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RESPONSE OF WHEAT CULTIVARS (*TRITICUM AESTIVUM* L.) TO ADDING NITROGEN FERTILIZERS METHODS

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Abstract:

The field study was carried out in Basra Governorate - Al-Haritha District - in the field of Agricultural Research Station - College of Agriculture - University of Basra during the agricultural season 2020-2021 in soil with a clay mixture. To study the response of wheat cultivars to the methods of nitrogen fertilizer addition, the experiment was applied by the split-plot method in a randomized complete block design RCBD with three replications; the experiment included two factors. The first factor is the methods of adding nitrogen fertilizer (banding, middle row, broadcast bands). The second factor includes four types of wheat (Rasheed, Baraka, Abu Ghraib-3, Ibaa-99). The results of the study showed a significant difference between the varieties in most of the studied traits, where the Rasheed variety was superior in the number of spikes (554.78) m^2, The efficiency of the spike (95.46), the number of grains in the spike (53.48) the grain of the spike $^{-1}$, the grain yield (5.21) t ha^{-1}, the biological yield (17.05) t ha^{-1}, and the harvest coefficient was (30.50) %. In contrast, the cultivar Ibaa- 99 gave the highest average weight of 1000 grains (60.43) g. The results showed that the method of adding urea in a mid-row band was significantly superior in the number of spikes (558.91) spike m^2, spike efficiency (95.86) %, the number of grains per spike (55.97), grain $spike^{-1}$, grain yield (5.29) t ha^{-1} and bio yield (16.99). t ha^{-1} and the harvest index (31.11) %, while the method of adding urea in broadcast bands gave the highest weight of 1000 grains (54.99) g. The interaction was significant between the varieties and methods of addition in the traits studied, between Rasheed cultivar and the method of adding urea in the mid-row band of the highest average grain yield (6.87) t ha.

Keywords: Triticum aestivum L.; Nitrogen fertilizers; Wheat cultivars

1.INTRODUCTION

Wheat, *Triticum aestivum* L., is an important and strategic cereal crop for most of the world's population. It provides humans with more than 25 % of calories and protein. It is the leading food for more than 40 countries and more than 35 % of its population (Busahk, 1998). Its importance is due to its gluten content; it is the basis for producing quality protein suitable for the industry of Bread (Al-Abdullah, 2015).

Iraq is one of the original places for the emergence of wheat, and despite being one of the countries where the success factors of this crop are available, its productivity is still low. The global cultivated area reached 736.5 million hectares. According to the FAO, its productivity is about 739.9 million tons (FAO, 2017). The cultivated area in Iraq for the year 2017 amounted to 788.5 thousand hectares, with a production of 2178 thousand tons (Directorate of Agricultural Statistics, 2018).

The reason for this decline is the poor productivity in large areas of the fields due to the influence of various factors, including the multiplicity of cultivated varieties resulting from not identifying approved varieties for farmers, which is reflected in the poor productivity. The field of developing varieties through breeding and improvement programs and subjecting them to many tests to determine their suitability to the environment of Iraq. Nitrogen fertilizers have a positive effect on increasing production due to the role of nitrogen in improving growth, which is positively reflected in the increase in yield and its components, as well as raising the efficiency of the vegetable mass, especially the flag leaf in the manufacture of amino acids that are transmitted to the grains and then increasing the proportion of gluten in the bean, which gives the dough its qualities excellent. (Peltonen, 1995) Nitrogen is the first element that determines the productivity of crops in general and grassroots crops in particular (Boehm, 2004).

Based on the previous, this study was carried out to determine the variety or varieties that give the highest yield, choose the best way to add nitrogen fertilizer that gives the highest yield and the best quality, and study the interaction between varieties and methods of adding to determine the combination that gives the highest yield of grain.

2.MATERIALS AND METHODS

The field experiment was carried out in Basra Governorate, Al-Haritha District, in Agricultural Research Station, College of Agriculture, Basra University, during the agricultural season 2020-2021. To study the response of cultivars of wheat (Rasheed, Baraka, Abu Ghraib-3, Ibaa-99), whose symbol is (V1, V2, V3, V4), to the sequence of the methods of adding nitrogen fertilizer (hollow, lines, scattering), which symbolized (T1, T2, T3) on the sequence, and the soil was silty clay. The soil chemical and physical analysis was carried out before planting in the College of Agriculture, Basra University laboratories, and the soil results were as shown in the table below.

Table (1) some physical and chemical properties of the experimental field soil before planting.

Properties	Value		Unit
PH	7.4		
EC	4.11		dS m $^{-1}$
Ready Nitrogen	37.00		mg Kg soil^{-1}
Ready phosphorous	12.75		
Soil Separators	sand	70	g Kg soil^{-1}
	silt	590	
	clay	340	
Positive ions . dissolved	Ca^{++}	1.21	mg. g
	Mg^{++}	0.622	
	Na^{++}	1.28	
	K^{+}	0.36	
	Cl^{-}	1.77	
	$So_4^{=}$	1.17	
	HCO_3^{-}	0.488	
soil ratio	silty clay		

The soil was prepared for cultivation by plowing, smoothing, and leveling it, and it was divided into 36 experimental units. The area of the experimental unit was 6 m^2 with a length of 3 m and a width of 2 m. It included 12 lines with a distance of 15 cm between one line and another. The experiment was applied using the split-plot design method in the RCBD randomized complete bock design design design with three replications. The planting was done on 19.11.2020.

Phosphate fertilization was carried out with an amount of 50 kg P. ha$^{-1.}$ It was calculated from the (DAP) fertilizer containing 20 % nitrogen and 46 % Phosphorous pentoxide fertilizer P2O5 and at a rate of one time when planting. Nitrogen fertilizer was added 120 kg. ha^{-1} as urea (46% N). According to the recommendation of the Ministry of Agriculture, in two equal batches, the first was calculated by adding dab fertilizer, and the deficiency was completed by adding urea fertilizer.

In contrast, the second batch was added 45 days after the first addition. The service operations were carried out by removing the weed continuously from the field, and the crop service and irrigation continued throughout the crop's life in the field. The plant was harvested on 04.15.2021 after the plant reached the stage of maturity.

Statistical analysis:

After collecting and tabulating the data for all the studied traits, they were statistically analyzed, according to the analysis of variance, using the ready-made SPSS statistical analysis program. The least significant difference test (LSD) was used to compare the arithmetic means at the probability level of 0.05 (Al-Rawi and Khalaf Allah, 1980).

3.RESULTS AND DISCUSSION

1- Spikes number (spike m2):

From Table (2), it is clear that these cultivars differ in this trait. Al-Rashid cultivar was significantly superior with the highest average (554.78) spike m^2, which differed significantly from the rest of the cultivars. While the cultivar Aba-99 gave the lowest average at (510.11) m^2, in addition to the fact that the discrepancy between the different wheat cultivars in this trait may be due to the genetic differences between the cultivars, and the ability of each cultivar to transform the straws into carrier straws for fertile ears depending on its ability to produce the largest amount of carbon metabolism products (Hucl, Baker.1988). Similar results were reached by Al-Shabib (2013), Abdul-Razzaq (2016), and Al-Hassan (2017); they stated that the difference between the varieties is due to the difference in their ability to produce and preserve the offal.

The adding methods of urea differed significantly in this trait. The method of adding fertilizer to the soil in the lines gave the highest average in the number of spikes, amounting to (558.91) spikes m^2, which differed significantly from the addition of manure spread over it, which recorded the lowest average in the number of spikes amounted to (491.91) spike m^2.

The effect of the interaction between the cultivars and the methods of addition was significant, as the results of Table (2) showed the superiority of the combination Rashid and the method of adding urea in lines, which recorded the highest number of spikes (567.00) spike m^2, which differed significantly from the rest of the combinations, while the combination Aba -99 and the addition of urea In prose recorded, the lowest number of spikes was (455.67) spikes m^2.

Table (2): Effect of cultivar, addition methods, and their interaction on spikes number (spike m^2)

Cultivar (V)	Addition methods (T)			Averages (V)
	T_1	T_2	T_3	
V_1	556.33	567.00	541.00	554.78
V_2	4 551.3	560.00	493.33	534.89
V_3	534.33	556.67	477.65	522.88
V_4	522.66	552.00	455.67	510.11
Averages (T)	541.17	558.91	491.91	
LSD $_{0.05}$	**V=3.99**	**T=10.67**	**V*T= 6.91**	

2- Spikes Efficiency (%):

The results shown in Table (3) show the superiority Rasheed cultivar significantly, recording the highest spike efficiency of (46.95) % compared to the Aba- 99 cultivar, which recorded the lowest average of (90.44) %, due to its superiority in the number of spikes per m2. The result agreed with the findings of Faleh (2015), Abdul Razzaq (2016), and Al-Hassan (2017) in the different cultivars in their study of the efficiency of the spike.

The methods of adding urea differed significantly with each other in this trait, where the method of adding urea in lines recorded the highest spike efficiency of (95.86) %, which did not differ significantly with the method of adding urea in a hole (94.28) %, while the method of adding urea to the soil gave less scattering. The efficiency of the spike is (87.78) %, and the reason for this is its superiority in the number of spikes (table 2).

The interaction between the cultivars and the additional methods showed a significant effect in Table (3). The combination gave the Al-Baraka cultivar the method of adding urea in a hole with the highest spike efficiency of (96.55) %, which did not differ significantly from several combinations. In contrast, the combination gave the cultivar Ibaa-99 and the method of adding urea in a lower hole. The average for this trait was (82.39%) and is due to the same reason above.

Table (3): Effect of cultivar, addition methods, and their interaction on spikes efficiency (%)

Cultivar (V)	Addition methods (T)			Averages (V)
	T_1	T_2	T_3	
V_1	95.27	94.86	96.26	95.46
V_2	96.55	95.56	87.43	93.18
V_3	92.87	96.53	85.02	91.47
V_4	92.45	96.49	82.39	90.44
Averages (T)	94.28	95.86	87.78	
LSD $_{0.05}$	**V=** 0.69	**T=** 2.55	**V*T=** 1.20	

3- Grains number per spike (grain spike^{-1}):

The results in Table (4) showed that Rasheed cultivar recorded the highest average number of grains, which amounted to (53.48) grains spike^{-1}, which differed significantly from the rest of the cultivars with an increased rate of (13.66%) compared to the average of Abu Ghraib -3, which gave (47.05) grain spikes^{-1}. The different cultivars of this trait may be due to the influence of the genetic factor and consequently the difference in their response to the prevailing environmental conditions, which led to their distinction in this trait, which was reflected in the increased feeding of the new breeding sites with their requirements of processed food necessary to increase their number, which affected the number of grains in the spike. Environmental factors and their interaction with genetic factors may also impact the different genetic structures and their variation in the number of grains in the spike (Abboud *et al.,* 2013). This result agreed with the findings of Al-Shabib (2013), Al-Abdullah (2015), Faleh (2015), and Al-Hassan (2017), who indicated that this trait is controlled by genetic factors specific to the cultivated variety.

The methods of adding urea differed significantly in this trait (Table 4), where the method of adding urea in the lines gave the highest average for this trait, which amounted to (55.97) grains spike^{-1}, which differed significantly from the method of adding urea in scattering, which gave (45.10) grains spike^{-1}. The percentage of increase in adding urea in lines amounted to (24.10) % more than the method of adding urea in scattering.

The interaction between the cultivars and the methods of addition was significant. The results of Table (4) showed the superiority of the combination of Rasheed and the addition of urea in the lines of the highest number of grains (58.17) grains spike^{-1}, while the combination of Abu Ghraib -3 and the addition of urea in scattering gave the lowest number of grains reached (40.25) Spike^{-1}. It is due to the same reason in the single factors.

Table (4): Effect of cultivar, addition methods, and their interaction on number of grains per spike (grain spike^{-1})

Cultivar (V)	Addition methods (T)			Averages (V)
	T_1	T_2	T_3	
V_1	54.18	58.17	48.11	53.48
V_2	53.17	56.11	47.40	52.22
V_3	45.46	55.45	40.25	47.05
V_4	46.50	54.18	44.65	48.44
Averages (T)	49.83	55.97	45.10	
LSD $_{0.05}$	V= 0.15	T= 0.13	V*T= 0.27	

4- Weight of 1000 grains (g):

The results in Table (5) indicate the superiority of the cultivar Iba-99 significantly, and it gave the highest average weight of 1000 grains (60.43 g), which differed significantly from the rest of the cultivars, while the cultivar Al-Rasheed gave the lowest average of (41.49) g, that the superiority of Iba-99 cultivar. This may be due to the small number of grains in the spike, which reduced the competition between grains for photosynthetic materials. This, in turn, led to an increase in the transfer rate of materials to the grain, which led to an increase in the weight of the grain. Also, the cultivars that recorded the lowest number of spikes led to an increase in the accumulation of nutrients in the grain. One spike, consequently, led to an increase in the weight of the grain, and this result is consistent with the findings of Al-Shabib (2013) and Al-Rikani and others (2017).

The methods of adding urea varied significantly among themselves in this trait (Table 5). The method of adding urea scattering gave the highest average for this trait, which reached (54.99) g, which differed significantly from the other two methods. The method of adding urea gave a lower average (49.40) g. The superiority of this method is due to giving it the fewest number of grains in the spike and the fewest number of spikes, which led to reducing competition for processed foodstuffs.

The interaction between the cultivars and the methods of addition was significant, so the combination of Iba-99 and the method of adding manure in scattering gave the highest average weight of 1000 grains (64.85 g), which differed significantly with the rest of the combinations. In contrast, the combination gave Rashid the method of adding manure in a lower average dose for this trait (39.46) g. Maybe due to the same as mentioned in the interpretation of the single factors (Table 5).

Table (5): Effect of cultivar, addition methods, and their interaction on the weight of 1000 grains (g)

Cultivar (V)	Addition methods (T)			Averages (V)
	T_1	T_2	T_3	
V_1	39.46	41.66	43.32	41.49
V_2	46.60	48.81	52.10	49.17
V_3	54.85	58.01	59.71	57.52
V_4	56.71	59.73	64.85	60.43
Averages (T)	49.40	52.05	54.99	
LSD $_{0.05}$	V= 0.56	T= 0.46	V*T= 0.97	

5- Grain yield (t ha^{-1})

The results in Table (6) show the superiority of the cultivar Rashid by giving it the highest average grain yield of (5.21) t ha^{-1} with a significant difference from all other cultivars. Al-Rasheed compared to the different cultivars, amounted to 10.38%, 6.54%, and 20.04% for the cultivars (Abu Ghraib-3, Al-Baraka, and Iba-99), respectively. The increase in grain yield is due to the increase in the number of spikes and the number of grains in the spike, as Hamam and Khaled (2009) mentioned. The superiority of a particular variety is due to the cultivars having preferred genes that are not present in other varieties, which is reflected positively in its performance. This result agreed with the findings of Al-Shabib (2013), Al-Abdullah (2015), Bektash and Naas (2016), and Al-Amri and Al-Obaidi (2016), who indicated the different varieties in grain yield when studying different varieties.

The methods of adding urea differed significantly in this trait, as shown in Table (6), where the method of adding urea in the lines gave the highest grain yield (5.29) t ha^{-1} compared to the method of adding urea dispersed, which gave the lowest grain yield (4.33) t ha^{-1}. This is maybe due to its superiority in the number of spikes per m2 and the number of grains in the spike in Tables (2) and (4).

The effect of the interaction between the cultivars and the additional methods was significant. So the Al-Rashid cultivar and the method of adding urea in the lines gave the highest grain yield (6.01) t ha^{-1}. Because of its superiority in the number of spikes and the number of grains in the spike, the combination of Iba-99 and adding urea in sprinkling recorded the lowest grain yield of (3.83) t ha^{-1}. The increase in grain yield for the rational combination and the addition of manure in lines compared to the combination of Aba-99 and manure spread amounted to about 56.9%.

Table (6): Effect of cultivar, addition methods, and their interaction on grain yield (t ha^{-1})

Cultivar (V)	Addition methods (T)			Averages (V)
	T 1	T 2	T 3	
V 1	5.05	6.01	4.56	5.21
V 2	4.80	5.29	4.60	4.89
V 3	4.70	5.12	4.35	4.72
V 4	4.45	4.74	3.83	4.34
Averages (T)	4.75	5.29	4.33	
LSD 0.05	V= 0.027	T= 0.025	V*T= 0.04	

6- Biological yield (t ha^{-1})

Table (7) showed that Rashid cultivar, with an average biological yield of (17.05) t ha $^{-1}$, was significantly superior to the rest of the other cultivars, followed by Al-Baraka cultivar, which gave (16.90) t ha $^{-1}$. In contrast, the cultivar Aba-99 gave the lowest average of (15.54) t ha^{-1}. The superiority of Al-Rasheed variety is due to its superiority in the flag leaf area number of straws per m^2. In addition to the increase in the grain yield, this agrees with what was reached by Yajam and Madani (2013), Muhammad and Issa (2013), Al-Shabib (2013), and Al-Abdullah (2015), who indicated the different cultivars of wheat in the biological yield.

The methods of adding urea differed significantly in this trait, as shown in Table (7), where the method of adding urea in the lines gave the highest biological yield (16.99) t ha^{-1}, while the method of adding urea in scattering gave the lowest vital yield (15.73) t ha $^{-1}$ for the same reasons above.

The results in Table (7) indicate that the superiority of the combination of Al-Rasheed cultivar and the method of adding fertilizer in the lines has the highest biological yield (17.50) t ha^{-1} and a significant difference from all other combinations except for the pond combination and the addition of fertilizer in lines (17.40). The superiority of this combination is due to its superiority in straws number, grain yield, and the number of spikes resulting from the increase in the number of straws. The combination of Iba-99 and the method of prose addition gave the lowest average amount of (14.55) t ha^{-1}, and the percentage of increase for the combination of Rashid and the addition in Ibaa-99 lines and the prose addition was (20.27) %.

Table (7): Effect of cultivar, addition methods, and their interaction on biological yield (t ha^{-1})

Cultivar (V)	Addition methods (T)			Averages (V)
	T 1	T 2	T 3	
V 1	17.05	17.50	16.59	17.05
V 2	16.88	17.40	16.43	16.90
V 3	15.80	16.44	15.38	15.87
V 4	15.43	16.63	14.55	15.54
Averages (T)	16.29	16.99	15.73	
LSD 0.05	V= 0.14	T= 0.23	V*T= 0.24	

7- Harvest index (%):

Table (8) showed that Rashid the highest average harvest index was recorded (30.50%), while the cultivar Iba-99, which gave the lowest harvest index, reached (27.90) %. This may be due to the increase in grain yield that was higher than the increase in the biological yield, which led to an increase in the harvest index. This result agreed with what was mentioned by Al-Shabib (2013), Faleh (2015), Al-Abdullah (2015), and Al-Hassan (2017), they indicated that wheat cultivars differ in the harvest index due to their difference in the value of the grain yield and the biological yield.

The methods of adding urea differed significantly in this trait, as shown in Table (8). The method of adding urea outperformed the lines and recorded the highest harvest index of (31.11) %. As a result of its superiority in grain yield, it compared to adding urea, which gave the lowest harvest index of 27.53 %.

As for the interaction between the cultivars and the addition methods (Table 8), the combination of Al-Rashid variety and adding urea in the lines gave the highest harvest index of (34.36) %, which differed significantly from all other combinations. In contrast, Abaa-99 and the addition of urea in scattering recorded the lowest harvest index (26.35) %. It is due to the same reason above.

Table (8): Effect of cultivar, addition methods, and their interaction on harvest index **(%)**

Cultivar (V)	Addition methods (T)			Averages (V)
	T 1	T 2	T 3	
V 1	29.62	34.36	27.52	30.50
V 2	28.43	30.39	27.99	28.94
V 3	29.74	31.16	28.27	29.73
V 4	28.83	28.53	26.35	27.90
Averages (T)	29.16	31.11	27.53	
LSD 0.05	V= 0.31	T= 0.41	V*T= 0.55	

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