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I Jemimah Jyothi
M.Sc., Department of Genetics
and Plant Breeding NAI, Sam
Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj,
Uttar Pradesh, India

Dr. G Roopa Lavanya
Associate Professor, Department
of Genetics and Plant Breeding,
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj,
Uttar Pradesh, India

Interrelationship and path analysis among quantitative characters in chickpea (*Cicer arietinum* L.) suitable to eastern plain zone of Uttar Pradesh

I Jemimah Jyothi and Dr. G Roopa Lavanya

Abstract

The present investigation consists of 21 genotypes of chickpea, which were grown under the Field Experiment Centre of the Department of GPB, SHUATS, Prayagraj following RBD with three replications. The data was collected on 12 characters to evaluate the analysis of variance, heritability, genetic advance, correlation and path analysis. High estimates of PCV, GCV, heritability coupled with high genetic advance as percent of mean were recorded for seed yield per plant, biological yield and harvest index. Number of seeds per plant and seed index showed positive and highly significant association with grain yield per hill and recorded high positive direct effect on grain yield per hill at both the genotypic and phenotypic levels. These characters such as number of seeds per plant and seed index should be given prior consideration during selection for seed yield improvement in chickpea.

Keywords: Chickpea, genetic variability, heritability, genetic advance, correlation and path analysis

Introduction

The chickpea or Bengal gram (*Cicer arietinum* L.) is a yearly legume of the Fabaceae family, the Faboideae subfamily. The *Cicer* genus consists of one species grown, the Chickpea (*Cicer arietinum* L.) and forty two wild life species. It is originated in South-Eastern Turkey adjoining Syria. The Mediterranean, Central Asia, the Near East and India were identified as four centres of diversity. Ethiopia is also a secondary centre. It is cultivated and consumed in significant quantities from South-East Asia to the Mediterranean countries in the Middle East. In terms of area it ranks second and in terms of production it ranks third among the pulses worldwide. In India it occupies 10.59 million hectare area and annual production of chickpea is 11.18 lakhs tones with productivity 1056 Kg per hectare. In U.P, chickpea is grown in 0.68 millionhectare region with overall production of 0.68 lakhs tones with productivity of 930 Kilogram per hectare (Source: Directorate of Economics and Statistics, Ministry of Agriculture and Welfare (DAC&FW), Govt. Of India, 2019).Chickpea seeds are high in protein content and it is a cool-climate food legume produced in many parts of the world, mainly by small farmers. It is an important protein source in vegetarian diets. The plant also plays a key part in agriculture systems because of its efficient symbiotic nitrogen fixation properties. Seed are the economic component in the plant and contain approximately 17-24% protein, 64% carbohydrates, 47% starches, 3.8-10.2% fat, 1.7-10% fibre and 6% soluble sugar. It is also rich in essential amino acid lysine but deficient in sulphur containing aminoacids methionine and cysteine. The present study was carried out to estimate the nature and magnitude of genetic variability parameters for yield and its attributing characters in chickpea and also to study the correlation among yield attributing traits with direct and indirect effects of various attributes on seed yield. Keeping the above facts in view, the present investigation "Inter relationship and Path Analysis among Quantitative Characters in Chickpea (*Cicer arietinum* L.)" has been studied.

Materials and Methods

An investigation consists of 20 chickpea genotypes accessions collected from the branch of Genetics and Plant Breeding. The accessions are evaluated by the help of randomized block design (RBD) with three replications. Investigation was carried out at Field Experiment Centre of the Branch of Genetics and Plant Breeding (GPB), Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh), during *Rabi*-2020-2021.

Corresponding Author:
I Jemimah Jyothi
M.Sc., Department of Genetics
and Plant Breeding NAI, Sam
Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj,
Uttar Pradesh, India

Current investigation is an effort has been made toward assess the amount of genetic variability, heritability, genetic advance, yield contributing components along with direct and indirect effects in the chickpea accessions. Data were recorded on 12 characters viz; Days to 50% flowering, days to 50% pod setting, plant height (cm), number of primary branches per plant, Number of secondary branches per plant, Number of days to maturity, Number of pods per plant, Number of seeds per plant, biological yield per plant (g), Seed index, Harvest index(%), and seed yield per plant (g).

Results and Discussion

Phenotypic coefficients of variation were higher in magnitude than genotypic coefficient of variation in respect to all the characters. The comparatively phenotypic coefficient of variation (PCV) and the genotypic coefficient of variation (GCV) not very high for all the characters. High GCV was recorded in Seed yield per plant (27.16) followed by number of pods per plant (25.44), Biological yield per plant (24.42) and Harvest index (24.17). Moderate estimates of GCV was recorded for Seed index (24.17), Number of seeds per plant (13.86) and Primary branches (12.14) while low GCV is recorded for Plant height (9.80), Secondary branches (8.64), 50% pod initiation (7.68), Days to 50% flowering (4.00) and Days to maturity (3.36).

High PCV was recorded for Seed yield per plant (29.16) followed by Harvest index (26.89), Biological yield per plant (26.82) and Number of pods per plant (26.08) while moderate PCV was recorded for Seed index (19.12), Primary branches (18.74) and Number of seeds per plant (16.36) while low PCV is recorded for Plant height (9.93), Secondary branches (9.26), 50% pod initiation (8.12), Days to 50% flowering (6.57) and Days to maturity (5.48).

High estimates of heritability in broad sense were documented for seed yield per plant (88.67), harvest index (84.98), seed index (83.29) and biological yield per plant (81.47), days to 50% pod formation (79.7), plant height (74.56), number of seeds per plant (71.8). Moderate heritability was recorded for days to maturity (39.4) and days to 50% flowering (37.2), number of pods per plant (35.19). Whereas, low heritability was recorded for number of secondary branches per plant (23.55) and number of secondary branches per plant (22.45).

Genetic advance varied from 0.06 (seed index) to 11.35 (number of seeds per plant). Moderate genetic advance was recorded for number of seeds per plant (11.35). Low genetic advance was recorded for plant height (8.38), harvest index (7.13), number of pods per plant (5.56), days to 50% pod formation (3.79), days to 50% flowering (3.20), days to maturity (1.42), seed yield per plant (1.07), number of secondary branches per plant (0.55), biological yield per plant (0.15) and number of primary branches per plant (0.10) and seed index (0.06). Low genetic advance estimates were observed for plant height, harvest index, number of pods per plant, days to 50% pod formation, days to 50% flowering, days to maturity, seed yield per plant, number of secondary branches per plant, biological yield per plant, number of primary branches per plant and seed index.

From top to bottom genetic advance as percent of mean was recorded maximum for number of seeds per plant (11.35) and low genetic advance was recorded for plant height (8.38), harvest index (7.13), number of pods per plant (5.56), days to 50% pod formation (3.79), days to 50% flowering (3.20), days to maturity (1.42), seed yield per plant (1.07), number of secondary branches per plant (0.55), biological yield per plant (0.15) and number of primary branches per plant (0.10) and seed index (0.06).

In the present investigation, phenotypic correlation coefficient analysis showed that seed yield per plant showed positive significant association with number of pods per plant (0.665**), Number of Seeds per plant (0.649**), Seed index (0.623**), and Harvest index (0.614**).

The correlation among the yield and yield attributing characters of Genotypic correlation coefficient analysis showed that seed yield per plant was positively and significantly associated with number of seeds per plant (0.705**), harvest index (0.684**), number of pods per plant (0.681**) and seed index (0.634**).

In the present investigation, at phenotypic level the maximum positive direct effects were depicted by Primary branches, Biological yield per plant, Days to maturity, Number of seeds per plant and seed index. While negative direct effect on Seed yield per plant was presented by Plant height, Secondary branches, Number of pods per plant, Days to 50% flowering, 50% pod initiation and Harvest index.

Table 1: Estimates of components of variance and genetic parameters for different characters in chickpea.

S. No	Characters	Coefficient of variation		Heritability	Genetic advance	Genetic advance as % of mean (5%)
		GCV	PCV			
1.	Plant Height	9.80	9.93	74.56	8.38	19.94
2.	Number of Primary Branches per Plant	12.14	18.74	23.55	0.10	5.53
3.	Number of Secondary Branches per Plant	8.64	9.26	22.45	0.55	8.42
4.	Number of Pods per Plant	25.44	26.08	35.19	5.56	18.84
5.	Biological Yield per Plant	24.42	26.82	81.47	0.15	34.89
6.	Days to 50% Flowering	4.00	6.57	37.2	3.20	5.03
7.	Days to Maturity	3.36	5.48	39.4	1.42	1.20
8.	Day to 50% Pod Initiation	7.68	8.12	79.7	3.79	3.48
9.	Number of Seeds per Plant	13.86	16.36	71.8	11.35	24.21
10.	Seed Index	17.25	19.12	83.29	0.06	29.56
11.	Harvest Index	24.17	26.89	84.98	7.13	35.44
12.	Seed Yield per Plant	27.16	29.16	88.67	1.07	36.22
13.	Plant Height	9.80	9.93	74.56	8.38	19.94

Table 2: Estimation of Phenotypic correlation coefficient for yield and its related traits in 21 chickpea genotypes.

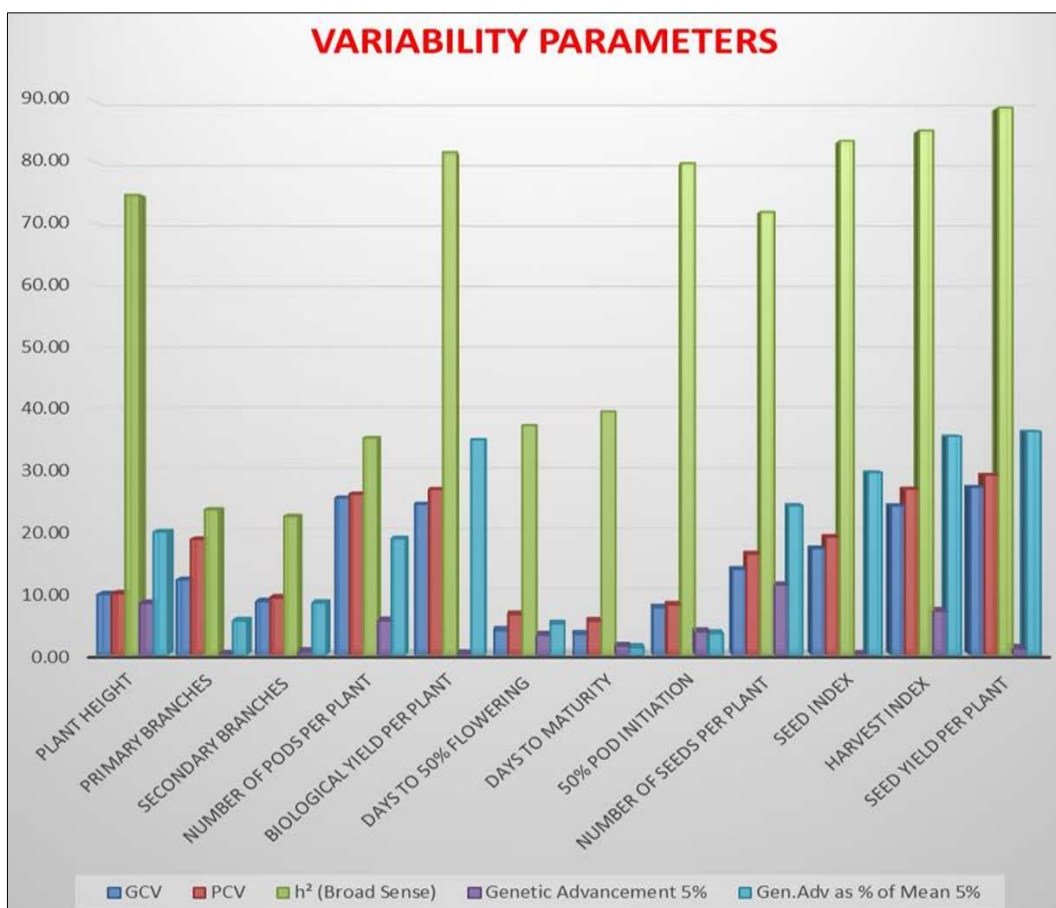
Characters	Plant height	Number of primary branches per plant	Number of secondary branches per plant	Number of Pods per Plant	Biological yield per Plant	Days to 50% Flowering	Days to Maturity	Days to 50% Pod Initiation	Number of Seeds per Plant	Seed index	Harvest index	Seed yield per Plant
Plant Height	1	-0.3592	-0.1347	-0.2304	-0.3308	0.1325	-0.3854	-0.0866	0.2003	-0.694**	-0.1089	-0.608**
Number of Primary Branches per Plant		1	-0.1505	0.0116	0.023	-0.1902	0.2589	-0.0464	-0.458*	0.1667	-0.2963	0.3478
Number of Secondary Branches per Plant			1	0.1054	0.1323	-0.0163	0.0714	0.1141	-0.2777	-0.0425	-0.318	0.3239
Number of Pods per Plant				1	0.484*	-0.145	0.16	0.15	0.470*	0.525*	0.692**	0.665**
Biological Yield per Plant					1	-0.133	-0.001	0.005	0.471*	0.524*	0.42	0.448*
Days to 50% Flowering						1	-0.0615	0.188	0.0932	-0.1365	0.2108	0.324
Days to Maturity							1	0.4259	-0.3464	0.3031	-0.1557	0.407
Days to 50% Pod Initiation								1	-0.1017	0.1127	0.0035	0.23
Number of Seeds per Plant									1	0.549**	0.495*	0.649**
Seed Index										1	0.432	0.623**
Harvest Index											1	0.614**
Seed Yield per Plant												1

Table 3: Genotypical correlation coefficient for yield and its related traits in 21 chickpea genotypes.

Characters	Plant Height	Number of primary branches per plant	Number of secondary branches per plant	Number of Pods per Plant	Biological yield per Plant	Days to 50% Flowering	Days to Maturity	Days to 50% Pod Initiation	Number of seeds per plant	Seed Index	Harvest Index	Seed yield per plant
Plant Height	1	-0.246	-0.022	-0.117	-0.218	0.246	-0.272	0.026	0.313	-0.581**	0.004	-0.495*
Number of Primary Branches per Plant		1	-0.039	0.124	0.135	-0.078	0.371	0.066	-0.346	0.279	-0.184	0.460*
Number of Secondary Branches per Plant			1	0.22	0.247	0.099	0.186	0.229	-0.163	0.073	-0.203	0.439*
Number of Pods per Plant				1	0.500*	-0.129	0.176	0.166	0.486*	0.541*	0.708**	0.681**
Biological Yield per Plant					1	-0.107	0.025	0.031	0.497*	0.550**	0.446*	0.474*
Days to 50% Flowering						1	-0.041	0.209	0.114	-0.116	0.232	0.345
Days to Maturity							1	0.440*	-0.332	0.317	-0.142	0.421
Days to 50% Pod Initiation								1	-0.086	0.129	0.02	0.246
Number of Seeds per Plant									1	0.605**	0.551**	0.705**
Seed Index										1	0.443*	0.634**
Harvest Index											1	0.684**
Seed Yield per Plant												1

Table 4: Direct and indirect effects of yield component traits on seed yield for 21 chickpea genotypes at Genotypic level.

Characters	Plant height	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Biological yield per plant	Days to 50% flowering	Days to maturity	Days to 50% pod initiation	Number of seeds per plant	Seed index	Harvest index	Seed yield per plant
Plant Height	-0.076	0.0187	0.0017	0.0089	0.0165	-0.0186	0.0207	-0.002	-0.0238	0.0442	-0.0003	-0.608**
Number of Primary Branches per Plant	-0.0556	0.2257	-0.0087	0.0279	0.0305	-0.0176	0.0837	0.0148	-0.0781	0.0629	-0.0416	0.3478
Number of Secondary Branches per Plant	0.0014	0.0025	-0.065	-0.0143	-0.0161	-0.0064	-0.0121	-0.0149	0.0106	-0.0047	0.0132	0.3239
Number of Pods per Plant	0.0002	-0.0002	-0.0003	-0.0016	-0.0008	0.0002	-0.0003	-0.0003	0.0002	-0.0006	0.0011	0.665**
Biological Yield per Plant	-0.0042	0.0026	0.0048	0.0097	0.0194	-0.0021	0.0005	0.0006	-0.0004	0.0107	-0.0086	0.448*
Days to 50% Flowering	-0.0797	0.0254	-0.032	0.0417	0.0348	-0.3248	0.0132	-0.0679	-0.0371	0.0375	-0.0753	0.324
Days to Maturity	-0.097	0.132	0.0664	0.0626	0.0088	-0.0144	0.356	0.1566	-0.1183	0.1129	-0.0505	0.407
Days to 50% Pod Initiation	-0.0038	-0.0095	-0.0331	-0.024	-0.0045	-0.0302	-0.0636	-0.1446	0.0124	-0.0186	-0.0028	0.23
Number of Seeds per Plant	0.0719	-0.0794	-0.0373	-0.0319	-0.0042	0.0262	-0.0762	-0.0196	0.2294	-0.085	0.0504	0.649**
Seed Index	-0.2522	0.1209	0.0315	0.1575	0.2385	-0.0501	0.1375	0.0558	-0.1607	0.4338	-0.1576	0.623**
Harvest Index	-0.0005	0.021	0.0231	0.0806	0.0508	-0.0264	0.0161	-0.0022	-0.025	0.0414	-0.114	0.614**



Graph 1: Histogram depicting genetic parameters for 12 quantitative characters in chickpea.

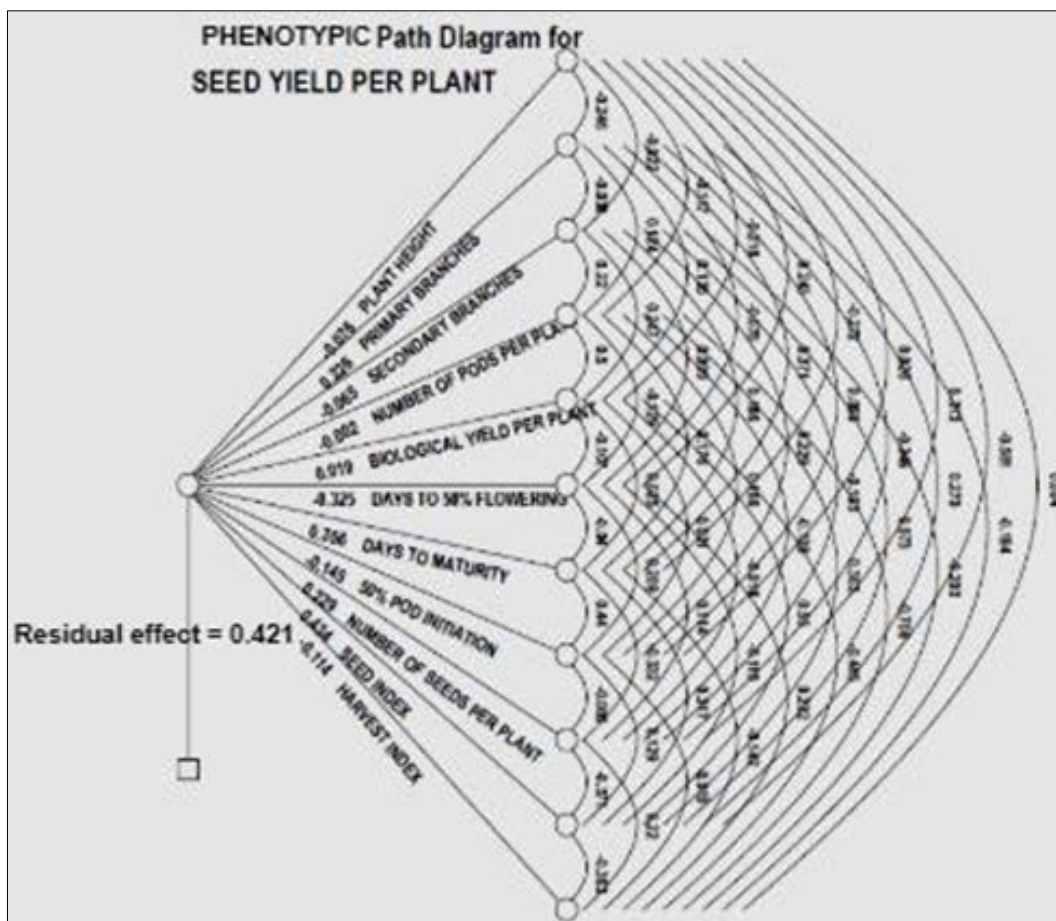


Fig 1: Phenotypic path diagram for 12 quantitative characters of chickpea genotypes

Conclusion

From the present investigation, it is concluded that NBEG 47 [17.08] and JG 24 [14.50] were found to be superior genotypes for higher seed yield per plant. High PCV, GCV, heritability and genetic advance as percentage of mean were recorded for seed yield per plant, biological yield and harvest index. Number of seeds per plant and seed index showed positive and highly significant association with seed yield per plant and recorded high positive direct effect on seed yield per plant at both the genotypic and phenotypic levels. These characters such as number of seeds per plant and seed index should be given prior consideration and were found most promising for commercial cultivation and hence it can be useful during selection for seed yield improvement in chickpea.

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