

ASSESSMENT OF CORRELATION AND PATH ANALYSIS IN COLLECTION'S GENOTYPES OF CHICKPEA

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Summary. Twenty three collection genotypes of chickpea were evaluated for 10 components of yield (3 phenological and 7 plant data) on grain yield per plant. Investigation was carried out on field of Institution in 2022-2023. Correlation analysis revealed significant relationship by characters: days taken to flowering and maturity, primary and secondary branches per plant and 100 grain weight with grain yield. Highly negative correlation with yield had component grain per pod. Path analysis revealed direct effect on yield following components: highest effect had character 100 grain weight (0.833) followed by pods per plant (0.562), days to flowering (0.362), primary branches per plant (0.192) and secondary branches per plant (0.074). Highest negative direct effect on yield had character grain per pod (-0.881) followed by grain per plant (-0.593), days taken to maturity (-0.106). Grain per plant was formed mainly on basis 6 components by indirect effects.

Keywords: chickpea, yield, components of yield, correlation, path analysis.

Introduction

Chickpea grain yield is influenced by a wide range of genetic, physiological, and ecological factors. It is essential to comprehend the relationships between grain yield and its yield components in order for effective breeding procedures and agronomic practices to increase productivity and satisfy the growing demand for this crop [3]. Correlation coefficients in general show associations among independent characters. Path analysis is used to determine the amount of direct and indirect effect of the causal components on the effect component. Much research has been done in this area. To my knowledge, in our republic up to the present time this kind of work was not carried out on collection genotypes of chickpea. Let us present the results of some works in this area.

Pakistan's researchers Babar Manzoor Atta et al. reported: thirty-two chickpea genotypes were evaluated for components of yield. Grain yield per plant showed highly significant positive correlation with days to maturity, primary branches, secondary branches and 100 seed weight and significant positive correlation with pods per plant. Path coefficient analysis revealed that pods per plant and 100 seed weight had the highest direct effect on grain yield per plant followed by secondary branches. Results revealed that a greater number of secondary branches, pods per plant and bold seed size are major yield contributing factors in selecting high yielding chickpea cultivars [1]. Mushtaq M.A. et al. reported: a study was carried out to investigate variability parameters and path coefficient analysis in twenty elite chickpea genotypes including three standards. Investigations regarding path coefficient showed that days taken to flowering had maximum direct influence on seed yield per plant followed by total weight of plant, 100 grains weight, primary branches, and plant height. These are important parameters for selecting maximum yielding genotypes in chickpea [4]. Also, Pakistan's researchers reported: correlation studies showed that biomass per plant, number of pods per plant, number of secondary branches per plant, number of seeds per pod and 100-seed weight were positive and significant at genotypic level but positive and highly significant at phenotypic level. Number of days taken to flowering, number of days taken to maturity, primary branches per plant, and secondary branches per plant were positively correlated with the grain yield per plant at genotypic and phenotypic levels [5].

In India, in a recent study, the authors reported: correlation studies showed that the traits viz. harvest index, 100 seed weight, number of pods per plant and number of secondary branches per plant recorded a highly positive significant correlation with seed yield at both genotypic and phenotypic level and days to 50% flowering at genotypic level with seed yield. From path coefficient analysis it is indicated that the characters viz., 100 seed weight, harvest index, number of pods per plant, days to 50% flowering and number of secondary branches per plant showed a positive direct effect on seed yield [6]. Also conducted research in India, Umesh reported: the results revealed significant positive correlations between grain yield and several traits, such as days to maturity, plant height, number of pods per plant, and 100-seed weight. Furthermore, path analysis elucidated the direct and indirect effects of these traits on grain yield. Plant height, number of pods per plant, and 100-seed weight emerged as crucial factors with significant direct impacts on grain yield [7].

Material and methods

The experimental material consisted of 23 chickpea collection genotypes. The experiment was conducted in the experimental field of Institution in 2022-2023. Planting genotypes was laid out in a randomized complete block design with three replications. Each plot consisted of 2 rows of 2.5 m length with 50 cm and 10 cm spacing between and within rows, respectively. Observations were recorded on three phenological traits (days to flower initiation, reproductive phase (from pod setting initiation to maturity) and days to maturity). Plant data: in each plot 7 plants were selected randomly to record following observations: primary branches per plant, secondary branches per plant, height plant, pods and grain per plant, grain per pod, 100 grain weight and grain yield per plant. The mean values are subjected to correlation and path analysis. To perform path analysis was used the methodology proposed by Dewey & Lu (1959), for grain yield as resultant variable and its components as independent variables [2]. Correlation and other data were calculated in program *Excel*. Condition of environment: both years was moderate droughty.

Result and discussion

Name and origin of investigated genotypes is presented in Table 1. These are genotypes were obtained from 8 foreign countries. The quantitative genotypes of countries: Moldova- 7, Russia - 6, India – 4 and one of each country Tunisia, Iran, Kyrgyzstan, Turkey, Ukraine and Azerbaijan. Based on the studied characters genotypes are most different from each other by character 100 grain weigh (ranged 13.3 – 41.4). In despite of large range 100 grain weight these genotypes are early and mid-season by maturity.

Table 1

Name and origin of investigated genotypes

Nr.	Genotype	Origin	Nr.	Genotype	Origin	Nr.	Genotype	Origin
1	MDI 02429	India	9	MDI 02505	Turkey	17	MDI 02434	Azerbaijan
2	MDI 02459	India	10	MDI 02422	Russia	18	MDI 02469	India
3	OR1 12	Moldova	11	MDI 02491	Russia	19	OR1-2b	Moldova
4	MDI 02479	Tunisia	12	MDI 02463	Ukraine	20	MDI 02433	India
5	MDI 02427	Russia	13	CS2-16	Moldova	21	MDI 02488	Moldova
6	MDI 02403	Iran	14	MDI 02495	Russia	22	MDI 02441	Moldova
7	CS1-18b	Moldova	15	MDI 02431	Moldova	23	MDI 02496	Russia
8	MDI 02437	Kyrgyzstan	16	MDI 02478	Russia	-	-	-

Maximum, minimum values of characters (range), mean values and variability by coefficient of variation are given in Table 2. Least variable (CV) were phenological characters: reproductive phase (1.96%), days taken to maturity (2.51%) days taken to flowering (4.4%) followed by secondary/primary branches (4.86%/6.03%), pods per plant and grain per pod 11.9% and 12.93%,

respectively. The most variable character is 100 grain weight (30.94%) followed by grain yield per plant (20.67%) and grain per plant (18.0%).

Correlation coefficient analysis: days taken to flowering exhibited highly significant values with days taken to maturity, primary branches per plant, highly negative relationship with grain per pod. Significant correlation was noted with secondary branches per plant, 100 grain weight and yield per plant. Moderate positive value DF displayed with plant height, moderate negative with grain per plant and negative with reproductive phase. Reproductive phase exhibited non significant positive correlation with grain per plant, pods per plant, grain per pod, with others characters negative non significant values. Days taken to maturity displayed significant positive correlation with primary branches per plant and yield per plant, highly negative relationship noted with grain per pod. Moderate correlation DM has had with 100 grain weight and secondary branches per plant, plant height, moderate and highly negative values noted with grains per plant and grain per pod, respectively. Primary branches per plant displayed significant positive correlation with secondary branches per plant, 100 grain weight and yield per plant, significant negative with grain per pod. Moderate positive value noted with height plant and moderate negative with grain per plant.

Table 2

Investigated characters and their generally characteristics

Characters	DF	RPh	DM	PBr/Pl	SBr/Pl	HPl	Pods/Pl	Grain/Pl	Grain/Pod	100 GW	GY/Pl
Min	47.5	32.5	86.5	1.77	5.79	19	19.2	17.4	0.91	13.3	3.6
Max	54	34.5	93	2.15	6.88	34.6	28.3	37.6	1.34	41.4	8.3
Mean	51.8	33.6	90.7	1.99	6.31	26.52	22.71	24.55	1.08	25.23	6.02
CV, %	4.4	1.96	2.51	6.03	4.86	15.18	11.9	18.0	12.93	30.94	20.67

Note: DF – days taken to flowering, RPh – reproductive phase, DM - days taken to maturity, PBr/Pl – primary branches per plant, SBr/Pl – secondary branches per plant, HPl – height plant, Pods/Pl, Grain/Pl – pods and grain per plant, Grain/Pod – grain per pod, 100GW – 100 grain weight, GY/Pl – grain yield per plant.

Secondary branches per plant exhibited significant positive correlation with 100 grain weight and yield per plant, significant negative with grain per pod, moderate positive with plant height and moderate negative with grain per plant. Height plant displayed moderate positive correlation with 100 grain weight and yield per plant and moderate negative with grain per plant and grain per pod. Pods per plant exhibited significant positive correlation with grain per plant and moderate positive with yield per plant. Grain per plant displayed significant positive value with grain per pod, and significant negative one with 100 grain weight, moderate negative correlation noted with yield per plant. Grain per pod exhibited highly significant negative relationship with 100 grain weight and yield per plant. Character 100 grain weight had significant positive relationship with yield per plant (Table 3).

Table 3

Data of phenotypic correlation among investigated characters in chickpea

	RPh	DM	PBr/Pl	SBr/Pl	HPl	Pods/Pl	Gr/Pl	Gr/Pod	100GW	GY/Pl
DF	-0.313	0.894	0.821	0.754	0.631	0.075	-0.608	-0.856	0.789	0.823
RPh	-	-0.181	-0.149	-0.066	-0.148	0.317	0.432	0.279	-0.195	-0.014
DM		-	0.805	0.753	0.628	0.173	-0.532	-0.869	0.772	0.832
PBr/Pl			-	0.829	0.398	0.099	-0.617	-0.845	0.875	0.864
SBr/Pl				-	0.43	-0.019	-0.664	-0.859	0.861	0.834
HPl					-	-0.056	-0.378	-0.431	0.315	0.329
Pods/Pl						-	0.684	-0.028	-0.129	0.371
Gr/Pl							-	0.703	-0.764	-0.382

Gr/Pod								-	-0.896	-0.869
100GW									-	0.824

Path analysis: the data pertaining to direct and indirect effects of yield attributes on, grain yield per plant is given in Table 4. The highest positive direct effect on grain yield exhibited character 100 grain weight (0.833) followed by pods per plant (0.562), days to flowering (0.362), primary branches per plant (0.192), secondary branches per plant (0.074). Highest negative direct effect on yield had character grain per pod (-0.881) followed by grain per plant (-0.593), days taken to maturity (-0.106). Very low negative direct effect on yield had plant height (-0.023). Negligible direct effect had reproductive phase (0.014). Days to flowering exhibited significant positive indirect effect through days to maturity (0.349), primary/secondary branches per plant (0.297/0.272), 100 grain weight (0.290), and plant height (0.228). Highest negative indirect effect DF displayed through grain per pod (-0.325), followed by grain per plant (-0.220) and reproductive phase (-0.113). Reproductive phase with all other characters had negligible indirect effects. Days to maturity exhibited negative indirect effect with all characters (except RPh, Gr/Pl and Gr/Pod), on grain per pod had moderate positive effect (0.094). Primary branches per plant produced moderate positive effect through 100 grain weight (0.168), secondary branches per plant (0.162), days to flowering/maturity (0.157/0.158), non-significant through plant height (0.076). Moderate negative indirect effects primary branches exhibited through grain per pod (-0.179), grain per plant (-0.118) and low negative through reproductive phase (-0.028).

Table 4

Data of path analysis: direct (underline) and indirect effects of yield components

	DF	RPh	DM	PrBr/Pl	SBr/Pl	HPl	Pods/Pl	Gr/Pl	Gr/Pod	100GrW
DF	<u>0.362</u>	-0.004	-0.102	0.157	0.055	-0.014	0.072	0.421	-0.829	0.754
RPh	-0.113	<u>0.014</u>	0.019	-0.028	-0.004	0.003	0.305	-0.299	0.274	-0.184
DM	0.349	-0.003	<u>-0.106</u>	0.158	0.056	-0.014	0.166	0.369	-0.833	0.728
PrBr/Pl	0.297	-0.002	-0.087	<u>0.192</u>	0.062	-0.009	0.095	0.427	-0.857	0.795
SBr/Pl	0.272	-0.001	-0.079	0.162	<u>0.074</u>	-0.009	-0.012	0.456	-0.811	0.808
HPl	0.228	-0.002	-0.066	0.076	0.031	<u>-0.023</u>	-0.053	0.262	-0.421	0.297
Pods/Pl	0.027	0.004	-0.018	0.019	-0.001	0.001	<u>0.562</u>	-0.474	-0.028	-0.121
Gr/Pl	-0.220	0.006	0.056	-0.118	-0.048	0.008	0.658	<u>-0.593</u>	0.690	-0.720
Gr/Pod	-0.325	0.004	0.094	-0.179	-0.065	0.01	-0.027	-0.487	<u>-0.881</u>	-0.852
100GrW	0.290	-0.003	-0.082	0.168	0.067	-0.007	-0.124	0.529	-0.838	<u>0.833</u>

Secondary branches had non-significant positive effects though 100 grain weight (0.067), primary branches (0.062), and days to flowering/maturity (0.055/0.056). Negative indirect effect secondary branches exhibited through grain per pod (-0.065) and grain per plant (-0.048). Plant height with all other character had negligible positive or negative effects. Pods per plant exhibited significant positive effect through grain per plant (0.658), followed by reproductive phase (0.305) and days to maturity (0.166), moderate positive effects were observed with primary branches (0.095) and days to flowering (0.072). Moderate negative effect pod per plant exhibited through 100 grain weight (-0.124). Grain per plant exhibited significant positive effect through 100 grain weight (0.529) followed by secondary/primary branches (0.456/0.427), days to flowering (0.421), days to maturity (0.369), plant height (0.262). Significant negative indirect effect grain per plant exhibited through grain per pod (-0.487). Grain per pod showed highly negative effect through 100 grain weight (-0.838), days to flowering/maturity (-0.829/-0.833) and primary/secondary branches (-0.857/-0.811) and significant negative indirect effect on plant height (-0.421). Significant positive effect grain per pod noted through grain per plant (0.690) and moderate positive one on reproductive phase (0.274). Character 100 grain weight exhibited significant positive effect through primary/secondary branches (0.795/0.808), days to flowering/maturity (0.754/0.728) and moderate positive through

plant height (0.297). Highly negative effect 100GW exhibited through grain per pod (-0.852), followed by grain per plant (-0.720) and moderate negative on reproductive phase (-0.184) some cases, the authors draw an analogy between the correlation and the direct effect on the yield. In my opinion, this is not correct enough. Based on the data presented by path analysis, there are quite a lot of data with a significant and even highly significant indirect effect (especially characters 100GW, Gr/Pod and Gr/Pl), so the direct effect should be considered in conjunction with indirect effects. High degree of similarity between correlation (characters - yield) and path analysis noted for characters with very high direct effects: grain per pod (-0.869(CC) (-0.881(PA))) and 100 grain weight (0.824(CC) – 0.883(PA)). Despite the low negative correlation of reproductive phase (-0.014) the direct effect of this character was positive (0.014). Characters with strong significant direct effects pods per plant and 100 grain weight are different from all the others that least susceptible to environmental condition and have higher level of inheritance. Despite the fact that significant negative direct effect had character's grain per plant (-0.593), in this character by indirect effects influence 6 positive (100GW, Pr&SBr, D/F&M and HPl) versus 3 negative (RPh, Pods/Pl and Gr/Pod) (positive and negative approximately to the same extent). Thus, the manifestation of character grain per plant mainly is based on indirect effects. If we consider the character pods per plant (direct effect 0.562), only 2 characters have significant positive indirect effect (grain per plant (0.658) and reproductive phase (0.305)). Let's look at another character height plant, low negative direct influence on yield have it (-0.023), but manifested indirect in the main through DF (0.228), Gr/Pl (0.262) and 100GW (0.297). With regard to the cited and other works in this area, in my opinion, the results are determined by the properties of the studied genotypes and environmental conditions. Therefore, the results obtained are specific to each study.

Conclusions

As a result of the research conducted, the following conclusions were made, (1) significant values of correlation were determined by characters days taken to flowering and maturity, primary and secondary branches per plant and 100 grain weight with grain yield, (2) by direct effect characters on yield are following parceling: highest significant effect had character 100 grain weight(0.833) followed by pods per plant (0.562), days to flowering (0.362), primary branches (0.192) and secondary branches per plant (0.074); highest negative direct effect on yield had character grain per pod (-0.881) followed by grain per plant (-0.593) and days taken to maturity (-0.106), (3) noted significant indirect effects on such characters as: grain per plant& pod and 100grain weight,(4) character grain per plant significant manifests itself by indirect effects of characters: 100GW, Pr&SBr, D/F&M and HPl, (5) concordance(similarity) values of correlation & path analysis noted by 2 characters with strong significant direct effect: grain per pod (-0.869(CC) (-0.881(PA))) and 100 grain weight (0.824(CC) – 0.883(PA)). So, it should be concluded that characters 100 grain weight, pods per plant, days to flowering and primary branches may be considered as the selection criteria for the improvement of grain yield.

Acknowledgments. This study was supported by the research project of the Subprogram 011102 „Increasing genetic diversity and agricultural crop breeding in the context of climate change”, funded by the Ministry of Education and Research.

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