EVALUATION OF YIELD PERFORMANCE AND STABILITY OF SOME BREAD WHEAT GENOTYPES

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Abstract

The objective of this study was to evaluate yielding ability of six bread wheat lines and cultivars under wide range of environments. The trials were conducted for the two growing seasons (2003/2004 and 2004/2005) in five main locations, namely El-Nubaria (New lands, West Delta), El-Gemmeiza and Kafr El Hammam (South Delta), Sids (Middle Egypt) and Shandaweel (Upper Egypt). The study revealed that the two common cultivars Giza 168 and Sakha 93 were the highest yielding ones , with regression slopes over environment not exceeding unity and considerable deviation from regression that pertain considerable stability over wide range of environment representing the main regions of Egypt . Other genotypes proved high level of stability but very humble productivity. The superiority of the two cultivars was related to the longest grain filling period, highest grain and straw yields / feddan. Therefore, growing these two cultivars Giza 168 and Sakha 93 allover Egypt is highly recommended.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the main human staple food in Egypt as well as in many other countries. In 2005 the national wheat production reached about 8 million tons as compared with 2.25 tons at early eighties. However, this production is far from self satisfaction as it is still below 60 % from local requirements, although the area devoted to wheat crop reached approximately 3 million Feddan. Therefore , vertical expansion , i.e. development of new cultivars having high yield potentiality with high stability over the country to decrease any fluctuation in productivity over seasons and locations, seems to be the only possible way to overcome this problem .

Thus, multilocation grain yield testing of new lines and cultivars in preliminary and advanced yield trials is a prerequisite for accurate yield potential and stability assessment. Comstock and Moll (1963) have shown statistically the effect of large environment genotype interaction. Moreover, Finlay and Wilkinson (1963) proposed the average yield of the varieties at each site to provide an inclusive measure of the environment .Eberhart and Russel (1966) suggested the use of environmental index. Rajaram *et al.* (1983) defined yield stability statistically as low square of the deviation of the location means of a particular cultivar from the regression line of these location means on the respective grain means. El- Nagar (1997) indicated that wheat cultivars

which had higher grain yield were unstable. Joppa *et al.* (1971) reported that stability analysis could materially assess the plant breeder in making decisions regarding the cultivar release, and added that a cultivar which had a regression coefficient more than unity may yield relatively more than the other cultivars in a high yield environment.

Mitkees *et al.* (1989) suggested computing BLI (Best Line Index) which included the productivity of line, its regression on environmental index and its deviation from regression (S^2_d), for final decisions , where BLI = $b \times \bar{x} / S^2_d$.

However, Bowman (1998) said that two year multilocation data would be useful to selected wheat cultivars.

MATERIALS AND METHODS

Six bread wheat genotypes were evaluated at five locations, for the two growing seasons (2003/2004 and 2004/2005). Names and Pedigree are presented in Table (1). The experimental design was RCBD in three replications. The studied characters were days to heading (DH), days to maturity (DM), plant height (Pl.ht) (cm), grain filling period (GF) and grain yield (GY) (ardab / feddan). For each character, analysis of variance was performed for each location in each growing season, and combined analysis over seasons and locations was computed. Stability parameters for grain yield were calculated according to Eberhart and Russell (1966) and best line index BLI was computed according to Mitkees (1980).

Table 1. Names and Pedigrees of six of bread wheat genotypes.

Genotypes	Name	Pedigree	Origin
G_1	KAUZ/GYS//KAUZ	CMBW90M4837-0TOPY-11M-2Y-010M-010Y-5M-015Y-OY-OHTY-OAP	ICARDA
G_2	CHAM-6	CM39992-8M-7Y-OM-OAP	ICARDA
G_3	CHAM-4	CM39816-1S-1AP-OAP	ICARDA
G_4	MEXIPAK 65	II8156-OPAK	ICARDA
G_5	Giza 168	MRL/BUC/SERI	EGYPT
G_6	Sakha 93	Sakha 92 / TR 810328	EGYPT

RESULTS AND DISCUSSION

1-Analysis of Variance: (ANOVA)

All the tested genotypes showed significant differences in days to heading, days to maturity, grain filling period, plant height, and grain yield.

Seasonal as well as location effects and their interactions with genotypes were also highly significant for all characters, Table (2).

The combined Analysis of Variance for locations and seasons indicated significant differences for all characters under study being different from location to another and from season to the other .

Table 2. ANOVA .Combined mean squares of the studied characters.

Source Of Variation	d. f.	DH	DM	GF	GY	Pl. ht
Season (S)	1	2177**	172**	1125**	22.24**	1229**
Location (L)	4	633**	1129**	140**	133.16**	440**
SL	4	88**	35	169**	1.87^{-}	280**
R / SL	20	17	6	23	5.51*	16
Genotype *G*	5	48**	214**	304**	96.67**	498**
SG	5	157**	84	69^{+}	2.41^{-}	77
LG	20	89**	132**	105**	6.71**	40^{+}
SLG	20	31^{+}	55**	93**	4.28^{-}	89**
error	100	19	14	35	3.19	27
C.V.%		4.43	2.55	12.23	13.94	5.01

d. f. =degree of freedom, DH= days to Heading, DM= days to Maturity, GF= grain filling

GY = Grain yield, Pl. ht= plant height.

2- Average Performance:

Though significantly different, the cultivars showed slight differences in days of heading Table (3), being varying over seasons and locations. However, all of them seemed to head at the same time, except for G_2 (CHAM-6). The two common cultivars, Giza 168 (G_5) and Sakha 93 (G_6) may be the earliest ones over all locations, being after 100 days from sowing. On the other hand, the effect of location did not exceed one week earlier. Heading in Upper Egypt (Shandawel and Sids), was about three days earlier than El-Gemmeiza and one week before Sakha. However, the all headed in average range of 99- 102 days from sowing.

For days to maturity the two common cultivars seemed to be the latest in maturity overall locations, except El-Nubaria Table (4). However, the average range of maturity ranged within 142-152 days.

Accordingly, the two common cultivars had the longest filling period, about 32 days from heading in most locations (Table 5).

These results were reflected in grain yield / fed, (Table 6) where the two cultivars Giza 168 and Sakha 93 yielded the highest consistently overall locations, averaging as 15.05 ard. / fed. for Giza 168 and 15.15 ard. / fed. for Sakha 93 with ranges of 11.69 – 18.38 ard. / fed. for the first and 12.22 – 18.21 ard. / fed. for the second .

Furthermore, These two cultivars were amongst the tallest genotypes overall locations Table (7), which would result in their superiority in straw yield , though not given in the present study .

Table 3. Average performance of days to heading for the six tested wheat genotypes over season and location during 2003/2004 and 2004/2005 growing seasons.

Locations (L)	S Season	G_1	G_2	G_3	G_4	G_5	G_6	AV	LSD at 0.05%
EL-Nubaria	1	118.33	120.00	113.00	117.33	98.33	101.00	111.33	2.88
	2	98.33	100.33	105.00	100.00	96.00	101.00	101.11	3.47
	$\bar{x}$	108.33	110.17	109.00	108.67	97.17	101.00	106.22	2.13
EL-Gemmeiza	1	101.67	122.33	104.00	103.33	105.33	98.33	105.83	21.78
	2	96.33	98.00	101.33	99.00	100.67	92.00	97.89	2.47
	$\bar{x}$	99.00	110.17	102.67	101.17	103.00	95.17	101.86	14.57
Kafr El-Hammam	1	100.00	102.33	103.00	104.00	100.67	101.00	101.83	1.65
	2	94.33	95.33	97.67	95.67	100.67	102.00	97.61	1.00
	$\bar{x}$	97.17	98.83	100.34	99.84	100.67	101.50	99.72	1.22
Sids	1	98.67	103.67	101.00	101.33	101.67	98.33	100.78	2.14
	2	97.67	97.00	97.33	94.67	98.33	98.33	97.22	4.48
	$\bar{x}$	98.17	100.34	99.17	98.00	100.00	98.33	99.00	1.37
Shandweel	1	96.00	97.67	99.33	96.33	100.67	99.00	98.17	4.24
	2	89.00	85.33	88.00	86.00	95.67	98.00	98.33	4.83
	$\bar{x}$	92.50	91.00	93.67	91.17	97.67	98.50	98.25	3.17
	$\bar{x}$	99.03	102.20	100.97	99.77	99.80	98.90	100.11	2.24

Table 4. Average Days to Maturity for the six tested wheat genotypes over season and location during 2003/2004 and 2004/2005 growing seasons.

Locations (L)	S Season	G_1	G_2	G_3	G_4	G_5	G_6	AV	LSD at 0.05%
EL-Nubaria	1	149.67	151.67	151.33	163.33	152.33	150.67	153.17	4.37
	2	152.00	161.00	161.00	149.00	152.33	150.67	154.33	2.87
	$\bar{x}$	150.84	156.34	156.17	156.17	152.33	150.67	153.75	3.46
EL-Gemmeiza	1	151.33	156.67	59.00	156.33	152.67	154.00	155.00	3.26
	2	159.67	145.33	49.00	146.33	150.67	154.33	150.89	2.84
	$\bar{x}$	155.50	151.00	54.00	151.33	151.67	154.17	152.95	2.88
Kafr El-Hammam	1	144.33	150.67	49.67	146.33	154.00	153.33	149.39	3.32
	2	142.00	142.67	149.33	142.67	154.00	151.33	147.00	3.02
	$\bar{x}$	143.17	146.67	149.50	144.50	154.00	152.33	148.20	2.97
Sids	1	145.33	150.67	148.00	144.33	149.33	149.33	147.83	2.01
	2	143.67	142.67	147.67	146.33	148.00	149.33	146.28	3.62
	$\bar{x}$	144.50	146.67	147.84	145.33	148.67	149.33	147.06	2.74
Shandweel	1	136.00	142.67	127.67	140.33	149.33	151.33	141.22	18.64
	2	127.67	132.33	132.00	132.61	152.33	53.00	138.33	6.08
	$\bar{x}$	131.84	137.50	29.84	136.77	150.83	52.17	139.78	12.98
	$\bar{x}$	145.17	147.64	147.27	146.77	151.50	51.73	148.35	6.02

Table 5. Average Grain Filling Period for the six tested wheat genotypes over season and location during 2003/2004 and 2004/2005 growing seasons.

Locations (L)	S Season	G_1	G_2	G_3	G_4	G_5	G_6	AV	LSD at 0.05%
EL-Nubaria	1	31.33	31.67	38.33	46.00	54.00	49.67	41.83	8.27
	2	53.67	68.67	56.00	49.00	56.33	49.67	54.22	5.08
	$\bar{x}$	42.50	46.17	47.17	47.50	55.17	49.67	48.03	6.33
EL-Gemmeiza	1	49.67	34.33	55.00	53.00	47.33	55.67	49.17	22.82
	2	63.33	47.33	47.67	47.33	50.00	62.33	53.00	4.54
	$\bar{x}$	56.50	40.83	51.33	50.17	48.67	59.00	51.08	15.18
Kafr El-Hammam	1	46.67	47.00	47.00	43.00	47.67	51.00	47.06	3.18
	2	46.00	45.67	50.33	51.67	49.67	51.00	49.06	3.97
	$\bar{x}$	46.33	46.33	48.67	47.33	48.67	51.00	48.06	3.32
Sids	1	44.33	48.33	44.67	42.33	53.33	52.33	47.56	3.69
	2	47.67	47.33	51.67	47.00	53.33	49.33	49.39	3.07
	$\bar{x}$	46.00	47.83	48.17	44.67	53.33	50.83	48.47	3.14
Shandweel	1	40.00	45.00	28.33	44.00	48.67	52.33	43.06	19.77
	2	38.67	47.00	44.00	46.67	56.67	55.00	48.00	8.70
	$\bar{x}$	39.33	46.00	36.17	45.33	52.67	53.67	45.73	14.09
	S_1	42.40	41.27	42.67	45.67	50.20	52.20	45.73	5.57
	S_2	49.87	49.60	49.93	48.33	53.20	53.47	50.73	2.16
	$\bar{x}$	46.13	45.43	46.30	47.00	51.70	52.83	48.23	2.98

Table 6. Average Grain Yield (ard. / fed.) for the six tested wheat genotypes over season and location during 2003/2004 and 2004/2005 growing seasons.

Locations (L)	S Season	G_1	G_2	G_3	G_4	G_5	G_6	AV	LSD at 0.05%
EL-Nubaria	1	12.22	13.06	10.82	12.36	18.63	18.13	14.21	4.79
	2	11.85	13.16	12.83	12.69	18.14	18.30	14.49	2.38
	$\bar{x}$	12.04	13.11	11.83	12.63	18.38	18.21	14.35	3.50
EL-Gemmeiza	1	9.45	9.67	7.97	8.25	11.09	11.41	9.64	1.40
	2	9.17	9.10	9.35	9.85	12.30	13.02	10.03	3.95
	$\bar{x}$	9.31	9.39	8.96	9.05	11.69	12.22	10.14	2.74
Kafr El-Hammam	1	11.17	10.54	10.19	9.44	13.39	14.49	11.54	1.16
	2	10.77	11.32	9.08	10.83	15.17	14.99	12.03	1.94
	$\bar{x}$	10.97	10.93	9.64	10.14	14.28	14.74	11.78	1.47
Sids	1	13.65	13.05	15.04	12.97	15.84	17.39	14.66	2.80
	2	13.21	15.98	15.54	16.65	14.65	14.36	15.07	5.24
	$\bar{x}$	13.43	14.52	15.47	14.67	15.24	15.87	14.86	3.87
Shandweel	1	10.95	10.55	11.50	11.91	14.36	14.36	12.27	1.49
	2	13.05	14.63	10.83	10.97	17.04	15.09	13.60	4.09
	$\bar{x}$	12.00	12.59	11.17	11.44	15.70	14.69	12.94	2.84
	$\bar{x}$	11.64	12.11	11.32	11.59	15.06	15.15	12.81	2.59

Table 7. Average Plant height (cm) for the six tested wheat genotypes over season and location during 2003/2004 and 2004/2005 growing seasons.

Locations (L)	S Season	G_1	G_2	G_3	G_4	G_5	G_6	AV	LSD at 0.05%
EL-Nubaria	1	95.0	105.0	97.0	100.0	109.0	110.0	102.67	7.22
	2	98.0	100.0	100.0	115.0	105.0	95.0	102.16	4.28
	$\bar{x}$	96.5	102.5	98.5	107.5	107.0	102.5	102.42	5.56
EL-Gemmeiza	1	113.0	111.0	108.0	118.0	117.0	103.0	111.66	14.25
	2	94.0	94.0	100.0	108.0	102.0	108.0	101.00	4.78
	$\bar{x}$	103.5	102.5	104.0	113.0	109.5	105.5	106.33	9.95
Kafr El-Hammam	1	105.0	113.0	115.0	118.0	107.0	110.0	111.33	7.15
	2	100.0	95.0	98.0	103.0	103.0	98.0	99.50	8.58
	$\bar{x}$	102.0	104.0	106.5	110.5	105.0	104.0	105.33	7.39
Sids	1	98.0	106.0	93.0	117.0	103.0	103.0	103.33	7.79
	2	100.0	102.0	103.0	113.0	100.0	99.0	102.83	7.83
	$\bar{x}$	99.0	104.0	98.0	115.0	101.5	101.0	103.08	7.31
Shandweel	1	94.0	99.0	96.0	98.0	107.0	99.0	98.83	14.61
	2	88.0	92.0	90.0	107.0	102.0	98.0	96.17	10.86
	$\bar{x}$	91.0	95.5	98.0	102.5	104.5	98.5	97.49	12.05
	$\bar{x}$	98.4	101.7	101.0	109.7	105.5	102.3	103.10	8.23

3-Stability Study :

Stability of a variety means that this variety would exert the minimum fluctuations over a wide range of environment , i.e. does the relatively the same over a wide range of environment .

The model $Y_{ij} = \mu_i + \beta_i I_j + S_{ij}$ was established by Eberhart and Russell (1966) to define the stability parameters that may be used to describe the performance of a variety over a series of environments . Y_{ij} is the variety mean of i^{th} variety at the j^{th} environment , μ_i is the i^{th} variety mean over all environments , β_i is the regression coefficient that measure the response of the i^{th} variety to the varying environment , S_{ij} is the deviation from regression of the i^{th} variety at the j^{th} environment and I_j is the environmental index . Thus, the definition of a stable variety will be one with b=1 and S^2_d=0 , approximately.

Accordingly , results in Table (8) indicate that all genotypes had b=1, except for G_1 , which had slope (b) less than unity but deviation from regression of zero , to show its high stability which resulted in the highest coefficient of determination (84%), but very low yield in moderate environment (11.64 ard. / fed.), i.e. the most stability the least productivity, in full agreement with El Nagar (1997). However, the two common cultivars Giza 168 and Sakha 93 had somewhat small deviation from regression (0.4794 and 1.5282) and moderate coefficients of determination (70 and 64 %) , but the highest yielding ability (15.059 and 15.152 ard / fad.) , consistently overall environment .

These results supported those obtained for both common cultivars obtained by Shehab El-Den *et. al.* (1999). They had slopes of (1.473 and 0.80) at North Delta , (1.21 and 1.20) at South Delta, (1.147 and 0.986) at New Lands out Valley, (1.28 and 1.19) at Middle Egypt and (0.978 and 1.16) at Upper Egypt with respective S^2_d of (3.28 and 6.24) , (4.75 and 3.20) , (0.75 and 0.06) , and (2.04 and 1.05) for Giza 168 and Sakha 93 at the five regions , respectively . Therefore they accounted for their increasing cultivation for the total wheat area by 2005 .

Finally, the two recommended commercial cultivars Giza 168 and Sakha 93 proved again their superiority over a wide range of environment of Egypt, with elegible deviations and none of the new genotypes could surpass any of them .

Table 8 . Stability parameters for grain yield of the tested genotypes during 2003/2004 and 2004/2005 growing seasons.

Parameter	G_1	G_2	G_3	G_4	G5	G_6
Variance , σ^2	1.93	4.41	6.28	5.42	5.96	4.89
Regression Intercept , a	11.65	12.21	11.30	11.58	15.06	15.15
Regression slope , b	0.685	0.998	1.161	1.078	1.065	0.949
Slope error, sb	0.105	0.186	0.241	0.224	0.270	0.252
Deviation from regression , S^2_d	∞	0.52	1.04	∞	0.48	1.53
Coefficient of determination , CD %	84	78	74	74	70	64

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تقييم القدرة المحصولية و ثباتها في بعض التراكيب الوراثية لقمح الخبز

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استهدفت الدراسة تقييم القدرة المحصولية لستة تراكيب وراثية لقمح الخبز في مدى واسع من الاختلافات البيئية. وقد نفذت هذه الدراسة في خمس محطات بحوث زراعية وهي النوبارية – الجميزة – كفر الحمام – سدس – شندويل، خلال الموسمين الزراعيين (٢٠٠٣/٢٠٠٤– ٢٠٠٤/٢٠٠٥) ،وتمت دراسة صفات عدد الأيام حتى طرد السنابل وعدد الأيام حتى النضج وطول النبات ومحصول الحبوب وفترة امتلاء الحبوب. وكذلك تم تقدير الثبات لمحصول الحبوب .

وقد أوضحت الدراسة أن الصنفين التجاريين جيزة ١٦٨ وسخا ٩٣ كانا أعلى التراكيب الوراثية محصولا بمعامل انحدار على دليل البيئة لم يختلف عن الوحدة، وبدرجة اختلاف عن الانحدار في الحدود المقبولة مما يسمح بالاستفادة منها في مدى واسع من البيئات في عموم الجمهورية ،وبهذا يوصى بزراعتهما في أى منطقة من مناطق الجمهورية.