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Performance of Some Bread Wheat Genotypes Under New Valley Condition

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ABSTRACT

This study aimed to assess the performance of six bread wheat genotypes introduced by a national wheat research program. These genotypes were sown at four planting dates 20th October, 10th November (recommended), 30th November and 20th December during two winter seasons of 2019/2020 and 2020/2021. The separate experiments were arranged in a randomized complete block design with four replications in each environment. The combined analysis of variance showed that mean squares due to environments were highly significant for number of spikes m^{-2}, 1000-kernel weight as well as grain yield (ard/fed) this result indicated that the studied genotypes exhibited different effect from environment to other. Mean squares due to genotypes x environments were highly significant for all studied traits except number of spikes/m^2. Parameters of phenotypic stability indicated that wheat genotypes Giza 171 and Misr3 are considered a stable verity for studied environments for grain yield (ard/fed), respectively, where had a coefficient of regression don't significantly differ from one and less amount of S^2di and adapted.

Keywords: wheat cultivars, stability parameters, planting dates.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop and significant staple food in the world. Its total cultivation area in 2021was 244.3 million hectares produced 907.8 million tons. Egypt was involved in these values with cultivation area 1.39 million hectares (3.32 million fadden) produced 9.0 million tons. In spite of this, Egypt is considered one of the biggest wheat importers, imports annually around 5.77 million tons where, the annual consumption of wheat is 14 million tons **(FAOSTAT, 2021)**. In addition, the gap between production and consumption is increasing due to population growing. For this reason, cultivated areas and productivity should be increased to reduce the gap. This can be achieved by developing high yielding varieties and cultivating wheat in newly reclaimed soils. Evidently, the main production constraints of such areas are the low fertility and moisture deficiency of the sandy soils with the ensuring drought and heat stress **Yousef (2009)**.

To improve this crop, breeders used the phenotypic stability for selection of wheat varieties in their breeding programs. Narrowing the adaptation of cultivars aim to maximize yield in particular areas by exploiting genotype (G) × environment (E) interaction **(Kaya *et al.,* 2002; Hamam and Abdel-Sabour, 2009; Mohiy *et al.,* 2021)**. This interaction gives clear the influences of different environments on cultivar performance and has a major role in assessment of performance stability of the breeding materials **Salous (2019)**.

This study aims to examine the performance and stability of grain yield of six bread wheat genotypes under New Valley conditions.

MATERIALS AND METHODS

The New Valley desert has been defined with hot and dry climate with temperatures is ranging in winter between 20 to 35 ºC, and in summer rise between 40 to 45 degrees, with extremely rare annual rainfall (Table 1).

Six bread wheat genotypes were tested at the experimental farm, Agricultural Research Station of El-Kharga, the New Valley under four planting dates 20th October, 10th November (recommended), 30th November and 20th December during two winter seasons of 2019/2020 and 2020/2021. The pedigree and origin of the studied bread wheat genotypes are presented in Table 2.

The experiment was laid out in a randomized complete block design (RCBD), with four replications for each planting date. The plot size was 3.6, each plot consisted of 6 rows, 3 m long and 20 cm apart. Wheat grains were hand drilled at the rate of 70 kg fed^{-1}. All agricultural practices were adopted as recommended for wheat production over the two growing seasons.

The measured characteristics were No. of spikes m^{-2}, No. of kernels/spike, 1000-kernel weight (g) and grain yield (ard fed^{-1}).

Analysis of variance was conducted according to **Gomez and Gomez (1984)** using SAS software (Version 9.2). Stability parameters were estimated by the methods described by **Eberhart and Russell**

(1966) from the regression analysis. These parameters i.e., regression coefficient (bi) and deviations from regression (s^2di) were estimated.

Table (1): Meteorological data for the two growing seasons in the experimental site

Month	Min. Temp. (°C)	Max. Temp. (°C)	Mean Temp. (°C)	Mean humidity (%)	Wind speed (km hr^{-1})	Precip. (mm)
2019 - 2020						
10/2019	23.0	36.2	29.6	29.8	11.7	0.00
11/2019	15.0	31.7	24.0	34.7	7.20	0.00
12/2019	9.1	23.9	16.8	46.6	7.40	0.00
1/2020	5.8	21.4	13.9	46.3	5.24	0.00
2/2020	6.3	23.8	15.7	45.3	5.87	0.00
3/2020	11.6	28.8	20.7	34.3	10.57	0.00
4/2020	15.6	30.7	23.6	28.3	7.57	0.00
5/2020	20.7	37.5	30.2	22.3	8.83	0.00
6/2020	25.4	39.2	32.8	22.7	9.75	0.00
2020-2021						
10/2020	21.1	37.1	29.6	31.0	9.34	0.00
11/2020	13.1	27.1	20.4	49.1	6.63	0.00
12/2020	9.9	25.5	18.1	43.9	6.51	0.00
1/2021	6.5	23.9	15.6	45.9	7.18	0.00
2/2021	7.3	24.0	16.5	43.4	8.26	0.00
3/2021	11.8	28.5	20.5	30.6	9.56	0.00
4/2021	16.5	33.7	25.7	25.3	11.74	0.00
5/2021	22.9	40.9	32.6	19.6	9.29	0.00
6/2021	24.5	39.9	32.7	22.5	12.32	0.00

Table 2. Pedigree, selection history and origin of the six bread wheat genotypes evaluated at this study

No	Genotypes	Pedigree and selection history	Origin
1	Gemmeiza 12	**OTUS /3/ SARA / THB // VEE.** (CMSS97Y00227S-5Y-010M-010Y-010M-2Y-1M-0Y-0GM)	Egypt
2	Shandaweel 1	**SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC.** (CMss93B00567S-72Y-010M-010Y-010M-3Y-0M-0THY-0SH)	Egypt
3	Sakha 95	**PASTOR//SITE/MO/3/CHEN/AEGILOPS SQUARROSA (TAUS)//BCN/4/WBLL1** (CMSA01Y00158S-040P0Y-040M-030ZTM-040SY-26M-0Y-0SY-0S)	Egypt
4	Sids 14	**BOW "S"/VEE"S"//BOW"S"/TSI/3/ BANI SEWEF 1.** (SD293-1SD-2SD-4SD-0SD)	Egypt
5	Masr 3	**BOW "S"/VEE"S"//BOW"S"/TSI/3/BANI SEWEF 1** (SD293-1SD-2SD-4SD-0SD)	Egypt
6	Giza 171	**Sakha 93/Gemmeiza 9.** (Gz 2003-101-1Gz-4Gz-1Gz-2Gz-0Gz)	Egypt

RESULTS AND DISCUSSION

Analysis of variance

Combined analysis of variance revealed highly significant differences among environments and genotypes for most studied traits (Table 3). These results explained the effect of climatic differences due to planting dates with growing seasons. Genotyped Showed different responses to different environmental conditions that point out the importance of the evaluation of genotypes under different environments to identify the best genotype for a certain environment.

The interaction of environments x genotypes was highly significant effect for 1000-kernel weight and grain yield, and insignificant effect was showed for number of spikes m^{-2}, indicating the different influences of climatic conditions on planting dates. Similar results were obtained by **Yousef (2009), El Ameen (2012) and Mohiy *et al.* (2021)**.

Table 3. Combined analysis of variance for studied traits of 6 bread wheat genotypes evaluated at 8 environments

S.O.V	df	Mean squares (MS)		
		No of spikes m^{-2}	1000-kernel weight	Grain yield (ard fed^{-1})
Environment	7	50788.306**	649.401**	102.190**
Error (a)	24	4475.894	10.882	5.376
Genotype	5	31906.085**	206.721**	216.534**
Env x Gen	35	3326.050	49.367**	28.297**
Error (b)	120	2710.912	12.349	4.545

** indicates highly significant at 0.01 level of probability.

Genotypes Performance

Data in Table (4) show the genotypes performance, environmental index (E. index) and phenotypic index (Pi) for all studied traits. The environmental index was estimated as the difference between the environment mean and the mean across all environments, it is directly reflecting the rich or poor environment in term of positive and negative, respectively.

Data revealed that E2 and E6 (planting date at 10th November 2019/2020 and 2020/2021 seasons, respectively) were favorable planting date for number of spikes m-2 and grain yield. This planting date recorded the highest means grain yield (18.79 and 17.66 ard fed-1) in both growing seasons, respectively. The E3 and E7 (planting date at 30th November 2019/2020 and 2020/2021 seasons, respectively) came in the second rank (17.71 and 16.59 ard fed-1). On the other hand, E4 and E8 (planting date on 20th December 2019/2020 and 2020/2021 seasons, respectively) were the poorest yielding environments (9.79 and 8.55 ard fed-1). The same results were obtained by (Ibrahim and Said, 2020). The effect of planting dates on wheat genotypes differed from one trait to another. Sakha 95, Shandweel 1 and Gemmeiza 12 genotypes surpassed other genotypes for number of spikes m-2. For 1000-kernel weight, Giza 171 genotype came in the first rank followed by Gemmeiza 12 genotype. The highest grain yield was recorded by Sakha 95 and Sids 14 genotypes.

Table (4): Mean performance for number of spikes m^{-2}, 1000-kernel weight, grain yield and their phenotypic index (Pi) of 6 bread wheat genotypes evaluated at 8 environments

Spikes m^{-2}										
Genotypes	E1	E2	E3	E4	E5	E6	E7	E8	Mean ($\bar{X}$)	Pi
Gemmeiza 12	403.0	534.0	422.0	350.0	398.5	515.4	412.1	376.4	426.4	8.9
Shandaweel 1	428.0	545.0	393.0	381.0	418.2	542.4	391.8	381.3	435.1	17.5
Sakha 95	436.0	532.0	477.0	395.0	428.0	512.9	480.9	398.5	457.5	40.0
Sids 14	379.0	440.0	455.0	388.0	381.3	430.5	448.9	391.1	414.2	-3.3
Masr 3	373.0	456.0	446.0	344.0	378.8	451.4	445.3	372.7	408.4	-9.2
Giza 171	305.0	409.0	409.0	341.0	311.2	399.7	405.9	328.4	363.7	-53.9
Mean ($\bar{X}$)	387.3	486.0	433.7	366.5	386.0	475.4	430.8	374.7	417.6	-
E. index	-30.2	68.4	16.1	-51.1	-31.6	57.8	13.3	-42.8	-	-
LSD 0.05	51.8	39.3	69.6	50.2	95.3	107.4	72.5	107.4	-	-
1000-kernel weight										
Genotypes	E1	E2	E3	E4	E5	E6	E7	E8	Mean ($\bar{X}$)	Pi
Gemmeiza 12	55.1	51.5	49.3	46.0	55.3	54.6	52.0	47.4	51.4	1.9
Shandaweel 1	52.6	43.9	47.8	44.7	55.2	38.6	50.1	42.8	47.0	-2.5
Sakha 95	50.9	47.2	47.5	45.7	53.7	47.8	49.4	45.8	48.5	-1.0
Sids 14	56.2	51.8	44.3	42.2	62.9	54.7	42.6	38.6	49.1	-0.3
Masr 3	55.2	48.9	44.3	40.9	56.8	51.5	42.2	38.3	47.3	-2.2
Giza 171	60.2	55.6	49.2	45.7	64.7	57.7	51.9	43.1	53.5	4.0
Mean ($\bar{X}$)	55.0	49.8	47.1	44.2	58.1	50.8	48.0	42.7	49.5	-
E. index	5.6	0.4	-2.4	-5.3	8.6	1.3	-1.4	-6.8	-	-
LSD 0.05	6.14	2.88	4.19	3.60	7.71	5.79	5.39	6.26	-	-
Grain yield (ard fed^{-1})										
Genotypes	E1	E2	E3	E4	E5	E6	E7	E8	Mean ($\bar{X}$)	Pi
Gemmeiza 12	14.72	17.88	19.81	9.33	14.17	16.60	23.12	8.43	15.51	-0.4
Shandaweel 1	14.75	19.50	15.75	9.24	14.24	19.43	12.96	7.87	14.22	-1.7
Sakha 95	20.31	17.88	22.13	12.66	15.98	17.50	18.70	10.66	16.98	3.8
Sids 14	21.69	22.13	17.75	10.37	19.68	21.32	19.05	10.81	17.85	2.6
Masr 3	15.75	17.69	15.00	8.61	15.30	14.80	12.08	7.29	13.32	-2.5
Giza 171	16.38	17.69	15.81	8.52	18.72	16.29	13.65	6.22	14.16	-1.7
Mean ($\bar{X}$)	17.27	18.79	17.71	9.79	16.35	17.66	16.59	8.55	15.34	-
E. index	-0.2	1.0	0.1	-1.7	-0.3	3.6	1.0	-3.5	-	-
LSD 0.05	2.97	2.29	2.91	1.25	3.56	4.66	8.01	3.50	-	-

Regression analysis

Grain yield and 1000-kernel weight were highly affected by the combination of environmental components (seasons and planting dates). Meanwhile, it was not significant and had a low portion when compared to the environment linear mean of squares for number of spikes m^{-2} (Table 5). It means that only the deviation mean square was considered important for this trait. Pooled deviation was highly significant for 1000-kernel weight and grain yield. Performance of different genotypes fluctuated significantly from their respective linear path of response to environments. Gemmeiza 12, Shandaweel 1, Sakha 95 and Sids 14, genotypes possessed significant variance based on stability analysis, while Masr 3 and Giza 171genotypes had small and insignificant deviation from linearity and would be stable for grain yield. These results agree with **Hamam and Abdel-Sabour 2009; El-Shamarka *et al.*, 2019; Ibrahim and Said 2020; Abd El-Rady (2022)**.

Eberhart and Russell (1966) defined a stable genotype as one which has a regression coefficient (b_i) equal to 1.0, and with mean square deviations from regression (S^2_{di}) equal to 0.0. apparently, a genotype that did not meet both qualifications would be classed as unstable. However, an ideal genotype would have both a high average performance over a wide range of environments plus stability. **Finlay and Wilkinson (1963)** used two values as a measure of both stability and adaptation. Genotypes with b_i < 1.0 were considered above average in stability and specially adapted to unfavorable environments. Cultivars with b_i=1 were described as average in stability and either poorly or well adapted to all environments, depending upon the cultivar mean yield.

The stability parameters (b_i and S^2_{di}) and the mean performance ($\bar{X}$) of the individual genotypes are presented in Table 6.

Number of spike/m²

There was significant genotypic variation for number of spike/m² among the 6 bread wheat cultivars used in the stability analysis. The results showed that Sakha 95 had the highest mean number of spikes/m² (457.53 spikes/m²), while the lowest mean number of spikes/m² was obtained from Giza 171 (363.69 spikes/m²) with an average 417.57 spikes/m² (Table 6). According to Eberhart and Russell (1966), two cultivars (Sakha 95 and Masr 3) were stable due to their bi's and S²di's did not differ from a unit and the zero, respectively. Out of them, one cultivar (Sakha 95) have the highest number of spikes compared with the grand mean over environments conditions. Moreover, Gemmiza 12 and Shandwel 1 performed consistently better in favorable environments because the regression coefficient (bi) was more than one plus showing the highest mean number of spikes compared with mean over all cultivars. Meanwhile, Sids 14 and Giza 171 was relatively better in stress environments because bi was less than one (bi<1) (Table 6 and figure 1).

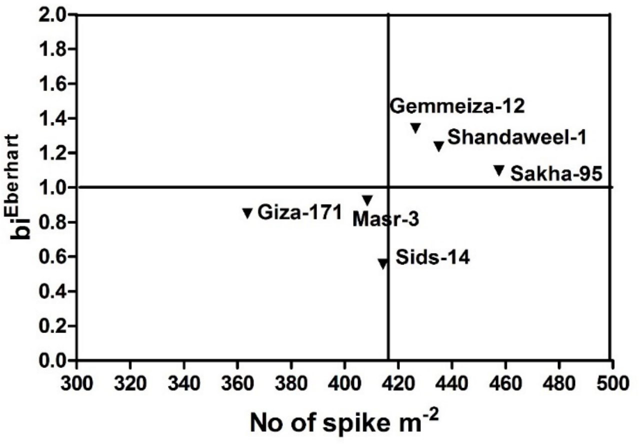

Fig. 1. Present graphically the relationships between the stability parameters (bi) and its mean performance of each genotype for number of spike m^{-2}

1000 kernel weight (g)

Means of 1000 kernel weight (g) ranged from 46.96 g for Shandaweel 1 to 53.51 g for Giza 171 with an average 49.46 g. Three cultivars (Sids 14, Masr 3 and Giza 171) were stable under favorable environments because the regression coefficient (bi) was more than one and S^2di was insignificant from zero, one of them (Giza 171) had a high mean of performance when compared with the mean overall cultivars. Meanwhile, Gemmeiza 12, Shandweel 1 and Sakha 95 was relatively better in stress environments because bi was less than one (bi<1) (Table 6 and figure 2).

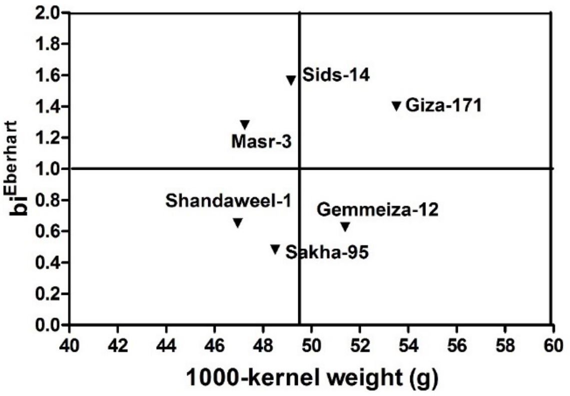

Fig. 2. Present graphically the relationships between the stability parameters (bi) and its mean performance of each genotype for 1000-kernel weight

Grain yield (ard./fed.)

The studied cultivars appeared to have a wide range of variability in average grain yield over environmental condition (two growing seasons and four planting dates) as shown in Table 6 and fig. 3. Mean grain yield ranged from 13.32 ard./fed. (Masr 3) to 17.85 ard./fed. (Sids 14) with an average of 15.34 ard./fed.. According to Eberhart and Russell (1966), three cultivars (Gemmeiza 12, Shandweel 1 and Giza 171) were stable over all the studied environments because the regression coefficient (bi) of these cultivars closed one and the deviation from regression (S^2di) was insignificant from zero. one of them (Gemmeiza 12) had a high mean of performance when compared with the mean overall cultivars. Moreover, Sids 14 performed consistently better in favorable environments because the regression coefficient (bi) was more than one plus showing the high yield. Meanwhile, Sakha 95 was relatively better in stress environments because bi was less than one (bi<1) plus showing the high yield compared with mean over all cultivars. These results are in line with those reported by **Seleem (2007) and Ali et al. (2020).**

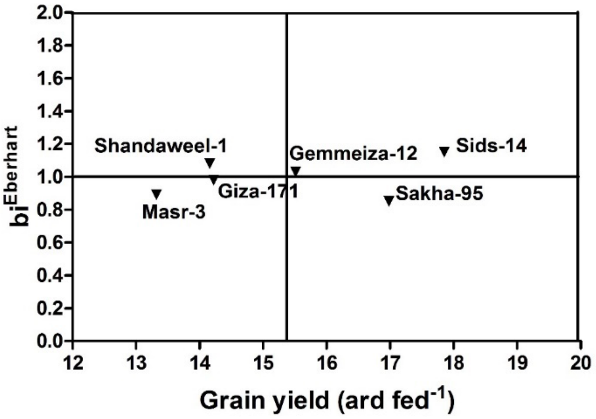

Fig. 3. Present graphically the relationships between the stability parameters (bi) and its mean performance of each genotype for grain yield (ard fed^{-1})

Table (5): Stability analysis for number of spikes m^{-2}, 1000-kernel weight and grain yield of 6 bread wheat varieties evaluated at 8 environments under New Valley condition

S.O.V	d.f.	No of spike m^{-2}	1000-kernel weight	Grain yield (ard fed^{-1})
Genotypes (G)	5	31906.09**	206.71**	216.55**
Env. + (Env. x G)	42	11236.43**	149.39**	40.61**
Env. (linear)	1	355518.15**	4546.27**	715.25**
G x Env. linear	5	4812.78	164.24**	30.28**
Pooled deviation	36	2565.22	25.19**	23.31**
Gemmeiza 12	6	1804.74	9.99	40.51**
Shandaweel 1	6	7214.87*	86.94**	22.42**
Sakha 95	6	330.65	5.27	34.86**
Sids 14	6	1830.11	26.92	22.92**
Masr 3	6	1228.58	14.15	11.12
Giza 171	6	2982.37	7.89	8.03
Pooled error	120	2697.861	13.08	7.42

*,** indicate significant differences at 0.05 and 0.01 levels of probability, respectively.

Table 6. Stability parameters of number of spikes m^{-2}, 1000-kernel weight and grain yield of 6 bread wheat genotypes evaluated at 8 environments under New Valley condition

Genotypes	No of spike m^{-2}			1000-kernel weight (g)			Grain yield (ard fed^{-1})		
	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}	Mean	b_i	S^2_{di}
Gemmeiza-12	426.38	1.342	-225.81	51.391	0.626	9.988	15.51	1.03	8.30
Shandaweel-1	435.13	1.235	1131.24	46.959	0.651	86.943	14.22	0.98	1.96
Sakha-95	457.53	1.095	-593.80	48.501	0.482	5.272	16.98	0.85	2.14
Sids-14	414.25	0.557	-220.70	49.159	1.563	26.922	17.85	1.15	0.58
Masr-3	408.41	0.922	-368.38	47.245	1.279	14.147	13.32	0.89*	-0.17
Giza-171	363.69	0.849	67.82	53.509	1.399	7.891	14.16	1.08	1.11
Mean	417.57			49.461			15.34		

** indicate highly significant differences at 0.01 level of probability.

CONCLUSION

According to Eberhart and Russell (1966), the cultivar Gemmeiza 12 was considered superior under different environmental conditions (two growing seasons and four planting dates) because it showed high mean performance for grain yield over these environments (15.51 ardab/feddan) when compared with grand mean beside acceptable stability parameters (bi near to one by 1.03, S^2di non-significant. Meanwhile, Sids 14 performed consistently better in favorable environments because the regression coefficient (bi) was more than one plus showing the high yield and Sakha 95 was relatively better in stress environments because bi<1 plus showing the high yield compared with mean over all cultivars. These genotypes could be useful in wheat improvement programs for enhancing stability.

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أداء بعض التراكيب الوراثية من قمح الخبز تحت ظروف الوادي الجديد

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[2] قسم المحاصيل – كلية الزراعة – جامعة الوادى الجديد – جمهورية مصر العربية

الملخص العربى

تهدف هذه الدراسة إلى تقييم أداء وثبات ستة تراكيب وراثية من قمح الخبز تم استنباطها ببرنامج بحوث القمح، معهد بحوث المحاصيل الحقلية بمركز البحوث الزراعية تحت ظروف الوادي الجديد. تم زراعة هذه التراكيب الوراثية في أربعة مواعيد زراعة في 20 أكتوبر و10 نوفمبر (موصى به) و30 نوفمبر و20 ديسمبر خلال الموسمين 2020/2019 و2021/2020. تم زراعة ثماني تجارب منفصلة تم استخدام تصميم القطاعات الكاملة العشوائية مع استخدام أربع مكررات في كل موعد فى الموسمين. أظهر التحليل المشترك للتباين أن عدد السنابل م 2 وعدد الحبوب فى السنبلة ووزن 1000 حبة وكذلك محصول الحبوب قد تأثرت معنويا بالبيئات. أشارت معاملات الثبات المظهرى إلى أن صنفى القمح جيزة 171، مصر 3 كانا الاكثر ثباتا فى البيئات المدروسة بالنسبة لصفة محصول الحبوب (اردب/ للفدان) على التوالى حيث ان معامل خط الانحدار للصنفين كان غير معنوى عن الوحدة وايضا الانحراف القياسى لهم كانت قيمته قليلة وغير معنوية عن الصفر.

واختلف تأثير مواعيد الزراعة على اصناف القمح التى تم دراستها من صفة إلى أخرى حيث تفوقت الاصناف سخا 95 وشندويل 1 وجميزة 12 فى صفة عدد السنابل م-2. أما بالنسبة لوزن 1000 حبة فقد جاء الصنف جيزة 171 في المرتبة الأولى يليه الصنف جميزة 12. بينما حققا الصنفين سخا 95 وسدس 14 أعلى إنتاجية بالنسبة لمحصول الحبوب.

الكلمات الدالة: أصناف القمح – ادلة الثبات – مواعيد الزراعة