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Genetic variability, correlation, path coefficient analysis on root nodulation and seed yield characters in chickpea (*Cicer arietinum* L.)

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Abstract
Chickpeas are an important legume crop that is commonly grown in the semi-arid tropics. It is one of the most important pulse crops in India. Variability is more significant when starting a breeding programme for yield and yield contributing features. During Rabi 2019-20, the experiment was carried out in the Field Experimentation Center of the Department of Genetics & Plant Breeding, SHUATS, Prayagraj. With a total of 23 genotypes and a check, they were evaluated in a Randomized Complete Block Design (RCBD). For each plant, C- 205 produced a high amount of seeds. The number of pods per plant, root dry weight, and nodule dry weight had high GCV and PCV, whereas the number of seeds per plant, seed production per plant, and nodule fresh weight had moderate GCV and PCV. Additive gene action, with equal contributions from additive and non-additive gene activity, is thought to regulate traits with a high heritability and a high genetic progress as a percentage of the mean. According to correlation coefficient analysis, there was a positive significant phenotypic and genotypic link between seed yield per plant and harvest index (0.84** and 0.87**), biomass (0.52** and 0.50**), and number of seeds per pod (0.36** and 0.34**). According to the path analysis results, harvest index, biological yield, shoot fresh weight, number of seeds per pod, number of pods per plant, and seed index all had a positive and direct effect on seed yield.

Keywords: Chickpea, genetic variability, root nodulation, GCV, PCV, correlation analysis and path analysis

Introduction
Chickpea has been an integral part of Indian agriculture since time, because of only its intrinsic value in terms of higher protein content, carbohydrates, minerals, nitrogen fixing ability and an alternative crop for crop diversification. Chickpea occupies a prime position among the pulses in the country with maximum hectare production and its higher nutritive value.

In recent years its cultivation has spread over an area of 11 m ha. India is one of the major chickpea producing countries contributing 11.23 M tons and 44.51% shares of total production. Chickpea contributes the most to India's pulse export basket, accounting for over half of all exports. (Commodity Profile for Pulses – March, 2019).

Chickpea is the World's third most important winter season food legume. It's well-known for its nutritious seeds, which have a high protein content (25.3-28.9%) after dehulling. There are major types of chickpea e.g. desi and kabuli. Desi chickpea is consumed as whole seeds, de-hulled splits or flour while, Kabuli Chickpeas are commonly eaten as whole grains. Chickpeas have long been recognised as a high-protein, high-vitamin, and high-mineral source in human diets and occupies a very important place in human nutrition in many developing countries. Increasing population growth has resulted in a sharp decline in the per capita availability of pulses in recent years.

Chickpea contains about 6% fat which is important in vegetarian diets of resources for consumers of chickpea. It contains nutritionally important minerals, notably calcium and iron, and the availability of iron is reported to be good. The protein quality is thought to be superior to that of other pulses (Hirdyani, 2014).

The objectives of present study are

- To study root and nodulation trait genetic variability, heritability, and genetic advance
- To determine which genotypes are best for root and high nodulation.
- To study path coefficient analysis at the genotypic and phenotypic levels in order to determine the significance of individual features in the genetic improvement of chickpea seed production.

Material and Methods

The materials consist of 23 chickpea lines and one check variety which was grown in *rabi*, 2019-20 was laid in three replications of a randomized complete block design (RCBD) with 24 genotypes. The experiment was conducted in the Field Experimentation Center of the Department of Genetics and Plant Breeding, SHUATS, Prayagraj, which is located about 5 kilometers from Prayagraj city and close to the Yamuna River. The location is 25.28 degrees north latitude, 81.54 degrees east longitude, and 98 meters above sea level. Prayagraj is positioned in the center of the Gangetic plains (Agro climatic zone IV).The soil in the experimental plot was sandy loam, a topography that is reasonably uniform and a normal fertility level. The property is well-drained with a reliable irrigation system. At the time of harvest, yield characters such as Days to 50% flowering, plant height (cm), number of pods per plant, number of seeds per plant, seed index (g), biological yield (g), harvest index (percent), and seed yield per plant (g) were studied. The Root Nodulation characters such as main root length (cm), number of nodules, Root fresh weight (g), Shoot fresh weight (g), Root dry weight (g), Shoot dry weight (g), Nodule fresh weight (mg), Nodule dry weight (mg), Nodule fresh weight (mg), Nodule dry weight (mg), Nodule fresh weight (mg), Nodule dry weight (mg), Nodule dry weight (mg)they were taken into account at the 45-day growth stage, Standard methodology was applied and observations were recorded from 5 plants of each replication for each variety.

Results and Discussion

Table 1 shows the results of the analysis of variance for the sixteen quantitative qualities.

For all of the above-mentioned traits, the mean sum of squares due to all genotypes was found to be extremely significant, suggesting considerable differences across the experimental materials and indicating a definite possibility for the purpose of improving the traits by further selection. Different genetic variability Parameters *viz.*, Genotypic coefficient of variation (GCV), Phenotypic coefficient of variation (PCV), heritability (H^2), Genetic advance (GA) of 24 genotypes are represented in Table 2. Mean performances of 24 genotypes were recorded in Table 3. Tables 4 and Table 5 show the genotypic and phenotypic coefficients of variation. Table 6 and Table 7 shows the genotypic and phenotypic path coefficient analysis.

Heritability was high for number of pods per plant (86.60) followed by plant height (80.60), root dry weight (78.60) number of seeds per pod (76.50), nodule fresh weight (73.80), nodule dry weight (69.10) days to 50% flowering (66.40),Number of nodules (64.30), harvest index (63.80) and seed yield per plant (62.80). Higher values for heritability indicates that it may be due to higher contribution of genotypic components. The traits with high heritability estimates showed that variation in these traits was predominantly governed by heritable factors, whereas both genetics and environment played equivalent roles in the expression of traits with moderately high heritability indicating that the expression of the trait was mostly influenced by environment rather than genetic. Traits with high heritability estimates in broad sense can be utilized for genetic improvement as they are least influenced by the environmental effects and thus have a potential for large genetic determination.

The interpretation of the type of gene activity involved in the development of distinct polygenic features is aided by assessing genetic advance. Additive gene action and non-additive gene action are indicated by high and low genetic advance values, respectively. In the present study a perusal of genetic advance (Table 2) showed that it was moderately high for number of pods per plant (46.34), followed by root dry weight (42.06), number of seeds per pod (37.46), nodule dry weight (36.19), seed yield per plant (31.36).

The phenotypic Correlation studies found that Seed yield per plant showed highly significant and positive association with biological yield (0.503**) followed by, number of seeds per plant (0.349**), seed index (0.335**), number of pods per plant (0.326**). It also showed positive but non-significant association with nodule fresh weight (0.19), days to 50 per cent flowering (0.13), root dry weight (0.02).While negative and significant association was recorded for root fresh weight (-0.682**).

The genotypic correlation studies Seed yield per plant showed significant and positive association with harvest index (0.844**), biological yield (0.529**) it showed positive but non-significant association with nodule fresh weight (0.0741), shoot fresh weight (0.219), seed index (0.1067). While negative and significant association was recorded for root fresh weight (-0.287*). While negative but non-significant association was recorded for main root length (-0.0356), nodule dry weight (-0.0792) and root dry weight (-0.0304).

As a result, selection for variables with a positive significant genotypic and phenotypic connection would be extremely useful in both indirect and direct grain yield selection. The traits that have direct effects on grain yield are thought to be significantly connected with it, according to genotypic path coefficient analysis. Harvest index, biological yield, number of seeds per pod, seed index, and number of pods per plant all had a positive and direct effect on grain yield, according to the path analysis results. The traits that have direct effects on grain yield are thought to be significantly connected with it, according to phenotypic path coefficient analysis.

Table 1: Analysis of variance (Fisher, 1936) for Yield Characters in Chickpea germplasm during Rabi -2019-20

S. No.		Mean sum of squares		
	Characters	**Replications**	**Treatments**	**Error**
	Degree of freedom	2	23	46
1.	Days to 50 flowering	18	99.75**	14.37
2.	Plant Height	16	106.22	7.88
3.	Number of Pods per plant	4	117.59	5.78
4.	Number of Seeds per plant	10	137.31**.	12.78
5.	Seed Index	3	9.56**	3.12
6.	Biological yield	2	9.07	2.29
7.	Harvest Index	20	334.86	53.31
8.	Seed yield per plant	0	12.88	2.12

*5% level of significance, ** 1% level of significance

Table 2: Genetic parameters of 24 chickpea germplasm for agronomic traits and root nodulation traits evaluated under field conditions during Rabi 2019, at SHUATS, Prayagraj

Traits	GCV %	PCV %	H^2	GA %
Days to 50 flowering	6.96	8.54	66.40	11.68
Plant Height	9.88	11.00	80.60	18.27
Number of Pods per plant	24.18	25.99	86.60	46.34
Number of Seeds per plant	20.80	23.79	76.50	37.46
Seed Index	8.23	12.90	40.70	10.82
Main Root length	13.06	17.52	55.60	20.06
Number of Nodules	16.09	20.08	64.30	26.58
Nodule fresh weight	18.22	21.21	73.80	32.25
Nodule dry weight	21.14	25.43	69.10	36.19
Root fresh weight	10.41	17.45	35.60	12.78
Shoot fresh weight	6.86	12.13	32.00	7.99
Root dry weight	23.03	25.98	78.60	42.06
Shoot dry weight	13.99	19.11	53.60	21.11
Biological yield	9.12	12.82	50.60	13.36
Harvest Index	16.28	20.38	63.80	26.77
Seed yield per plant	19.21	24.26	62.80	31.36

GCV-Genetic Coefficient Variance, PCV- Phenotypic Coefficient Variance, H^2- Broad Sense Heritability, GA-Genetic Advance

Table 3: Mean Performance of 24 chickpea germplasm for agronomic traits and root nodulation traits evaluated under field conditions during Rabi 2019, at SHUATS, Prayagraj

S. no	Genotypes	DF50	PH (cm)	NPP	NSP	SI (g)	MRL	NN	NFW (mg)	NDW (mg)	RFW (g)	SFW (g)	RDW (g)	SDW (g)	BY (g)	HI (%)	SYPP (g)
1	C-205	82.000	57.067	42.800	45.700	18.667	19.033	3.034	239.433	143.167	0.763	1.983	0.097	0.787	16.233	79.918	12.973
2	C-127	75.000	56.867	24.000	24.667	17.667	19.433	4.734	146.433	116.867	0.697	1.907	0.103	0.773	16.700	45.403	7.500
3	C-115	82.000	51.500	21.567	24.700	14.333	25.400	5.767	201.067	174.767	0.820	1.873	0.073	0.820	13.933	65.180	9.157
4	C136	81.333	64.067	24.167	24.767	16.333	25.467	6.467	168.667	150.767	0.740	1.993	0.077	0.700	14.200	51.220	7.177
5	C-210	67.667	51.433	33.100	40.267	16.667	26.167	7.000	258.367	239.067	0.820	1.963	0.053	0.753	17.900	41.762	7.470
6	C-133	85.333	73.667	19.100	19.107	16.000	18.767	7.100	176.133	154.000	0.840	1.920	0.097	0.677	15.680	50.322	7.850
7	C-126	73.333	55.200	20.400	26.667	18.333	26.800	5.833	273.367	254.000	0.796	1.966	0.110	0.734	14.533	62.675	9.133
8	C-1021	78.667	71.067	19.733	31.900	16.333	21.267	4.400	141.067	199.733	0.830	2.020	0.110	0.703	15.100	62.870	9.433
9	C-137	79.333	58.800	18.300	22.600	20.667	25.533	4.234	270.033	252.933	0.787	1.930	0.117	0.693	13.800	58.121	8.067
10	C-224	78.667	64.000	22.567	22.567	20.000	21.067	5.953	257.333	247.033	0.797	2.057	0.050	0.733	16.433	50.308	8.200
11	C-1025	69.333	56.133	35.800	43.133	21.333	25.367	6.034	268.333	257.833	0.556	2.040	0.069	0.678	21.333	59.366	12.667
12	C-223	87.333	61.867	22.200	27.333	16.333	26.100	5.600	240.333	209.533	0.587	1.883	0.077	0.523	15.600	75.495	11.833
13	C-1022	71.000	58.800	22.533	35.267	17.667	20.933	6.267	166.067	136.367	0.820	1.913	0.080	0.787	17.667	59.252	10.467
14	C-222	69.667	61.267	24.700	35.000	20.333	18.633	6.400	258.767	246.800	0.730	1.890	0.063	0.566	15.367	58.043	8.983
15	C-1014	74.000	52.933	21.800	28.267	19.333	23.333	6.467	184.933	172.400	0.773	1.997	0.103	0.807	16.467	63.058	10.400
16	C-1044	70.333	61.333	29.333	35.333	15.333	28.133	7.200	252.700	238.133	0.753	1.890	0.080	0.520	15.533	63.277	9.757
17	C-203	68.667	54.133	31.000	36.533	15.667	19.800	5.413	240.433	221.900	0.708	1.961	0.143	0.512	16.067	39.006	6.267
18	C-1011	82.333	52.200	21.067	32.767	18.333	27.600	6.851	242.200	230.900	0.759	1.947	0.088	0.735	17.567	45.318	7.970
19	C-112	85.000	55.233	23.667	29.333	17.667	28.100	6.009	242.867	232.700	0.774	2.427	0.102	0.724	17.467	65.627	11.400
20	C-128	79.667	52.667	20.800	28.467	18.667	26.567	5.869	203.500	154.500	0.762	2.165	0.089	0.677	17.600	71.902	12.677
21	C-1013	77.667	58.167	22.667	28.333	17.333	24.267	7.657	180.100	150.967	0.461	2.486	0.091	0.855	18.133	66.605	12.067
22	C-1026	73.000	50.200	36.400	38.200	17.000	18.293	5.939	241.300	224.233	0.652	2.143	0.121	0.537	17.567	69.683	12.267
23	C-1023	76.333	58.867	22.533	29.533	17.667	22.200	5.658	263.767	236.767	0.639	1.597	0.106	0.466	18.733	68.362	12.813
24	UDAY	72.667	53.933	25.733	33.067	19.333	19.267	5.553	278.667	266.367	0.847	2.143	0.088	0.682	17.867	55.759	10.000
	Mean	76.681	57.975	25.249	30.979	17.792	23.230	5.893	224.828	204.656	0.738	2.004	0.091	0.685	16.562	59.522	9.855
	Range Lowest	67.667	50.200	18.300	19.107	14.333	18.293	3.034	141.067	116.867	0.461	1.597	0.050	0.466	13.800	39.006	6.267
	Range Highest	87.333	73.667	42.800	45.700	21.333	28.133	7.657	278.667	266.367	0.847	2.486	0.143	0.855	21.333	79.918	12.973
	C.V.	4.945	4.843	9.526	11.542	9.936	11.674	11.998	10.856	14.141	14.010	10.008	12.014	13.007	9.015	12.268	14.804
	S.E.	2.189	1.621	1.389	2.064	1.021	1.566	0.408	14.092	16.708	0.060	0.116	0.006	0.052	0.862	4.216	0.842
	C.D. 5%	6.232	4.615	3.953	5.877	2.905	4.457	1.162	40.114	47.563	0.170	0.330	0.018	0.147	2.454	12.001	2.398

Table 4: Genotypic correlation between different traits evaluated in chickpea during Rabi 2019-20 at SHUATS, Prayagraj

Trait	DF50	PH	NPP	NSP	SI	MRL	NN	NFW	NDW	RFW	SFW	RDW	SDW	BY	HI
DF50	1.00														
PH	0.40**	1.00													
NPP	-0.42	-0.383**	1.00												
NSP	-0.598**	-0.423**	0.871**	1.00											
SI	-0.287*	-0.13	0.06	0.17	1.00										
MRL	0.300*	-0.270*	-0.264*	-0.14	-0.19	1.00									
NN	-0.16	0.01	-0.258*	-0.19	-0.296*	0.385**	1.00								

NFW	-0.277*	-0.424**	0.345**	0.370**	0.515**	0.262*	-0.04	1.00							
NDW	-0.344**	-0.18	0.09	0.22	0.445**	0.255*	0.10	0.884**	1.00						
RFW	0.05	0.11	-0.342**	-0.243*	-0.09	0.03	-0.259*	-0.09	0.08	1.00					
SFW	0.14	-0.19	0.05	0.00	0.18	0.316**	0.261*	-0.12	-0.05	-0.528**	1.00				
RDW	0.00	-0.12	-0.02	-0.06	-0.23	-0.280*	-0.392**	-0.11	-0.06	-0.01	0.07	1.00			
SDW	0.261*	-0.17	-0.19	-0.19	0.15	0.17	-0.01	-0.493**	-0.534**	0.19	0.560**	-0.257*	1.00		
BY	-0.375**	-0.367**	0.451**	0.528**	0.517**	-0.01	0.21	0.21	0.13	-0.670**	0.347**	-0.16	-0.02	1.00	
HI	0.359**	-0.03	0.14	0.14	0.09	0.19	-0.338**	0.10	-0.09	-0.399**	0.14	0.09	-0.07	0.03	1.00
SYPP	0.13	-0.20	0.326**	0.349**	0.335**	0.14	-0.19	0.19	-0.03	-0.682**	0.286*	0.02	-0.10	0.503**	0.878**

Table 5: Phenotypic correlation between different traits evaluated in chickpea during Rabi 2019-20 at SHUATS, Prayagraj

Trait	DF50	PH	NPP	NSP	SI	MRL	NN	NFW	NDW	RFW	SFW	RDW	SDW	BY	HI
DF50	1.00														
PH	0.22	1.00													
NPP	-0.33 **	-0.26 *	1.00												
NSP	-0.43 ***	-0.32 **	0.80 ***	1.00											
SI	-0.12	-0.13	0.03	0.10	1.00										
MRL	0.09	-0.20	-0.22	-0.11	0.00	1.00									
NN	-0.20	-0.03	-0.18	-0.10	-0.11	0.25 *	1.00								
NFW	-0.22	-0.27 *	0.28 *	0.25 *	0.29 *	0.10	-0.02	1.00							
NDW	-0.28 *	-0.15	0.07	0.17	0.24 *	0.17	0.04	0.80 ***	1.00						
RFW	0.03	0.12	-0.11	-0.10	-0.08	-0.18	-0.11	0.00	0.00	1.00					
SFW	0.13	-0.18	0.08	0.06	0.08	0.00	0.15	-0.09	-0.09	-0.01	1.00				
RDW	0.04	-0.08	-0.02	-0.02	-0.08	-0.15	-0.35 **	-0.11	-0.09	-0.11	0.02	1.00			
SDW	0.08	-0.07	-0.11	-0.11	0.12	0.06	0.00	-0.34 **	-0.37 **	0.24 *	0.28 *	-0.20	1.00		
BY	-0.26 *	-0.27 *	0.29 *	0.46 ***	0.21	-0.05	0.25 *	0.17	0.13	-0.26 *	0.17	-0.13	-0.04	1.00	
HI	0.32 **	-0.07	0.08	0.13	-0.01	0.00	-0.22	-0.02	-0.18	-0.16	0.15	0.02	-0.06	0.00	1.00
SYPP	0.13	-0.20	0.23	0.36**	0.11	-0.04	-0.04	0.07	-0.08	-0.28*	0.22	-0.03	-0.08	0.52**	0.84**

Table 6: Genotypic Direct (in bold) and indirect effects of 16 traits on seed yield in chickpea evaluated in Rabi 2019

Trait	DF50	PH	NPP	NSP	SI	MRL	NN	NFW	NDW	RFW	SFW	RDW	SDW	BY	HI	SYPP
DF50	-0.072	-0.029	0.030	0.043	0.021	-0.022	0.012	0.020	0.025	-0.004	-0.010	0.000	-0.019	0.027	-0.026	0.128
PH	0.044	0.110	-0.042	-0.047	-0.015	-0.030	0.001	-0.047	-0.019	0.012	-0.021	-0.013	-0.019	-0.041	-0.003	-0.196
NPP	-0.013	-0.012	0.031	0.027	0.002	-0.008	-0.008	0.011	0.003	-0.011	0.002	-0.001	-0.006	0.014	0.004	0.326**
NSP	0.036	0.025	-0.052	-0.060	-0.010	0.008	0.012	-0.022	-0.013	0.015	0.000	0.004	0.012	-0.032	-0.008	0.349**
SI	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	0.000	0.000	0.335**
MRL	0.013	-0.011	-0.011	-0.006	-0.008	0.042	0.016	0.011	0.011	0.001	0.013	-0.012	0.007	0.000	0.008	0.140
NN	-0.006	0.000	-0.010	-0.008	-0.012	0.015	0.039	-0.002	0.004	-0.010	0.010	-0.015	-0.001	0.008	-0.013	-0.186
NFW	-0.039	-0.059	0.048	0.052	0.072	0.037	-0.006	0.139	0.123	-0.013	-0.016	-0.015	-0.069	0.029	0.014	0.186
NDW	0.020	0.010	-0.005	-0.013	-0.026	-0.015	-0.006	-0.052	-0.059	-0.005	0.003	0.003	0.031	-0.008	0.005	-0.026
RFW	-0.005	-0.010	0.029	0.021	0.008	-0.003	0.022	0.008	-0.007	-0.086	0.045	0.000	-0.017	0.057	0.034	-0.682**
SFW	-0.016	0.022	-0.006	0.000	-0.021	-0.037	-0.031	0.014	0.006	0.062	-0.118	-0.008	-0.066	-0.041	-0.016	0.286*
RDW	-0.001	-0.014	-0.002	-0.007	-0.027	-0.033	-0.046	-0.012	-0.007	-0.001	0.008	0.118	-0.030	-0.019	0.011	0.024
SDW	0.039	-0.026	-0.028	-0.028	0.022	0.025	-0.002	-0.073	-0.079	0.029	0.083	-0.038	0.148	-0.003	-0.011	-0.102
BY	-0.183	-0.179	0.220	0.257	0.252	-0.005	0.104	0.102	0.066	-0.327	0.169	-0.078	-0.010	0.488	0.013	0.503**
HI	0.311	-0.026	0.125	0.118	0.077	0.165	-0.292	0.089	-0.078	-0.346	0.118	0.078	-0.064	0.023	0.865	0.878**
SYPP	0.128	-0.196	0.326**	0.349**	0.335**	0.140	-0.186	0.186	-0.026	-0.682**	0.286*	0.024	-0.102	0.503**	0.878**	1.000
Partial R^2	-0.009	-0.022	0.010	-0.021	0.000	0.006	-0.007	0.026	0.002	0.058	-0.034	0.003	-0.015	0.245	0.759	

Table 7: Phenotypic Direct (in bold) and indirect effects of 16 traits on seed yield in chickpea evaluated in Rabi 2019

TRAIT	DF50	PH (cm)	NPP	NSP	SI (g)	MRL	NN	NFW (mg)	NDW (mg)	RFW (g)	SFW (g)	RDW (g)	SDW (g)	BY (g)	HI (%)	SYPP (g)
DF50	0.005	0.001	-0.002	-0.002	-0.001	0.001	-0.001	-0.001	-0.002	0.000	0.001	0.000	0.000	-0.001	0.002	0.130
PH(cm)	0.000	-0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.205
NPP	-0.004	-0.004	0.013	0.010	0.000	-0.003	-0.002	0.004	0.001	-0.002	0.001	0.000	-0.001	0.004	0.001	0.228
NSP	0.004	0.003	-0.007	-0.009	-0.001	0.001	0.001	-0.002	-0.002	0.001	-0.001	0.000	0.001	-0.004	-0.001	0.360**
SI(g)	-0.001	-0.001	0.000	0.001	0.008	0.000	-0.001	0.002	0.002	-0.001	0.001	-0.001	0.001	0.002	0.000	0.107
MRL	-0.001	0.003	0.003	0.002	0.000	-0.015	-0.004	-0.002	-0.003	0.003	0.000	0.002	-0.001	0.001	0.000	-0.036
NN	-0.005	-0.001	-0.004	-0.002	-0.003	0.006	0.023	-0.001	0.001	-0.003	0.003	-0.008	0.000	0.006	-0.005	-0.044
NFW(mg)	0.005	0.006	-0.006	-0.006	-0.007	-0.002	0.001	-0.022	-0.018	0.000	0.002	0.003	0.008	-0.004	0.000	0.074
NDW(mg)	-0.010	-0.005	0.003	0.006	0.009	0.006	0.002	0.029	0.036	0.000	-0.003	-0.003	-0.014	0.005	-0.007	-0.079
RFW(g)	0.000	-0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	-0.007	0.000	0.001	-0.002	0.002	0.001	-0.287*
SFW(g)	-0.001	0.001	-0.001	0.000	-0.001	0.000	-0.001	0.001	0.001	0.000	-0.007	0.000	-0.002	-0.001	-0.001	0.219
RDW(g)	0.001	-0.002	-0.001	0.000	-0.002	-0.004	-0.010	-0.003	-0.003	-0.003	0.001	0.027	-0.005	-0.004	0.001	-0.030
SDW(g)	0.001	-0.001	-0.001	-0.001	0.001	0.001	0.000	-0.004	-0.004	0.003	0.003	-0.002	0.011	-0.001	-0.001	-0.076

BY(g)	-0.140	-0.147	0.157	0.247	0.109	-0.028	0.133	0.089	0.066	-0.142	0.090	-0.067	-0.022	0.527	-0.002	0.529**
HI (%)	0.277	-0.056	0.072	0.114	-0.008	0.001	-0.185	-0.017	-0.157	-0.137	0.127	0.018	-0.051	-0.003	0.855	0.844**
SYPP(g)	0.130	-0.205	0.228	0.360**	0.107	-0.036	-0.044	0.074	-0.079	-0.287*	0.219	-0.030	-0.076	0.529**	0.844**	1.000
Partial R^2	0.001	0.000	0.003	-0.003	0.001	0.001	-0.001	-0.002	-0.003	0.002	-0.001	-0.001	-0.001	0.278	0.721	

Conclusion

Based on the Results of this study, it can be stated that significant variety can be further utilized for chickpea improvement. Selection will be effective in this population due to high GCV, PCV, heritability, and genetic advance for traits (i.e., Number of pods per plant).The harvest index, biological yield, and number of seeds per plant all had a significant positive phenotypic correlation with seed yield per plant, paving the way for indirect selection of traits for seed yield improvement. Harvest index has a strong direct effect on seed yield, hence it should be prioritized during selection.

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