ESTIMATION OF SOME GENETIC PARAMETERS IN BREAD WHEAT *Triticum aestivum* L. For WASIT AND DIWANIYYA LOCATIONS

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ABSTRACT

Nine cultivar of bread wheat (tamuwze1,tamuwze2, maksibak ,IPA95, IPA99, Latifia, Abo-graib and sham6) were used in this study to estimate some of the genetic parameters which were cultivated in two locations of Wasit and Diwaniyya in the fields of one of the farmers of each location during the winter farming season (2015). Randomized Complete Block Design (RCBD) was used with three replicates. Plant height, tillers number per m^2, number of grains per spike 1000 grain weight and total yield were studied. The results revealed significant differences among genotypes for the studied traits at both locations. The highest genetic variance of both locations was obtained of 17449.07 and 16471.29, respectively. The highest percentage of genetic difference coefficient was observed for the tillers number per m2 (23.08% and 27.63% respectively) for Wasit and Diwaniyah locations, respectively. High heritability estimates associated with a high genetic yield for the number of spike grains and weight of 1000 tablets for both locations. Genetic correlation coefficients were higher than the correlations of the phenotypic correlations of both traits and both locations, This indicates that variation exists between genotypes due of genetic factors with little effects to the environment in spite of diversity of environments. The highest direct effect of the plant height, the number of spike grains, and 1000 grain weight, which reached of (0.869, 0.610, 0.20), respectively for Wasit location, (1.704, 1.07, 0.804) for Diwaniyah location. The path coefficient revealed that the direct selection of plant height, number of spike and 1000 grain weight would be effective in improving the bread wheat yield, particularly in Diwaniyah.

تقدير بعض المعالم الورثية في حنطة الخبز لموقعي واسط والديوانية

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المستخلص

لتقدير بعض المعالم الوراثية في 9 تراكيب وراثية من حنطة الخبز (تموز 1وتموز2ومكسيباك واباء 95 ولطيفية واباء 99 وابوغريب وشام 6) زرعت في موقعين واسط والديوانية في حقول احد مزارعي كل موقع خلال الموسم الزراعي الشتوي (2015) .استخدم تصميم القطاعات العشوائية الكاملة بثلاث مكررات ، درست صفات ارتفاع النبات وعدد الاشطاء للمتر المربع وطول السنبلة وعدد حبوب السنبلة ووزن 1000 حبة والحاصل الكلي . اظهرت النتائج وجود فروقا معنوية بين التراكيب الوراثية لجميع الصفات المدروسة لكلا الموقعين . كان اعلى تباين وراثي لصفة الحاصل في كلا الموقعين بلغت 17449.07 و 16471.29 بالتتابع . لوحظت اعلى نسبة معامل اختلاف وراثي لصفة عدد الاشطاء بلغت 23.08 % و27.63% بالتتابع لموقعي واسط والديوانية . رافقت $h^2_{.b.s}$ عالية مع تحصيل وراثي عال لصفة عدد حبوب السنبلة ووزن 1000 حبة لكلا الموقعين. كانت معاملات الارتباطات الوراثية اعلى من معاملات الارتباطات المظهرية لكل الصفات ولكلا الموقعين مما يشير الى التغاير الموجود بين التراكيب الوراثية كان بالدرجة الاساسية تغايرا وراثيا مع وجود تاثير قليل للبيئة على الرغم من من تنوع البيئتين. كان اعلى تأثير مباشر في الحاصل لصفة ارتفاع

النبات وعدد حبوب السنبلة ووزن 1000 حبة اذ بلغ 0.869 و0.610 و 0.20 بالتتابع لموقع واسط و1.704 و 1.07 و0.804 لموقع الديوانية .وبذا كشف معامل المسار ان الانتخاب المباشر لارتفاع النبات وعدد حبوب السنبلة ووزن الحبة سيكون فعالا في تحسين محصول حنطة الخبز ولاسيما في موقع الديوانية.

1. INTRODUCTION

Bread Wheat (*Triticum estivum* L.) is an important and dependable crop crop in reducing the food gap, which has become a world problem. By 2050, the world's population is expected to reach 9 billion, up from 5.5 billion in 1995. The percentage of self-sufficiency of wheat did not exceed 41.66%. Therefore, the interest in soil and crop service operations has a prominent role in increasing the quantity of crops, but the increase does not meet the needs with continuous of the population increase. This is why the trend towards breeding programs by raising high-yielding varieties and adapting to multiple environments. The crop trait of the most important traits in the breeding and improvement of wheat as it is a complex quantitative trait and controlled by a large number of gene correlation as well as affected by environmental factors. Falconer [17] used the genetic correlations to measure the degree of stability of the character in the community under two environment, mentioned three sources of genetic variance affect the external appearance are the genetic differences and environmental differences within each treatment and environmental differences not related to the treatment (external factors), also the same researcher mentioned, the main cause of the correlation is the pleiotropy effect, which affects two or more traits, so the isolation of such a gene causes immediate variations in the traits affecting it. Therefore, the study of the genetic and environmental correlation coefficient between wheat yield and its components aims at identifying the most influential traits and considering them as an electoral criterion to improve the yield. There are two types of production indicators, which are indirect indicators such as the heritability and the other directly, such as correlation coefficient and path factor [5, 8]. Several studies have shown that the correlation coefficient values are higher than the phenotypic correlation values [3, 10, 11,14]. This indicates the significant contribution of genetic factors and that the environment has not significantly affected actual correlations. Al-Hamdai and Jabouri [4] found a significant genomic and phenotypic correlation for plant height, spikes number per plant and grains number per spike. Ashfaq et.al [14] showed the genetic and phenotypic correlations of grain yield were significant and positive with the number of spike grains and grain weight. The results of Al-Zuhairi [7] showed that the spike length, the tillers number, the number of spike grains, and the weight of 1000 grains were associated with a significant positive correlation (0.63, 0.76, 0.87 and 0.78) respectively. Hadi, et.al [10] obtained similar results except for the spike length which did not have a significant correlation with the yield. Therefore, the genetic correlation is a real correlation, stable and reliable in breeding and improvement programs, but the election of one of the components instead of the yield may not be effective because of the correlation between the components of the same. To overcome this, it is proposed to analyze the path by dividing the phenotypic and hereditary correlation coefficient between the yield and its components into direct and indirect effects. Wright [24] presented a pathway analysis that gives a clear picture of the degree that can be adopted in plant breeding as a tool for selection. Asif et al [15] studied the analysis of the path using 20 advanced lines of bread wheat found that the mean weight of the grain had a positive direct effect and a high correlation with the grain yield, and suggested the possibility of direct selection of the grain weight trait. Iftikhar, et.al [19] analyzed the path coefficient using the characteristics of plant height, the branches number in the plant, the spike length, the number of spike grains and the average grain weight as independent variables and the grain yield of the plant as a responsive variable. They concluded that it is possible to use the spike length, number of spike grains and grain weight Because of their direct positive effects and their positive genetic correlations with the yield. The study aimed to identify the most relevant traits of plant yield and to obtain information on the direct and indirect effects of the traits that contribute to the formation of the high yield for the purpose of using them as election criteria to improve the wheat content in Wasit and Diwaniya.

2. MATERIALS AND METHODS

To study some genetic parameters, heritability, correlations of genetic, phenotypic, environmental and pathological for nine cultivars of bread wheat (tamuwze1,tamuwze2, maksibak ,IPA95, IPA99, Latifia, Abo-graib and sham6), an experiment was conducted in Wasit and Diwaniya location on 15/11/2015 according to the Randomized Complete Block Design with three replicates in sandy loam soil for two locations. A total of 120 $kg.h^{-1}$ of seeds was used on the lines, the distance between the line and other was 20 cm. Nitrogen fertilizer was added in the form of urea 46% nitrogen according to the recommendations of the fertilizer 50 kg urea per hectare in two batch, the first one after 30 days of cultivating and the second one at the expulsion stage of the spike and 50 kg per dunum of phosphate fertilizer (one superphosphate) one batch at tillage [1]. Field operations were carried out from irrigation and weeding whenever needed. The branches number, the spike length (cm), the number of spike grains, and the weight of 1000 grains (g) and the total yield (kg / dunum) were studied after collecting the data for the studied traits and their classification and then analyzed according to the design used and estimated the phenotypic components, genetic and environmental variance based on the predicted mean variance according to the fixed model and tested the genetic and environmental differences from zero according to a method of kempthorne [20]. The phenotypic variance is estimated from the equation that has placed by Mather and jinks [22], the differences of environment, heredity and appearance according to the method described by Falconer [17] and estimated heritability in the broad sense of the method explained by Hanson et.al [18]. The heritability limits was based in the broad sense according to what Al-ethary said [9] are less than 20% low and tend to be 20-50% medium and more than 50% higher and the expected genetic improvement was estimated according to method of kempthorme [21]. The ranges adopted for the expected genetic improvement limits as indicated by Agarwal and Ahmed [12] are as follows below 10% low and 10-30% medium and more than 30% high, the environmental, genetic and phenotypic correlation coefficients between the pairs of traits were estimated by Walter [24]. The path coefficient [25] was used to identify the direct and indirect effects of the different properties as described by Lu and Dewey [16].

According following equations:

$$\sigma^2 g = \frac{MSV - MSE}{r}$$

$$\sigma^2 E = \text{MSE}$$

$$\sigma^2 P = \sigma^2 g + \sigma^2 e$$

$$h^2_{b.s} = (\delta^2\ g / \delta^2\ p) \times 100$$

MSV = total number of squares for genotypes
MSE = Total squares for experimental error
r= Number of replicates
Phenotypic, genetic and environmental difference σ^2 P, σ^2 g, σ^2 E
$h^2_{b.s}$= heritability in the broad sense

The expected genetic improvement was estimated as follows:

$$GA = K.\ \sigma\ p\ .h^2_{.b.s}\ .$$

where GA is the expected genetic improvement, K is the intensity of the selection 1.55 for the intensity of the election 15%, σ p standard deviation, $h^2_{.b.s}$ heritability in the broad sense.

genetic improvement as a percentage

$$GA\% = \frac{GA}{\bar{X}} \times 100$$

where $\bar{X}$ is the average trait. The Genetic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV) are estimated as follows:

$$PCV = (\sqrt{\sigma^2 p} / \bar{x}) \times 100$$

$$GCV = (\sqrt{\sigma^2 g} / \bar{x}) \times 100$$

The common differences are only the following equations:

$$GCoV = VG\sqrt{VG(x)xVG(y)}$$

$PCoV = VP\sqrt{VP(x)xVP(y)}$

where GCOV = common genetic variation, X = first trait, Y = second trait, PCoV = common phenotypic variation. Genetic, phenotypic and environmental correlations were calculated according to the following equations:

$r_{Gxy} = \frac{covGxy}{\sqrt{\partial^2 GX.\partial^2 GY}}$

$r_{Pxy} = \frac{COVPXY}{\sqrt{\partial^2 PX.\partial^2 PY}}$

$r_{Exy} = \frac{COVEXY}{\sqrt{\partial^2 EX.\partial^2 EY}}$

where X, Y are the two common traits of the study, COVG, COVP, and COVE are common genetic, phenotypic and environmental variations, respectively, rGxy, r Pxy and r Exy have genetic, phenotypic and environmental correlations, respectively. Analysis of genetic correlations was carried out to their direct and indirect effects using the path coefficient. To calculate the path coefficient, the following equation was used:

$R_{py} = P_{ry} = (1 - \sum xiyrxiy)^{1\backslash 2}$

3. RESULTS AND DISCUSSION

Tables (1, 2) show that there are significant differences in the Genotypes of the bread wheat and in both Wasit and Diwaniya locations.

Table 1: Variance analysis of the studied traits of bread wheat varieties in Wasit.

Variation sources	Freedom degrees	Traits					
		Plant height	Number of branches	Spike length	Number of spike grains	Weight of 1000 grains	Total yield $kg.h^{-1}$
Replicates	2	1.926	0.704	0.259	1.593	0.333	1886.111
Genotypes	8	**348.70	**14.20	**6.81	**261.18	**313.17	**53095.83
Experimental error	16	4.218	0.995	0.426	1.218	1.417	748.611

Table 2: Variance analysis of the studied traits of bread wheat varieties in Diwaniyah.

Variation sources	Freedom degrees	Traits					
		Plant height	Number of branches	Spike length	Number of spike grains	Weight of 1000 grains	Total yield $kg.h^{-1}$
Replicates	2	2.481	0.037	0.593	0.333	1.148	1319.444
Genotypes	8	**357.65	**18.90	**6.51	**271.67	**265.65	**53066.67
Experimental error	16	5.065	0.579	0.384	1.667	1.273	3652.778

Variation components

The genetic variation was higher than the environmental variability of all the traits studied in the bread wheat. In both sites, a high percentage of phenotypic variation was found for all traits (0.98, 0.93, 0.94, 0.99, 0.99, 0.98) for Wasit location and (0.98 0.96, 0.94, 0.99, 0.99 and 0.93) for Diwaniya location as shown in Table (3, 4). The high contribution of genetic heterogeneity and low environmental variation indicates that all these traits are genetically controlled, this confirmed by Hadi et.al [10] and Almajidy et.al [13].

Genetic, phenotypic and environmental heterogeneity coefficient

The values of the genetic heterogeneity coefficient were approximated from the values of the phenotypic variation coefficient for all studied traits and for both locations, indicating that the homogeneity of the plants was phenotypic and that the external appearance was genetically determined. This is evident by the low values of the environmental heterogeneity factor for both traits and for both locations as shown in Table (3, 4), the highest genetic heterogeneity coefficient for tillers number was 23.22% for Wasit and 26.27% for Diwaniya respectively.

Table 3: Some statistical and genetic constants of the studied traits of bread wheat in Wasit.

Statistical constants \ Traits	Plant height	Number of branches	Spike length	Number of spike grains	Weight of 1000 grains	Total yield kg.h^{-1}
General average	95.04	9.04	10.07	59.19	36.88	909.44
Environmental variation	1.41	0.33	0.14	0.41	0.47	249.54
Standard error	1.40	0.32	0.13	0.40	0.46	249.53
Genetic variation	114.83	4.40	2.13	86.65	103.92	17449.07
Standard error	51.98	2.12	1.02	38.93	46.68	7915.46
Phenotypic variation	116.24	4.74	2.27	87.06	104.38	17698.61
Standard error	33.55	1.37	0.66	25.13	30.13	5109.15
Environmental variation coefficient	1.25	6.37	3.74	1.108	1.863	1.74
Genetic variation coefficient	11.28	23.22	14.49	15.73	27.63	14.53
Phenotypic variation factor	11.34	24.08	14.96	15.77	27.69	14.63
Heritability in the broad sense	0.98	0.93	0.94	0.99	0.99	0.98
Expected genetic improvement	16.51	3.14	2.19	14.39	15.77	203.29
Expected genetic improvement as a percentage	17.37	34.71	21.74	24.32	42.74	22.35

Table 4: Some statistical and genetic constants of the studied traits of bread wheat in Diwaniya.

Statistical constants \ Traits	Plant height	Number of branches	Spike length	Number of spike grains	Weight of 1000 grains	Total yield kg.h^{-1}
General average	94.26	9.41	9.85	58.78	37.93	937.22
Environmental variation	1.69	0.190	0.126	0.555	0.422	1217.59
Standard error	1.68	0.193	0.128	0.556	0.424	1217.59
Genetic variation	117.53	6.11	2.04	90.00	88.13	16471.29
Standard error	53.32	2.82	0.97	40.49	39.60	7921.08
Phenotypic variation	119.22	6.29	2.17	90.56	88.55	17688.89
Standard error	34.42	1.82	0.63	26.14	25.56	5106.34
Environmental variation coefficient	1.38	4.66	3.63	1.27	1.72	3.723
Genetic variation coefficient	11.50	26.27	14.50	16.14	24.75	13.69
Phenotypic variation factor	11.58	26.68	14.95	16.19	24.81	14.19
Heritability in the broad sense	0.98	0.96	0.94	0.99	0.99	0.93
Expected genetic improvement	16.68	3.77	2.15	14.66	14.52	191.95
Expected genetic improvement as a percentage	17.70	40.09	21.81	24.94	38.27	20.48

Heritability in the broad sense

Tables (3, 4) show that heritability values were high, ranging from 0.93 to 0.99 for the number of spike grains and the grain weight at Wasit location and 0.94 for the spike length to 0.99 for the number of spike grains and the grain weight for Diwaniya location, The high heritability values of all studied traits indicate the importance of genetic variability as one of the main components of the phenotypic variation of the studied traits. In both locations, it is possible to infer the desired genotype, so that plant breeders can election the desired trait based on the external appearance of the plant and rely on mass selection instead of Pedigree selection [6]. These results agreement with Maogda Hassan [3], Hadi et.al [10] and Almajidy et.al [13].

Expected genetic improvement

The predicted genetic improvement values for the studied traits of both locations ranged from 2.14 cm for the spike length trait in Diwaniya to 203.29 kg.h-1 for the Wasit location. The highest average percentage of 1000 weight grain for both locations was 42.73% and 38.27% for Wasit and Diwaniya, respectively, 40.08% and 34.70% for the tillers number for both locations. The combination of a high degree of heritability with high genetic yield indicates a significant efficacy for the expected selection and improvement of the traits in future breeding programs, especially if the host gene has an effective role in controlling traits. This confirms the importance of these two traits as an electoral guideline for improving wheat yield. Similar results obtained by Almajidy et.al [13].

Genetic, phenotypic and environmental correlations

Table (5) shows the coefficients of environmental, genetic and phenotypic correlation between pairs of studied traits in the study locations. it was noted from the table that the genetic correlations were higher than the phenotypic correlations of all the studied traits and for both locations, indicating the heterogeneity between the genotypes was mainly genetically heterogeneous with little effect on the environment despite the diversity of environments and this agrees with Hadi et.al [11]. It was noted that the yield was correlation associated, genetically, significantly and positively for both plant height and for both locations. A genetically, significantly, and phenotypic correlation was also associated with the spike length, the tillers number and the grain weight in Wasit location. The genetic and phenotypic correlation of these traits was not significant in Diwaniya location. The multiple effect of pleiotropy and the isolation of such a gene leads to changes in the traits that affect it and this is the main cause of the association, and the positive gene correlations result from the increase of some genes for both traits. It is noted that the plant height was associated genetically and phenologically significant with the spike length and the weight of 1000 grains in both locations, while there was no significant genomic and phenotypic correlation to the plant height in the tillers number, the number of spike grains and for both locations. The spike length was associated genetically and phenologically with high significant with the number of spike grains and weight of 1000 grains for both locations. The tillers number trait showed a genetically and phenologically significant association with the number of spike grains for Diwaniyah location, but did not reach the significant level at Wasit location, and was associated with the weight of 1000 grains genetically and phenologically and significant for both locations. It was noted from the same table that the environmental correlations of all the traits and for both locations were insignificant, which confirms the importance of genetic variances and low environmental variances, pointing out that all these traits are genetically controlled and the environment was not affected despite the different environmental conditions between Wasit and Diwaniya. This is consistent with Zuhairi [7], Ranger [23], Hassan [3], Hadi et.al [10] and Almajidy et.al [13].

Table 5: Correlation coefficients between the studied traits in Wasit and Diwaniyah sites.

Traits		Wasit			Diwaniyah		
		Environmental	**Genetically**	**phenotypic**	**Environmental**	**Genetically**	**phenotypic**
Yield	**Plant height**	-0.358	0.783**	0.768**	0.157	0.620*	0.599*
	Spike length	-0.348	0.514*	0.484	0.291	0.473	0.461
	The tillers number	-0.282	0.862**	0.756**	0.036	0.481	0.459
	The number of spike grains	-0.114	0.169	0.167	0.037	0.326	0.315
	Weight of 1000 grains	-0.237	0.599*	0.591*	-0.394	0.276	0.259
Plant height	**Spike length**	0.195	0.676*	0.656**	-0.146	0.849**	0.814**
	The tillers number	0.157	0.421	0.408	0.368	0.170	0.174
	The number of spike grains	0.002	0.164	0.163	0.045	0.428	0.424
	Weight of 1000 grains	-0.097	0.524*	0.519*	0.181	0.528*	0.525*
Spike length	**The tillers number**	0.434	0.562*	0.554*	-0.245	0.597*	0.559*
	The number of spike grains	0.138	0.806**	0.781**	-0.087	0.696**	0.671**
	Weight of 1000 grains	0.170	0.852**	0.826**	0.500-*	0.750**	0.718**
The tillers number	**The number of spike grains**	0.124	0.458	0.443	-0.245	0.597*	0.559*
	Weight of 1000 grains	0.363	0.747**	0.726**	0.224	0.538*	0.531*
The number of spike grains	**Weight of 1000 grains**	0.560*	0.738**	0.737**	-0.153	0.844**	0.838**

Path coefficient

To learn more about the nature of the relationship between the yield and other traits, the path of the correlation coefficient for the variables affecting on wheat yield grain was analyzed in the study locations. Tables (6, 7) show the path coefficient analysis of the correlation coefficient of the variables affecting the bread wheat yield in both Wasit and Diwaniyah locations. It was noted in the two locations of Wasit and Diwaniya that the plant height has a directly, positively and very high effect in the yield trait which reached of 0.869 and 1.704, respectively. The plant height trait achieved indirectly, positively and very high effect on the tillers number in the Wasit location and positively and medium effect at Diwaniya location. The total effects were positive for trait in both locations as a result of direct, positive and high effects. The plant height had an negatively and indirect effect in the spike length trait of -0.43 and -1.24 respectively, Its indirect effect was very low in the number of spike grains for Wasit location and high in Diwaniya location, and had an indirect, positive and low effect in the weight of 1000 grains at Wasit location and negative at Diwaniya location reached to -0.429, which reduced the overall effects of the location of Diwaniya compared to Wasit location. As for the tillers number, although their direct effect in the yield was negative in both locations, the indirect effect was affected by the plant height, the spike length and the number of its grains, making their total effects in yield were positive and also with the spike length trait for Diwaniya location. its effect was also negative -0.818 in grain yield. However, its total effect was positive and low due to its indirect effect on the height and the tillers number and weight of 1000 grains, while the direct effect of the spike length was very low in Wasit location. The number of spike grains had a high direct effect in both locations (0.610 and 1.074) although it had an indirect effect, negative in the tillers number trait and positive for the other studied traits. The grain weight also had a direct effect on the yield in both locations, it was higher in the location of Diwaniyah, which reached 0.804 while it was 0.20 in Wasit location. This trait has negative and indirect effects in the spike length in Wasit and in both two traits of the spike length and the grains number in Diwaniya location, which led to a decrease in their total effects to 0.167 and 0.316 respectively. It was concluded from these results that the most significant traits in the bread wheat yield are plant height, spike number and grain weight in Wasit and Diwaniya locations. Similar results were obtained by Asif et.al [15] and Iftikhar et.al [19]. Plant breeders can use these traits as election criteria in wheat breeding programs, especially in Diwaniya. It is also possible to conclude that these studied traits contribute to yield heterogeneity of 32% and 36% for the sites of Wasit and Diwaniya, respectively, the remaining varation in interpretation of 68% and 64% for other traits not studied in this research. Therefore, we recommend that many other traits be added so that we can explain as much as possible the yield variance. We recommend that more sites be added to the study due to the low variation between the two sites under study.

Table 6: Path coefficient analysis, total effect values, direct effect (diameter values) and indirect effects (above and below diameter) of some bread wheat traits in Wasit

Traits	Plant height	Spike length	The tillers number	The number of spike grains	Weight of 1000 grains	Total effect
Plant height	0.869	0.249	-0.430	0.033	0.048	0.768
Spike length	0.570	-0.656	0.338	0.156	0.076	0.484
The tillers number	0.451	0.443	0.092	-0.542	0.147	0.591
The number of spike grains	0.355	-0.363	0.089	0.610	0.067	0.756
Weight of 1000 grains	0.142	0.270	-0.512	0.068	0.200	0.167
Remaining effect	0.318					

Table 7: Path coefficient analysis, total effect values, direct effect (diameter values) and indirect effects (above and below diameter) of some bread wheat traits in Wasit

Traits	Plant height	Spike length	The tillers number	The number of spike grains	Weight of 1000 grains	Total effect
Plant height	1.704	0.187	-1.204	0.341	-0.429	0.599
Spike length	1.387	-1.479	0.600	0.539	-0.587	0.461
The tillers number	0.895	0.570	-0.818	-1.062	0.674	0.259
The number of spike grains	0.297	-0.827	0.350	1.074	-0.434	0.459
Weight of 1000 grains	0.723	0.467	-0.992	-0.685	0.804	0.316
Remaining effect	0.356					

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