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EVALUATION OF FOUR PROMISING BREAD WHEAT GENOTYPES TO DIFFERENT PHOSPHORUS LEVELS FOR YIELD AND ITS COMPONENTS

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ABSTRACT

The study was done during winter season 2020-2021 at field of College of Agricultural Engineering Sciences, Duhok University, to evaluate the influence of different phosphorus fertilizer P2O5 rate (0, 60, 90, 120kg ha-1 on yield and yield components of four promising bread wheat Bura, Jehan-99, Apst-35 and Apst-26. The experiment was Laid out in factorial experiments using randomize complete block design with three replications. Significant difference in plant height, flag leaf area (cm), spike length(cm), No. seed spike, weight of seed per spike, 1000-seed weight and total yield were observed by the application of different phosphorus fertilizer 120kg ha-1. However, only days to 75% flowering was not significant affected by different rate of phosphorus fertilizer. Also the results exhibited that the Apast-35 was significant in plant height (104.91cm), flag leaf area (40 cm2), spike length (15.4cm), No. seed per spike (37), seed weight of spike (1.48g), 1000-seed weight (41.09g) and total yield 3.66 (t.ha-1). The simple correlation exhibited positive and significant between yield and plant height (0.89), leaf area (0.85), 1000-seed weight (0.76), No. seed per spike (0.87) and weight of seed spike (0.92), this main these traits were intributed to increase the yield under rate 120kg ha-1of phosphorus P2O5.

INTRODUCTION

Phosphorus is the most important nutrient for plant after nitrogen, its essential plant nutrient required by plant in a large quantity. Phosphorus plays important role in several metabolic processes such as macromolecules, metabolic pathways and degradation. The wheat crop is more required amount of phosphorus as compared to other cereal crops. However, the recovery is as low at 15%-20% of the applied phosphorus, while the remaining is fixed as insoluble phosphorus in soil matrix and 1% of total phosphorus exists in a soluble from a variable for plant and fixations occurred as unreached form to plant for growth (Wahid *et al*.,2015; Timsina and Connor.,2001; Rodriguez and Fraga 1999 and Barbers.,1995).

Several researches indicated that application of phosphorus with adequate amount improve, the plant height, shoots and roots in wheat. Also application of phosphorus to wheat crop significantly increased No. Tiller. plant^{-1}, straw and grain yield Compare it to the control. The unbalanced nutrient in the soil from the improper input of nutrients are probably responsible for the reduced flag leaf and canopy of photosynthetic traits and leaf area index and for the fast declining of flag leaf photosynthetic traits during grain filling, resulting in the reduced in grain yield. (Ali *et al*., 2012; Hussain *et al*.,2008; Karamanos *et al*.,2003 and Valizaden *et al*.,2002). Ortiz *etal*.,2002 revelated that phosphorus efficiency as the ability of genotypes to utilize the nutrient from the soil in the production of grain and biomass. Plant breeders in the world are making efforts to develop high yielding wheat genotypes which as significant and adaptive to a wide range of agro-climatic conditions. Also Sabri *et al*.,2002 revelated that 35% to 50% of bread wheat improvement has been attained through the introduction newly-developed genotypes. The objective of this study to estimate the bread wheat genotypes in producing maximum yield under different phosphorus levels.

MATERIALS AND METHODS

A broad wheat-field was carried out at the farm of field crops department, College of Agricultural Engineering Sciences, University of Duhok, during season 2020-2021. The soil was characterized by loam texture, PH 7.6, low organic matter content (1.6%), high $CaCO_3$ (51%) and a variable P at 6.4mg kg (analyzed in soil laboratory at soil and water department). The average rainfall during the experimental period 35.10m. month. the monthly rainfall (mm) 2020-2021 was 25.1(Nov.), 40.5(Dec.) 83.0(Jan), 19.20(Feb.), 40.8(Mar.) and 2(Apr.) giving in total rainfall for the season of 210.6mm so that using supplementary irrigation (three irrigating to complete the growing season June and July. Experimental variable involved four levels of phosphorus (0, 60, 90 and 120 $kg.ha^{-1}$) applied in a banding at the planting date. Four wheat genotypes (Bura, Jehan-99, Apst-35 and Apst-26) were planted seeds were in 30/11/2020. The sowing density was $120kg.ha^{-1}$. The experiment was arranged in a factorial experiment using randomize complete block design (RCBD) with three replications, and 1/3 of the nitrogen was applied during planting; The remaining urea was applied with broadcast application as 1/2 (80kg ha^{-1}) at tillering and 1/2 (80kg ha^{-1}) at the booting stage. Each genotypes were planted in three row with 3 meter length and 0.20 m between rows, the total No. The total area of experiment was 0.40 *3=1.2m^2.

The data collected from plant height, flag leaf area, spike length, seed weight of spike, 1000-seed weight, No. grain spike and grain yield. The data was analyzed statistically by Minitab. program and the mean differences among the treatment was compared by Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The analysis of variance revealed that bread wheat genotypes, phosphorus levels and their interaction significantly effect on plant height Table (5). Maximum plant height (104.91 cm) was recorded from Apast-35, while the maximum plant height (103.16 cm) was attained when phosphorus was applied at the rate of 120kg ha^{-1}. The plant height increased linearly with increase the application of phosphorus. For interaction between bread wheat genotypes and phosphorus rate, the combination 120kg ha^{-1} P_2O_5 * Apast-35 was recorded the higher value 116.0 cm, that is, an increase in plant height 23-8 percentage. From the result in the same table, it was found that the Apast-35 has exceeded in plant height at level of 120kg ha^{-1} phosphorus. Phosphorus plays an important role in an array of cellular processes. It also helps in cell division and enzyme activation. The above results are in confirmation with finding of Timsina and Connor,2001; Wahid *et al*.,2015 and Tilahun *et al*.,2020.

The mean of days to 75% flowering in indicated in Table 1. The main effect of bread wheat genotypes, phosphorus levels and their interaction had a highly significant (P <0.001) effect on days to 75% flowering of bread wheat genotypes Table 5. Significantly higher mean days to 75% flowering (132.1 days) was recorded from Apast-26. Zero application of phosphorus resulted in long days (134.3 days) to 50% flowering. The short days to 75% flowering (126.6 days) was observed in 120kg ha^{-1} P_2O_5. For interaction between the bread wheat genotypes and phosphorus levels, the combination zero P application and Apast-26 was obtained the higher value (139.6 days). This means that the different levels of phosphorus led to the early flowering and maturity. This result also in agreement with Hussain *et al*.,2008 ; Ali *et al* .,2012 and Melesse.,2017.

The main effect of bread wheat genotypes, phosphorus levels and their interaction had highly significant (P< 0.001) effect on flag leaf area Table 5. The data relating to flag leaf area influenced by different genotypes is presented in Table 2.

Table (1): Effect of bread wheat genotypes, phosphorus levels and their interaction on plant height and days to 75% flowering.

Phosphorus levels	Plant height cm					Days to 75% flowering				
	Bura	Jehan-99	Apast-35	Apast-26	Mean	Bura	Jehan-99	Apast-35	Apast-26	Mean
0	82.6 i	86.0 h	88.3 gh	82.3 I	84.83	128.6 ef	138.0 b	131.0 cd	139.6 a	134.3 a
60	93.3 f	90.3 g	104.0 c	86.0 h	93.41 c	123.3 j	128.0 f	121.3 k	129.6 de	125.5 c
90	96.3 de	95.6 ef	111.33 b	97.0 De	100.83 b	127.3 fg	130.0 de	124.3 ij	127.6 fg	127.3 b
120	94.6 ef	99.0 d	116.0 a	103.0 C	103.16 a	125.6 hi	126.3 gh	123.0 j	131.6 c	126.6 b
Mean	91.75 b	92.75 b	104.91 a	92.08 b		126.2 c	130.5 b	124.9 d	132.1 a	

The values followed by different letters in the same column differ from each other's at probability 5% level.

The largest leaf area (40.0 cm^2) was recorded from Apast-35 bread wheat genotypes, while the smallest (27.6 cm^2) was obtained from Bura. For the phosphorus levels, the rate 120kg.ha^{-1} recorded the higher value (35.4 cm^2) and the lower value (28.2 cm^2) was obtained by zero phosphorus application. Regarding to interaction between bread wheat genotypes and phosphorus levels, the combination 120kg ha^{-1} * Apast-35 had the higher value (46.4 cm^2). From the results in the same table, an adequate quantity from available source of phosphorus is vital for the growth and increase the division of cell plant and due to increase leaf area. The effect of bread wheat genotypes, phosphorus levels and their interaction on spike length was presented in Table 5. Spike length varied due to bread wheat genotypes, the maximum value (15.4 cm) was obtained from Apast-35, whereas the minimum values were recorded from Bura and Jehan-99 (12 cm), also the influence of phosphorus rate in spike length, the rate 120kg ha^{-1} recorded the higher value (14.0 cm) at an increase rate 23.5% significant effect was observed on the interaction effect of bread wheat genotypes and phosphorus levels, the higher value (16.3 cm) was recorded by combination 120kg.ha^{-1} * Apast-35 similar results were obtained by Moushumi *etal*.,2018 and Debele.,2021.

No. grain per spike was highly significant over different phosphorus levels Table 5. The highest No. grains per spike (36.9) from 120k. ha^{-1} showed and the lowest (28.5) from no phosphorus application Table 3. For the effect of bread wheat genotypes was found to be highly significant Table 5. The highest No. grains per spike (37.0) was recorded from Apast-35, while the lowest value (33.0) was obtained from Bura. For the effect of interaction, significant difference was observed in terms. The highest No. grain spike (43.0) was recorded from combination 120kg.ha^{-1} * Apast-35, Whereas the lowest value (25.3) was obtained from combination Apast-26 and zero phosphorus application.

Table (2): Influence of bread wheat genotypes, phosphorus levels and their interaction on flag leaf area and spike length.

Phosphorus Levels Kg ha^{-1}	Flag leaf area (cm)					Spike length (cm)				
	Bura	Jehan-99	Apast-35	Apast-26	Mean	Bura	Jehan-99	Apast-35	Apast-26	Mean
0	24.6 k	29.8 h	35.7 d	22.8 L	28.2 c	10.0 g	10.0 g	14.0 d	9.0 h	10.7 c
60	26.7 j	29.7 h	37.9 c	30.6 g	31.2 c	12.0 e	11.3 ef	15.3 bc	10 g	12.2 b
90	28.7 i	30.8 g	39.3 b	30.8 g	32.5 b	12.0 e	12.0 e	16.0 ab	10.6 fg	12.6 b
120	30.5 g	32.9 e	46.4 a	31.8 f	35.4 a	14.3 d	14.6 cd	16.3 a	10.6 fg	14.0 a
Mean	27.6 d	30.8 b	40.0 a	29.0 c		12.0 b	12.0 b	15.4 a	10.1 c	

The values followed by different letters in the same column differ from each other at probability 5% level.

Bread wheat genotypes, phosphorus levels and interaction between them were highly significant effect on weight of seed spike. The effect of different levels of phosphorus on weight of seed spike, the higher value (1.47g) was obtained from Apast-35. For interaction between genotypes and phosphorus levels, the combination 120kg.ha^{-1} * Apast-35 had higher value (1.80g). the result indicated that P-fertilizer and genotypes significantly increased No. seed per spike and weight of seed spike.
The increase in phosphorus application and the response of wheat genotypes lead to an improvement in the root system and plant growth, especially the flag leaf area in the photosynthesis, which caused an increase in the No. grain per spike and weight of seed spike. These results are similar the finding of Shawl *et al*.,2021 and Bairwa *et al*.,2018. The results clear that, the phosphorus fertilizer has positive effect on yield components of bread wheat genotypes.

Genotypes of bread wheat, phosphorus levels and interaction between them were highly significantly ($P < 0.001$) on thousand grain weight Table 5. The higher mean values (41.09 g) was obtained from Apast-36 followed by Jehan-99 (35.30g). for the phosphorus levels effect the higher value (38.07g) was observed from 120kg ha^{-1} while the lowest value (31.56g) was recorded from zero phosphorus application. Concerning the interaction between wheat genotypes and phosphorus levels, the combination 120kg ha^{-1} * Apast-36 was recorded the highest value (44.59g), whilst the lowest value (26.73) was obtained from combination Bura * zero phosphorus application Table 4. The main total yield of bread wheat genotypes is indicated in Table 4.

Table (3): Effect of bread wheat genotypes, phosphorus levels and their interaction on No. seed per spike and weight of seed spike.

Phosphorus Levels Kg ha^{-1}	No. seed per spike					Weight of seed spike (g)				
	Bura	Jehan-99	Apast-35	Apast-26	Mean	Bura	Jehan-99	Apast-35	Apast-26	Mean
0	29.3 Jk	28.0 K	31.6 gh	25.3 L	28.5 c	0.78 L	0.88 k	1.22 e	0.78 L	0.92 d
60	32.3 h	30.0 Ij	35.6 cd	28.6 jk	31.6 c	0.95 j	1.01 i	1.38 c	0.94 j	1.07 c
90	34.0 ef	31.0 Hi	37.6 b	31.0 hi	33.4 b	1.05 h	1.14 g	1.53 b	1.06 h	1.10 b
120	36.6 bc	35.0 De	43.0 a	33.0 fg	36.9 a	1.17 f	1.38 c	1.80 a	1.33 d	1.47 a
Mean	33.0 b	31.0 C	37.0 a	29.5 d		0.99 d	1.10 b	1.48 a	1.03 c	

The values followed by different letters in the same column differ from each others at probability 5% level.

Main effect of genotypes, phosphorus levels and their interaction had significantly effect on total yield Table 5. Application of 120kg.ha^{-1} of phosphorus was recorded the higher value (3.32 t.ha^{-1}) while the lowest value (2.42 t/ha) was observed from zero phosphorus application. For the bread wheat genotypes, the higher value (3.66 t.ha^{-1}) was obtained from Apast-35, whereas the lowest value (2.47 t.ha^{-1}) was recorded from Apast-26. Regarding the interaction between bread wheat and phosphorus level, the higher value (4.01 t.ha^{-1}) was recorded from combination 120kg ha^{-1}* Apast-35, while the minimum value (1.82 t.ha^{-1}) was obtained from combination Apast-26 and zero phosphorus application or control. Application of phosphorus an adequate quantity from available source is vital for the yield and quality of wheat. An emphasis should be given on the efficient use of P fertilizer in order to maintain sustainable wheat production.

Application of adequate amount of phosphorus improves wheat grain yield. Thus, there is a need to apply the adequate level of phosphorus for obtaining higher yield with a good quality product of wheat. Also from the results in the Table 4. The Apast-36 was significant in the most of yield components such as 1000 grain weight, No. grain per spike and weight of grain spike and gave the higher yield at 120kg ha^{-1} phosphorus level. These results are supported by the finding of Shawl *et al*.,2021; Moushumi *et al*.,2018; Bairwa *et al*.,2018 and Hussain *et al*.,2017.

Table (4): Influence of bread wheat genotypes, phosphorus levels and their interaction on 1000-seed weight and total yield $T.ha^{-1}$.

Phosphorus Levels Kg ha^{-1}	1000-seed weight (g)					Total yield $T.ha^{-1}$				
	Bura	Jehan-99	Apast-35	Apast-26	Mean	Bura	Jehan-99	Apast-35	Apast-26	Mean
0	26.73 N	31.30 k	38.16 e	31.56 k	31.94 d	2.28 i	2.45 h	3.12 d	1.82 j	2.42 d
60	28.91 M	34.53 h	39.78 c	33.69 i	34.23 c	2.77 f	2.60 g	3.63 b	2.14 i	2.78 c
90	30.64 L	36.59 f	41.85 b	35.72 g	36.20 b	2.90 ef	2.81 f	3.90 a	2.54 gh	3.04 b
120	32.71 J	38.77 d	44.59 a	36.23 fg	38.07 a	2.98 e	2.90 ef	4.01 a	3.37 c	3.32 a
Mean	29.75 C	35.30 b	41.09 a	34.30 c		2.73 b	2.69 b	3.66 a	2.47 c	

The values followed by different letters in the same column differ from each others at probability 5% level.

The simple correlation coefficient between yield and yield components and some growth parameters were presented in Table 6. The results revelated that significant positive correlation was detected between total grain and plant height (0.897), Leaf area 0.872, Spike length 0.854, 1000-seed weight 0.765, No. seed spike (0.878) and weight of seed per spike 0.922, while the weight of seed spike was significant correlated with plant height (0.922), Leaf area (0.933) Spike length 0.856, 1000-seed weight (0.911) and No. seed per spike (0.890). the 1000-seed weight was correlated with plant height (0.787), Leaf area (0.912) Spike length (0.744).

Table (5): Analysis of variance for yield and some growth parameter of bread wheat genotypes under different phosphorus levels.

s.o.v	d.f	M.s							
		Plant height cm	Days to 75% flowering	Leaf area cm^2	Spike length cm	No. of seed per spike	Weight of seed per spike (g)	1000-seed weight (g)	Yield T/ha.
Replication	2	6.43	0.77	0.25	0.64	1.08	0.001	0.32	0.038
Phosphorus (P)	3	**791.36	**189.02	**106.30	**21.50	**145.18	**0.54	**83.25	**1.74
Varieties (V)	3	**487.63	**142.74	**371.60	**57.38	**127.02	**0.60	**261.06	**3.37
P xV	9	**45.80	**14.59	**11.94	**1.51	**2.78	**0.005	**1.05	**0.16
Error	30	3.17	0.66	0.10	0.26	0.70	0.0001	0.09	0.007
Total	47								

*, significant at 0.05 level
**, significant at 0.01 level

From the results in table 6 , selection should be made for increased yield because the yield depend on the yield components such 1000-seed weight, No. seed per spike and spike length and also in this study grain yield had the highest communality and consequently the high relative contribution in wheat grain yield, present findings are in confirmation with Ebrahim nejad and Rameeh.,2016; and Mohammed and Mohammed 2020.

Table (6): Simple correlation coefficient between yield and studied traits.

	Plant height traits	Leaf area cm	Spike length cm	Days to 75% flowering	1000-seed weight	No. seed spike	Weight of seed spike (g)
Leaf area cm^2	** 0.828						
Spike length cm	** 0.755	** 0.821					
Days to 75% flowering	** -0.642	** -0.536	** -0.706				
1000-seed weight	**0.787	** 0.912	** 0.744	** -0.390			
No. seed spike	** 0.872	** 0.815	** 0.865	** -0.750	** 0.673		
Weight of seed spike	** 0.922	** 0.933	** 0.856	** -0.583	** 0.911	** 0.890	
Total yield	** 0.897	** 0.872	** 0.854	** -0.640	** 0.765	** 0.878	** 0.922

*, significant at 0.05 level

**, significant at 0.01 level

CONCLUSION

Wheat is a dominant crop in the Kurdistan region the phosphorus is very important for wheat production so that the application of 90 and 120 kg ha^{-1} P_2O_5 increase the yield and yield components and the Apst-35 was a good response to different phosphorus levels and the highest yield was observed at 120kg P_2O_5.

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CONFLICT TO INTEREST

On behalf of all co-authors, the corresponding author declare that there is no conflict of interest in this paper.

تقويم اربعة تراكيب وراثية الواعدة من حنطة الخبز للحاصل و مكوناته تحت تأثير اربعة مستويات من السماد الفوسفاتي

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الخلاصة

أُجريت الدراسة خلال الموسم الشتوي من عام 2020–2021 في كلية علوم الهندسة الزراعية جامعة دهوك لتقدير تأثير اربعة مستويات من السماد الفوسفاتي على الحاصل ومكوناته لأربعة تراكيب الوراثية متفوقة من حنطة الخبز. أستخدام تصميم القطاعات العشوائية الكاملة RCBD وبثلاث مكررات، أظهرت النتائج وجود فروقات معنوية في صفة لأرتفاع النبات والمساحة الورقية و طول السنبلة وعدد البذور في السنبلة و وزن السنبلة ووزن الف حبة والحاصل الكلي وعند اضافة 120 كغ\هـ باستثناء عدد الايام من الزراعة الى ٧٥٪ تزهير كما أظهرت النتائج تفوق الصنف Apast-35 في ارتفاع النبات (104.91 سم) و المساحة الورقية(40 سم٢) وطول السنبلة (15.4 سم) وعدد البذور في السنبلة (37) ووزن السنبلة (1.48 غرام) و وزن الف حبة (41.09 غرام) و الحاصل الكلي 3.66طن/ هكتار. أظهر معامل الارتباط البسيط (r) علاقة معنوية وموجبة بين الحاصل وارتفاع النبات بلغ (0.89) والمساحة الورقية (0.85) ووزن ألف بذرة (0.76) وعدد البذور في السنبلة (0.87) ووزن السنبلة (0.92) ذلك يعني ان هذه الصفات ساهمت مساهمة فعالة في زيادة الحاصل تحت مستويات المختلفة من السماد الفوسفاتي.

الكلمات الدالة: فسفور ، حنطة الخبز ، الحاصل.

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