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Genetic studies on yield traits of late sown elite *kabuli* chickpea lines

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ABSTRACT

Present study was carried out to assess the genetic variability and correlation for yield and its contributing traits using 89 elite lines of *kabuli* during *rabi* 2018-19. Analysis of variance revealed, the significant differences among the lines for all the traits indicated that the presence of sufficient amount of genetic variability among the lines. High GCV% and PCV % accounted for the traits seed yield per plant followed by stem height at initiation of first flower, number of effective pods per plant, total number of pods per plant and biological yield per plant. High heritability coupled with high genetic advance as percentage of mean noted for seed yield per plant, stem height at initiation of first flower and number of effective pods per plant. Selection of the line had more than 25 cm stem height at initiation of first flower, viz. FLIP12-278C, FLIP12-161C, JGK-2018-5, ICCV181309 and ICCV181305, would be suitable for mechanical harvesting. Seed yield per plant showed highly significant and positive association with biological yield per plant , harvest index, 100 seed weight , total number of effective pods per plant, while highly significant but negative correlation with days to pod initiation followed by days to 50% flowering and days to flower initiation. Lines identified having maximum 100 seed weight, viz. JGK-2018-1, JGK-2018-2, JGK-2018-3,JGK-2018-4, RVSVT-K-105, RVSVT-K-110 and ICCV181307.The diverse promising lines could be used in chickpea breeding programme and improved nutritional foodsecurity.

Keywords: Genetic variability, GCV, Genetic advance, Heritability, *Kabuli* chickpea, PCV

Chickpea (*Cicer arietinum* L.) is a self pollinated food legume and important source of balanced human diet throughout the world to improve nutritional food security. Among pulses crops, chickpea ranks third worldwide, (Muehlbauer and Sarker 2017) with a production of 14.8 mt from an area of 13.98 mha and an average yield of 1058 kg/ha. India ranked first in area and production, contributing to 67% of world's chickpea production with 10.17 mha area and 11.35 mt production and 1116 kg/ha an average productivity. M.P. covers 1.92 mha area, 2.48 mt production and 1288 kg/ha an average productivity (Source: Directorate of pulse development report 2019-20). Chickpea can improve properties of soil due to symbiotic nitrogen fixation. Large seeded *kabuli* chickpea domestic types appear to have evolved from the small seeded *desi* chickpeas. It has white flower and beige colour. It is marketed only as whole grain and usually exported to either north Indian states or other countries hence their demand in north Indian states is gradually increasing. It fetches higher price than *desi* and increases the *kabuli* growing area and improves the living standard of pulse farmer. Rice fallow crop system vacated the field up to the end of the November, When irrigation facility is not enough for wheat cultivation after rice then early mature chickpea can be taken under late sown conditions. Magnitude of genetic variations is the basis of selection, a pre-requisite for crop improvement programme and improvement in yield component mainly depends on highly heritable variation. The knowledge of high heritability coupled with high genetic advance helps the plant breeder, making desirable selection and improve the genotypic value of lines. Association between seed yield and yield component traits are requisite to selection criteria and also determine their relative significance to improve crop yield and helps to identify best combinations of attributes for obtaining higher yield in *kabuli* chickpea. The present investigation was carried out to assess the genetic variability and association of yield related traits and identify high yielding *kabuli* lines with better architecture suitable for late sown conditions.

MATERIALS AND METHODS

The study was carried out at seed breeding farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

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(MP) during first fortnight of December *rabi* 2018-19. The experimental material consisted of 89 elite and indigenous lines of *kabuli* chickpea obtained from ICRISAT (Pattancheru), ICARDA (Morocco) and JNKVV (Jabalpur) evaluated in Randomized Complete Block Design.The recommended agronomical and plant protection practices were followed for the successful raising of the crop. Experiment made to identify the desirable phenological, morphological and quantitative traits influencing yield. Observations were recorded on fifteen quantitative traits and data was subjected to the standard statistical analysis and studied various genetic parameters of variabilityand association between seed yield and yield component traits to improve seed yield.

RESULTS AND DISCUSSION

The mean sum of squares due to treatment was found highly significant for all the traits indicated significant variations among all lines sown under late sown conditions. This indicated that the presence of a sufficient amount of genetic variability among the lines which is prerequisite for selection. Hence, there is large scope for inclusion of these variable lines of *kabuli* chickpea in breeding program for yield and its attributing traits. A wide range of genetic variation was observed for various quantitative traits (Table 1). The range of variability was observed for phenological traits, viz. days to flower initiation from 35 to 76 days with an average value of 57 days and from 42 to 81 days for days to 50% flowering with a mean value of 63 days, 47 to 85 days for days to pod initiation exhibited a mean value 69 days and 108 to 129 days for days to maturity with a mean value of 122 days.Plant height exhibited a range from 38 to 68 cm with an average height of 54 cm, height of first fruiting node showed range from 9.4 to 29.3 cm with an average height 14.2 cm. Some lines, viz. FLIP 12-278C, FLIP 12-161C, JGK- 2018-5, ICCV 181309 and ICCV 181305 were identified on the basis of per se performance of mean value of height of first fruiting node, had greater than 25 cm and suitable plant architecture had semi erect to erect type with tall stature. Number of primary branches ranged from 2.9 to 8.5 with an average of 4.5, whereas number of secondary branches showed mean value of 10.5 with ranged from 4.1 to 16 and total number of pods per plant varied from 18.4 to 62.3 with an average of 39.4 pods. Number of effective pods per plant showed range from 15.8 to 59.3 with an average of 36 pods, while number of seeds per pod varied from 1.2 to 2 with a mean value of 1.5 seeds. Variation was also observed for hundred seed weight from 25.33 to 58.16 g with mean value of 36.18 g. Therefore, seven *kabuli* chickpea lines (JGK- 2018-1, 2, 3, 4, RVSVT-K-105, 110 and ICCV 181307) recorded as extra large seeded on the basis of mean value greater than 45 g. Biological yield per plant varied from 19.9 to 62.3 g and had an average value of 35.5 g. Elite and indigenous lines under study showed harvest index with range from 29 to 67.5% with an average value of 48.5 %. Whereas seed yield per plant recorded an average yield value of 17.2 g with ranged from 10.4 to 32.3 g.These findings are in accordance with earlier results observed by Arora *et al.* (2018), Babbar and Tiwari (2018) and Solanki *et al*. (2019).

Success of plant breeders in selecting genotypes that produces higher yield and its related traits depends on existence and exploitation of genetic variability to the fullest extent (Fig 1). Further, high genotypic and phenotypic coefficient of variation were noted (Table 1) for seed yield per plant (36.1% and 37.0%) followed by height of first fruiting node (35.0% and 36.0%), number of effective pods per plant (29.0% and 29.8%), total number of pods

Table 1 Genetic parameters of variability for quantitative traits of *kabuli* chickpea lines grown under late sown conditions

Traits	Grand mean	Range		Coefficient of variation		h^2% (Bs)	GA as % of mean at 5%
		Mini	Maxi	GCV (%)	PCV (%)		
DTFI	57.2	35.0	76.3	17.4	17.8	95.8	35.1
50%F	63.4	41.6	81.6	16.6	16.9	96.7	33.7
DTPI	69.4	47	85.3	14.1	14.4	96.6	28.6
DTM	121.8	108.3	129.3	4.1	4.5	85.6	7.9
PH	53.8	38.4	68.7	11.9	12.4	93.0	23.7
HFN	14.2	9.4	29.3	35.0	36.0	94.8	70.3
PB	4.5	2.9	8.5	24.9	28.6	76.0	44.8
SB	10.5	4.1	16.0	23.7	26.7	79.0	43.4
TNPP	39.4	18.4	62.3	27.4	28.2	94.4	54.9
NEP	36.0	15.8	59.3	29.0	29.8	94.3	58.0
NSP	1.5	1.2	2.0	8.3	13.0	52.5	11.2
100SW	36.1	25.3	58.1	16.2	16.5	96.4	32.9
BY	35.5	19.9	62.3	27.4	28.1	95.1	55.1
HI	48.5	29.0	67.5	20.9	21.9	91.5	41.3
SYP	17.2	10.4	32.3	36.1	37.0	95.5	72.8

Table 2 Correlation coefficient analysis for yield and its related traits in *kabuli* chickpea under late sown conditions

Traits	DTFI	50% F	DTPI	DTM	PH	HFN	PB	SB	TNPP	NEP	NSP	100S W	BY	HI	SYP
DTFI	1	0.988**	0.950**	0.625**	-0.263**	0.126*	0.119	0.073	0.173**	0.137*	-0.041	-0.329**	0.012	-0.656**	-0.442**
50% F		1	0.969**	0.608**	-0.276**	0.123*	0.132*	0.075	0.186**	0.149*	-0.034	-0.354**	-0.004	-0.680**	-0.472**
DTPI			1	0.492**	-0.252**	0.165**	0.135*	0.031	0.160**	0.116	-0.062	-0.404**	-0.109	-0.706**	-0.579**
DTM				1	-0.170**	-0.07	0.205**	0.126*	0.170**	0.168**	0.029	0.120*	0.347**	-0.269**	0.105
PH					1	-0.086	-0.156*	-0.139*	-0.187**	-0.183**	-0.012	0.255**	-0.140*	0.271**	0.062
HFN						1	-0.034	0.075	-0.024	-0.037	0.057	-0.05	0.019	-0.249**	-0.178**
PB							1	0.277**	0.261**	0.246**	-0.078	-0.085	0.156*	-0.115	0.04
SB								1	-0.131*	-0.139*	0.004	-0.061	-0.01	0.004	0.015
TNPP									1	0.982**	0.079	-0.171**	0.653**	-0.257**	0.309**
NEP										1	0.084	-0.147*	0.684**	-0.211**	0.367**
NSP											1	0.056	0.079	0.033	0.092
100S W												1	0.203**	0.359**	0.440**
BY													1	-0.068	0.729**
HI														1	0.620**
SYP															1

DTFI : Days to flower initiation, 50% F: Days to 50% flowering, DTPI : Days to pod initiation, DTM : Days to maturity, PH : Plant height, HFN : Stem height at initiation of first flower, PB : Number of primary branches per plant, SB : Number of secondary branches per plant, TNPP : Total number of pods per plant, NEP: Number of effective pods per plant, NSP : Number of seeds per pod, 100 SW : 100 seed weight, BY : Biological yield, HI: Harvest index, SYP: Seed yield per plant

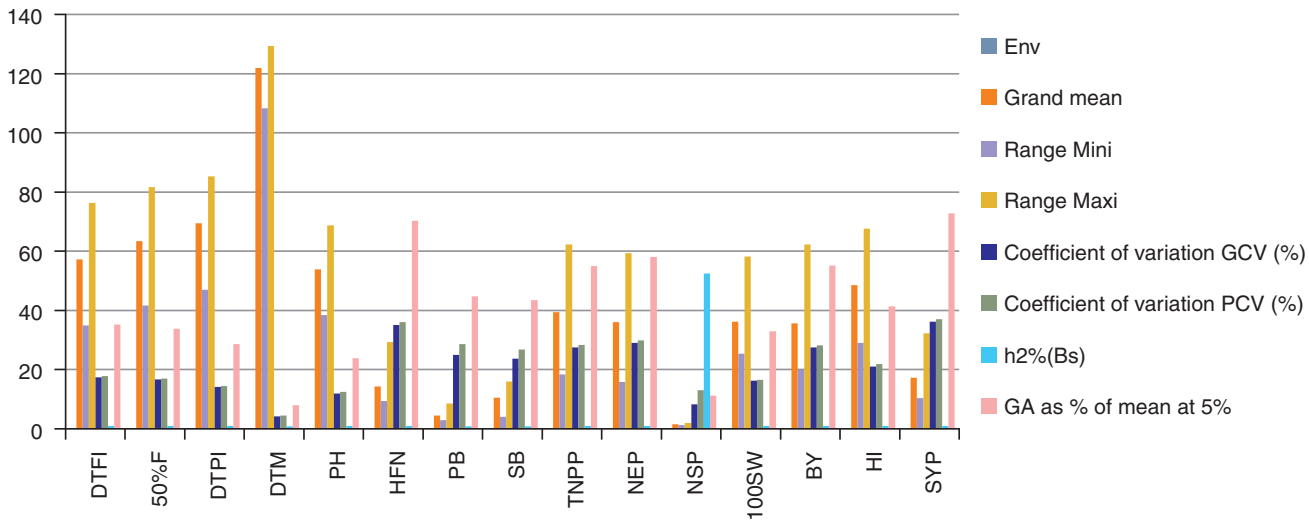

Fig 1 Graphical presentation of genetic parameters of variability of *kabuli* chickpea for quantitative traits.

per plant (27.4% and 28.2%) and biological yield per plant (27.4% and 28.1%). The phenotypic coefficient of variation is the expression of genotype along with environment and their interaction. It was of higher degree in comparison to its corresponding genotypic coefficient of variation for all the characters under study. This designated that there was a little influence of the environment on the expression of these characters. Closeness between PCV% and GCV % indicated low environmental influence on the characters. Similar findings were noted by Joshi *et al.* (2018), Johnson *et al*. (2018), Arora *et al.* (2018), Sharma *et al.* (2018), Shengu *et al.* (2018), Solanki *et al*. (2019) and Jida *et al.* (2019). High heritability along with high genetic advance as percentage of mean was noted for following traits respectively, seed yield per plant (95.5% and 72.8%), height of first fruiting node (94.8% and 70.3%), number of effective pods per plant (94.3% and 58.0%), biological yield per plant (95.1% and 55.1%) noted for high heritability along with high genetic advance as percentage of mean. Hence, these traits seem to be major yield contributing factors; selection of these characters would be effective for improvement on seed yield in *kabuli* chickpea.These findings are in accordance with earlier results observed by Tiwari and Babbar (2016), Sowjanya *et al.* (2017, Munde *et al.* (2018), Shanmugam and Kalaimagal (2019).

The phenotypic correlation coefficient analysis for the fifteen quantitative traits were computed (Table 2). Seed yield per plant showed highly significant and positive correlation with biological yield per plant (0.729) followed by harvest index (0.620), 100 seed weight (0.440), total number of effective pods per plant (0.367), total number of pods per plant (0.309), while highly significant and negative correlation with days to pod initiation (-0.579) followed by days to 50% flowering (-0.472), days to flower initiation (-0.442) and stem height at initiation of first flower (-0.178). Days to flower initiation exhibited highly significant and positive correlation with days to 50% flowering (0.988), days to pod initiation (0.950) and days to maturity (0.625) and total number of pods per plant (0.173). Days to 50% flowering showed highly significant and positive correlation with days to pod initiation (0.969), days to maturity (0.608) and total number of pods per plant (0.186). Days to pod initiation observed highly significant and positive correlation with days to maturity (0.492), stem height at initiation of first flower (0.165) and total number of pods per plant (0.160). Days to maturity showed highly significant and positive correlation with the biological yield per plant (0.347), number of primary branches (0.205), total number of pod per plant (0.170) and total number of effective pods per plant (0.168). Phonological traits (flowering and maturity) contribute a vital role in increasing grain yield and yield related traits of chickpea. Similar results were also reported by Sowjanya *et al.* (2017), Solanki *et al.* (2019), Manikanteswara *et al.* (2019) and Tsehaye *et al.* (2020).

Plant height exhibited highly significant and positive correlation with harvest index (0.271) and 100 seed weight (0.255). Number of primary branches per plant showed highly significant and positive correlation with number of secondary branches (0.277), total number of pods per plant (0.261) and total number of effective pods per plant (0.246). Number of secondary branches per plant was observed significant but negatively correlated with total number of pods per plant (-0.1313) and number of effective pods per plant (-0.1391). Total number of pods per plant observed highly significant and positive correlation with total number of effective pods per plant (0.982), biological yield per plant (0.653) and seed yield per plant (0.309). Total number of effective pods per plant exhibited highly significant and positive correlation with biological yield per plant (0.684) and seed yield per plant (0.367). Hundred seed weight showed highly significant and positive correlation with seed yield per plant (0.440), harvest index (0.359) and biological yield per plant (0.203).These result similar accordance with Tiwari and Babbar (2016), Dhuria and Babbar (2017), Solanki *et al.* (2019) and Tsehaye *et al.* (2020).

It can be concluded that elite lines could be selected to

give the attention of the traits with high heritability coupled with high genetic advance as percentage of mean. While making selection, maximum weight age should be given to highly positive correlated traits with seed yield per plant, viz. biological yield per plant, harvest index, 100 seed weight, total number of effective pods per plant and total number of pods per plant to improve higher seed yield. Lines highly correlated with the trait 100 seed weight were JGK-2018-1, JGK-2018- 2, JGK-2018-3, JGK-2018-4, RVSVT-K-105, RVSVT-K-110 and ICCV181307. These diverse promising lines had desirable yield component traits under late sown conditions and prefer to selection and could be better exploit for future *kabuli* chickpea hybridization programme.

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