Response of bread wheat(*Triticum aestivum* L.) and triticale (X.Triticosecale Wittmack) varieties at different levels of phosphate fertilization under Basra Governorate conditions

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abstract

A field experiment was carried out during the winter agricultural season 2023-2024 at the Agricultural Research Station of the College of Agriculture - University of Basrah - Karma Ali site, which is located at a longitude of 47.80° W and a latitude of 30.57° N in the soil of a Silty loam to study the response of three varieties of (bread) wheat (IPA- 99, Bhooth- 22 and Al-Rasheed) and one variety of Tritical (Amal-7)Under the influence of four levels of phosphate fertilizer (0, 50, 100 and 150 kg) P2O5 h-1 under the conditions of Basrah Governorate. The seeds of the varieties were sown on 15/11/2023, and phosphate fertilizer was added at once before planting according to the study levels, and the experiment was applied according to the method of factor experiments using the design of complete random block (R.C.B.D) with three repeaters . The results indicated the superiority of the Rasheed variety in the qualities of the plant height, the area of the flag leaf, number of spikes, number of grains spike, grain yield and biological yield, amounting to respectively, While the IPA-99 variety outweighed 1000 grains amounted to (48.88) g, and the Amal-7 variety outperformed the percentage of protein in grains amounted to (13.25%). While the fertilizer level exceeded 150 kg P2O5 ha-1 significantly in most of the studied characteristics (plant height, flag leaf area, number of shoots, number of spikes, number of grains per spike, weight of 1000 grains, grain yield, biological yield and protein percentage in grains amounted to respectively. The intervention between the two factors of the study superiority of the Rasheed variety at the level of fertilizer 150 in the characteristics studied (plant height, area of the flag leaf, number of ears, kg P2O5ha-1 number of grains in spike, grain yield and Biology yield and amounted to respectively. While the interaction between the variety IPA- 99 at the fertilizer level 150 kg P2O5 ha-1 by giving the highest weight of 1000 grains amounted to (56.23 grain) and the interaction between the variety Amal-7 at the fertilizer level of 150 kg P2O5 ha-1 by giving the highest protein content in the grain amounted to (13.76. %(

Keywords : varieties , bread wheat , triticale , phosphate fertilization

Introduction

Prepare the wheat crop Triticum aestivum L. is an important crop of the poaceae family of grass, Which ranks first in the world in terms of production and area, as it occupies more than half of the cultivated land. It provides about 70% of the world's population's food, as the global production of wheat grown globally amounted to 796.19 million tons of hectare-1 and an average of 3.58 tons hectare-1 (23) At the Iraq level, production reached 2675 thousand tons hectares-1 for the year 2023, according to statistics (16) Despite technical advances, production remains low per unit area. The wheat crop of Tritical produced by humans from hybridization between wheat and rye, which is self-pollinated similar to wheat, and is characterized by containing 15% protein of the total weight of the seed and 3.7% lysine, which is one of the amino acids

Materials and methods

A field experiment was carried out during the winter agricultural season 2023-2024 at the Agricultural Research Station of the College of Agriculture - University of Basrah - Karma Ali site, which is located at a longitude of 47.80° west and a latitude of 30.57° north, in order to study the response of varieties of wheat and Tritical to levels of phosphate fertilizer under theconditions of Basrah Governorate. The soil of the experiment site was randomly sampled at a depth of 0-30 cm and mixed with each other to homogeneously and then pneumatically dried, grinded, graced and passed through a sieve diameter its holes of 2 mm. A sample was taken for the purpose of conducting an analysis of the chemical and physical properties of the field soil before

necessary in protein that most other cereal crops lack energy as well as toleranceto breakup and decomposition to a large degree (6), that phosphorus is considered It is one of essential the important, and necessary nutrients in the growth of crop production, in addition to the importance of the vital processes of plant growth, as well as its role in increasing production and improving quality, providing important nutrients for plant growth, increasing their availability and stimulating plant growth and development (9), and Due to the lack of previous studies on the response of varieties of wheat and triticale to levels of phosphate fertilizer and determine the best level to give the high yield under the conditions of Basra Governorate

planting, and the analysis of the samples was carried out in the central laboratory - College of Agriculture - University of Basrah, the results of which are shown in (Table 1). The experimental land was prepared by plowing two perpendicular plows by the dump plow and the soil was smoothed Then the land was divided into experimental units, where it amounted to 48 experimental units and three repeaters and an area of $(2 \times 2 = 4 \text{ m } 2)$, and a distance of 50 cm between the experimental units and a distance of 1.5 m) between one repeater and another to prevent interference of phosphate fertilization levels between the experimental units. Phosphate fertilizer was added at once mixing with the soil before planting at four levels (0, 50, 100, 150) kg

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P2O5 h -1 in the form of dab (46% P2O5), and potash fertilizer was added at a rate of 120 kg K h-1 in the form of potassium sulfate (50% K2O) when planting (4) Nitrogen fertilizer was added at a rate of (120)kg N h-1 in the form of urea fertilizer (N46%) (3). It is added in two batches equally, the first after the emergence of seedlings and the second in the elongation stage (13), The amount of nitrogen fertilizer contained in the dab fertilizer was calculated and completed with urea fertilizer Field

Plant height (cm(

Calculated as an average of ten randomly selected plants in the flowering phase and measured the height from the base of the plant to the top of the terminal spikelet

Flag leaf area (cm2(

The area of the flag leaf was calculated as an average of ten randomly selected plants from each experimental unit when the flowering phase was completed

Number of spikes (spikem-2(

I calculated the number of spikes for the group of plants harvested from an area of square meters of median lines.

Number of grains (spike -1(

According to the average number of grains, ten spikes were taken randomly from each experimental unit, and after neglecting them, the seeds were calculated manually.

Weight 1000 grain (g(

I took a random sample of grains per experimental unit after mixing them, counted 1000 grains of them and extracted their weight with a sensitive balance..

Total grain yield(tons ha-1(

After thresher of the sample harvested from an area of one square meter, straw and grain

to reach the fertilizer recommendation. Seeds of three varieties of wheat were planted (IAP-99, Bhooth-22 and Al-Rasheed) and one variety of Tritical (Amal- 7 On 15/11/2023, the seeds were planted inside the boards and the single board contains 10 lines and the distance between one line and another 20, and the amount of seeds for wheat 120 kg hectare-1(2) and for Tritical at a seeding rate of 140 kg h-1(1.(

Traits

weight were separated, and the weight of the harvested area was converted to ton hectare-1. Biology yield (tons ha-1(

It was estimated from the weight of the plants harvested from the same area taken to calculate the yield and was transferred on the basis of ton hectare-1, as it included the weight of the total dry matter (grains + straw) plus the ten plants that were taken to study the components of the yield.

Protein content in grain(%)

Taking 0.2 g of the ground grain sample, after passing through a sieve Qatar its holes 1 mm and then digested the sample by adding a mixture of 4% of concentrated sulfuric acid, pyr and chloric with heating until a clear solution is obtained according to the method of Cresser and Parsons (1979) and then transfer the digestion product in volumetric bottles and complete the size to 50 cm 3, then nitrogen was estimated in it by a microkjeldhal device,

Harvest time

The harvest was done when the plants reached full maturity on 15-4-2024

Statistical Analysis

The data were gathered ,tabulated, and statistical analysis was performed using the Gen stat statistical analysis system program at

the 5% probability level. the averages were

compared using the least significant difference

Traits		Values	Units
Degree of soil react	Degree of soil reaction (PH)		-
Electrical conductiv	vity (E.C)	7.32	DC-Siemens M ⁻¹
Organic matter		9.4	g kg ⁻¹
Items prefab	Nitrogen	49.61	
	Phosphorus	5.35	mg kg Soll
	Potassium	115	
Soil spepators	Sand	374	
2 on spopmons	Silt	532	g kg ⁻¹ Soil
	Clay	94	
texture Silty loam			

 Table (1) Some chemical and physical properties of field soil before planting

Results and discussion Plant height (cm:(

The results of Table (2) showed the superiority of the Rasheed variety by giving the highest of the plant amounting to 106.76 cm and a significant difference from the varieties (IAP-99, Bhooth -22 and Amal -7) Which were given averages of 99.77, 93.31 and 94.41 cm respectively, and this may be due to genetic differences between the varieties in the number of knots and the length of the upper phalange, which is one of the important characteristics that distinguish wheat varieties from each other (19) and this result is consistent with (12). The results of Table (2) indicated the superiority of the fertilizer level 150 kg P2O5 ha- 1 which gave the highest height of the plant amounted to 105.27 cm and a significant difference from other fertilizer levels and was given the comparison

treatment (without addition) the lowest average plant 91.98 The reason may be due to the role of phosphorus in increasing the absorption of nutrients necessary for growth and thus led to an increase in the physiological processes of the plant, including photosynthesis, increased growth, cell division and elongation, and this result is consistent with (10). The overlap between the two factors of the study also shows that there are significant differences in the characteristic of plant height as the Rasheed variety was given at the fertilizer level 150 kg P2O5 ha-1 higher The average for this trait was 115.56 cm. while the variety gave Bhooth-22 when the comparison was treated (without addition), the lowest 88.23cm average was

Varieties	Phosphate f	Average			
	0	50	100	150	varieties
IPA -99	93.46	96.96	101.60	107.05	99.77
Bhooth-22	88.23	91.47	95.27	98.24	93.31
Rasheed	97.72	103.85	109.89	115.56	106.76
AMAL-7	88.47	93.02	95.91	100.23	94.41
Average fertilizer	91.98	96.33	100.67	105.27	
L.S.D(0.05)	varieties	Levels		Interaction	
	0.75	0.75		1.50	

 Table (2) Effect of Varieties and Phosphate Fertilizer Levels and interaction between them on plant height (cm(

Flag leaf area (cm2:(

The results of Table (3) led to significant differences between the varieties of the flag paper area, as the Rasheed variety recorded the highest area of the flag paper amounted to 57.58 cm2 while the Bhooth-22 variety the lowest area of the flag leaf amounted to 42.66 cm 2, and the reason may be due to the difference in genetic and physiological abilities between the varieties, which led to an increase in the efficiency of obtaining the requirements of growth, which is reflected in the increase in the area of the flag leaf, as well as genetic variation between varieties may contribute to an increase in leaf space, and this result is consistent with (5). While the addition of phosphate fertilizer levels led to a significant increase in the area of the flag leaf and gave the fertilizer level 150 kg P2O5 ha-1 the highest average of 53.03 cm2, while the comparison treatment (without addition) gave the lowest average of 44.29 cm2, and the reason may be due to the readiness of phosphorus added to the soil as a result of the high additions of phosphate fertilizer led to an increase in the absorption of water and nutrients in sufficient quantities needed by the plant This positively affected the growth and development of the plant and increased the efficiency of photosynthesis, which led to an increase in the area of the flag leaf, and this result is consistent with (15). As for the overlap, the Rasheed variety exceeded at the fertilizer level 150 kg P2O5 ha-1 by giving the highest area to the flag leaf amounted to 61.81 cm2, while the variety recorded Bhooth-22 When compared (without addition), the minimum area of the flag leaf was 37.59 cm2

Varieties	Phosphate f	average			
	0	50	100	150	varieties
IPA -99	45.70	49.36	52.97	56.15	51.04
Bhooth-22	37.59	40.80	44.84	47.44	42.66
Rasheed	52.19	56.48	59.85	61.81	57.58
AMAL-7	41.70	41.60	46.42	50.70	44.94
average fertilizer	44.29	47.06	51.02	53.03	
L.S.D(0.05)	varieties	Levels		Interaction	
	0.48	0.48		0.96	

Table (3) Effect of varieties and levels of phosphate fertilizer and the interaction between them	
on the area of the flag leaf (cm2	

Number of spikes (spike m-2:(

The results of Table (4) indicate that there are significant differences between the varieties in the number of spikes m-2 and gave the Rasheed variety the highest number of spikes m-2 amounted to 518.8 spike m-2 while the variety gave Amal -7 the lowest number of spikes m-2 amounted to 396.2 spike m-2, The reason for the variation of these varieties among themselves in the description of the number of spikes can be due to their difference in the genetic factor and its role in determining the variety's ability to comb and the ability of the variety later to convert these fragments into fertile spikes, which prompted the production of the largest amount of photosynthetic materials, and this result agreed with (17), who indicated that the varieties differed among tillers in the number of spikes due to their difference in Genetic ability to form and maintain segments. The results of Table (4) showed that there are significant differences between the levels of

phosphate fertilizer, as the level was recorded Fertilizer 150 kg P2O5 ha-1The highest average for this trait reached 529.6 spike m-2, while the comparison treatment (without addition) recorded the lowest average for this trait amounted to 364.8 spike m-2 The reason is due to the increase in the readiness of phosphorus in the soil solution, which encouraged the formation of a dense root system and lateral roots, which positively affected the increase in the number of fertile shoots, which led to the formation of spikes and increase their number, and this result is consistent with) (10) . As for the overlap between the two factors of the study, the Rasheed variety recorded at the fertilizer level 150 kg P2O5 ha-1 the highest number of spikes amounted to 596.7 spikes m-2 while the when varietv Amal-7 the comparison treatment (without addition) recorded the lowest number of spikes m-2 amounted to 309.7 spike m-2.

Varieties	Phosphate	average			
	0	50	100	150	varieties
IPA -99	382.7	456.3	496.7	529.3	466.2
Bhooth-22	326.3	435.7	447.1	471.2	420.0
Rasheed	440.7	526.3	536.3	596.7	518.8
AMAL-7	309.7	337.1	416.7	521.3	396.2
average fertilizer	364.8	438.8	474.2	529.6	
L.S.D(0.05)	varieties	Levels		Interaction	
	19.2	19.2		38.54	

 Table (4) Effect of Varieties and Phosphate Fertilizer Levels and interaction between Them on

 the Number of Spikes (spik m-2(

Number of grains (spike -1:(

The results of Table (5) showed significant differences between the varieties, as the variety excelled by giving the Rasheed highest number of grains spike -1 and amounted to 61.02 spike grains-1, while the variety Amal -7 recorded the lowest average of 49.25 spike grains -1, and the reason for the superiority of the Rasheed variety may be due to the variation between the different varieties of wheat in this trait may be due to genetic differences between varieties. The ability of each variety to tiller spores into tillers of fertile ears depends on its ability to produce the largest amount of carbon metabolites (14). These findings are consistent with the findings of (7)). The results of Table (5) showed the moral superiority of the fertilizer level 150 kg P2O5 ha-1 As the highest number of grains per spike was recorded at 59.66 spike grains-1 While the comparison treatment was recorded (without addition) The lowest number of grains per spike amounted to 45.66 spike grains-1, and the reason may be due to the role of phosphorus in improving vegetative growth and regulating the work of hormones within the plant led to raising the efficiency of photosynthesis and thus to increasing the grain nodes in the spike and this leads to an increase in the number of grains spike -1 This result was consistent with the findings of (8) and (10), who indicated an increase in the yield and its components of the wheat crop when increasing the levels of phosphate fertilizer. As for the overlap between the varieties and the levels of phosphate fertilizer, it was found that there are significant differences in the number of grains in the spike, as the Rasheed variety at the fertilizer level gave 150 kg P2O5 ha-1 the highest number of grains per spike amounted to 70.43 spike grains -1 while the variety gave Amal-7 when treating the comparison (without addition) the lowest number of grains spike amounted to 42.03 grains -1 spike

Varieties	Phosphate	average			
	0	50	100	150	varieties
IPA -99	45.07	49.43	53.50	57.13	51.28
Bhooth-22	43.97	47.80	51.93	56.03	49.93
Rasheed	51.57	57.73	64.37	70.43	61.02
AMAL-7	42.03	47.73	52.20	55.03	49.25
average fertilizer	45.66	50.67	55.50	59.66	
L.S.D(0.05)	varieties	Levels		Interaction	
	1.08	1.08		2.17	

Table (5) Effect of varieties and levels of phosphate fertilizer and the interaction between them on the number of grains per spike (grain spike -1(

Weight 1000 grain (g:(

The results of Table (6) showed significant differences between the varieties in the characteristic of weighing 1000 grains (g), as the variety excelled in IPA -99 the highest weight of 1000 grains of 48.88 g, while the variety gave Bhooth -22 the lowest weight of 1000 grains amounted to 42.76 g. The reason for this is that it is not possible to increase the components of the yield together under the influence of the studied coefficients and this comes from the state of competition between these components, which in their entirety represent the mouth (Sink) on what the source produces of dry matter in the plant and the reason for the superiority of the variety IPA -99 in this characteristic is mainly due to the low averages of the number of spikes M-2 and the number of grains in spike (Table 4 and 5) sequentially, as well as genetic differences between varieties. This finding agreed with what(18), The Table (6) also indicates that the

fertilizer level exceeded 150 kg P2O5 ha-1 by giving the highest weight of 1000 grains of 50.71 g, while the comparison treatment(without addition) gave the lowest weight of 1000 grains of 39.03 g, and the reason for this may be due to the increase in phosphorus readiness Whichled to the encouragement of carbon metabolites carbohydrates) (proteins and and thus transported and stored in grains, which led to an increase in the weight of the grain, and this result agreed with (21). As for the overlap between varieties and phosphate fertilizer levels, The superiority of the variety in IPA -99 at the fertilizer level 150 kg P2O5 ha-1 giving the highest weight of 1000 grains amounted to 56.23 g while the variety gave Bhooth-22when treating the comparison (without addition) the lowest weight of 1000 grains amounted to 38.02 g.

Variation	Phosphate fertilizer levels (kg ha ⁻¹)				average
varieues	0	50	100	150	varieties
IPA -99	40.56	47.40	5133	56.23	48.88
Bhooth-22	38.02	42.01	44.42	46.62	42.76
Rasheed	39.11	46.36	50.50	53.05	47.25
AMAL-7	38.43	44.32	45.86	46.93	43.86
Average fertilizer	39.03	45.02	48.03	50.71	
L.S.D(0.05)	Varieties	Levels		Interaction	
	0.58	0.58		1.16	

 Table (6) Effect of varieties and levels of phosphate fertilizer and their interaction in the weight of 1000 grains (g(

Total grain yield(tons ha-1:(

The results in Table (7) indicate the superiority of the Rasheed variety significantly in the grain yield by giving the highest grain yield of 5.469 tons ha-1 with an increase of 24.66%, while the variety gave Amal - 7 the lowest average of 4.387 tons ha -1, and the reason for the increase in grain yield may be due to the increase in the area of the flag leaf and the number of grains in spike and the number of spikes (Table 3, 4 and 5) sequentially as well as its superiority in increasing the number of fertile ears This result agreed with the findings of (5) and (7) who showed that the varieties differ among themselves in the quality of grain yield. Table (7) also shows that there are significant differences between the levels of phosphate fertilizer, as the fertilizer level gave 150 kg P2O5 ha-1 The highest grain yield was 5.899 kg ha-1 Compared to the treatment of The comparison (without addition) that gave the

lowest grain yield of 3.738 tons ha-1, and the reason may be due to the increase in phosphate fertilizer levels in the soil led to an increase in plant nutrition with nutrients necessary for growth well as as its contribution to increasing the area of the flag leaf (Table 4) It is the last leaf and is an important source in the processing of grains in dry matter in the period of grain fullness and increase the rate of growth and photosynthesis within the plant and the transfer of processed materials and stored in grains, which leads to an increase in yield and this result is consistent with (22). As shown by the overlap between varieties and phosphate fertilizer levels, the Rasheed variety excelled at the fertilizer level of 150 kg P2O5 ha-1 giving the highest grain yield of 6.158 tons ha-1 while the variety Amal-7 gave the lowest grain yield of 3.257 tons ha-1.

Variation	Phosphate	average			
varieues	0	50	100	150	varieties
IPA -99	3.805	4.987	5.592	5.984	5.092
Bhooth-22	3.453	4.162	4.683	5.778	4.519
Rasheed	4.436	5.457	5.827	6.158	5.469
AMAL-7	3.257	4.149	4.467	5.674	4.387
Average fertilizer	3.738	4.689	5.142	5.899	
L.S.D(0.05)	Varieties	Levels		Interaction	
	0.16	0.16		0.32	

 Table (7) Effect of varieties and phosphate fertilizer levels and their interaction on grain yield

 (ton ha-1(

Biology yield kg (tons ha-1:(

The results of Table (8) showed the superiority of the Rasheed variety by giving the highest yield of 17.017 tons ha-1, while the Bhooth-22 variety gave the lowest biological yield of 14.681 kg h-1, and the reason may be due to the fact that the Al-Rasheed variety has a high ability to grow from cultivation to full maturity compared to the rest of the other varieties, as well as the existence of genetic differences between the varieties Which results in an increase in the efficiency of vegetative cladding formation in the interception of sunlight and its use during the growing season and its difference in the process of net photosynthesis per unit area, and is expressed by the result of the production of total dry matter, which represents the yield of grains and straw, and by increasing these two components, the vital yield increases, and this result is consistent with (11). As shown in Table (8) above the level of 150 kg P2O5 ha-1 giving the highest yield of 18.123 tons ha-1 compared to the comparison treatment (without addition) as it gave the lowest average for this trait amounted to 13.471 tons ha-1, and the reason may be attributed to the efficiency of phosphorus and its role in increasing growth and yield and its components and thus reflected positively in increasing the bioyield, this result agreed with (20) and (10). As shown by the overlap between varieties and phosphate fertilizer levels, the Rasheed variety excelled at the fertilizer level of 150 kg P2O5 ha-1 by giving the highest average for this trait of 18.425 tons ha-1, while the Bhooth-22variety recorded when the comparison was treated (without addition) the lowest average for this trait was 12.558 tons ha-1.

Variation	Phosphate	average			
varieues	0	50	100	150	varieties
IPA -99	13.202	16.399	17.047	18.231	16.220
Bhooth-22	12.558	13.840	14.348	17.979	14.681
Rasheed	14.519	17.405	17.718	18.425	17.017
AMAL-7	13.606	14.693	15.459	17.856	15.404
average fertilizer	13.471	15.584	16.143	18.123	
	varieties	Levels		Introduction	
L.S.D(0.05)	0.52	0.52		1.05	

in

 Table (8) Effect of varieties and phosphate fertilizer levels and their interaction in biology yield (kg ha-1(

Protein

content

Among the results of Table (9) there are significant differences between the varieties included in the study, as the variety Amal -7 excelled by giving the highest protein content in the grains amounted to13.25%, while the Bhooth-22 variety gave the lowest protein percentage in the grains amounted to 10.90%, and the reason is due to the genetic differences between the varieties in this characteristic, These differences lead to a difference in their protein content, and this is what was agreed upon (18), Table (9) showed that the fertilizer level exceeded 150 kg P2O5 h-1 In the characteristic of the percentage of protein in the grains by giving the highest percentage of protein amounted to 12.89% compared to the comparison treatment (withouta additive) if it gave 11.33% The reason may be due to the importance of phosphorus in its composition (adenosine tri (ATP), which works to produce grain:(%)

and transfer energy during photosynthesis, in addition to the formation of energy compounds and plant metabolic compounds, and phosphorus has an important role in increasing the concentration of protein in grains and maintaining the activity and effectiveness of leaves in the manufacture of carbohydrates, and may be the cause of increased protein In grains resulting from an increase in nitrogen in the leaves and moves to the grain in order to be stored, and this salvation is consistent with (8). As the results of Table (9) showed that there is a significant overlap between the varieties and the levels of phosphate fertilizer, as the Amal-7 variety was recorded at the fertilizer level of 150 kg P2O5 ha-1 The highest protein content reached 13.76%, while the Bhooth - 22 When the comparison was treated (without addition), the lowest percentage of protein was 10.46. %

Variation	Phosphate	average			
varieues	0	50	100	150	varieties
IPA -99	11.10	11.40	12.50	13.26	12.06
Bhooth-22	10.46	10.46	10.66	11.80	10.90
Rasheed	10.70	11.53	12.13	12.73	11.77
AMAL-7	12.86	13.03	13.36	13.76	13.25
average fertilizer	11.33	11.60	12.16	12.89	
L.S.D(0.05)	varieties	Levels		Interaction	
	0.20	0.20		0.40	

Table (9) Effect of varieties and levels of phosphate fertilizer and their interaction on the percentage of protein in grains(%)

Conclusion

The study showed that the variety differed among them in the traits outweighed the Rashid variety in most of the studied traits and

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