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Research Paper

Effect of dual pods on seed yield and seed weight in chickpea (*Cicer arietinum* L.) genotypes in South Eastern Rajasthan

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Abstract : Chickpea (*Cicer arietinum* L.) is the most important pulse crop of India and Rajasthan owing to its role in combating malnutrition besides integral component in crop rotation and maintaining soil fertility. A few chickpea genotypes bearing double pods were assessed to study the effect of double pods on seed weight and seed yield of chickpea.The genotypes RKGDP 10 and RKGDP 20 were observed to be high yielding owing to their high number of total pods per plant along with higher number of double pods. The study emphasized the importance of higher number of pods and double pods for achieving higher yield levels but with decreased seed size.

Key Words : Chickpea, Double pods, Seed weight, Yield

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Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop contributing 39 and 48 per cent, respectively, to the total area and production of pulses in the country. The productivity of chickpea is higher than the national productivity of pulses. Pulses are an integral component in a balanced vegetarian diet as a source of protein to combat malnutrition besides playing an important role in crop rotation and maintaining soil fertility. In India, chickpea is cultivated in an area of 9.67m.ha. with the production of 10.09 m. tons and productivity of 1043 kg/ ha (2018-19). It occupies 1.57 m. ha. area in Rajasthan giving production of 1.68 m.tons (2017-18) while zone V (humid south eastern plain zone) contributes 3 and 5 per cent, respectively to the total area and production of the state with the productivity higher than the national and state average. Although, India is the highest producer of chickpea, yet has to import it from other countries to meet the huge domestic demand. Therefore, increasing chickpea production through effective breeding approaches is a prime concern of Indian agriculture.

Most of the chickpea germplasm accessions produce a single flower at each flowering node, but some lines produce two, three or more flowers per axis and have the potential to form more than two pods per peduncle. Varieties having two flowers per peduncle were first described by Shaw and Khan (1931). Thus, chickpea bears both single and double pods per peduncle;

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however, single pod is dominant over the latter. The triple-owered trait (st) in the domestic chickpea is controlled by a single recessive gene. The double-owered trait (sd) is dominant over the triple-owered trait and the dominance relationship of these alleles at the S locus was reported to be S (single ower) >sd (double ower) >st (triple ower) (Srinivasan *et al.,* 2006). Keeping in view the importance of chickpea, a few chickpea genotypes along with check bearing double pods were assessed for yield and yield contributing traits to study the effect of double pods on seed weight and seed yield of chickpea.

Material and Methods

The experimental trial was conducted at Agricultural Research Station, Kota (Agriculture University, Kota) during *Rabi* 2019-20 with twenty three double podded genotypes including check in Randomized Block Design with three replications. The spacing between row to row and plant to plant was maintained at 30 and 10 cm, respectively. All the recommended package of practices was followed to raise a good crop. The observations were recorded on randomly selected five competitive plants from each plot for yield and yield contributing traits *viz*., total number of pods per plant, number of single pods per plant, number of double pods per plant, 100-seed weight (g) and seed yield (kg/ha).

Results and Discussion

The details of the genotypes, yield and yield contributing characters are provided in Table 1. Out of the twenty three genotypes studied, highest number of pods per plant was observed in the genotype RKGDP 20 (177) and RKGDP 11 (174.9) followed by RKGDP 16 (166.8), RKGDP 15 (165.8) and RKGDP 10 (164.5). Out of total number of pods per plant, highest number of double pods was observed in RKGDP 15 (132) and RKGDP 20 (127.9) followed by RKGDP 16 (126.9) and

Table 1 : Yield and yield contributing characters of double podded chickpea genotypes

Sr. No.	Genotypes	Pedigree	Total no. of pods	Total no. of double pods	Total no. of single pods	% double pods	Frequency of dual pods	Seed yield/plot (g)	100-seed wt.(g)	Growth habit
1.	RKGDP 1	GNG 469 X RKG 27-99-1	88	75	13	85.23	High	2186	19.23	SE
2.	RKGDP 2	GNG 469 X RKG 27-99-4	65.8	56.3	9.5	85.56	High	2002	16.97	SE
3.	RKGDP 3	JG 2000-87 X JG 2000- 14-6	69.5	59.6	9.9	85.76	High	2012	23.13	SS
4.	RKGDP 4	JG 2000-87 X JG 2000- 14-14	68.9	57.7	11.2	83.74	High	2362	20.73	SE
5.	RKGDP 5	GNG 1958 X JG 2000-14-3	87	74.8	12.2	85.98	High	2173	19.53	SS
6.	RKGDP 6	GJG 0604 X ICCV 96029-5	56.5	47	9.5	83.19	High	1836	18.90	SE
7.	RKGDP 7	IPC 12-39 X IPC 12-229-1	112.6	88.1	24.5	78.24	Moderate	2205	21.93	SE
8.	RKGDP 8	JG 2000-87 X JG 2000- 14-8	129.3	92.3	37	71.38	Moderate	1781	23.13	SS
9.	RKGDP 9	JG 2000-87 X JG 2000- 14-9	107.3	83.6	23.7	77.91	Moderate	2028	23.90	SS
10.	RKGDP 10	JG 2000 - 87 X JG 2000-14-10	164.5	122.8	41.7	74.65	Moderate	2362	23.00	SS
11.	RKGDP 11	GAG 0604 X ICCV 96030-1	174.9	110.7	64.2	63.29	Low	2142	29.30	SE
12.	RKGDP 12	GAG 0604 X ICCV 96030-2	89.8	65	24.8	72.38	Moderate	1774	20.17	E
13.	RSG 931 (C)		83.2	61.9	21.3	74.40	Moderate	1952	16.43	SS
14.	RKGDP 13	GNG 469 X RKG 27-99-2	127.9	109.5	18.4	85.61	High	1927	21.67	SS
15.	RKGDP 14	KAK 2 X IPC 2009 - 171-2	118.2	73.9	44.3	62.52	Low	1404	22.20	SS
16.	RKGDP 15	Phule G 07104 X IPC 2007-69-3	165.8	132	33.8	79.61	High	2102	17.80	SE
17.	RKGDP 16	PC- 1 X JG 2000-14-8	166.8	126.9	39.9	76.08	Moderate	1950	21.13	E
18.	RKGDP 17	GNG 1958 X RKG 13-511-2	84.8	58.9	25.9	69.46	Low	2038	19.13	SS
19.	RKGDP 18	GNG 1958 X RKG 13-511-3	151.7	112.9	38.8	74.42	Moderate	1183	16.80	SE
20.	RKGDP 19	GNG 1958 X RKG 13- 511-4	133.1	108.7	24.4	81.67	High	2318	20.93	SE
21.	RKGDP 20	GNG 1958 X RKG 13- 511-6	177	127.9	49.1	72.26	Moderate	2287	19.03	SE
22.	RKGDP 21	IPC 12-39 X IPC 12-229-7	87.9	60.5	27.4	68.83	Low	1525	27.70	SE
23.	RKGDP 22	JG 2000-14 X ICCV 96029-4	115.7	66.8	48.9	57.74	Low	2013	22.60	SE

RKGDP 10 (122.8). The highest seed yield was observed in the genotypes RKGDP 10 and RKGDP 4 (2362 kg/ha) followed by RKGDP 19 (2318 kg/ha), RKGDP 20 (2287 kg/ha) and RKGDP 7 (2205 kg/ha).The genotypes RKGDP 10 and RKGDP 20 were observed to be high yielding owing to their high number of total pods per plant along with higher number of double pods, thereby implying the importance of number of pods and double pods in achieving higher yields. The frequency of double pods was moderate to high in all these genotypes, suggesting that not all the double podded genotypes studied were high yielding, but only those in which the proportion of double pods to total number of pods was high. The genotypes RKGDP 1, RKGDP 2, RKGDP 3, RKGDP 4, RKGDP 5 and RKGDP 6, although had low number of total pods but had high frequency of double pods along with higher yields, may be due to higher number of seeds per pod, further implying that besides high number of double pods, number of seeds per pod should also be high to achieve higher yields ultimately. Single poddedness is a trait dominant over double poddedness (Kumar *et al*., 2000 and Kumar *et al*., 2003). Homozygous recessive allele of this gene (ss) governs the production of double flowers and pods per peduncle, therefore, it's difficult to obtain a plant having absolute double pods rendering any significant yield increase. However, once progeny in the F2 and F3 populations having two pods per axil are selected for this unique trait controlled by a single recessive gene, will not segregate in later generations (Muehlbauer *et al*.,1987). The lowest yield was observed in the genotypes RKGDP 18, RKGDP 14 and RKGDP 21 in which the frequency of double pods was, in general, low.

As per Singh and Rheenen (1989, 1994) the double-flowered trait enhances seed yield under certain environment. Kumar *et al.* (2000) also indicated that the double flowered trait is not stable trait. The"s" allele is variable for expression of double flower in certain environment and has unstable penetrance and variable expressivity. The allele appears to show greater penetrance and enhanced expressivity under soil moisture stress. It was also supported by Rubio *et al*. (1998) and Srinivasan *et al.* (2006) that the expressivity of this trait can be manipulated by changing the genetic background and the environmental conditions.

The double-podded trait in chickpea is a signicant trait for increasing yield (Sheldrake *et al*., 1978; Adak *et al*., 2017 and Koseoglu *et al*., 2017) and seed yield stability (Rubio *et al*., 1998 and Rubio *et al*., 2004). Progeny having double or more pods should be considered in breeding programmes because these progeny had higher numbers of pods and seeds per plant and seed yields than their counterparts. In contrary to these reports, no significant yield increase of double podded lines was observed over the single podded checks by Verma *et al*. (2019) which was also in conformity to the earlier studies by Knights (1987) and Rubio *et al*. (2004). Tarikul and Deb (2013) suggested that for realizing the possible potentiality of this trait, further studies are needed to investigate detailed reasons for variable expressivity of this recessive gene, so that stable high yielding, double-flowered and double podded genotypes can be developed for yield improvement in chickpea.

The 100-seed weight of all these genotypes was below 25g indicating their seed size to be small to medium bold. This is in conformity to the earlier report by Kumar *et al*. (2000) who also reported that although, the increased number of pods and seeds contributes to the higher yield but, there was a slight decrease in seed size of the double-podded genotypes. An increase in the size of seed may have a role in the decreased penetrance and expressivity of this allele among the double-podded segregants. Seed size in chickpeas is not only governed by genetic factors but also aected by environment (Muehlbauer *et al*., 1987; Toker, 1998; Upadhyaya *et al*., 2006) generally having a high heritability (Muehlbauer *et al*., 1987 and Koseoglu *et al*., 2017). On the contrary, Rubio *et al.* (2004) suggested that the double pod gene has no effects on both yield and seed size, although, confers a higher yield stability than the single pod gene. The mean yield of the lines with bushy growth habit, across all environments, was higher than that of the erect habit lines. The growth habit of most of the high yielding genotypes identified in the present study was also semi spreading to semi erect, therefore, in conformity to the earlier studies.

Conclusion:

The results of the present study emphasize the importance of higher number of pods, double pods and seeds per pod for achieving higher yield levels with decreased seed size. Thus, it can be concluded that all the double podded genotypes may not be necessarily high yielding but only those in which the frequency of double pods is higher, leading to higher number of total pods per plant and seeds per pod. However, the results may vary with the material studied, methodology used, sample size and the prevailing environmental conditions.

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