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WHEAT RESPONSE TO THE NITROGEN FERTILIZERS IN PRODUCTIVITY

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SUMMARY

Nitrogen is a macronutrient considered as one of the important components to combat the nutritional deficiency in growth and yield-related traits, and help physiological processes in wheat (*Triticum aestivum* L.) crop. The presented study sought to evaluate two Iraqi wheat cultivars (Babel-113 and Bahouth-10) in integration with three nitrogen fertilizer (NF) levels (50, 75, and 100 kg N ha^{-1}), carried out in 2022–2023 at the Al-Hashimiya Agriculture Directorate, Hilla City, Iraq. The study proceeded in a randomized complete block design (RCBD) using a split-plot arrangement, with two factors and three replications. The results showed wheat cultivar Babel-113 was significantly better than the other cultivar Bahouth-10 in all studied traits. Cultivar Babel-113 performed better in traits, germination ratio, germination speed, plant height, leaf area, spikes number, grains per spike, 1000-grain weight, and grain yield (88.39%, 84.49%, 91.40 cm, 31.45 cm^2, 469, 92.07, 51.34 g, and 5.226 t ha^{-1}, respectively). The NF with the highest dose (100 kg N ha^{-1}) proved significantly superior to two other lower doses (50 and 75 kg N ha^{-1}) in all studied traits. Wheat cultivars (Babel-113 and Bahouth-10) combined with the nitrogen fertilizer 100 kg N ha^{-1} showed the best performance than all other interactions.

Keywords: Wheat (*T. aestivum* L.), cultivars, nitrogen fertilizer, sprinkler irrigation, germination ratio, growth and yield traits

Key findings: The results showed wheat (*T. aestivum* L.) cultivars Babel-113 and Bahouth-10 combined with NF 100 kg N ha^{-1} performed better for all the traits. However, cultivar Babel-113 was leading compared with Bahouth-10 for growth and yield traits.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) crop is one of the most important strategic crops worldwide, as it is at the forefront of cultivated area and production. The world's emphasis on its importance and cultivation encouragement with all means lead to an increased production. In Iraq, the wheat farming community faces less interest from the Government in providing the necessary needs to increase the cultivated area, which can occur positively in increasing production and achieving self-sufficiency (Alaamer and Al-Sharifi, 202**1**). Iraq still suffers from low wheat crop production despite available success factors for its cultivation. This might be due to two reasons, i.e., the first is reliance on old wheat cultivars, and the second is the farming community's lack of knowhow about the wheat's advanced production technology. Nitrogen fertilizers are considerably the basic and indispensable element that generally contributes to increasing wheat crop productivity (Rovelo *et al.,* 2019; Alsharifi *et al.,* 2021a, b).

Past studies revealed wheat cultivars differed with growth and yield-related traits, such as plant height, grains per spike, and grain yield (Hamzah and Alsharifi, 2020). The soil analysis determining the amount of nitrogen fertilizers it needs, and adding them according to its requirement, improves soil characteristics prepared for planting the wheat crop. Nitrogen fertilizers are crucial in improving plant growth characteristics (Abdulhamed *et al*., 2021). Increased nitrogen fertilizer concentrations to suit plant growth has shown to have a positive effect on the 1000-grain weight, which is vital in the yield components and contributes to increasing the grain yield per plant (Jbeil and Faleh, 2014; Shtewy *et al.,* 2020; Alaamer *et al.,* 2023a).

Production efficiency of wheat cultivars depends mainly on the spike length and its thickness and flag leaf area, playing a major role in increasing plant productivity by raising the grain weight. Appropriate cultivar selection can result from the spike length, which is a characteristic that expresses the state of water deficiency, as it increases the use of water and the dry matter amount during the seed formation stages (Merza *et al.,* 2023). However, long stems that can replace dead leaves in photosynthesis characterize some wheat cultivars.

The farming community depending on grains for their food seek to raise productivity with improved quality, by adopting cultivars with the highest yield (Kaba *et al*., 2015; Ghali *et al*., 2020). Enhancing the wheat productivity is necessary to ensure food security provision in Iraq to suit the rising population. It is also common that genetic aspects of the cultivars and the environmental factors, such as, temperature, humidity, and the photoperiod length affect any crop's economic yield, resulting from different agricultural regions, essential in improving crop characteristics (Ola *et al*., 2012; Mohammed *et al*., 2022).

Environmental factors and field practices have an impact on the grains number per spike in wheat crop (Abedi *et al*., 2011; Alsharifi *et al*., 2022). Appropriate environmental conditions — well lighting intensity and relatively low temperatures stimulate wheat plants to produce better photosynthesis to meet the plant's requirements for varied stages of developing peaks and the spike growth, consequently forming more grains (Al-Shmari, 2011). Best crop management and the appropriate cultivars' adoption, tolerable to all conditions during the growth period until the grain yield, are critical factors in the success of crops. Cultivars are mostly distinct from each other by yield-related components and eventually grain yield.

Adding chemical fertilizers in large quantities that exceed the soil and plant needs negatively affects the soil and plant health, causing major economic losses for farmers (Al-Hilfy and Flayyah, 2017; Alaamer *et al*., 2022). Therefore, to reduce the addition of chemical fertilizers adversely altering the human health, it is necessary to add decomposed organic fertilizers to the soil with a positive effect on increasing growth characteristics and overall grain yield (Ibraheem, 2018). The grains number per spike and 1000-grain weight are the most important yield- contributing traits associated with enhanced production (Al-Taher and Al-Hamdawi, 2016). Thus, the primary aim of this study was to evaluate two Iraqi wheat cultivars (Babel-113 and Bahouth-10) in integration with nitrogen fertilizer levels.

MATERIALS AND METHODS

Plant materials and procedure

A field experiment commenced during the winter of 2022–2023 in fields of the Al-Hashimiya Agriculture Directorate, Hilla City, Iraq (latitude 32-32.30 North, longitude 45-44.30 East). Two Iraqi wheat cultivars, Babel-113 and Bahouth-10, reached evaluation combined with nitrogen fertilizer levels (50, 75, and 100 kg N ha^{-1}) for growth and yield-related traits and grain yield. The process of adding seeds and NF transpired simultaneously, in proportions specified above, using a seeding and fertilizing machine (Gasparo type). The experiment had a randomized complete block design (RCBD) using split-plot arrangement, with two factors and three replications. The wheat cultivars remained in main plots, while applying nitrogen fertilizer levels ensued on subplots. The experimental unit area was 2.5 m × 2.5 m, with 10 rows having a distance of 20 cm between the rows.

The land designated for the experiment sustained plowing with a moldboard plow at 20 cm depth, smoothed with rotary harrows, then leveled, and divided into experimental units. For studying the soil chemical and physical properties, random samples came from the field soil at a depth of 20 cm before planting the wheat crop, with the said soil analysis shown in Table 1 (Hu *et al.,* 2012). The experimental soil fertilization employed a triple super phosphate (P_20_5) fertilizer at the rate 100 kg ha^{-1}, added at once during soil preparation. In the experiment, the wheat cultivar seeds' planting occurred on November 01, 2022. For nitrogen fertilizer (50, 75, and 100 kg N ha^{-1}) application, the urea fertilizer (46% N) used had four batches. The first at the planting time, the second at the three-leaf stage, the third at the second node appearance, and the fourth at the lining stage.

The experimental land received six irrigation during the growing season. The sprinkler irrigation method operated the motors and sprinkler paths using an alternative solar energy (Figure 1a, b, and c). In a center pivot irrigation system, one side of the system is immovable, while the other side rotates clockwise using frames moved by a small motor. A river or well can serve as a water

Table 1. Physical and chemical properties of the experimental soil.

Depth	Texture %			
	Clay	Silt	Sand	
	44	24	32	Silt Clay loam
	Soil physical properties			
	Sbd (Mg m^{-3})	Tsp (%)	Spr (Kpa)	
0-20 cm	1.33	50.18	1562.023	
	1.35	49.43	1573.027	
	1.34	50.18	1592.129	
VA	1.36	49.93	1563.775	
	Soil chemical properties			
	E.C (ds\cm^3)	HP		
0-20 cm	1.46	6.56		
	Soluble cation meq\I			
	Na	K	Ca+Mg	
	11.42	14.45	54.82	
	O.C (%)	CEC (Meq\100g)	CaCo3 (%)	O.M (%)
	0.45	32.91	4	0.54

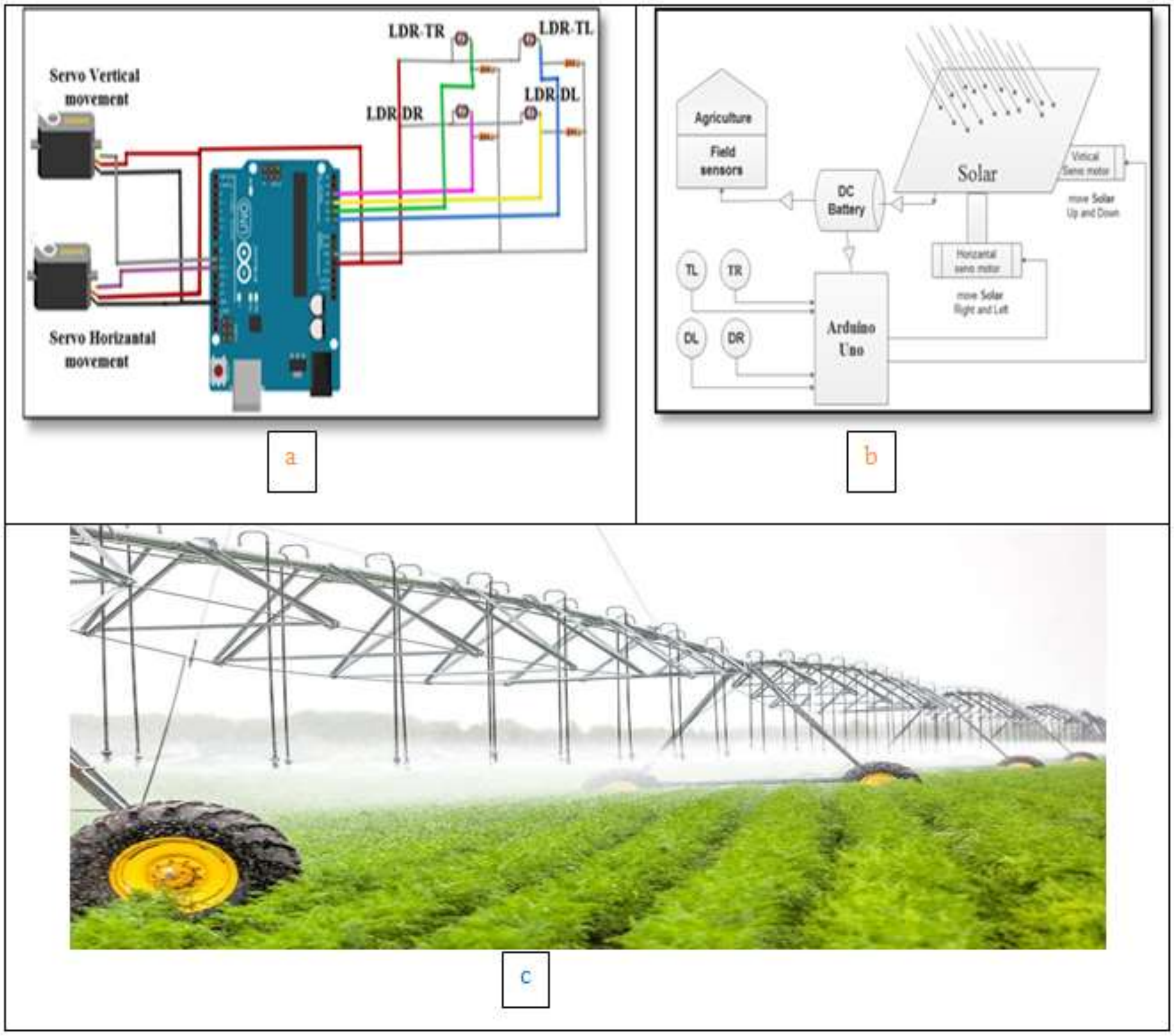

Figure 1 (a, b, c). a) Generating electrical energy with solar panels, b) Delivering electricity for the experiment field, and c) Sprinkler irrigation method in the field (Alaamer *et al.,* 2023b).

source, with the water transported through primary pipes to sprinklers. The advantage of pivot irrigation system is it requires few workers and water irrigates 13–130 hectares from a single water supply point. Moreover, the specially designed steel structure can be functional for different lengths of the center pivot. Meanwhile, a single bridge with one overhang (80 m) is the easiest center sprinkler system one can choose, with a sturdy design allowing 11 bridges (650 m) with bolted corners and pivots strong enough to withstand high winds. Solar-powered irrigation systems show the potential to reduce greenhouse gas emissions per unit of energy used to pump water by more than 95 percent compared with diesel-powered alternatives or fossil fuel-powered electricity grids. The control of narrow and broad leaf weeds used the Plus pesticide, with a control machine TF-22B power sprayer. Wheat cultivars' harvesting happened on May 18, 2023.

Data recorded and statistical analysis

The counted germination ratio operated for an area of one m^2 in each experimental unit and replicate (Shtewy *et al.,* 2020). The germination speed (GS) calculation used the following equation:

$$G_S = \frac{AB1 + AB2 + AB3}{WS}$$

Where:
GS: Germination speed %
A: Number of germinated seeds
B: Number of days from the cultivation date
Ws: Seeds' total number.

The plant height measurement used a standard tape, from the beginning of the soil surface to the end of the spike top (Jamshidi and Tayari, 2011). The leaf area (LA) computation employed the following equation (Pask *et al.,* 2012; Dandan and Yan, 2013):

$$L_A = L_L \times L_W \times 0.95$$

Where:
L_A: Leaf area (plant.cm^2)
L_L: Leaf length
L_W: Leaf width.

Counting the spikes' number continued in a longitude one meter, converting the result multiplied by five to convert it to m^2 (Alaamer *et al.,* 2021). Counting the grains per spike occurred in 25 spikes, and then averaged (Boghdady, 2013). The 1000-grain weight calculation used a sensitive balance (Charles *et al*., 2014). The grain yield computation proceeded for the wheat plants harvested in an area of one m^2 in each experimental unit (Malarvizhi *et al*., 2011). All the recorded data for various germination, growth, and yield-related traits incurred an analysis of variance (ANOVA) using the Genstat statistical analysis. The means comparison and separation utilized the least significant difference ($LSD_{0.05}$) test.

RESULTS

Germination parameters

Wheat cultivar Babel-113 emerged superior and showed the highest average of germination ratio (88.39%) compared to the cultivar Bahouth-10 (86.57%) (Table 2, Figure 2). This may refer to the varied genetic makeup of the genotypes from differences in primary and secondary genes and the extent of influence of added nitrogen fertilizers (Alaamer *et al*., 2022). The results also indicated significant differences among nitrogen fertilizer doses for germination ratio. The nitrogen level of 100 kg N ha^{-1} recorded the topmost average germination ratio of 90.59%, while the level of 50 kg N ha^{-1} appeared with the lowest average (85.04%). This indicates that nitrogen fertilization may improve soil characteristics, which positively affect the soil and increase germination ratios (Alsharifi *et al.,* 2021). Bilateral interaction between the cultivar Babel-113 and 100 kg N ha^{-1} revealed a germination ratio of 91.15%.

For germination speed, wheat cultivar Babel-113 exhibited the ultimate average (84.49%), which excelled the cultivar Bahouth-10 (86.57%) (Table 2, Figure 2). The reason may be the variations between the cultivars' genetic structure, reflecting positively with the cultivar Babel-113 compared with the cultivar Bahouth-10, with a noticeable decrease in germination speed (Shtewy *et al.,* 2020). The results also indicated significant differences among the nitrogen fertilizer doses for germination speed. The nitrogen level 100 kg N ha^{-1} gave the highest average of germination speed (84.74%) versus the 50 kg N ha^{-1}, which provided the lowest average (80.83%). It indicates nitrogen fertilization may improve soil characteristics, positively modifying the soil, and eventually enhancing the germination speed (Abedi *et al.,* 2011). In the interaction of cultivar Babel-113 and nitrogen fertilizer (100 kg N ha^{-1}), it showed the best results and achieved the maximum germination speed (86.04%) compared with both cultivars for all other nitrogen fertilizer levels.

Table 2. Effect of wheat cultivars and nitrogen fertilization (NF) on germination parameters.

C	NF (N kg ha^{-1})	GR	GS
Bahouth-10	50	83.91	79.01
	75	85.76	80.32
	100	90.03	83.44
Babel-113	50	86.17	82.65
	75	87.84	84.77
	100	91.15	86.04
C	Bahouth-10	86.57	80.92
	Babel-113	88.39	84.49
NF (N kg ha^{-1})	50	85.04	80.83
	75	86.80	82.55
	100	90.59	84.74
$LSD_{0.05}$	C	1.087	1.246
	NF	1.422	2.101
	C*NF	1.893	3.421

C: Cultivars, NF: Nitrogen Fertilizer, GR: Germination Ratio, GS: Germination Speed.

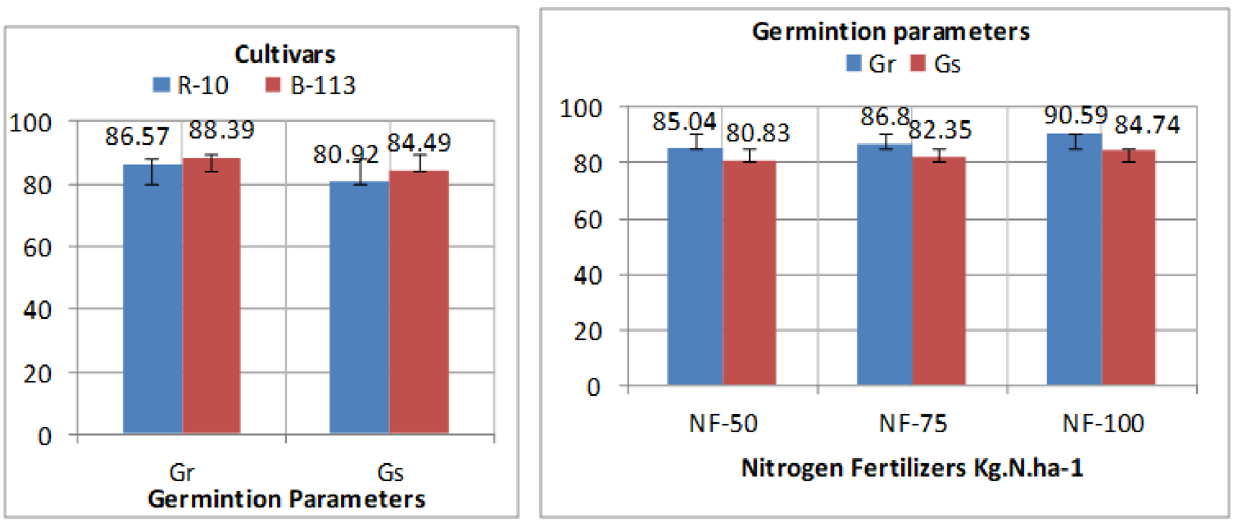

Figure 2. Effect of wheat cultivars and nitrogen fertilization (NF) on germination parameters.

Vegetative growth parameters

For vegetative growth parameters, the wheat cultivars and nitrogen fertilizer levels revealed a notable impact and considerable differences (Table 3, Figure 3). Wheat cultivar Babel-113 gave the highest average of plant height (91.40 cm) and proved significantly superior to wheat cultivar Bahouth-10, with the least plant height (89.06 cm). The difference in genetic composition of the cultivars for plant stature may be due to their difference in the number of nodes and intermodal length because of their differences in the primary and secondary genes in the genome (Jamshidi and Tayari, 2011). The findings also exhibited marked differences among the nitrogen fertilizer levels for plant length. The nitrogen level of 100 kg N ha^{-1} was visible with the supreme average for plant height (91.87 cm), while the level of 50 kg N ha^{-1} manifested with the lowest average (88.73 cm). This revealed that nitrogen fertilization could improve the soil characteristics, favorably influencing plant growth and raising the plant height (Ghali *et al.,* 2020). The bilateral interaction between

Table 3. Effect of wheat cultivars and nitrogen fertilization (NF) on vegetative growth parameters.

C	NF (N kg ha^{-1})	PH	LA
Bahouth-10	50	86.51	29.21
	75	88.02	30.08
	100	91.66	31.93
Babel-113	50	90.18	30.82
	75	91.92	31.02
	100	92.09	32.51
C	Bahouth-10	89.06	30.40
	Babel-113	91.40	31.45
NF (N kg ha^{-1})	50	88.73	30.01
	75	89.97	30.55
	100	91.87	32.22
$LSD_{0.05}$	C	1.802	1.616
	NF	2.413	1.753
	C*NF	3.643	2.089

C: Cultivars, NF: Nitrogen Fertilizer, PH: Plant Height, LA: Leaf Area.

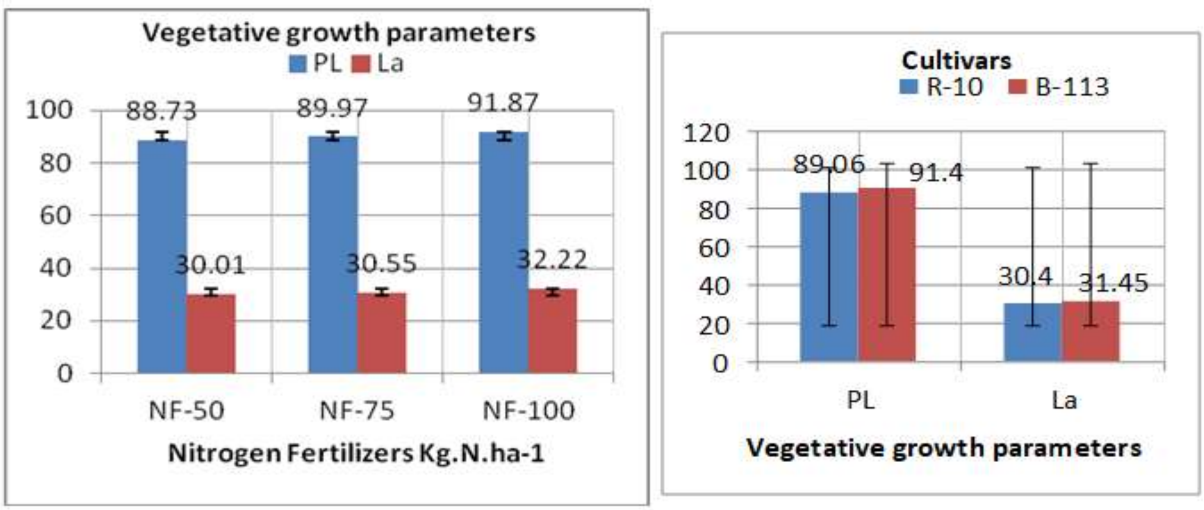

Figure 3. Effect of wheat cultivars and nitrogen fertilization (NF) on vegetative growth parameters.

the cultivar Babel-113 and nitrogen dose (100 kg N.ha^{-1}) showed an enhanced plant height (92.09 cm) compared with all other interactions.

For leaf area, significant differences were evident between the averages of the two wheat cultivars (Table 3, Figure 3). Cultivar Babel-113 scored the highest average of leaf area (31.45 cm^2), varying substantially for the second cultivar Bahouth-10, which achieved the lowest average for the said trait (30.40 cm^2). The variations in wheat cultivars for leaf area might be due to genetic variations in cultivars' genetic makeup (Jbeil and Faleh, 2014). With increased nitrogen fertilizer doses (100 and 75 kg N ha^{-1}), the wheat leaf area enhanced to 32.22 and 30.55 cm^2, respectively, compared with the lowest value for leaf area (30.01 cm^2) obtained with the 50 kg N ha^{-1}. These differences could refer to the fact that leaf area is a quantitative trait governed by genes affected by the environment and soil fertility with the nitrogen fertilizers' addition (Shathar and Alsharifi, 2023). The bilateral interaction between the cultivar Babel-113 and nitrogen fertilizer level (100 kg N ha^{-1}) displayed the best results, with an increased leaf area of 32.50 cm^2 in wheat plants.

Grain yield traits

The wheat cultivars and nitrogen fertilizer levels showed a significant influence on grain yield parameters (Table 4, Figure 4). Cultivar Babel-113 indicated more spikes (469 spikes m^2) than the cultivar Bahouth-10 (415 spikes m^2). The reason could be the distinction in the genetic makeup of the cultivars and their ability to own improved growth characteristics and increased grain yield (Alaamer *et al.,* 2023a). Wheat cultivars Babel-113 and Bahouth-10 with the nitrogen fertilizer level of 100 kg N ha^{-1} showed the utmost number of spikes (475 spikes m^2), while the lowest number of spikes (404 spikes m^2) was visible with the low level of nitrogen (50 kg N ha^{-1}). These variations may also refer to the number of plants per unit area, which also lead to variations in the spikes and grains number, and the soil characteristics affected by the added nitrogen fertilizer (Alsharifi *et al.,* 2021). However, the maximum number of spikes (501 spikes m^2) emerged with the bilateral interaction between the wheat cultivar Babel-113 and the nitrogen level of 100 kg N ha^{-1} compared with all other interactions.

For grains per spike, wheat cultivar Babel-113 demonstrated the premier average (92.07 grains $spike^{-1}$) and was significantly superior to the wheat cultivar Bahouth-10, which had the lowest average for the said trait (89.93 grains $spike^{-1}$) (Table 4, Figure 4). The said trait has control from the genetic factors, which led to differences in averages, depending on the cultivars' genetic makeup. The results also indicated remarkable differences among the nitrogen fertilizer levels for grains per spike. The nitrogen level 100 kg N ha^{-1} appeared with the highest average (92.22 grains $spike^{-1}$), while the lowest nitrogen level 50 kg N ha^{-1} was also with the lowest average for the said trait (89.44 grains $spike^{-1}$). The improved soil physical properties with nitrogen fertilizers during the growth period resulted in increasing the number of grains per spike in wheat (Rovelo *et al.,* 2019). The highest number of grains per spike (93.34 gains $spike^{-1}$) was evident from the bilateral interaction between the cultivar Babel-113 and nitrogen level 100 kg N ha^{-1}), versus all other interactions.

On the 1000-grain weight, cultivar Babel-113 gave the maximum average value (51.34 g); however, it did not differ significantly from the cultivar Bahouth-10 (50.09 g) for the said trait (Table 4, Figure 4). The outcomes indicated noteworthy variances among the nitrogen fertilizer levels for 1000-grain weight. The nitrogen level of 100 kg N ha^{-1} arose with the highest average (51.90 g), with the lowest average (49.11 g) obtained

Table 4. Effect of wheat cultivars and nitrogen fertilization (NF) on yield parameters.

C	NF (N kg ha^{-1})	SN	GS	1000-Gw	Gy
Bahouth-10	50	389	88.16	48.13	3.962
	75	407	90.55	50.94	4.094
	100	449	91.09	51.19	4.905
Babel-113	50	419	90.72	50.08	4.556
	75	488	92.15	51.34	5.204
	100	501	93.34	52.61	5.917
C	Bahouth-10	415	89.93	50.09	4.230
	Babel-113	469	92.07	51.34	5.226
NF (N kg ha^{-1})	50	404	89.44	49.11	4.259
	75	448	91.35	51.14	4.650
	100	475	92.22	51.90	5.411
$LSD_{0.05}$	C	60.531	2.708	2.244	0.607
	NF	75.683	3.015	3.516	1.121
	C*NF	128.011	5.219	4.824	1.33

C: Cultivars, NF: Nitrogen Fertilizer, SN: Spikes Number, GS: Grains per Spike, 1000-Gw: 1000-grain Weight, GY: Grain Yield.

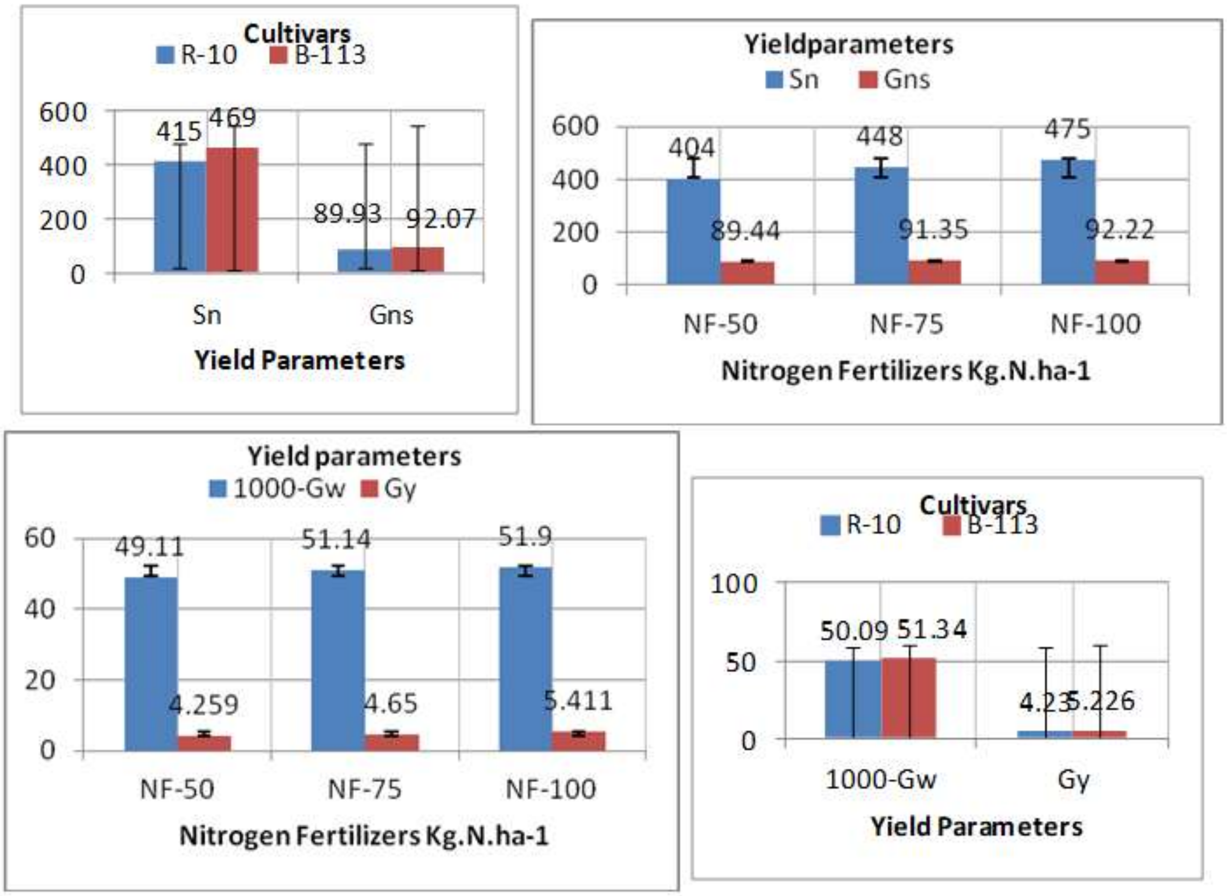

Figure 4. Effect of wheat cultivars and nitrogen fertilization (NF) on yield parameters.

with the nitrogen level of 50 kg N ha^{-1}. The improved plant growth conditions resulted from the ideal distribution of fertilizer ratios, as reflected in an increase in the 1000-grain weight for both cultivars (Al-Hilfy and Flayyah, 2017; Alaamer *et al.,* 2022). The bilateral interaction between the cultivar Babel-113 and nitrogen level 100 kg N ha^{-1} showed the best performance with an increased 1000-grain weight (52.61 g).

For grain yield, cultivar Babel-113 was superior by showing the maximum average value (5.226 t ha^{-1}) and was significantly better than the cultivar Bahouth-10 (4.259 t ha^{-1}) (Table 4, Figure 4). The results further denoted an increased nitrogen fertilizer (100 kg N ha^{-1}) dose raised the grain yield (5.411 t ha^{-1}), followed by low doses of nitrogen fertilizer (75 and 50 kg N ha^{-1}). The grain yield gradually decreased to 4.650 and 4.259, respectively. The best outcome of this study came from the bilateral interaction between the wheat cultivar Babel-113 and nitrogen fertilizer (100 kg N ha^{-1}), providing the topmost grain yield (5.917 t ha^{-1}), followed by all other interactions of both cultivars with nitrogen fertilizer levels. Grain yield is a complex trait and the sum of yield components, thus, any increase in one or more yield-attributing traits will have a direct positive effect on the grain yield (Malarvizhi *et al.,* 2011).

DISCUSSION

The presented study focused on two wheat cultivars, three nitrogen fertilizer levels, and their interactions. In wheat crop, the use of nitrogen fertilization level of 100 kg N ha^{-1}

during the entire growing season led to an increase in productivity compared with the grain yield obtained from the two low nitrogen levels (50 and 75 kg N ha^{-1}) (Imdad *et al.,* 2018). The reason for the increased grain yield results from improving growth conditions during the plant life, represented by enhancing the field soil condition and providing nutrients to the plants. This reflected positively by increasing the total grain yield in wheat crops.

The simultaneous addition of nitrogen fertilizer in varying quantities during the critical growth stages for the emergence and development of shoots and spikes was vital in providing a continuous nutritional supply and its effect**.** Improving growth opportunities by increasing the leaf area, as well as, prolonging the growth period help provide the necessary nutritional support for the growth and emergence of the optimum number of productive plants until the end of the growing season (Al-Rafi'I and Al-Anbari, 2013**)**. Improvement in the wheat yield due to soil fertility enhancement, along with increased nitrogen fertilizer level (100 kg N ha^{-1}), achieved the highest values for wheat growth and grain yield parameters.

The variation in the number of plants per unit area also caused differences in the grain number from the improved soil characteristics, affected by nitrogen fertilizers with a lesser dose (50 kg N ha^{-1}) versus increased nitrogen levels, causing wheat crops' growth deterioration (Sohail *et al.,* 2018). The findings showed the extent of the response of the wheat cultivar Babel-113 with nitrogen fertilizer 100 kg N ha^{-1}, by giving the best performance as compared with the cultivar Bahouth-10. Concerning low doses of nitrogen fertilizer (50 and 75 kg N ha^{-1}), they gave unrewarding results for all the studied traits in both wheat cultivars (Alsharifi *et al.,* 2022).

The adoption to grow wheat cultivars Babel-113 and Bahouth-10, with nitrogen fertilizers (50, 75, and 100 kg N ha^{-1}), reflected in all the studied characteristics' improvement for crop growth in both wheat cultivars. These comprised germination percentage (86.57% and 88.39%), germination speed (80.92% and 84.49%), plant height (89.06 and 91.40 cm), leaf area (30.40 and 31.45 cm^2), spikes number (415 and 469 spikes m^2), grains per spike (89.93 and 92.07 grains $spike^{-1}$), 1000-grain weight (50.09 and 51.34 g), and grain yield (4.230 and 5.226 t ha^{-1}). Nitrogen fertilization played a considerable role in the presented study and significantly affected the growth and productivity of the wheat crop. The findings of Alsharifi *et al.* (2021b) revealed high-yielding wheat cultivars require large and regular amounts of nitrogen nutrition to provide high energy for photosynthesis, as nitrogen is also necessary for building amino acids and proteins.

Nitrogen availability in large quantities in the chloroplast gives its green color. Chloroplasts are essential for photosynthesis, where good nitrogen nutrition improves photosynthesis efficiency and enhances the productive splitting coefficient. In turn, it increases the number of spikes per unit area and the number of grains per spike with increased grain yield and vitality (Abbadi, 2015; Naas and Al-Majidi, 2024). The promising results also indicated nitrogen fertilizer level of 100 kg requires application to get the best results with the highest productivity in both wheat cultivars (Babel-113 and Bahouth-10).

CONCLUSIONS

Wheat cultivar Babel-113 showed significant superiority compared with the cultivar Bahouth-10 in the studied parameters. The interaction of wheat cultivar Babel-113 and nitrogen fertilizer 100 kg N ha^{-1} showed remarkable performance versus other interactions.

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