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Response of wheat varieties, *Triticum aestivum* L., to spraying by iron nano-fertilizer

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ABSTRACT

A field experiment was carried out in winter 2019 in the north of Basra Governorate to find response of four varieties of wheat (Baraka, Tammuz-2, Latifia and Ibaa-95) to different concentrations of iron nano-fertilizer (0, 1, 2 and 3 g L^{-1}). The experiment was designed by applying factorial experiments using a randomized complete block design (RCBD) with three replications. This study revealed the superiority of variety Baraka in grain yield and biological yield, which reached 4.892 and 12.943 ton ha^{-1}, respectively, as a result of its superiority in growth characteristics and yield components. Iron nano-fertilizer exhibited a significant impact on all studied traits, so that, 3 g L^{-1} displayed the highest average of grain yield (4.966 ton ha^{-1}). Regarding to the interactions, the variety Baraka by spraying iron nan-fertilizer at 3 g L^{-1} exhibited the highest average of grain yield (5.800 ton ha^{-1}) due to its superiority in yield components.

Keywords: *Triticum aestivum* L., Varieties, Wheat, Iron nan-fertilizer.
Article type: Research Article.

INTRODUCTION

Wheat crop, *Triticum aestivum* L., ranks the first in the world in cultivated area and production. Its importance is due to being the main food for over 40 countries in the world, equivalent to 35% of the world's population, since it constitutes a nutritional value represented by the good balance in grain between proteins and carbohydrates and its containment amounts of fats, vitamins and some minerals (Bushuk 1998). Although Iraq is one of the first countries with the emergence of wheat due to its cultivation factors, its productivity is below the required level of its high production (1.80 ton ha^{-1}; Agricultural Statistics Directorate 2018) compared to global production, whose productivity reached 2.762 ton ha^{-1} (FAO 2018). To promote this crop's cultivation, achieving a qualitative and quantitative improvement in its productivity requires firstly interest in varieties used in agriculture due to the changes in the environment. Therefore, attention must be paid to developing varieties with high productivity, good quality and suitable for the prevailing conditions. Therefore, many centres and research institutions worked in this field. Many varieties have been adopted ideal for the environmental conditions and the changes in them, with good production, excellent quality, and good stability in the region. Given these varieties which have been produced, researchers should conduct comparative experiments with local varieties. After their superiority over local varieties, experiments were conducted to adapt and improve the crop's quality and productivity. These varieties with a good economic return for farmers should be paid attention to the proper crop service operations in order to increase production and maintain the quality compatible with these varieties' performance. Among these processes, the technology of nano-fertilizers by employing nano-materials or packages of fertilizer which can supply one or more nutrients towards improving growth and production with better performance than conventional fertilizers (Rakhimova *et al.* 2021; Kamali Omidi *et al.* 2022). The latter leads to slow release mechanism of nutrients along with slow crop growth (Liu & Lal 2015). The nano-fertilizers are more soluble, effective, faster penetration and representation in plant tissues than regular fertilizers which are often not ready for plant after addition, especially those that are added to the soil. It is necessary to reduce nutrient loss in

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fertilization, reduce pollution with these fertilizers, and increase productivity by adopting new applications with the help of technology. Nano-materials and nano-fertilizers or envelopes of nano-nutrients possess useful properties of crops, since they release nutrients on demand and control the release of chemical fertilizers that regulate plant growth (Nair *et al.* 2010). Iron is an essential micronutrient in plant growth and development, since it enters into insoluble structures inside the plant. Also, it helps synthesizing chlorophyll, although it is not included in the chlorophyll composition. It was also found that iron participates in biological compounds such as Cytochrome, which are involved in photosynthesis, respiration and active absorption (AL-Naimi 2000). Studies have indicated a difference between varieties in growth and yield and also its components. Jabail *et al.* (2019) found significant differences between varieties in the yield components, including the spike and grain numbers, since the variety Abu-Ghraib exhibited the highest yield of 3948.68 kg ha^{-1}. In another study by AL-Abdullah, (2015), significant differences were found between the varieties, since variety Ibaa-99 displayed the highest grain yield (3.59 ton ha^{-1}), due to its superiority in a number of spikes per m^2 and its weight of 1000 grains than the rest of studied varieties. AL-Hussanawy (2016) also reported the significant elevations in grain yield of Rasheed variety with the highest average of 8.43 ton ha^{-1} due to its superiority in yield components. Abdul-Razaq (2016) noted when cultivating variety Ibaa-99, the highest grain yield was recorded at 7,299 ton ha^{-1} compared to variety Latifia, which exhibited the lowest (5.330 ton ha^{-1}). AL-Asseel *et al.* (2018) reported that Ibaa-99 significantly outperformed in grain yield as a result of its superiority in yield components. AL-Abody (2019) also reported significant differences between the grain yield varieties due to the yield component differences. As for the response of varieties to nano-fertilizers, Armin & Mashhadi (2014) in Iran studied the effects of spraying chelated iron with different concentrations, reporting the increased grain yield compared to the treatments with no additional nano-fertilizers. Bakhtiari *et al.* (2015) studied the effect of spraying concentrations of iron nano-oxide on wheat plants, concluding that a higher concentration of nano-particles exhibited the highest grain yield of 776.53 kg ha^{-1}, with a significant difference from the rest of the sprayed concentrations and also compared to the control treatment, with the lowest (3316.5 kg ha^{-1}). This elevation results from an upraise in the yield components which were affected by growth characteristics. Jan Mohammadi et al. (2016) found a significant increase in grain yield due to addition of nano-fertilizers as micro-elements, including iron, and upraising in the yield and percentage of protein in grains. AL-Juthery *et al.* (2018a) also reported that there was a significant increase in the grain and protein yields as a result of adding nano-fertilizers. This study aimed to determine the most suitable variety for the region and determine the optimal concentration of iron nano-fertilizer suitable for the varieties under this study to increase production, improve the quality, and study the response of the varieties to the iron nano-fertilizer concentrations.

MATERIALS AND METHODS

The experiment was carried out in winter 2019 in the field at 80 km north of Basra City, Iraq in soil with a silty loam texture. Its physical and chemical characteristics are shown in Table 1. Two important factors in growth and productivity of wheat, were as follows:

1. Four varieties including Tamouz-2, Al-Baraka, Latifia, Ibaa-95 symbolized by V_1, V_2, V_3 and V_4. The seeds were sourced from the General Authority for Agricultural Research, Ministry of Agriculture, Iraq.
2. Iron nano-fertilizer:

We used iron nano-fertilizer with four concentrations (0, 1, 2 and 3 g L^{-1}) symbolized by F_0, F_1, F_2 and F_3. According to crop growth stages, the fertilizers were added in two stages, including tillering and pollination (Elhayani 2009). The plants were sprayed until complete wetness and in the early morning using a 10-L sprinkler on the back. A diffuser was used, which is a (bright) cleaning solution. The comparison (control) treatment was sprayed with only distilled water. The experiment was carried out according to the Factorial Experiment according to Randomized Complete Block Design (RCBD) with three replication. After preparing the soil of experiment from plowing, smoothing and leveling operations, we divided the field into experimental units with an area of 2 × 3 = 6 m^2 per experimental unit. The distance between one line and another was 15 cm. The seeds were planted on November 21, 2018, with a seed quantity of 120 kg ha^{-1} (Ministry of Agriculture 2000). The nitrogen fertilizer was added in the form of urea, in an amount of 200 kg ha^{-1}, in two batches, the first, at the planting and the second in the pollination stage. Phosphate fertilizer was added in one batch before planting, with a quantity of 100 kg ha^{-1}, in the form of triple superphosphate fertilizer. Also, crop service operations were carried out, including irrigation and weeding, according to all experimental units' needs. Plants were harvested on 03/05/2019, and the following characteristics were studied:

1. The growth characteristics (plant height, leaf area, spines number, and spike length) were calculated as an average of ten plants randomly taken from the midlines of each experimental unit.
2. The yield and its components were spikes number per m^2, grains number per spike, the weight of 1000 grains, grain yield and biological yield estimating from the harvested plants for 1 m^2 area of each experimental unit after leaving the guard lines. The data were statistically analysed according to the experiment's design and using the lowest significant difference test.

Table 1. Some physical and chemical properties of field soils before planting

Properties	Unit	Value
Electrical conductivity (EC)	ds m^{-1}	4.82
pH	-	7.5
Organic matter (OM)	mg kg^{-1}	0.25
Nitrogen	mg kg^{-1}	0.714
Available phosphor	mg kg^{-1}	5.4
Available Iron	mg kg^{-1}	2.4
Available Zinc	mg kg^{-1}	0.43
Available potassium	mg kg^{-1}	2.7
Sand	%	54.17
Silt	%	41.25
Clay	%	4.58
Soil texture	–	loam silt

RESULTS AND DISCUSSION

Plant height (cm)

Table 2 shows the existence of significant differences between varieties. Al-Baraka surpasses with a significant difference from the rest of varieties, exhibiting the highest average of plant height of 122.25 cm, while Tamouz-2 displayed the lowest average (94.50 cm) which may be due to the differences in the number of phalanges and its lengths, especially the upper phalanx, as an important characteristic (Muhammad 2000). This result agreed with Al-Salim *et al.* (2017) and Saad & AL-Absawy (2018). According to Table 2, there was a significant increase in plant height with an elevation in the iron nano-fertilizer concentration. So that, F_3 exhibited the highest average (116.75 cm), with a significant differences from the rest of treatments, while F_0 displayed the lowest average (104.00 cm). The reason for the rise in plant height may be attributed to the availability of nano-fertilizer for the plant nutritional element, due to the behaviour and characteristics of these fertilizers in the speed of penetration, absorption and photosynthesis, along with the role of iron in enhancing growth by incorporating vital processes in plant and its participation in improving the formation of chlorophyll. In the case of interaction between varieties and iron concentrations, it was shown in Table 2 that there are significant differences between the combinations. The combination between Al-Baraka and F_3 exhibited the highest average of plant height (131.00 cm), while the combination between Tamouz-2 and F_0 displayed the lowest average (90.00 cm), which may be due to the difference in varieties in their response to nano-fertilizer. This result may be due to differences in genotype between the varieties, leading to differences in their growth because of the differences in their ability to prepare the foodstuffs necessary for growth.

Flag leaf area (cm^2)

Table 3 depicted that there were significant differences in flag leaf area due to the differences in the compositions of the added nano-composite. So that, F_3 exhibited the highest average of 41.58 cm^2 with a significant differences for all the concentrations while F_0 displayed the lowest average (29.16 cm^2). This result may be due to the increased concentrations of added iron nano-fertilizer because of the properties of these fertilizers in providing the nutrient to plant for a long period and in different growth stages and the role of iron in activating a number of enzymes involved in many physiological processes (Abu-Dahi and Al-Yunis, 1988). It leads to rise in the photosynthesis process and thus the elevated dry matter produced, which declined the state of competition between the plant parts, hence increased the flag leaf area. As for the effect of interaction between varieties and concentrations of iron nano-fertilizer, the combination of Al-Baraka variety × F_3 resulted in the highest average (51.26 cm^2), with a significant difference from most of the combinations, while combination of Tamouz-2 and F_0 exhibited the lowest average (24.03 cm^2; Table 3).

Table 2. Effects of varieties and levels of iron Nano-fertilizer and their interaction on plant height (cm).

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	90.00	94.00	95.00	99.00	94.50
Al-Baraka	110.00	121.00	127.00	131.00	122.25
Latifia	111.00	114.00	117.00	119.00	115.25
Ibaa-95	105.00	111.00	115.00	118.00	112.25
Mean F	104.00	110.00	113.50	116.75	
LSD = 0.05	V = 0.91		F = 0.91		V = 1.82 × F

Table 3. Effects of varieties and levels of iron Nano-fertilizer and their interaction on the flag leaf area (cm^2).

Varieties (V)	Iron Nano-Fertilizer Concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	24.03	26.29	31.18	37.99	29.87
Al-Baraka	40.30	44.55	50.45	51.26	46.64
Latifia	23.55	25.77	30.33	36.88	29.13
Ibaa-95	28.77	30.25	33.19	40.18	33.10
Mean F	29.16	31.71	36.29	41.58	
LSD = 0.05	V = 1.07		F = 1.07		V = 2.15 × F

Tillers number (tiller m^{-2})

Table 4 indicated significant differences between the varieties in the characteristic of the tillers number. Al Barakah exhibited the highest average for this characteristic, amounting to 488.50 tillers m^{-2}, followed by Tamouz-2, Latifia and Ibaa-95, respectively which may be due to the genetic factors of different varieties, since this trait is considered genetically, and the varieties differ in their susceptibility to tillering. This result is in agreement with AL-Abdullah (2015) and Abdul-Razaq (2016), who reported significant differences between varieties in this characteristic. In addition, Table 4 depicted a significant difference in the tillers number. Spraying the plants with 3 g L^{-1} nano-fertilizer (F_3) exhibited the highest average tillers, while the control group (F_0) displayed the lowest average (410.9 tillers). This may be due to the role of iron and its readiness in the early stages of plant and elevation of its performance in vegetative growth, hence reflecting in the upraised tillers number. As for the interaction between cultivars and nano-fertilizer, the combination of Al-Baraka × F_3 recorded the highest average for this characteristic, reaching 532.0 tillers m^{-2}, while the combination between Tamouz-2 and F_0 exhibited the lowest average (382.7 tillers m^{-2}).

Table 4. Effects of varieties and levels of iron nano-fertilizer and their interaction on tillers number (tiller m^{-2}).

Varieties (V)	Iron Nano-Fertilizer Concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	382.7	398.0	470.7	518.0	442.30
Al-Baraka	439.3	477.3	505.3	532.0	488.50
Latifia	409.3	412.3	457.3	487.3	441.60
Ibaa-95	412.3	453.0	489.3	513.3	467.00
Mean F	410.9	435.2	480.7	512.7	
LSD = 0.05	V = 13.26		F = 13.26		V= 26.51 × F

Spike length (cm)

Table 5 indicated that there were significant differences in the characteristic of spike length between the varieties, so that, Al-Baraka outperformed. It exhibited the highest average of spike length (14.25 cm), while Tamouz-2 displayed the lowest average (11.10 cm). The varieties differences in spike length may be due to its genetically-determining and relating to some extent to spike number per grain (Friend 1965). This result was consistent with results obtained by AL-Abody (2019) who reported the differences in the spike length of varieties. According to Table 5, a significant difference was observed between the different concentrations of iron nano-fertilizer, so that,

F_3 revealed the highest average for of spike length (13.19 cm), with a significant difference from other treatments, while F_0 displayed the lowest average (11.36 cm). The increased spike length in F_3 may be due to the act of this treatment in enhancing the photosynthesis process efficiency during spike emergence, since the nano-composition has given the availability of nutrient during the different stages of plant growth. Al-Baraka variety which sprinkled by F_3 revealed the highest average of spike length (15.73 cm). In contrast, Tamouz-2 in all treatments displayed the lowest average (10.26 cm).

Table 5. Effects of varieties and levels of iron nano-fertilizer and their interaction on spike length (cm).

Varieties (V)	Iron Nano-Fertilizer Concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	10.26	10.83	11.63	11.70	11.10
Al-Baraka	12.80	13.53	14.93	15.73	14.25
Latifia	10.96	11.36	11.76	12.36	11.61
Ibaa-95	11.43	12.20	12.06	12.96	12.16
Mean F	11.36	11.98	12.60	13.19	
LSD = 0.05	V = 0.39		F = 0.39		V = 0.78 × F

Number of spikes (m^2)

It was noticed from Table 6 that Al-Baraka recorded the highest average number of spikes as 473.50 spikes m^{-2}, with a significant difference from the rest of varieties, followed by Ibaa-95. Latifia recorded the lowest average for this trait (401.60 spikes m^{-2}). The differences of these varieties in this characteristic may be due to the genetic factor and its role in determining the ability of a variety to be tillering (Table 4) as well as the ability of variety later to convert these tillers into fertile stems, which prompted the production of the largest amount of photosynthetic materials. This result was consistent with the findings by Al-Shabeeb (2013) and AL-Taher & AL-Kifae (2018) who indicated that the varieties differed in the spikes number due to their differences in their ability to form and preserve the tillers. In addition, the results of Table 6 showed a significant elevation in this characteristic with an upraise in F_3 which exhibited the highest average (480.40 spikes m^{-2}), with a significant difference from the rest of concentrations, while F_0 showed the lowest average (378.70 spikes m^{-2}). The increase in this trait is due to the role of iron in enhancing the photosynthesis process efficiency and thus elevating the formation of the spikes producing grains. This is consistent with Al-Refai (2006) who reported an elevation in the spikes number by a rise in the iron concentration. In the case of interaction between varieties and iron nano-fertilizer, Al-Baraka with a high fertilizer concentration (F_3) exhibited the highest average (517.00 spikes m^{-2}), with a significant difference from most of the combinations. The interaction betweenTamouz-2 variety and F_0 displayed the lowest average (342.70 spikes m^{-2}).

Table 6. Effects of the varieties and levels of iron nano-fertilizer and their interaction on number of spikes (per m^2).

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	342.70	358.00	430.70	478.00	402.30
Al-Baraka	424.30	462.30	490.30	517.00	473.50
Latifia	369.30	372.30	417.30	447.30	401.60
Ibaa-95	378.30	419.00	455.30	479.30	433.00
Mean F	378.70	402.90	448.40	480.40	
LSD = 0.05	V = 13.26		F = 13.26		V = 26.51 × F

Number of grains per spike

According to Table 7, the varieties showed a remarkable variation among themselves in seeds number per spike. Al-Baraka variety exhibited the highest average at 60.17 grains $spike^{-1}$, with a significant difference from the rest of the varieties, while Latifia variety displayed the lowest average (37.94 grains $spike^{-1}$). This may be due to the fact that the grains number in a spike is a quantitative characteristic that is genetically determined and its inheritance coefficient is high (Scott *et al*. 1983) similar to the result of differences between varieties in growth traits including leaf area (Table 3). This result was consistent with AL- Abdullah (2015) and Al-Hassan (2017), who indicated that genetic factors control this trait. As shown in Table 7, the concentrations of iron nano-fertilizer

exhibited a significant effect on grains number per spike, so that, F_3 significantly exceeded over the remaining concentrations, (50.94 grains spike^{-1}), while F_0 showed the lowest average (38.84 grains spike^{-1}). This may be attributed to the role of iron in enhancing the photosynthesis process and thus rise in the production of dry matter, which provided an appropriate opportunity to reduce the state of abortion with flowers, as a result of reducing the state of competition among them for the food product. The interaction between the varieties and the concentrations of iron nano-fertilizer was significant in the grains number per spike. The interaction between Al-Baraka and F_3 achieved the highest average (68.80 grains spike^{-1}), while the combination between Latifia and F_0 exhibited the lowest (30.63 grains spike^{-1}; Table 7).

Table 7. Effects of varieties and levels of iron nano-fertilizer and their interaction on a number of grains spike^{-1}.

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	32.20	37.20	41.07	42.73	38.30
Al-Baraka	50.87	58.67	62.33	68.80	60.17
Latifia	30.63	33.33	42.80	45.20	37.99
Ibaa-95	41.67	43.53	45.53	47.03	44.44
Mean F	38.84	43.18	47.93	50.94	
LSD = 0.05	V = 1.91		F = 1.91		V = 3.82 × F

Weight of 1000 grains (g)

Table 8 shows that the varieties of wheat differed significantly with each other in the weight of 1000 grains. Latifia variety outperformed by giving the highest average (35.02 g), while Al-Baraka exhibited the lowest average (29.98 g) which may be due to the fact that it is not possible to increase the yield components. Together, under the influence of the studied treatments, this results from the state of competition between these components, which in its entirety represent the "Sink" for what the "source" produces dry matter in the plant. The reason for the superiority of Latifia variety in this characteristic is mainly due to the low averages of two characteristics of spikes number m^{-2} and grains number per spike. The results of Table 8 indicate that there is a significant difference in the weight of 1000 grains due to the addition of different concentrations of Iron nano-fertilizer. F_3 exhibited the highest average (35.99 g), while F_0 displayed the lowest (29.94 g). The rise in the weight of 1000 grains by the elevated concentration of iron nano-fertilizer may be due to the role of iron in enhancing photosynthesis products, which led to an increased area of flag leaf area (Table 3). The interaction between the varieties and the concentrations of iron nano-fertilizer exhibited no significant effect on this trait.

Grain yield (tons ha^{-1})

It is evident from Table 9 that the Al-Baraka variety exhibited the highest average grain yield of 4,892 ton ha^{-1}, with a significant difference from the rest of varieties. Latifia displayed the lowest average amounting to 4.022 ton ha^{-1}. The increase in the yield may be due to an increase in spikes number m^{-2} (Table 6) and grains number per spike (Table 7). This result is consistent with the findings by AL-Abdullah (2015) and AL-Saedan (2019) who reported significant differences in the grain yield of the varieties under study. Also, it was observed from the data of Table 9 that F_3 exceeded by giving the highest average grain yield (4,986 ton ha^{-1}), while the lowest average belonged to F_0 (3.747 ton ha^{-1}). F_3 led to an enhancement in the source efficiency once preparing dry matter due to the increased growth characteristics, thus upraised the yield components of spikes number m^{-2} (Table 6) and grains number per spike (Table 7).

Table 8. Effects of varieties and levels of iron Nano-fertilizer and their interaction on weight of 1000 grains (g).

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	31.13	31.70	33.53	36.90	33.32
Al-Baraka	26.83	29.20	30.90	33.00	29.98
Latifia	31.13	35.13	36.43	37.40	35.02
Ibaa-95	30.67	34.23	35.17	36.67	34.18
Mean F	29.94	32.57	34.01	35.99	
LSD = 0.05	V = 1.16		F= 1.16		V = NS × F

Table 9 also depicts the presence of significant interaction between the varieties and concentrations of iron nano-fertilizer in their effect on grains yield. The interaction between Al-Baraka and F_3 exhibited the highest average grain yield (5.800 ton ha^{-1}), with a significant difference from the rest of the combinations. The interaction between Latifia and F_0 displayed the lowest average for this characteristic (3,430 ton ha^{-1}).

Table 9. Effects of varieties and levels of iron nano-fertilizer and their interaction on grain yield (ton ha^{-1}).

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	3.600	4.110	4.287	4.557	4.138
Al-Baraka	4.137	4.657	4.973	5.800	4.892
Latifia	3.430	3.790	4.370	4.500	4.022
Ibaa-95	3.820	4.317	4.597	5.007	4.435
Mean F	3.747	4.218	4.557	4.966	
L.S.D.(0.05)	V= 0.10		F= 0.10		V= 0.21×F

Biological yield (ton ha^{-1})

Table 10 depicted significant differences between the varieties in the characteristic of biological yield. Al-Baraka revealed the highest average (12.943 ton ha^{-1}), while Latifia displayed lower average (9.893 ton ha^{-1}). The reason for the superiority of Al-Baraka in this characteristic is its superiority in grain yield (Table 9) due to the increase in its components as a result of its superiority in the growth characteristics, which provided a better opportunity to enhance the photosynthesis process and also due to the superiority of this variety in plant height (Table 2). The data in Table 10 indicated that F_3 significantly outperformed in the characteristic of biological yield, as it indicated the highest average of 13,585 ton ha^{-1}, while F_0 displayed the lowest average (9.047 ton ha^{-1}). This increase is due to the role of iron in the raised bio-yield (grain + straw).

Table 10. Effects of varieties and levels of iron nano-fertilizer and their interaction on biological yield (ton ha^{-1}).

Varieties (V)	Iron nano-fertilizer concentrations (g L^{-1}; F)				Mean Varieties
	F_0	F_1	F_2	F_3	
Tamouz-2	8.999	9.899	11.879	12.969	10.936
Al-Baraka	10.211	11.777	14.122	15.661	12.943
Latifia	7.878	8.918	10.989	11.789	9.893
Ibaa-95	9.101	10.211	12.432	13.812	11.389
Mean F	9.047	10.201	12.355	13.558	
LSD = 0.05	V = 0.56		F = 0.56		V = NS × F

CONCLUSION

1. According to the results, Al-Baraka exhibited the highest grain yield due to its superiority in the yield components and growth characteristics.
2. The varieties responded to the iron nano-fertilizer by displaying the highest grain yield at higher concentrations of fertilizer.

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