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GENOTYPIC VARIABILITY AND INTERRELATIONSHIPS AMONG EARLINESS AND YIELD-RELATED TRAITS IN BREAD WHEAT CULTIVARS UNDER DIFFERENT PHOSPHORUS LEVELS AND NITROGEN FORMS

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ABSTRACT: This study aimed to assess the genotypic variability among high-yielding bread wheat cultivars evaluated under three phosphorus (P) levels and three nitrogen (N) forms, clarifying the relationship between earliness and yield traits, and determining the amount of direct and indirect impacts of attributed agronomic traits on grain yield. The field experiment was carried out at Om-Elzain village, Zagazig, during 2017-18 and 2018-19 growing seasons. The results revealed that the evaluated cultivars revealed significant variation for all studied traits. Similarly, P levels presented significant effects on earliness and most yield traits in both seasons. While the N forms did not significantly affect all studied traits in both seasons except plant height, number of spikes/m^2, and 1000-grain weight. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all evaluated traits. The difference between PCV and GCV was very low for days to heading, days to maturity and number of spikes/m^2, while it was relatively higher for number of grains/spike and biological yield. The heritability in broad sense (h^2_b) values were high for 1000-grain weight, number of spikes/m^2, and days to maturity. Plant height, spike length, number of spikes/m^2, number spikelet/spike, 1000-grain weight and biological yield displayed positive direct effect on grain yield. The highest indirect effects on grain yield were assigned for plant height, 1000-grain weight and flag leaf area through biological yield.

Key words: Wheat, earliness traits, yield traits, genotypic and phenotypic coefficients of variation, correlation coefficient, path analysis

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop worldwide. It is the major source of starch and provides considerable amounts of protein, vitamins, phytochemicals, and dietary fiber (**Shewry and Hey, 2015**). Its total cultivated area in Egypt was 3.36 million feddan in 2019 which produced 9.0 million tons (**FAOSTAT, 2021**). Notwithstanding, Egypt is one of the biggest wheat importers, with imports yearly around 10 million tons. Moreover, the gap between exaggerated consumption and national production is expanding due to the fast-growing pop ulation and abrupt climate change (**Mansour *et al*., 2020**). Therefore, increasing wheat production has become a crucial prerequisite to cope with the current constraints.

Mineral fertilization is applied to sustain and improve wheat production (**Mansour *et al.*, 2017**). Phosphorus (P) is a crucial macronutrient to successful growth of all plant cells (**Li *et al.*, 2021**). Besides nitrogen (N) is a major component of chlorophyll, amino acids, energy-transfer compounds, and nucleic acids in plant cells (**Van Tol and Armbrust, 2021**). Accordingly, evaluation of wheat genotypes under different nutrient levels and forms is important to identify more efficient ones in utilizing mineral nutrients (**Mansour *et al*., 2017**).

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The effectiveness of breeding programs is affected significantly by the magnitude of the association between grain yield and its attributed traits as well as the importance of each trait (**Abd-Allah *et al*., 2018**). Path analysis is an efficient statistical analysis to break down the relationships of contributed traits to grain yield into their direct and indirect impacts (**Janmohammadi *et al*., 2014**). Furthermore, genotypic and phenotypic correlations among yield traits could help through indirect selection by selecting easier measuring traits in breeding programs (**Pordel-Maragheh, 2013**).

The current study aimed to assess the genotypic variability among three wheat cultivars evaluated under different phosphorus levels and nitrogen forms as well as to clarify the relationship between wheat earliness and yield traits and determine the amount of direct and indirect impacts of attributed traits on grain yield.

MATERIAL AND METHODS

Field experiment was carried out at the area designated for wheat production in Om-Elzain village, Zagazig, Egypt (30° 39′ N, 31° 23′E) during 2017-18 and 2018-19 growing seasons. The average monthly temperatures, relative humidity, and cumulative precipitation during the two seasons are shown in Table 1. The experimental field soil was clay in texture, its analysis is listed in Table 2. According to the optimal period of wheat, sowing took place on the third week of November in both growing seasons. The preceding crop in both seasons was maize. Standard agronomic treatments in the region including irrigation, weed, disease, and pest control were followed as recommended for wheat production.

Two phosphorus levels versus non-added control (15.5 and 31 kg P_2O_5/fed), three high-yielding commercial cultivars (Shandawel-1, Sids-14, and Sakha-95) and three nitrogen forms (urea 46%N, ammonium sulfate 20.5% N and ammonium nitrate 33.5%N) at a rate of 80 kg N/fed were evaluated. A Spilt-split plot design was applied with three replications. The phosphorus levels were specified to the main plots, wheat cultivars were randomly distributed into subplots and nitrogen forms were randomly allocated in sub-subplots. Each plot consisted of 12 rows 0.15 m apart and 5-m long and the seeding rate was 350 seeds m^{-2}. The used nitrogen amounts (80 kg N/fed) were split into equal three doses, at sowing, after three weeks from sowing, and after 50 days after sowing.

Days to heading represented the number of days between sowing and the date when approximately 2-cm of awns were visible on 50% of stems in the plot. Days to maturity represented the number of days between sowing and the day when approximately 50% of the spikes turned yellow. Flag leaf area (cm^2) was recorded on 10 randomly from the middle rows of each plot at the heading. Plant height (cm) was measured as the distance from the ground surface to the top of the spike excluding awns for 10 plants per plot at maturity. The number of spikes was counted in 0.5 m^2 in each plot. Spike length, number spikelet/spike, number of grains/ spike were measured from 10 randomly selected spikes at each plot. The 1000-grain weight was estimated as the weight of 1000 grains sampled from the harvest of six central rows. Grain and biological yields were recorded by harvesting six central rows from each plot and converting the weight to kilograms per feddan.

Data of the two seasons were analyzed using split-split plot design to study the main effects of P rates, wheat cultivars, and N forms, as well as their interactions using R software version 4.1.1. The phenotypic correlation coefficients and path analyses were calculated according to the revised method of **Dewey and Lu (1959)**.

Genotypic variance (σ^2g), phenotypic variance (σ^2p), phenotypic coefficient of variation (PCV), and genotypic coefficient of variation (PCV) were estimated according to **Burton and Devane (1953)**.

RESULTS AND DISCUSSION

Analysis of Variance

The analysis of variance for earliness and yield traits of three bread wheat cultivars evaluated under three phosphorus levels and three nitrogen forms are presented in Table 3. The P levels presented substantial effects on earliness and most yield traits in both seasons except spike length. The evaluated cultivars displayed significant variation for all studied

Table 1. Monthly minimum (Tmin,◦C) and maximum (Tmax,◦C) temperatures, relative humidity (RH, %), and total precipitation (Prec., mm) for both seasons (2017-2018 and 2018-2019)

Month	Tmin	Tmax	RH.	Prec.
First season (2017-2018)				
November	17.98	22.34	67.21	15.82
December	16.08	20.18	70.42	5.27
January	13.58	17.88	69.38	15.82
February	13.83	19.46	71.12	10.54
March	15.14	22.59	63.64	0.00
April	17.00	24.26	64.76	0.00
May	20.67	27.50	66.49	0.00
Second season (2018-2019)				
November	19.37	23.67	65.30	15.81
December	15.63	19.24	69.01	17.44
January	11.34	17.00	66.03	21.63
February	12.12	17.77	69.27	5.27
March	13.34	18.88	70.16	11.09
April	15.00	21.58	66.50	0.00
May	19.07	27.62	61.25	0.00

Table 2. Soil properties of the experimental site for both seasons 2017-2018 and 2018-2019

Season	Sand (%)	Silt (%)	Clay (%)	Texture	PH	Electrical conductivity (dS/m)	Organic matter (%)	Availabe nutrients (mg/kg soil)		
								N	P	K
2017-18	18.9	34.2	46.9	clay	8.31	1.32	1.62	45.6	12.0	215
2018-19	17.2	33.6	48.7	clay	8.22	1.12	1.59	36.71	10.2	322

Table 3. Mean of squares for earliness and yield-related traits of bread wheat cultivars evaluated under three phosphorus levels and three nitrogen forms during two growing seasons of 2017-18 and 2018-19

SOV	DF	DH	DM	FLA	PH	SL	NS/m^2	NS/S	NG/S	TGW	GY	BY
First season (2017-2018)												
Phosphorus (P)	2	4.46**	7.94**	58.11*	33.64*	2.64^{NS}	3397^{NS}	3.23^{NS}	29.45^{NS}	947.2**	264766**	2394968*
Error a	4	0.23	0.24	7.60	5.75	0.31	799.9	0.55	37.74	8.78	47549	242953
Cultivar (C)	2	45.42**	112.8**	481.5**	380.5**	5.29**	35437**	38.03**	81.13*	575.7**	4073730**	2307220**
P×C	4	1.27^{NS}	1.09^{NS}	25.73*	14.10*	1.89**	13754**	1.78^{NS}	122.0**	179.8**	14951^{NS}	513642^{NS}
Error b	12	0.82	1.15	5.16	6.76	0.35	362.8	0.70	17.66	6.19	41990	222131
Nitrogen (N)	2	0.64^{NS}	0.09^{NS}	7.60^{NS}	14.80^{NS}	0.29^{NS}	6581**	0.21^{NS}	3.96^{NS}	114.4**	17035^{NS}	148835^{NS}
P×N	4	0.16^{NS}	0.44^{NS}	5.64^{NS}	5.40^{NS}	0.29^{NS}	2731**	0.87^{NS}	8.92^{NS}	56.07**	52455^{NS}	131012^{NS}
C×N	4	0.07^{NS}	0.07^{NS}	14.37^{NS}	3.71^{NS}	0.30^{NS}	2560**	0.68^{NS}	48.25^{NS}	88.65**	119666**	387086^{NS}
P×C×N	8	0.23^{NS}	0.28^{NS}	10.58^{NS}	14.83**	0.36^{NS}	5676**	1.32*	85.99*	67.03**	30554^{NS}	164742^{NS}
Error c	36	0.37	0.21	6.13	4.55	0.24	282.7	0.49	20.91	6.41	23381	211393
Replication	2	2.94	3.83	16.03	14.0	1.02	184.8	1.37	13.4	16.56	1893	6362
Total	80	1.81	3.58	23.09	20.20	0.59	2894	1.72	37.63	68.52	145228	345837
Second season (2018-2019)												
Phosphorus (P)	2	5.32**	22.26**	294.8**	14.92*	5.28*	15828**	8.98^{NS}	365.1**	103.4^{NS}	832729**	7467752**
Error a	4	0.28	0.57	2.83	1.90	1.22	594.0	1.40	2.92	18.35	38477	175068
Cultivar (C)	2	54.18**	128.8**	753.5**	600.7**	5.63**	3696**	43.03**	127.7**	642.0**	1579098**	11410000**
P×C	4	1.52^{NS}	3.15^{NS}	44.05*	7.72*	0.23^{NS}	2263*	2.16*	93.02**	115.1**	64528^{NS}	1071539^{NS}
Error b	12	0.98	2.82	8.35	1.90	0.31	513.9	0.49	9.21	8.52	61885	217590
Nitrogen (N)	2	0.77^{NS}	0.78^{NS}	13.55^{NS}	11.31*	0.64^{NS}	1569^{NS}	2.06^{NS}	21.41^{NS}	96.79**	10545^{NS}	12119^{NS}
P×N	4	0.19^{NS}	0.76^{NS}	9.62^{NS}	2.73^{NS}	0.18^{NS}	3939**	0.16^{NS}	8.79^{NS}	81.77**	52746^{NS}	231400^{NS}
C×N	4	0.08^{NS}	0.89^{NS}	25.49^{NS}	3.00^{NS}	0.38^{NS}	5500**	2.31*	14.09^{NS}	32.07*	45406^{NS}	116734^{NS}
P×C×N	8	0.27^{NS}	0.59^{NS}	38.67*	4.15^{NS}	0.27^{NS}	700.4^{NS}	0.96^{NS}	54.70**	37.67**	44691^{NS}	298023^{NS}
Error c	36	0.44	0.61	13.90	2.94	0.33	671.7	0.80	11.86	8.87	30748	271701
Replication	2	3.08	1.04	4.56	4.38	1.38	380.2	2.74	24.37	8.80	1097	9127
Total	80	2.16	4.84	42.13	18.57	0.64	1611	2.25	31.59	42.68	100950	759565

DH is days to heading, DM is days to maturity, FLA is flag leaf area, PH is plant height, SL is spike length, NS/m^2 is number of spikes per square meter, NS/S is number spikelet/spike, NG/S is number of grains/spike, TGW is 1000-grain weight, GY is grain yield and BY is biological yield.

NS: Not significant, * $p < 0.05$, ** $p < 0.01$

traits. While the N forms did not significantly affect all studied traits in both seasons except plant height, number of spikes/m^2 and 1000-grain weight. Likewise, **Majeed *et al*. (2014), Deng *et al*. (2018) and Assefa *et al*. (2021)** demonstrated significant differences among P levels and stimulating impact of high P levels on yield attributes of wheat. Correspondingly, **Yan *et al*. (2010), McDonald *et al*. (2015) and Bilal *et al*. (2018)** recorded similar genotypic variation in yield traits under different P levels. Significant interaction effect between P levels and wheat cultivars was noted for different yield attributes in both seasons (Table 3). The interaction between P level and N form was not significant for all studied traits except number of spikes m^{-2} and 1000-grain weight (Table 3). Likewise, the interaction between wheat cultivars and N forms was not significant for all tested traits except number of spikes m^{-2}, 1000-grain weight, and grain yield.

Genotypic Variability

The phenotypic (PCV) and genotypic (GCV) coefficients of variation values are shown in Table 4. The PCV was higher than GCV values in all investigated traits. Notwithstanding, the values of PCV and GCV differed slightly. The difference between PCV and GCV was very low for days to heading, days to maturity and number of spikes/m^2 (Table 4). This proves slight environmental impacts on these traits. Nevertheless, the difference was relatively higher for number of grains/spike and biological yield. The relatively higher difference between PCV and GCV implies to higher effect of the environment on the expression of these traits. Moreover, broad-sense heritability (h^2_b) values ranged from low to high values for studied traits. The highest h^2_b values were assigned for 1000-grain weight, number of spikes/m^2, and days to maturity. High values of h^2_b for these traits suggest the majority of additive gene action in the inheritance of these traits and thereupon propose selection in early generations. These results are in line with that reported by **Ijaz *et al*. (2015), Dao *et al*. (2017), Abd-Allah *et al*. (2018) and Sharma *et al*. (2018).**

Correlation Coefficient

The correlation coefficients between earliness and yield traits are shown in Table 5. The results revealed that plant height, number of spikes/m^2, 1000-grain weight and biological yield had positive and significant correlation with grain yield. Furthermore, flag leaf area and plant height displayed significant and positive correlation coefficients with biological yield. Besides, number of grains/spike exhibited positive and significant correlation coefficients with spike length and number spikelet/spike. The obtained results proved the importance of these traits in improving grain yield. Similar trends were elucidated by **Poudel *et al*. (2017), Kamara *et al*. (2021) and Gharib *et al*. (2021)**.

Path Coefficient Analysis

Direct and indirect effects of yield attributed traits on grain yield are shown in Table 6. Plant

Table 4. Genotypic variability parameters for the studied traits in three bread wheat cultivars evaluated under three phosphorus levels and three nitrogen forms averaged over both seasons

Trait	σ^2G	σ^2E	σ^2P	GCV	PCV	h^2b
Days to heading	1.241	0.464	1.705	1.105	1.295	0.728
Days to maturity	2.635	0.430	3.065	1.212	1.293	0.877
Flag leaf area (cm^2)	15.46	6.020	21.48	9.510	11.21	0.720
Plant height (cm)	11.99	5.149	17.14	2.050	3.129	0.700
Spike length (cm)	0.233	0.270	0.503	4.218	6.197	0.463
Number of spikes/m^2	2609.6	341.0	2950.6	11.34	12.05	0.884
Number spikelet/spike	1.192	0.539	1.731	5.132	6.183	0.689
Number of grains/spike	13.80	21.45	35.25	5.692	9.097	0.391
1000-grain weight	63.30	6.542	69.85	24.65	25.90	0.906
Grain yield (kg/fed)	114533	29553	144086	10.02	11.23	0.795
Biological yield (kg/fed)	122092	216298	338391	4.107	6.837	0.361

σ^2G: genotypic variance, σ^2E: environmental variance, σ^2P: phenotypic variance, GCV: genotypic coefficient of variation, PCV: phenotypic coefficient of variation and h^2b: heritability in broad sense.

Table 5. Correlation coefficients for the evaluated traits averaged over both seasons

Trait	DH	DM	FLA	PH	SL	NS/m^2	NS/S	NG/S	TGW	BY
DM	0.410^{**}									
FLA	0.604^{**}	0.574^{**}								
PH	0.429^{**}	-0.270^{*}	0.256^{*}							
SL	0.416^{**}	0.481^{**}	0.410^{**}	0.074^{NS}						
NS/m^2	-0.339^{**}	-0.412^{**}	-0.437^{**}	0.101^{NS}	-0.411^{**}					
NS/S	-0.457^{**}	0.012^{NS}	-0.405^{**}	-0.447^{**}	0.065^{NS}	0.095^{NS}				
NG/S	0.001^{NS}	0.168^{NS}	0.177^{NS}	-0.114^{NS}	0.443^{**}	-0.143^{NS}	0.380^{**}			
TGW	-0.054^{NS}	-0.300^{**}	-0.079^{NS}	0.268^{*}	-0.268^{*}	0.390^{**}	0.112^{NS}	0.030^{NS}		
BY	0.247^{*}	-0.067^{NS}	0.273^{*}	0.575^{**}	0.176^{NS}	0.133^{NS}	-0.200^{NS}	0.118^{NS}	0.363^{**}	
GY	0.146^{NS}	-0.588^{**}	-0.119^{NS}	0.649^{**}	-0.182^{NS}	0.307^{**}	-0.237^{*}	-0.193^{NS}	0.473^{**}	0.573^{**}

DH : days to heading, DM : days to maturity, FLA : flag leaf area, PH : plant height, NS/m^2 : number of spikes per square meter, SL : spike length, NS/S : nnumber spikelet/spike, NG/S : number of grains/spike, TGW : 1000-grain weight, BY : biological yield and GY : grain yield.

Table 6. Direct and indirect effect of yield traits on wheat yield

	DF	DM	FLA	PH	SL	NS/m^2	NS/S	NG/S	TGW	BY
DF	**0.271**	-0.217	-0.038	0.069	0.007	-0.004	-0.023	0.000	-0.008	0.090
DM	0.111	**-0.530**	-0.036	-0.043	0.008	-0.005	0.001	-0.025	-0.044	-0.025
FLA	0.164	-0.304	**-0.063**	0.041	0.006	-0.005	-0.020	-0.026	-0.011	0.100
PH	0.116	0.143	-0.016	**0.160**	0.001	0.001	-0.022	0.017	0.039	0.210
SL	0.113	-0.254	-0.026	0.012	**0.016**	-0.005	0.003	-0.065	-0.039	0.064
NS/m^2	-0.092	0.218	0.028	0.016	-0.006	**0.012**	0.005	0.021	0.057	0.049
NS/S	-0.124	-0.006	0.026	-0.072	0.001	0.001	**0.050**	-0.056	0.016	-0.073
NG/S	0.000	-0.089	-0.011	-0.018	0.007	-0.002	0.019	**-0.146**	0.004	0.043
TGW	-0.015	0.159	0.005	0.043	-0.004	0.005	0.006	-0.004	**0.146**	0.133
BY	0.067	0.036	-0.017	0.092	0.003	0.002	-0.010	-0.017	0.053	**0.366**

DH : days to heading, DM : days to maturity, FLA: flag leaf area, PH : plant height, NS/m^2 : number of spikes per square meter, SL : spike length, NS/S : nnumber spikelet/spike, NG/S : number of grains/spike, TGW : 1000-grain weight, BY: biological yield and GY : grain yield.

height, spike length, number of spikes/m^2, number spikelet/spike, 1000-grain weight and biological yield displayed positive direct effect on grain yield. This confirms the efficacy of direct selection for these traits to achieve high grain yield. The highest indirect effects on grain yield were assigned for plant height, 1000-grain weight and flag leaf area through biological yield (Table 6). This indicates the presence of a true relationship between the aforementioned traits and grain yield. The obtained results depict that direct and indirect selection through these traits is very useful for developing high-yielding wheat genotypes. These results are in agreement with that reported by **Naghavi and Khalili (2017), Abd-Allah *et al*. (2018) and Sharma *et al*. (2018)**.

REFERENCES

Abd-Allah, H.T., H.A. Rabie, E. Mansour and A.A. Swelam (2018). Genetic variation and interrelationships among agronomic traits in bread wheat genotypes under water deficit and normal irrigation conditions. Zagazig J. Agric. Res., 45: 1209-1229.

Assefa, S., W. Haile and W. Tena (2021). Effects of phosphorus and sulfur on yield and nutrient uptake of wheat (*Triticum aestivum* L.) on Vertisols, North Central, Ethiopia., Heliyon, 7 (e06614): 1-12.

Bilal, H.M., T. Aziz, M.A. Maqsood, M. Farooq and G. Yan (2018). Categorization of wheat genotypes for phosphorus efficiency. PloS one, 13 (e0205471): 1-20.

Burton, G.W. and D.E. Devane (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material 1. Agron. J., 45 (10): 478-481.

Dao, A., J. Sanou, V. Gracen and E. Danquah (2017). Selection of drought tolerant maize hybrids using path coefficient analysis and selection index. Pak. J. Boil. Sci., 20 : 132-139.

Deng, Y., W. Teng, Y. Tong, X. Chen and C. Zou (2018).Phosphorus efficiency mechanisms of two wheat cultivars as affected by a range of phosphorus levels in the field. Front. Plant Sci., 9 (1614):1-12.

Dewey, D.R. and K.H. Lu (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J., 51: 515-518.

FAOSTAT (2021). Food and Agriculture Organization of the United Nations. Statistical Database. Availabe online: http:// www.fao.org/faostat/en/#data (accessed on 5 November 2021).

Gharib, M.A.A.H., N. Qabil, A.H. Salem, M.M.A. Ali, H.A. Awaad and E. Mansour (2021). Characterization of wheat landraces and commercial cultivars based on morpho-phenological and agronomic traits. Cereal Res. Commun., 49: 149-159.

Ijaz, F., I. Khaliq and M.T. Shahzad (2015). Estimation of heritability for some yield contributing traits in F2 populations of bread wheat (*Triticum aestivum* L.). J. Agric. Res., 53: 157-164.

Janmohammadi, M., N. Sabaghnia and M. Nouraein (2014). Path analysis of grain yield and yield components and some agronomic traits in bread wheat. Acta Univ. Agric. Silvic. Mendel. Brun., 62: 945-952.

Kamara, M.M., K.M. Ibrahim, E. Mansour, A. Kheir, M.O. Germoush, A. El-Moneim, M.I. Motawei, A.Y. Alhusays, M.A. Farid and M. Rehan (2021). Combining ability and gene action controlling grain yield and its related traits in bread wheat under heat stress and normal conditions. Agron., 11 (1450):1-27.

Li, A., B. Hu and C. Chu (2021). Epigenetic regulation in nitrogen and phosphorus responses of plants. J. Plant Physiol., 153363: 258-259.

Majeed, M.A., R. Ahmad, M. Tahir, A. Tanveer and M. Ahmad (2014). Effect of phosphorus fertilizer sources and rates on growth and yield of wheat (*Triticum aestivum* L.). Asian. J. Agric. Biol., 2: 14-19.

Mansour, E., A. Merwad, M. Yasin, M. Abdul-Hamid, E. El-Sobky and H. Oraby (2017). Nitrogen use efficiency in spring wheat: Genotypic variation and grain yield response under sandy soil conditions. J. Agric. Sci., 155: 1407-1423.

Mansour, E., E.S. Moustafa, E.-S.M. Desoky, M. Ali, M.A. Yasin, A. Attia, N. Alsuhaibani, M.U. Tahir and S. El-Hendawy (2020). Multidimensional evaluation for detecting salt tolerance of bread wheat genotypes under actual saline field growing conditions. Plants, 9 (1324): 1-22.

McDonald, G., W. Bovill, J. Taylor and R. Wheeler (2015). Responses to phosphorus among wheat genotypes. Crop Pasture Sci., 66: 430-444.

Naghavi, M.R. and M. Khalili (2017). Evaluation of genetic diversity and traits relations in wheat cultivars under drought stress using advanced statistical methods. Acta agric. Slov., 109 (2): 403-415.

Pordel-Maragheh, F. (2013). Investigate the relationship and path coefficient analysis between yield and its components in the number of winter wheat genotypes in the cold region of Ardabil. Eur. J. Zool. Res., 2: 82-88.

Poudel, A., S.K. Ghimire, B.R. Ojha, B.D. Acharya and D.B. Thapa (2017). Effect of Terminal drought stress on morpho-physiological and yield potential traits of bread wheat genotypes. Pak. J. Biol. Sci., 5: 1145-1153.

Sharma, P., M. Kamboj, N. Singh, M. Chand and R. Yadava (2018). Path coefficient and correlation studies of yield and yield associated traits in advanced homozygous lines of bread wheat germplasm. Int. J. Curr. Microbiol. Appl. Sci., 7: 51-63.

Shewry, P.R. and S.J. Hey (2015). The contribution of wheat to human diet and health. Food Energy Secur., 4: 178-202.

Van Tol, H.M. and E.V. Armbrust (2021). Genome-scale metabolic model of the diatom Thalassiosira pseudonana highlights the importance of nitrogen and sulfur metabolism in redox balance. PloS one, 16 (e0241960): 1-35.

Yan, H., W. Liu, X. Liu, G. Li and S. Zhang (2010). Comparison of rhizosphere impacts of two wheat genotypes differing in phosphorus utilization efficiency. Can. J. Plant Sci., 90: 311-317.

التباين الوراثي والعلاقات المتبادلة بين التبكير وصفات المحصول في أصناف قمح الخبز تحت مستويات مختلفة من الفوسفور وصور النيتروجين

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تهدف هذه الدراسة إلى دراسة التباين الوراثي بين أصناف قمح الخبز عالية المحصول حيث تم تقييمها تحت ثلاثة مستويات من الفوسفور وثلاثة صور من النيتروجين، كذلك توضيح العلاقة بين صفات التبكير وصفات المحصول وتحديد مقدار التأثيرات المباشرة وغير المباشرة لهذه الصفات. أجريت التجربة الحقلية في قرية أم الزين بالزقازيق خلال موسمي الزراعة 2017-2018 و 2018-2019. أظهرت النتائج أن الأصناف التي تم تقيمها أظهرت تباينًا معنويًا لجميع الصفات المدروسة. كذلك أظهرت مستويات الفسفور تأثيرات معنوية على صفات التبكير ومعظم صفات المحصول في كلا الموسمين. بينما لم تؤثر صور النيتروجين معنوياً على جميع الصفات تحت الدراسة في كلا الموسمين باستثناء ارتفاع النبات وعدد السنابل في المتر المربع ووزن الألف حبة كان معامل التباين المظهرى (PCV) كان أعلى من معامل التباين الوراثى (GCV) لجميع الصفات تحت الدراسة. كان الفرق بين PCV و GCV منخفضًا لعدد الأيام حتي التزهير، عدد الأيام حتى النضج وعدد السنابل في المتر المربع، بينما كان الفرق عالي نسبيًا لعدد حبوب السنبلة والمحصول البيولوجي. وكانت قيم كفاءة التوريث في المعنى الواسع (h^2b) عالية لصفة وزن الألف حبة، عدد السنابل في المتر المربع وعدد الأيام حتى النضج. أظهر ارتفاع النبات وطول السنبلة، عدد السنابل في المتر المربع، عدد السنيبلات في السنبلة، وزن الألف حبة والمحصول البيولوجي تأثيرًا إيجابيًا مباشرًا على محصول الحبوب. كذلك تم تحديد أعلى تأثيرات موجبة غير مباشرة على محصول الحبوب لارتفاع النبات، وزن الألف حبة ومساحة ورقة العلم من خلال المحصول البيولوجي.

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