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# Effects of Different Densities of Iron Fertilizer on Mung Bean Yield

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## ABSTRACT

This research has been conducted to evaluate the effects of application of different densities of iron chelate nanofertilizer (Biozer) on germination, growth and quality of mung bean plant (Vigna radiata). The results of yield have shown that the use of nano-iron fertilizer at density of 10 and 50 ppm has been beneficial for the plant. Growth parameters and sugar test in mung bean plant in iron nano-fertilizer treatments are higher than conventional iron fertilizer treatments and the use of nano-fertilizer in addition to the said benefits are economical and its consumption is also considered economical.

**Keywords:** *Nano iron fertilizer, germination, iron chelate fertilizer, growth factors, mung bean, vigna radiate*

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## 1. Introduction

Micronutrients, in addition to their role in the quality and quantity of agricultural products, have a considerable effects on human and animal health because it is plant food. Most of the soils of Iran have high pH and calcareous and in this type of soils there are fewer low-consumption elements and the reason is low absorption of these elements and finally the need of plants for these elements is on the peak (Mousavi and his Co-workers., 2011 Malakouti and Tehrani, 1999; Alloway , 2008). Irregular use of phosphate fertilizers in poor soils with low-nutrient rich elements such as iron, zinc and manganese is also the cause of the imposed deficiency of these elements (Mousavi, 2011; Mousavi and his co-workers., 2007). Therefore, the density of low-consumption elements in agricultural crops and dry crops are reduced. ( Abduo and his co-workers, 2011; Salimpour and his co-workers, 2010, Khorgamy and Farnia 2009, Ibrahim and Ali 2009). Iron is the fourth most abundant element on earth, but due to its low solubility in alkaline soils, it is not available for the needs of plants and microorganisms. Iron is an important element in agricultural products, as it is essential for many important enzymes, including cytochrome, chlorophyll synthesis, maintenance of chloroplast structure, and enzyme activity ( Zahariev, 2003, Welch 2002). Due to the effect of pH on the solubility of iron, at pH = 7, the amount of water-soluble iron is about 10-18 mol per liter, while the density required for normal plant growth is about 8-10 mol per liter. In general, the solubility of trivalent iron decreases soil pH increases (Briat 2005, Schulte 2004). Iron deficiency has a severe effect on chloroplast protein because chloroplast protein decreases significantly due to iron deficiency. In severe iron deficiency, cell division stops and leaf growth decreases (Mohammad and Aly, 2004; Manthey and Crowley 1997). The area from which the iron is not transported to the plant, symptoms of deficiency first appear on young leaves. Iron deficiency in plants is exclusive to the specific plants characterized by yellow leaves with green roots (Interveinal chlorosis). In corn and sorghum, it apparently gives way to the plant. If the condition is very severe, all the plants may be affected and turned very bright yellow or even white. In addition to it, at high density of iron solution, plants may show apparent signs of iron poisoning, including root weakness, reduced root branching, and mottled leaves.

Plant species in wetlands have mechanisms for oxidizing iron in the root zone to limit excessive iron absorption (Batty and Younger 2003 Schmidt (1994). Plants in soil aerobic conditions have two strategies to justify the availability of Iron compounds: first: siderophore secretion (a non-protein amino acid, a strategy seen in the grameen family); second, separation of iron from soil chelates or restoration of trivalent iron to divalent iron by proton leakage can occur, this strategy that can be found in monocotyledonous and dicotyledonous plants (Romheld and Marschner1996; Romheld, 1997).

The following methods can be used to treat iron deficiency:

1. Prevention of iron deficiency after indication; In order to do this, soil ventilation is appropriate.
2. Planting different species that are resistant to iron deficiency
3. Proper irrigation management; high water consumption causes poor nutrition and exacerbates iron deficiency.
4. (Consumption of iron fertilizer) Fageria and his Co-workers, 2002 Chouliaras his co-workers., 04 120 Li and his co-workers, 2005).

Nanotechnology as a powerful technology has the ability to make changes in life sciences, medicine and treatment, agriculture and food industries, marine industries, oil and petrochemicals, architecture and construction, water refining and consumption, etc. These technologies include the production of chemical pesticides and fertilizers using nanoparticles and nanocapsules. This generation of toxins and fertilizers have the ability to release or delay, absorb and affect more and adapt to the environment. (Bowmister and his co-workers., 2009; Boards and his co-workers 2009).

Thus, the use of nanofertilizers, for accurate control of the release of food elements can be an effective step for achieving sustainable agriculture and suitable environment (Cui and his co-workers, 2006) With the advent of nanofertilizers as a substitute for conventional fertilizers, fertilizer nutrients are gradually released into the soil in a controlled manner (Chinnamuhu & Boopahthi, 2009).

Green mung bean with the scientific name of Vigana radiata (L.) Wilczek) in the order of fabales The genus fbaceae (= Leguminosae) is found with 640 genus and 17200 species. Wild forms of green mung bean are commonly found in southern hot areas, Southeast and East Asia, and Northern Australia. Mung bean is a one-year-old plant which can have a length of 25-90 cm, with angled stems having several branches and leaves. It is hairy and in some breeds has an ivy stem. The mung bean is known as hot climate plant which has the ability to endure dryness to a great extent. It is a summer plant andrequires relatively high heat. In Iran, this plant is grown after the wheat and barely is harvested.

Flowering during the growth and development of mung bean, like other crops, is one of the important phonological events. Mung beans are one of the valuable grains which are rich in phosphorus. Mung bean seeds are rich in protein and contain about 25% protein, which is consumed either as a whole or ground. Cultivation of green mung bean is known as “Green Fertilizer” and is considered important for enriching the soil because it is a legume plant and has the ability to stabilize atmospheric nitrogen, it is also considered useful in preventing soil erosion.

The goal of the present research was to investigate the effect of nano-iron chelate and iron chelate fertilizer and the effect of these two fertilizers in different concentrations of germination and growth and yield of mung bean plant.

## 2. Method and Materials

Healthy mung bean seeds were obtained from Safiabad Agricultural Research Center in Dezful. First, healthy seeds of green mung bean plant (vigna radiata) with 75% germination power were chosen and disinfected in 10% medium hypochlorite solution, and then they were washed several times with distilled water. Nano Biozer iron chelate fertilizer was provided by Nano Technology Central Research Company and sequestern iron chelate fertilizer 138 was taken from the market.

In each petri dish, 20 mung bean seeds were added on filter paper and on the first day, 8 ml of each treatment including distilled water for the control group, different densities of nano-iron chelate Biozer fertilizer in 5 levels (10, 50, 250, 100, 500 ppm) and iron chelate squasteron fertilizer 138 in 5 levels ((10, 50, 250, 100, 500 ppm) were added to them and petri dishes were placed in transparent plastic bags and then transferred to germination chambers with optical conditions of 16 hours of light and 8 hours of darkness at a maximum temperature of 29 ° C and a minimum of 22 ° C and a light intensity of 150 µmol.m-2S-1 and with the duration of 10 days, the number of seeds that germinated each day was counted and the germination scale of indication of one millimeter from root has been taken into consideration. After 10 days, the petri dishes were removed from the plastic bags and the percentage and speed of germination, Vigour, index I Vigor index II, the stem length and root length, wet and dry weight of obtained seeds were measured. (Jan Mohammadi and his co-workers 2005).

Germinated seeds were transferred to 20 cm diameter plastic flowerpots containing sand and soil in a ratio of 2: 1. The buds were placed in the soil at a depth of 2 cm. Growth of plants in cultivation chambers with optical conditions of 16 hours of light and 8 hours of darkness at a maximum temperature of 29 ° C and a minimum of 22 ° C and a light intensity of 150 µ mol . m-2S-1 and after

30 days treatment harvesting process was performed. During this process, different parts of the tested and treated plant were separated from each other. Length of root, length of stem and amount of chlorophyll a and b, amount of flavonoid and sugar solution were measured. For dry samples, the samples were dried in a drier of 70 degree for 72 hours. Samplings were performed in three replications.

Finally, the growth indices of the plant were measured and the statistical analysis of the data was performed using SPSS 216 series software along with Anova one way Tukey test at the level of statistical probability $P<0.05$ was conducted. Graphs of all experiments were drawn using Excel 2010 Program.

## 3. Discussion

Figure 1 shows the changes in germination percentage and Figure 2 shows the changes in germination rate in different treatments of nano-iron fertilizer and conventional iron fertilizer. The results show that despite of the relative increase in germination percentage in nano-fertilizer treatments, there was no significant difference between all nano-fertilizer and control treatments. Raskar and Laware (2012) reported that the highest density of nanoparticles had the lowest germination percentage and the lowest nanoparticles density had the highest germination percentage. According to the results of this experiment, the germination rate increased in all treatments of iron nanofertilizer, but it was not useful. This increase was more in 10 ppm treatment than other treatments. Faizi and his co-workers (2013) reported that exposure to 100 ppm of iron oxide nanoparticles had the highest germination rate compared to other treatments.

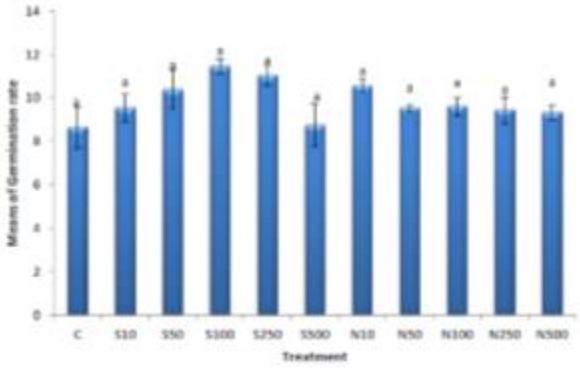


Figure 1

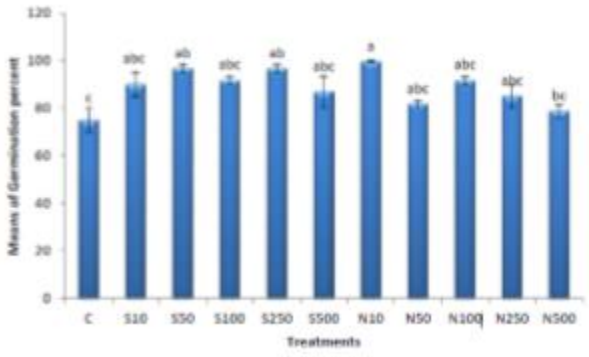


Figure 2

Figure 1 ) Changes in germination percentage in different treatments
Figure 2 ) Changes in germination rate in different treatments

Figure 3 indicates the changes in germination stem length and Figure 4 shows the changes in germination root length in different treatments of nano-iron fertilizer and ordinary iron fertilize stem length in germination test increased between 10 and 50 ppm treatments among iron nano fertilizer treatments compared to control showed a decrease and in 250 and it showed a significant increase in 50 ppm treatments . All the differences in the treatments of ordinary iron fertilizer were not significant. Root length in germination test between iron nano fertilizer treatments at 50 ppm treatment compared to the control was significantly increased, and at500 ppm treatment significant decrease was shown. Raskar and Laware (2014) stated that lower concentrations of nanoparticles had the longest root and stem length, but higher concentrations had the shortest root and stem length. Pramod and his co-workers (2011) has reported that with the increase of concentration of ZnO Nanoparticles and similarly growth of the length and stem also increases. In order to grow mung bean, the best response for root and stem growth was observed at a concentration of 20 ppm higher than the control.

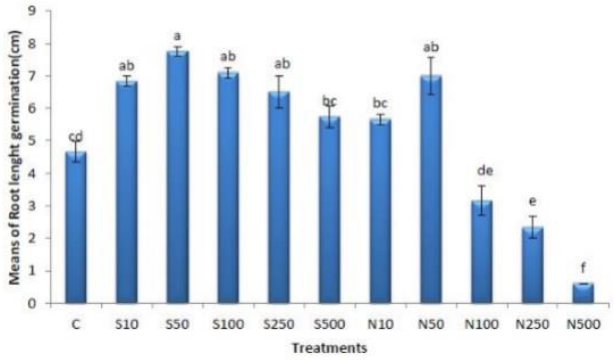


Figure 3

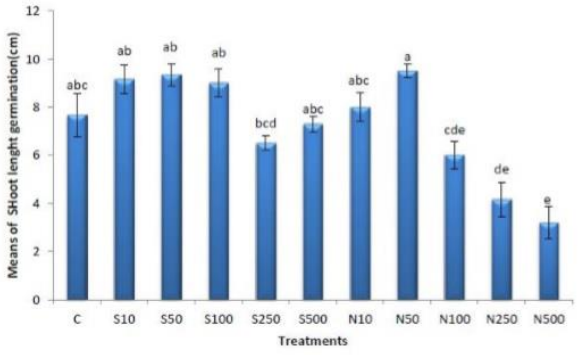


Figure 4

Figure 3 ) Changes in stem length of germination in different treatments
Figure 4) Changes in root length of germination in different treatments

Figure 5 shows total dried weight and figure 6 shows total wet weight in different treatments of iron nonofertilizer. The result showed that total dry weight of the plant in different treatments of iron nonofertilizer only in 10 and 50 ppm in comparison with control and all treatments of ordinary iron fertilizers compared to control group showed a considerable increase. Total wet weight of plant in different treatments of iron nonofertilizer in 10, 50, 100 ppm and all treatments of ordinary iron fertilizers compared to control group had a significant increase. Lawer and Rascar (2014) have stated that the lowest concentrations of nanoparticles had most weight in dried and wet forms. However, higher concentrations had least weight in wet and dry forms. It is possible that due to increasing concentration iron chelate fertilizer causes the collection of chelate iron fertilizer and eventually blocks the ways of roots that prevent seeds from absorbing water (Faizi and his co-workers, 2013). In smith's work, different higher concentrations of iron oxide for growing plants of wheat have been displayed whose outcomes have similarities with yield findings of this experiment.

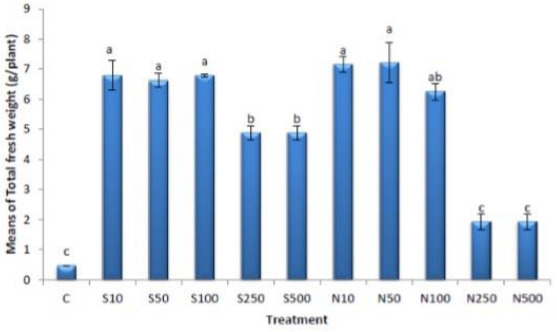


Figure 5

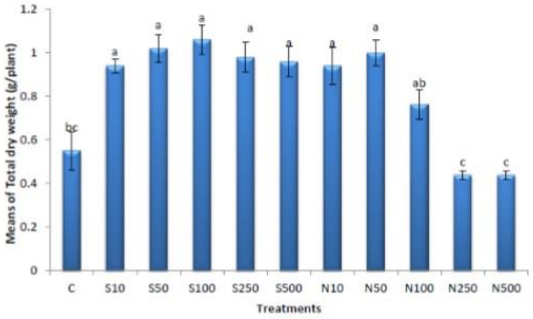


Figure 6

Figure 5) the changes in total dry weight in different treatments
Figure 6) the changes in total wet weight in different

Figure 7 shows Vigour index I in different treatments and figure 8 shows Vigour index II in different treatments. Index structure 1 in different treatments of iron nonofertilizer of 500 ppm had a significant decrease and in the treatments of ordinary iron fertilizer of 10, 50, 100 ppm had a more significant increase. Index structure 2 in different treatments of iron nonfertilizer of 10 ppm compared to control group had a significant increase and in ordinary iron fertilizer in all type of concentrations a significant increase was shown.

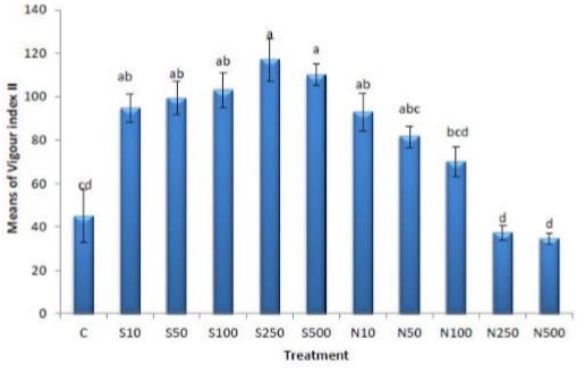


Figure 7

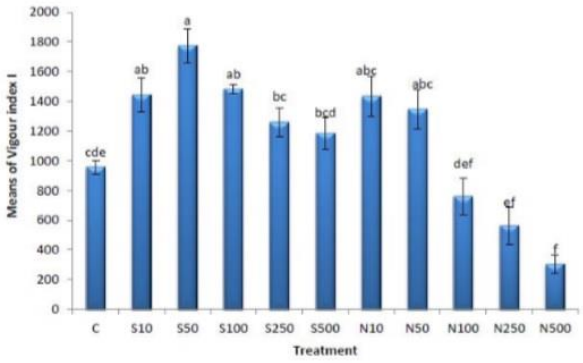


Figure 8

Figure 7 ) Vigour index I in different treatments

Figure 8) Vigour index II in different treatments.

Figure 9 shows the changes in stem length and Figure 10 shows the changes in root length .

Stem length in treatment of nano-iron fertilizer at 50 pm and 250 ppm had a significant increase and decrease, respectively. In ordinary iron fertilizer treatments, ppm 50 showed a significant increase. Root length in nanofertilizer treatments did not show a significant difference compared to the control and in ordinary iron fertilizer treatment, there was a significant increase of 250 ppm. Elvier and Raskar (2014) stated that lower concentrations of nanoparticles had the longest root and stem, but higher concentrations had the shortest root and stem.

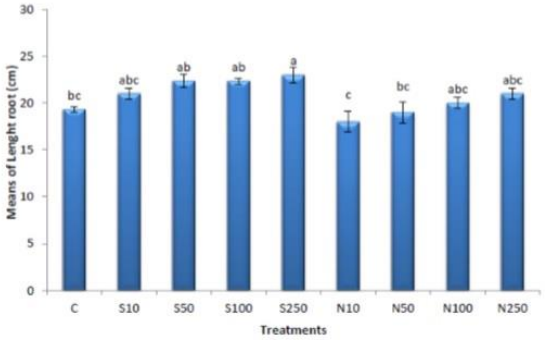


Figure 9

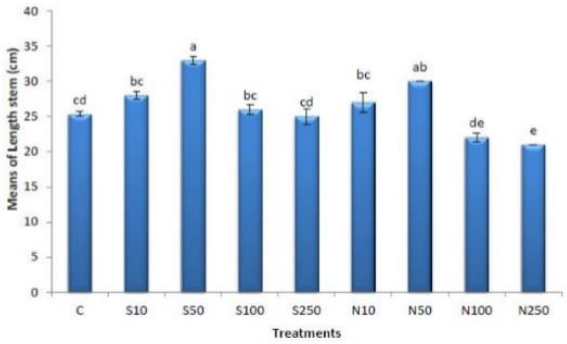


Figure 10

Figure 9) the changes in stem length

Figure 10) the changes in root length

Figure 11 shows the changes of chlorophyll a and Figure 12 shows the changes of chlorophyll b in different treatments of nano-iron fertilizer and conventional iron fertilizer .The amount of chlorophyll a in the treatment of iron nanofertilizer ppm 50 showed a significant increase and there was no significant change in normal iron fertilizer compared to the control. Chlorophyll b level was significantly reduced in iron nanofertilizer treatment at 10 ppm, but no significant difference was observed in conventional iron fertilizer treatments.

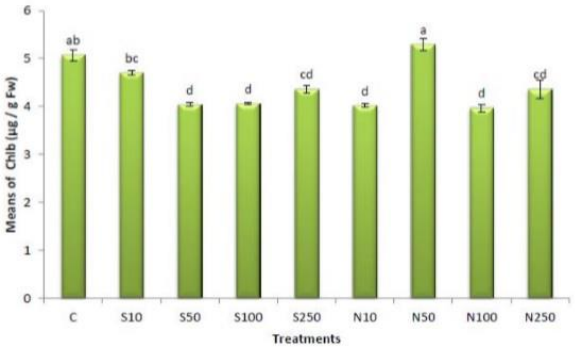


Figure 11

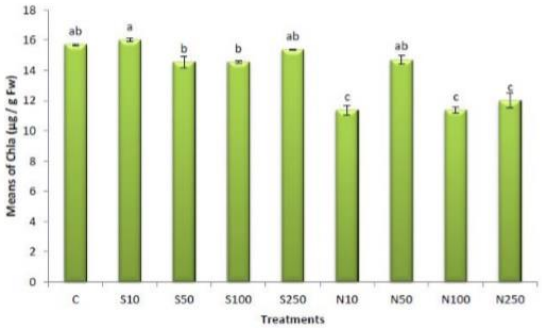


Figure 12

Figure 11) the changes of chlorophyll a in different treatments

Figure 12) the changes of chlorophyll b in different treatments

Figure 13 shows the changes of flavonoids and Figure 14 shows changes of sugar solution in different treatments. The amount of flavonoids in iron nanofertilizer treatments at 250 ppm showed a significant decrease compared to the control .And no significant changes were shown in ordinary iron fertilizer treatment compared with the control. In general, different types of flavonoids are produced in plants depending on the nature of the stress applied to them. The synthesis of isoflavones and some other flavonoids is induced when plants are infected or injured or exposed to low temperatures and nutrient deficiency conditions, gets inducted. Induction of biosynthesis of phenolic compounds has been observed in wheat in response to nickel toxicity and in maize in response to aluminum toxicity .The amount of sugar solution in the iron nanofertilizer treatment showed a significant increase of 10 pm and other treatments had a significant decrease compared to the control. In the treatment of conventional iron fertilizer, pp 250 had a significant reduction compared to the control. Iron deficiency inhibits leaf growth, cell number, cell size and division, as well as chlorophyll, protein, starch and sugar content. Decreased amount of carbohydrates solution in severe stress treatments may occur due to the use of carbohydates in the synthesis of metabolites because proline is located in the air branch. (Irrigoyen and his co-workers, 1992).

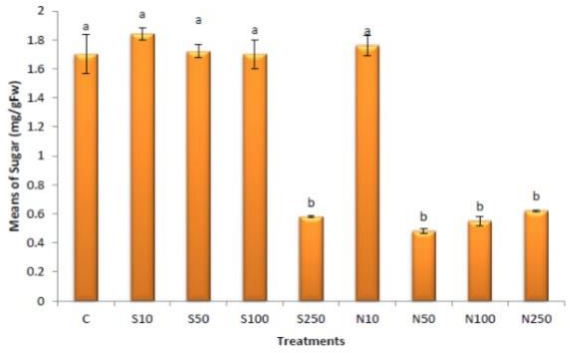


Figure 13

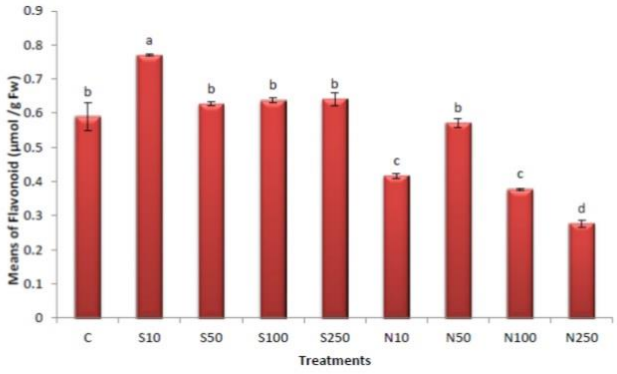


Figure 14

Figure 13) the changes of flavonoids solution in different treatments

Figure 14 shows changes of sugar solution in different treatments

## 4. Conclusion

Growth parameters and most biochemical experiments of nano and conventional fertilizers were better than control, so the use of these fertilizers in specific concentrations of 10 and 50 ppm is beneficial for the plant. On the other hand, the amount of sugar in iron nanofertilizer had increased, which was better than conventional fertilizer, so the use of iron nano fertilizer is preferred and that economically, the cost of iron nanofertilizer is much lower than ordinary iron fertilizer. It is also less used. In addition, it is used as commercial fertilizer on farms, so by using nano -iron fertilizer instead of regular fertilizer, fertilizer nutrients in the soil are gradually released which reduces the toxicity caused by the overuse of fertilizers. Sequesterine iron EDDHA 831 fertilizer has proven to have a

lot of advantages and is the world's best fertilizer. The use of nano-iron fertilizer is recommended in case of spraying solution and EDDHA is also useful for spraying solution and soil.

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