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Genetic variability and correlation studies for yield and its component traits in advance breeding lines of chickpea (*Cicer arietinum* L.)

Shikha Upadhyay, Anita Babbar, Deepak Katkani and Shailendra Sagar Prajapati

Abstract
The present studies were conducted to the estimation of correlation, variability and heritability for quantitative traits in advance breeding lines of chickpea (*Cicer arietinum L.*) under randomized completely block design with three replications in the field of the department of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, during the crop season 2020 - 2021.Heritabilities for total number of pods per plant, number of effective pods per plant, hundred seed weight, biological yield and plant height were high than those for the other traits. The high heritability (92.7%) coupled with high genetic advance (51.4%) for the trait no of effective pod per plant followed by total no of pod per plant, hundred seed weight biological yield and seed yield per plant, these traits should be used as selection criteria while formulating breeding strategies Correlation studies showed positive and significant (p<0.05) relationships between seed yield per plant, secondary branch per plant, total number of pods per plant, number of effective pods per plant, number of seeds per pod, hundred seed weight, biological yield and harvest index. Days to maturity, days to 50% flowering, height of first fruiting node plant height and primary branches per plant was negative and non-significantly correlated with seed yield per plant at phenotypic levels.

Keywords: Chickpea, correlation, genotypic and phenotypic coefficient of variation, heritability, seed yield

Introduction
Pulses are widely cultivated crops since ancient times throughout the World. They are a rich source of protein, dietary fiber, and micronutrients and have several health benefits. Chickpea (*Cicer arietinum* L.) is a widely consumed pulse in the world (Kaur and Prashasd 2021) [9]. It is food legume crop mainly grown in continents of tropical and subtropical (Fikre and Bekele, 2019) [5]. Turkey is believed as the center of origin of the chickpea crop, based on the electrophoresis of seed protein (Ladizinsky & Adler, 1976) [13], and it spread *via* Silk Route towards West and South along with human migration. It is a drought-resistant crop thus, does not require much irrigation and can also be cultivated in areas of limited rainfall. The future food market is more emphasized on food security and the needs of sustainable protein supplement. World's populations are now shifting towards a vegan diet, so aim is on exploring plant-based protein sources it is an inexpensive and rich source of protein (20-22%).In the breeding programs, selection is based on yield and yield-attributed characters. Genetic variability among trait is desirable selection criteria as heritability differentiated genotype on the basis of their genetic composition and their environmental interaction. Genetic gain supports research program by providing improvement for new induction by selections. The ultimate success of crop improvement program related to heredity variation present in lines is done by heritability estimates. Determination of the correlation coefficients between yield and yield criteria is crucial so as to select favorable plant types for fruitful breeding (Toker 1998) [24]. Correlation of coefficients in general shows associations among the independent characteristics and the degree of linear relation between these characteristics, but it cannot provide basis of association. The aim of this research is to demonstrate the genetic variability, heritability and genetic gain and interrelationship of some yield components among themselves and with seed yield in the advanced breeding lines of chickpea.

Material and Methods

The experimental material for the existing research consisted 30 advance breeding lines of desi chickpea. The investigational research was laid out in randomized complete block design (RCBD) with three replications during *rabi* seasons 2020-21 at Seed Breeding Farm, Department of Plant Breeding and Genetics, JNKVV Jabalpur. Research plot having of 2 rows of 4.0 m length, inter and intra-row spacing was 30.0 and 10.0 cm respectively. Prescribed agronomical practices were implemented to grow crop successful. Five modest evocative plants are selected at random from the plot in each replication for recording the further quantitative observations on yield and its contributing traits, like, days to 50% flowering, days to maturity, plant height (cm), height of first fruiting node (cm), number of primary branches per plant, number of secondary branches per plant, stem thickness (mm), total number of effective pods per plant, number of seeds per pod, 100 seed weight (g), biological yield per plant (g), harvest index (%) and seed yield per plant (g). The data was subjected to standard statically analysis for genetic parameters of variability and correlation coefficient.

Result and Discussion

Genetic parameters of variability for yield and its component traits are presented in Table 1. In the study, the highest genotypic coefficient of variances were found for number of effective pods per plant (25.8%) followed by seed yield per plant (23.9%), total number of pods per plant (23.3%), and hundred seed weight (21.1%), while lowest genotypic coefficient variance was found for days to maturity (6.0%) and days to 50% flowering (6.6%). Similar findings were reported by Jida *et al*. (2019) [8] for total number of pods per plant, Kumar *et al*. (2020) [11] for number of effective pods per plant and total number of pods per plant, Mohibullah *et al*. (2020) [16] for seed yield per plant and secondary branches per plant and Kumar *et al*. (2021) [10] for 100 seed weight. The highest heritability (92.7%) was found for total number of pods per and no of effective pod per plant. The range of heritability was estimated 45% to 92.7%.The high values of heritability were found for hundred seed weight (90.1%), biological yield(87.3%), plant height (86%), days to maturity(85%) and seed yield per plant (83.8%), while lowest value was for stem thickness (45%).The high value of genetic advance were found for number of effective pods per plant (51.4%) followed by total number of pods per plant (46.3%), seed yield per plant (45.2%), while low for days to 50% flowering (11.9%) and days to maturity (14.4%).The greater values of genetic advance indicated that number of effective pod per plant, total number of pod per plant and seed yield per plant can be used for selecting higher yielding genotypes.. These results were in accordance with the findings of Yucel *et al*. (2006), Singh *et al*. (2012), Gul *et al*. (2013) Tiwari *et al*. (2016) and Hussain *et al*. (2017) [25, 19, 6, 23, 7].

Correlation coefficient analysis

The association study interprets relation of component traits with yield which provide basis of selection. The phenotypic correlation coefficient analysis for quantitative traits was presented in table 2., where seed yield per plant exhibited a significant positive correlation with secondary branches per plant (0.1094), total no. of pods per plant (0.5886), number of effective pods per plant (0.5215), number of seeds per pod (0.2700), hundred seed weight (0.4986), biological yield (0.8025), and harvest index (0.4403). These results suggested that improvement in these positive correlated traits will accelerate the boost in seed yield per plant. These results were in accordance with those reported by Babbar *et al*., (2012) [2] for total number of pods per plant, biological yield, plant height and 100 seed weight, Shanmugam and Kalaimagal (2019) [18] for positively significant correlation with number of secondary branches, number of seeds per plant, 100 seed weight, biological yield per plant and harvest index with seed yield per plant, Manikanteswara *et al*., (2019) [14] for harvest index and pod per plant. Seed yield per plant negatively correlated with days to 50% flowering (-0.0955), days to maturity (-0.1703), plant height (-0.1349), height of first fruiting node (-0.0603) and primary branches per plant (-0.1218). These traits may be important yield predictor by means of early maturing chickpea varieties by negative correlation with days to 50% flowering along with days to maturity. As above mention result supported by Babbar *et al*., (2012) [2] for significant negative correlation with days to 50% flowering and for no of primary branches per plant by Mohammadi and Talebi (2015) [15]. Harvest index showed significant positive correlation with number of seeds per pod (0.1731) and significant negative correlation with days to 50% flowering (-0.3639), days to maturity (-0.4684), plant height (-0.4975), height of first fruiting node (-0.2475) and primary branches per plant (-0.1970).Biological yield per plant showed significantly positive correlation with secondary branches per plant (0.1976), number of effective pods per plant (0.4839), total number of pods per plant (0.5814) and hundred seed weight (0.4741). The similar result was also reported by Ali *et al*., (2011) [1] for total no of pods per plant, and 100- seed weight, for secondary branches per plant by Tesfamichael *et al*. (2015) [21]. Hundred seed weight showed significant positive correlation with primary branches per plant (0.2422) and stem thickness (0.2303). No of seeds per pod showed significant positive correlation with primary branches per plant (0.2052) negative correlation with days to 50% flowering (-0.2788), plant height (-0.3339) and stem thickness (-0.4706).Number of effective pods per plant showed significant positive correlation with total number of pod per plant (0.9606) and negative correlation with primary branches per plant (-0.2744).Total no of pod per plant significantly negative correlated with primary branches per plant (-0.1818).secondary branches per plant showed positive correlation with days to 50% flowering (0.1967) and negatively correlated with plant height (-0.3142). Primary branches per plant showed positive correlation with plant height (0.2095). Stem thickness showed positive correlation with plant height (0.4682) and height of first fruiting node (0.4667).Plant height showed significantly positive correlation with days to maturity (0.4534) and days to 50% flowering (0.3557). Height of first fruiting node showed significantly positively correlation with days to 50% flowering (0.5955), days to maturity (0.6022) and plant height (0.7322). The above described finding were also justified by these mentioned researcher Thakur *et al*. (2009) [22] and Kumawat *et al*. (2021) [12]. The correlation studies reveal more emphasis in yield attributing traits like biological yield, total and effective no of pods per plant and hundred seed weight, which act like a key factor for selection of high yielding genotypes.

Table 1: Estimates of genetic components

Characters	Range			GCV (%)	PCV (%)	H^2 (bs) %	GA as % of mean
	Mini.	Maxi.	Av.				
DTF	53	70	60.0	6.64	7.24	79.8	11.9
DM	92	118	106.0	6.01	6.25	85.0	14.4
PH	43.67	74.37	59.2	12.96	13.98	86.0	24.7
HFFN	15.63	38.33	24.9	20.08	22.91	76.8	36.7
ST	2.39	3.98	3.13	9.09	13.54	45.0	12.6
PB	2.13	3.97	3.05	9.97	12.87	60.0	15.9
SB	9.37	28.67	20.13	19.06	23.94	63.0	31.3
TNP	39.25	149.67	81.6	23.34	24.24	92.7	46.3
NEP	37.36	135.96	71.2	25.88	26.88	92.7	51.4
NSPP	1.01	1.94	1.27	12.45	17.14	52.7	18.6
HSW	14.76	44.11	25.56	21.16	22.30	90.1	41.4
BY	24.33	63.65	42.5	20.87	22.34	87.3	40.19
HI	39.58	82.55	53.02	13.78	17.23	64.0	22.7
SYPP	12.07	39.63	22.39	23.99	26.21	83.8	45.2

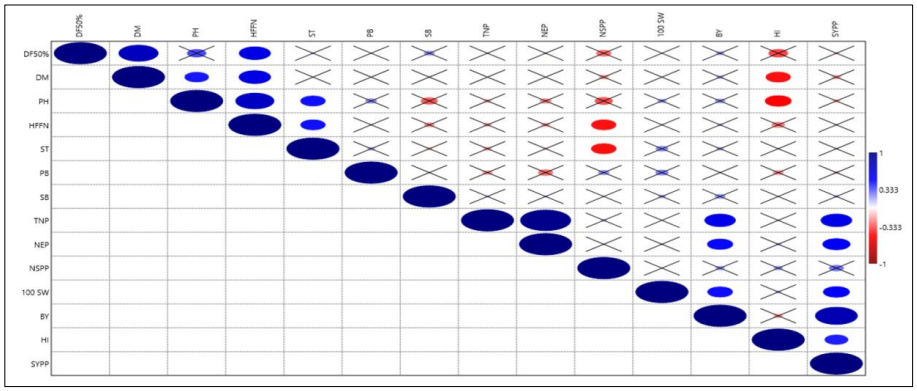

Fig 1: Correlation among different traits and seed yield and its attributing traits

Table 2: Correlation among traits in chickpea

Ch.	DF50%	DM	PH	HFFN	ST	PB	SB	TNP	NEP	NSPP	HSW	BY	HI	SYPP
DF50%	1	0.7503**	0.3557**	0.5955**	0.0854	-0.0079	0.1967*	0.0685	0.0754	-0.2788**	0.0194	0.1559	-0.3639**	-0.0955
DM		1	0.4534**	0.6022**	0.0522	-0.0242	0.0778	0.0254	0.0075	-0.1806	-0.0378	0.1380	-0.4684**	-0.1703
PH			1	0.7322**	0.4667**	0.2095*	-0.3142**	-0.1440	-0.2162*	-0.3339**	0.1652	0.1867	-0.4975**	-0.1349
HFFN				1	0.4667**	0.0516	-0.1952*	-0.1565	-0.1671	-0.4655	0.0241	0.1066	-0.2475*	-0.0603
ST					1	0.1406	-0.1176	-0.1595	-0.0989	-0.4706**	0.2303*	0.1379	-0.0694	0.0858
PB						1	0.0055	-0.1818*	-0.2744*	0.2052*	0.2422**	0.0139	-0.1970*	-0.1218
SB							1	0.0932	0.0876	0.0431	0.1436	0.1976*	-0.0468	0.1094
TNP								1	0.9606**	0.1059	-0.0340	0.5841**	0.0736	0.5886**
NEP									1	-0.0357	-0.0673	0.4839**	0.1047	0.5215**
NSPP										1	-0.0544	0.1737*	0.1731*	0.2700*
HSW											1	0.4741**	0.1111	0.4986**
BY												1	-0.1704	0.8025**
HI													1	0.4403**
SYPP														1

*Correlation is significant at 5% level and **Correlation is significant at 1% level. Where, DTF: days to 50% flowering, DM: Days to maturity, PH: Plant height(cm), NPBPP: Number of primary branches per plant, NSBPP: Number of secondary branches per plant, TNPPP: Total number of pods per plant, HFFN(cm): Height of first fruiting node, ST(mm): Stem thickness, NEPPP: Number of effective pods per plant, NSPP: Number of seeds per pod, HSW(g): 100 Seed weight, BY(g): Biological yield per plant, HI(%): Harvest index, SYPP(g): Seed yield per plant.

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Conflict of interest: None

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