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RECOGNITION AND DETERMINATION OF RELATED TRAITS IMPORTANCE WITH SEED YIELD IN CHICKPEA (*CICER AIETINUM*)

ABSTRACT

To study the relationship between seed yield and its components 5 varieties and 18 different genotypes of Cicer arietinum were evaluated. This study was carried out under dryland farming during 2007 in research farm of Razi university. Path analysis showed that in the first level of yield, the highest direct effect was related to biological yield and the highest indirect effect was related to seed number per plant due to biological yield. In second level of yield due to the seed number per plant double seed pod number had the highest direct effect and the highest indirect effect was related to hundreds seed weight due to double the seed pod number. In second level of yield due to biological yield, the highest direct effect was related to high plant and the highest indirect effect was related to high plant due to second branch number. In the third level of yield due to a hundred seed weight, the highest direct effect was related to pod diameter and the highest indirect effect was related to pod length due to pod diameter. Factor analysis showed that 5 factors explained 81.65 percent of the variance. Cluster analysis based on ward method were arranged genotypes in 3 clusters.

Key words: chickpea, factor analysis and cluster analysis., path analysis, yield, yield components,

INTRODUCTION

Chickpea (*Cicer arietinum*) with 2n=16 chromosome is one of the grains spices that it contains 17- 24 percent protein. According to population increasing, protein request and farm extending limitation, it is necessary to do research for improving yield and related traits with yield (Pirdadeh, 2005; Hamzeh, 2004).

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The study of seed yield and effective traits on yield in chickpea genotypes showed some genetic variation for yield components. The effect of secondary branch number, hundred seed weight and pant length to yield in chickpea was positive and significant (Kanouni, 2003). The study of planting date effect on yield and yield components of chickpea in Khorasan showed a significant correlation between branch number per plant and seed yield (Porsa *et al.*, 2003). Optimization of chickpea production management using computer simulation showed a positive significant correlation between seed yield and biological yield (Soltani *et al.*, 2007). The study of genetic variation potential in Iranian chickpea using factor analysis defined six independent factors that they explained 62.5 percent of population variance (Aghaei *et al.*, 2005). In a research, effective traits on seed yield in 36 chickpea lines was determined and four factors explained 77.2 percent of variance (Kamel *et al.*, 2008). The study of chickpea genotypes variation in Turkey using factor analysis showed that one factor had a fixed level (0.99) for all of the genotypes (Vural *et al.*, 2007). In determining the most effective traits on chickpea yield using factor analysis, a research was done and showed that the first factor contained yield and seed yield, blight resistance and plant length. Also two other factors contained branch number, pod number per plant and seed weight (Toker *et al.*, 2004). In Pakistan, factor analysis of chickpea genotypes reported a high relationship between blight resistance and first factor (Iqbal *et al.*, 2004). The study of chickpea genetic variation using factor analysis showed that the morphological and physiological function was increased due to hybridization between genotypes (Khan *et al.*, 1991). The study of chickpea intraspecific variation using factor analysis reported the most significant results and explanations (Narayan *et al.*, 1976). In a research, three factors were determined for different morphological and agronomic traits in chickpea genotypes that they explained the most of the variance (Moreno *et al.*, 1978).

The present research was done to determine the important agronomic traits of chickpea and their relationship with yield, and recognizing some traits that they could be used for direct selection in breeding. Also in this research, the studied traits were analyzed using factor analysis, and hidden factors were recognized for studying the interrelationship between morphological traits and evaluation of chickpea local mass family relationships with together and also with famous varieties.

MATERIAL AND METHOD

In this research, 18 local masses and 5 varieties of chickpea planted on two randomized complete block design (Table 1). There were 3 lines in per plot. Line's distances were 50 cm, plot's distances were 100 cm and block's distances were 2 m. During the research weeds were eliminated in two steps by hand. Sampling was done during the growing period. Final harvesting was done by hand. 18 traits were studied (Table 2).

Table 1

List of studiem genotypes.

Row	Name in this research	Gene bank code	Location of collection	Row	Name in this research	Gene bank code	Location of collection
1	1	215002	Markazi	13	57	215813	Unknown
2	2	215004	Markazi	14	79	216118	Unknown
3	7	215056	Unknown	15	82	216147	Unknown
4	8	215079	Mazandaran	16	83	216149	Unknown
5	9	215161	Unknown	17	96	216277	Unknown
6	18	215295	Unknown	18	104	216356	Unknown
7	33	215538	Khorasan	19	ILC482	-	Turkey
8	39	215567	Unknown	20	Bivanij	-	Kermanshah
9	41	215611	Unknown	21	Jam	-	Fars
10	51	215701	Unknown	22	Arman	-	ICARDA
11	52	215743	Unknown	23	Hashem	-	ICARDA
12	54	215754	Unknown				

Table 2

List of traits measured in chickpea

Row	Trait	Row	Trait
1	Biological Yield	10	Hundred Seed Weight
2	Chlorophyll Amount	11	Fertilization Percent
3	Pod Number Per Plant	12	Harvest Index
4	Pod Length	13	Seed Yield
5	Pod Diameter	14	Secondary Branch Number
6	Seed Number Per Pod	15	Plant Length
7	Single Seed Pod Number	16	First Flowering Date
8	Double Seed Pod Number	17	%50 of Flowering Date
9	Seed Number Per Plant	18	First Poding Date

We used EXCEL and SPSS software for statistical analysis.

RESULT

Because of seed yield importance, in table 3, we just showed the correlation between seed yield and other traits. The results showed that seed yield had a significant correlation with seed number per plant, biological yield, pod number per plant and single seed pod number (Table 3). In the study of seed yield and its related traits in chickpea genotypes, secondary branch number, hundred seed weight and plant length had a significant positive effect on seed yield (Kanouni, 2003). In the study of the chickpea planting date on yield and its components in Khorasan, there was a significant correlation between branch number per plant and seed yield (Porsa *et al.*, 2003).

Table 3

Correlation coefficients of measured grain yield traits in chickpea

Traits	Correlation with seed yield	Traits	Correlation with seed yield
Seed yield	1	Hundred seed weight	0.225
Biological yield	0.724**	Fertilization percent	-0.096
Pod number per plant	0.509*	Harvest index	0.311
Pod length	0.205	Plant length	-0.022
Pod diameter	0.136	Secondary branch number	0.331
Seed number per pod	0.215	Chlorophyll amount	0.114
Single seed pod number	0.723**	First flowering date	-0.070
Double seed pod number	0.013	%50 flowering date	0.183
Seed number per plant	0.494*	First podding date	0.161

* and ** — significant at 5% and 1% respectively

Fig. 1. Shows Path analysis diagram based on correlation analysis results and the true relationship between different traits.

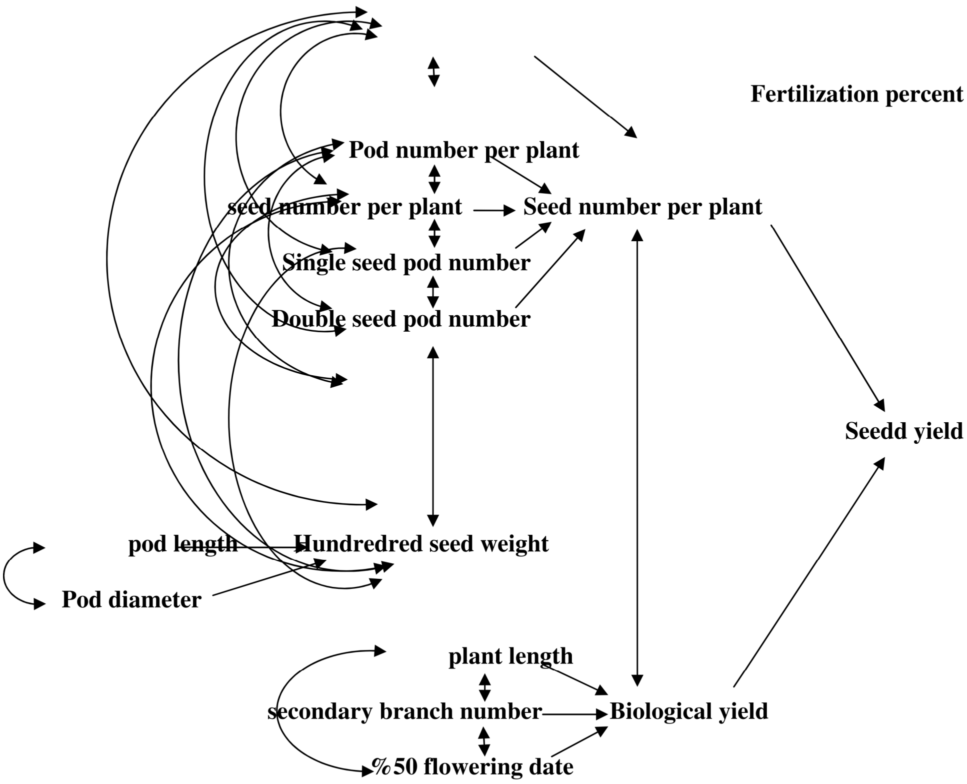

Fig. 1 Path analysis diagram for grain yield in chickpea

Table 4

Path analysis results in the first level of yield

Traits in the first level of yield	Correlation with seed yield per plant	Frist trait direct effect on seed numberper plant	First trait indirect effect	
			Seed number	Biological yield
Seed number per plant	0.494*	0.262	-	0.249
Biological yield	0.724**	0.628	0.104	-

* and ** — significant at 5% and 1% respectively

Path analysis results showed that highest direct effect on the first level of yield was related to biological yield and the highest indirect effect was related to seed number per plant due to biological yield (Table 4). In the second level of yield due to the seed number per plant, the highest direct effect was related to double seed pod number and the highest indirect effect was related to a hundred seed weight due to double the seed pod number (Table 5). In second level of yield due to biological yield, the highest direct effect was related to plant length and the highest indirect effect was related to plant length due to the secondary branch number (Table 6). In the third level of yield due to a hundred seed weight, the highest direct effect was related to pod diameter and the highest indirect effect was related to pod length due to the pod diameter (Table 7).

Table 5

Path analysis results in the second level of yield due to seed number per plant.

A	B	C	Secondary traits indirect effect on seed number per plant due to					
			I	II	III	IV	V	VI
I	0.246^{ns}	0.001	-	0.015	-0.002	0.179	-0.036	-0.004
II	0.777**	-0.145	0.0001	-	0.001	-0.144	0.525	-0.007
II	0.380^{ns}	-0.010	0.0002	-0.103	-	-0.015	0.055	-0.005
IV	0.677**	0.741	0.0002	-0.073	-0.001	-	0.039	-0.015
V	0.753**	0.804	0.0001	-0.058	-0.004	-0.010	-	-0.014
VI	-0.653**	0.018	-0.0002	0.057	0.003	0.032	-0.635	-

**: Significant at 1%, NS: non significant (R^2= 0.972).
Legend:
I — Fertilization percent
II — Pod number per plant
III — Seed number per pod
IV — Single seed pod number
V — Double seed pod number
VI — Hundred seed weight
A — Traits of second level of yield due to seed number per plant
B — Correlation with seed number per plant
C — Secondary traits direct effect on seed number per plant

Table 6

Path analysis results in the second level of yield due to biological yield

Traits of second level of yield due to biological yield	Correlation with biological yield	Secondary traits direct effect on biological yield	Secondary traits indirect effect on		
			Plant length	Secondary branch number	%50 flowering date
Plant length	-0.343^{ns}	0.100	-	-0.444	0.001
Secondary branch number	0.670**	0.691	-0.064	-	0.043
%50 flowering date	0.349^{ns}	0.150	0.001	0.198	-

* and **: Significant at 5% and 1%, respectively, NS: non significant (R^2= 0.481)

Table 7

Path analysis results in the third level of yield due to hundred seed weight

Traits of second level of yield due to hundred seed weight	Correlation with hundred seed weight	Secondary traits direct effect on hundred seed weight	Secondary traits indirect	
			Pod length	Pod diameter
Pod length	0.532**	0.360	-	0.496
Pod diameter	0.920**	0.900	0.198	-

**: Significant at 1% (0.847)

The result of Factor analysis showed that the five factors explained 81.65 percent of variance (Table 8).

Table 8

Factor analysis results

Traits	First Factor	Second F.	Third F.	Fourth F.	Fifth F.
100 seed weight	<u>0.960</u>	0.052	0.045	-0.023	-0.041
Pod diameter	<u>0.932</u>	-0.052	0.181	0.008	-0.045
Double seed pod N.	<u>-0.847</u>	0.101	0.210	0.087	-0.039
Seed N. Per plant	<u>-0.721</u>	0.634	0.035	0.173	0.097
Seed yield	0.181	<u>0.892</u>	0.015	0.322	-0.058
Single seed N.	-0.166	<u>0.887</u>	-0.119	0.074	0.139
Biological yield	0.136	<u>0.803</u>	0.357	-0.284	-0.080
Pod N. Per plant	-0.484	<u>0.759</u>	0.214	-0.248	-0.074
First flowering date	0.045	-0.049	<u>0.751</u>	-0.237	-0.206
%50 flowering date	-0.089	0.136	<u>0.738</u>	0.152	0.056
First podding date	-0.126	0.052	<u>0.669</u>	0.600	0.013
Pod length	0.507	0.197	<u>0.667</u>	-0.133	0.000
Secondary branch N.	0.009	0.523	<u>0.569</u>	-0.368	-0.295
Chlorophyll amount	0.401	0.143	-0.451	-0.010	0.430
Harvest index	0.087	0.045	-0.222	<u>0.867</u>	-0.193
Seed N. Per pod	-0.278	-0.003	0.136	<u>0.858</u>	0.232
Fertilization percent	-0.212	0.080	-0.032	-0.125	<u>0.875</u>
Plant length	0.232	-0.276	-0.147	0.410	<u>0.632</u>
Variance %	22.034	20.355	16.044	14.196	9.023
Cumulative variance %	22.034	42.39	58.433	72.629	81.652
Stagnant root	3.966	3.664	2.888	2.555	1.624

Factor analysis is used to decrease data, recognizing of main yield components, clustering of traits, according to their relationships, and genetic variation studies.

In this research, factor analysis was done due to principal component analysis with varimax rotation. The highest factor indexes in per factor was used to name factors. For main indexes recognizing in per factor, we just used indexes that they were more than 0.5 (Table 8).

According to factor analysis, five factors were resulted that they explained more than 81 percent of total variance. The highest indexes in first factor were related to a hundred seed weight, pod diameter, double seed pod number and seed number per plant, so it could be named seed size determination factor. The second factor was contained seed yield, single seed pod number, biological yield and pod number per plant that it explained 20.36 percent of the variance, so it could be named yield factor. The third factor explained 16 percent of the variance. The most important traits in this factor determination were first flowering date, 50% flowering date, first pod date, pod length and secondary branch number, so it could be named phonological factor. The fourth factor explained 14.20 percent of the variance. In this factor, harvest index and seed number per pod were important that it could be named harvest index factor. The fifth factor explained 9 percent of the variance. The most important traits in this factor were fertilization percent and plant length, so it could be named fertilization factor.

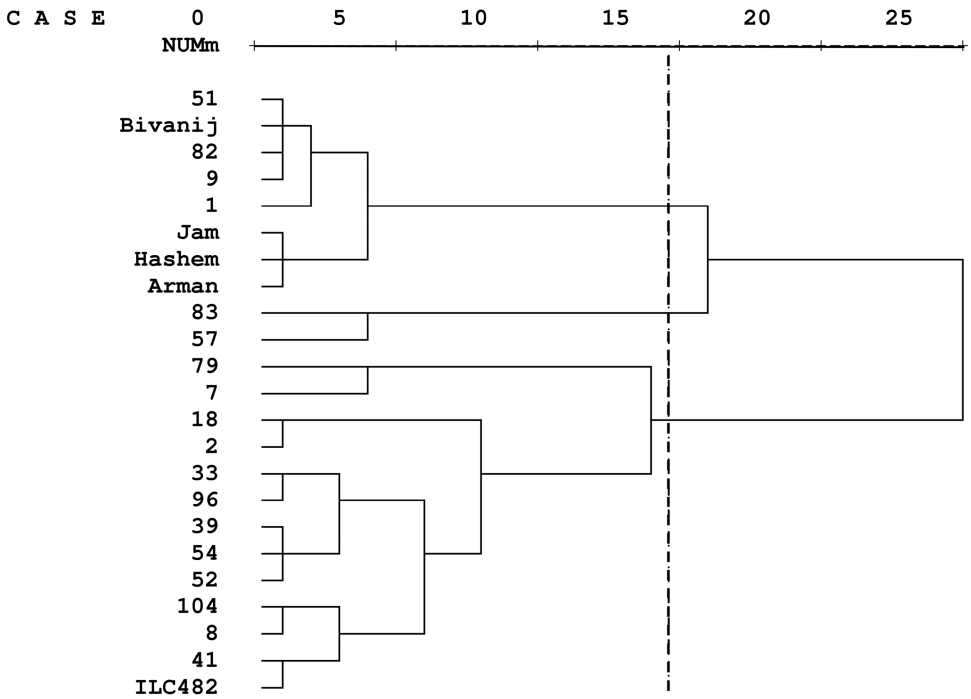

Fig. 2. Dendrogram based on the ward method of cluster analysis for studying the traits in chickpea

Cluster analysis

To genotypes clustering based on their characters and finding out their similarity and differences, we used cluster analysis, so similar samples were arranged in one cluster.

The results of the data cluster analysis using WARD method arranged genotypes in three clusters (Fig. 2) and result of discriminate analysis confirmed that (Table 9).

Table 9

Discriminate analysis results based on the studied traits for clustering genotypes in chickpea.

Predicted clusters	First cluster		Second cluster		Third cluster		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1	8	100	0	0	0	0	8	100
2	0	0	2	100	0	0	2	100
3	0	0	0	0	13	100	13	100

The first cluster contained 1, 9, 51 and 82 genotypes and Bivanij, Jam, Arman and Hashem varieties. These samples were similar together based on seed yield and biological yield with a low amount and pod length and pod diameter with high amount. The second cluster contained 57 and 83 genotypes that they were similarly based on seed yield, pod length and pod diameter with a high amount and pod number per plant with a low amount. The third cluster contained 2, 7, 8, 18, 33, 39, 41, 52, 54, 79, 96 and 104 genotypes and ILC482 variety that they were similarly based on fertilization percent first podding date with a high amount.

The result of cluster analysis based on morphological and agronomic traits was not confirmed geographical clustering. It may be for the reason that seed movement between different regions or having a common ancestor in crosses.

DISCUSSION

According to high direct effect of seed number per plant and biological yield on seed yield and a high effect of single and double seed pod number of seed number per plant, it can be resulted that selecting these traits will cause the seed number per plant increasing and finally seed yield will be increased. Also hundred seed weight had a high direct effect on seed number per plant due to double seed pod number that it is effective due to pod length and pod diameter.

Finally because of chickpea seed size importance, we can product bigger seeds of chickpea and increase chickpea yield due to the increasing pod diameter.

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