The Pharma Innovation Journal 2022; 11(10): 1358-1361

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(10): 1358-1361

www.thepharmajournal.com
Received: 25-08-2022
Accepted: 30-09-2022

Rupsingh Netam
Department of Genetics and Plant Breeding, CoA, IGKV, Raipur, Chhattisgarh, India

Shalu Kumari
Department of Genetics and Plant Breeding, CoA, IGKV, Raipur, Chhattisgarh, India

Ritu R Saxena
Department of Genetics and Plant Breeding, CoA, IGKV, Raipur, Chhattisgarh, India

NK Rastogi
Department of Genetics and Plant Breeding, CoA, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Rupsingh Netam
Department of Genetics and Plant Breeding, CoA, IGKV, Raipur, Chhattisgarh, India

Identification of donors for late sown condition under rice based cropping system in chickpea (*Cicer arietinum* L.)

Rupsingh Netam, Shalu Kumari, Ritu R Saxena and NK Rastogi

Abstract
The experiment was conducted using thirty-seven desi chickpea genotypes. Observations on quantitative traits had been noted on five plants which were chosen from every plot and replications at different growth stages. Variance analysis relates to observable variations for any trait in individuals. The mean sum of squares due to genotypes studied for all the yield characters reveal that the seed yield and its component traits seem to have considerable genetic variability which can be utilized in selection. Out of 37 genotypes studied, two genotypes namely, RKG 21-4 and PBC 626 showed extra early flowering (<40 Days) whereas, five genotypes *viz*., BG 4032; RSGD-984; BG 372 (ch); RKG 21-3 and RKG 21-4 recorded early maturity (<90 days) in late sown condition under rice based cropping system; genotypes, GNG-2555; BRC-8; NBeG 1634; GL18148 and IPC 2017-373 possessed height of first pod *i.e.,* more than 30 cm. Twenty genotypes had very small hundred seed weight (< 25g), 15 genotypes had small hundred seed weight (20-25 g), and two genotypes had medium hundred seed weight (26-35 g). For high seed yield per plant, entries RVG 203 (ch); IPC 2006-77 (ch); Phule G 1314-3-27 and NDG 17-6-3 possessed high yield under rice based cropping system. PCV values are higher than GCV values which showed that there is variability among genotypes. High magnitude of PCV coupled with GCV was exhibited by secondary branches, pods per plant, harvest index and plot yield in grams. Days to flowering and plant height were the two traits which showed along high heritability with high genetic advance. Plot yield in grams showed significant and positive association with seed yield per plant, harvest index and pods per plant both at phenotypic and genotypic level. Biological yield, harvest index and pods per plant exhibited positive direct effect on seed yield per plant.

Keywords: Chickpea, variance, GCV, PCV, Late sown condition, rice based cropping system

Introduction
Chickpeas (*Cicer arietinum* (L.) 2n = 2x = 16] belong to the *Cicer* genus, Cicereae tribe, Leguminosae and subfamily Papilionaceae commonly known as gram, Bengal gram or chickpeas. They are the most important cold-season edible grain legumes in the world after common beans (*Phaseolus vulgaris* L.) and peas (*Pisum sativum* L.). It originated in south-eastern Turkey (Ladizinsky, 1975) [5]. It is an annual, self-pollinated diploid legume crop. In Indian agriculture, chickpea crops have played a significant role. They are high in protein and help to keep cropping system productive. India leads the world in both area and yield of pulses, but there is still a large disparity between demand and supply.

Chickpeas rank third in the global legumes category, with India being the main producer, followed by Pakistan and Turkey (Source: FAO) as the main producing countries. This is the most widely grown legume crop in India, accounting for 40 % of total production (source: FAO), making it the world's leading producer of chickpeas. India produces about 6 million tons of gram (Source: FAO), accounting for a major share of about 70% of the world's total production (Source: Farmer Portal, farmer.gov.in).

The world's area, output and productivity are 13.7Mha, 14.24 MT, and 1038.4 Kg/ha, respectively (FAOSTAT, 2019) [17], compared with Kabuli, India mainly produces desi chickpeas. The area, yield, and productivity of chickpeas in India are 9.5 trillion hectares, 9.93 tons, and 1041.1 kg/ha (Source: FAOSTAT, 2019) [17]. The current area and yield of Chhattisgarh is 293,000 hectares and 203,000 tons (Source: Ministry of Agriculture and FW, Government of India, 2018) [18].

Rice based copping system can be described as mix of farming practices that comprises of rice as the major crop followed by subsequent cultivation of other crops. Rice based copping system is a major cropping system practices in India, which include the rotation of crops involving cereals, pulses, oilseeds, etc. Chickpea crop is taken after *Kharif* crops (mainly rice) in India. This type of cropping system is known as rice based cropping system.

Rice based Cropping System – A new cropping system helps farmers grow two crops a year where before they could only grow one crop. The new system combines early and late ripening varieties of rice with chickpeas. Because the long duration rice varieties can be harvested too late, there's time to sow a chickpea crop for late sown condition to take advantage of the moisture still left in the soil and the land wasn't left fallow. Now, farmers can grow an extra crop, a big advantage where there is no need to irrigation.

Paddy is the main crop of Chhattisgarh which is cultivated in large area. The rice crop is planted in different periods, namely early, mid and late, according to soil type and water availability. Generally, early rice is harvested in the last week of October, medium duration rice is harvested in the second week of November, and late-maturing rice is harvested in the first week of December. In the late maturity field of paddy or in the late sown rice field, farmers can sow the late sown varieties of chickpea (which matures early), so that the field will not remain fallow in winter season and the farmer will also get some good income and also increase rice and chickpea productivity, production potential and economic returns, improvement of cropping system may play a vital role.

Material and Methods

The present investigation was carried out during *Rabi*, 2021-22, at Research cum Instructional farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, during the *Rabi* season of 2021-22. Chhattisgarh is situated between 17°14' N and 24°45' N latitudes and 79°16' E and 84°15' E longitudes. Raipur (C.G.) is lies at 21°16'N latitude and 81°36' E longitude with an altitude of (289.60 m) above mean sea level. The maximum monthly mean temperature was 36.52 °C during March, 2022 and minimum monthly mean temperature was 12.80 °C during January, 2022.

Thirty-seven genotypes of chickpea were taken for this research and were sown in the field, in RBD with 3 replications on 14th December, 2021. Each plot comprised of 4 rows of 4m length in each replication. The row x row and plant x plant distance of 30 cm and 10 cm and net plot area was 4.8 m^2. The seeds were pre-treated with Bavistin, Trichoderma, Rhizobium and PSB cultures. Fertilizer dose @ of 20:40:20 kg per hectare (NPK) was applied. Two irrigations were given to the trial after one month of sowing and after 45 days of first irrigation. Randomly five plants were selected from each of the plot in each replication for collecting data on yield and yield attributing traits.

The coefficient of variation for different traits was calculated as suggested by Burton and De Vane (1953) [4]. Broad sense heritability (Hanson *et al*., 1956) [2]; Expected genetic advance (GA) (Johnson *et al.*, 1955) [1] and correlation coefficient analysis at phenotypic and genotypic (Miller *et al*., 1958) [3] and coefficient analysis was done as suggested by Lenka and Mishra (1973) [7].

Results and Discussion

In the present study, the mean sum of squares due to genotype/treatments was found to be highly significant for all of the yield traits except seeds per pod which showed non-significant results presented in Table 1. This clearly illustrates that all genotypes have variability in all aspects. The fact that genotype x environment interaction accounts for such a large and reasonably significant portion of total variation indicates that genotypes react to the environment differently.

The estimates of various genetic parameters are presented in Table 2. High magnitude of PCV coupled with GCV was exhibited by secondary branches, pods per plant, harvest index and plot yield in grams. For the trait, pods per plant, Sharma and Saini 2010 [6]; Jha *et al*., 2015 [9] and Mishra *et al*., 2014 [10] reported same findings. Likewise for secondary branches, Sharma and Saini 2010 [6] found same results. Moderate values of PCV coupled with GCV were recorded by traits namely, days to 50 per cent flowering and plant height. High PCV coupled with moderate GCV were shown by height of first pod, primary branches, and seeds per pod, hundred seed weight, biological yield and seed yield per plant. PCV values are higher than GCV values; it means that apparent variation is not only due to genotype but also due to the influence of environment. Sometimes the selection based on such traits which have high PCV than GCV may be misleading. However, the relative values of these types of coefficients give an idea about the magnitude of variability present in the genetic population.

High estimates of heritability **(**h^2_{bs}) were observed for days to maturity followed by plant height and days to 50 per cent flowering. This indicate that though these characters are least influenced by the environmental effects, the selection for the improvement of such traits may not be useful, because broad sense heritability is based on total genetic variance which includes both fixable (additive) and non-fixable (dominance and epistatic) variances. For plant height, Mallu *et al*., 2014 [7]; for days to flowering, Mallu *et al*., 2014 [7], Nizama 2013 [12], Puri *et al.*, 2013 [13], Babbar *et al*., 2012 [14] found same results. Similarly, for days to maturity, Monpara and Dhaneliya, 2013 [15] and Babbar *et al*., 2012 [14] reported the same findings. However, the moderate values of heritability were recorded by height of first pod and rest of the traits had low values of heritability. This indicates that the trait is highly influenced by the environmental effects and genetic improvement through selection will be difficult due to masking effects of the environment over the genotypic effects. High heritability indicates that all of the traits under investigation have a good index of transmission.

High values of genetic advance as percent of means were recorded by days to 50 % flowering, plant height, height of first pod, secondary branches, seeds per pod, hundred seed weight, harvest index and plot yield in grams. This shows that the characters are governed by additive genes and selection will be rewarding for improvement of such traits. Three characters namely, pods per plant, biological yield and seed yield per plant exhibited moderate values of genetic advance. Days to flowering and plant height were the two traits which showed high heritability with high genetic advance. However, height of first pod showed moderate heritability with high genetic advance.

The days to 50 % flowering ranged from 37 to 64.33 days, with a mean value of 51.36 days (Table 3). The genotypes (RKG 21-4) and (PBC 626) recorded early flowering of 37.00 days and 39.33 days, respectively for days to 50 percent flowering, whereas, extra early flowering genotype PG 281 took 64.33 days for 50 percent flowering under late sown condition (Table 3). Similar result reported by Anusha *et al*., (2020) [16].

Crop maturity was reported to be ranged from 86 days to 102 days with an average of 96.56 days. The earliest physiological

maturing genotype was BG 4032 (86 days), while, GL16056 reported (102 days) late maturing than the other genotypes (Table 3).

The genotype IPC 2017-373 recorded maximum height of first pod (Table 4). The height of first pod varied from 16.27 cm to 40.13 cm, with a mean of 25.31 cm (Table 4). Five genotypes had tallest height (>30cm) of first pod, namely, GNG-2555 (30.40); BRC-8 (30.47); NBeG 1634 (31.73); GL18148 (34.53) and IPC 2017-373 (40.13).

The average hundred seed weight was 18.91 g ranging from 11.51 g to 27.40 g. The genotype, BG 372 (ch) had the lowest 100-seed weight, whereas the genotype IG21-06 had the highest 100-seed weight. 20 genotypes had very small seed weight (<25g), 15 genotypes had small seed weight (20-25 g), 02 genotypes had medium seed weight (26-35 g), and none of the genotype had large and very large seed weight (36-45 and >45 g) out of 37 genotypes investigated (Table 5).

Plot yield presented in Table 6 showed an average of 213.35 g with lowest and highest values of 14.67 g and 394.67 g, respectively. The genotype RKG 21-4 reported the highest plot yield value, whereas the genotype PG 281 recorded the lowest plot yield. This character's coefficient of variation was found to be 28.49 percent, suggesting that there is a lot of variance.

Table 1: Analysis of variance of thirteen yield and yield attributing traits in thirty seven chickpea geno types

SV	DF	DTF	DTM	PH	HOFP	PB	SB	SPP	PPP	HSW	BY	HI	SYP	PLYG
Replication	2	22.77	1.77	34.64	11.59	20.01	4.17	0.04	272.09	3.80	368.04	608.60	228.43	122288.62
Treatment	36	147.32**	65.76**	106.47**	68.48**	1.63*	6.48**	0.17	70.18**	54.33**	389.96**	302.81**	61.87**	34369.13**
Error	72	17.48	2.15	8.45	10.29	1.15	2.88	0.05	39.18	16.02	229.70	106.72	44.34	13461.21

* And ** significant at 0.05 and 0.01 probability level

Table 2: Genetic variability parameters for thirteen yield attributing traits

Parameters	DTF	DTM	PH	HOFP	PB	SB	SPP	PPP	HSW	BY	HI	SYP	PLYG
GM	51.36	96.56	41.33	25.31	3.31	4.62	1.25	15.79	18.91	38.56	38.31	14.41	213.35
Min.	37.00	86.00	30.67	16.27	2.00	2.87	0.93	3.60	11.51	20.00	15.86	6.00	14.67
Max.	64.33	102.00	55.80	40.13	4.80	9.53	2.07	28.80	27.40	69.33	59.42	26.67	395.67
PCV (%)	15.18	5.00	15.52	21.53	34.64	43.69	23.60	44.57	28.38	43.64	34.24	49.18	67.00
GCV (%)	12.81	4.77	13.83	17.40	12.02	23.70	16.34	20.36	18.90	18.96	21.11	16.78	39.13
h^2 $_{(bs)}$ (%)	71.23	90.81	79.45	65.33	12.04	29.42	47.96	20.87	44.36	18.87	37.99	11.65	34.11
GA as % of mean	22.27	9.36	25.40	28.97	8.59	26.48	23.32	19.16	25.93	16.96	26.80	11.80	47.08

DTF = Days to flowering; DM = Days to maturity; PH = Plant Height (cm); HOFP = Height of First Pod (cm); PB = Primary Branches; SB = Secondary branches; PPP = Pods per plant; SPP = Seeds per pod; HSW = Hundred Seed Weight (g); BY = Biological Yield (g); SYP = Seed yield per plant (g); HI = Harvest index (%); PLYG = Plot yield (g)

Table 3: Classification of chickpea genotypes based on days to flowering (DTF) and days to maturity (DM)

Classification	Entry no	Classification	Entry no
DTF		DTM	
Extra early (<40 Days)	RKG 21-4 (37.00) ; PBC 626 (39.33)	Early (<90 Days)	BG 4032 (86.00); RSGD-984 (86.33); BG 372 (ch) (87.67); RKG 21-3 (88.33); RKG 21-4 (89.00)
Early (40-60 Days)	BG 4032 (40.33); RKG 21-3 (41.00); PBC 624 (41.33); RVG 203 (ch) (41.67); RSGD-984 (42.33); IPCB 2014-88 (43.00); GJG 1810 (44.33); JG 2021-68 (45.67); IG21-06 (45.67); Phule G1216-10-17 (45.67); NBeG 1634 (49.00); RSGD-1155 (49.00); RVG 202 (ch) (50.33); NBeG 1423 (51.67); GJG 1907 (54.00); NDG 17-6-3 (54.00); BG 4031 (54.00); H 19-16 (54.33); IG21-05 (55.00); Phule G 1314-3-27 (55.00); IPC 2016-231 (55.33); JG 2021-71 (55.33); GNG-2555 (55.33); BG 372 (ch) (55.33); DC 2021-1664 (55.33); BRC-8 (55.33); H 19-12 (55.67); PG 282 (56.33); IPC 2006-77 (ch) (56.67); GL18148 (57.33); GNG-2549 (57.67); IPC 2017-373 (60.00)	Medium (90-100 days)	PBC 626 (90.67); RVG 203 (ch) (91.00); PBC 624 (91.00); IG21-05 (93.00); JG 2021-71 (95.33); RVG 202 (ch) (96.00); RSGD-1155 (96.00); Phule G1216-10-17 (96.00); JG 2021-68 (96.33); NBeG 1634 (96.67); RVSSG-109 (97.00); BG 4031 (97.67); GNG-2555 (98.00); GJG 1810 (98.33); Phule G 1314-3-27 (99.00); GJG 1907 (99.00); IG21-06 (99.00); H 19-12 (99.00); GNG-2549 (99.00); DC 2021-1664 (99.00); IPC 2016-231 (99.33); IPCB 2014-88 (99.33); H 19-16 (100.00); GL18148 (100.00); NBeG 1423 (100.33); BRC-8 (100.33
Medium (60-80 Days)	GL16056 (60.33); RVSSG-109 (63.00); PG 281 (64.33)	Late (>100 Days)	PG 281 (100.67); IPC 2006-77 (ch) (101.33); PG 282 (101.67); IPC 2017-373 (101.67); NDG 17-6-3 (101.67); GL16056 (102.00)

Table 4: Classification of chickpea genotypes based on height of first pod (HOFP)

Classification	Entry no
Short < 20cm	IPC 2006-77 (ch) (16.27); RVG 203 (ch) (16.33); GL16056 (19.47) RSGD-984 (19.53); PBC 626 (19.67)
Medium 20-30 cm	RKG 21-3 (20.07); RSGD-1155 (21.60); PBC 624 (22.20); JG 2021-71 (22.27); Phule G1216-10-17 (22.87); GJG 1810 (23.27); RKG 21-4 (23.33); RVG 202 (ch) (23.33); H 19-16 (23.53); PG 281 (23.53; JG 2021-68 (23.73); GJG 1907 (24.80); NDG 17-6-3 (25.00); BG 372 (ch) (25.07); BG 4032 (25.27); RVSSG-109 (25.33); IPCB 2014-88 (25.73); IG21-05 (25.80); IPC 2016-231 (26.00); IG21-06 (26.73); PG 282 (27.07); Phule G 1314-3-27 (27.40); BG 4031 (27.93); GNG-2549 (28.33); NBeG 1423 (28.93); C-21250 (29.33); H 19-12 (29.60)
Tall > 30 cm	GNG-2555 (30.40); BRC-8 (30.47); NBeG 1634 (31.73); GL18148 (34.53); IPC 2017-373 (40.13)

Table 5: Classification of chickpea genotypes based on seed index

Classification	Entry no	Classification	Entry no
Very small (<20 g)	BG 372 (ch) (11.51); IPC 2006-77 (ch) (13.51); JG 2021-68 (13.52); JG 2021-71 (13.56); RSGD-984 (14.16); PG 281 (14.35); RSGD-1155 (14.69); GNG-2549 (14.77); PBC 624 (14.94); H 19-12 (15.12); BG 4032 (15.14); GL16056 (15.37); PG 282 (15.58); BRC-8 (15.82); PBC 626 (16.22); RKG 21-3 (17.06); IPC 2016-231 (17.89); DC 2021-1664 (19.07); RKG 21-4 (19.61); Phule G 1314-3-27 (19.83)	Small (20-25 g)	NDG 17-6-3 (20.53); IPC 2017-373 (20.56); NBeG 1423 (20.67); BG 4031 (20.74); RVG 202 (ch) (21.27); RVG 203 (ch) (21.35); NBeG 1634 (21.44); GL18148 (21.45); IPCB 2014-88 (22.02); RVSSG-109 (22.46); IG21-05 (23.15); Phule G1216-10-17 (23.51); GJG 1907 (24.21); GNG-2555 (24.23); GJG 1810 (25.48)
		Medium (26-35 g)	H 19-16 (27.40); IG21-06 (27.40)
		Large (36-45 g)	None
		Very large (>45 g)	None

Table 6: Classification of chickpea genotypes based on high seed yield (g)

Classification	Entry no
	SYP
High seed yield (>20 g)	RVG 203 (ch) (26.67); IPC 2006-77 (ch) (24.67); Phule G 1314-3-27 (20.00); NDG 17-6-3 (20.00)
Medium seed yield (10-20 g)	RKG 21-4 (19.33); IPCB 2014-88 (19.33); NBeG 1634 (18.00); RVG 202 (ch) (18.00); RSGD-984 (17.33); IG21-05 (16.67); GJG 1907 (16.67); IG21-06 (16.00); GL16056 (16.00); IPC 2016-231 (15.33); Phule G1216-10-17 (15.33); BRC-8 (15.33); BG 4032 (14.67); RSGD-1155 (14.67); BG 4031 (14.67); JG 2021-68 (14.00); GNG-2555 (14.00); NBeG 1423 (13.33); H 19-12 (12.67); RKG 21-3 (12.67); PBC 626 (12.00); JG 2021-71 (12.00); DC 2021-1664 (11.67); PBC 624 (11.33); RVSSG-109 (10.67); IPC 2017-373 (10.67)
Low seed yield (<10 g)	H 19-16 (10.00); GNG-2549 (10.00); PG 282 (9.33); GJG 1810 (8.67); BG 372 (ch) (8.00); GL18148 (7.33); PG 281 (6.00)

References

1. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variations in Soybean. Agron. J. 1955;47:314-318.
2. Hanson CH, Robinson HF, Comstock RE. Biometrical studies of yield in segregating populations of Korean Lespedeza. Agronomy Journal. 1956 Jun;48(6):268-272.
3. Miller PA, Williams JE, Robinson HF, Comstock RE. Estimates of variance and co-variance in upland cotton and their implications in selection. Agron J. 1958;50:126-131.
4. Burton GW, Vane EM. Estimating heritability in tall fescue (*Festuca circunclinaceae*) from replicated clonal material. Agronomy journal. 1953 Oct;45(10):478-481.
5. Ladizinsky G. A new *Cicer* from Turkey. Notes from the Royal Botanic Garden, Edinburgh. 1975;34:201-202.
6. Anonymous. Project Coordinator's Report, All India Coordinated Research Project on chickpea. Indian Institute Pulses Research, Kanpur; c2014. p. 29.
7. Lenka D, Mishra B. Path coefficient analysis of yield in rice varieties. Indian J. Agric. Sci. 1973 Jan;43(4):376-379.
8. Sharma LK, Saini DP. Variability and association studies for seed yield and yield components in Chickpea (*Cicer arietinum* L.), Res. J Agric. Sci. 2010;1(3):209-211.
9. Jha UC, Basu P, Singh D. Genetic variation and diversity analysis of chickpea genotypes based on quantitative traits under heat temperature stress. International Journal of Bio-Resource and Stress Management. 2015;6(6):700-706.
10. Mishra S, Babbar A. Selection strategies to assess the promising kabuli chickpea promising lines under normal and heat stress environments. Electronic Journal of Plant Breeding. 2014 Nov 21;5(2):260-267.
11. Mallu TS, Mwangi SG, Nyende AB, Rao NG, Odeny DA, Kumar RA. Assessment of genetic variation and heritability of agronomic traits in chickpea (*Cicer arietinum* L.) International Journal of Agronomy and Agricultural Research; (IJAAR). 2014;5(4):76-88.
12. Nizama JR. Genetic variability and heritability among quantitative traits in chickpea under tropical region. Asian Resonance. 2013;5(2):45-48.
13. Puri MK, Johnson PL, Sharma RN. Study of variability, diversity and association analysis of chickpea (C*icer arietinum* L.) germplasm under normal and late sown condition of Chhattisgarh state. Trends in Biosciences. 2013;6(6):723-731.
14. Babbar A, Prakash V, Tiwari P, Iqbal MA. Genetic variability for chickpea (*Cicer arietinum* L.) under late sown season. Legume Research: An International Journal. 2012 Mar 1;35(1):1-7.
15. Monpara BA, Dhameliya HR. Genetic behavior of earliness related traits and seed yield in chickpea (*Cicer arietinum* L.). Pakistan Journal of Biological Sciences: PJBS. 2013 Sep 1;16(18):955 - 959.
16. Anusha T, Trivikrama A, Reddy V, Jayalakshami, Ahammed KS. Genetic variability studies for yield and quality traits in chickpea (*Cicer arietinum* L.). Int. J Curr. Microbial. App. Sci. 2020;9(09):2995-3000.
17. Food and Agriculture Organization of the United Nations (FAO). FAOSTAT Statistical Database, Statistical Division. Rome; c2019.
18. Government of India. Millennium development Goals, India Country Report 2015. Minsitry of Statistics, Planning and Implementation. Govt of India, New Delhi; c2016. Available from: Accessed March 03, 2018. https://doi.org/mospi.nic.in/sites/default/files/publication_reports/mdg_2july15_1.pdf.