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GENOTYPE-ENVIRONMENT INTERACTION FOR SOME EXOTIC CHICKPEA GENOTYPES

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ABSTRACT

Thirty eight exotic chickpea genotypes from ICARDA were evaluated with the commercial cultivar Giza-3 for seed yield and some of its components during two growing seasons (2002/03-2003/04) at Maryout and El-Maghara Research Stations, Desert Research Center under five environmental conditions (Env.$_{1}$, Env.$_{2}$, Env.$_{3}$, Env.$_{4}$ and Env.$_{5}$). The first and second ones were under dry methods by using irrigation at sowing date only in addition to the seasonal rainfall during both growing seasons, whereas the third, one was carried out at the second season (2003/04) by irrigated after 45 days from sowing date in addition to the seasonal rainfall at Maryout Research Station. The fourth and fifth ones were carried out at El-Maghara Research Station, under drip irrigation at all 6 days interval for one hour.

The results indicated that there was a wide range of variability on yield and yield components between the two locations with high genotypic differences .In addition to the genotype × environment interaction was significant and a major portion of such was accounted by the deviation from linear response. Seed yield and some of its components influenced by the supplemental irrigation after 45 days from sowing date. High values of these traits were obtained when chickpea plants were irrigated once again after 45 days from sowing at Maryout Research Station in the second season. This outyielded by 32.41% and 48.21% for seed yield per plant compared with Env.$_{1}$ and Env.$_{2}$.

Inaddition, genotypes No. 27 followed by No. 7, 17 and 16 had the highest mean values for seed yield. Moreover, genotypes No. 27, 11, 31 and 29 recorded the highest mean values for number of seeds / plant as compared with the other genotypes either exotic or local one (Giza- 3).

Stability studies revealed that, genotypes No. 17 was more stable for seed yield / plant on the basis of (bi) and (S^2di) which did not differ significantly from unity and zero, respectively and ranked third for seed yield compared with the other genotypes, also, it gave a suitable number of seeds / plant. From such studies it could be concluded that, genotype no. 17 consider the best genotype because it's more stable under five different environmental conditions.

Keywords: Chickpea, genotype x environment interaction, drought, rainfall, supplemental irrigation and stability.

INTRODUCTION

Chickpea (*Cicer arietinum*) is amongst the world's most important pulse crops that cultivated on about 10 million ha annually to produce about 6 million tons of dry seed (Saxena, 1985). Generally, in the Mediterranean region, chickpea grown in areas receiving > 350 mm of rainfall per year without receiving any supplemental irrigation that depending on water stored in the soil profile.

The knowledge of variability for the different genotypes is important in plant breeding programs. Further, the genetic resources should be evaluated under different environmental conditions, especially the exotic ones because the absence information on genotype × environment interaction, as well as the estimation of heritability and prediction of genetic advance become biased (Comstock and Moll, 1963). A wide range of variability among the environmental conditions for evaluation the yield production considers a prerequisite for proper selection decision. However, evaluation genotypes depending on the interaction of genotype × environment led to unsuitable dedication for breeder to select the most stable genotype under such locations. In the same respect, Eberhart and Russell (1966) defined a specific relationship of stability genotype which regression coefficient, bi equal to 1 and mean square deviation from regression, S^2di equal to zero.

Nimje (1991) mentioned that chickpea seed yield and number of pods/plant improved greatly by using irrigation systems up to three, on scheduling at pre-sowing, branching and pod-filling stages. However, Prabhakar and Saraf (1991) found that two irrigation systems for chickpea during vegetative and reproductive stages gave 6-q/ha seed yield as compared with no irrigation. Also, El-Waraky and El-Koliey (2000) found that, chickpea production could be improved by applying three irrigation times at branching, flowering and pod development stages. They also added, if two irrigation times were only available, the best stages for yield production when their scheduling at branching and pod development stages. Also it there was one available irrigation, the most suitable time on its scheduling at pod development stage for getting the highest yield and water use efficiency of chickpea at Malawi (Middle Egypt) conditions.

Saxena *et al* (1990) found that, irrigation chickpea in winter and spring seasons increased seed yield by 56 and 72 %, respectively. Over those receiving 316 mm annual rainfall precipitation, using irrigation is consider a way to increase the productivity and yield stability of chickpea in Northern Syria and the most yield production depends on the total rainfall and its distribution over the growing season.

The present study aimed to determine the genetic stability and best genotype among 38 exotic chickpea genotypes compared with the commercial cultivar Giza-3 grown under different five environmental conditions.

MATERIALS AND METHODS

Five filed experiments with 38 exotic as well as local cultivar Giza-3 of chickpea plant were cultivated at a randomized complete block design with three replications. The experimental plot consists of three ridges 3m long and 60 cm apart. One seed hand planted in each hill spaced by 20 cm on one side of the ridge. The first and second experiments ($Env._1$ and $Env._2$), dry method were carried out by using one irrigation time at sowing date at Maryout Experimental Station during 2002/03 and 2003/04 growing seasons, and after that plants were left to grown under seasonal rainfall. Whereas, the 3 rd experiment ($Env._3$) they was carried out at Maryout during 2003/2004 that received two irrigation's, the first at sowing and the second after 45 days from sowing in additional to the seasonal rainfall. The 4^{th} and 5^{th} experiments ($Env._4$ and $Env._5$) were cultivated at El-Maghara Research Station during 2002/03 and 2003/04 growing seasons, by using drip irrigation at 6 days interval with one hour for every irrigation time (dripped gave 8L/hour). chickpea genotypes are presented in (Table-1).

Table (1): The pedigree and origin of 39 chickpea genotypes.

Entry NO.	Cross No./ Entry Name	Pedigree	Origin	FAO Status*
1	× 2000TH 2	FLIP 97-50C x Sel 99TER 85021	ICARDA/ICRISAT	U
2	× 2000 TH 13	FLIP 93-58Cx FLIP 98-29C	ICARDA/ICRISAT	U
3	× 2000TH 14	FLIP 98-14C x FLIP 98-64C	ICARDA/ICRISAT	U
4	× 2000TH 15	FILP 97-28C x FLIP 98-129C	ICARDA/ICRISAT	U
5	× 2000TH 17	FILP 97-25C x S 98588	ICARDA/ICRISAT	U
6	× 2000TH 19	FLIP 98-64C x FLIP 98-10C	ICARDA/ICRISAT	U
7	× 2000TH 21	FILP 98-64C x FLIP 98-47C	ICARDA/ICRISAT	U
8	× 2000TH 31	FILP 98-29CxS 99093	ICARDA/ICRISAT	U
9	× 2000TH35	FILP 98-29CxS 99442	ICARDA/ICRISAT	U
10	× 2000TH 39	FILP 98-29Cx S 99001	ICARDA/ICRISAT	U
11	× 2000TH 43	FLIP 98-138C x Sel 99TER 85035	ICARDA/ICRISAT	U
12	× 2000TH 44	FLIP 98-138C x Sel 99TER 85074	ICARDA/ICRISAT	U
13	× 2000TH 45	FLIP 98-138C x Sel 99TER 85075	ICARDA/ICRISAT	U
14	× 2000TH 46	FLIP 98-138C x Sel 99TER 85461	ICARDA/ICRISAT	U
15	× 2000TH 47	FLIP 98-138C x Sel 99TER 85468	ICARDA/ICRISAT	U
16	× 2000TH 59	ILC 3843 x FLIP 98-52C	ICARDA/ICRISAT	U
17	× 2000TH 69	(FLIP 91-61C x FLIP 85-5C) xFLIP 98-29C	ICARDA/ICRISAT	U
18	× 2000TH 73	(FLIP 84-11C x FLIP 88-32C) xFLIP 98-29C	ICARDA/ICRISAT	U
19	× 2000TH 74	(FLIP 91-61C x FLIP 87-90C) xFLIP 98-129C	ICARDA/ICRISAT	U
20	× 2000TH 77	(FLIP 84-14C x ILC 2398) xFLIP 98-29C	ICARDA/ICRISAT	U
21	× 2000TH 86	(FLIP 93-2C x FLIP 90-137) xFLIP 98-10C	ICARDA/ICRISAT	U
22	× 2000TH 88	(FLIP 84-92C x FLIP 90-172C) xFLIP 98-47C	ICARDA/ICRISAT	U
23	× 2000TH 90	(FLIP 84-145C x S 95338) xFLIP 98-10C	ICARDA/ICRISAT	U
24	× 2000TH 102	(FLIP 93-62C x FLIP 93-259C) xFLIP 98-10C	ICARDA/ICRISAT	U
25	× 2000TH 110	(FLIP 91-14C x ICCV 6) xFLIP 98-47C	ICARDA/ICRISAT	U
26	× 2000TH 154	GLK 95069 x FILP 98-132C	ICARDA/ICRISAT	U
27	× 2000TH 155	GLK 95075 x FILP 98-52C	ICARDA/ICRISAT	U
28	× 2000TH 156	GLK 95075 x FILP 98132C	ICARDA/ICRISAT	U
29	× 2000TH 163	GLK 95072 x FILP 98-52C	ICARDA/ICRISAT	U
30	× 2000TH 164	GLK 95072 x S 98588C	ICARDA/ICRISAT	U
31	× 2000TH 167	L 551x FLIP 98-52C	ICARDA/ICRISAT	U
32	× 2000TH 168	L 551x FLIP 98-129C	ICARDA/ICRISAT	U
33	× 2000TH 175	Lebanese market sample-1 x Sel 99TER 85581	ICARDA/ICRISAT	U
34	× 2000TH 176	Lebanese market sample-1 x Sel 99TER 85530	ICARDA/ICRISAT	U
35	× 2000TH 177	Lebanese market sample-1 x Sel 99TER 85534	ICARDA/ICRISAT	U
36	× 2001TH 178	Lebanese market sample-1 x Sel 99TER 85485	ICARDA/ICRISAT	U
37	ILC 482	Long term check	Turkey	D
38	FLIP 82-150	ILC 523 x ILC 183 (Improved check)	ICARDA/ICRISAT	D
39	Giza-3	Agric. Research Center	Egypt	U

*D=Designated, U = Undesignated

All genotypes were sown at Maryout and EL-Maghara Research Stations, Desert Research Center at 25 th November and the first week of December respectively, to evaluate 38 chickpea genotypes introduced from ICARDA as well as the commercial cultivar Giza –3. The pedigree and origin of the 39

Some chemical and physical analysis of soil and irrigation water is presented in (Table 2). The experimental fields were fertilized using calcium superphosphate at the rate of 25 kg of P_2O_5 per feddan before sowing and honing practiced when necessary.

Table (2): Some chemical and physical analyses of soil and irrigation water of the two experimental stations.

Locations	Types	EC dsm^{-1}	pH	Cations me/L				Anions me/L			$CaCO_3$ %	Textural Class
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	$SO_4^{=}$		
Maryout	Soil (0-30)	4.80	7.7	17.3	9.22	30.65	1.09	3.6	32.00	22.66	24.0	Loamy clay
	Water	3.52	7.5	7.02	8.03	17.33	0.42	9.33	16.44	6.87	-----	
El-Maghara	Soil (0-30)	0.9	7.4	4.00	1.50	3.30	0.15	1.80	5.20	1.95	11.7	Sand
	Water	4.06	8.4	11.4	3.48	24.6	0.69	4.40	32.20	3.57	------	

The meteorological data of total seasonal rainfall and its distribution during growth stages for the two growing seasons at Maryout Research Station are presented in Table (3)

Table (3): Monthly mean rainfall (mm) at Maryout Research Station.

Month	2002/2003	2003/2004
October	4.31	0.25
November	2.03	4.52
December	69.60	41.91
January	38.10	70.86
February	83.80	56.64
March	40.64	2.03
April	0.25	0.25
Total	238.73	176.46

Source: Meteorological Desert Research Center Lab.

The data of each experiment, were recorded and computed for number of seeds per plant, 100- seed weight and seed yield per plant using ten individual plants chosen randomly from each plot. The data were analyzed on individual plant for mean basis the ordinary analysis of variance for R.C.B.D. According to Snedecor and Cochran (1967).

The genetic stability parameters were calculated for all the studied traits as suggested by Eberhart and Russell (1966).

For genetic evaluation and stability Wricke and Weber (1986) proposed equivalence model to evaluate the balance response of G × E interaction as follows

$$Wi= \Sigma_j (y_{ij} - y_i - y_j + y_{..})^2$$

Where: Wi is the ecovalence of the ith genotypes, y_{ij} is the mean performance of genotype (i) in the j^{th} environment, y_i and y_j are the genotype and environment mean deviation, respectively and y is the overall mean.

The statistical analysis was computed by using the least significant difference (LSD) for comparing the mean performance of the tested chickpea genotypes.

RESULTS AND DISCUSSION

Data presented in Table (4) indicated that a significant difference among chickpea genotypes as well as environments and genotype × environment interaction for all traits recorded. The data also indicated that chickpea genotypes responded differently to the different environmental conditions suggesting the importance of assessment of genotypes under different environments in order to identify the best genetic makeup for each particular environment. These findings are in line with those previously obtained by Omar (2004b) in chickpea and Afiah and Omar (2003) in barley plants.

Table (4): The genotypes mean performance in each environmental condition of 39 chickpea genotypes for seed yield and some yield components.

G.	No. of seeds/plant					100-seeds weight (g)					Seed yield/plant (g)				
	Env_1	Env_2	Env_3	Env_4	Env_5	Env_1	Env_2	Env_3	Env_4	Env_5	Env_1	Env_2	Env_3	Env_4	Env_5
1	14.6	13.2	26.3	24.6	21.5	19.3	18.5	23.9	22.5	20.4	2.8	2.5	6.3	5.5	4.5
2	34.1	23.1	37.4	34.2	31.3	13.8	13.0	19.1	20.4	19.0	4.7	2.9	7.1	7.0	5.8
3	15.2	13.2	24.1	24.3	22.4	21.1	18.7	23.7	22.1	22.2	3.2	2.5	5.7	5.3	5.0
4	13.7	11.6	22.6	23.0	22.9	16.4	16.1	20.4	21.9	20.4	2.2	1.9	4.6	5.0	4.7
5	29.7	21.2	36.1	32.3	29.9	13.5	11.5	18.5	19.8	20.2	4.0	2.6	6.7	6.4	6.0
6	32.3	22.5	38.1	35.1	31.6	20.3	17.6	21.7	21.3	21.6	6.5	4.0	8.2	7.5	6.8
7	28.5	22.5	29.7	29.6	29.6	25.0	20.3	26.0	23.4	22.3	7.2	5.0	7.7	6.9	6.6
8	27.4	19.9	34.8	35.8	31.4	15.9	16.1	19.1	20.7	21.4	4.4	3.1	6.6	7.4	6.6
9	26.6	23.4	33.5	37.5	36.8	17.4	14.4	20.1	20.9	18.6	4.8	3.7	6.8	7.8	6.9
10	15.0	12.9	25.1	30.1	29.9	11.4	10.5	14.3	17.4	17.7	1.7	1.3	3.6	5.2	5.3
11	40.3	32.7	45.8	41.8	37.9	9.8	8.5	11.4	13.5	16.1	3.9	2.9	5.3	5.6	6.1
12	18.3	15.5	32.1	28.4	27.3	15.6	12.6	18.0	19.8	20.5	2.8	2.0	5.8	5.3	5.6
13	21.4	16.4	29.8	28.7	27.3	15.2	11.9	17.0	19.6	18.9	3.3	2.2	5.1	5.6	5.2
14	19.2	16.6	29.4	27.7	28.0	10.2	9.7	11.2	14.0	16.6	2.0	1.6	3.3	3.9	4.6
15	26.2	18.7	34.1	34.4	32.4	20.6	17.0	21.9	20.6	20.6	5.5	3.3	8.6	7.1	6.7
16	31.7	25.5	37.8	40.4	37.5	17.5	17.0	19.8	20.9	19.5	5.6	4.4	7.5	8.5	7.3
17	34.1	30.1	35.6	33.6	32.4	18.4	14.9	20.5	21.7	20.7	6.3	4.7	7.3	7.3	7.7
18	20.7	14.3	28.0	27.4	23.6	17.3	16.5	18.9	19.4	20.0	3.6	2.3	5.3	5.3	4.7
19	37.2	24.8	37.4	34.5	30.5	15.2	12.0	15.3	17.1	18.4	5.1	3.0	5.8	5.9	5.6
20	15.4	14.2	23.1	22.5	23.5	10.2	9.6	13.6	14.9	14.7	1.5	1.4	3.1	3.4	3.5
21	31.8	20.5	35.1	31.7	31.9	15.4	13.4	19.0	19.8	20.3	4.9	3.1	6.7	6.3	6.5
22	10.6	9.3	20.3	21.9	20.1	16.6	13.9	21.0	21.7	20.2	1.8	1.5	4.3	4.8	4.0
23	29.4	22.9	34.7	33.1	30.6	16.2	14.3	21.6	20.7	20.2	4.8	3.6	7.5	6.9	6.2
24	16.0	14.3	22.8	17.6	21.3	12.9	12.0	14.9	14.9	15.5	2.1	1.7	3.4	2.6	3.3
25	36.0	29.0	28.5	27.6	23.0	19.3	17.4	21.4	20.1	20.1	6.9	5.3	6.1	5.5	4.6
26	12.2	11.5	20.8	20.7	17.8	16.3	14.4	18.3	19.4	19.3	2.0	1.8	3.8	4.0	3.3
27	48.7	34.6	45.1	38.0	35.8	19.3	16.9	20.5	20.7	18.6	9.4	6.0	9.2	7.9	6.7
28	18.6	15.1	30.5	24.9	21.2	14.2	12.0	17.4	17.8	18.7	2.7	2.1	5.3	4.4	4.0
29	32.2	26.2	42.6	38.5	40.1	17.3	15.1	19.9	20.1	17.8	5.5	4.1	8.5	7.7	7.1
30	15.8	14.9	24.8	21.6	22.5	11.5	9.3	15.2	15.7	16.5	1.8	1.4	3.8	3.4	3.7
31	36.8	31.1	41.4	38.2	35.0	10.8	9.5	11.5	13.2	13.7	4.0	3.1	4.8	5.1	4.8
32	12.2	10.9	21.3	21.1	18.8	8.5	8.9	11.2	12.5	11.4	1.0	1.0	2.4	2.6	2.1
33	33.2	29.4	33.1	28.4	23.9	13.1	13.2	15.1	15.6	14.9	4.4	3.8	5.0	4.4	3.6
34	18.4	18.0	30.4	31.4	28.4	14.9	14.1	18.3	19.4	18.7	2.8	2.5	5.6	6.1	5.3
35	31.8	27.1	35.2	29.1	27.3	13.7	12 3	16.3	16.1	15.0	4.3	3.4	5.8	4.7	3.8
36	16.3	12.8	22.0	21.1	25.1	8.6	8.9	11.4	12.4	11.6	1.4	4.0	2.5	2.6	2.9
37	17.3	15.0	20.7	20.4	21.7	11.8	11.0	16.7	17.9	17.3	2.0	1.6	3.4	3.6	3.8
38	14.8	15.5	23.8	28.4	31.0	17.8	15.0	21.6	21.4	19.2	2.6	2.4	5.1	6.1	5.9
$Giza_3$	15.3	17.5	25.4	29.1	28.8	19.5	16.3	23.1	24.0	21.2	2.9	2.9	5.9	7.0	6.1
Mean	24.3	19.7	30.8	29.5	28.0	15.4	13.7	18.2	18.9	18.5	3.8	2.9	5.6	5.6	5.2
LSD	1.71	1.13	1.27	1.02	0.92	0.75	0.57	0.54	0.44	0.28	0.34	0.23	0.32	0.28	0.22

L.S.D.: Least significant difference **G = genotype**

From the previous data it's been clearly that, the average number of seeds per plant, 100-seed weight and seed yield per plant were enhanced for plant grown under $Env._{3,\ 4}$ and $_{5.}$ respectively, as compared with $Env._1$ and $Env._2$. Such findings may be due to the supplementary irrigation of chickpea plants which given to $Env._3$ after 45 days from sowing date and the irregular irrigation for $Env._4$ and $Env._5$. In the same manner, Saxena *et al* (1990) and Sivakumar and Piara Singh (1987) obtained similar results under such conditions. Simallarly Omar (2004a), found that yield of faba bean genotypes affected differently under various soil moisture content, which affected the opportunities for selecting appropriate genotypes for certain soil moisture.

Moreover, genotypes No.27, 16, 17, 6 and 29 gave the highest mean values for all studied traits of chickpea plants under all environmental conditions. The results obtained by Omar (2004b) indicated that, all chickpea genotypes varied significantly with respect to all studied characters for the two growing seasons under three water regime treatments .In the same respect, Ammar *et al*., (2003) suggested that 100-seed weight, plant weight, number of branches/plot could be considered a suitable selection criteria for improving lentil seed yield indirectly for plant breeders.

Omar (2003) and Darwish *et al*., (1999), found that the environmental effects under newly reclaimed conditions affected greatly yield and its components performance of faba bean genotypes. Also, Bayoumi (2003), mentioned that selection for mean productivity in lintel plants under water regime will be accompanied by an increase in mean yield in both stress and non stress conditions.

The data in Tables 5 and 7 revealed that, the differences between grand mean for overall environment conditions and for each one mean performances for the three traits recorded covered a wide range and displayed a good distribution within the range. Consequently, the required assumption for stability analysis is full-filled (Russel and Prior, 1975). The data also revealed that, seed yield / plant ranged from 2.9g for the $Env._2$ and 5.6g in both $Env._3$ and $Env._4$. In addition, $Env._3$ and $Env._4$ were the best environment conditions for number of seeds/plant and 100-seed weight, respectively. The superiority of Maryout yield production especially in the Env.3 may be due to the additional irrigation after 45 days from sowing and the good distribution of chickpea in a critical stages through the growing season. Many authors previously detected significant effects of environmental conditions on chickpea seed yield such as Brown *et al*., (1989) El-Waraky and Koliey (2000), Sivakumar and piara Singh (1987) and Saxena *et al* (1990).

Table (5): Analysis of variance for seed yield and some yield components of 39 chickpea genotypes grown under 5 different environmental conditions.

Source of variance	d.f.	No. of seeds/plant	100-seed weight (g)	Seed yield/plant (g)
Replicates	10	16.58	0.93	0.57
Environments (Env.)	4	2326.97 **	592.50 **	182.12 **
Genotypes (G.)	38	664.27 **	150.36 **	31.41 **
Env. x G.	172	30.51 **	4.15 **	1.44 **
Error	380	7.65	1.38	0.42

** Significant at 0.01 level of probability. d.f. = Degrees of freedom.

The data represented in Table (6) recorded significant genotypes x environments (Linear) interactions for all traits under investigation.

Table (6): Analysis of variance for yield and some yield components of 39 Chickpea genotypes grown under 5 different environmental conditions.

Source of variance	d.f.	No. of seeds/plant	100- seed weight (g)	Seed yield /plant (g)
1- Total	194	67.33	14.97	3.68
2- Genotypes (G.)	38	221.44 **	50.12 **	10.47 **
3- Env. + G. x Env.	156	29.80 **	06.41 **	2.02 **
a- Env. Linear	1	3102. 97 **	790.02 **	242.83 **
b- G. x Env. linear	38	14.54	2.27 *	0.86 *
c- Pooled deviation deviation	117	8.48	1.06 *	0.34
Genotype -1	3	3.83	2.34 **	0.40 **
Genotype -2	3	9.51 **	0.79	0.15
Genotype -3	3	2.72	1.10 *	0.04
Genotype -4	3	5.25 *	0.67	0.19
Genotype -5	3	3.67	0.52	0.01
Genotype -6	3	5.17	0.50	0.47 **
Genotype -7	3	2.24	5.22 **	0.62 **
Genotype -8	3	1.57	1.21 **	0.15
Genotype -9	3	11.40 **	1.01 *	0.24
Genotype -10	3	27.84 **	1.97	1.12 **
Genotype -11	3	7.25 **	3.39 **	0.32 *
Genotype -12	3	3.94	0.81	0.14
Genotype -13	3	0.46	0.78	0.09
Genotype -14	3	3.43	4.74 **	0.58 **
Genotype -15	3	1.47	1.67 **	0.48 **
Genotype -16	3	3.64	0.33	0.20
Genotype -17	3	2.07	0.46	0.20
Genotype -18	3	0.61	0.19	0.02
Genotype -19	3	19.34 **	1.76 **	0.29 *
Genotype -20	3	4.19	0.41	0.15
Genotype -21	3	8.19 **	0.24	0.12
Genotype -22	3	6.86 **	0.27	0.21
Genotype -23	3	1.04	0.82	0.11
Genotype -24	3	5.17	0.12	0.14
Genotype -25	3	25.23 **	0.71	0.93 **
Genotype -26	3	2.88	0.11	0.46 **
Genotype -27	3	47.10 **	1.23 **	2.63 **
Genotype -28	3	6.65 **	0.35	0.19
Genotype -29	3	2.74	1.18 *	0.11
Genotype -30	3	3.17	0.34	0.10
Genotype -31	3	4.43	0.81	0.04
Genotype -32	3	2.83	0.60	0.07
Genotype -33	3	19.75 **	0.15	0.35 *
Genotype -34	3	8.50 **	0.20	0.27
Genotype -35	3	11.41 **	0.41	0.27
Genotype -36	3	7.99 **	0.49	0.12
Genotype -37	3	0.37	0.45	0.13
Genotype -38	3	31.42 **	1.42 **	0.54 **
Giza - 3	3	15.61 **	1.34 **	0.63 **
4- Pooled error	380	2.52	0.46	0.14

*** and ** significant at 0.05 and 0.01 levels of probability, respectively.**
*** d.f = degrees of freedom**

Such finding indicated that the differences among genotypes for their regression on the environmental index proceeded further to estimate the (bi) values. Pooled deviation means squares were insignificant for all traits except 100-seed weight trait which suggesting a linear regression also assume partial importance considering each individual genotype.

Darwish *et al.*, (1990) found that the significant genotype × environment interaction for most traits indicates that the tested genotypes ranked differently across newly reclaimed environmental conditions as well as all environments for faba bean seed yield and its components.

Abdalla *et al.*, (2003) found that genotypes chickpea possessed reaction under various environmental conditions. Moreover, they added that some traits on yield components could compensate it's a great extent the low performance of other associated traits. The differences between chickpea genotypes under the five environmental conditions for all studied traits reached the significance level (Table7). Genotype No.27 followed by7,17 and 16 had the highest mean values for seed yield. Whereas, genotypes 27, 11, 31 and 29 recorded the highest mean values for number of seeds / plant compared with the other genotypes as well as the check cultivar (Giza- 3). In the same manners, Omar (2004b) found that seed yield of chickpea plant decreased with increasing soil moisture deficit. On the other hand, the check cultivar recorded a moderate value for number of seeds/plant and yielding ability as compared with all different genotypes.

Eberhart and Russell (1966) model provides a mean of partitioning the genotype x environment interaction for each genotype into two parts. 1) The variation due to the response of genotype to varying environmental index (sum of squares due to regression) and 2) The unexplainable deviation from the regression on the environmental index. They added that a stable genotype would have high mean performance. Moreover Eberhart and Russell (1969) and Brecse (1969) reported that the most important stability parameter appeared to be the minimum deviation mean square. According to such model report data in table (7) show that, the slope of the regression genotype did not deviate significantly from unity in genotypes No. 11, 17, 18, 26, 28 and 3 for seed yield / plant. On the other hand, the deviation from regression mean squares (S^2di) were not significant for genotypes 37, 12,8,2,3,4,13,16,17,20,21,22,23,24,28,29,30,32 and 36 for seed yield / plant.

It could be concluded from the data in table (7) detected that, genotype No. 17 was stable for seed yield / plant on the basis of (bi) and (S^2di) which did not differ significantly from unity and zero, respectively and ranked in third order for seed yield as compared with the other genotypes. Also, such genotype yielded a suitable number of seeds / plant.

In addition to high yield, trait consistency over several environmental conditions considered much a desired for commercial exploitation of the suitable genotype. Stability measurements such for Wricke's ecovalence model was the best one for evaluation statistical method that term ecovalence (Wi), consider a simple method to compute the genetic variance and more directly related to genotype x environment interactions. Genotypes with Wi equal zero regarded as a high of stability that did not change its performance from one environment to another. According to the meaning of the word "ecovalence" the average stable genotype possesses high ecovalence (low values of Wi that equal high ecovalence). From the data of Wi parameters it could be clearly showed that genotypes No.18,3,30,13,26, 37,28and 17 considered being more stable for all traits under investigation (Table 7).

Table (7): Mean values of seed yield and some yield components over environments, regression coefficient (bi) and deviation mean squares (S^2di) for 39 chickpea genotypes.

G	No. of seeds/plant				100- seed weight (g)				Seed yield /plant (g)			
	Mean	bi	S^2di	Wi	Mean	bi	S^2di	Wi	Mean	Bi	S^2di	Wi
G -1	20.02	1.26	1.31	17.07	20.93	0.79	1.89	7.89	4.33	1.25	0.26	1.62
G -2	32.02	1.06	6.99	29.23	17.05	1.46	0.33	6.73	5.50	1.39	0.01	1.54
G -3	19.83	1.13	0.20	9.36	21.57	0.71	0.65	5.11	4.35	1.11	-0.09	0.23
G -4	18.76	1.18	2.73	17.57	19.01	1.12	0.22	2.31	3.69	1.15	0.06	0.73
G -5	29.82	1.17	1.14	13.52	16.71	1.73	0.06	12.23	5.15	1.40	-0.13	1.18
G -6	31.91	1.24	2.65	20.31	20.48	0.71	4.62	3.23	6.60	1.18	0.33	1.74
G -7	28.01	0.63	-0.28	17.38	23.38	0.46	4.76	21.73	6.69	0.62	0.48	2.74
G -8	29.87	1.43	-0.95	19.14	18.65	1.01	0.76	4.29	5.65	1.42	0.01	1.63
G -9	31.55	1.25	8.88	37.81	18.29	1.08	0.55	3.16	6.00	1.31	0.11	1.35
G -10	22.31	1.61	25.32	94.93	14.26	1.37	1.51	8.58	3.42	1.31	0.98	3.97
G -11	39.70	0.95	4.74	22.93	11.87	1.13	2.93	10.47	4.75	1.01	0.18	0.83
G -12	24.28	1.54	1.42	34.81	17.28	1.40	0.35	5.66	4.30	1.39	-0.001	1.55
G -13	24.65	1.26	-2.06	6.79	16.52	1.33	0.32	4.53	4.27	1.15	-0.05	0.44
G -14	24.19	1.26	0.91	15.08	12.33	0.98	4.28	14.17	3.08	0.88	0.44	1.77
G -15	29.15	1.49	-1.05	23.00	20.14	0.66	1.21	7.46	6.24	1.51	0.34	3.30
G -16	34.59	1.29	1.12	17.13	18.95	0.70	-0.13	2.79	6.64	1.27	0.07	1.07
G -17	33.15	0.37	-0.45	38.92	19.24	1.19	-2.16	2.06	6.67	0.93	0.06	0.66
G -18	22.80	1.25	-1.91	6.76	18.41	0.63	-0.27	3.33	4.24	1.03	-0.12	0.09
G -19	32.88	0.84	16.82	61.08	15.58	0.93	1.31	5.37	5.08	0.87	0.15	0.99
G -20	19.72	0.94	1.67	12.23	12.59	1.10	-4.68	1.42	2.56	0.78	0.02	0.67
G -21	30.19	1.13	5.67	25.54	17.57	1.34	-0.22	3.04	5.46	1.19	-0.02	0.72
G -22	16.44	1.24	4.34	24.78	18.66	1.46	-0.19	5.03	3.25	1.18	0.07	0.80
G -23	30.12	1.00	-1.48	3.34	18.60	1.37	0.36	5.29	5.79	1.24	-0.03	0.79
G -24	18.40	0.68	2.64	23.44	14.03	0.66	-0.34	2.77	2.62	0.53	0.009	1.73
G -25	28.81	-0.38	22.71	228.46	19.63	0.57	0.25	5.75	5.67	-.09	0.80	10.04
G -26	16.58	0.95	0.37	9.11	17.53	0.95	-0.35	0.36	2.99	1.02	0.32	0.46
G -27	40.41	0.35	44.58	176.45	19.22	0.54	0.77	8.03	7.83	0.45	2.49	9.76
G -28	22.05	1.23	4.13	25.20	16.02	1.24	-0.11	2.16	3.69	1.01	0.05	0.59
G -29	35.91	1.46	0.22	23.92	18.04	0.81	0.73	4.32	6.60	1.39	-0.03	1.40
G -30	19.91	0.90	0.65	10.07	13.65	1.35	-0.12	3.49	2.83	0.86	-0.04	0.39
G -31	36.52	0.75	1.91	19.18	11.77	0.72	0.35	3.78	4.37	0.62	-0.10	0.91
G -32	16.86	1.07	0.31	8.88	10.50	0.70	0.14	3.59	1.83	0.60	-0.07	1.03
G -33	29.62	-3.37	17.22	146.65	14.39	0.44	-0.31	6.37	4.24	0.19	0.21	4.86
G -34	25.34	1.37	5.98	36.00	17.08	1.06	-0.26	0.66	4.46	1.29	0.13	1.38
G -35	30.10	0.40	8.89	64.09	14.67	0.71	-5.11	2.94	4.40	0.57	0.13	3.17
G -36	19.46	0.95	5.47	22.76	10.59	0.71	2.78	3.16	2.67	0.54	-0.02	11.87
G -37	18.45	0.47	-2.16	18.20	14.95	1.47	-9.42	5.46	2.89	0.80	-0.0	0.53
G -38	22.67	1.24	28.90	96.83	19.01	1.13	0.97	4.65	4.43	1.19	0.40	2.42
Giza-3	22.58	1.08	13.09	63.74	20.82	1.29	0.88	5.74	4.95	1.44	0.49	3.14
Mean	26.40	1.00	5.96		16.92	1.00	0.60		4.62	1.00	0.20	
L.S.D.	3.65	--	--		8.33	--	--		0.73	--	--	
S.E.	0.24	--	--		1.29	--	--		0.05	--	--	

S.E. standard error
Wi = stability rank of Wricke and Weber (1986)
*** G Genotype**

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التفاعل بين التركيب الوراثي و البيئة لبعض التراكيب الوراثية المستوردة من الحمص

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استخدمت في هذه الدراسة ثمانية و ثلاثون تركيبا وراثيا مختلفا من الحمص المستوردة من المركز الدولي لبحوث المناطق الجافة ايكاردا (سوريا) مقارنة مع الصنف التجاري المصري جيزة-٣ و ذلك لدراسة التفاعل بين التركيب الوراثي و البيئة(الثبات الوراثى) لهذه المجموعة من التراكيب الوراثية بهدف تقييم و انتخاب احسن هذه التراكيب في سلوك أدائها الوراثي تحت ظروف خمس بيئات متباينة خلال موسمي الزراعة ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤ في كل من محطتي بحوث مريوط و المغارة التابعة لمركز بحوث الصحراء

١-البيئة الأولى والثانية : الزراعة الجافة مع إعطاء ريه الزراعة و استكمال النمو تحت تأثير معدلات الأمطار السنوية بمحطة بحوث مريوط (٢٣٩ ، ١٧٦مم) في السنة الأولى والثانية على الترتيب.
٢-البيئة الثالثة : الزراعة الجافة مع إعطاء ريه الزراعة ثم إعطاء ريه أخرى بعد ٤٥ يوم من الزراعة بالإضافة إلي معدل المطر السنوي بمحطة بحوث مريوط (١٧٦ مم) في السنة الثانية.
٣- البيئة الرابعة والخامسة : الزراعة تحت ظروف الري بالتنقيط في محطة بحوث المغارة في السنة الأولىوالثانية.

هذا و قد سجلت البيانات على متوسط محصول ١٠ نباتات فردية منتخبة عشوائيا لصفات عدد البذور بالنبات و وزن محصول البذور للنبات و وزن الـ ١٠٠ بذرة من جميع البيئات تحت الدراسة.
و قد أظهرت النتائج ما يلي:

١- جميع التراكيب الوراثية تحت الدراسة كانت متباينة في أداء سلوكها للصفات المدروسة كنتيجة لمعنوية تفاعل التركيب الوراثى مع البيئة.
٢- أظهرت تحليلات تفاعل التركيب الوراثي مع البيئة لكل تركيب وراثى على حده للصفات المدروسة أن التراكيب الوراثية قد تباينت فى استجابة صفاتها المختلفة للتباين فى ظروف البيئة مما يشير إلى أهمية الاستفادة من هذه التراكيب فى برامج تربية الحمص لظروف الإجهاد البيئي المختلفة.
٣- أظهرت التراكيب ٣٧، ١٢، ٨، ٢، ٣، ٤، ١٣، ١٦، ٢٠ أعلى قيم لمتوسط محصول البذرة للنبات تحت ظروف جميع البيئات المدروسة.وبالتالى يمكن الاستفادة من هذه التراكيب باستخدامها كسلالات جديدة للزراعة تحت ظروف الأراضى الجديدة
٤- اظهر التركيب الوراثى رقم ١٧ أعلى درجة من الثبات الوراثى لمحصول البذرة تحت جميع البيئات تحت الدراسة مقارنة بجميع التراكيب الوراثية الأخرى فى البيئات المختلفة مما يشير إلى أهمية هذا التركيب فى استخدامه كسلالة جديدة لزراعتها فى البيئات المختلفة من الصحراء الغربية وسيناء.

هذا ويمكن الاستفادة من هذه التراكيب المتفوقة فى محصول البذرة باستخدامها كسلالات جديدة ملائمة للزراعة تحت الظروف البيئية المختلفة او استخدامها كآباء فى برامج التربية لتحمل ظروف الإجهاد البيئى.