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Research Paper

The Effects of Iron Fertilization and sulfuric acid Application in Irrigation water on Root Growth and Chemical composition of Bean cultivars in a Calcareous soil

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Abstract
Legumes are main sources of plant proteins for human and animal nourishment. Beans with 20-25% protein, 55-65% carbohydrates and 1-5% lipid play a major role in nutrition of poor nations which are not able to feed ourselves with animal proteins. Thus, increasing yield and quality of beans is an effective way for reducing protein deficiency in developing countries. One of the factors that reduces yield and quality of beans in calcareous soils of Iran is iron deficiency. High pH and calcium and bicarbonate contents of calcareous soils induce leaf choruses which limits plant growth and yield and reduces the quality of beans. To determine the effects of soil and foliar applied iron fertilizers and sulfuric acid on roots of four spotted bean cultivars, a factorial experiment was conducted using a completely randomized design and three replications. The experimental factors were iron fertilizers and bean cultivars. Fertilizer factor included: (a) soil application of ferrous sulfate (25 and 50 mg/kg) and Fe-EDDHA (3 and 6 mg/kg), (b) foliar application of Fe-EDTA(1 and 2 mg/L) and ferrous sulfate (2 and 4 g/L), (3) soil application of sulfuric acid through the irrigation water (2 and 4 g/L) and (4) control (without iron fertilizer).The spotted bean cultivars used in this study were Tallash, Khomein, COS16 and a Local cultivar. The results of this experiment showed that there were significant differences between the effects of soil and foliar applied iron fertilizers and spotted bean cultivars root with respect to root dry and weights. The bean cultivars responded differently to iron fertilization and the highest and the lowest increase in root dry and weights were measured for the local and Khomain cultivars respectively. The results of the experiment showed that application of sulfuric acid by irrigation water at the rate of 4.mg/l increased the fresh and dry weight of root. The application of sulfuric acid also increased the root concentrations of N, K, P, Fe, Cu, Mn, and Zn significantly. The application of soil and foliar applied iron also increased the root concentration of Fe, K, N, P and decreased the root concentration of Cu, Zn, Mn.
Key words: Spotted bean / iron fertilizers / sulfuric acid / chemical composition

Introduction

Cereal belong to legumes (papilanacea) that contain 750 structures and 200 types. Protein is one of the most important and essential nutrition's in the animal foods. This matter is supported with two herbaceous and animal sources. Among herbaceous family, two important herbaceous family contains gramins as a type of calory supportive source and legumes family as a type of protein supportive sources that is important for the provision of protein in the human beings. Papilanaceae is considered that most important agriculture product after wheat and rice that are used globally for nutrition and they can provide the main nutrition and they can provide the main nned of protein for them. The most important provinces that produce beans are the following ones: Lorestan, Markazi, Chahar Mahal Bakhtiari, Zanjan and Hamadan.Also Zanjan province is one of the main regions of beans cultivation in the country that is ranked 3 in the country and in terms of performance, its average is three.

Iron is the first necessary item for the survival of the plant that has low consumption. Lack of Iron that appears as leaf chlorosis in fregh leafs is regarded as the most important problems in the plants in the conditions of calcareous soils (chen & Barak, 1982).

Cultivation and having products in calcareous soils and the ones with high level of pH has always had problems.

The most important part of the problems originates from this reason that in these soils because of having high pH and also high level of calcium. The food elements that their absorption is dependent on pH such as phosphor and other stabilized low-consumed elements will not be available for the plant any longer (oskigoli, 1994).

The researchers try to acidify soil and decrease pH level of the soil to decrease the stability level of the soil and so they can increase the solubility level of nutrition elements in the soils. In most of the situations, some types of acidulous materials such as sulphur and acid sulphuric have been used to achieve this goal (Tisdal et al, 1984).

To acidify soil will improve the absorption of low- consumed elements and the growth of roots will improve with the help of acidic pH. In calcareous soil the absorption of low- consumed material especially iron has encountered with some problems in the cultivation of beans and lack of iron is observations, the different types of beans have different levels of potentials in terms of performance and the possibility is that we can observe different reactions to the lack of iron.

As a result, it is necessary to conduct some studies in this field to identify the performance of these types to different types of iron fertilizers. Thus it is necessary to investigate the performance and quality of the beans to observe the effects of iron fertilizers sources with the methods of soil consumption and solution consumption that can improve the quality of beans products to the utmost level.

Instruments and methods

To conduct this survey, the intended soil should be low in terms of iron absorption, so the sample soil was provided from the Land of Zanjan University in the compound from and also it was extracted from the surface of the soil (0-20 centimeters). After basic decomposition the soil was passed from 2mm sift. The results of soil decomposition are shown in Table 1.

Table 1: The Results of soil Decomposition in this Experiment

مسcu	Fe	K	Zn	P	Mn	Soil texture	pH Soil	Soil EC (ds/m)	Moisture Percentage	Organic Carbon
			(Mg/Kg)							
						Loam				
0.04	0.68	1.02	490	1.22	2.5		7.67	1.14	1.27	4.28

In order to study the effects of soil applications and iron solution and acid sulphuric application in irrigation was effective on the growth and chemical composition of different types of beans in calcareous soil. It was conducted in the experimental situation and with three repetitions in the random scheme and in the Zanjan University. In this experiment, 2 levels of acid sulphuric containing 2 and 4 grams of liter, and calcareous sulphate 75 and 150 kg in Hectare, calcareous sekosetrin 3 and 6 mg ram in a kilo, and ferry sulfate with solution strength of 2 and 4 gram in the liter and Fe – EDTA were all considered in 1 and 2 grams in a liter.

Also there was one experimental level. This experiments had 44 treatments that was conducted in three repetitions and totally there was 132 experimental situations.

Using experimental treatments to the soil was conducted in plastic vases that for each vote the amount of soil was 3 kilogram to use treatment, we can use acid sulphuric acid in the irrigation water and it was used for irrigation. the level of plt in the irrigation water and after acid sulphuric addition with the strength of 2 and 4 grams in a liter decreased from 7/3 to 1/90 and 1/70 respectively. Fore alpha treatment and sequestering 138 were added to distilled water as a type of soil consuming usage and then it was added to soil of vases in the spray form regularly. for spray iron solution with Fe- EDTA and Foray sulfate, it was tested initially out of experimental testing place on the leafs of beans and after ensuring certainty about not having any burn, they were implemented during 2 times and before blooming in every 18 during 2 times and before blooming in every 18 days.

The first stage of spray solution was conducted in the 10th of July in the way that all the plants were soaked completely.

The second stage was implemented is days later. Spraying solution was conducted in the evenings and one hour before sunset in the evenings and one hour before sunset in the clear weather. Bean seed had four types called Khomeini, Tallish, local, and cos 16 from Khodabandeh city and its cultivation was on 6th of Jun in 2008. In each vase 3 seeds of bean with the depth of five from the surface of soil was cultivated and after cultivation, we had irrigation.

Irrigation was conducted with the help of pumped water of city and it should be mentioned that acid sulphoric treatment was conducted in the irrigation water. The amount of consumed water in each irrigation could change the humidity level of the soil to the potentials of the land.

With reference to the growth period of beans types in October and November 1387, and after the separation of roots and washing them with distilled water they were dried and weighted at 60 centigrade temperature.

Then the dried samples were ground and they were passed from 0/5 mm sifts.

Prepared for laboratory analysis.

The required amount of elements contained Azote and it was based on a typical method of casual distill, and phosphor was measured with Spectrophotometer machine and potassium also was measured with film photometer machine. The low-consumed elements contained Zn, Fe, Mn, and Cu were all measured by atomic absorption machine.

After cleat collection and gathering the required information, we made use of SASS to analyze variances. Excel software was used to draw graphs.

Discussions and conclusion

The results of the experiment showed that there is a significant difference between the different types of beans in dry and fresh weight. (Table 2). The highest and the lowest level of fresh and dry weight were observed respectively in local and khomein types.

Table 2. The results of variance decomposition root in dry and weight spotted bean cultivars

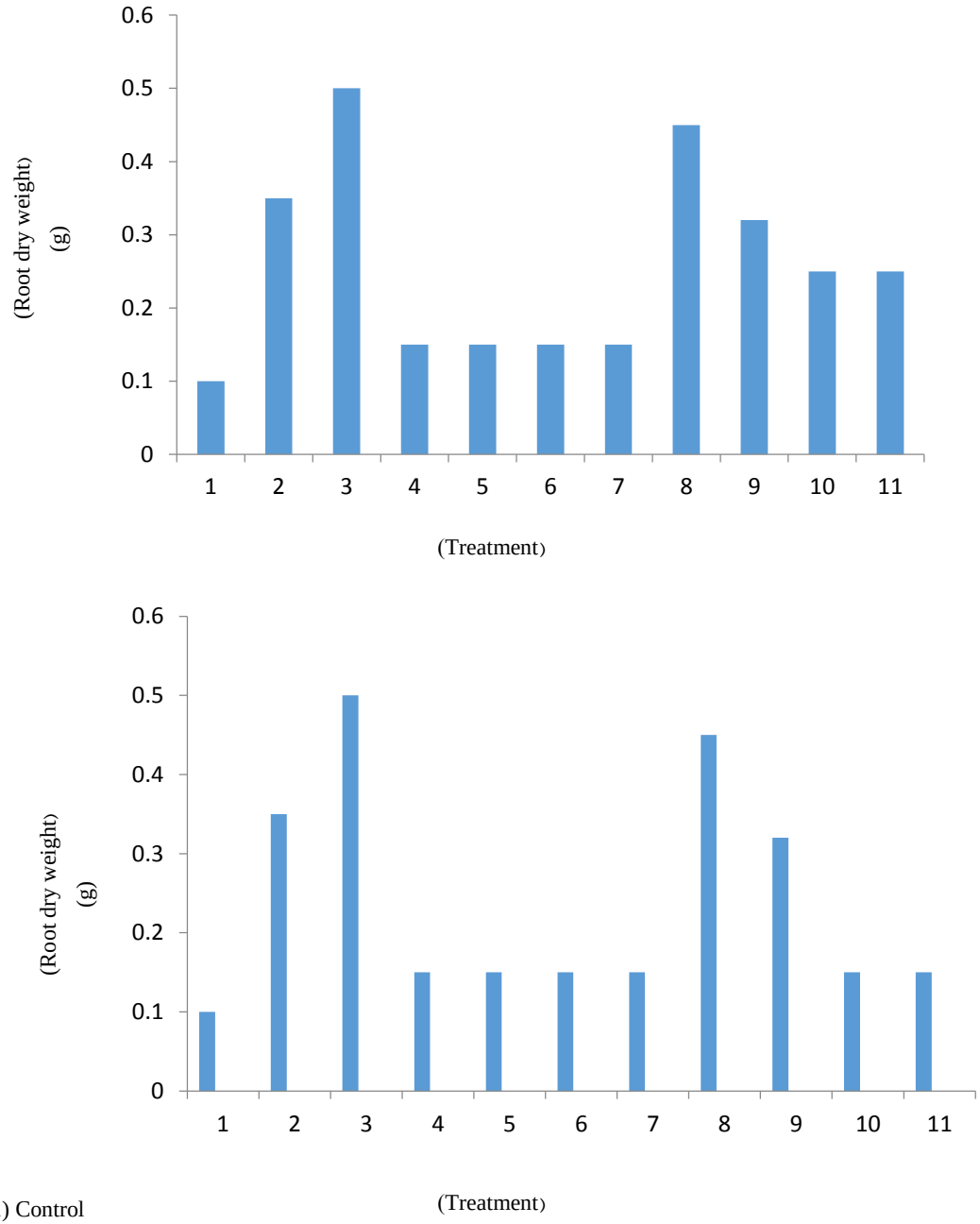
Cultivars	Root dry weight(g)	Root fresh weight(g)
(Tallash)	0.212b	2.031b
(Khomain)	0.192c	2.006c
(COS16)	0.216b	2.028b
(Local)	0.238a	2.099a

Many researchers conducted many studies about the relationship between growth and physiological parameters of bean roots and they concluded that Genotype roots of beans had some significant differences in terms of absorption power, that this difference in the power of absorption will lead to increase of Biomass in some numbers. (Byrne et al, 2001, Jaegger, et al, 2000).

As it can be seen in Table II, the highest weight of fresh and dry roots was related to local number that this weight increase can show the genetic talent of this rate in the absorption. Also the increase of secondary roots can be another reason to increase fresh and dry weight (Hamze et al, 2004). Based on the ideas. Of some researchers, this kind of weight increase in the beans is influenced by genetic factors of the plants (Morghan, 2002).

Also pentane and varennes (2005) showed that growth parameters and the style of nutrition in different types would lead to stability differences against lack of iron that this issue can be effective on fresh and dry weight. The application of acid sulphuric in the irrigation water was in the rate of 4 gram in the liter that its proportion to iron fertilizers sources increased in fresh and dry weights of roots. Besides, there was a significant difference. Between iron fertilizers sources. (Diagram1).

Diagram 1: The effects of Iron fertilizers and application sulfuric acid in Irrigation water on root dry and weights



1) Control
2) Soil applied sulfuric acid,2 gr/liter
3) Soil applied sulfuric acid, 4gr/liter
4) Soil applied ferrous solphate,75kg/ha
5) Soil applied ferrous solphate, 150kg/ha
6) Soil applied Fe-EDDHA, 3mg/kg
7) Soil applied Fe-EDDHA,6mg/kg
8) Foliar applied ferrous sulphate, 2gr/liter
9) Foliar applied ferrous sulphate, 4gr/liter
10) Foliar applied Fe-EDTA, 1gr/liter
11) Foliar applied Fe-EDTA, 2gr/liter

Different types of products grow at different levels of soil pH. Some products have good growth in higher pH. Sirohi and khan (2008) have revealed that acidifying soil will lead to the dry and fresh wet incense of clover roots, even if beans do not have good growth in high poll level and in the presence of lime and carbonate, and also Osmond et al, (2002). Have reported that the growth of bean roots will increase with the increase of pH. Kenoo *et. al* (2000) heve revealed that this type of fresh and dry weight increase in the root can be because of photosynthesis increase. Shaukat and khan (2008) also have reported that acid rain with pH at 3 and 4 levels can increase the fresh and dry weight in the tomato significantly.

These results rein line with the studies of Guardia and Alkantra (2002) that have shown that the decrease of Bicarbonate content and soil pH can decrease the fresh and dry weights in onion and peach roots. As it can be seen in diagram1, there is a significant difference between different sources of iron in terms of dry and fresh weights and all iron applied sources in either

solution spray or calcareous form has higher rate in comparison with control group. The highest rate of dry and fresh rate was related to Iron sulfate (2 gram in a liter). Peter and Roca (2003) investigated the growth of bean in the lack of iron and compared the roots in terms of morphology and physiology.
The results of their research showed that the plants with the lack of iron were shorter, thicker, and in brown colors while other roots had white colors and were taller.
Lack of iron can lead to weight decrease and root length that has negative effects on the weight of root. Romizadeh and Karimian (1996) have reported that the application of iron sources on fresh and dry weights has had significant effects and the same results have been reported by Moosavi and Ronaghi (2010) that soil application and iron solution spray has had significant effect on dry and fresh weights. Also pestanna and varennes (2005) showed that the application of iron fertilizer sources in different levels has had different effects on the amount of fresh and dry weights in control groups. The same and similar results were reported by click et, al, (2008) that showed the application of iron solution spray in the increase of dry and fresh weight of corn root.
Based on the diagram, it can be shown that amongst the applied iron fertilizer sources, the highest rate of fresh and dry weights was related to iron sulfate in the form of solution spray. In line with our studies, Ghasemi et al. (2005) showed that the application of iron sulfate in the form of spray solution of peas genotypes could increase dry and fresh weights of roots. Also peter and Roca (2003) have used iron fertilizer sources in the beans for the investigation of iron lack in the beans the results of the study showed that the application of iron sulfate in solution spray form had significant effect on the growth of roots and sprayed. beans with iron sulphate hadootirregular morphological structures in the roots while making use of Fe- EDDHA in the form of solution spray had little effect on the growth of root in comparison with iron sulfate.
Application of acid sulphoric in irrigation water led to the increase of N, P, K, Mn, Zn, Fe, Cu in the roots compared to control group (Table 3).
Table 3: The results of variance analysis and the effects of iron fertilizers and application of acid sulfuric in irrigation water on root chemical composition

(Control) شاهد	4.9c	0.52c	0.08f	82.50c	53.75b	51.80b	20b
Soil applied sulfuric acid (2g/liter)	6.16a	0.56a	1.12cd	536.53a	57.08a	58.88a	24.72a
Soil applied sulfuric acid (4g/liter)	6.20a	0.55b	1.02de	537.22a	57.91a	59.44a	25.27a
Soil applied ferrous sulfate (27kg/ha)	5.40b	0.28g	0.93e	522.92a	44.44ef	46.38d	12.91ef
Soil applied ferrous sulfate (150kg/ha)	5.42b	0.28g	1.01de	501.53a	45.55e	46.66d	13.75de
Soil applied Fe-EDDHA(3mg/kg)	5.51b	0.29f	1.18c	380.14b	48.19c	49.16c	14.44cd
Soil applied Fe-EDDHA(6mg/kg)	5.57b	0.29f	1.24c	380.83b	48.75c	50.83b	15.41c
Foliar applied ferrous sulfate (2g/liter)	5.72b	0.29e	1.43b	530a	45.69e	45.13de	11.25gh
Foliar applied ferrous sulfate (4g/liter)	5.50b	0.29e	1.51b	631.11a	46.94d	46.11d	12.22fg
Foliar applied Fe-EDDHA (1g/liter)	5.55b	0.30d	1.67a	526.81a	44.02f	44.16e	10.27h
Foliar applied Fe-EDDHA (2g/liter)	5.58b	0.30d	1.76a	528.75a	44.86ef	44.58e	10.97h

Acidifying soil can improve the absorption level of high frequency used and low- frequency used elements in the soil and the roots in acidic environment can have better growth.
Acidifying soil will lead to the decrease of Iron type. III by Reductase enzyme that is not a good stimulator. In order to respond and compensate for the iron deficiency, Zaharieve el al. (2004), Schmidth (2006), Data and Fennadez (2000) also have reported that grown sun flowers had higher level of Zn and Cu compared to the control group in the roots. It was in a manner that with chemical decomposition, we had higher and significant level of increase in the iron, Zn, and Cu in the root compared to control group. Based on Table III, acid sulfuric application in the irrigation water led to the increase of potassium in the root. The reason for this increase is related to the neutralization of Bicarbonate Ion by acid sulfuric (Gardia & Alcantara, 2002).
The application of iron fertilizer sources in the form of solution spray and soil led to the increase of Azot, potassium and Iron and the decrease of fosphore, Mangenez, and copper on the root (Table 3). The decrease in the level of fosphore content root was related to the creation of iron fosphate (kalbasi et al, 1988). Miler and Clike (2008) have reported that with the increase of iron in jenotypes of tomato and the increase of potassium compared to control group, the rate of copper, Mangenez, and Zinc will decrease in the root and in some types of jenotypes, they fo not have significant differences with control group.
Also celike et al (2006) have shown that with the application of Fe- EDTA in the form of potassium solution spray can be increased in the experimental group of corn compared to control group.
As it can be seen in Table III, the sources of iron fertilizer can decrease the strength of copper, Mangenez, and zinc.

The factors that have effect on the soluble features of Mangenez and Oxidation and revival of the soil can determine the potential feature of Mangenez absorption. In a greenhouse study conducted by Mosavi and Ronghi (2010), the interactive effects of iron and mangenez were investigated. The results of the study showed that the application of soil fertilizer sources could decrease the strength of Mangenez in the root and the absorption of Mangenez decreased in the root and in comparsion with control group. Also Mortvedet (2003) in a report found that the reason of strength decrease of Mangeze was related to its strength level which was low.

Roomizadeh and karimian (1996) have reported that the application of different types of iron sources in the absorption of copper or its transfer was effective which was in line with the results of Liebenberg (2004).

Goos and Janson (2003) have revealed that the presence of iron will prevent from zine element absorption in the roots. Also they have referred to the interactive negative effect of iron and zinc that are similar to the results of ltavlin et al (2005).

Based on the results of these researchers, the application of iron fertilizer source led to the obstacles of absorption by the roots. The application of iron fertilizer sources could lead to iron absorption in the root. In the plants with the lack of iron it was located in surrounding regions while in the plants with enough irons, the mechanism of iron structure was observable in main roots (Charalambos et al, 2008).

The results of the study by some scientists like Rombola and Brugeman (2002) showed that the absorption of iron was in the form of Fe^{+2}. In the condition of iron fertilizer sources in the soil form, iron Fe^{+3} should change to Fe^{+2} and then it should be absorbed. Differently, iron fertilizer sources can be absorbed in solution spray from and there is no need to change and to have kalat.

Moosavi and Ronaghi (2010) have shown that leaf spray of Iron sulfate can increase the strength of iron solution in the roots that is similar to the findings of Liebenberg (2004).

Edward (2013) dealt with the investigation of leaf application and iron fertilizer soil sources and iron on spinach plant.

The results of the study showed that content of iron in the roots in the treatments that had been sprayed by iron sulfate were higher than control groups, while in other iron treatments, there was not significant differences between them.

Also it was shown that the application of leaf could transfer iron in the plants easier. In the trend of solution spray, the absorption manner was in the form of leaf absorption while in the soil consumption of iron, initially Fe^{+3} was changed to Fe+2 by Ferik rodaktaz enzymeand then it was absorbed.

Conclusion:

Based on the results of this study, local figure had superiority to commercial figures in terms of Fresh and dry weight. The usage of 4 gram acid sulfuric in one liter of irrigation water could increase the rate of fresh and dry weights for the roots in beans that was more effective than other types of treatments. The application of acid sulphoric in irrigation water was more important that other treatments in terms of providing iron deficiency and its absorption.

Solution spray with iron sulfate was more effective than other solution sprays of iron fertilizers to solve chlorosis due to lime strucyre.

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