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Genetics of Double Poddedness and its Significance in Improvement of Chickpea (*Cicer arietinum* L.)

V. S. Girase* and R. B. Deshmukh

Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (M.S.), India

ABSTRACT

The results of present studies revealed that singal recessive gene governed the double poddedness in chickpea, single poddedness being dominent over the double poddedness. The F_2 population of both the crosses segregated in the ratio of 3 SP : 1 DP. Non-significant X^2 values with probability between 0.30 - 0.70 indicated good fit to the observed ratio. Further, non-significant X^2 value with probability between 0.20 - 0.30 in backcross population confirmed the monogenic F_2 ratio. Number of pods exhibited positive and stronger association with grain yield but its association with 100 seed weight was negative in both the cases. This indicated that there could be possibility of reduction in seed size while selecting high yielding plants. Hence due weightage should be given to yield as well as seed size while effecting selection. Further, regression analysis revealed that, the grain yield was more dependent on double pods/plant than single pods/plant.

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INTRODUCTION

Chickpea is the important crop for human nutrition and soil health. Normally, chickpeas have one flower or pod on each peduncle, but double pod types are not uncommon. Double pod (DP) types produced 6-11 per cent more grain yield than single pod - (SP) types (Sheldrake *et al.*, 1978). Double poddedness in chickpea is an important attribute which could be exploited in developing drought tolerant short duration varieties for cultivation in central and South Indian states, where growing season is short as compared to northen states. Such genotype may also find a place in northen states where chickpea is growm late in December.

This character is useful under adverse growing conditions but in general it associated with small seed size and susceptibility to *Fusarium* wilt. JG-62, Selection 436 and others are the known examples. Hence present investigation was undertaken to know the genetics of double poddedness and feasibility for developing double podded genotypes with bold seed size and resistance to wilt.

MATERIALS AND METHODS

Artificial crossing in chickpea is tidious, hence two crosses and their backcrosses were effected for present study. Parents, F_1, F_2 and BC_1 generation of two crosses viz., JG-62 x Vijay and JG-62 x ICC-4958 involving three diverse parents namely, Vijay (Single pod, wilt resistant), JG-62 (double pod, small seed) and ICC-4958 (single pod, bold seed) were grown in compact family block design with three replication. Single row was assigned for parents, F_1, BC_1 and 30 rows for F_2 generation, spaced 30 cm apart with plant to plant

* Cotton Improvement Project, M.P.K.V., Rahuri-413 722 (M.S.).

distance of 15 cm. Single and double pod plants were counted in all the generations. Chi-square (X^2) test (Fisher, 1941) was used for testing the goodness of fit. For correlation analysis 20 single and double podded plant were selected and obeserved separately for number of pods/plant, 100-seed weight and grain yield/plant in each cross.

Correlation of total number of pods with 100 seed weight and grain yield/plant was estimated separately for single and double podded plants to understand the exact role of double poddedness in determining grain size and yield per plant.

RESULTS AND DISCUSSION

In double podded plants, it was observed that flowers are generally produced in twin conditions but, only few axile/peduncle produce double pods. This depends upon genotype and the environmental conditions. In the present investigation the crosses JG-62 x Vijay and JG-62 x ICC-4958 showed 14 and 11 per cent, respectively double podded plants in F_2 generation, while the well established double podded genotype JG-62 showed 70% double podded plants. However within double podded plants the double podded axils ranged from 2 to 38 per cent in cross JG-62 x Vijay and from 3 to 32 per cent in cross JG-62 x ICC-4958 in F_2 population. In general double podded percentage is higher in small podded plants than bold one. Higher percentage of double pods does not necessarily mean the more number of double pods or total pods per plant. Hence due consideration should be given to more number of double pods or total pods rather than higher precentage of pods, while exercising selection.

In persent studies both the crosses produced single podded F_1s which indicated the dominance of single poddedness over the double poddedness. The F_2 population of both the crosses segregated in the ratio of 3 SP : 1 DP. Non-significant X^2 value in cross 1 (X^2=0.67, P=0.30-0.50) and cross 2 (X^2 = 0.36, P = 0.50 - 0.70) indicated good agreement between observed and expected frequencies (Table 1). This indicated that single recessive gene was involved in the expression of double poddedness. Athwal and Brar (1964) also reported single recessive gene for double poodedness in chickpea. These monogenic F_2 ratios were confirmed by growing backcross population (90 plants in each cross) of both the crosses, which segregated in the ratio of 3 SP : 1 DP (Table 2). Non-significant X^2 value having probability between 0.20 - 0.30 in both the crosses confirmed the observed F_2 ratio (3:1). It was believed that, the double pod gene is linked with one of the wilt susceptible genes and double podded types generally were susceptible to *Fusarium* wilt. However through breeding, wilt resistance segregants with double podded character have been isolated (Kumar amd Haware, 1983b; Girase, 1999).

TABLE 1

Segregation for double poddedness in F_2 generation of two crosses in chickpea.

Cross	*Class*	*No. of F_2 plants*		*Deviation*	*X^2*	*P-*	*Ratio*
		Observed	*Expected*	*(0-E)*		*value*	
JG-62 X Vijay	SP	345	337.5	-7.5	0.17	—	3:1
	DP	105	112.5	7.5	0.50	—	
	Total	450	450.0	0.0	0.67	0.30 0.50	3:1
JG-62 X ICC-4958	SP	343	337.5	5.5	0.09	—	3:1
	DP	107	112.5	-5.5	0.27	—	
	Total	450	450.0	0.00	0.36	0.50- 0.70	3:1

TABLE 2

Segregation for double poddedness in BC_1 generation of two crosses in chickpea.

Cross	Class	No. of BC_1 plants		Deviation (0-E)	X^2	P-value	Ratio
		Observed	Expected				
JG-62 X Vijay	SP	50	45	5	0.56	—	1:1
	DP	40	45	-5	0.56	—	
	Total	90	90	0		0.20-0.30	1:1
JG-62 X ICC-4958	SP	51	45	6	0.80	—	1:1
	DP	39	45	-6	0.80	—	
	Total	90	90	0	1.60	0.20-0.30	1:1

SP = Single podded plants. DP = Double podded plants.

Correlation analysis revealed that grain yield positively and significantly associated with pods per plant in single as well as double podded plants. Singh *et al.* (1997) also reported significant positive association between number of pods/plant and grain yield. However, 100 seed weight exhibited non-significant positive association with grain yield in single podded plants, whereas, its association with yield in double podded plants was negative but non-significant. Similarly 100 seed weight showed non-significant negative correlation with number of pods per plant in both single and double podded plants. Negative association between yield and 100 seed weight in double podded plants indicated that, there could be possibility of reduction in seed size while selecting high yielding plants. So it is better to consider yield as well as bold seed size simultaneously while selecting desirable segregants. Further negative association could be disrupted by biparental mating between segregants in F_2 generation followed by selection of high yielding bold seeded plants. It is concluded that pods/plant is an important trait in improvement of yield in both single and double podded chickpea. Further association of pods/plant with yield was greater in double podded plants (0.953**) than single podded plants (0.829**). It was also interesting to know that, the association of number of single pods (0.87*) and double pods (0.44*) from double podded plant with grain yield was significantly positive. Further, regression analysis revealed that, grain yield was more dependent on double pods/plant (0.37**) than single pods/plant (0.13**) and both these traits contributed 92 per cent variability in grain yield. These finding enlighten that further improvement in grain yield of chickpea could be achieved by exploiting double poddedness in this crop by adopting the concept of transgressive segregation followed by selection.

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