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EVALUATION OF SOME CULTIVARS AND LINES OF BREAD WHEAT UNDER LOW INPUT CONDITIONS

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ABSTRACT

The field experiment was conducted at Sakha Agricultural Research Station, ARC, Egypt during 2008/09 and 2009/10 wheat growing seasons. Eight genotypes of bread wheat were evaluated under irrigated as well as water stress with nitrogen fertilizer rates; 25, 50 and 75 kg N/fad. This study was performed as split-split plot design using four replications. Measurements were taken on grain yield and related traits. The stress susceptibility index was calculated. The results show that irrigation regime had highly significant effects on all characters, except for kernel weight in the second season. Moreover, all characters differed significantly among N application rates at active except for kernel weight in the second season. Highly significant genotype differences occurred for all characters in both seasons. Sids 12 recorded the highest grain yield in both seasons. Plants fertilized with 75 kg N/fad under normal irrigation recorded the highest grain yield compared with those under stress treatment in the first season. Sids 13 recorded the highest number of spikes/m^2 under normal irrigation in the first season. Line 2 recorded the heaviest kernel weight under normal irrigation without differences with Line 1 and Gemmeiza 11 under the same condition of irrigation in the first season. The highest number of kernels per spike was obtained from Sids 12 under normal irrigation in 2008/09 season. Sids 12, Shandaweel 1 and Sids 13 recorded the highest grain yield under normal irrigation in 2008/09 season. Sids 12 recorded the highest number of kernels per spike under 75 kg N/fad in the second season. Line 2, Sakha 93, Giza 168 and Sids 13 were the most tolerant genotype showing least reduction in grain yield (the lowest value of stress susceptibility index). In conclusion, these cultivars could be used in wheat breeding program to develop new bread wheat cultivars tolerant to water stress.

Keyword: Wheat, genotypes, irrigation treatments, N fertilizers rates, yield, yield components, stress susceptibility index.

INTRODUCTION

Bread wheat (*Triticum aestivum vulgares* L.) is the world's most important grain crop and it covers more of the earth's surface than any other food crop. The wheat production in Egypt is estimated by around six million tons produced from 2.9 million fad (ARC, 2010). Despite many efforts of wheat breeders, it is still subject to important yield losses due to abiotic stresses such as water stress, salinity or high temperatures and/or biotic (diseases etc.). These stresses reflect the need to increase the productivity of wheat crop under limited available water resources. The breeding efforts were therefore, undertaken to evolve wheat genotypes tolerant to water stress and produce higher yields with one or two irrigations (Mahboob *et al.*, 2009). Developing high-yielding wheat cultivars under stress conditions in arid and semi-arid regions is an important objective of breeding programs. Water stress is one of the most important environmental stresses that can regulate plant growth and development, limit plant production, alter the physiological and biochemical properties of plants (Abd EL-Rahman, Magda, 2004). Therefore, stress affects plant growth, tillage, photosynthesis, grain number and size (Tavakoli and Owise, 2004). Moreover, Zhaohui Wang *et al*. (2005) indicated that by using supplemental irrigation at grain-filling stage increased grain yield indicating that wheat at tillering, stem elongation and grain-filling stages was more sensitive to water deficit than it was at dormant stage. Moisture stress is known to reduce biomass, grains per spike and grain size at any stag. So, the effect of the moisture stress was dependant on its intensity and length of moisture stress (Bukhat, 2005). Developing stress tolerant varieties in arid and semi arid environmental conditions has been accepted as the most important factor for increasing crop potential, yield improvement and stability. Therefore, the identification of effective parameters on yield and their relationship under water deficit conditions is a fundamental challenge for cereals improvement programs (Moayedi *et al*., 2010). Nitrogen management is a key to successful wheat production. Numerous studies indicate that N fertilization can increase both wheat grain yield and grain protein concentration (Selles and Zentner, 2001). The general objective of this study was to identify superior genotypes under low nitrogen fertilizer rates as well as different irrigation regimes and to investigate the interactive effects of irrigation and N fertilization on wheat grain yield and its components.

MATERIALS AND METHODS

Plant materials:

The eight genotypes of bread wheat which used in this study are presented in Table (1).

Table 1: Name and pedigree of eight wheat genotypes used in this investigation.

No.	Genotype	Pedigree
1	**Gemmeiza 11**	BOW"S"/KVZ"S"//7C/SER182/3/GIZA168/SAKHA61. GM7892-2GM-1GM-2GM-1GM-0GM
2	**Sids 12**	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT"S"/ 6/MAYA/VUL//CMH74A.630/4*SX. SD720096-4SD-1SD-1SD-0SD.
3	**Sids 13**	ALMAZ- 19= KAUZ "S" // TSI/SNB "S". ICW94-0375-4AP-2AP-030AP-0APS-3AP-0APS-050AP-0AP- 0SD.
4	**Shandaweel 1**	CAZO/KAUZ//KAUZ. CMBW90 Y3279-OTOPM-02010M-02010Y-3M-0SH
5	**Line 1**	TEG/GAMFRENCH 0GZ-OGZ-1S-OS
6	**Line 2**	SAKHA 93 /3/VEE/PJN//2* KAUZ S.14954-4S-1S-1S-1S-OS.
7	**Sakha 93**	Sakha 92/ TR 82010328 S 8871-1S-2S-1S-0S
8	**Giza 168**	Mrl / Buc // Seri CM 93046-8M-0Y-0M-2Y-0B

Experimental design and cultural practices:

Two field experiments were conducted at the Experimental Farm of Sakha Agricultural Research Station, ARC, Egypt during 2008/09 and 2009/10 wheat growing seasons. A split-split plot design with four replications was used. Two water stress treatments (normal and stress conditions (one irrigation was given after 29 days from sowing) being the main plots, three levels of nitrogen fertilizer were assigned to subplots. Eight wheat genotypes were allocated to the sub-sub plots. The sub-sub-plot area of the experimental unit was 4.2 m^2 (1.2 m width; 6 rows × 20 cm apart and 3.5 m long).

During growing season, fields were fertilized with nitrogen in the form of Urea (46% N) at the following rates: 25, 50 and 75 kg N/fad Nitrogen fertilizer was divided to two equal doses and was added before the first and the second irrigation. Recommended agricultural practices for growing wheat were applied.

In both seasons, wheat was preceded by maize and rice respectively. The soil of experimental sites was well prepared. Super-phosphate (15% P_2O5) was applied at the rate of 100 kg/fad during preparing soil. The mechanical and chemical analyses of the experimental soil were presented in Table 2. In addition, Monthly rainfalls during the two growing seasons were presented in Table 3.

Table 2: Mechanical and chemical properties of the experimental soil of the experimental site during 2008/09 and 2009/10 seasons.

Characters	2008/09	2009/10
Chemical analysis		
N (Available ppm)	26	24
P (Available ppm)	22	20.6
K (Available ppm)	315	407
Soil pH	8.06	7.89
Mechanical characters		
Sand %	18.2	16.3
Silt %	39.1	38.5
Clay %	42.7	45.2
Soil texture	clay	clay

Table 3: Monthly averages of temperature (C°), relative humidity, and total rain fall at Sakha during 2008/09 and 2009/10 wheat seasons.

Month	Temperature (C°)				Relative humidity (%)		Rainfall (mm)	
	2008/09		2009/10		Mean		Mean	
	Max	Min	Max	Min	2008/09	2009/10	2008/09	2009/10
Nov.	26.00	8.30	25.11	10.32	67.58	64.72	0.5	0
Dec.	22.35	7.08	22.72	8.92	67.65	66.44	17.5	5.8
Jan.	20.57	7.07	21.77	7.77	67.05	71.48	3.5	0
Feb.	21.14	7.28	23.38	9.19	64.88	65.11	12.5	22.2
Mar.	22.34	7.13	23.92	9.18	65.54	62.09	0	0
Apr.	27.15	11.00	28.77	11.76	62.65	68.62	0	0
May	29.63	13.12	30.26	15.43	60.69	57.88	0	0

Max = maximum, Min = minimum

Data were recorded on number of fertile tillers/m^2 (spikes/m^2), number of kernels per spike, kernel weight (g) and grain yield (t/fad) for both seasons. Grain yield was estimated from the four central rows to eliminate the border effect of each plot.

The stress susceptibility index (SSI) was used as a measure of water stress tolerance in terms of minimization of the reduction in yield caused by unfavorable versus favorable environments. SSI was calculated for each genotype according to the formulae of Fisher and Maurer (1978): SSI = (1 - y_d/y_p)/SI. Where: yd = mean yield in stress environment, Y_p= mean yield in normal condition = potential yield, SI = stress intensity = 1 - (mean y_d of all genotypes / mean y_p of all genotypes).

Statistical analysis:

Data collected on different crop characteristics in the two seasons were analyzed statistically by employing MSTATC program computer software package 1990. All differences among treatment means were compared by using Duncun Multiple Range Test (Duncan, 1955) at 5%.

RESULTS AND DISCUSSION

Yield and its components:

Irrigation treatments significantly affected each of number of spikes/m^2, number of kernels per spike and grain yield in the two seasons and on kernel weight in the second season only (Table 4). Generally, it could be concluded that the highest means of most characters were produced under normal irrigation in both seasons. Some workers explained the decrease in grain weight under water stress by the reduced grain fertility period and/or reduction in photosynthesis and translocation of reserves to grains (Fisher and Maurer, 1978 and Keim and Kronstad, 1981). These significant differences may be due to more of moister which led to available minerals. Similar results were obtained by Abdel-Moneam and Sultan (2009), Aziz Ur Rehman *et al*. (2010) and Sharshar (2010). Increasing grain yield with increasing number of irrigation had attributed to the increase in yield components values such as number of spikes/m^2, number of grains/spike, kernel weight. Moreover, Menshawy *et al*. (2006) reported that there were insignificant differences in grain yield between five and six irrigation treatments. These results are in general agreement with those obtained by Moayedi *et al*. (2010) and Sharshar (2010).

All characters differed significantly among N application rates except for kernel weight in the second season. Similar results have been reported by El-Sayed, Soad and Hammad (2007), EL-Hag, Dalia (2008) and Nasser (2009). Generally, reduction of kernel weight may be attributed to more number of spikes/m^2 and kernels per spike that affect grain filling and decrease kernel weight and size. Similar results were reported by EL-Hag, Dalia (2008). Meanwhile, Hamam and Abdel Sabour (2008) and Nasser (2009) recorded that increasing nitrogen fertilizer rate increased kernel weight. Also, increasing number of kernels per spike might due to the increase in availability of nutrition, which provided by higher rate of nitrogen fertilizer. These results are in agreement with those reported by EL-Hag, Dalia (2008), EL-Samahy, Basma (2009) and Nasser (2009). On the other side, increasing grain yield/fad as a results of increasing nitrogen fertilizer rate may be due to the increases in yield components i.e., number of spikes/m² and number of kernels per spike. This increase in grain yield/fad in both seasons might be due to the improvement of plant growth. Similar results have been reported by EL-Samahy, Basma (2009) and Nasser (2009), while Carolina *et. al.* (2008) reported that increasing N rate had no significant effects on grain yield.

Table 4: Means of number of spikes/m², kernel weight and number of kernels per spike of wheat genotypes as affected by irrigation treatment, nitrogen fertilizer rate and their interactions in 2008/09 and 2009/10 seasons.

SOV	No of spikes/ m²		1000 Kernel weight (g)		No of Kernels/ spike		Grain yield (t/fad)	
	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10
Irrigation treatment (I):								
Normal	370a	312a	50.1a	47.0	62.5a	62.9a	3.132a	2.944a
Stress	273b	250b	46.5b	47.6	54.4b	56.6b	2.749b	2.407b
F test	*	*	**	NS	*	**	**	*
Nitrogen rate (kg N/fad) (N):								
25	297c	233c	49.6a	47.9	54.2b	57.2b	2.690b	2.257c
50	319b	292b	48.7a	47.4	58.6ab	59.1b	2.999a	2.774b
75	348a	318a	46.6b	46.6	62.5a	62.8a	3.132a	2.996a
F test	**	**	*	NS	*	**	**	**
Genotype (G):								
Gemmeiza 11	250d	208d	55.6a	56.0a	64.1a	63.8a	2.903b	2.584b
Sids 12	312c	286c	49.1b	46.4c	64.0a	63.5a	3.134a	2.790a
Sids 13	386a	363a	39.1d	40.2d	57.2bc	60.2ab	2.961b	2.810a
Shandweel 1	329bc	317b	43.4c	41.2d	60.1ab	64.0a	2.987b	2.839a
Line1	278d	216d	54.2a	55.3a	61.0ab	60.0ab	2.846b	2.237c
Line2	335bc	288bc	54.1a	50.0b	54.1c	55.8cd	2.944b	2.803a
Sakha 93	348b	277c	46.5bc	46.6c	49.1d	53.0d	2.868b	2.627b
Giza 168	335bc	294bc	44.2c	41.9d	58.0bc	57.4bc	2.881b	2.715ab
F test	**	**	**	**	**	**	**	**
Interaction effects								
I x N	NS	NS	NS	NS	**	NS	NS	*
I x G	*	NS	*	NS	**	NS	*	NS
N x G	NS	NS	NS	NS	NS	*	NS	NS
I x N x G	NS	NS	NS	NS	NS	NS	NS	NS

***, ** and NS indicate that *p*< 0.05. *p*< 0.01 and not significant, respectively. In each factor, means designated by the same latter are not significantly different at *p*< 0.05 level according to Duncan"s Multiple Range Test.**

Data presented in Table 4 also indicate that highly significant differences occurred among genotypes for grain yield and its component characters in both seasons. Sids 13 cultivar gave the highest number of spikes/m² compared to the other genotypes, while Gemmieza 11 had the lowest value in both seasons. The variation among wheat genotypes in number of spikes/m² could be attributing to the genetical variation as well as their interaction with the environmental conditions. These results are in agreement with those obtained by Moayedi *et al*. (2010), and Sharshar (2010). Also, Gemmieza 11 recorded the heaviest kernel weight (55.6 and 56.0 g) than those of other genotypes in both seasons. On the other hand, Sids 13 recorded the lowest kernel weight (39.1 and 40.2 g) in both seasons, respectively. Similar results were reported by Abd EL-Rahman, Magda (2008) and Sharshar (2010). Concerning number of kernels per spike, the cultivar Gemmeiza 11, Sids 12 recorded (64.1 and 64.0) without insignificant difference with Shandaweel 1 and Line 1 in 2008/09 season. While, Shandaweel 1, Gemmeiza 11 and Sids 12 recorded (64, 63.8 and 63.5) without insignificant differences with Sids 13 and Line 1 in 2009/10 as compared with Sakha 93 which recorded the lowest numbers (49.1 and 53.0) in both seasons, respectively. Varietals differences in number of kernels per spike were reported by several researchers; Aglan (2009), Moayedi *et al*. (2010) and Sharshar (2010). Moreover, Sids 12 recorded the highest grain yield 3.134 t/fad (20.89 ard/fad) in the first season and Shandaweel 1, Sids 13, Line 2 and Sids 12 had recorded 2.839, 2.810, 2.803 and 2.790 t/fad (18.926, 18.733, 18.686 and 18.6 ard/fad) in the second one. These results are in agreement with Abd EL-Rahman, Magda (2008), Moayedi *et al*. (2010) and Sharshar (2010).

Effect of interaction between irrigation treatments and N application rates:

Data presented in Table 5 illustrate significant to highly significant effects due to **i**nteraction between irrigation treatment and nitrogen fertilizer rate on number of kernels per spike only in 2008/09 season. Application of 75 kg N/fad recorded the highest number of kernels per spike (66.8) when wheat plants watering with normal recommended irrigation. Regarding grain yield, the effect of interaction between irrigation treatment and nitrogen fertilizer rate was significant only in 2009/10 season. Wheat Plants which received 75 kg N/fad under normal irrigation had recorded the highest grain yield (3.20 t/fad) (21.33 ard/fad) as compared with plants received 25 kg N/fad under stress treatment which recorded the lowest grain yield 1.91 t/fad (12.733 ard/fad) (Table 5).

Table 5: Mean number of kernels per spike and grain yield as affected by the interaction between irrigation treatment and nitrogen fertilizer rate in 2008/09 and 2009/10 seasons respectively.

Nitrogen fertilizer rate (kg N/fad)	No of Kernels/ spike		Grain yield (t/fad)	
	08/09		09/10	
	N	S	N	S
25	61.0b	47.5c	2.61d	1.91e
50	59.8b	57.4b	3.01b	2.52d
75	66.8a	58.1b	3.20a	2.79c

Means designated by the same latter are not statistically different at *5%* level, according to Duncan"s Multiple Range Test.

N = Normal irrigation, S = Stress condition

Effect of interaction between irrigation treatments and genotypes:

There was a significant interaction between irrigation treatment and wheat genotypes in the first season only for grain yield and its components tested in this study (Table 4). Also, Sids 13 recorded the highest number of spikes/m^2 under normal irrigation; 438 spikes/m^2 (Table 6). These variations among genotypes might reflect, partially, their different genetic backgrounds. These results revealed that the genotypes responded differently to water regime for these characters and reflected the possibility of selecting the most tolerant genotypes. On the other hand, Line 2 recorded the heaviest kernel weight (58.0 g) under normal irrigation without differences with Line 1 and Gemmeiza 11 under the same condition of irrigation (Table 6).

Table 6: Mean of Number of spikes/m^2, kernel weight, Number of kernels per spike and grain yield as affected by interaction between irrigation treatments and genotypes in 2008/09 season.

Genotype	No of spikes/ m^2		1000 Kernel weight (g)		No of Kernels/ spike		Grain yield (t/fad)	
	08/09		08/09		08/09		08/09	
	N	S	N	S	N	S	N	S
Gemmeiza 11	269e-g	232g	57.1ab	54.0a-c	65.4bc	62.8b-d	3.20a-c	2.61i
Sids 12	269e-g	274e-g	52.7bc	45.6d-g	74.9a	53.2ef	3.34a	2.93d-g
Sids 13	438a	334cd	38.4h	39.9h	61.7b-d	52.6ef	3.07a-e	2.85e-h
Shandweel 1	395ab	263fg	44.6e-g	42.2f-h	66.8b	53.5ef	3.27ab	2.71hi
Line1	314c-e	242g	55.6ab	52.9bc	61.5b-d	60.5b-d	3.03c-e	2.66hi
Line2	392ab	278e-g	58.0a	50.1cd	57.7de	50.4fg	3.05c-e	2.84f-h
Sakha 93	396ab	299d-f	46.8d-f	46.2d-f	53.3ef	44.9g	3.09b-d	2.65hi
Giza 168	407a	262fg	47.4de	40.9gh	58.9c-d	57.0d-f	3.02c-f	2.74g-i

Mean designated by the same latter are not statistically different at *5%* level, according to Duncan"s Multiple Range Test.
N = Normal irrigation, S = Stress condition.

Also, Table (6) shows that the highest number of kernels per spike was obtained from Sids 12 (74.9) under normal irrigation. But for grain yield, Sids 12, Shandaweel 1 and Sids 13 recorded the highest grain yields (3.34, 3.27 and 3.07 t/fad) (22.26, 21.8 and 20.47 ard/fad), respectively under normal irrigation (Table 6).

Effect of interaction between nitrogen fertilizer rates and genotypes:

The interaction between nitrogen fertilizer rate and wheat genotype significantly affected number of kernels per spike only in 2009/10 season, (Table 4). Data presented in Table (7) indicate that Sids 12 recorded the highest number of kernels per spike (74.1) under 75 kg N/fad as compared with the other genotypes under different nitrogen fertilizer treatments.

Table 7: Number of kernels per spike as affected by the interaction between nitrogen fertilizer rate and wheat genotype in 2009/10 season.

Genotype	Nitrogen fertilizer rates (kg N/fad)		
	25	**50**	**75**
Gemmeiza 11	61.4b-g	62.5b-f	67.4b
Sids 12	55.6e-i	60.8b-g	74.1a
Sids 13	57.4c-h	60.5b-h	62.6b-f
Shandweel 1	64.0b-d	63.0b-e	65.0bc
Line1	56.9d-i	60.9b-g	62.4b-f
Line2	55.1f-i	53.9g-i	58.4c-h
Sakha 93	49.6i	52.9hi	56.6d-i
Giza 168	57.9c-h	58.3c-h	56.0e-i

Means designated by the same latter are not statistically different at *5%* level, according to Duncan"s Multiple Range Test.

Stress susceptibility index for grain yield:

A grain yield-based stress susceptibility index (SSI) was used to estimate relative susceptibility to stress because it adjusts for variation in yield due to differences in genotypic yield potential and environment stress intensity. Fisher and Maurer (1978) and Saadalla (2001) found reasonable agreement among SI values across different experiment in all but a few genotypes. However, Bruckner and Frohberg (1987) reported a large shifts in SSI values across environmental stress. They associated these variations with different genotypes maturities and genotypes × environment interaction.

These processes, which are associated with crop growth and development, had influenced by water stress. At present, one of many indicators of stress tolerance used in wheat breeding program is the stress susceptibility index which represent the grain yield measured under well watered and water stress conditions (Bruckner and Frohberg, 1987). Stress susceptibility index was used as a parameter to provide a measure of stress resistance based on minimization of yield loss under stress as compared to the optimum condition rather than on yield level under non-stress. This index has been used to characterize relative stress tolerance of wheat genotypes. Low stress susceptibility index (SSI<1) is synonymous with higher stress tolerance, Meanwhile, high susceptibility index (SSI >1) mean higher stress sensitivity. Stress susceptibility index was calculated for the studied wheat genotypes from the mean yield, for two and five irrigations treatments. Studied wheat genotypes could be categorized according to susceptibility index into two distinct groups. The first group included genotypes that were insignificantly affected by irrigation treatments (had SI lower than the unity) while, the second group which had higher susceptibility index than unity were significantly affected by irrigation treatments.

Data presented in (Table 8) show that wheat genotypes i.e Line 2, Sakha 93, Giza 168 and Sids 13 were the most tolerant genotypes for grain yield which had recorded the SSI value of 0.608, 0.738, 0.921 and 0.960 respectively. These results indicated that these genotypes are more tolerant under stress conditions and could be involved in breeding programs to develop wheat genotypes suitable for growing under stress condition.

Meanwhile, the wheat genotypes Sids 12, Line 1, Shandaweel 1 and Gemmieza 11 recorded values of SSI more than unit; 1.020, 1.110, 1.216 and 1.404, respectively. These results are in agreement with those obtained by Morgan (2005) and Gab Alla (2007).

Table 8: Mean of grain yield and stress susceptibility index (SSI)as influenced by irrigation treatments and wheat genotypes over the two seasons. 2008/09 and 2009/10.

Genotypes	Grain yield (t/fad)		Over all mean	SSI
	Normal irrigation	Stress condition		
Gemmeiza 11	3.070	2.417	2.744	1.404
Sids 12	3.210	2.714	2.962	1.020
Sids 13	3.112	2.659	2.886	0.960
Shandaweel 1	3.208	2.618	2.913	1.216
Line 1	2.775	2.308	2.542	1.110
Line 2	3.012	2.735	2.874	0.608
Sakha 93	2.910	2.585	2.748	0.738
Giza 168	3.008	2.588	2.798	0.921
Mean	3.038	2.578	---	---

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تقييم بعض الأصناف و السلالات من قمح الخبز تحت مدخلات منخفضة

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أجريت هذه الدراسة فى المزرعة البحثية بمحطة البحوث الزراعية بسخا، مركز البحوث الزراعية، جمهورية مصر العربية في موسمي ٢٠٠٩/٢٠٠٨ م – ٢٠١٠/٢٠٠٩ م. وتم تقييم ثمانية تراكيب وراثية من قمح الخبز تحت ظروف الري الطبيعية والإجهاد المائي وباستخدام معدلات تسميد نيتروجيني مختلفة منخفضة (٢٥، ٥٠ و٧٥ كجم نيتروجين للفدان) وقد تم تصميم التجربة بنظام القطع المنشقة مرتين في أربعة مكررات. وقد تم جمع البيانات على المحصول ومكوناته كما تم حساب معامل الحساسية للإجهاد. وقد أوضحت النتائج أن تاثير نظام الري كان عالي المعنوية لكل الصفات ماعدا صفة الألف حبة في الموسم الثاني. علاوة على ذلك اختلفت المعنوية بين معدلات التسميد النيتروجيني ماعدا صفة الألف حبة في الموسم الثاني. كان هناك اختلافات وراثية عالية المعنوية لكل الصفات في الموسمين وقد سجل الصنف سدس ١٢ أعلى محصول في كلا الموسمين. سجلت النباتات التي سمدت بمعدل ٧٥ كجم نيتروجين للفدان تحت ظروف الري العادية أعلى قيم في محصول الحبوب مقارنة بمعاملة الإجهاد في الموسم الأول و كان سدس ١٣ الأعلى في عدد السنابل في المتر المربع تحت ظروف الري العادية في الموسم الأول. كذلك كانت السلالة ٢ الأثقل في وزن الألف حبة تحت ظروف الري العادي وبدون اختلافات مع كل من السلالة ١ والصنف جميزة ١١ تحت نفس ظروف الري في الموسم الأول. أيضاً سجل الصنف سدس ١٢ أعلى عدد من الحبوب في السنبلة تحت ظروف الري العادي في موسم ٢٠٠٩/٢٠٠٨. وقد سجل كل من سدس ١٢ وشندويل ١ وسدس ١٣ أعلى محصول حبوب تحت ظروف الري العادية في موسم ٢٠٠٩/٢٠٠٨. كما سجل الصنف سدس ١٢ أكبر عدد من حبوب السنبلة عند التسميد بمعدل ٧٥ كجم نيتروجين للفدان في الموسم الثاني. ولقد أظهرت كل من السلالة ٢ وسخا ٩٣ وجيزة ١٦٨وسدس ١٣ أكبر قدرة على تحمل ظروف الإجهاد المائي حيث أظهرت أقل فقد في محصول الحبوب (أقل قيمة لمعامل الحساسية للإجهاد) ولذا يوصى باستخدامها في برامج التربية لإستنباط أصناف جديدة متحملة للإجهاد المائي.

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