

The role of NPK nanofertilizer in the growth of four bread wheat cultivars

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Abstract

A field experiment was conducted during the winter season 2021-2022 in ALeskandria sub-district, Babylon province, according to the randomized complete block design (RCBD), with split plot arrangement, and with three replicates. In order to study the growth response of four cultivars of bread wheat to foliar nutrition nano NPK , the experiment included two factors, the first of which were four cultivars of wheat ((IPA,Barcelona ,Edan ,and Cihan). The second factor is four concentrations of nano-zero NPK (full mineral recommendation), 2g/L, 1.5g/L, and 1g/L. The results showed the following: The Edna cultivar excelled in the flag leaf area reaching (39.46) cm², the content of the flag leaf of chlorophyll amounted to (48.49) µg/cm², the plant height reached (98.84) cm, and the dry matter weight at the stage of 100% flowering amounted to (7.318) tons ha⁻¹.The fertilization treatment (B2) excelled by giving it the largest flag leaf area , which amounted to (41.72) cm², and the content of the flag leaf of chlorophyll amounted to (47.66) micrograms / cm².The plant height reached (95.42) cm, and the weight of the dry matter at the stage of 100% flowering reached (6.72) tons. ha⁻¹. The interaction between cultivars and fertilizer treatments excelled in most of the growth traits.

Introduction

wheat crop(*Triticum aestivum* L.) which belongs to the Poaceae family, is one of the most important grain crops in the world, and more than two-thirds of the world's population depends on it, where it provides human food with more than 25% of calories and proteins[7] . It ranks first in terms of cultivated area and production in the world, where its global production reached 761.6 tons for the year [8], and in Iraq it reached 6331 thousand dunums [5].Low productivity is one of the most important problems facing increasing production and achieving self-sufficiency. Therefore, productivity efficiency must be raised by providing the necessary nutrients for plants using modern technologies, including nanotechnology. As it has a promising future in modern agriculture, because it has the ability to improve soil fertility and provide nutrients to plants [11] .Nano fertilizers are modified fertilizers that are manufactured by physical, chemical or biological methods using nanotechnology. These can enhance crop yields and increase quality standards for agriculture.[14, 6] So the study came with a purpose. Determining the most effective concentration of NPK nanofertilizer on crop

growth characteristics, as well as determining the cultivar most responsive to NPK nanofertilizer

Materials and methods

1) The experiment location

The experiment was applied in a village in Babylon province, with the aim of studying the role of nano-fertilizer in the growth of four cultivars of wheat.Random soil samples were taken from the field and analyzed in the laboratories of the Soil Research Department of the Agricultural Research Department of the Ministry of Agriculture.

2) agricultural operations

The experimental ground was prepared from Tilling and smoothing, and was divided into main plot and sub plot. The dimensions of the sub plot were (2 x 2) m² with three replicates. The number of experimental units was 48 experimental units. The seeds were planted on 27/11/2021.As it was sown inside each line, at a depth of 5 cm, and the amount of seed was used 120 kg.ha⁻¹ [3]. It was harvested after full maturity was completed on (23/5/2022).Fertilization was done using NPK

mineral fertilizer with an average of 200 kg ha⁻¹ and triple superphosphate fertilizer (P₂O₅ 45) with an average of 100 and granulated potassium sulfate (K% 41.50) (Jadoua and Saleh, 2013) and spraying with NPK nano fertilizer included three levels (1,1.5,2 g/L) The experiment was conducted in a split-plot design and in a randomized complete block design. Where the experiment included two factors, the first factor, the main factor, and four cultivars of bread wheat (IPA - Barcelona-Edna-Cihan), and the second factor included four levels of NPK nano-zero fertilizer (1,1.5,2 g/L)

studied traits

1- The flag leaf area (cm²)

It was calculated from the average of ten flag leaves of the vertical stems of each experimental unit and was calculated according to the following equation

Flag leaf area = flag leaf length x width at the center x 0.95 [15]

2. Flag leaf chlorophyll content (µg/cm²)

It was estimated by a Chlorophyll meter type (spad502) for three leaves randomly from the middle, top and bottom of the plant for a period of plants for each experimental unit after 100% completion of flowering

3. Plant height (cm)

Calculated as an average of ten randomly selected plants from each experimental unit from the soil surface level to the base of the spike

4- Dry matter weight at 100% flowering stage (ton ha⁻¹)

The harvested plants were placed in perforated paper bags and dried in an electric oven at 68 °C for 48 hours, then at 105 °C for three hours, weighed and converted into tons ha⁻¹ [1].

Results and discussion

1- The flag leaf area

The results of the statistical analysis showed that there were significant differences between the cultivars and the fertilization treatments, and the interaction between them in the flag leaf area. It is noted from Table (1) that the Edna cultivar was excelled in the flag leaf area, which amounted to (39.64) cm², which differed significantly from the rest of cultivars. Table (1) shows that there are significant differences between the fertilization treatments. Where the B4 fertilization treatment excelled by giving it the largest flag leaf area, which amounted to (41.72) cm², with a significant difference from the other fertilization treatments. The results of the interaction showed that the Edna cultivar at the level of B4 fertilization was more responsive than the rest. Where the largest flag leaf area is given (46.51) cm². The activity of nanomaterials appears when there is a compatibility between the composition of the leaf between the composition of the leaf in terms of the number of its pores and its diameter with the diameter of the added nanomaterials, and this is reflected in the penetrating quantities of nanoparticles within the plant tissues and thus stimulates the vital activities within the plant (Siddiqui et al., 2014). This was similar to what was reached by [2]

Table (1) Effect of cultivars and fertilization treatments and their interactions on flag leaf area (cm²)

average fertilizers	cultivars				nano fertilizers
	Jehan	Edna	Barcelona	IPA	
29.295	24.820	35.737	25.167	31.457	B ₁
34.679	31.623	37.610	36.707	32.777	B ₂
35.945	32.683	38.710	39.383	33.003	B ₃
41.721	38.757	46.510	40.507	41.110	B ₄
0.312	0.876				ISD5%
	31.971	39.642	35.441	34.587	average cultivar
	0.487				ISD5%

Flag leaf content of chlorophyll µg/cm²-

It is noted from Table (2) that the Edna cultivar has the highest average content of chlorophyll in the flag leaf, which amounted to (48.49) µg/cm³. The level of fertilization B4 recorded the highest average of (47.66) for this trait, and the level of fertilization B4 achieved the highest significant interaction

with the Edna cultivar, which amounted to (50.66) µg/cm³. The reason for the increase is due to nanomaterials possessing more physical and chemical activity than conventional fertilizers, which stimulate the enzymatic activities of the photosynthesis process, and this increases the ability of green traits to absorb light and convert it into chemical energy that plants benefit from [4] and [13]

Table (2) Effect of cultivars and fertilization treatments and their interactions on total chlorophyll (µg/cm³).

average fertilizers	cultivars				nano fertilizers
	Jehan	Edna	Barcelona	IPA	
41.125	39.703	42.793	41.133	40.870	B ₁
44.890	41.867	50.920	44.017	42.757	B ₂
45.689	42.480	49.620	45.557	45.100	B ₃
47.665	43.120	50.660	49.737	47.143	B ₄
0.329	0.829				ISD5%
	41.793	48.498	45.111	43.968	average cultivar
	0.455				ISD5%

Plant height

The results in Table (3) indicated that there were significant differences between the cultivars and the fertilization treatments and the interaction between them, where the Edna cultivar gave the highest average plant height,

amounting to (98.81)cm, and the level of fertilization B4 achieved the highest average plant height, which amounted to (95.42) cm. The results in Table (3) also indicated that there was a significant interaction between the cultivars and the fertilization treatments, where the IPA cultivar achieved the highest

significant interaction at the level of fertilization B4, which reached (101.74) cm. Perhaps the reason for the increase is due to spraying plants with NPK nanoparticles, even at low levels, which may contribute to

increasing the average of material transfer represented by its role in increasing the diameter of the stem and the number of its vessels [9] .

Table (3) Effect of cultivars and fertilization treatments and their interactions on plant height (cm)

average fertilizers	cultivars				nano fertilizers
	Jehan	Edna	Barcelona	IPA	
91.148	85.660	98.950	87.830	92.150	B ₁
91.875	86.660	101.030	86.550	93.260	B ₂
92.223	89.480	95.640	85.990	97.780	B ₃
95.425	89.130	99.860	90.970	101.740	B ₄
0.717	1.202				ISD5%
	87.733	98.870	87.835	96.233	average cultivar
	0.608				ISD5%

4- Dry matter weight at 100% flowering stage (ton.ha⁻¹)

The results in Table (4) showed that there were significant differences between the cultivars and the fertilization treatments and the interaction between them in the weight of the dry matter at the stage of 100% flowering, where the two cultivars Edna and IPA achieved the highest average of dry matter at 100% flowering, which amounted to (6.666, 7.318) ton.ha⁻¹. The reason for the excelled of

the Edna cultivar in this trait is due to its excelled in the flag leaf area and its content of chlorophyll, and this was reflected in the increase in other growth indicators. The B4 fertilization treatment also excelled in the highest average of dry matter weight at the stage of 100% flowering, which reached (6.725) ton.ha⁻¹. The Edna cultivar gave the highest significant interaction in dry matter weight at 100% flowering stage, which amounted to (7.823) ton.ha⁻¹.

Table (4) Effect of cultivars, fertilization treatments and their interaction on dry matter weight at 100% flowering stage (ton.ha⁻¹)

average fertilizers	cultivars				nano fertilizers
	Jehan	Edna	Barcelona	IPA	
5.401	3.673	7.207	4.443	6.280	B ₁
4.829	3.350	6.510	3.173	6.283	B ₂
5.878	3.933	7.730	5.003	6.847	B ₃
6.725	5.550	7.823	6.273	7.253	B ₄
0.527	0.855				LSD5%
	4.127	7.318	4.723	6.666	average cultivar
	0.427				LSD5%

- conclusions

The nano-fertilization level of 2 g/L gave the highest average in vegetative growth traits. Edna cultivar also showed a positive response at the nano-fertilization level of 2 g/L.

Recommendations

Using NPK nano fertilizer at a concentration of 2 g / liter on other cultivars of wheat crop and using concentrations higher than the concentration that was used in the experiment

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