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Effect of FE foliar application on morphological and physiological traits of different dryland wheat cultivars

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ABSTRACT

A Split plot experiment based on randomized complete block design (RCBD) with three replications was conducted in 2012,Treatments were included the time of foliar application with 3 levels (tillering stage, heading stage and no spray (control)) as main factor and cultivars in 4 levels (Sardari, Rijav, Biseton and Rashid) as the second factor. Plant characteristics such as plant height, length of the peduncle, length of stamen, diameter of node, the number of node, and spike of length Fe and leaf area index were considered. Results showed that the time of Fe foliar application had a significant effect on studying traits. With respect to Duncan's Multiple Range test, mean comparison results revealed that the Fe foliar application at tillering stage and treatment control (no application) had the greatest and the least effect on traits respectively. Also there was significantly different among cultivars, as among cultivars the maximum and minimum mean of traits was obtained for Rijav and Rashid respectively. The interaction of foliar application × cultivar for plant height and leaf area index was also significant. Highest the wheat height and LAI were observed at foliar application in tillering with Rijav cultivar and the lowest means to control with the Rashid it can be concluded that the most suitable application of Fe solution for improvement morphological and physiological properties of different dry land wheat cultivars (in the same climate condition) was tillering stage, since more impression of Fe was observed in early growth stages.

Key words: Fe foliar application, Leaf area index and Rijav cultivar.

INTRODUCTION

Wheat is the world's most important cereal crop in terms of both area cultivated (232 million ha) and amount of grain produced (595 million t). It is widely grown throughout the temperate zones (in Northern Europe up to 60 °N) and in some tropical/sub-tropical areas at higher elevations. The major centers are: Europe (131 million t grain, 27 million ha), the former USSR (108 million t grain, 48 million ha), North America (106 million t grain, 42 million ha), China (96 million t grain, 30 million ha) and India (50

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million t grain, 23 million ha). Iron deficiency is a growing health concern in the developing world, and responsible for diverse of health complications including anemia and impairments in the immune system (Welch and Graham 2004). It is estimated that nearly half of the world population is affected by Fe deficiency problem. The Major reason for the widespread occurrence of Fe deficiency in human populations is very little dietary diversity and high consumption of cereal-based foods with very low amount and poor availability of Fe (Bouis 2003; Welch and Graham 2004). Increasing concentration and bioavailability of Fe in commonly-eaten food crops are, therefore, a big global challenge and an important public health issue. Various strategies are available to alleviate Fe deficiency problem globally. Among these strategies, agricultural strategies like plant breeding and agronomic approaches (e.g., fertilization) seem to be highly cost-effective and easily applicable in the developing world (Cakmak 2008). In case of agronomic approaches, there are few published data in the literature dealing with the role of Fe fertilization on Fe concentrations in the edible parts of staple food crops. Most of the studies about Fe fertilization focused more on correction of Fe deficiency problem. In addition, in contrast to Zn, Fe fertilization seems to be not effective in increasing Fe concentrations of cereal grains (Rengel*et al*. 1999). Recent evidence in the literature indicates that the nitrogen nutritional status of plants has a positive influence on grain accumulation of Fe (Kutman*et al*. 2010), possibly by contributing to release of Fe-mobilizing compounds from leaves and roots enhancing root uptake and transport of Fe via increasing pool of transporter proteins facilitating translocation and phloem transport of Fe via chelation with nitrogenous compounds and improving seed deposition of Fe by increasing amount of proteins in seeds (Cakmak*et al*. 2010). In the present study, we investigated the role of soil- and/or foliar-applied various Fe fertilizers on grain accumulation of Fe in wheat under different N nutrition régimes. Considering the importance of dry land agriculture in the world and also one of dry land wheat crop sin Iran and the world is considered the important and strategic, Lack of iron in many dry land areas, this study was carried out designed to investigate the effects of foliar applications iron on morphological and physiological traits of wheat cultivars in Kermanshah.

MATERIALS ANDMETHODS

This research in October 2012 at 15kilometers Kermanshah in longitude 47 degrees 04 minutes and latitude 34 degrees 19 minutes Greenwich meridian supplemented. Height of above sea level was 1410 meters and the average annual rainfall in this region 485.7mmper year. Climate and soil characteristics were shown inTables1and 2.

Table 1- Meteorological date of field station in 2012

Mons	Mean temperature (°C)	Total sunny hours	Mean humidity (%)	Total precipitation (mm)	Number days of rain (day)
April	10.8	236.5	63	59.7	10
May	14.5	261.8	64	132.2	11
June	21.7	347.4	45	0.5	1
July	26.3	396.1	36	0	0
August	26.8	332.7	34	0	0
September	23.7	313.8	39	4.7	2
October	18.3	287.1	43	1.8	2

November	10.2	243.4	57	26.6	3
December	4.3	225.7	59	30.5	4

Table 2- Physical and chemical properties of experimental field soil

Soil depth(cm)	Fe $Mg.kg^{-1}$	K P.P.M	P P.P.M	N %	OC %	CEC $Meq.mg^{-1}$	pH	EC $dS.m^{-1}$	Sp %
0-30	2.2	545	9.1	0.14	1.25	30.7	7.5	0.73	54

The experiment was a split plot (split-plot) in a randomized complete block design with three replications. Factors studied was include the major factors the timeat3levels of foliar application iron (tillering, heading and control) (chelated iron, 138) and subplot consisted of four cultivars Sardari, Rijav, Biseton and Rashid. The cultivars used are dry land wheat varieties early and autumn, cultivation in most cold areas of the country. Each plot consisted ofsixplantinglinelength10m, width1.2meters and between rows 20 cm and plant spacing 5cm (density of 100,000plants per hectare). Use fertilizer nitrogen, phosphorus and potassium according to soil test results done. Iron fertilizer was applied at tillering and heading stage. Traits including plant height, flag leaf length, peduncle length, node of drops, number of nodes, spike of length and leaf area index. To determine the plant height at physiological maturity, 10 plants and only selected from each plot of land with respect to the margin (the crown) to the top of the main spike was measured regardless of the awn and this time was measured the node number, flag leaf length and panicle length. Peduncle length was measuredly ruler from flag leaf nodetothespikedistanceof10 plants from each plot. The node of drops was measured with coils. The leaf area index using the device the LAI meter and obtained from two plants in each plot. Significance between means was tested using Duncan Multiple Range Test. A probability value of $P \leq 0.05$ indicated that the difference was statistically significant. MSTATC and 16 SPSS software using statistical calculations and plotting graphs were done using EXCEL software.

RESULTSANDDISCUSSION

Analysis of variance of the data for treats showed plant height, flag leaf length, peduncle length, node of drops, number of nodes, spike of length and leaf area index were significantly affected by foliar application and cultivar. The interaction of s foliar application × cultivar for plant height and leaf area index was also significant. Highest the wheat height was observed at foliar application in tillering with Rijav cultivar and the lowest means to control with the Rashid (Table 6), considering that iron is essential for wheat and plays a major role in the biochemical activities (such as production phyto hormones) and the vegetative growth and If the fertilizer at the beginning of the growing season wheat will be more favorable effect, because the increased in leaf area, which directly increases will be the photosynthesis in wheat, as a result, the rate of growth in all vegetative parts of the plant height that also grows. During the research on wheat reported thatthe1.5mgCukg, compared with control, plant height increases by 23

percent (Kumar, et al. 2009). The findings of Nazran et al. (2010) showed that foliar applications of chelated iron at the beginning of stem elongation found the best result in increased plant foliar on making effective plant pigments such as chlorophyll, carotene and gezantufil in plants and it will be effective in improving plant growth. The maximum length of the flag leaf of wheat obtained when sprayed to tillering and lowest during the control (Table 4), this can be due to the positive effect of iron foliar application increased growth of and thereby increase the level and length of flag leaf of wheat. Foliar application of iron in wheat flag leaf length and leaf area were increased so that foliar application treatments were significantly different from control (no foliar application) showed. Also between cultivars highest and lowest flag leaf length respectively, in cultivar Rijav and Rashid was observed (Table 5). Experiment on wheat showed that the use of copper will be increases in plant growth such as height, flag leaf length, leaf area index (Kumar, et al. 2009). Highest the wheat peduncle length was observed at foliar application in tillering and the highest means to cultivar Rijav (Table 4 and 5). During the test on wheat showed that treatment foliar application comparison of control the peduncle length higher (Hemantaranjan and Garg, 1988). The maximum spike of length the wheat obtained when sprayed at tillering and minimum values of the control (Table 4). During the experiment on wheat plants by the application of Fe were observed increases the spike of length the wheat and showed that significant difference between treatment so fir on chelate with control (no to use it) (Nazran et al. 2010). The cultivar used in the highest and lowest spike of length the wheat, respectively, was observed in Rijav and Rashid (Table 5). Ziyaiyan et al. (2001) stated that the use of foliar application Fe cause of improved the length of the flag, plant height, spike of length, leaf area index, which will be lead to an increase in performance eventually. Comparison indicates that there are significant differences between treatments so that the maximum node of drops was foliar application Fe at tillering wheat (Table 4),Also in the cultivars, the maximum node of drops was in Rijav cultivar(Table5), It can be as well as others seen that the positive effect of Fe on growth and wheat genotypes. Silsipoor (2008) reported that foliar application of micronutrients such as iron and Zn was cause increased in wheat node of drops. There are significant differences between foliar application time and cultivars on number of nodes, so foliar application at tillering wheat highest number of nodes than other treatments (Table4), The use of chelated Fe in primary stages of improve growth, biochemical reactions and enzyme activation had a positive impact on the reported results Silsipoor (2008) is consistent. Also Rijav cultivar was higher than of the trait (Table 5) and considering that can be this genetic trait, among other cultivars, Rijav cultivar is greater number of nodes Zarin Abadi and Ehsan Zadeh (2004) reported that genetic variation there are between wheat traits such as peduncle length, number and node of drops and the issue is high of potential value in wheat breeding programs. Highest the wheat LAI was observed at foliar application in tillering with Rijav cultivar and the lowest means to control with the Rashid (Table 6), this can be attributed to the use of cultivars type and foliar application Fe, because the use of Fe and vegetative development all stage has an effect that has been shown to improve the growth of wheat. During the research on the wheat was observed that foliar application of micronutrients elements cause be increases indifferent parts of the plant growth as the length of the flag leaf, LAI and peduncle length observed (Kumar, et al. 2009).During the experiment results showed that foliar application wheat had greater leaf area index compared to the control treatment (Hemantaranjan and Garg, 1988).

Table 3- Analysis of variance of traits

SOV	df	Mean square						
		Height	Flag leaf length	Peduncle length	Node of drops	Number of nodes	Spike of length	Leaf area index
Replication	2	189.08	28.61	5.18	0.189	3.02	24.74*	2.04
Spraying (S)	2	203.15*	24.57**	3.64**	0.55*	0.77**	10.11**	5.52*
Ea	4	135.12	7.18	2.97	0.24	0.54	2.08	0.49
Cultivar (C)	3	108.27**	10.87**	1.02**	0.88**	0.39**	12.73**	1.55**
S×C	12	92.44*	1.41	1.08	0.09	0.14	4.13	0.98**
Eb	18	1.21	2.35	0.12	0.004	0.12	0.41	0.04
CV (%)	-	4.2	8.9	5.5	7.6	6.7	9.1	3.2

* and ** are significant at 5 and 1 % probability levels, respectively

Table 4. Means comparison of iron application times effects on studied traits

Treatment	Flag leaf length (cm)	Peduncle length (cm)	Node of drops (mm)	Number of nodes	Spike of length (cm)
Spraying at tillering	20.15 a	17.4 a	3.50 a	4.33 a	14.7 a
Spraying at heading	18.60 b	15.5 b	3.25 b	4.17 b	13.2 b
No-Spraying (Control)	17.20 c	14.1 c	3 c	3.8 c	11.8 c

Means in each column ,followed by similar letter are not significantly different using Duncan's Multiple Range Test at P≤0.01

Table 5. Means comparison of iron application on different wheat cultivars

Treatment	Flag leaf length (cm)	Peduncle length (cm)	Node ofdrops (mm)	Number of nodes	Spike of length(cm)
Sardari	19.1 b	16.33 b	3.37 b	4.2 a	13.8 b
Rijav	20.1 a	17.2 a	3.40 a	4.3 a	14.5 a
Biseton	18.9 b	15.2 c	3.33 b	4.05 ab	13.66 b
Rashid	18.1 c	15.3 c	3.2 c	3.97 b	13.2 c

Means in each column ,followed by similar letter are not significantly different using Duncan's Multiple Range Test at P≤0.01

Table 6. Mean comparison of interaction effects of time spraying × cultivars on height and LAI.

Treatment		Height (cm)	Leaf area index
Spraying	**Cultivar**		
Tillering	Sardari	112.7 b	4.8 b
Tillering	Rijav	116.5 a	5.1 a
Tillering	Biseton	110.8 b	4.5 c
Tillering	Rashid	109.7 b	4.3 cd
Heading	Sardari	109.4 b	4.4 c
Heading	Rijav	110.1 b	4.5 c
Heading	Biseton	106.5 c	4.2 cd
Heading	Rashid	105.1 c	4.1 d
Control	Sardari	99.7 d	4 d
Control	Rijav	101.4 cd	4.2 cd
Control	Biseton	96.6 e	3.9 de
Control	Rashid	95.4 e	3.7 e

Means in each column, followed by similar letter are not significantly different using Duncan's Multiple Range Test at $P \leq 0.01$.

CONCLUSION

This experiment showed that foliar application Fe in the early stages of growth (tillering stage) had a better effect on the morphological and physiological traits and it was due to the positive impact of iron in increasing of the leaf area index and consequently increasing of photosynthesis. Among the cultivars, Rijav cultivar had the highest amount among the studied traits that it can be attributed to the genetic, environmental conditions and better utilization of Fe by this cultivar.

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