Indian J. Genet., 70(4): 383-385 (2010)

Short Communication

Genetics of bushy growth habit and its implications in chickpea improvement

J. S. Sandhu, S. K. Gupta[1], Inderjit Singh, B. S. Gill and R. Bhardwaj*

Dept. of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana 141 004
[1]ICRISAT, Patancheru, Hyderabad

(Received: May 2010; Revised: September 2010; Accepted: October 2010)

Chickpea (*Cicer arietinum* L.) plant is generally erect, semi-erect, spreading, semi-prostrate or prostrate (mainly wild annual *Cicer* species) in growth habit depending on the angle of branches arises from the vertical axis. Spontaneous mutations are the source of genetic variability and have resulted into dwarf erect compact type plants with high number of branches arising from base, commonly called as "bushy mutants" in chickpea [1-3]. In a study [4], it was reported that mean yield of the lines with bushy growth habit, across all environments, was higher than that of the erect habit lines. Thus, two bushy lines GL 23137 and GL 23138 were isolated from segregating population of a wide cross of chickpea for their use in chickpea improvement. These bushy lines were diverse in origin from the previously reported bushy mutants. Therefore, the present study was planned to workout the genetics of growth habit and its implication in chickpea improvement.

Two bushy lines GL 23137, GL 23138 and one erect and tall line, GG 1267 were selected for this study and their characteristics are given in Table 1. The bushy lines GL 23137 and GL 23138 differed from each other in growth habit; GL 23137 is erect, compact and dwarf while GL 23138 is semi-prostrate at early stage, compact and dwarf. The GG 1267 is tall and erect i.e. of normal growth habit and possesses resistance to ascochyta blight (*Ascochyta rabiei*). Both bushy lines were crossed as male parent with GG 1267 during crop season 2006-07. Their F_1's were advanced to F_2 and at the same time fresh F_1's and BC_1's and BC_2's generations were also developed. All the five generations *viz*., parents, F_1's, F_2's and BC_1's and BC_2's were raised during 2008-09. At 90 days after sowing, growth habit of the plant was recorded into two categories-bushy or normal growth habit. The χ^2 test was applied to find the most fitted genetic ratios.

The perusals of results are presented in Table 2. The F_1's of both the crosses were normal in growth habit thus showing its dominance over bushy plant type. The F_2 generations of both the crosses segregated into two phenotypic classes of normal and bushy plant types and showed a good fit to the ratios of 13 normal : 3 bushy. This indicated digenic inhibitory gene action and dominance of normal plant type. It also suggested that one of the gene controlling the normal plant type masked the effect of corresponding gene responsible for bushy growth habit. The BC_1 generations of both the crosses did not segregate and all the plants were of normal plant type. However, the BC_2 generations in both the crosses showed 1 normal : 1 bushy plant type segregation pattern which confirmed the digenic inheritance of normal plant type. It also indicated that normal plant habit was controlled by one dominant and one recessive gene. The recessive gene for normal plant type was not able to express in the presence of dominant gene for bushy plant type and the dominant gene for normal plant type was inhibitory to the dominant gene for bushy plant type. Based on these results, the following gene symbols can be assigned to parents:

*Corresponding author's e-mail: js_sandhuin@yahoo.co.in
Published by Indian Society of Genetics & Plant Breeding, F2, First Floor, NASC Complex, PB#11312, IARI, New Delhi 110 012
Online management by indianjournals.com

Parent	Growth Habit	Genotype Proposed
GG 1267	Tall	AAbb
GL 23137	Bushy	aaBB
GL 23138	Bushy	aaBB

Recessive factor governed monogenic inheritance of bushy character whereas dominant factor governed normal plant type was reported [5] from a study on spontaneous macro mutant derived from a green seeded variety L 168. However, this study reports digenic inheritance of normal/bushy plant type where dominant gene for normal plant type inhibits the effect of dominant gene for bushy plant type. The difference in genetic control of bushy plant type of present study was due to diverse genetic origin from the previously reported mutants and genetic control in both bushy lines were same as evident from their origin.

It was interesting to observe the busy plants of different plant height in F_2 populations of both the crosses (Fig. 1). Thus, bushy plants with medium plant height has great practical significance. These bushy plants were erect, compact and lodging resistant. These recombinants are being carried forward to develop the stable lines and populations of F_2 crosses for the development of RILs. The bushy recombinants with medium plant height will be highly suitable for irrigated and heavy soils of north India where recommended varieties generally lodge due to excessive growth leading to low yields. The new compact plant type will also allow more population per unit area to achieve high yield and also suit for mechanical harvesting. Furthermore, new compact plant type allows more aeration in canopy and that will help to escape the crop from the devasting foliar diseases, ascochyta blight (*Ascochyta rabiei*) and botrytis gray mold (*Botrytis cinerea*). On the other hand, RILs developed from these populations will help to tag the genes for bushy trait and their further manipulations. Thus, new plant type

Table 1. Distinguishing characters of bushy mutant and normal parents involved in the cross

Parents/mutant	Pedigree	Plant height (cm)	No. of primary br/plant	No. of secondary br/plant	No. of pods/ plant	Pod size	Growth habit
GG 1267	FG190xPBG 1	42.10	1.10	7.30	22.80	Large	Normal
GL23138	BG256x*C.judaicum* No. 185	24.00	4.40	14.4	16.0	Small	Prostrate and bushy dwarf
GL 23137		17.10	2.90	12.0	15.90	Small	Dwarf

Table 2. Segregation for growth habit in different generations of chickpea crosses

Cross/Generation	Observed		Expected		χ^2 value	Remarks
	Normal	Bushy	Normal	Bushy		
Cross GG 1267 x GL23137						
F_1	20	-	20	-	-	-
BC_1 (F_1 x GG 1267)	24	0	24	0	-	Justifies 13:3 ratio
BC_2 (F_1 x GL 23137)	10	9	9.5	9.5	0.053	Good fit for 1:1 ratio as non-significant at 5%
F_2	1400	278	1363	315	5.34	Good fit for 13:3 as non-significant at 1%
Cross GG 1267 x GL 23138						
F_1	20	0	20	-	-	-
BC_1 (F_1 x GG 1267)	22	0	22	0	-	Justifies 13:3 ratio
BC_2 (F_1 x GL 23138)	13	12	12.5	12.5	0.04	Good fit for 1:1 ratio as non-significant at 5%
F_2	1487	310	1460	337	2.65	Good fit for 13:3 as non-significant at 5%

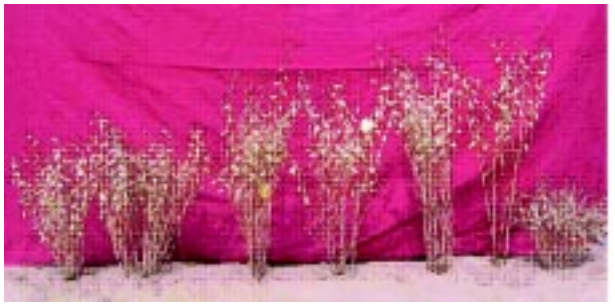

Fig. 1. Bushy plants with different growth habit 1: Parent, 2: Normal Parent, 3-7: Recombinants varying in plant height

will be a key factor for the revival of chickpea crop in north India being suitable for heavy soil, facilitate mechanical harvesting to achieve higher yields for comparative economic returns in comparison to competitive wheat crop of the region.

References

1. **Athwal D. S., Bhalla S. K., Sandhu S. S. and Brar H. S.** 1970. A fertile dwarf and three other mutants in *Cicer*. Indian J. Genet., **30**: 261-266.
2. **Singh H. and Dahiya B. S.** 1974. A note on inheritance of bushy mutant in chickpea. Curr. Sci., **43**: 731-732.
3. **Sandhu J. S., Brar H. S. and Verma M. M.** 1990. Inheritance of a plant type mutant and its utilization in chickpea. Euphytica., **48**: 111-112.
4. **Rubio J., Flores F., Moreno M. T., Cubero J. I. and Gil J.** 2004. Effects of the erect/bushy habit, single/double pod and late/early flowering genes on yield and seed size and their stability in chickpea. Field Crops Res., **90**: 255-262.
5. **Dahiya B. S., Lather V. S., Sollanki I. S. and Ram Kumar.** 1984. Useful spontaneous mutants in chickpea (*Cicer arietinum* L.). Curr. Sci., **53**: 1210-1211.