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PHENOTYPIC AND GENOTYPIC STABILITY FOR EARLINESS, YIELD AND ITS COMPONENTS IN SOME CHICKPEA GENOTYPES

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ABSTRACT: ***High productivity and stability of performance over environment are two desired features in chickpea genotypes .The objectives of the present investigation were to evaluate some genotypes of chickpea for their yield stability under different environments. Nineteen genotypes chickpea ,namely Giza 1 ,Giza3, Giza 4 cultivars and sixteen genotypes from ICARDA and Zarzoura were grown in a randomized complete block design with three replications in the three locations (El-Gemmeiza, Giza and Zarzoura) in two grown seasons 2004/2005 and 2005/2006.Seven traits including morphological traits ,yield and yield components i.e. flowering and maturity dates, number of branches /plant, number of capsoules /plant ,100 seed weight and seed yield /plant were recorded.***

All traits showed highly significant mean squares for genotypes, environments and genotypes x environment interaction. Genotype number 7 gave the highest desirable significant for flowering and maturity date, number of capsoules /plant and seed yield /plant .Moreover environments compared to the other genotypes, while genotype number 4 gave the least significant one.

According to phenotypic stability (Eberhart and Russell 1966) ,genotypes numbers 7,5,11, 13, and 14 for flowering date ,numbers of 7,5 and 8 for maturity date , numbers 2,3,5 and genotype 6 for number of branches /plant ; number 2, 3, 6, 7, 10 and 13 for number of capsoules /plant; numbers 1,3,4,8,11 and 12 for 100 seed weight and genotypes numbers 1,2,3, 6,7 and 14 for seed yield /plant gave mean values above grand mean and their regression coefficients (bi) did not differ significantly from unity .Also ,the minimum deviation mean squares (S^2d) were detected

Average genotypic stability was recorded by genotypes number 5, 7, 9, and 19 for flowering date ;by genotype number 12 for maturity date ,by 7 ,4 and 9 for number of branches /plant ,by 2,9,3 and 10 for number of capsoules /plant, by 4,2,6,7,8 and 9 for seed index and by 7 ,12 and 14 for seed yield /plant .The promising genotype number 7 is likely to be candidate to replace

the present alternative varieties whereas gave superior traits earliness ,yield and its components.

Key Words*: Phenotypic and genotypic stability, G x Y interaction stable, unstable, genotypes*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an annual seed legume .The history of Chickpea is an ancient crop that has been grown in India, the Middle East and parts of Africa for many years. It may have been grown in Turkey nearly 7,400 years ago. Much of the world's chickpea supply (80 to 90%) comes from India where poor soil.

Common uses in Egypt are in soups, vegetable combinations, or as a component of fresh salads in restaurant salad bars. Some livestock feeding trials have been conducted and these show chickpea to be a good source of protein for feeds, except that the amino acids methionine and cystine are deficient.

Information about phenotypic stability is useful in selecting crop varieties for general cultivation as well as for breeding programme. The phenotypic performance of a genotype is not necessarily the same under diverse agro-ecological conditions. Some genotypes perform well in some environments but do not in others. Genotype x environment (GE) interaction as explained by Bakhsh *et al*., (1995) are of notable importance in the development and evaluation of plant varieties as they reduce the stability of genotypic values under diverse environments. Given the prevalence of GE interaction, use of the regression coefficient (b-values) and deviation from regression (stability indices) provide information permitting more effective comparisons of different genotypes for yield and adaptation across the varied locations. Many workers like Finlay & Wilkinson (1963) Westerman (1971), Khan *et al*., (1987), Khan *et al*., (1988) and Ali *et al*., (2001) described the importance of genotype x environment interaction in stability analysis.

Eberhart and Russell (1966) proposed a model to test the stability of varieties under various environments. They defined a stable variety as having unit regression over the environments (b=1.00) and minimum deviation from the regression ($S^2d=0$).Therefore a variety with a high mean yield over the environments ,unit regression coefficient (b=1) and deviation from regression as small as possible ($S^2d=0$), will be a better choice as a stable variety Tai (1971) suggested the partioning the genotype x environment interaction effect of a genotype into two components, α statistic that measures the linear response to environmental effects and λ statistic that measures the deviation from linear .The genotype x environment interaction was studied by different researcher in various crops (Singh *et al*., 1987; Jain and Pandya 1988 and Zubair & Ghafoor, 2001) The stability parameters have also been studied in seed legumes for measuring

phenotypic stability (Khan *et al*.1987; Bakhsh *et al* 1995 and Qureshi 2001) but still it is very important information that should be available for the forth – coming chickpea varieties Therefore ,the present investigation was aimed to evaluate some genotypes of chickpea for their yield stability under different environments.

MATERIALS AND METHODS

Six field experiments with sixteen genotypes as well as three local cultivars of chickpea were evaluated at a randomized complete block design with three replications .The experimental plot consists of three ridges 3 m long and 60 cm. apart and 20 cm between hills on one side of the ridge and one plant per hill. The experiments were performed at Al-Gemmeiza, Giza and Zarzoura Agriculture Research Stations, Agriculture Research Center ,in Egypt during 2004/2005 and 2005/2006 seasons. These sites represent Middle Delta, Middle Egypt and North Delta, respectively. Each experiment included nineteen genotypes, namely Giza 1, Giza3, Giza 4 cultivars and sixteen genotypes from ICARDA and Zarzoura .The name, pedigree and origin are presented in Table (1). The same planting date (20 and 25 November) was approximately applied during the two growing seasons across the three locations. The dry method of planting was used and the rest of cultural practices were followed as used for ordinary Chickpea in the area. This investigation studied the effect of genotypes, environments and their interaction on yield and yield components and estimating stability parameters for flowering and maturity dates, number of branches /plant, number of capsoules /plant, 100 seed weight and seed yield /plant

A regular analysis of variance of a randomized complete block design of separate environment was carried out for each trait according to Snedecor and Cochran (1967). A combined analysis of the six experiments carried out whenever homogeneity of variance was detected .The stability analysis was computed according to Eberhart and Russel (1966) and Tai (1971) to detected the phenotypic and genotypic stability for the previous traits .In the analysis of the data, genotypes were considered as fixed variables while, years and locations were considered as random variables

RESULTS AND DISCUSSION

Combined analysis of variance for flowering date ,maturity date, number of branches/plant, number of capsoules /plant ,100 seed weight and seed yield /plant of chickpea genotypes is presented in Table (2) .Bartlett's test of homogeneity of error variances showed that the variance estimates were homogenous for all traits .Highly significant differences among genotypes were detected for all traits studied, indicating that the presence of genetic variability in these genotypes .Also a highly significant mean square of genotypes x environments, was detected indicating that genotypes carried genes with different additive and additive by additive gene effects, which seemed to be inconstant from environment to another.

Table (1).
Table (2).

The significant Ex G effects demonstrated that genotypes responded differently to the variation in environmental conditions of location and indicated the necessity of testing chickpea genotypes at multiple environments. This shows the difficulties encountered by breeders in selecting new genotypes for release .These difficulties arise mainly from the masking effects of variable environments. Thus, it is important to study adaptation patterns ,genotypes response and their stability in multi- location trails .Significant difference were exhibited among genotypes for all traits studied and the genotypes responded differently at the different environments. This may lead to the conclusion that it is essential to determine the degree of stability of each genotypes.

Environment mean squares were significant for all the studied traits, indicating an over all differences among six environments (table 3). The environment number 5 (Giza) followed by environment number 2 (Giza) gave the earliest for flowering and maturity dates compared with other environments. While, the environment number 4 (El-Gemmeiza) gave the highest mean values for number of branches /plant and number of capsoules /plant. These results indicating that the climatic conditions and soil properties of environment number 4 (El-Gemmeiza) encouraged production of chickpea genotypes .Also ,environment number 6 (Zarzoura) and environment number 3 (Zarzoura) gave the highest mean values for 100 seed weight and seed yield /plant, respectively. Previously report of Sivakumar and Piara Singh (1987) and Saxena *et al* (1990) detected significant environmental effects on the yielding ability of some chickpea genotypes.

Genotypes and genotypes x environments interaction were found to be significant for all traits, revealing that genotypes carried genes with different additive and additive x additive effects which seemed to be inconstant from environment to another.

The differences among genotypes overall environments regarding the all traits reached the significant level (Table 4). Genotype Etay 38 (number 7) gave the desirable highest significant for flowering and maturity dates, number of capsoules /plant, seed yield /plant and seed yield /fed .over all environments compared to the other genotypes .While, FLIP99 -19c genotype showed significant lateness of maturity and lowest one for number of branches and number of capsoules and seed yield /plant. The average of mean performance for number of branches /plant ranged from 2.97 for genotype FLIP99 -19c to 4.54 for genotype FLIP98 -37c. The genotype FLIP99 -19c followed by ILC7374 gave the heavier 100 seed weight overall environments.

The stability analysis:

Results of pooled analysis of variance in Table 4 showed that genotypes mean square were highly significant for all the traits studied .Mean squares due to environment and genotype –environment interaction were highly significant for all traits and suggested that the genotype interact considerably with the varying environments.

Table (3).

Table (4).

The significance of genotype – environment (Linear) mean squares was detected for all traits indicating that genotypes differ genetically in linear response to different environments when they were tested with pooled deviations .On the other hand the highly significant of pooled deviation for all traits under study indicated that the major components differences for stability were due to deviation from the linear function .This results lead to the conclusion that it is necessary to determine the degree of stability for each genotype .These results are in harmony with those previously reached by Khan *et al*. (1987), Omar (2004) and Omar *et al* (2004)..

Phenotypic and genotypic stability parameters:

The phenotypic stability of the studies genotypes were measured by the three parameters, i.e. mean performance over environments ,the linear regression and the deviations from regression function (Table 5). Eberhart and Russell (1966) reported that the phenotypes stability of genotype is that which has a high mean yield, b_i value equal one and the deviation from regression near zero.

According to these reports genotypes number 7 ,5 .11,13 and 14 for flowering date; number 7,5 and 8 for maturity date ;number 2,3,5 and 6 for number of branches /plant; number 2,3,6,7 10 and 13 for number of capsoules /plant ; number 1 ,3,4,8,11 and 12 for 100 seed weight and number 1,2,3,6,7 and 14 for seed yield /plant gave mean values above the grand mean and their regression coefficients (bi) did not differ significantly from unity. Also, the minimum deviation mean squares (S^2d) were detected, revealing that these genotypes were more phenotypic stable than others under the environment studies for these trait.

For all traits studied, mean performances in addition to estimates of the parameters α_i and λ_i for each genotypes are presented in tables (6). It was evident that the relative ranking of genotypes according to their mean performance over the environments were not the same for all traits and the estimated statistics of genotypic stability were done.

The distribution of α_i and λ_i values (genotypic stability parameters) of genotypes are presented in graphics and it should be noticed that the vertical axis is α_i which ranges from –1 to 1. The curves are prediction limits for α_i =0 at levels of probability of 0.90, 0.95 and 0.99 and the horizontal axis is λ_i .Otherwise ,the two vertical lines are the confidence intervals for λ_i = 1 .The area between the two vertical line and inside curve (α_i =0 and λ_i =1) includes the average stable genotypes and the area between the two vertical lines and under the curve (α_i < 0 and λ_i =1) includes above average stable genotypes.

Table (5).

Table (5c).

Table (6).

From the results illustrated in table (6) and Fig (1) it could be stated that the genotypes number 7,5,19,6,8,11 and 14 showed the average degree of genotypic stability. While, the genotypes number 7,5,9 and 19 gave the earliest of flowering date compared with grand mean and it had average degree of stability for this trait.

For maturity date the results indicated that the genotype number 12 gave the below average degree of stability .While other genotypes were not stable for this trait.

From the results presented in table 5 and illustrated in Fig (3), it could be stated that the estimated α_i statistics were not significantly differed than zero for all genotypes except number 1 at 0.95 level of probability .

The estimated λ_i statistics were not significantly differed than unity for genotypes number 2,4,5,6,8 and 9 for number of branches /plant .This result indicates that the checkpea number 7,4,9,6,2 and 5 showed the below average degree of stability .Also, the first three genotypes gave significantly higher mean performance compared the grand mean .

Fig (4) gives a graphic summary that could be useful in identifying the genetically stable genotypes for number of capsoules. It could be noticed that the average stability area in the Fig. (4) contained genotypes number 1,2,4,5,8,9,10,11 and 12 were not significant different from α_i = 0 at all probability levels .The genotype number 2 ,9 and 10 in addition ,gave the highest number of capsoules /plant than grand mean ,indicating that these genotypes fitted in this case for average stability .However, the genotypes 1,4,5,8,11,and 12 gave lower mean values than the grand mean ,indicating that these genotypes performed better under less fvourable environments.

The distributions of the α_i and λ_i values for 100 seed weight are plotted in Fig (5) .The average area at different probability levels in the figure contained genotypes 7 ,4 ,2,6 ,9 and 8 .The genotype number 7 was above average of stability and it gave the highest 100 seed weight .However the 4,2,6 and 9 were the average of stability and it gave the highest mean values than grand mean ,indicating that these genotypes are fitted in this case for favourable environments as they had high (b_i) values than one.

Fig (6) gaves a graphic summary that could be useful in identifying the genetically stable genotypes for seed yield /plant .It could be noticed that the average stability area in the figure contained genotypes number 15,7,12 and 14 were not significant different from α_i =0 at all the probability levels .The other genotypes were unstable for this trait .Among the average stable of genotypes number 7 and 14 are highest seed yield /plant than grand mean and gave the average genetic stability over all environments .The both genotypes may be recommended to be released for commercial chick pea production ,which they performed better under all environments .It could be stated that , only of the high yielding promising genotype number 7 that had satisfactory stability .Etay 38 genotype was the promising genotype ,where gave superior traits in earliness yield and yield components .This promising genotype number 7 is likely to be candidate to replace the present alternative varieties whereas gave superior traits (earliness yield and some of yield components).

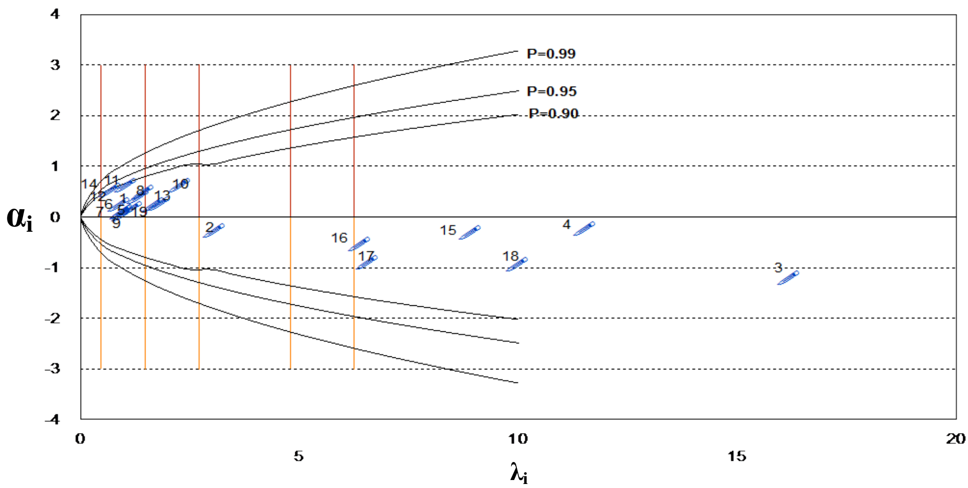

Fig (1) Distribution of stability statistics of heading date

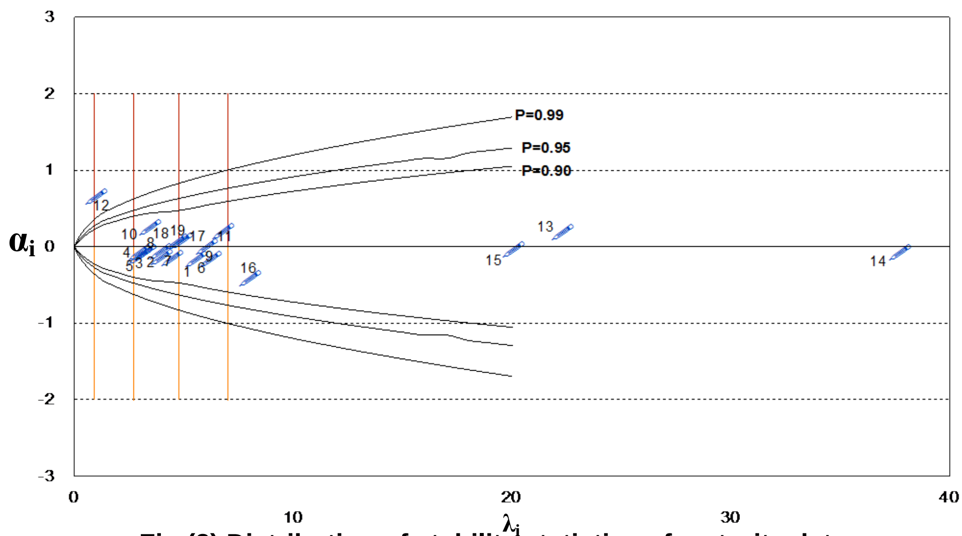

Fig (2) Distribution of stability statistics of maturity date

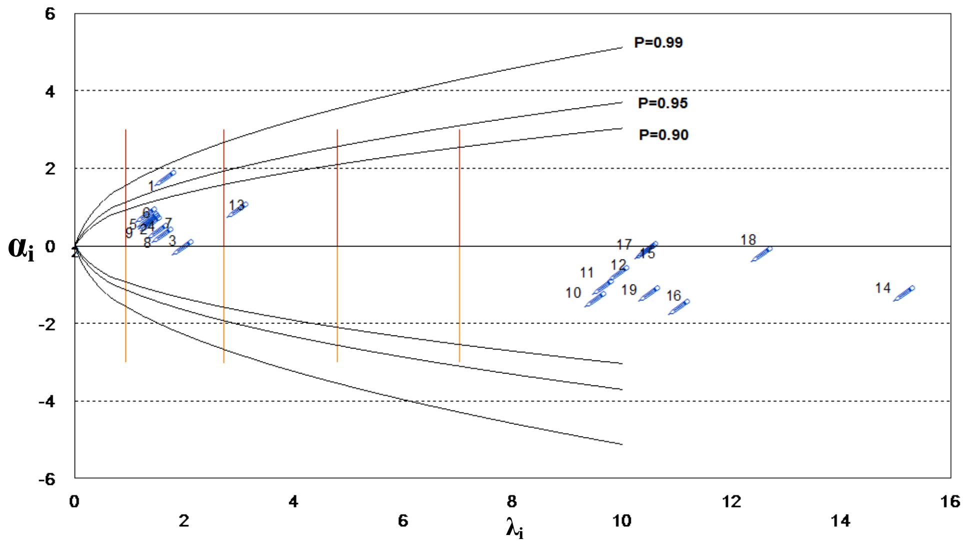

Fig (3) Distribution of stability statistics of number of branches/plant

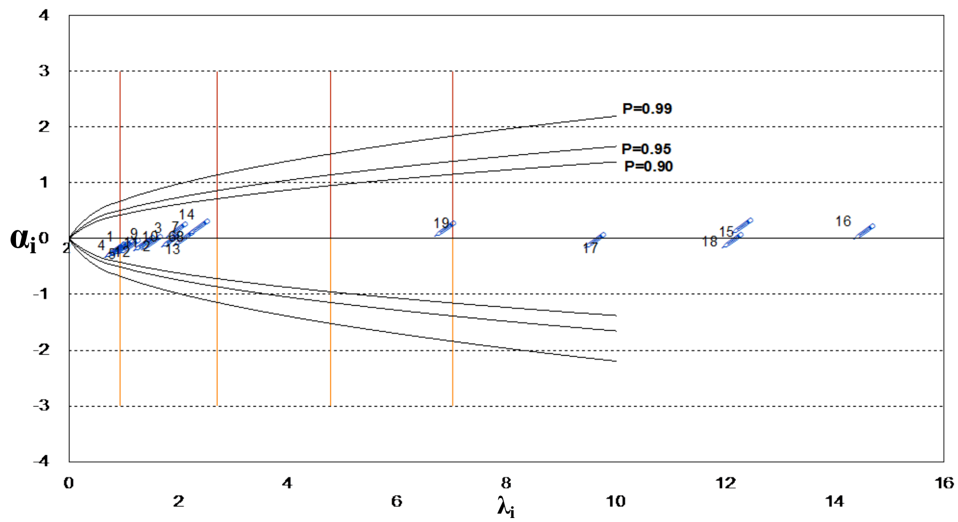

Fig (4) Distribution of stability statistics of number of capsoules/plant

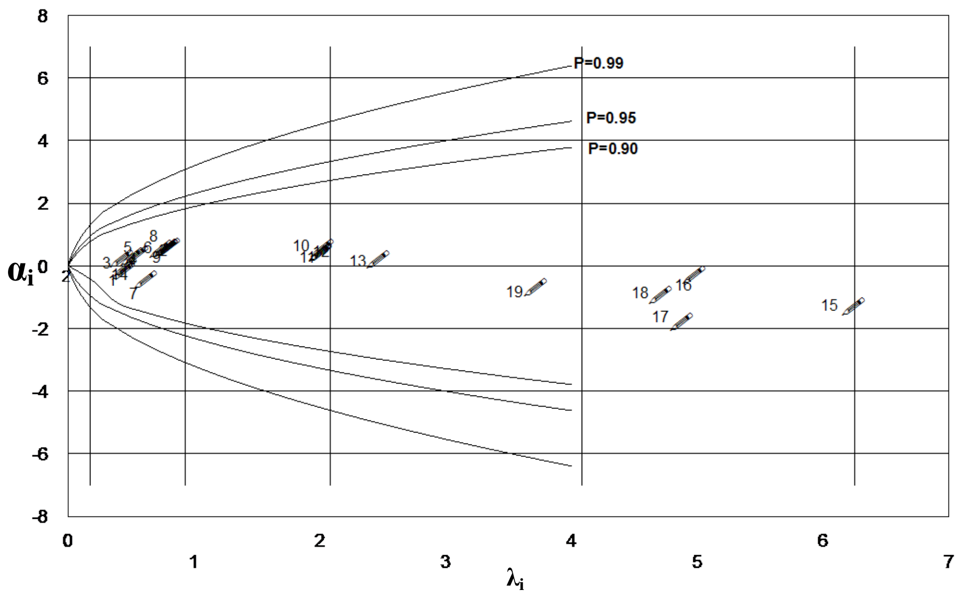

Fig (5) Distribution of stability statistics of 100 seed weight

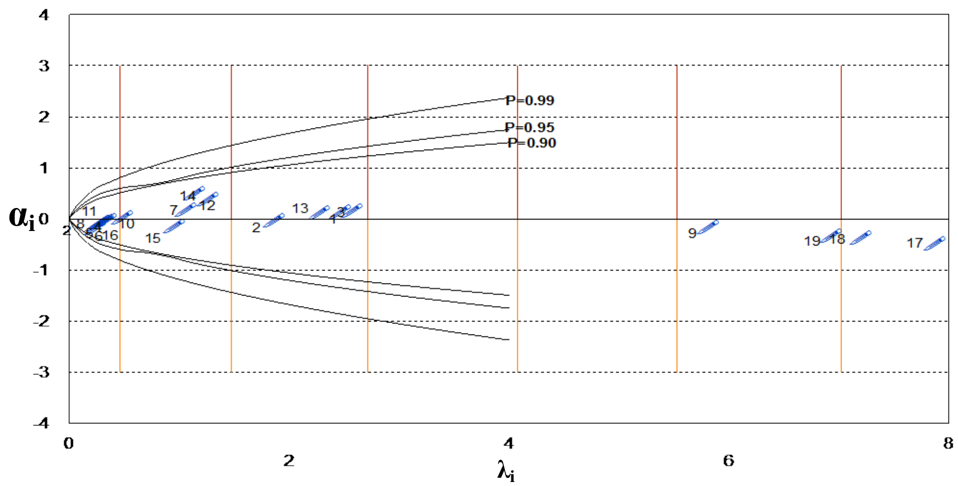

Fig (6) Distribution of stability statistics of seed yield /plant

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الثبات المظهرى والوراثى للتبكير والمحصول ومكوناتة فى بعض التراكيب الو راثية فى الحمص

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الملخص العربي

إن المحصول العالي مع ثبات الإنتاج يعتبران من أهم الصفات الواجب توافرها فى أي صنف حمص لهذا أجرى البحث لدراسة تقييم بعض التراكيب الوراثية للحمص من حيث الصفات المورفولوجية والمحصولية ومعالم الثبات المظهري والوراثي تحت بيئات مختلفة وكانت التراكيب المدروسة هى ثلاثة أصناف من الحمص جيزة ١ ، جيزة ٣ ، جيزة ٤ ، وستة عشر أصل وراثى مستوردات من الايكاردا ومحطة البحوث الزراعية بايتاى البارود (زرزورة). تم زراعة التجربة خلال موسمي ٢٠٠٥/٢٠٠٤ ،٢٠٠٦/٢٠٠٥ فى ثلاثة مكررات فى المزرعة البحثية لكل من الجيزة والجميزة وايتاى البارود وتم اخذ سبعة صفات وهى تاريخ التزهير والنضج وعد الفروع للنبات وعدد الكبسولات لكل نبات ووزن ١٠٠ بذرة ، ومحصول البذور للنبات .

ويمكن تلخيص النتائج المتحصل عليها فيما يلى :

١- أشارت النتائج إلى أن الفروق بين التراكيب الوراثية (كمتوسطات لكل البيئات المدروسة) عالية المعنوية لكل الصفات تحت الدراسة وكذلك تأثير البيئات على كل الصفات المدروسة عالي المعنوية كما أوضحت النتائج أن كل الصفات أظهرت إختلافاً عالي المعنوية فى إستجابة التراكيب الوراثية للبيئات المختلفة أي أن تأثير كل من التركيب الوراثى والبيئة وتفاعل التركيب الوراثى مع البيئة كان عالى المعنوية على الصفات المدروسة. أعطى التركيب الوراثى Etay38

أعلى معنوية مرغوبة لكل الصفات المدروسة (تاريخ التزهير والنضج وعدد الفروع للنبات وعدد الكبسولات لكل نبات ووزن ١٠٠ بذرة، ومحصول الحبوب للنبات في كل البيئات بالمقارنة مع باقى التراكيب الوراثية بينما التركيب الوراثى رقم Flip99-19C أعطى اقل معنوية لكل الصفات المدروسة.

٢- أظهرت النتائج أن التراكيب الوراثية رقم ٧ ، ٥ ، ١١ ، ١٣ ، ١٤ أعطت أعلى القيم لصفة تاريخ التزهير بينما كانت والتراكيب الوراثية رقم ٧ ، ٥ ، ٨ لميعاد النضج، والتراكيب الوراثية رقم ٢ ، ٣ ، ٥ ،٦ لعدد الفروع لكل نبات والتراكيب الوراثية رقم ٢ ،٣ ، ٦ ، ٧، ١٣،١٠ لعدد الكبسولات للنبات والتراكيب الوراثية رقم ١ ، ٣ ، ٤ ،٨ ، ١٢، ١١ لزيادة وزن ١٠٠ بذرة ورقم ١ ، ٢، ٣ ، ٦ ، ٧ ، ١٤ للمحصول البذور لكل نبات ثباتا مظهرياً أعلى من المتوسط العام للصفات المذكورة حيث أن معامل الانحدار لاينحرف عن الوحدة وأعطى أقل قيمة.

٣- أظهرت التراكيب الوراثية رقم ٥، ٧، ٩، ١٩ لميعاد التزهير ١٢ لميعاد النضج ٧ ،٤ ،٩ لعدد الفروع لكل نبات ، ٢ ، ٩ ، ١٠،٣ لعدد الكبسولات / نبات ، ٤، ٢، ٦، ٧، ٨، ٩ لوزن ١٠٠ بذرة ورقم ٧ ،١٢ ، ١٤ لوزن محصول البذور / نبات ثباتا وراثيا على مستوى البيئات تحت الدراسة واظهر التركيب الوراثي رقم ٧ ثباتا وراثيا للتبكير والمحصول العالى وكذلك مكونات المحصول ولابد من عمل تجارب اوسع لزراعة هذا التركيب الوراثى واحلالة بالاصناف التجارية .

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

Entry no.	Genotypes	Pedigree	Origin
1	FLIP 97 –174C	X94TH122 /(FLIP 90-20C x FLIP 90-97C) x FLIP 90-124C	ICARDA/ICRISAT
2	FLIP 98-37C	X95TH47/(FLIP 88-6C x ILC3373)x FLIP 89 –4C	ICARDA/ICRISAT
3	FLIP 98 –174C	X95TH24/(FLIP 91 – 196C x FLIP 87 33C)	ICARDA/ICRISAT
4	FLIP 99 –19C	X96TH23/(FLIP 93- 146C x FLIP 93 – 98 C)	ICARDA/ICRISAT
5	FLIP 99-33C	X96TH6/(FLIP 88 –83C xFLIP 94-4C)	ICARDA/ICRISAT
6	ILC263	PI339223	Turkey
7	Etay 38	Giza 195 x Giza 531	Egyptian
8	Tochki	Agriculture research center	Egyptian
9	Giza 1	Agriculture research center	Egyptian
10	Giza 4	(ILCFLIP84- 92)x ILC613	Egyptian
11	Giza 3	Selection from FLIP8020	Egyptian
12	ILC7374	ICC 4866	Russia
13	FLIP 97-85C	X94TH12/FLIP 90 – 132Cx S91347	ICARDA/ICRISAT
14	FLIP 97-110C	X94TH12/FLIP 90 – 132Cx S91347	ICARDA/ICRISAT
15	FLIP 99 –54C	X96TH45/(FLIP 91 – 149CxFLIP 93-194C)xFLIP91-105C	ICARDA/ICRISAT
16	FLIP 97 –219C	X94TH12/FLIP 90 – 132Cx S91347	ICARDA/ICRISAT
17	FLIP 97-229C	X94TH107/(FLIP 90 – 63Cx S91104) xS91347	ICARDA/ICRISAT
18	FLIP-121C	X94TH12/FLIP 90 – 132Cx S91347	ICARDA/ICRISAT
19	FLIP 99-44C	X96TH24/FLIP 93 – 176Cx UC 15	ICARDA/ICRISAT

Table (2): Combined analysis of variances for flowering and maturity dates, number of branches /plant, number of capsoules/plant, 100 seed weight ,seed yield /plant .

Sources of variation	d.f	Flowering date	maturity date	number of branches /plant	number of capsoules/ plant	100 seed weight	seed yield /plant
Environments(Env.)	5	241.5**	365.8**	3.947**	633.168**	41.718**	74.817**
Rep within Env.	12	4.062	0.916	0.448**	20.841**	4.757**	1.797
Genotypes	18	1331.208**	492.444**	5.716**	1251.425**	555.460**	109.218**
Env. x genotypes	90	19.744**	14.455**	0.800**	18.155**	4.482**	1.664**
Error	216	4.1076	1.750	0.107	4.545	1.771	0.647

Table (3):.Mean values of morphological characters, yield and yield components as affected by locations and genotypes combined analysis of 2004/2005 and 2005/2006 seasons

Locations		Flowering date	maturity date	number of branches /plant	number of capsoules / plant	100 seed weight	seed yield /plant
1-(EL-Gemmeiza)		84.088	167.544	3.449	31.211	32.521	9.991
2-(Giza)		83.789	166.737	3.232	29.877	32.143	9.546
3-(Zarzoura)		87.123	171.597	3.800	33.947	33.811	12.607
4-(EL-Gemmeiza)		86.561	168.333	3.904	38.211	33.787	11.244
5-(Giza)		81.772	164.491	3.781	31.579	33.297	11.321
6-(Zarzoura)		86.246	165.228	3.818	36.842	34.401	11.861
Genotypes							
FLIP 97 –174C	(1)	87.778	165.889	4.167	32.667	39.004	11.999
FLIP 98-37C	(2)	94.00	170.00	4.539	40.389	39.522	14.822
FLIP 98 –174C	(3)	91.389	171.444	4.078	48.278	35.362	15.729
FLIP 99 –19C	(4)	91.722	174.111	2.972	21.722	43.059	8.405
FLIP 99-33C	(5)	78.61	165.167	4.333	30.056	32.877	8.866
ILC263	(6)	88.778	165.944	4.228	37.944	39.611	13.997
Etay 38	(7)	56.111	149.444	3.500	51.222	37.781	16.868
Tochki	(8)	88.056	165.056	3.261	27.389	35.473	9.231
Giza 1	(9)	79.333	166.889	4.144	39.778	28.069	10.162
Giza 4	(10)	75.333	166.389	4.017	47.111	24.369	10.753
Giza 3	(11)	90.722	165.778	3.878	29.556	34.871	9.587
ILC7374	(12)	92.278	169.167	4.472	24.278	41.310	8.984
FLIP 97-85C	(13)	87.00	168.333	3.478	32.778	29.450	10.676
FLIP 97-110C	(14)	85.167	170.389	3.144	33.333	29.963	11.300
FLIP 99 –54C	(15)	85.111	173.833	3.206	28.056	26.673	9.918
FLIP 97 –219C	(16)	89.222	164.444	3.017	26.00	28.407	9.884
FLIP 97-229C	(17)	88.278	166.00	3.133	29.222	28.729	9.423
FLIP-121C	(18)	82.556	170.444	3.011	29.444	29.496	9.969
FLIP 99-44C	(19)	82.222	170.389	3.033	29.389	29.180	10.228
Average		84.929	167.321	3.663	33.611	33.326	11.094
L.s.d at 5%		3.463	2.260	0.559	3.643	2.274	1.374

Table (4):.Mean squares of variance for G x E interaction for morphological characters, yield and yield components for combined data

Sources of variation		d.f	Flowering date	maturity date	number of branches /plant	number of capsoules/ plant	100 seed weight	seed yield /plant
Total		113	79.487	35.369**	0.574	80.605	31.297	7.344
Genotypes		18	443.736**	164.166**	1.905**	417.144**	185.146**	36.406**
Env.(genotypes xEnv)		95	10.471**	10.965**	0.322**	16.840**	2.147**	1.838**
Env.(Linear)		1	402.674**	609.684**	6.578**	1055.305**	69.426**	124.710**
(genotypes x Env.)Linear		18	6.040**	1.678**	0.233**	1.091	1.407**	0.362
Pooled deviation		76	6.363**	5.299**	0.260**	6.906**	1.438**	0.570**
FLIP 97 –174C	(1)	4	1.855	3.629**	0.093**	1.415	0.264	0.639**
FLIP 98-37C	(2)	4	4.690**	2.516**	0.056	2.500	0.534	0.458*
FLIP 98 –174C	(3)	4	26.077**	2.014**	0.078**	3.161**	0.322	0.613**
FLIP 99 –19C	(4)	4	18.375**	2.010**	0.063	1.295	0.260	0.061
FLIP 99-33C	(5)	4	1.240	1.832**	0.056	1.295	0.353	0.069
ILC263	(6)	4	1.592	4.087**	0.055	3.162**	0.552	0.053
Etay 38	(7)	4	1.278	2.859**	0.056	3.540**	0.401	0.254
Tochki	(8)	4	2.043	2.536**	0.060	1.295	0.504	0.046
Giza 1	(9)	4	1.210	1.847**	0.055	2.219	0.540	1.468**
Giza 4	(10)	4	3.408**	2.184**	0.414**	2.219	1.401**	0.106
Giza 3	(11)	4	0.840	4.494**	0.413**	1.752	1.380**	0.055
ILC7374	(12)	4	1.432	0.474	0.420**	1.567	1.381**	0.310
FLIP 97-85C	(13)	4	2.443**	15.208**	0.128**	3.306**	1.689**	0.564**
FLIP 97-110C	(14)	4	1.146	25.861**	0.651**	4.047**	0.273	0.284
FLIP 99 –54C	(15)	4	14.141**	13.638**	0.438**	21.891**	4.463**	0.228
FLIP 97 –219C	(16)	4	10.088**	5.336**	0.485**	25.875**	3.437**	0.043
FLIP 97-229C	(17)	4	10.415**	3.950**	0.439**	17.039**	3.645**	2.001**
FLIP-121C	(18)	4	15.965**	3.022**	0.528**	21.528**	3.319**	1.826**
FLIP 99-44C	(19)	4	2.641*	3.178**	0.453**	12.115**	2.594**	1.757**
Pooled error		228	1.368	0.568	0.041	1.800	0.642	0.235

Table (5):.Estimates of phenotypic stability for flowering and maturity dates, number of branches /plant, number of capsoules /plant, 100 seed weight, seed yield /plant of nineteen chickpea genotypes.

genotypes	Flowering date					maturity date					number of branches /plant				
	Average	b	S^2d	t_{b-1}	t_{b-0}	Average	b	S^2d	t_{b-1}	t_{b-0}	Average	b	S^2d	t_{b-1}	t_{b-0}
1	87.778	1.420	0.487	1.419	4.797	165.889	0.857	3.061	-0.422	2.550	4.167	2.600	0.051	3.085	5.013
2	94.00	0.756	3.322	-0.517	1.607	170.00	0.955	1.948	-0.160	3.409	4.539	1.560	0.015	1.382	3.850
3	91.389	-0.144	24.709	-1.031	-0.130	171.444	0.942	1.445	-0.227	3.762	4.078	1.019	0.036	0.040	2.143
4	91.722	0.804	17.007	-0.210	0.863	174.111	0.942	1.442	-0.228	3.767	2.972	1.310	0.021	0.726	3.065
5	78.61	1.136	-0.128	0.562	4.694	165.167	0.936	1.264	-0.264	3.919	4.333	1.601	0.014	1.491	3.971
6	88.778	1.190	0.225	0.692	4.339	165.944	0.851	3.519	-0.415	2.386	4.228	1.643	0.014	1.600	4.087
7	56.111	1.082	-0.089	0.334	4.404	149.444	0.869	2.291	-0.435	2.914	3.500	1.601	0.014	1.491	3.971
8	88.056	1.514	0.674	1.656	4.875	165.056	0.876	1.967	-0.440	3.115	3.261	1.393	0.018	0.941	3.334
9	79.333	1.118	-0.158	0.494	4.676	166.889	0.894	1.279	-0.440	3.726	4.144	1.768	0.014	1.911	4.400
10	75.333	1.634	2.039	1.581	4.074	166.389	1.265	1.616	1.016	4.848	4.017	-0.174	0.373	-1.073	-0.159
11	90.722	1.547	-0.528	2.748	7.768	165.778	1.222	3.926	0.595	3.266	3.878	0.117	0.372	-0.807	0.107
12	92.278	1.650	0.064	2.499	6.344	169.167	1.671	-0.094	5.519	13.743	4.472	0.408	0.379	-0.536	0.370
13	87.00	1.262	1.075	0.774	3.718	168.333	1.203	14.639	0.296	1.748	3.478	1.861	0.087	1.410	3.049
14	85.167	1.271	-0.222	1.166	5.463	170.389	0.945	25.293	-0.060	1.053	3.144	-0.054	0.609	-0.768	-0.039
15	85.111	0.718	12.773	-0.345	0.878	173.833	0.772	13.069	-0.348	1.185	3.206	0.921	0.396	-0.070	0.818
16	89.222	0.491	8.719	-0.736	0.712	164.444	0.597	4.768	-0.986	1.465	3.017	-0.355	0.443	-1.145	-0.300
17	88.278	0.142	9.047	-1.223	0.203	166.00	1.022	3.382	0.0636	2.913	3.133	0.962	0.398	-0.033	0.854
18	82.556	0.116	14.597	-1.0182	0.133	170.444	1.083	2.454	0.271	3.529	3.011	0.851	0.487	-0.119	0.689
19	82.222	1.292	1.273	0.827	3.659	170.389	1.089	2.609	0.283	3.461	3.033	-0.035	0.411	-0.905	-0.031

Table (5):.Continue

genotypes	number of capsoules /plant					100 seed weight					Seed yield /plant				
	Average	b	S^2d	t_{b-1}	t_{b-0}	Average	b	S^2d	t_{b-1}	t_{b-0}	Average	b	S^2d	t_{b-1}	t_{b-0}
1	32.667	0.852	-0.385	-0.926	5.339	39.004	0.903	-0.378	-0.359	3.359	11.999	0.946	0.404	0.557	3.760
2	40.389	0.964	0.699	-0.168	4.544	39.522	1.548	-0.108	1.432	4.046	14.822	1.060	0.223	0.003	3.785
3	48.278	1.009	1.361	0.038	4.229	35.362	1.296	-0.319	0.997	4.360	15.729	1.040	0.378	0.506	3.776
4	21.722	0.829	-0.505	-1.114	5.434	43.059	1.260	-0.382	0.974	4.720	8.405	0.930	-0.174	-0.226	10.093
5	30.056	0.829	-0.506	-1.114	5.434	32.877	1.345	-0.289	1.109	4.323	8.866	1.043	-0.167	-0.043	9.693
6	37.944	1.009	1.362	0.038	4.229	39.611	1.564	-0.090	1.451	4.022	13.997	1.016	-0.182	-0.485	10.564
7	51.222	1.031	1.739	0.124	4.085	37.781	0.649	-0.241	-1.057	1.958	16.868	1.100	0.018	1.016	6.097
8	27.389	0.829	-0.505	-1.114	5.434	35.473	1.520	-0.139	1.400	4.091	9.231	1.044	-0.189	-0.866	11.009
9	39.778	0.941	0.418	-0.290	4.711	28.069	1.553	-0.102	1.439	4.039	10.162	1.01	1.232	-0.296	1.817
10	47.111	0.941	0.418	-0.290	4.711	24.369	1.537	0.759	0.868	2.482	10.753	1.037	-0.129	0.446	8.301
11	29.556	0.897	-0.048	-0.579	5.051	34.871	1.416	0.737	0.678	2.305	9.587	1.016	-0.180	-0.417	10.452
12	24.278	0.874	-0.233	-0.746	5.205	41.310	1.431	0.738	0.702	2.329	8.984	1.013	0.075	1.846	6.442
13	32.778	1.183	1.505	0.752	4.850	29.450	1.207	1.047	0.305	1.775	10.676	0.971	0.329	0.500	3.909
14	33.333	1.228	2.246	0.846	4.551	29.963	0.991	-0.369	-0.032	3.621	11.300	0.724	0.048	2.444	7.2506
15	28.056	1.254	20.090	0.405	1.998	26.673	-0.110	3.821	-1.004	-0.099	9.918	0.882	-0.008	-0.561	4.797
16	26.00	1.142	24.074	0.208	1.673	28.407	0.796	2.794	-0.209	0.821	9.884	1.103	-0.192	-1.754	10.5
17	29.222	0.994	15.238	-0.011	1.794	28.729	-0.557	3.003	-1.559	-0.557	9.423	1.007	1.765	-0.798	1.012
18	29.444	0.990	19.728	-0.015	1.590	29.496	0.220	2.677	-0.817	0.231	9.969	1.126	1.591	-0.645	1.249
19	29.389	1.195	10.315	0.418	2.559	29.180	0.425	1.952	-0.681	0.505	10.228	0.925	1.521	-0.563	1.368

Table (6):.Parameters of genotypic stability for morphological characters, yield and yield components of nineteen chickpea genotypes

Genotypes	Flowering date		Maturity date		Number of branches/plant		Number of capsoules/plant		100 seed weight		Seed yield /plant	
	α	λ	α	λ	α	λ	α	λ	α	λ	α	λ
1	0.4272	1.136	-0.1426	5.2634	1.8052	1.5206	-0.1528	0.7832	-0.109	0.3763	0.1781	2.4994
2	-0.2478	2.8906	-0.0452	3.6468	0.6317	1.2528	-0.037	1.3939	0.6177	0.7149	0.0008	1.7964
3	-1.1645	16.0103	-0.0574	2.9226	0.0215	1.838	0.0094	1.7626	0.3341	0.4476	0.1588	2.3992
4	-0.1992	11.3312	-0.0574	2.9226	0.3501	1.4613	-0.176	0.7144	0.2929	0.3614	-0.0224	0.2415
5	0.1383	0.7667	-0.0635	2.6598	0.6787	1.2283	-0.176	0.7144	0.3889	0.4858	-0.0047	0.2713
6	0.193	0.9821	-0.1487	5.9268	0.7256	1.2067	0.0094	1.7626	0.636	0.7381	-0.045	0.2105
7	0.0835	0.789	-0.1304	4.1351	0.6787	1.2283	0.0326	1.9736	-0.395	0.5545	0.2049	0.9894
8	0.5229	1.2483	-0.1244	3.6701	0.444	1.38	-0.176	0.7144	0.5861	0.6765	-0.0748	0.1816
9	0.12	0.7477	-0.1061	2.6724	0.8664	1.1597	-0.0601	1.2363	0.6238	0.7226	-0.1439	5.7438
10	0.6451	2.0815	0.2659	3.1572	-1.3246	9.3756	-0.0601	1.2363	0.606	1.9574	0.0582	0.4159
11	0.5566	0.5039	0.2233	6.4976	-0.996	9.5121	-0.1065	0.9742	0.4696	1.9452	-0.0393	0.2175
12	0.6611	0.8637	0.6727	0.6776	-0.6674	9.7924	-0.1296	0.8698	0.4867	1.9445	0.4118	1.1907
13	0.2671	1.5043	0.2042	22.0191	0.9712	2.8359	0.1898	1.8345	0.2339	2.406	0.1504	2.2065
14	0.2759	0.7051	-0.0547	37.4272	-1.1896	15.0192	0.2362	2.242	-0.01	0.3915	0.5213	1.0723
15	-0.2871	8.7175	-0.02277	19.7439	-0.0889	10.2965	0.2632	12.185	-1.2515	6.181	-0.1075	0.8926
16	-0.5173	6.2094	-0.4032	7.7229	-1.5292	10.9137	0.1473	14.4173	-0.229	4.9109	-0.1468	0.1681
17	-0.8725	6.3829	0.0224	5.7175	-0.042	10.3287	-0.0062	9.497	-1.755	4.813	-0.452	7.8021
18	-0.8992	9.803	0.0833	4.366	-0.1671	12.4115	-0.0099	11.9997	-0.8786	4.6482	-0.349	7.132
19	0.2969	1.6247	0.0894	4.5947	-1.1685	10.3657	0.2023	6.7433	-0.6474	3.6572	-0.2989	6.8648