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Effect of different environmental location on the estimation of genetic parameters in the characters of growth and yield of varieties of wheat

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Abstract

An experiment on nine varieties of wheat (tamoz 1, tamoz 2, Abba 95, Abba 99, maxebak, alrasheed, latefeae, Abu greeb and Sham 6) was carried out in three different locations (Wasit, Diwaniya and Dhi- Qar) during winter 2016-17. In order to estimate some of genetic traits. The experiment was applied according to RCBD, with three replicates. Assess the components of phenotypic variation (G and E) based on expected mean variance of the fixed model. The predicted genetic improvement was assessed and the phenotypic, genetic and environmental variances were significantly tested for zero. According to the environmental, genetic, and phenotypic variation, the extent of inheritance in the broad sense, and the limits of expected genetic improvement. alrasheed cultivar was the best in yield (4.267, 4.532, and 4.308 tons .e.1) for the location respectively. The second site gave the highest average grain yield (3.600 tons.h^{-1}). Wasit Governorate recorded the highest variance and environmental difference coefficient (862.5 and 3.38) respectively. Diwaniyah Governorate achieved the highest genetic and phenotypic differences (27659.722 and 28522.222) respectively. While the province of Dhi-Qar showed a difference of genetic and phenotypic (18.693 and 18.847) sequentially. Dhi-Qar recorded highest inheritance rate in the broad sense (0.98), highest expected genetic and improvement percentage (244.963,28.738%), Compared to the governorates of Wasit and Diwaniyah.

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Introduction

One third of the human population shares wheat grains as a staple food, and man tried hard to find varieties that were impregnated, tolerant and productive in all the different and harsh conditions of the environment. This effort lasted for a long period of human history and its conflict with nature. It was able to offer varieties that grow in different environments with a relative difference in productivity, Some of which have a high level of performance and productivity, based on environmental and genetic variability and variability. The variation of phenotypic and genetic characteristics and their milestones is the basis for the improvement of any vegetarian society by choice and hybridization or vice versa. Variations are either the result of a genetic, environmental or interrelated effect (Chenu *et al*, 2011), and genetic improvement depends on the amount of inheritance of these variants. Some traits of growth and yield of varieties in heterogeneous environments can be predicted or estimated after identification of their phenotypic and genetic characteristics (Demisie, 2016 and Mohamed, 2013) and the strength of their association (Herrera *et al*, 2017).

High-yielding or relatively fixed varieties for several years and in several locations rely on the capacity of their genetic base, Mutwali *et al.* (2015) which helps them adapt to different environmental conditions. Varieties with a high degree of genetic variation are more likely to grow and have higher yields than a homogenous or less genetically modified structure. The inherited variations resulting from severe environmental variation or the change in growth factors may cause the appearance of different phenotypic traits resulting from altered gene expression. The absence of hereditary variability among varieties or having similar variability in genotype and phenotypic behavior reduces their competitiveness and a certain range of growth factors (Mut *et al.*, 2010 and Storck *et al.*, 2016).

The theory of genetics has shown that genetic shift is likely to occur in genetically modified species and at significantly lower rates when exposed to severe or sudden internal or external effects in those communities.

The principal component analysis (PCA) is currently used to determine the persistence of species, their interrelationships with their environments and the growth factors assumed to determine the relationship between genes based on their genetic expression (Abd El Mohsen and Amein, 2016., Mehari *et al.*, 2015). The sources of variation that affect the external appearance and genetic structure are caused by genetic and environmental differences (Khan and Khalil, 2011., Subira *et al.*, 2015), and their overlap reduces the association between genetic and phenotypic values due to the multiple effects of genes, causing genetic variations in the traits responsible for them. Large-scale genotypes have additional effects, while hybrids have sovereign genetic effects, superior genetic dominance (Bornhofen *et al.*, 2017), or silent genes, which appear in a particular environment (Mohammadi *et al.*, 2016 a). Quantities have a low degree of inheritance and when in the broad sense, more than 50% are high and are affected by a low percentage of the environment may not be accompanied by high genetic progress when the standard deviation is low, indicates the host action of the gene, and if it ranged between 20-50% or less than 20% They are medium and hereditary in succession to that character and are accompanied by an average or low hereditary progression.

The function is under the influence of an additional genetic act. The inheritance of these traits contains both the host and the non-host of the gene (Agarwal and Ahmad, 1982) and the persistence of the genetic act depends on the improvement ratio (Mohammadi *et al.*, 2016 a., Mather and Jink, 1982). Therefore, it is possible to predict and estimate certain traits of growth and yield of species in different environments after their morphological and genetic characteristics and the strength of their association (Bhatta, 2015., Khalil *et al.*, 2016., Mohammadi *et al.*, 2016 b., Walter, 1975). The difficulty of collecting the improved quantitative qualities in the plant because of the environmental genetic interference (GE) This study was conducted in several sites to study the response of the components of the grain of several varieties by the indicators of environmental and genetic variation and its effect on the grain yield of several varieties of bread wheat. Where the identification of genetic traits and the impact of the environment on them, which can be an electoral guide in breeding programs and improve the wheat bread crop, to determine and the selection of best hybrid for the environment of Iraq, where the crop of wheat grain is the first crop in Iraq.

Materials and methods

Field preparations

A field experiment was carried out in three different ecological sites at the Kutlocation of Wasit Governorate and in Al-Shamiya, Diwaniyah Governorate and Shatrahlocation in DhiQar governorate, with the aim of estimating some of the genetic characteristics of nine varieties of bread wheat (Tamoz 1 and Tamoz 2, maxebac, Alrasheed, Abba 95, latefeae, Abba 99, Abu greeb and Sham 6).

The experiment was applied according to the design of the complete random sectors with three replicates, in the sand-sanded soil of the three location. The seeds were planted by 120kg E-1 in mid-November 2015. The agriculture was carried out in the lines between the line and the other 20cm, and the superphosphate fertilizer was added by 200kg e-1 at a time of tillage. The urea fertilizer was added 46% nitrogen by 200kg E-1 in two batches after 30 days of planting and at the point of centrifugation. The experimental unit area was 5x4m².

Crop measurements

The traits of plant height (cm), number of taller, length of spike (cm), number of grains in spike, 1000g (grain) and grain (ton/ha) were studied. The components of phenotypic (genetic and environmental) variability were estimated based on the predicted variance of the fixed model. Estimated genetic improve Expected and tested the genetic and environmental differences from zero according to the method Kempthorme (1969). The phenotypic variation is derived from Mather and Jinks (1984). Environmental, genetic, and phenotypic factors were calculated according to Falconer (1981), and H3BS was estimated by Hanson *et al.,* (1956) as broad-sense heritability and adopted the limits of inheritance in the broad sense, if less than 40% is low and 40-60% average and more than 60% high. The observed Observance Selection Response (Ro) ranges and limits, as indicated by Agarwal and Ahmed (1982), are low if less than 10% and moderate if they are between 10-30% and higher than 30% are high. The mean values of the traits were tested using the least significant difference at a significant level of 5% and 1%. The analysis of variance was performed according to the design used by Kempthorme (1969) to test the significance of the coefficients.

Determination of phenotypic variance according to variance equation VE + VG = VP

Where: VG= variance, environmental variance VE and phenotypic variance (VP). The difference coefficients were calculated according to the following equations Mather and Jinks (1982).

PCV = σp / x X 100

GCV = σg / x X 100

ECV = σe / x X 100

The coefficient of phenotypic variation is the Coefficient of phenotypic variance (GCV) and the GCV (Coefficient of phenotypic variance). The coefficient of environmental variation is Coefficient of phenotypic variance (ECV), the standard deviation of the total variance (Pσ), the standard deviation of genetic variation (Gσ) and the standard deviation (E) σ where:

PCV = σp / x

H2 BS = Vg / Ve

Re = i × V Vp × h2 Re

Ro = S × H2.

Statistical analysis

The data were analyzed statistically according to the variation analysis method (ANOVA) for R.C.B.D, the sequencing of splinter panels and the use of the last significant difference test (L.S.D) to compare means of treatments at a level of probability (5%).

Result and discussion

The first location (Wasit-Kutlocation)

Table (1) shows that the cultivars at the first site differed significantly in all their growth characteristics, grain yield and components.

The total number of cultivars was higher than the total number of cultivars in the plant height and 107.667cm respectively. The results indicate the superiority of the rational variety by giving the highest average number of taller, the length of the spike, the number of grains in the spike, the weight of 1000 grains, the plant yield (12.667 tellers, 1, 12.66cm, 70.667 spike, 55.00g, 4.267 tons, Compared with other species, where the average of the two cultivars Maxipac and 95 were similar with the lowest average number of plant tellers (6.333 plant branches -1). The yield of July 2 was less than the average length of the spike (8.667cm) and the length of the spike, the number of spike grains and the weight of 1000 grain of the class 6 (8.667, 40.667 and 20.667) respectively decreased. The average grain yield was 2.853 tons.

The main reason for the different characteristics between the studied varieties is due to the genetic variation between these varieties in terms of nature and genetic behavior, and the superiority of the rational in the product of the grain to its superiority in all components of the yield, which reflected positively by giving the highest grain in the unit area. The absence of genetic differences between species can reduce their competitiveness and a certain range of growth factors (Mather and Jinks, 1982., Mohammadi *et al.*, 2016 b).

Table 1. Average height of plant and grain yield and components of the genetic composition of bread wheat in the first location (Wasit governorate).

	Genotype	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
1	Tamoz1	85.000	9.667	10.000	64.333	34.000	3.213
2	Tamoz2	86.000	8.667	8.667	66.333	35.667	3.307
3	maxebac	82.333	6.333	9.333	61.333	30.667	2.853
4	alrasheed	102.667	12.667	12.667	70.667	55.000	4.267
5	Abba 95	104.333	6.333	10.333	62.000	34.333	3.880
6	latefeae	102.000	6.667	9.000	59.333	31.667	3.387
7	Abba 99	107.667	8.000	10.667	58.667	33.000	4.133
8	Abu greeb	102.000	10.333	10.000	50.667	31.667	3.827
9	Sham 6	84.000	7.333	8.667	40.667	20.667	2.947
	L.S.D 0.05	2.797	1.657	0.833	1.695	1.602	0.358
	L.S.D 0.01	3.854	2.283	1.147	2.335	2.207	0.493

Genetic and phenotypic values (Wasit)

The results of Table (2) indicated that the genetic variability of the studied traits is relatively similar to the phenotypic variance. It was higher than the environmental variance. The highest environmental variability of the yield components was achieved by the number of grains (0.32) and the highest genetic variation recorded at 100.30, 80.30 and 108.33 followed by grain weight and number of grains 80.58 and 79.69, the difference was not high compared to other studied traits. The values of the genetic variation coefficient were relatively proportional to the values of the phenotypic variation coefficients. The highest number of branches (6.55) was recorded in the number of branches. The highest weight was obtained by the weight of the grains (26.30). The difference was the difference in the number of branches of the plant (Mutwali *et al.*, 2015). The highest difference was the weight difference of the grains (26.34) A simple relative coefficient of genetic variation of the number of branches per plant (25.28). The results indicate that all values of inheritance in the broad sense were high and all traits, with a minimum of 0.93 for the number of branches in the plant, while the values of the number of grains and the weight of 1000 tablets were similar to 1.00. The predicted genetic improvement values for grain count and grain weight (13.78 and 13.86) were affected sequentially. However, when calculated as a percentage, the highest genetic improvement expected was for the weight of the pill (40.69). The values of the coefficient of environmental and genotypic variation are consistent with the homogeneity of the effect of these traits.

The difference in the results is due to the high heterogeneity between the components of the product and the high coefficient of phenotypic differences. The coefficient of genetic variation was the main factor influencing homogeneity of the phenotypic characteristics of all studied traits. In other words, sources of variation that affect the external appearance and genetic structure are caused by genetic differences and environmental impacts (Herrera *et al*, 2017.,Mut *et al*, 2010).

Table 2. The general mean, variance, and the environmental and genetic differences of varieties of bread wheat in Wasit Governorate.

Statistical and genetic constants	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
General average	95.111	8.444	9.926	59.333	34.074	3.532
Environmental Contrast	0.87	0.31	0.08	0.32	0.29	891.98
The standard error	0.87	0.30	0.08	0.32	0.29	891.97
Genetic variation	107.46	4.25	1.50	79.38	80.30	15403.70
The standard error	48.45	2.04	0.71	35.64	36.04	7293.68
Phenotypic variation	108.33	108.33	1.58	79.69	80.58	16295.68
The standard error	31.27	1.32	0.45	23.01	23.26	4704.16
Coefficient of environmental variation	0.98	6.55	2.89	0.95	1.57	3.38
Genetic variation coefficient	10.90	24.41	12.34	15.02	26.30	14.04
Factor of phenotypic variation	10.94	25.28	12.65	15.05	26.34	14.45
Inheritance in the broad sense	0.99	0.93	0.95	1.00	1.00	0.95
Expected genetic improvement	16.00	3.09	1.85	13.78	13.864	187.03
Expected genetic improvement as a percentage	16.826	36.549	18.652	23.228	40.689	21.165

The second location (Diwaniyah -Shamiya governorate)

The results of Table (3) indicated that the differences between the plant varieties and all the traits of the yield components and the grain yield indicate that there is a genetic difference between them. The average height of the plant (112.33cm) was higher than the other cultivars, especially the Maxibac species, which achieved the lowest height of the plant (82.33cm). The superiority of the class Spectroscopic by giving the highest average number of taller plant (12.33 tellers) compared to other varieties, which decreased significantly in the average this trait, and reached its lowest value 5.67 teller. Leaf-1 for spectrum. Cultivar surpassed 99 fathers moral scoring the highest average length of spike (11.67cm) while average this trait was significantly decreased for the class Cham 6 which achieved less than the length of the spike was 8.33cm. Superiority of good breed in the average characteristics of the most important components of winning number of grains spike and weight of 1000 grains (69.33 grain. Spike -1 and 54.00g), making it superior in the average quotient of grain per unit area as the 4532 Tun.h-1 was compared to other varieties, which averages less achieved, especially class Cham 6, which was significantly lower for all varieties and achieved a lower average quotient of grain reached 2532 Tun.h-1, and the reason is due mainly to a major decline in all holds grain components. Perhaps insult is also due to the presence of some inherited mutations caused by environmental variability or extreme change in the order of growth factors that led to the emergence of different qualities superficial caused by changing the characteristics of gene expression careless (Mutwali *et al.*, 2015).

Genetic and phenotypic variation values (Diwaniya)

Table (4) showed that the genetic variance of the studied traits differed slightly from the phenotypic variance, but was higher than the environmental variance. The highest environmental variation was obtained from the weight components of 1000 tablets (0.565), while the number of grains recorded the highest genetic variation (75.259) (75.559), followed by the weight of the grain which gave 62.250 and the difference was not high compared to the other studied traits.

The values of the genetic variation coefficient were similar to those of the relative phenotypic variance coefficients. The number of branches recorded the highest environmental difference coefficient (5.955), the highest genetic difference coefficient (25.382), and the highest difference coefficient (26.071). The results indicate that all inheritance values in the broad sense were high and for all traits ranging from 0.991 to 1000 and 0.996 for spike.

The predicted genetic improvement values of the components were affected and the highest genetic improvement was obtained for the number of grains and grain weight (13.420 and 12.118) respectively. As for the genetic improvement expected as a percentage, the number of branches achieved the highest percentage of all components of the product (38.303). Genetic improvement depends on the amount of inheritance of these variants.

Table 3. Average height of the plant and the yield of grain and its components for the genetic composition of bread wheat in the province of Diwaniyah.

Genotype	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
Tamoz1	85.00	10.00	11.00	60.00	35.33	4.080
Tamoz2	85.00	9.67	9.00	67.33	35.33	4.092
Maxebac	82.33	6.67	9.00	62.33	34.00	2.668
Alrasheed	106.33	12.33	11.33	69.33	54.00	4.532
Abba 95	105.33	7.00	10.67	57.67	36.00	3.852
Latefeae	103.33	5.67	10.00	52.67	31.67	3.160
Abba 99	112.33	8.00	11.67	55.33	34.00	3.748
Abu greeb	104.33	9.67	9.67	52.33	31.00	3.732
Sham 6	84.33	6.33	8.33	40.67	24.67	2.532
L.S.D 0.05	3.87	1.49	1.32	1.64	2.25	0.352
L.S.D 0.01	2.81	2.06	1.80	2.26	3.11	0.485

Table 4. The general mean, variance, and environmental and genetic differences of varieties of bread wheat in Diwaniya Governorate.

Statistical and genetic constants	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
General average	96.481	8.370	10.074	57.519	35.111	3.600
Environmental Contrast	0.878	0.248	0.193	0.299	0.565	862.500
The standard error	0.876	0.247	0.191	0.297	0.564	862.500
Genetic variation	142.458	4.514	1.162	75.259	61.685	27659.722
The standard error	64.102	2.131	0.609	33.791	27.840	12758.701
Phenotypic variation	143.336	4.762	1.355	75.559	62.250	28522.222
The standard error	41.378	1.375	0.391	21.812	17.970	8233.656
Coefficient of environmental variation	0.971	5.955	4.360	0.951	2.140	3.263
Genetic variation coefficient	12.371	25.382	10.701	15.082	22.369	18.479
Factor of phenotypic variation	12.409	26.071	11.555	15.112	22.471	18.765
Inheritance in the broad sense	0.994	0.948	0.858	0.996	0.991	0.970
Expected genetic improvement	18.443	3.206	1.547	13.420	12.118	253.856
Expected genetic improvement as a percentage	19.116	38.303	15.360	23.331	34.514	28.206

Third location (DhiQar Governorate –Shatrah)

The results of Table (5) indicated that 30% of the high-altitude varieties did not differ significantly in the average height of their plants. Both Rasheed and Abba 95 and Aba 99 were similar in the mean 104.33cm/Plant and the record of Maksibac lowest average plant height of 82.33cm.

The cultivar Sabah recorded the highest mean number of branches in the plant (12.33 branches). Note that Sabah cultivar was significantly higher in the number of taller plant (12.33 branch 1), while one third of the cultivars (maxibac, 95 and spectral) were similar and significantly decreased in the mean (6.33 branch -1).

The two cultivars were significantly superior to the average length of the spike (11.33 and 11.00cm respectively), compared to the other varieties which gave lower values for the mean. The grain in the spike was 71.00 spike seed -1, while all varieties were significantly lower in this medium, especially Cham 6, which gave the lowest average number of grains with spike of 37.33 spike-1. The Rasheedvariety was significantly higher in the average weight of 1000 grain, compared to the other varieties, which gave very low values for the highest average of this characteristic, especially Cham 6, with an average weight of 1000 grain of 22.00g. All indicators of the components of the product indicate the superiority of the rational variety of the components of the product, which was positively reflected in the superiority of the same category in the grain yield for the unit area (4.308 tons e-1), which is the final index of the accumulation of these components, while having a negative impact and a significant low trend of the class Which gave the lowest average of the components of the grain and the total, which amounted to 2,640 tons e - 1.

Table 5. Average height of the plant and the yield of grain and its components for the genetic composition of bread wheat in the third location (DhiQar governorate).

Genotype	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
Tamoz1	85.00	10.33	9.00	57.67	31.67	4.208
Tamoz2	84.00	10.00	9.67	71.00	34.67	3.348
Maxebac	82.33	6.33	9.33	58.67	33.67	2.360
Alrasheed	104.33	12.33	11.33	69.00	52.00	4.308
Abba 95	104.33	6.33	10.33	61.00	34.33	3.572
Latefeae	100.67	6.33	9.33	54.00	31.00	3.132
Abba 99	104.33	8.00	11.00	54.67	28.33	3.652
Abu greeb	100.33	9.33	9.67	52.33	31.67	3.468
Sham 6	83.33	7.33	8.67	37.33	22.00	2.640
L.S.D 0.05	1.910	1.52	1.27	1.65	1.562	0.246
L.S.D 0.01	2.632	2.10	1.75	2.28	2.153	0.338

Genetic and descriptive variation values (DhiQar)

The results in Table (6) show that the genetic variance values of the grain content were relatively close to the phenotypic variance, which was significantly higher than the environmental variability. The number of grains in the spike achieved the highest environmental variation (0.304), the highest genetic variation (97.375) (97.679) and a significant difference from the rest of the other components. The values of genetic and phenotypic variation coefficients were relatively close. The number of branches was highest with the highest environmental difference coefficient (5.985), the highest genetic variation (24.531), and the difference between the weight difference coefficient of 1000 (24,090) and the highest difference coefficient (25,250). 1000 tablets (24.141).

Table 6. The general mean, variance, and environmental and genetic differences of varieties of bread wheat in DhiQar Governorate.

Statistical and genetic constants	Plant height	Number of tiller	Long of spike	Number of spike grains	Weight of 1000 grains	Grain yield (ton.h-1)
General average	94.296	8.481	9.815	57.296	33.259	3.408
Environmental Contrast	0.406	0.258	0.179	0.304	0.272	420.216
The standard error	0.404	0.257	0.176	0.302	0.270	420.214
Genetic variation	103.968	4.329	0.630	97.375	64.194	25390.278
The standard error	46.677	2.053	0.367	43.683	28.830	11543.596
Phenotypic variation	104.373	4.586	0.809	97.679	64.466	25810.494
The standard error	30.130	1.324	0.233	28.198	18.610	7450.848
Coefficient of environmental	0.676	5.985	4.311	0.962	1.567	2.405
Genetic variation coefficient	10.813	24.531	8.085	17.223	24.090	18.693
Factor of phenotypic variation	10.834	25.250	9.162	17.249	24.141	18.847
Inheritance in the broad sense	0.996	0.944	0.779	0.997	0.996	0.984
Expected genetic improvement	15.774	3.133	1.085	15.271	12.393	244.963
Expected genetic improvement as a percentage	16.728	36.939	11.057	26.653	37.261	28.738

The results showed that the number of grains and weight of 1000 grains achieved the highest inheritance ratio in the broad sense (0.997 and 0.996) sequentially among the components studied. The number of grains recorded the highest predicted genetic improvement values (15,271). The weight of 1000 tablets gave the highest percentage of expected genetic improvement (37.261) followed by the number of plant branches (36.939). The results showed that the number of tallers and grains and the weight of 1000 grian for high variability values and the coefficient of genetic and phenotypic differences were significant. In addition, the total number of grains per hectare in Wasit, Diwaniyah and DhiQar (0.95, 0.97 and 0.984) As well as the expected high and expected percentage of genetic improvement.

Conclusion

We conclude from this that the selection of these traits is the most appropriate method of breeding that can be adopted to improve the grain yield of those varieties. Varieties with a high degree of genetic variability are more likely to grow and have higher yields than a homogeneous or less genetically modified structure. Some traits of growth and yield of varieties in heterogeneous environments can be predicted or estimated after their morphological and genetic characteristics (Chenu *et al.*, 2012., Khan and Khalil, 2011). In the light of the results, we conclude from the following study:

1. Diwaniyah location exceeded the grain yield by giving the highest rate of varieties was 3600kg/ha compared to other observers who gave the average grain yield was 3532 and 3408kg/ha, respectively
2. The superiority of the rational variety in all environmental sites (Wassit Diwaniyah and DhiQar) with a rate of 4267 and 4532 and 4308kg/ha, respectively.
3. The highest genetic and phenotypic variation was the location of Diwaniya 2766 and 28522 sequentially.
4. Highest genetic and phenotypic coefficient of the site of DhiQar was 18,693 and 18,847 and the highest inheritance ratio in the broad sense amounted to 0.98.

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