ARTICLE / INVESTIGACIÓN

Evaluation of new genetic structures under the dimensions from *Cicer arietinum*

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Abstract: Twenty-one chickpea genotypes were tested to evaluate genetic variation in some agronomic traits, heritability and genetic advance. The experiment was conducted in field crops during the 2018 -2019 growing season. A Randomized Complete Block Design (CRD) with three replications was used; data were collected for days to 50% flowering, plant height, number of primary branches per plant, number of secondary branches per plant, the height of the first pod from the ground, number of pods per plant, number of seeds per pod, biological yield per plant, seed yield per plant, harvest index and 100-seed weight. Analysis of variance showed a highly significant mean square difference for all traits except the number of pods per plant, harvest index and 100-seed weight. Genotypes (7,18) were more distinctive than the other genotypes in most characteristics. The high value of the genotypic coefficient of variation was found for biological yield per plant (29. 772), seed yield per plant (24.757) and the number of primary branches (24.849). High heritability was recorded for the first pod height from the ground (67.8) and plant height (60.8). High expected genetic advance as a percentage of the mean was estimated for biological yield per plant (41.144), seed yield per plant (39.61), and the number of primary branches per plant (38.382).

Key words: Genetic variability, Heritability, genetic advance, Chickpea.

Introduction

Chickpea (*Cicer arientinum* L.) is considered the third among pulses, and the world pulses production is 12%[1]. Chickpea ranks as an essential source of protein for the rural poor who cannot buy animal products. In Iraq, chickpeas' productivity is unstable due to cultivars with a narrow genetic base, which exposes them to biotic stresses in fencing production. Genetic diversity is needed in crop breeding programs to improve the productivity of cultivars by using the introduced germplasm one method. Information on genetic parameters in new germplasm is needed to improve genetic diversity in breeding and breeding programs[2]. High variations in days to maturity, the number of plant pods and seed yield in chickpea[3], plant height and the number of plant branches[4], are decisive factors in deciding which traits still show high variability value by phenotypic and genotypic value and coefficient of variation, giving the idea about the amount of variability in the population, (genetic status). In addition to genetic variation, heritability is an important parameter in the selection of specific traits, high heritability value in a broad sense was found in 100-seed weight, and the number of seed plant^{-1} in chickpea by (4), seed yield and number of branches plant F1[5]. Estimated high broad-sense heritability for (6), biological yield and its related traits in soybean, days to 50% flowering in chickpea by (1),(7) found high broad-sense heritability for the number of branches and biological yield along with genetic advance in chickpea with the same traits[8]. Genetic variability, heritability and genetic advance in chickpeas were studied, and a low genetic coefficient of variation for days to 50% flowering and plant height indicated common environmental effects on these traits. Heritability effects are essential in expressing the reliability of phenotypic characters with high heritability, which is influential in selecting such characters and desiring future chickpea breeding programs. The present study aims to determine the genetic variability, heritability and genetic advance in 21 genotypes of chickpeas.

Materials and methods

The experiment was carried out in the field crops Department. College of Agricultural Engineering Science, Duhok University, Iraq. In the growing season, March 2018 using, twenty genotypic and one check (local cultivars) were used in this study (Table 1). The source of genotypic seed was obtained from International Center for dry Agriculture ICARDA; all the genotypes seeds were sown in randomized complete block design R C B D with three replication in three-row 4 m long 50cm between and 20cm within the row all Agricultural practices were performed recommended for chickpea productions Five plants selected round only for each phenotype to recording data of the following traits:-number of days to 50%vflowering, number of secondary branches per plant height of fresh pod.cm., number of pods per plant, number of seed per pods, Biological yield gm, grain yield per plant gm, selection index and 100 seed weight gm.

Citation: AliAgwan I M M, Altaweel M S, Ali Askander H S. Evaluation of new genetic structures under the dimensions from Cicer arietinum. Revis Bionatura 2022;7(4) 55. http://dx.doi.org/10.21931/RB/2022.07.04.55
Received: 27 March 2022 / **Accepted:** 22 October 2022 / **Published:** 15 November 2022

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Data were subjected to analysis of variance to define the phenotypic and genotypic, and environmental variance and coefficient of variation according to the formula suggested by (9),

Environmental variance O'²e=MSE

GA=KO'Ph²

Where:-

K=selection intensity under 10%=1.76

O'p=standard variance of the phenotype

h=heritability in a broad sense

GA=genetic advance.

GAM=GAlX̄*100

Where:-

GAM=genetic advanced percent of the mean

x̄=mean of population.

Genetic advance is considered high when it is more than 30% and 10-30%medium less than 10% low[12].

The study was carried out to evaluate the performance of 21 new inputs derived from the International Center for Dry Agriculture ICARD shown in Table 1.

GA=KO'Ph²
Where:-
K=selection intensity under 10%=1.76
O'p=standard variance of the phenotype
h=heritability in a broad sense
GA=genetic advance.
GAM=GAlX̄*100
Where:-
GAM=genetic advanced percent of the mean
x̄=mean of population.

NO.	Genotypes	Pedigree
1	FLIP07-180C	X03TH-29/(S99858XFLIP97-26)XS00432
2	FLIP07-193C	X02TH 61/S99520XL.Mt-1
3	FLIP09-63C	X05TH7/X04TH-126XFLIP01-18
4	FLIP09-88C	X05TH64/X04TH-202XFLIP00-17
5	FLIP09-97C	X05TH64/X04TH-202XFLIP00-18
6	FLIP09-113C	X05TH64/X04TH-202XFLIP00-19
7	FLIP09-114C	X05TH64/X04TH-202XFLIP00-20
8	FLIP09-122C	X05TH64/X04TH-202XFLIP00-21
9	FLIP09-220C	X05TH64/X04TH-202XFLIP00-22
10	FLIP09-221C	X05TH64/X04TH-202XFLIP00-23
11	FLIP09-222C	X05TH64/X04TH-202XFLIP00-24
12	FLIP09-223C	X05TH64/X04TH-202XFLIP00-25
13	FLIP09-224C	X05TH64/X04TH-202XFLIP00-26
14	FLIP09-225C	X05TH64/X04TH-202XFLIP00-27
15	FLIP09-226C	X05TH64/X04TH-202XFLIP00-28
16	FLIP09-227C	X05TH64/X04TH-202XFLIP00-29
17	FLIP09-228C	X05TH64/X04TH-202XFLIP00-30
18	FLIP09-230C	X05TH64/X04TH-202XFLIP00-31
19	FLIP09-231C	X05TH64/X04TH-202XFLIP00-32
20	FLIP09-232C	X05TH64/X04TH-202XFLIP00-33
21	Duhok variety	Local check variety

Table 1. Numbers, Names and Pedigrees genotypes of chickpea.

The land was plowed with the plowing disc plow, and the soil was mowed with disc harrows the twenty. On 23-12-2014, under the demographic conditions in the fields of one of the farmers of the region of the province of Nineveh in the experiment design of the random segments full RCBD three replicates where the experimental unit consists of two lines length of 4 m for the line and 50 cm between the line and another and (20 cm) between Joura and other, The fertilizer was added Luria (N% 46) at an average rate of (120 kg / e) in the first two steps after germination and the second at the beginning of the stage of holding flowers, and the amount of precipitation during the growing season. At the end of the growing season, the studies were carried out on five plants randomly selected from the experimental unit. The yield was estimated by harvesting the experimental unit plants and studying the number of days for 50% flowering, plant height (cm), total plant count, Qurna length (Kg/ha), dry seed yield (kg/ha), harvest index (%), the weight of 100 seeds (g). The data were analyzed statistically according to the design of the entire random sectors (RCBD. Using the SAS (2004) program, genetic, phenotypic, and environmental variations were estimated according to the way they were explained[11].

$$\sigma^2_g = (M.S.t - M.s.e)/r$$

$$\sigma^2_e = M.S.e \quad \sigma^2_p = \sigma^2_g$$

The standard error of phenotypic variation was estimated (12) according to the equation:

$$SE(\sigma^2 G) = \sqrt{\frac{1}{r^2}\left[\frac{2(msg)^2}{k+2} + \frac{2(mse)^2}{k+2}\right]}$$

$$SE(\sigma^2 E) = \sqrt{\frac{2(mse)^2}{k+2}} \qquad SE(\sigma^2 p) = \sqrt{\frac{2(\sigma^2 p)^2}{N}}$$

Note that k = degrees of freedom for each source (genetic structures or experimental error), r = number of replicates, where N = total degrees of freedom of genetic structure and experimental error and calculation of the values of phenotypic differences (PCV) and genotype (9), depending on the ranges used by(12), which is less than 10%, low, 10-30% medium, and more than 30% high.

$$Phenotypic Coefficient of Variation (P.C.V.) = \frac{\sqrt{\sigma^2_P}}{\bar{X}} \times 100)$$

And to find inheritance values broadly in how they have been explained[9]. The scales described above were based on (1999). The inheritance values in the broad sense are less than 40%, 40-60% medium, and 60% or higher.

$$H^2 = \frac{\sigma_G^2}{\sigma_P^2}$$

The predicted genetic improvement was estimated when 5% of the plants were selected[11,12] suggested the expected genetic improvement as a percentage of the mean: less than 10%, 10-30% medium, and more than 30% high.

The physical and genetic correlations between the pairs of studied traits were found as explained by using the Excel program and tested its significance in how it was described[10].

$$Msp_{(cov.)} = Msg_{(cov.)} + Mse_{(cov.)} \qquad rP = \frac{Msp_{(cov.)}}{\sqrt{Msp_{(1)} \times Msp_{(2)}}}$$

$$\sigma_{G\times Y} = \frac{Msg_{(cov.)} - Mse_{(cov.)}}{r} \qquad rG = \frac{\sigma_{G\times Y}}{\sqrt{Msg_{(1)} \times Msg_{(2)}}}$$

Results

Analysis of variance

Analysis of variance (Table 2) for all genotypes studied traits showed highly significant differences in the mean square for all studied traits except the number of pods per plant, harvest index and 100seed weight; this indicates the high genetic variability in genotypes can be used in chickpea breeding program. Similar results were obtained by (13–15).

Mean performance :

S.O.V	d.f	Days to 50% flowering	Plant height (cm)	No. of primary branches per plant	No. of second branches per plant	First height pod (cm)	No. pods per plant	No. seed per pod	Biology yield of Per plant	Grain yield of Per plant	Harvest index %	100 seed weight g.
Replication	2	5.762	1.714	0.008	87.246	1.440	2407.284	0.146	953.581	1184.736	3314.336	5.168
Genotype	20	** 197.071	** 48.537	** 1.024	** 230.100	** 45.276	n.s. 614.419	** 0.205	** 2213.293	** 470.206	n.s. 655.777	n.s. 174.356
Error	40	76.662	8.575	0.211	42.430	6.197	474.265	0.052	640.596	88.550	311.030	86.546

Table 2. Mean square of variance analysis for studied traits in chickpeas *And **indicating significance at levels 0.05 and 0.01, respectively.

Characters Genotype	Days to 50% flowering	Plant height (cm)	No. of primary branches per plant	No. of second branches per plant	First height pod (cm)	No. pods per plant	No. seed per pod	Biology yield of Per plant (gm/plant)	Grain yield of per plant (gm/plant)	Harvest index (%)	100 seed weight (g)
1	77.000	26.700	1.700	49.600	26.700	34.300	1.200	100.140	30.052	29.905	24.700
2	84.000	28.200	1.700	48.867	28.200	33.600	1.500	100.140	19.333	29.905	20.355
3	76.000	22.900	2.500	36.733	22.900	22.300	1.500	162.600	55.810	34.167	21.314
4	80.000	21.000	2.500	27.467	21.000	28.300	1.500	88.350	39.857	56.109	21.040
5	76.000	29.800	2.200	46.200	29.800	29.100	1.500	140.388	42.253	29.880	11.955
6	95.000	23.200	2.000	32.933	23.200	30.800	1.100	102.750	46.075	51.663	29.793
7	65.000	30.700	3.000	65.800	30.700	45.400	1.750	135.900	70.355	54.151	24.094
8	90.000	29.300	3.500	21.200	32.900	38.400	1.100	94.820	26.001	27.295	20.501
9	67.000	26.900	2.200	57.133	26.900	36.600	1.300	154.180	63.830	42.430	20.958
10	70.000	29.600	1.800	30.667	29.600	33.400	1.500	107.400	42.018	40.487	22.446
11	80.000	25.200	2.900	62.733	25.200	41.700	1.500	128.080	56.570	44.240	21.880
12	86.000	24.100	1.500	28.800	24.100	24.000	1.500	88.950	58.490	77.377	21.510
13	72.000	22.300	1.700	53.267	23.300	37.300	1.200	119.910	42.135	40.134	21.020
14	72.000	25.300	1.500	24.600	25.300	18.800	1.700	136.820	50.320	36.990	21.376
15	81.000	20.200	2.300	59.267	20.200	39.200	1.500	111.640	45.140	42.194	20.635
16	78.000	28.100	1.700	40.733	28.100	45.400	1.500	146.700	52.757	36.016	20.800
17	85.000	32.600	2.300	47.600	29.100	32.200	1.300	77.250	50.640	74.175	42.090
18	64.000	25.600	2.600	60.133	26.500	32.700	1.100	131.740	37.123	27.831	46.920
19	70.000	24.200	1.700	32.467	29.200	25.100	1.200	149.900	42.100	27.869	20.115
20	72.000	24.800	1.300	35.533	24.800	23.400	1.600	166.240	53.338	32.198	23.655
21	75.000	15.300	1.400	20.333	16.800	10.667	0.600	130.500	32.535	26.316	19.935
Average	**76.905**	**25.524**	**2.095**	**42.003**	**25.929**	**31.556**	**1.364**	**76.905**	**45.559**	**76.905**	**23.671**
L.S.D. (0.05)	**14.870**	**4.973**	**0.780**	**11.063**	**4.228**	**36.985**	**0.387**	**42.984**	**15.981**	**29.952**	**15.799**
			1.062	**15.057**	**5.754**	**50.339**	**0.527**	**58.504**	**21.751**	**40.766**	**21.504**

Table 3. Mean performance of twenty–one genotypes of chickpea for studied traits.

Showed the mean performance of Twentyone's –genotypes for studied traits, the result discovered many genotypes earlier than the check variety for days 50% flowering genotypes (6 and 8) were the latest with (95,90)days respectively while the genotypes18were the earliest with (64) days. For plant height which is one of the desirable traits in chickpeas which decreases lodging effect and improves ultimate seed yield, the genotype with modest plant height and high yield traits could be essential to use for genetic improvement of chickpea varieties; the result showed the tallest plant among the twenty–one genotype, found in genotypes (17,18) with value (32,60) and (30.70) cm. respectively, while the shortest plants with (15.30) cm for genotypes (21). Regarding the number of primary branches per plant, genotype (8) had the highest number, with (3.50) branches and the lowest number for genotype (20), with (1.30) branches; for the number of secondary branches, per plant, genotype (7,11) recorded the highest number with (65.8 and 62.73) respectively with the lowest number of genotype (8) with (21.20). The same table showed that genotype (8), with (32.90) cm was the highest of the first pod from the ground, while genotype (21) was the shortest for the same trait, for the number of pods per plant genotypes (7 and 16) with (45.4) had the highest number and lowest with (10.66) for genotypes (21). Regarding the number of seed per pod, genotypes (7 and 14) gives a maximum number of (1.75 and 1.700) respectively, and the minimum number of seed per pod is recorded by genotypes (8,18) with (1.100). For

Characters	VG	VE	VP	GCV	PCV	H²%	GA	GA as a percent of mean
Days to flowering 50%	** 40.136	** 76.662	** 116.798	8.238	14.053	39.4	7.650	9.948
Plant height (cm)	** 13.321	n.s. 8.575	** 21.896	14.299	18.333	60.8	5.864	22.976
No. of primary branches per plant	n.s. 0.271	n.s. 0.211	** 0.482	24.849	33.139	56.20	0.804	38.382
No. of second branches per plant	** 62.557	** 42.430	** 104.987	18.830	24.394	59.60	12.577	29.943
First height pod (cm)	** 13.026	n.s. 6.197	** 19.223	13.920	16.909	67.80	6.120	23.604
No. pods per plant	** 46.718	** 474.265	** 520.983	21.660	72.332	9.0	4.216	13.362
No. seed per pod	n.s. 0.051	n.s. 0.052	n.s. 0.103	16.557	23.529	49.50	0.327	24.000
Biology yield of plant (gm)	** 524.232	** 640.596	** 1164.828	29.772	44.379	45.0	31.642	41.144
Seed yield per plant (gm)	** 127.219	** 88.550	** 215.769	24.757	32.242	59.0	17.841	39.161
Harvest index %	** 114.916	** 311.030	** 425.946	13.939	26.836	27.0	11.470	14.915
100 seed weight (gm)	** 29.270	** 86.546	** 115.816	22.856	45.464	25.30	5.603	23.669

Table 4. Genetic parameters of studied traits in chickpeas.

biological yield per plant, genotypes (20 and 2) with values (166.240 and 162.600g) give the highest value (166.240 and 162.600g) provide the highest value of biological yield per plant and lowest for genotype (1x) with (xx.25g) the same table showed that genotype (x^-) had the highest value with (70.355)for grain yield per plant and lowest for genotype (2) genotype (2) with (19.330g), for harvest index genotypes (12) record the high value (77.377) and low value for genotype (21) with (26.316). Genotype (18) records the high value of 100 seed weight with (46.92)g and the lowest for genotype (5) with (11.955); we conclude from the previous results that genotype (7) was more distinctive than other genotypes in number of secondary branches per plant, number of pod per plant, number of seed per pod and grain yield per plant, followed by genotype (18) was earliest with day 50% flowering and 100 seed weight (g). In contrast, genotype (8)was superior in the number of primary branches per plant and the highest first pod from the ground; the results were consistent with other researchers[1,15–17].

Illustrated some of the genetic parameters for studied traits, it is clear that the genetic variation was highly significant for all traits except the number of primary branches per plant and number of seeds per pod; the high phenotypic variance as compared to genotypic variance explains the role of environment in the expression of the trait such value provides information of the extent of variability, it is clear the highest value of the phenotypic coefficient of variation were record in the number of pod per plant with (x^-2.332)100 seed weight (45.464)g .and biological yield per plant (44.379) g., while the higher genetic coefficient, of variation, were found in natural product per plant (29.772)g.,seed yield per plant (24.757) g and the number of primary branches per plant (24.849). Similar results were observed by (18)[1,19,20]. From the same table, the heritability estimate value was high for the height of the first pod from the ground (67.8) and plant height (60.8). At the same time, it was medium for the number of secondary branches per plant (59.6), Number of seeds per pod (49.5), biological yield per plant (45) and grain yield per plant (59) and low for other traits. The results were in agreement with other researchers(13,21). genetic advance as present of mean at 10% selection intensity was high for biological yield (41.144),seed yield per plant (39.161)and number primary branches per plant (38.382). At the same time, it was low for the number of days 50%flowering (9.948)and medium for other traits, from the present study showed that the high-value heritability followed by the medium of expected genetic advance as percent value for plant height and high the first pod from the ground these two traits could be improved easily more than the other traits in the present study, a similar result was found by (5,13,15,22,23).

Discussion

In Colombia, approximately 176,000 cultivated hectares benefit 52,000 families in 422 municipalities of 30 departments,

Monte Carlo Simulation Analysis (MCS)

After structuring costs, the most influential cost component was direct labor, representing 53% of the total cost. The cost of culture media was 12% of the total, IMC represented 5%, and operating expenses, including administrative expenses and infrastructure, were 30% (Figure 2).

Conclusions

Many genotypic structures of chickpeas are estimated in this study many characters. The mean square has a highly significant difference for all traits except the number of pods per plant, harvest index and 100 seed weight. The genotypic coefficient variation has a high value in biological yield, seed yield per plant and number of primary branches. Heritability has a high value in the first pod and plant high. The expected genetic advance has a high value as percent in many characteristics such as biological and seed yield number of primary branches in the plant.

Funding

Self-funding

Acknowledgments

In this section, we acknowledge any person who supports us in completing this project.

Conflicts of Interest

There is no conflict

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