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Research Note

Inheritance of some morphological characters in chickpea (*Cicer arietinum* L.)

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Abstract
The present investigation was undertaken to generate information on the inheritance of flower colour, leaflet size and pigmented stem in chickpea (*Cicer arietinum* L.). Parents, F_1's, and F_2's of crosses Vijay x PKV-4, Digvijay x PKV-4 and BDNG-797 x PKV-4 were evaluated during *rabi*, 2018-19. The monogenic inheritance was confirmed for two traits, pink *vs.* white flower colour and pigmented *vs.* non pigmented stem pigmentation. Leaflet size, small *vs.* broad was controlled by duplicate gene action. The genetic inheritance of these morphological traits is essential for the selection of superior and desirable transgressive segregants for the genetic improvement of the crop. These results are of essential significance because these traits are used as visual markers in chickpea breeding for early recognition of the hybrid nature of plants.

Key words: Chickpea, Inheritance, morphological traits.

In India, chickpea (*Cicer arietinum* L.) is cultivated at about 10.56 m. ha. area with a production of about 11.23 m.t. and productivity of 1063 kg/ha, which is lower than the global average. The low productivity could be ascribed to biotic and abiotic stresses, narrow genetic bases and poor management practices, etc. There are two distinct types of cultivated chickpea these are classified as *desi* and *kabuli*. Both types had been geographically isolated for many years are having great contrast for various plant architectural and yield component traits. Therefore, it may be possible to improve yield by transgressive hybridization. For that matter, it is essential to have knowledge about the mode of inheritance of the traits. Genetics of several morphological traits in chickpea has been reported by Rao *et al*. (1980), Tefera (1998), Sayyed (2000), Burse *et al*. (2017) and Gediya L.N. *et al.* (2018). The present study was, therefore, aimed to study the genetics of three morphological traits *viz.,* flower colour, leaflet size and stem pigmentation in three crosses involving *desi* and *kabuli* parents.

The experimental material comprised of three crosses *viz.,* Vijay x PKV-4, Digvijay x PKV-4 and BDNG-797 x PKV-4. The female parents were having pink flower colour, small leaflet size and pigmented stem and the male parent, PVK-4 were with white flower colour, broad leaflet and non pigmented stem (**Table .1)**. The crosses were made during *rabi,* season 2017-18 to obtain the first filial (F_1) generation. Evaluation work was carried out with parents, F_1's, and F_2's which were grown during *rabi* 2018-19 at the Research Farm of Agricultural Botany Department, College of Agriculture, Latur in Randomized Block Design (RBD). Sowing was carried out at the spacing of 30 cm and 10 cm between the rows and plant, respectively. The dibbling method was used for sowing. At the time sowing recommended dose of fertilizer was 25 kg N + 50 kg P_20_5 per hectare as well as other cultural practices were taken. During the period when the experiment was in the field, the weather condition remained suitable for the healthy growth of the crop. Observation took randomly selected plants in the F_1 generation and in F_2 on an individual

Table 1. Characteristics of parents and their F_1s

S. No.	Name of parents and crosses	Flower colour	Leaflet chape	Stem pigmentation	Seed type
1	Vijay	Pink	Small	Pigmented	Desi
2	BDNG-797	Pink	Small	Pigmented	Desi
3	Digvijay	Pink	Medium	Pigmented	Desi
4	PKV-4	White	Large	Non Pigmented	Kabuli
5	Vijay × PKV-4	Pink	Medium	Pigmented	-
6	Digvijay × PKV- 4	Pink	Medium	Pigmented	-
7	BDNG-797 × PKV-4	Pink	Medium	Pigmented	-

plant basis. Flower colour was recorded at the time of flowering and it was recorded as white and pink colour. Leaflet size was observed on two leaves per plant on the fifth or sixth leaf from the top of primary branches for this measurement and sampling done at the time of 50% flowering. Stem pigmentation observation was made twice on single plants basis and recorded as pigmented or non pigmented (DUS test by PPV and FR Authority GOI, 2007). The chi-square test was applied to the observed segregation in the F_2 generations of the three crosses.

Flower colour is a useful morphological marker in chickpeas. The information on the inheritance of such morphological character would be helpful to the chickpea breeder in changing the architecture of the plant because flower colour is a valuable morphological marker in cultivated chickpea and also help in the early recognition of the hybrid character of plants (Hasan and Deb, 2013).

In the present investigation, inheritance of flower colour was studied in three crosses *viz*., Vijay x PKV-4, Digvijay x PKV-4 and BDNG-797 x PKV-4. The female parents, Vijay, Digvijay and BDNG 797 were pink flowered and male parent PKV-4 was white flowered (**Table 2 & Plate 1)**. All three crosses between pink flowered and white flowered parents gave pink flowered F_1. A good fit to a 3: 1 ratio for pink and white flowered plants was observed in the F_2 of all crosses with non significant X^2 values. The ratio was confirmed by non significant value of the analysis of the heterogeneity among the crosses ($X^2_{\text{Heterogeneity}} = 0.249$ at df = 2; p = 0.882), suggesting that the white colour is recessive over pink colour and inherited mono-genically. It was noted that, in chickpea, single gene inheritance has been reported between pink and white flower colour parents by several researchers such as Pimplikar (1943), Patil (1967), Mian (1971), Sayyed (2000), Jain (2003), Atanasov and Mihov (2006), Hasan and Deb (2013) and Burse *et al*. (2017).

Inheritance of leaflet size was studied in three crosses *viz*., Vijay x PKV-4, Digvijay x PKV-4 and BDNG-797 x PKV-4. For this purpose, Vijay, Digvijay and BDNG-797 (small leaflets) were crossed with PKV-4 (broad leaflets) (**Plate 1)**. In the F_1 generation, all crosses had small

Table 2. Segregation for flower colour in F_2 generation of three crosses of chickpea

S. No.	Name of the crosses/	Parents/ generations	Flower color	Expected ratio	Number of plants		χ^2	*P* value
					Observed	Expected		
1	Vijay (Pink) x PKV-4 (White)	F_1	Pink					
		F_2	Pink	3	109	100.5		
			White	1	25	33.5	2.875	0.089
2	Digvijay (Pink) x PKV-4(White)	F_1	Pink					
		F_2	Pink	3	75	70.5		
			White	1	19	23.5	1.148	0.283
3	BDN 797 (Pink) x PKV-4 (White)	F_1	Pink					
		F_2	Pink	3	115	109.5		
			White	1	31	36.5	1.105	0.293
	Heterogeneity(df-2)						0.249	0.882

FLOWER COLOR

Pink flower (*Desi*)

White flower (*Kabuli*- PKV 4)

LEAFLET SIZE

Broad leaflet (*Kabuli*- PKV4) **Small leaflet (*Desi*)**

STEM PIGMENTATION

PIGMENTED (*Desi*)

NON PIGMENTED (*Kabuli*)

Plate 1. Variation in morphological characters of chickpea

leaflets since small leaflets size was dominant over broad leaflets size. In the F_2 generation, all three crosses and pooled data gave a good fit to 15:1 (small: broad) leaflet size (**Table 3)**. The ratio was confirmed by non significant value of the analysis of the heterogeneity among the crosses ($X^2_{Heterogeneity}$ = 2.111 at df = 2; p = 0.347), suggesting that broad leaflet is recessive and controlled by duplicate gene action. Digenic inheritance of leaflet size was also reported by earlier workers like Pandey and Tiwari (1981).

The inheritance of stem pigmentation was studied in three crosses *viz.* Vijay x PKV-4, Digvijay x PKV-4 and BDNG-797 x PKV-4. The female parents *viz*., Vijay, Digvijay and BDNG-797 (Pigmented) were crossed with the male parent, PKV-4 (Non pigmented). In these crosses and their pooled data gave a good fit to 3 pigmented: 1 non pigmented, suggesting that the non-pigmented trait character was recessive over pigmented and controlled monogenically (**Table 4** and **Plate 1)**. This is confirmed by non significant heterogeneity test ($X^2_{Heterogeneity}$ = 3.650 at df = 2; p = 0.161), and which agree with the earlier findings of Ghatge (1994), Tefera (1998) and Sayyed (2000).

This experiment also reported that white flower and non pigmented stem was highly heritable in the F_2 generation and these traits could be manipulated easily into other variety to make new recombination with *desi* chickpea because it is admitted that the white flower colour and

Table 3. Segregation for leaflet size in F_2 generation of three crosses of chickpea

S. No.	Name of the crosses	Parents/ generations	Leaflet size	Expected ratio	Number of Plants		χ2	*P* value
					Observed	Expected		
1	Vijay (Small) x PKV-4 (Broad)	F_1	Small					
		F_2	Small	15	122	125.6		
			Broad	1	12	8.4	1.673	0.195
2	Digvijay (Small) x PKV-4(Broad)	F_1	Small					
		F_2	Small	15	84	88.1		
			Broad	1	10	5.9	3.089	0.078
3	BDN 797 (Small) x PKV-4 (Broad)	F_1	Small					
		F_2	Small	15	137	136.9		
			Broad	1	9	9.1	0.001	0.965
	Heterogeneity(df-2)						2.111	0.347

Table 4. Segregation for stem pigmentation in F_2 generation of three crosses of chickpea

S. No.	Name of the crosses	Parents/ generations	Stem pigmentation	Expected ratio	Number of plants		χ2	*P* value
					Observed	Expected		
1	Vijay (Pigmented) x PKV-4 (Non Pigmented)	F_1	Pigmented					
		F_2	Pigmented	3	109	100.5		
			Non Pigmented	1	25	33.5	2.875	0.089
2	Digvijay(Pigmented) x PKV-4 (Non Pigmented)	F_1	Pigmented					
		F_2	Pigmented	3	66	70.5		
			Non Pigmented	1	28	23.5	1.148	0.283
3	BDN 797 (Pigmented) x PKV-4 (Non Pigmented)	F_1	Pigmented					
		F_2	Pigmented	3	112	109.5		
			Non Pigmented	1	34	36.5	0.228	0.632
	Heterogeneity (df-2)						3.650	0.161

non pigmented stem are the main identities of *kabuli* chickpea. Therefore, the study of flower colour and stem pigmentation revealed that the inheritance pattern of qualitative traits of chickpea is monogenic in nature and simply inherited mendalian's ratio.

The results of the present experiment on the inheritance of morphological characters would be helpful to the chickpea breeder to use in changing the architecture of the chickpea, early recognition of the hybrid character of plants and can be used as a valuable morphological marker in cultivated chickpea.

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