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SELECTION OF DROUGHT TOLERANT HULL-LESS BARLEY GENOTYPES UNDER RAINFED CONDITIONS IN NORTHERN EGYPT*

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ABSTRACT

This study aimed to identify some hull-less barley genotypes under rainfed condition and select the favorite lines to be grown in large scale to sustain developments of the rainfed areas and to select other genotypes to be used in the breeding program.

Two field experiments were carried out in rainfed areas, the first experiment was conducted at two locations' Rafah and El-Matala in North Sinai and included 20 hull-less barley (Hordeum vulgare L.) genotypes in addition to G.130 as check cultivar. This experiment was named advanced naked barley yield trial (ANBYT) in 2008/2009 season. The second experiment was: On farm verification for hull-less barly (On F. Veri. HB) which included 7 genotypes selected from the ANBYT in 2008/2009 in addition to the check variety G.130. This experiment was carried in 2009/2010 season at two locations namely: Rafah Agric. Expt. Stn. and Rafah El-balad. Randomized complete block design in three replications was used for the two experiments.

Results of this study identified 7 genotypes in the first season (2008/2009) could be useful for the hull-less barley breeding program. These 7 genotypes were no 2, 3, 4, 9, 10, 11 and 13 in ANBYT (2008/2009) and were promoted to the second experiment (ON F. Veri. HB). Genotype no.5 (LHB 2005/1) significantly surpassed the check variety in water use efficiency (WUE) and harvest index (HI). On the other side grain yield (GY) of LHB2005/1 over yielded the check variety (G.130) with 8.4%. This result means that genotype no. 5 could be released as a new drought tolerant hull-less barley cultivar.

Key words: Genotypes, Hull-less barley, drought tolerance, WUE, yield, rainfed, Sinai sites.

INTRODUCTION

Barley (*Hordeum vulgare L.*) is as ancient as the origin of agriculture itself. The antiquity of barley is documented to the period of 5000 to 7000 B.C. Barley flour was used instead of wheat to make bread (Bukantis and Goodman, 1980). In Egypt, barley is the dominant crop grown in rainfed areas. It is mainly used for animal feed and was recently used as human food. Hull-less barley, now, is gaining renewed interest as food component because of its soluble dietary fibers and β glucan content in particular as compared with other cereals. In this respect, El-Sayed (2002) compared 11 hull-less barley genotypes with Sakha 69 wheat cultivar regarding grain protein percentage, total and soluble β glucan contents. These three chemical traits of hull-less barley exceeded those of Sakha 69 cultivar. In this respect, El-Sayed (2003a and 2003b) developed three drought tolerant hull-less barley cultivars (G. 129, G.130 and G131) for rainfed and newly reclaimed areas.

Releasing high yielding stable and drought tolerant hull-less barley cultivars is essential to sustain barley production in rainfed areas as dual purpose crop. There fore, the objective of this study is to identify hull-less barley genotypes that could be recommended to be grown in barley production.

MATERIALS AND METHODS

Two yield trials were conducted in this study namely, advanced naked barley yield trial (ANBYT) and on farm verification naked barley trial (ON-F-VER-NBYT).

ANBYT included twenty genotypes in addition to the check variety (G130). It was grown in tow locations in rainfed areas in 2008/2009 barley growing season. Seven genotypes were selected from the ANBYT and were grown in the ON-F-VER-NBYT in 2009/2010, in two sites, in rainfed areas. Tables 1 and 2 illustrate the names and pedigree of the genotypes grown in each of the two experiments.

The experimental unit areas for the two experiments were:

(1) 8 rows, 3.5 m long, 20 cms apart for ANBYT
(2) 10 rows, 5 m long, 20 cms apart for ON-F-VER-NBYT
(3) Seeding rate was 35 kg seeds/feddan, while sowing antes were during the last week of November, without fertilization as the traditional under rainfed.

The experimental design used in the two experiments was randomized complete block design (RCBD).

Monthly and seasonal-rainfall (mm) in the different locations of the study are shown in Table (3).

Traits recorded:

a. Plant height (PlHt): the distance from the soil surface to the top of the spike of the matured plant, excluding the awns.
b. Spike length (main spike, cm).
c. Grain yield (GY): weight of clean grains after threshing in Kg/ha.
d. Straw yield (SY): weight of straw after threshing at harvest in Kg/ha.
e. Biological yield (BY): weight of biomass (grain + straw) at harvest in kg/ha.
f. Harvest index (HI): Grain yield divided by biological yield.
g. Water use efficiency (WUE) = grain yield (GY) /evapotranspiration (ET).

Water use efficiency: (WUE) is defined as the yield (Y) of marketable crop produced per unit of water used in evapotranspiration (ET) i.e. WUE=Y/ET (Arnon 1975). Because there was no run off, percolation or water table effects, the seasonal rainfall is approximately equal to the ET (El-Sayed and Noaman' 1992)

Data was subjected to statistical analysis according to the methods of variance analysis using Least Significant Differences (LSD) for the comparison among means (Snedecor and Cochran, 1967). Bartelett's test of homogeneity indicated no statistical evidence for heterogeneity. Thus, combined analyses of variance for two experimental sites in each experiment were done.

Table (1): Names and pedigree of advanced naked barley yield trial (ANBYT) 2008/2009

Ent.	Name / Pedigree	Source
1	**GIZA 130**	**Giza**
2	**LHB 2003/ 2**	**Giza**
3	**LHB 2005/ 1**	**Giza**
4	**LHB 2005/ 8**	**Giza**
5	LHB 93/4 / GIZA 129	B-NBYT 2007/2008 No.7-Giza
6	LHB 93/4/ GIZA 129	B-NBYT 2007/2008 No.8-Giza
7	LHB 93/4/ GIZA 129	B-NBYT 2007/2008 No.9-Giza
8	NOHA/3/ROBUR-BAR/142-B//ASTRIX/ SUTTER 332. 3 /4/GLORIA-BAR/COPAL /5/BERMEJO/6/ ALISO /CI 3909. 2/7/LINO/8/ CONGONA/3/ATACO/ ACHIRA// HIGO/ 4/ ZARZA// GLORIA-BAR/COME-B /3/SEN	B-NBYT 2007/2008 No.12-Giza
9	BF891M/ *LHB 93/1*	B-NBYT 2007/2008 No.15-Giza
10	GIZA 119/4/ NUDINKA/WEIHENSTWPHAN 173// IRAN /3/PERUGIA	B-NBYT 2007/2008 No.16-Giza
11	CLN-B/80.5138//GLORIA-BAR/COPAL/3/CERRAJA/4/PENCO/ CHEVRON-BAR	B-NBYT 2007/2008 No.17-Giza
12	KAMIAK/PETUNIA 1//PETUNIA 2	B-NBYT 2007/2008 No.18-Giza
13	PINON/3/CHAMICO/TOCTE//CONGONA/4/PETUNIA 1	B-NBYT 2007/2008 No.21-Giza
14	ROBUST//GLORIA-BAR/ COPAL/3/ ALISO/ CI3909.2/4/ AYAROSA/5/ PETUNIA 1/6/ CHAMICO/ TOCTE// CONGONA	B-NBYT 2007/2008 No.22-Giza
15	Libya/ICNBF8-614	B-NBYT 2007/2008 No.26-Giza
16	Atahualpa-	B-NBYT 2007/2008 No.33-Giza
17	Alpha/Durra//Himalaya-26	B-NBYT 2007/2008 No.34-Giza
18	NOHA/3/ROBUR-BAR/142-B//ASTRIX/ SUTTER 332. 3/4/GLORIA-BAR/COPAL /5/BERMEJO/6/ALISO/CI 3909. 2/7/LINO/8/ CONGONA/3/ATACO/ACHIRA// HIGO/4/AYAROSA	B-NBYT 2007/2008 No.11-Giza
19	TOCTE/TOCTE//BERROS/3/PETUNIA 1/4/CANTUA	B-NBYT 2007/2008 No.25-Giza
20	Barjouj/ICNBF8-614	B-NBYT 2007/2008 No.27-Giza
21	Alanda-01-	B-NBYT 2007/2008 No.32-Giza

Table (2): Names and pedigree of on farm verification trial for naked barley (ON F.Veri. NBYT) 2009/2010

Ent.	Name / Pedigree	Source
1	BF891M/ *LHB 93/1*	A-NBYT 2008/2009 No.9-Giza
2	GIZA 119/4/ NUDINKA/WEIHENSTWPHAN 173// IRAN /3/PERUGIA	A-NBYT 2008/2009 No.10-Giza
3	CLN-B/80.5138//GLORIA-BAR/COPAL/3/CERRAJA/4/PENCO/ CHEVRON-BAR	A-NBYT 2008/2009 No.11-Giza
4	PINON/3/CHAMICO/TOCTE//CONGONA/4/PETUNIA 1	A-NBYT 2008/2009 No.13-Giza
5	**LHB 2005/** 1	A-NBYT 2008/2009 No.3-Giza
6	**LHB 2005 8**	A-NBYT 2008/2009 No.4-Giza
7	**LHB 2003/ 2**	A-NBYT 2008/2009 No.2-Giza
8	**GIZA 130**	A-NBYT 2008/2009 No.1-Giza

Table (3): Monthly and seasonal rainfall (mm) of N. Sinai during 2008/2009 and 2009/2010.

Month	2008/2009 (N.Sinai)		2009/2010 (N.Sinai)	
	Rafah	**El-Matala**	**Rafah Exp Stn**	**Rafah El-balad**
October	130.5	98.5	2.82	0.9
November	6.26	2.0	0	0
December	10.64	3.4	25.0	22.8
January	21.9	16.0	46.3	38.7
February	37.56	32.3	80.1	75.0
March	21.91	14.6	15.0	4.8
April	0	0	0	0
Seasonal rainfall	228.8	166.8	169.3	142.2

RESULTES AND DISCUSSION

1-Advanced Naked Barley Yield Trial (ANBYT):

Plant height (PlHt), Spike Length (Sp-L), biological yield (BY), grain yield (GY), straw yield (SY), harvest index (HI) and water use efficiency (WUE) traits and their ranks are presented in Tables 4, 5 and 6 respectively.

The statistical analysis of PlHt and Sp-L of the 21 genotypes showed significant differences among the genotypes at Raffah and El-Matala as well as over the two sites (Table

4) with some exceptions. Means of PlHt clearly indicated that 2 genotypes surpassed the check variety (no.1) at Raffah and 8 genotypes surpassed the check at El-Matala. The tallest genotype at both Raffah (56.7 cm) and El-Matala (46.7 cm) was Gen. no, 4. The shortest genotype was recorded for Gen. no. 21 at Rafah and Gen. no. 16 at El-Matala. While Sp-L clearly indicated that 10 genotypes surpassed the check variety (no.1) at Raffah and 9 genotypes surpassed the check at El-Matala. The tallest genotype at Raffah (6.0 cm) was Gen no,13 and El-Matala (6.0 cm) was Gen. no, 9. The shortest genotype was recorded for Gen. no. 16 at Rafah and El-Matala. These results are in agreement with those obtained by Singh (1989), Li *et al* (1991), Assad *et al* (1998), Afifi (1999) and Afiah and Moselhy (2001).

Biological yield (BY) of the under investigation genotypes (Table 5) showed significant differences among the 21 genotypes at Raffah and El-Matala as well as over the two locations. G.130 (no. 1) the check variety ranked 7 and 19 at Rafah and El-Matala respectively; G.no.4 ranked the first (1413.7 kg/ha) at Raffah meanwhile Gen. no. 20 ranked the first (15666.7 kg/ha) at El-Matala. 6 genotypes over yielded the check variety G.130 (no.1) at Raffah, 18 at El-Mattala. These results are in harmony with those obtained by ***El-*** Sayed *et al.* (2007), Assad *et al* (1998) and Noaman *et al.* (1997).

Regarding the grain yield (GY) in Table 5, the analyses of variance showed significant differences among genotypes at each of the two locations in addition to the over two locations. Six genotypes over yielded G.130 at Rafah (Gen. nos. 4, 10, 11, 13, 18 and 19), one genotype at El-Matala (G. no. 9), while four genotypes over yielded G. 130 over all locations (Gen. no. 4, 9, 10 and 11). These results are similar to those obtained by El-Sayed *et al* (2003a and b), El-Sayed *et al* (2007), Assad *et al* (1998)and Noaman *et al* (1997).

According to Table 7, genotypes nos. 2, 3, 4, 9, 10, 11, and 13 gaves high GY with good performance for the other studied trials, so they were selected and promoted to the second level of yield trial (ON-F-Ver-HB) for re-evaluation and screening in 2009/2010 season.

Water use efficiency (WUE) was calculated acording to (Arnon, 1975) from the formula. WUE= GY in kg-ha/ ET mm water depth taking in consideration that evapotranspiration (ET) is approximately equal to the seasonal rainfall as it mentioned in the material and methods. There fore, WUE in each locality depend on the numerator because the seasonal rainfall (denominator) is the same for all tested genotypes at the site. Thus, WUE referee to the potential of each genotype to utilize the limited amount of rainfall to produce GY and BY. Data in (Table 5) showed that the highest value for WUE was recorded for Gen. no. 4 at Raffah as well as over all location and Gen. no. 9 at El-Matala.

Straw yield (SY) values are shown in (Table 6). The analyses of variance of this character show significant differences among the genotypes at each of Rafah and El-Matala as well as the combined values of the two locations.

The highest SY was obtained from Gen. no. 4 at Rafah and Gen. no. 20 for the combined values of the tow locations. On the other hand 19 genotypes over yielded the check variety G.130 at El-Matala and 17 genotypes over the two locations. It was observed that SY had the same behavior of PlHt and BY. This finding is similar to those observed by El-Bana *et al.* (2010), Noaman *et al* (1997), Assad *et al.* (1998), Afifi (1999) and Mursi *et al.* (1973). Harvest Index (H.I.) is the ratio of the GY to the BY. Results presented in (Table 6) show significant differences among the hull-less barley genotypes in HI. The highest HI value was recorded for Gen. no. 6 at Rafah, Giza 130 at El-Matala as well as over the two locations. Results of these characters are in harmony with those obtained by Gouis (1992), Ellen (1993) and Assad *et al.* (1998).

Table (4): Plant height (PlHt cm), spike length (Sp-L cm) and rank values (R) for 21 hull-less barley genotypes in ANBYT grown under rainfed in 2008\2009 season.

	Rafah				El-Matala				Combined			
Gen. no	PlHt in cm	R	Sp-L In cm	R	PlHt In cm	R	Sp-L In cm	R	PlHt In cm	R	Sp-L In cm	R
1	51.7	3	5.0	11	38.3	9	5.3	10	45.0	4	5.2	8
2	53.3	2	5.0	13	38.3	6	5.7	4	45.8	2	5.3	7
3	45.0	11	5.3	6	38.3	5	5.7	5	41.7	7	5.5	5
4	56.7	1	5.7	4	46.7	1	5.3	7	51.7	1	5.5	6
5	45.0	10	5.7	3	31.7	16	4.7	16	38.3	15	5.2	11
6	50.0	5	5.7	5	33.3	15	4.3	17	41.7	8	5.0	13
7	43.3	15	4.3	20	35.0	11	5.0	12	39.2	13	4.7	18
8	40.0	16	5.0	15	40.0	3	5.3	9	40.0	11	5.2	9
9	45.0	12	5.3	9	38.3	7	6.0	1	41.7	9	5.7	1
10	51.7	4	5.7	2	40.0	4	5.7	6	45.8	3	5.7	2
11	45.0	13	5.3	8	40.0	2	6.0	2	42.5	6	5.7	3
12	36.7	20	4.3	19	38.3	8	5.7	3	37.5	17	5.0	14
13	50.0	7	6.0	1	35.0	12	5.3	8	42.5	5	5.7	4
14	46.7	9	5.0	14	30.0	19	4.3	18	38.3	16	4.7	19
15	43.3	14	5.0	10	36.7	10	4.7	15	40.0	12	4.8	15
16	38.3	19	4.0	21	25.0	21	3.7	21	31.7	21	3.8	21
17	50.0	6	5.0	12	31.7	17	5.3	11	40.8	10	5.2	10
18	48.3	8	5.0	16	30.0	20	4.3	20	39.2	14	4.7	20
19	40.0	17	5.3	7	33.3	14	4.3	19	36.7	19	4.8	16
20	40.0	18	5.0	17	35.0	13	5.0	14	37.5	18	5.0	12
21	36.7	21	4.7	18	30.0	18	5.0	13	33.3	20	4.8	17
Means	45.6		5.1		35.5		5.1		40.5		5.1	
LSD at 0.05 level for Locations												
Gen.	NS		1.34		9.15		NS		7.63		NS	
L×G	NS		NS		NS		NS		NS		NS	
CV	16.6%		15.9%		15.6%		19.2%		16.4%		17.6%	

Table (5): Biological yield (BY, kg/ha), grain yield (GY, kg/ha), WUE (kg grain/1m^{3}water) and rank values (R) for 21 hull-less barley genotypes (ANBYT) grown under rainfed in 2008\2009 season.

	Rafah						El-Matala						Combined					
Gen.	BY	R	GY	R	WUE	R	BY	R	GY	R	WUE	R	BY	R	GY	R	WUE	R
1	5178.5	7	1026.8	7	0.504	7	856.7	19	372.0	2	0.223	2	3017.6	18	699.4	5	0.364	4
2	6428.5	2	1151.8	4	0.567	3	6750.0	8	190.5	18	0.114	18	6589.3	7	671.1	7	0.341	8
3	5922.6	3	982.1	9	0.482	9	11000.0	4	339.3	3	0.203	3	8461.3	2	660.7	8	0.343	7
4	8035.7	1	1413.7	1	0.690	1	3666.7	14	214.3	13	0.128	13	5851.2	8	814.0	1	0.409	1
5	3392.8	15	508.9	20	0.250	20	2950.0	17	220.2	12	0.132	11	3171.4	16	364.6	18	0.191	18
6	1785.7	21	532.7	19	0.262	18	2900.0	18	193.5	16	0.116	16	2342.9	20	363.1	19	0.189	19
7	2321.4	20	595.2	16	0.260	19	3850.0	13	223.2	10	0.134	10	3085.7	17	409.2	15	0.197	16
8	2529.7	19	669.6	13	0.331	13	5466.7	11	193.5	17	0.166	17	3998.2	13	431.5	14	0.224	12
9	5178.5	8	1011.9	8	0.498	8	11700.0	3	428.6	1	0.257	1	8439.3	3	720.2	4	0.377	3
10	5654.7	5	1294.6	2	0.566	4	8333.3	5	241.1	8	0.145	8	6994.0	5	767.9	2	0.355	5
11	5892.8	4	1202.4	3	0.586	2	7773.3	6	312.5	4	0.187	5	6833.1	6	757.4	3	0.386	2
12	4464.3	10	639.9	15	0.311	15	3150.0	15	223.2	9	0.134	9	3807.1	14	431.5	13	0.222	13
13	4107.1	13	1032.7	6	0.509	5	3033.3	16	312.5	5	0.187	4	3570.2	15	672.6	6	0.348	6
14	5178.5	9	848.2	10	0.417	10	4993.3	12	276.8	6	0.166	6	5085.9	11	562.5	10	0.291	10
15	3571.4	14	580.4	17	0.283	17	7000.0	7	178.6	20	0.107	20	5285.7	10	379.5	17	0.195	17
16	2738.1	18	669.6	14	0.331	12	800.0	20	35.7	21	0.021	21	1769.0	21	352.7	20	0.176	21
17	3392.8	16	580.4	18	0.283	16	5950.0	10	187.5	19	0.112	19	4671.4	12	383.9	16	0.198	15
18	4107.1	12	753.0	11	0.368	11	616.7	21	220.2	11	0.132	12	2361.9	19	486.6	11	0.250	11
19	5357.1	6	1047.6	5	0.506	6	6206.7	9	211.3	14	0.127	14	5781.9	9	629.5	9	0.316	9
20	4285.7	11	744.0	12	0.325	14	15666.7	1	199.4	15	0.120	15	9976.2	1	471.7	12	0.222	14
21	3035.7	17	431.5	21	0.210	21	13440.0	2	267.9	7	0.161	7	8237.9	4	349.7	21	0.185	20
Means	4407.6		843.7		0.407		6004.9		240.1		0.144		5206.2		541.9		0.275	
LSD at 0.05 level for Locations																		
Gen.	992.3		166.8		0.104		1033		55.02		0.074		705.3		86.47		0.051	
L×G	NS		NS		NS		NS		NS		NS		997.5		NS		0.073	
CV	13.6%		12.0%		15%		10.4%		14%		13.9%		11.8%		13.9%		16.5%	

Table (6): Straw yield (SY, kg/ha), harvest index (HI) and rank (R) values for 21 hull- less barley genotypes (ANBYT) grown under rainfed in 2008\2009 season.

Gen	Rafah				El-Matala				Combined			
	SY	R	HI	R	SY	R	HI	R	SY	R	HI	R
1	4151.6	9	19.7	8	484.7	20	43.6	1	2318.2	18	31.7	1
2	5276.7	2	17.9	12	6559.5	8	2.9	18	5918.1	7	10.4	16
3	4940.4	3	16.8	17	10660.7	4	3.1	16	7800.6	3	10.0	18
4	6622.0	1	17.7	13	3452.4	14	5.9	7	5037.2	9	11.8	10
5	2883.9	15	15.1	19	2729.8	16	7.4	4	2806.8	16	11.3	14
6	1253.0	21	30.3	1	2706.6	18	6.9	6	1979.8	19	18.6	3
7	1726.2	20	25.8	3	3626.8	13	5.8	8	2676.5	17	15.8	5
8	1860.1	19	26.5	2	5273.2	11	3.6	13	3566.7	13	15.1	6
9	4166.6	8	19.7	9	11271.4	3	3.7	12	7719.0	4	11.7	11
10	4360.1	5	22.7	6	8092.3	5	2.9	17	6226.2	5	12.8	8
11	4690.4	4	20.4	7	7460.8	6	4.0	11	6075.6	6	12.2	9
12	3824.4	10	14.3	21	2926.8	15	7.1	5	3375.6	14	10.7	15
13	3074.4	13	25.2	4	2720.8	17	10.4	3	2897.6	15	17.8	4
14	4330.3	6	17.7	14	4716.6	12	5.6	9	4523.4	11	11.6	12
15	2991.0	14	16.4	18	6821.4	7	2.6	19	4906.2	10	9.5	19
16	2068.4	18	24.5	5	764.3	19	4.5	10	1416.4	21	14.5	7
17	2812.5	16	17.1	16	5762.5	10	3.2	15	4287.5	12	10.2	17
18	3354.1	12	18.4	11	396.4	21	35.8	2	1875.3	20	27.1	2
19	4309.5	7	19.5	10	5995.4	9	3.4	14	5152.4	8	11.5	13
20	3541.7	11	17.6	15	15467.3	1	1.3	21	9504.5	1	9.5	20
21	2604.1	17	14.5	20	13172.2	2	2.0	20	7888.1	2	8.2	21
Means	5764.8		7.9		3563.9		19.9		4664.4		13.89	
LSD at 0.05 level for Locations												
Gen.	945.8		4.265		1040		2.356		691.9		2.399	
L×G	NS		NS		NS		NS		978.5		3.392	
CV	16.8%		13%		10.93%		18.1%		12.91%		15.0%	

2-On Farm Verification (ON-F-VER.):

Plant height (PlHt), Spike length (SpL), Biological yield (BY), Grain yield (GY), Straw yield (SY), Harvest index (HI) and water use efficiency (WUE) traits and their ranks are presented in Tables 7, 8 and 9 respectively. PlHt of the 8 genotypes showed significant differences among the genotypes at Rafah (Rafah Exp Stn. and Rafah El-Balad site) as well as over the two sites (Table 7). Means of this trait clearly indicate that 4 genotypes surpassed the check variety (no.8) at both Rafah Exp Stn and Rafah El-Balad site. The tallest genotype at Rafah Exp Stn was no, 2 (51.7 cm) while at Rafah El-Balad site farm Gen. no. 6 (48.3 cm) was the tallest. The shortest genotype was recorded for Gen. no. 4 (36.7 cm) at Rafah Exp Stn,

Gen. no.3 (38.3 cm) at Rafah El-Balad site these results are in agreement with those obtained by Singh (1989), Li, C.D. *et al* (1991), Assad *et al.* (1998), Afifi (1999) and Afiah and Moselhy (2001). Sp-L clearly indicates to 3 genotypes surpassed the check (no.8) at Rafah Exp. Stn. and 2 genotypes surpassed the checks at Rafah El-Balad site.

The tallest genotype at Rafah Exp Stn (6.0 cm) and Rafah El-Balad site (5.7 cm) was no, 2. The shortest genotype was recorded for Gen. no. 4 at Rafah Exp Stn and no. 5 at Rafah El-Balad site. These results are in agreement with those obtained by Singh (1989), Li, C.D. *et al.* (1991), Assad *et al.* (1998), Afifi (1999) and Afiah and Moselhy (2001).

Concerning BY, (Table 8), the genotypes showed significant difference at 5% level. G.130 the check variety enquired the first rand at Rafah Exp Stn as well as for the combined data of the two sites. These results are in harmony with these obtained by El-Sayed *et al.* (2003a and b).

Regarding grain yield (GY) in Table (8), significant differences were detected among locations and genotypes. Rafah Exp Stn gave the highest grain yield (458.8 kg/ha) followed by Rafah El-Balad site (437.5 kg/ha) the significant differences among genotypes revealed that only one Gen. no. 5 significantly exceeded G. 130 in grain yield. G.130 was outbreak in grain yield by Gen. no. 5 at Rafah Exp Stn and Rafah El-Balad site respectively. Gen. no 5 seemed to be the most stable genotypes since it ranked first at Rafah Exp Stn and Rafah El-Balad site respective order. It was noticed that gain yield under the severe drought stress prevailed at Rafah El-Balad site was relatively lower than that of Rafah Exp Stn. Highly significant interaction effects between genotypes and locations were found concerning grain yield. Gen. no. 5 at Rafah Exp Stn gave the highest grain yield and significant increase than the check variety G. 130. Under severe drought stress at Rafah El-Balad site one genotypes outyielded the check cultivar Giza 131 in grain yield with height significant differences. G.130 was outbreak in (GY) by one genotypes at Rafah Exp Stn and Rafah El-Balad site. This finding is similar to those observed by El-Bana *et al.* (2010), Noaman *et al.* (1997), Assad *et al.* (1998), Afifi (1999) and Mursi *et al.* (1973).

Regarding water use efficiency (WUE) in Table (8), significant differences were detected among locations, genotypes and locations x genotypes interaction. The two locations can be ranked according to their drought stress as follows: Rafah Exp Stn and Rafah El-Balad site. The respective values for WUE at the two locations were 0.302, 0.333 kg/m3, respectively. Average water use efficiency (WUE) of 8 genotypes as affected by different seasonal rainfall (mm) in 2007/2008 season. Data in Table (8) show clearly that (WUE) significantly was decreased with decreasing seasonal rainfall (mm) in 2009/2010 season. These results are in agreement with those of Aggarwal *et al.* (1986b). Rafah El-Balad site was the most sever environment. Gen. no. 5 gave the highest WUE (0.510) compared with all the other genotypes in 2009/2010 season. In the same time Gen. no. 5 gave more WUE than G. 130. Rafah El-Balad site the most severe drought stress as well as over all location.

Data of SY, HI and their ranks (R) values at the two sites at Rafah Exp Stn., Rafah El-Balad and the combined analysis of the two sites are presented in (Table 6).

The SY differences among the tested genotypes showed significant difference at each of the two sites and the combined values of these two sites. There results are in harmony with those obtained by El-Bana *et al.* (2010), Afifi (1999), Noaman *et al.* (1997) and Mursi *et al.* (1973). At Rafah Exp Stn., G.130 gave the highest SY (2833 kg/h), while Gen.nos. 2 and 3 gave SY with no significant difference than G.130 SY. Rafah El-Balad site farm site, Gen. no. 1 yielded the highest SY with no significant difference about G.130 the check variety and with significant difference about the other genotypes. The combined analyses of SY showed significant difference among genotypes. The highest SY was recorded from G.130 the check variety.

The results of harvest index in (Table 9) showed significant differences among the hull-less barley genotypes and their combined data, Gen. no. 5 (LHB2005/1) recorded the highest HI at both the two sites and their combined values. This results the recommendation to grow this genotypes in large scale in rainfed areas as drought tolerant variety. Results of this characters are in harmony with those obtained by Gouis (1992), Ellen (1993) and Assad *et al.* (1998).

Table (7): Plant height (PlHt/cm), spike length (Sp-L/cm) and rank (R) values (R) for 21 hull-less barley genotypes (ON Farm –Ver) grown under rainfed in 2009/2010 season.

	Rafah Exp Stn				Abo – ktafa				Combined			
Genotypes	Plht	R	Sp-L	R	Plht	R	Sp-L	R	Plht	R	Sp-L	R
1	43.3	3	4.7	7	46.7	2	5.0	5	45.0	3	4.8	6
2	51.7	1	6.0	1	46.7	3	5.7	1	49.2	1	5.8	1
3	41.7	6	5.7	2	38.3	8	4.7	6	40.0	7	5.2	4
4	36.7	8	4.3	8	40.0	7	4.7	7	38.3	8	4.5	7
5	43.3	4	5.0	5	41.7	6	4.0	8	42.5	6	4.5	8
6	48.3	2	5.3	3	48.3	1	5.7	2	48.3	2	5.5	2
7	40.0	7	5.0	6	46.7	4	5.0	4	43.3	5	5.0	5
8	43.3	5	5.3	4	45.0	5	5.3	3	44.2	4	5.3	3
Means	43.5		5.2		44.2		5.0		43.9		5.1	
LSD at 0.05 level for												
Locations												
Genotypes	NS		NS		NS		NS		5.70		0.88	
L×G	NS		NS		NS		NS		NS		NS	
CV	9.98%		13.44%		11.88%		15.66%		10.99%		14.56%	

Table (8): Biological yield (BY kg/ha), grain yield (GY kg/ha), WUE and rank values (R) For 8 hull-less barley genotypes (ON Farm–Ver) grown under rainfed in 2009/2010 season.

	Rafah Exp Stn						Rafah El-Balad site						Combined					
Geno.	BY	R	GY	R	WUE	R	BY	R	GY	R	WUE	R	BY	R	GY	R	WUE	R
1	2200.0	6	356.7	8	0.211	8	2966.7	1	416.7	5	0.293	5	2583.3	2	386.7	7	0.252	7
2	2433.3	4	373.3	7	0.221	7	2250.0	6	400.0	6	0.281	6	2341.7	7	386.7	8	0.251	8
3	2333.3	5	416.7	6	0.246	6	2566.7	4	375.0	7	0.264	7	2450.0	5	395.8	6	0.255	6
4	1933.3	8	450.0	5	0.266	5	2100.0	7	375.0	8	0.264	8	2016.7	8	412.5	5	0.265	5
5	2133.3	7	666.7	2	0.394	2	2800.0	2	725.0	1	0.510	1	2466.7	4	695.8	1	0.452	1
6	2766.7	2	506.7	4	0.299	4	2033.3	8	425.0	4	0.299	4	2400.0	6	465.8	4	0.299	4
7	2700.0	3	590.0	3	0.348	3	2300.0	5	516.7	3	0.363	3	2500.0	3	553.3	3	0.356	3
8	3566.7	1	733.3	1	0.433	1	2733.3	3	550.0	2	0.387	2	3150.0	1	641.7	2	0.410	2
Means	2508.3		511.7		0.302		2468.8		472.9		0.333		2488.5		492.3		0.317	
LSD at 0.05 level for Locations																		
G.	559.5		113.9		0.055		534.6		120.9		0.078		426.6		91.6		0.06	
L×G	NS		NS		NS		NS		NS		NS		522.6		112.2		NS	
CV.	12.7%		12.7%		12.7%		12.4%		14.6%		14.6%		12.6%		13.6%		13.8%	

Table (9): Straw yield (SY), harvest index (HI) and rank (R) values for 8 hull-less barley genotypes (ON Farm–Ver) grown under rainfed in 2009/2010 season.

	Rafah Exp Stn				Rafah El-Balad site				Combined			
Genotypes	SY	R	HI	R	SY	R	HI	R	SY	R	HI	R
1	1843.3	6	16.6	7	2550.0	1	14.3	8	2196.7	2	15.5	8
2	2060.0	4	15.4	8	1850.0	5	17.8	6	1955.0	4	16.6	6
3	1916.7	5	18.2	6	2191.7	2	14.6	7	2054.2	3	16.4	7
4	1483.3	7	23.3	2	1725.0	7	17.8	5	1604.2	8	20.6	3
5	1466.7	8	31.3	1	2075.0	4	25.9	1	1770.8	7	28.6	1
6	2260.0	2	18.4	5	1608.3	8	20.9	3	1934.2	6	19.7	5
7	2110.0	3	21.9	3	1783.3	6	22.6	2	1946.7	5	22.2	2
8	2833.3	1	20.8	4	2183.3	3	20.0	4	2508.3	1	20.4	4
Means	1996.7		20.8		1995.3		19.2		1996.3		20.0	
LSD at 0.05 level for												
Locations												
Genotypes	553.8		5.75		456.4		3.04		395.6		3.6	
L×G	NS		NS		NS		NS		484.6		NS	
CV.	15.8%		15.3%		13.1%		9.0%		14.5%		13.1%	

This study revealed 8 hull-less barley genotypes 7 of them identified as drought tolerant and they have high agronomic scores. These 7 accessions could be used in he different purposes in barley breeding program. In addition, the study identified one genotype (LHB 2005/1) could be released as new drought tolerant hull-less barley variety for rainfed areas.

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انتخاب تراكيب وراثية من الشعير العارى متحملة للجفاف تحت ظروف الزراعة المطرية فى شمال مصر *

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***ورقة علمية مستخلصة من نشاط المشروع المصرى الاوربى للتنمية المستدامة لانتاج الشعير تحت ظروف الزراعة المطرية بمصر**

يعتبر الشعير من اكثر المحاصيل الحقلية تاقلما للاجهاد المائى فهو المحصول الرئيسى الذى ينمو تحت ظروف الاجهاد المائى وقلة خصوبة التربة فى الساحل الشمالى الغربى (مطروح)والشرقى (سيناء) وقد اقيمت تجربة حقلية لمقارنة اصناف الشعير المنتخبة من مصادر محلية ومستوردة اشتملت على 29 تركيب وراثى من الشعير العارى تم تقيمها للتحمل للجفاف من خلال تجربتين محصوليتين التجربة المحصولية المتقدمة (ANBYT) سنة 2008-2009 والتى تحتوى على ٢١ تركيب وراثى زرعت فى موقعين وكل تركيب وراثى فى ٨ سطور طول السطر ٣,٥م المسافة بينها ٢٠سم والتجربة التاكيدية (On-F-Ver) والتى تحتوى ٨ تراكيب وراثية زرعت فى موقعين وكل تركيب وراثى فى ١٠اسطور طول السطر ٥م المسافة بينها ٢٠ سم حيث اشتملت كل تجربة على ثلاث مكررات وزرعت هذه التجارب فى ٤ موقع فى جمهورية مصر العربية خلال مواسم 2008-2009 و٢٠٠٩-٢٠١٠ وكان الهدف الرئيسى من هذه الدراسة هو غربلة اصناف االشعير العارى عالية االانتاجية القادرة على تحمل الجفاف واوضحت النتائج الاتى:

فى التجربة المحصولية المتقدمة (ANBYT) تم انتخاب 7 تراكيب وراثية تفوقت فى محصول الحبوب على صنف المقارنة جيزة ١٣٠ وصعدت هذه التراكيب المتفوقة وتم زراعتها فى التجربة التاكيدية

(On-F-Ver) بالاضافة الى صنف المقارنة جيزة ١٣٠ حيث تفوق التركيب الوراثي رقم ٥ على صنف المقارنة فى صفة المحصول والكفاءة الاستعمالية لمياه الامطار.

خلص البحث الى امكانية استخدام ٧ تراكيب وراثية فى برنامج تربية الشعير العارى لتحسين هذا المحصول بالاضافة الى امكانية نشر التركيب الوراثى رقم ٥ كصنف جديد للزراعة فى مناطق زراعة الشعير المطرية بمصر. وتفوق هذا التركيب الوراثى تفوقا ملحوظا فى المحصول على صنف المقارنة (جيزة ١٣٠) بالاضافة لتفوقه المعنوى فى دليل الحصاد والكفاءة الاستعمالية لمياه الامطار المحدودة على صنف المقارنة ايضا.

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