikes grain number were counted and average of them were reported. After harvesting for measurement of 1000 grain weight, some grains were selected randomizly and counted by grain counter and then weighted accurately. After physiological ripining biological yield were determined by draining of whole plants which were harvested at 2.4 m2 of center of each plot at 75c for 48h at aven. For avaluating of grain yield after measurement of biological yield, spikes were removed from stems and after winnow net grain weight were determined. Harvest index were calculated by Sarmadnia and Koocheki (1994) method,

$$\text{Harvest index} = \frac{\text{grain yield}}{\text{biological yield}} \times 100$$

The data were analyzed by MSTAT-C soft-ware and the figures were drawn by Excel 2010.

3. Results and discussion

3.1. Spike number

Analysis of variance of the data showed that cultivars and interaction of cultivars and iron nano chelated fertilizer had significant effects on spike number ($p \leq 0.01$ and $p \leq 0.05$ respectively), however, iron nano chelated fertilizer treatment hadn't significant effect on spike number (table 2). Means comparation of simple effect of cultivar on spike number showed that maximum spike number was observed in Azar 2 (c3) cultivar (30.90 spike m2) also there were no signinficant differences between Zagros (c1) and Koohdasht (c2) cultivars and Zagros

cultivar had the least spike number (16.72 spike m2) (table 3). Means comparation of different levels of iron nano chelated fertilizers had no significant differences and maximum and minimum spike number were observed at F4 and F1 by 23.60 and 20.76 spike respectively (table 3). Means comparation of interaction of two factors indicated that c3f4 had the highest spike number (40.12) and c1f2 had the lowest spike (table 4). According to this table c1 and c2 cultivars hadn't significant differences however c3 cultivar had meaningfull effect at different iron levels and had the high values. Spike number is the most important factors that grain yield are depending to it, because after flowering and decreasing of leaf area, spike number plays the important role in plant photosynthesis. Previously effect of microelements on spike number had been reported (Soyler et al, 2005).

3.2. Grain number per spike

Analysis of variance of the data indicated that cultivar treatment had the meaningfull effect on grain number per spike ($p \leq 0.05$) also the effect of iron nano chelate and interaction of two factors were not meaningfull (table 3). Means comparation of cultivars on grain number per spike showed that maximum grain number was achieved from Zagros cultivar (26.92) and minimum grain number was in Azar 2 cultivar (22.54) although there were no statically differences between Koohdasht and Azar 2 cultivars (table 3). Means comparation of different iron chelated fertilizer foliar levels were not meaningfull, however, F4 treatment with 24.50 grain number had the highest value and control treatment with 23.37 grain number had the lowest value (table 3). Results of means comparation of interaction of two factors indicated that C1F3 treatment had the highest grain number per spike (29.07) and C3F3 treatment had the lowest value (21.07)(table 4), this means that interaction of cultivars on grain number was meaningfull and nano fertilizer had no effect on grain number which is agree with simple effect of nano fertilizer. Other interactions had no significantly effect on grain number.

3.3. 1000 grain weight

Analysis of variance of the data reveled that effect of cultivar and iron nano chelated fertilizers on 1000 grain weight was statically meaningfull also, interaction of them were no significant (table 2). According to table 3, Means comparation of cultivars on 1000 grain weight indicated that Azar 2 cultivar had the highest 1000 grain weight (36.79g) and also there were no statically differences between Zagros and Koohdasht cultivars, however, Koohdasht cultivar had the lowest 1000 grain weight (32.69g). As showed in table 3, application of iron nano chelate had no effect on increasing of 1000 grain weight, however, F4 and F1 treatments had the maximum and minimum of 1000 grain weight (35.93 and 32.15 respectively). Means comparation of interaction of two factors reveled that also C3F2 treatment had the maximum 1000 grain weight (38.58) and C2F1 treatment had the lowest value (30.80), however, in general combination of Azar 2with other fertilizer levelsresulted in high 1000 grain weight. Morshedi et al. (1999) reported that iron and zinc elements caused to increasing of carbohydrate, 1000 grain weight and grain number per spike which is agree with our results. Mohamad et al (2006), results showed that foliar application of microelements at emengencing, shooting and ripining stages increased spike number, grain number per spike, 1000 grain weight, biological yield and grain yield of wheat.

Table 2
Azalysis of variance of data on quantitive propertises of wheat.

Means of squares			df	Source
1000 grain weight	Grain per spike	Spike number		
9.076	6.754	191.094	2	Repeat
55.535*	62.408*	707.121**	2	Factor A (cultivar)
22.812*	4.944ns	15.875ns	3	Factor B (fertilizer)
3.394ns	9.413ns	86.114*	6	A×B
5.252	14.401	24.567	22	Error
			36	Total
6.67	15.57	22.41		CV%

,*,**, ns, significant at $p \leq 0.01$ and $p \leq 0.05$, no significant, respectively

3.4. Biological yield

Analysis of variance of the data showed that cultivars and iron nano chelate treatments had no meaningfull effect on biological yield, however, interaction of these two factors was significant at $p \leq 0.05$ (table 5). Means

comparision of cultivars indicated that Azar 2 (c3) had the highest biological yield (6027 kg\ha) and Koohdasht (c2) cultivar had the lowest value (5717 kg\ha) also there were no meanngfull differences between Zagros and Azar 2 (table 6). Also there were no meaningfull differences between iron nano chelated fertilizers levels, however, F2 and F4 treatments had maximum and minimum biological yield (5798 and 5536g\ha respectively). Results of interaction of two factors show that biological yield of C1 and C3 treatments by increasing of fertilizer doses increased, however, biological yield of C2 treatments decreased where C2F3 and C2F4 had 4751 and 4591kg\ha respectively (table 7). Ashrafi et al. (2006) reported that all the fertilizers which were enhanced by Iron caused to increasing of dry weight of corn (Zea mays) compared with controle.

Table 3

compare means of simple effect of cultivar and iron nano chelated fertilizers on quantitive propertises of wheat.

1000 grain wheight (g)	Grain per spike	Spike number (m2)	Treatments
33.62b	26.92^{a}	16.72^{b}	C1
32.69b	23.64^{b}	18.72^{b}	C2
36.79a	22.54^{b}	30.90^{a}	C3
32.15b	23.37^{a}	20.76^{a}	F1
34.78a	25.16^{a}	22.84^{a}	F2
34.61a	24.46^{a}	21.26^{a}	F3
35.93a	24.50^{a}	23.60^{a}	F4

Different letters in each column indicate significant difference at p≤0.05. C1, Zagros, C2, Koohdasht, C3, Azar 2, F1, controle, F2, (1.5 per 1000), F3 (2.5 per 1000) and F4, (3.5 per 1000).

Table 4

comper means of interaction of two studied factors on quantitive propertises of wheat.

1000 grain weight (g)	Grain per spike	Spike number (m2)	Iron nano chelate	Cultivar
31.71^{cd}	26.03^{ab}	16.24^{d}	F1	
33.4^{bcd}	27.97^{ab}	15.00^{d}	F2	
33.71^{bcd}	29.07^{a}	20.25^{cd}	F3	C1
35.66^{abc}	24.06^{ab}	15.40^{d}	F4	
30.80^{d}	22.23^{ab}	19.15^{cd}	F1	
32.37^{cd}	25.03^{ab}	20.81^{cd}	F2	
32.50^{cd}	23.23^{ab}	19.64^{cd}	F3	C2
35.10^{abcd}	24.07^{ab}	15.27^{d}	F4	
33.93^{bcd}	23.81^{ab}	26.91^{bc}	F1	
38.58^{a}	22.47^{ab}	32.69^{ab}	F2	
37.63^{ab}	21.07^{b}	23.89^{bcd}	F3	C3
37.03^{ab}	24.80^{ab}	40.12^{a}	F4	

Different letters in each column indicate significant difference at p≤0.05. C1, Zagros, C2, Koohdasht, C3, Azar 2, F1, controle, F2, (1.5 per 1000), F3 (2.5 per 1000) and F4, (3.5 per 1000).

3.5. Grain yield

Analysis of variance of data illustrated that effect of cultivar, iron nano chelate and interaction of them were statically meaningfull at p≤0.01 (table 5). According to table 6, means comparision of cultivar on grain yield reveled that Zagros cultivar had the highest grain yield (2530 kg\ha)and also there were no significant differences between Koohdasht and Azar2 cultivars, however, Azar 2 cultivar had the lowest value (1473 kg\ha). Means comparision of iron nano chelated fertilizer on grain yield showed that by increasing of fertilizer dose plant production increased where maximum grain yield was observed in F3 tratments (2199 kg\ha) and minimum grain yield were observed in F1treatments (1266kg\ha) (table 6). Means comparision of interaction of two factors showed that C1F3 and C1F4 by having of 3278 and 2967 kg\ha had the highest grain yield and minimum grain yield were observed in C3F1 and C2F1 treatments (table 7). Comparison of Zagros cultivar at F2-F4 with Azar 2 cultivar reveled that genotype plays important role in inceasing of grain yield than fertilizer usage. At main effects of iron

nano chelated fertilizers on grain yield, F3 and F4 had no significant differences, however, a significant differences were observed when these combined by cultivars. The reason of this is resulted in genotype (cultivar) differences. In other hand, genotypic differences let to the differences in plants yield. According to table 7, it could be suggested that application of iron nano chelated fertilizers compared with controle treatment could promote wheat grain yield and Zagros cultivar had good reflect to this fertilizer and used better than rest. Significant effect of microelements content of fertilizers on grain yield of wheat were previously reported (Siadat et al. 1998).

3.6. Harvest index

Analysis of variance of data showed that effect of cultivars and iron nano chelated fertilizers levels were statically signifiacint at p≤0.01, however, the interaction effects of them were no significant (table 5). Means comparision of cultivars levels on harvest index showed that harvest index from C1 cultivar to C3 cultivar was rediuced where maximum harvest index was achieved in Zagros cultivar (C1)(43.99%) and Azar 2(C3) by having of 24.68 % had the minimum value. In other hand, Zagros cultivar by better using of assimilates and allocation of it in grain could improve economical yield compared with rest. Although Azar 2 cultivars had the highest biological yield, however, because of unsufficient allocation of assimilates in grain had the lowest harvest index (table 6). Means comparision of different iron nano chelated fertilizers on harvest index showed that same as grain yield by increasing of nano chelated fertilizers harvest index increased where maximum harvest index was in F4 treatment also there was no significant differences between F3 and F4 treatment and minimum harvest index was in controle treatment (table 7). Means comparision of interaction of two factors indicated that C1F4 and C1F3 had the highest values (55.59 and 48.75% respectively) and C3F1 and C2F1 treatments had minimum values (17.95 and 21.36% respectively). In general, interaction of C3 cultivar with fertlizers treatment had the lowest harvest index compared with C1 and C2 cultivars (table 7). These results showed that nano fertilizer had less effect on harvest index, however, when this fertilizers combained with cultivars it lets to increasing of harvest index and transfer coefficient of assimilates to grain which emphasize importance of cultivars.

Table 5
analysis of variance of data for yield and yield component.

Means of squares			df	source
Harvest index	Grain yield	Biological yield		
19.351	60133.967	35290.283	2	R
1143.777**	4059591.838**	2313333.15ns	2	Factor A (cultivar)
455.383**	1586115.982**	116487.192ns	3	Factor B (fertilizer)
53.120ns	329379.628**	2171207.826*	6	A×B
22.499	43775.983	692311.783	22	Error
			36	Total
14.16	11.24	14.77		CV%

*,**, ns, significant at p ≤ 0.01 and p ≤ 0.05, no significant, respectively.

Table 6
means of simple effect of treatments on yield and yield component of wheat.

Harvest index (%)	Grain yield (kg\ha)	Biological yield (kg\ha)	Treatment
43.99[a]	2530[a]	5717[ab]	C1
31.82[b]	1582[b]	5160[b]	C2
24.68[c]	1473[b]	6027[a]	C3
23.88[c]	1266[c]	5590[a]	F1
32.35[b]	1874[b]	5798[a]	F2
38.56[a]	2199[a]	5615[a]	F3
39.19[a]	2108[a]	5536[a]	F4

Different letters in each column indicate significant difference at p≤0.05. C1, Zagros, C2, Koohdasht, C3, Azar 2, F1, controle, F2, (1.5 per 1000), F3 (2.5 per 1000) and F4, (3.5 per 1000).

4. Conclusion

According to results and reducing production costs and environmental considerations using of iron nano chelated fertilizer foliar applicaton at 2.5per thousand and Zagros cultivar for obtaing of suitable wheat grain yield in dry lands is recommended.

Table 7
means of interaction of treatments on yield and yield component of wheat.

Harvest index (%)	Grain yield (kg\ha)	Biological yield (kg\ha)	Iron nano chelate	cultivar
32.70^{bcd}	1520^{cd}	4659^{b}	F1	
38.81^{b}	2356^{b}	6093^{ab}	F2	
48.75^{a}	3278^{a}	6742^{a}	F3	C1
55.96^{a}	2967^{a}	5374^{ab}	F4	
21.36^{ef}	1228de	5968^{ab}	F1	
30.96^{bcd}	1646^{c}	5367^{ab}	F2	
38.97^{b}	1810^{c}	4715^{b}	F3	C2
35.98^{bc}	1643^{c}	4591^{b}	F4	
17.59^{f}	1052^{e}	6142^{ab}	F1	
27.27^{cde}	1619^{c}	5934^{ab}	F2	
27.96 ^{cde}	1508^{cd}	5388^{ab}	F3	C3
25.90^{def}	1712^{c}	6643^{a}	F4	

Different letters in each column indicate significant difference at p≤0.05. C1, Zagros, C2, Koohdasht, C3, Azar 2, F1, controle, F2, (1.5 per 1000), F3 (2.5 per 1000) and F4, (3.5 per 1000).

References

Ashrafi, A.H., Shariatmadari, Y., Rezaeinajad, F., Noorbakhsh., 2004. Effect of fertilizers enhanced by iron on Maize at greenhouse condition. Ninth congr. soil sci., Tehran, Iran.

Chohura, P., Kołota, E., komosa, A., 2007. The effect of different source of iron on nutritional value ofgreenhouse tomatofruit grown in peat substrate. Vegetable crops res. Bullet., 67, 55-61.

Havling, T.L., Beaton, J.D., Tisdale, S.L., elson, W.L.N., 1999. Soil fertility and fertilizer. 6 ed. Printice Hall. New Jersey. USA.

Hossein Talaei, G.h., 2012. Effect of bio and chemical fertilizers on yield and yield components of cumin (cimin cimio). MsC thesis. Univ. Shahed, Tehran, Iran.

Karimi, H., 1991. Wheat. Tehran univ. perss. pp 7-131.

Khaje Poor, M.R., 1998. Principles of Agriculture, Second Edition, published by Jahad Daneshgahi, Univ. Isfahan.

Khalaj H., Labaffi Hossein Abadi M.R. Nazaran M.H., Sheibani K. and Razazi A. 2008. Application of nano-organic fertilizer, foliar fertilizer and chelated iron on the apple and pear yield.

Khalil Mahhaleh, J., Reza doost, S., Roshdi, M., 2002. Effect of foliar micronutrient elements on quantitative and qualitative characteristics of 704 corn silage in the Khoy region. Ninth Congr. Soil Sci.,Tehran. Iran.

Kolivan, M., 1987. Sugur beat farming.research institude press.

Lindsay, W.L. 1992. In micronutrients in agriculture, Madison, Wis Soil sci. soc. America.

Malakooti, M.J., Tabataei, S.J., 1998. Plant feeding by foliar application. 8th technical j. Agr. Educat. Publ. Karaj.Iran.

Malakooti, M.J., Lotf, A., 1998. Effect of zinc on increasing of quantitive and quality of productions. Karaj, Iran.

Mohamad, A.M., Aslam, S.A., Rozina, G.U.L., Sajid, K., 2006. Response of Wheat to foliar application of nutrients. Department of Agronomy, NWFP Agricultural University, Pakestan. Agr. Res. Inst., Qutta Balochista Pakistan.

Morshedi, A., Rezaei, H., Malakooti, J., Naghibi, J., Rezaei, H., 1999. Effect of Iron foliar application on yield and qualitive characters of enhanced rapeseed grains at Bordsir Kerman., 12,55-63.

Nazaran, A., Pardakhti, M., Hokm Abadi, H., Ashtiani, M., 2005. The role of green space in reducing air pollution and the effect of iron chelate fertilizer Khazra' increase the efficiency of new plants. First Env. Eng. Conf.

Noor Gholi poor, F., Malakooti, M.J., Khavazi, K., 2000. Role of Utio basilous bacteria and dissolved phosphate bacteria enhancing phosphour absorption from soil phosphate resources by Maize and necessity of biological fertilizers production in Iran. Review article. Agr. Educat. publ., 383-400.

Pahlavan-rad., Mohammad, R.g., Pessarakli, M., 2009. Response of Wheat Plant to Zinc, Iron and Manganes Applications and Uptake and Concentration of Zinc, Iron and Manganes in Wheat Grains. Comm. Soil Sci. Plant Analys., volume 40, pages 1332-1322.

Sadri, M.H., Malakooti, M.J., 1997.Determine the critical levels of micronutrients in wheat fields of Kurdistan. J. Soil Water. Res. Inst. Soil Water.

Sarmadnia, G.M., Koucheki, A., 1996. Crop Physiology (translation).sixth edition. Mashhad Jahad Daneshgahi Press.

Siadat, A., Hashemi Dezfooli, A., Radmehr, M., Adineh, L.A., 1999. Effect of microelement on tield and absorption of nitrogen, phosphorous and potassium on wheat. Sixth Congress of Soil Sci. Mashhad Univ., pp. 453.

Soylur, S.B., Sade, A., topal, N., Akgun., Gezgin, S., 2005. Responses of Irrigated durum and Bread Wheat Cultivars to Boron Application in Low Boron Calcareous Soil. Turk. J. Agric., 29; 275-286.

Vanluit. B., Boxma, R., 1981. Quality check of iron chelates applied to ornamental shrubs on sphagnum peat. J. Hort. Sci., 56,125-137.