Correlation and Path Coefficient Analysis for Seed Yield and Yield Components in Chickpea under Rainfed Condition

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Abstract:

Chickpea is rich in protein and micronutrients and plays a significant role in human diet especially as accompaniment to staples, but seed yields in Kurdistan are still below the crop potential This investigation was conducted during the spring seasons of 2017, at Bakrajo Research Station, College of Agricultural Sciences/University of Sulaimani to determine relationships among yield and some yield components using correlation and path coefficient analysis in chickpea grown under rainfed conditions. The character seed yield showed positive and highly significant correlation with most characters including plant height, number of branches per plant, deep of roots, number of pods per plant, number of seeds per pod, 100 seed weight, dry mater weight, pod weight per plant, protein percentage and biological weight. Characters dry matter weight per plant recorded the highest positive direct effect on seed yield reached 0.848, while the maximum positive indirect effect on seed yield recorded by weight of pods per plant via dry matter weight per plant with 0.795.

Key words: Chickpea, Correlation coefficient, Path-analysis, seed yield.

تحليل الارتباط ومعامل المسار لحاصل البذور و مكوناته للحمض تحت الظروف الديمية

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المستخلص:

يعتبر الحمص غني بالبروتين والمغذيات الصغرى وهو يلعب دور مؤثر في غذاء الانسان و خاصة الاغذية المرافقة ولكن انتاجية المحصول في كردستان ظلت تحت أقل من طاقة المحصول طبق البحث خلال الموسم الربيعي 2017 في محطة بحوث بكرجو- كلية العلوم الزراعية – جامعة السليمانية للتحديد علاقات الحاصل و بعض مكوناته باستخدام تحليلي الارتباط ومعامل المسار اظهرت صفة حاصل البذور أرتباط معنويا موجبا وعاليا مع اغلب الصفات المدروسة متضمنة ارتفاع النبات عدد الفروع نبات عمق الجذور عدد قرنات نبات عدد البذور قرنة وزن 100 بذرة وزن المادة الجافة وزن قرنات نبات نسبة البروتين و الحاصل البايولوجي سجلت وزن المادة الجافها نبات التأثير المباشر الموجب الاعلى على حاصل البذور ب 0.848

بينما اعلى تأثير غير المباشر موجب على حاصل البذور سجل من قبل وزن قرنات نبات عن طريق وزن المادة الجافه نبات ب 0.795 .

الكلمات المفتاحية : الحمص ، معامل الارتباط ، تحليل المسار و حاصل البذور.

Introduction:

Chickpea (*Cicer arietinum* L.) a member of Fabaceae family is one of the most important pulse crop in the world It ranks third as a valuable pulse crop on globe and first in South Asia for its area and production. Ninety two percent of the area and eighty nine percent of the production of chickpea grain are concentrated in semi-arid tropical countries (1, 11) It is cultivated in about 33 countries of central and west Asia Europe, North and South America Ethiopia North Africa, and Australia (14). The average yield of chickpea is relatively low in the country. This is primarily due to poor genetic makeup of the cultivars available, excessive vegetative growth, low tolerance to diseases and non-availability of grains of improved varieties which need immediate attention of the breeders for the evolution of maximum yielding varieties which fulfill the requirements of ever increasing population. Many of the studies on correlation and path analyses have been conducted in field crops. Correlation coefficients between yield and yield components and direct and indirect effects of various plant characters on yield and yield components have been reported by (2, 3, 17, 18, 20and 26). Sing et al.(22) Reported that seed yield had close association with harvest index and plant height and harvest index had high direct and positive effect on seed yield and selection for high harvest index would lead to high seed yield. Positive and significant correlations were found among seed yield and plant height, number of branch, number of pods per plant, harvest index and number of seeds per plant(5) Talebi et al (23) Examined 36 genotypes and reported positive and significant relationships between 100 seed weight and plant height, seed yield and number of pod/ plant, number of seed/pod and harvest index Eser at.el (7) Recorded closest interrelationship between grain yield per unit area and harvest index, 100-grains weight and grains per plant in chickpea. Jahhar and Mane (9) Reported that the correlation was significant in chickpea between grain yield and all yield parameters except plant height. Plant height had negative direct influence on grain yield. Tripathi at el (25) Evaluated path analysis for 8 traits in 40 diverse varieties of chickpea. Maximum yield per plant was associated with pods per plant, primary branches per plant and 100-grains weight.

Hence the present research was made to study the association among the characters and study the direct and indirect effects of yield components in seed yield of chickpea.

Materials and methods:

The present study was carried out in the fields of Agriculture Research Station at Bakrajo College of Agricultural sciences University of Sulaimani during the spring seasons of 2017 to study the effect of different tillage systems and NPK fertilizer levels on yield and yield components of chickpea. The experiment was arranged as split- plot arrangement The Tillage manners (Mold board plow to depth of (25 cm)

followed by Cultivator one pass (10 cm) (T1) Disk plow to depth of (25 cm) followed by Cultivator one pass(10 cm) (T2) and Cultivator one pass(T3) were implemented in the main plots and conducted with Randomized Complete Block Design(RCBD) , different levels of NPK fertilizer levels (0,40 and 80 kg ha^{-1}) from NPK fertilizer complex (15-15-15) were implemented in the subplots. Each main plot was consisted of three subplots with 4 rows, each subplot consist of 6 rows (0.30 m between rows and 0.20 m between plants) ; thus, the plant population was 200,000 plant ha-1.

Studied Characteristics:

Plant height (cm), Number of branches per plant, Depth of roots per plant, Number of bacterial nods per plant, Number of pods per plant, Number of seeds per plant, 100 seed weight (g) Dry matter weight ($g.plant^{-1}$) Pod weight ($g.plant^{-1}$) Average pod weight (g), Harvest Index, Protein percent (%),Biological yield ($ton.ha^{-1}$) and Seed yield ($ton\ .ha^{-1}$)

Correlation Analysis:

The correlation coefficient was conducted to determine the degree of association of characters with yield and also among all the criteria studied. Phenotypic correlations were computed between characters in the growing season using the formula given by (21).

Path Coefficient Analysis:

The path coefficient analysis was carried out as suggested by (6) seed yield was kept as resultant variable and other traits as causal through (Analysis of Moment Structures) AMOS Ver. 18 Software.

Results and discussion:

The correlation was performed among different characters of the evaluated interaction of tillage systems and varieties as shown in Table 1 and Figure 1. Plant height exhibited positive and highly significant correlation with the number of branches per plant, depth of roots, number of pods per plant, number of seed per plant, 100 seed weight, dry matter weight per plant, pod weight per plant, protein percentage, biological yield and seed yield This was in accordance with the findings of (10,13and 12) in chickpea. Number of branches per plant recorded positive and highly significant correlation with deep of roots, number of bacterial nods per plant , number of pod per plant, number of seed per plant, 100 seed weight, dry matter weight per plant and pod weight per plant but it correlated positively and significantly with protein percentage and biological yield and seed yield. Almost similar results are given by (24) Depth of roots positive and highly significant correlation with the number of seed per plant, 100 seed weight, dry matter weight per plant, pod weight per plant and seed yield but it correlated positively and significantly with number of bacterial nods per plant, number of pods per plant, protein percentage and biological yield. The characters number of bacteria per plant gave positive and significantly correlation with the 100 seed weight only The characters number of pod per plant recorded positive and highly significant correlation with number of seed per plant, dry matter weight per plant, pod weight per plant, protein percentage, biological yield and seed yield but it

correlated positively and significantly with 100 seed weight. The characters number of seed per plant gave positive and highly significant correlation with the 100 seed weight, dry matter weight per plant, pods weight per plant, protein percentage, biological yield and seed yield. The characters 100 seed weight recorded positive and highly significant correlation with dry matter weight per plant and pod weight per plant but it correlated positively and significantly with biological yield and seed yield. Positive and highly significant correlation was recorded between dry matter weight per plant and pod weight per plant protein percentage, biological yield and seed yield. Biomass had significant correlation with plant height at genotypic levels as similarly reported by (15) The characters pod weight per plant gave positive and highly significant correlation with protein percentage, biological yield and seed yield. The characters protein percentage produced positive and highly significant correlation with biological yield and seed yield. The characters biological yield recorded positive and highly significant correlation with seed yield. Hamdi at.el (8) Also reported that seed yield was positively and significantly correlated with pod numbers, harvest index. High positive correlation of number of pods per plant with seed yield may be attributed to the increased sink strength (16) The positive association between grain yield and yield attribute is also in accord with an earlier study on character association in chickpea by (3, 20, and 2) .

Data in Table 2 and Figure 2 illustrate the path coefficient analysis between seed yield and other characters. Characters dry matter weight per plant recorded the highest positive direct effect on seed yield reached 0.848, while maximum negative direct effect value of seed yield recorded by depth of roots reached - 0.547.

The characters weight of pods per plant and number of seeds per pod recorded high positive indirect effect on seed yield via the character dry matter weight per plant with 0.795 and 0.791 respectively, while the character 100 seed weight and number of branches per plant recorded high negative indirect effect also *via* dry matter weight per plant with -0. 531 and -0.503 respectively. These results indicated the importance of dry matter weight can be used in indirect selection for increase seed yield. Borate and Dalvi (4) founded that number of pods per plant had the highest direct positive effect on seed yield in chickpea .While Ozdemer (19) pointed that number of branches is among the important yield components, which have significant direct effects and indirect effects.

Table 1: Correlation analysis among the studied characters.

characters	Pant height (cm)	No. of Branches. plant^{-1}	Depth of roots (cm)	No. of bacteria nod.plant^{-1}	No .of pod .plant^{-1}	No .of seeds.plant^{-1}	100 Seed weight (g)	Dry matter weight (g.plant^{-1})	Pod weight (g. plant^{-1})	Average pod weight (g)	HI	Protein %	Biological yield (t.ha^{-1})	Seed yield (t.ha^{-1})
Pant height (cm)	1.000													
No. of Branches. Plant^{-1}	0.880**	1.000												
depth of roots (cm)	0.835**	0.919**	1.000											
No. of bacterial nods.plant^{-1}	0.638	0.820**	0.752**	1.000										
No .of pods .plant^{-1}	0.936**	0.821**	0.781**	0.414	1.000									
No .of seeds.plant^{-1}	0.890**	0.862**	0.904**	0.484	0.944**	1.000								
100 Seed weight	0.806**	0.923**	0.970**	0.771*	0.764*	0.878**	1.000							
Dry matter weight (g.plant^{-1})	0.867**	0.886**	0.908**	0.570	0.916**	0.933**	0.891**	1.000						
Pod weight (g.plant^{-1})	0.855**	0.812**	0.831**	0.364	0.964**	0.979**	0.806**	0.937**	1.000					
Average pod weight (g)	-0.648	-0.422	-0.217	-0.447	-0.499	-0.270	-0.258	-0.329	-0.254	1.000				
HI	-0.295	-0.066	-0.149	0.225	-0.327	-0.324	-0.066	-0.125	-0.357	-0.035	1.000			
Protein %	0.883**	0.729**	0.666**	0.339	0.923**	0.832**	0.634	0.810**	0.860**	-0.556	-0.425	1.000		
Biological yield (t.ha^{-1})	0.851**	0.768**	0.763**	0.323	0.940**	0.908**	0.713*	0.895**	0.953**	-0.312	-0.502	0.926**	1.000	
Seed yield (t.ha^{-1})	0.866**	0.834**	0.807**	0.419	0.957**	0.923**	0.779*	0.960**	0.963**	-0.361	-0.279	0.914**	0.970**	1.000

***. Correlation is significant at the 0.05 level (2-tailed), $t_{0.05}$ (7) =2.365**

****. Correlation is significant at the 0.01 level (2-tailed), $t_{0.01}$ (7) =3.499.**

Table 2: Path coefficient analysis among the studied characters.

Characters	Pant height (cm)	No. of Branches .plant^{-1}	Depth of roots(cm)	No. of bacteria nod.plant $^{-1}$	No .of pod .plant^{-1}	No .of seeds. plant^{-1}	100 Seed weight (g)	Dry matter weight (g.plant^{-1})	Pod weight (g. plant^{-1})	Average pod weight (g)	HI	Protein %	Biological yield (t.ha^{-1})
Pant height (cm)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
No. of Branches	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Depth of roots(cm)	-0.457	-0.503	-0.547	-0.411	-0.428	-0.495	-0.531	-0.497	-0.455	0.119	0.082	-0.365	-0.418
No. of bacterial nods.plant^{-1}	0.190	0.245	0.224	0.298	0.124	0.145	0.230	0.170	0.109	-0.133	0.067	0.101	0.096
No .of pods .plant^{-1}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
No .of seeds.plant^{-1}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100 Seed weight (g)	-0.110	-0.126	-0.132	-0.105	-0.104	-0.120	-0.136	-0.121	-0.110	0.035	0.009	-0.086	-0.097
Dry matter weight (g.plant^{-1})	0.735	0.751	0.770	0.484	0.777	0.791	0.756	0.848	0.795	-0.279	-0.106	0.687	0.759
Pod weight (g.plant^{-1})	0.282	0.267	0.274	0.120	0.317	0.322	0.265	0.309	0.329	-0.084	-0.118	0.283	0.314
Average pod weight (g)	-0.124	-0.081	-0.042	-0.086	-0.095	-0.052	-0.049	-0.063	-0.049	0.191	-0.007	-0.106	-0.060
HI	0.013	0.003	0.007	-0.010	0.014	0.014	0.003	0.006	0.016	0.002	-0.044	0.019	0.022
Protein %	0.336	0.278	0.254	0.129	0.352	0.317	0.242	0.309	0.328	-0.212	-0.162	0.381	0.353
BY	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Seed yield Correlation	**0.866**	**0.834**	**0.807**	**0.419**	**0.957**	**0.923**	**0.779**	**0.960**	**0.963**	**-0.361**	**-0.279**	**0.914**	**0.970**

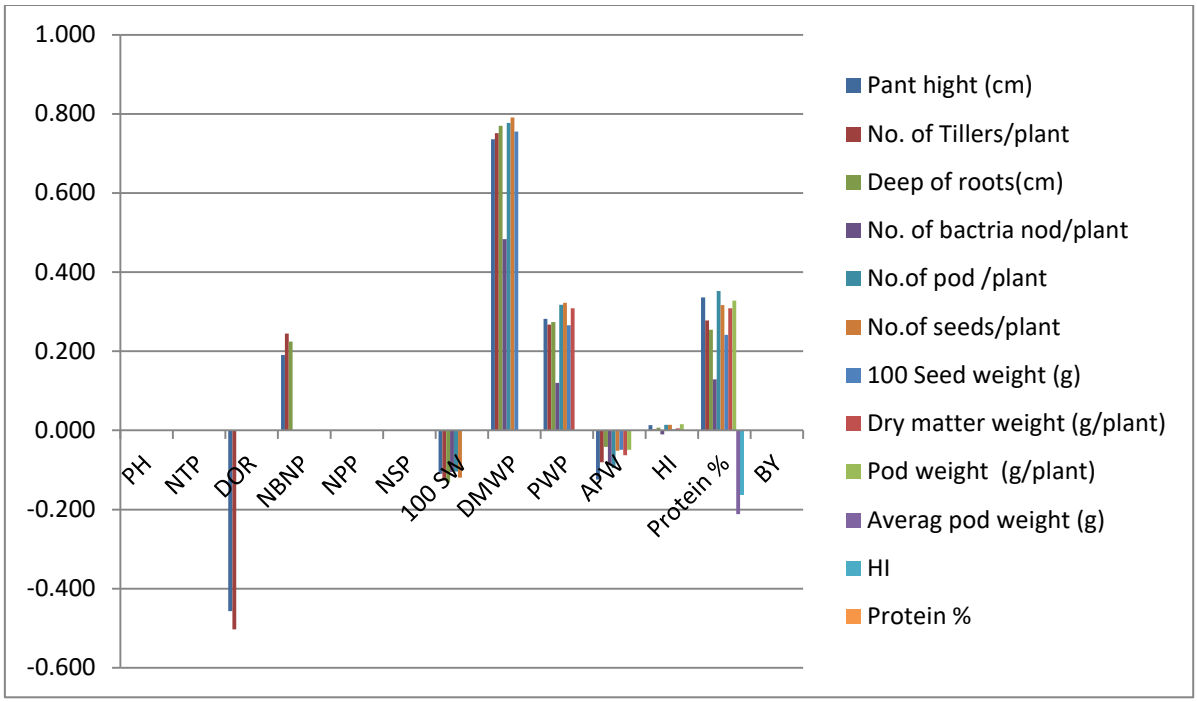
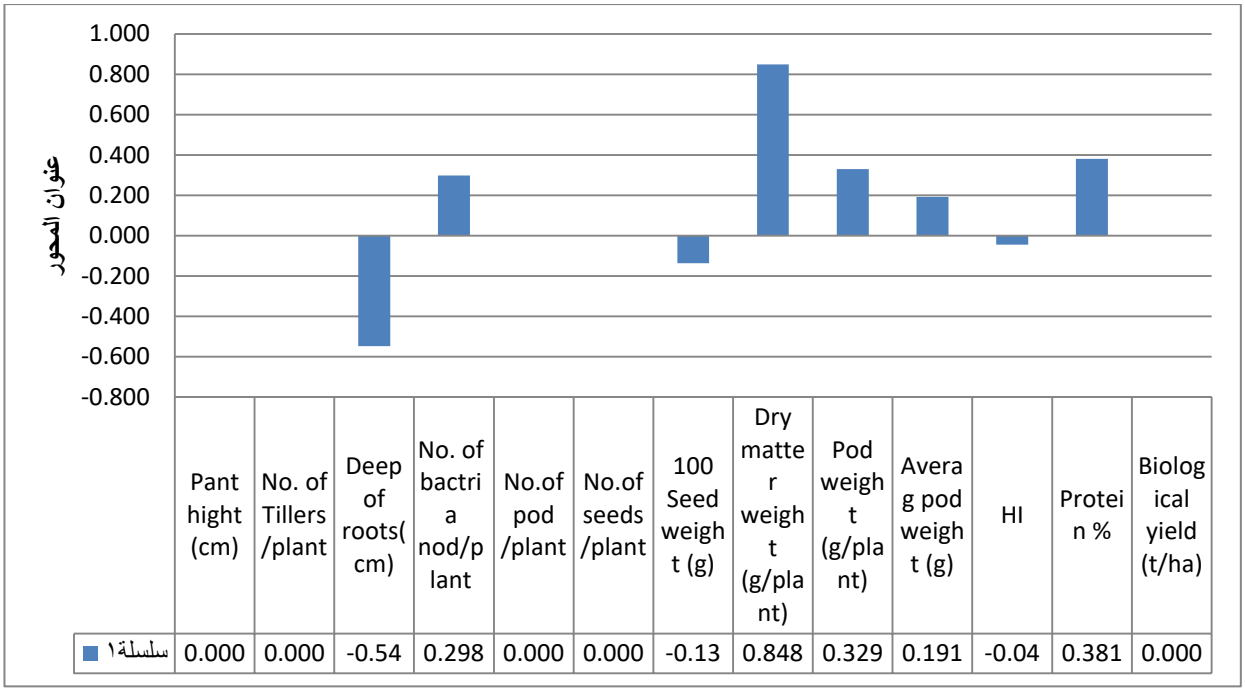


Figure1: Simple correlation coefficient among studied characters



	Pant hight (cm)	No. of Tillers /plant	Deep of roots(cm)	No. of bactria nod/plant	No.of pod /plant	No.of seeds /plant	100 Seed weight (g)	Dry matter weight (g/plant)	Pod weight (g/plant)	Averag pod weight (g)	HI	Protein %	Biological yield (t/ha)
سلسلة١	0.000	0.000	-0.54	0.298	0.000	0.000	-0.13	0.848	0.329	0.191	-0.04	0.381	0.000

Figure 2: Path coefficient analysis illustrate direct and indirect effect of yield component in seed yield .

Appendix 1 : Calculated (t) .

Characters	Pant height (cm)	No. of Tillers /plant	Deep of roots(cm)	No. of bacteria nod/plant	No .of pod /plant	No. of seeds/plant	100 Seed weight (g)	Dry matter weight (g/plant)	Pod weight (g/plant)	Average pod weight (g)	HI	Protein %	Biological yield (t/ha)	Seed yield (t/ha)
PH														
NTP	4.893													
DOR	4.015	6.177												
NBNP	2.193	3.787	3.014											
NPP	7.055	3.811	3.314	1.204										
NSP	5.151	4.503	5.603	1.465	7.588									
100 SW	3.607	6.359	10.602	3.206	3.133	4.845								
DWP	4.611	5.044	5.727	1.838	6.061	6.858	5.192							
PWP	4.368	3.676	3.954	1.035	9.556	12.719	3.602	7.117						
APW	-2.251	-1.231	-0.589	-1.323	-1.522	-0.740	-0.707	-0.922	-0.696					
HI	-0.818	-0.175	-0.400	0.612	-0.915	-0.907	-0.175	-0.334	-1.013	-0.093				
Protein %	4.966	2.818	2.365	0.952	6.356	3.963	2.172	3.660	4.458	-1.771	-1.244			
BY	4.285	3.169	3.120	0.903	7.265	5.719	2.687	5.308	8.341	-0.869	-1.535	6.505		
SY	4.587	4.000	3.619	1.222	8.750	6.362	3.289	9.090	9.457	-1.025	-0.768	5.953	10.597	
	t (0.05)	**2.365**												
	t (0.01)	**3.499**												

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