



Research Article

Inheritance of double flower per peduncle and flower colour in chickpea (*Cicer arietinum* L.)

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Abstract

The double-flower per peduncle trait is known to contribute to increased seed yield in chickpea (*Cicer arietinum* L.). Reciprocal crosses have been done between white single-flowered *kabuli* type (BARI chola-8) and the pink double-flowered *deshi* type (BARI chola-4). Results obtained in this investigation indicated that the single flowered trait in chickpea was completely dominant over double-flowered trait since all the population of F₁ are single flowered and in F₂ single and double flower segregate following 3:1 ratio which indicate Double-flowered trait controlling by a single loci recessive gene. In this experiment it was found that double flower per peduncle trait is highly heritable character in chickpea. In case of flower color pink color is complete dominant over white flower color and white flower color were governed by single recessive gene. Therefore, manipulation of these traits is easy.

Key word

Chickpea, flower color, number of flower per peduncle.

Introduction

Chickpea (*Cicer arietinum* L.) is a highly nutritious grain legume crop. It is an important source of energy, protein, mineral, fibers and other potentials health-beneficial phytochemical. It can play an important role in overcoming problems related to nutritional insecurity of the poor in developing countries like Bangladesh. Chickpea is an annual diploid (2n =16) species (Van der Maesen, 1972) with low out crossing due to cleistogamic flower (Toker *et al.*, 2006). It is divided into two groups as "Macrosperma" or "Kabuli" and "Microsperma" or "Desi" on the basis of plant characteristics. The *Kabuli* group has relatively larger seed size (100 seed mass >25g) (Singh and Diwakar, 1995) with creamy color, white flower and no pigmentation on the plant. In contrast, *Desi* group has different seed color, pink flower and show pigmentation on the plant. 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). As per Singh and Rhenen (1989, 1994) the double-flowered trait enhances seed yield under certain environment. Sheldrake *et al.* (1978) remove the second flower in double-flowered genotypes and conclude that the double-flowered character conferred the yield advantage of 6-11%. Among the released or cultivated chickpea germplasm in Bangladesh only one variety produce two flower per peduncle viz., BARI chola-4 (*deshi*). *Kabuli* type chickpea is nutritionally superior to *deshi* chickpea because of high biological value and utilizable protein. Yielding ability of *kabuli* chickpea could be possibly improved by introducing double-flower

trait from *deshi* chickpea. Keeping this view in mind this study was carried out to find the inheritance of double flower per peduncle in chickpea.

Material and methods

Two chickpea varieties viz., BARI chola-8 (*kabuli*) and BARI chola-4 (*deshi*) were considered in this investigation. Both direct and reciprocal crosses were made to obtain F₁ and subsequent generation. The parents viz., BARI chola-8 and BARI chola-4 are single flowered with white colour and double-flowered with pink colour per peduncle respectively. The crosses were made in the *rabi* season (2010-11). The F₁ and F₂ generations were grown during *rabi* seasons of 2011-12 and 2012-13 respectively. Normal crop management practice was followed. Plant was classified into single flowered per peduncle, double flowered per peduncle, pink color flower and white color flower types. Observations of data on number and color of flower per peduncle were recorded through visual observation on randomly selected plants from in F₁ generation and on individual plant basis in F₂ generation. Recorded data were analyzed with the help of chi-square (χ^2).

Results and discussion

In the present investigation, it is observed that all the F₁ generations obtained from direct and reciprocal crosses between single flowered and double-flowered chickpea variety were single flowered. The results indicated that the single flowered trait in the chickpea were completely dominant over double-flowered trait. The result of the present study is in agreement with previous studies reported in chickpea by Kumar *et al.*

(2000) and Kumar *et al* (2003). In the F_2 generation these single flowered F_1 s, produce both single and double flower per peduncle (Figure: 1). The data for the two types of flower number per peduncle fit well to the ratio of 3:1 (Table 1). The results indicated that the trait, double flower per peduncle was monogenic in nature and governed by single recessive gene. The value of probability “p” showed non-significant. Their heterogeneity also had good fit to the ratio 3:1. The same result was also reported by several researchers (Khan and Akhtar, 1934; Kumar *et al.*, 2000; Gaur and Gour, 2002; Kumar *et al.*, 2003). Recessive gene for double flower trait was designated as *s* by Khan and Akhtar (1934). Thus genotype of single flower and double flower are *SS* and *ss* respectively. According to Kumar *et al.* (2000) this *s* allele is variable for expression of double flower in certain environment which also supported by Rubio *et al* (1998). Though most gene symbol in chickpea has triple alpha-code, D’Cruz and Tendulker (1970) used *sfl* for the allele double-flower trait. Singh and Chaturvedi (1998) report that allelic relationship between gene controlling double flowered and single flowered trait and Gaur and Gour (2002) suggested another gene symbol *cym* for the gene controlling the multi-flower trait. Following the nomenclature guidelines for *Pisum* gene symbol, Srinivasan *et al.* (2006) suggested *sfl^d* for the allele for the double trait. They also showed that two loci, *Sfl* (for one, two or three flower per peduncle) and *Cym* (more than three flower per peduncle) has control on number of flowers per peduncle in chickpea. Therefore, based on the above informations and the results of this study, it is proposed that the single flowered and double flowered genotypes are *SflSfl* and *sfl^dsfl^d* respectively.

At the same time, investigated result indicated that mode of flower color segregation were also following same where pink color were complete dominant over white flower color and white flower color were governed by single recessive gene. Observed results are presented at Table 2. In the present investigation linkage between number of flower per peduncle and color of flower were not yet tested but as per Kumar *et al* (2003) there were no linkage between above two traits in chickpea. Though, the double flowered trait is not stable trait (Kumar *et al.* 2000) and the expressivity of this trait can be manipulated by changing the genetic background and the environmental conditions Srinivasan *et al.* (2006).

The double flowered trait and also white flower colour are governed by single recessive gene each and segregates independently. Manipulation of these traits into high yielding variety as well as *kabuli* type variety is easy because of monogenic in nature. To take the advantage 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 as well as double podded *kabuli* genotypes can be developed, which in return increase the yield improvement of *Kabuli* chickpea.

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Table 1. Goodness of fit χ^2 test for F₂ phenotypic classes single and double flower per peduncle in chickpea

Cross ♀ × ♂	Phenotype of F ₁	Observed frequencies in F ₂ Phenotypic classes			Expected Genetic Ratio	χ^2	P
		Single	Double	Total			
V-4 × V-8	Single	127	29	156	3:1	3.42	0.0644
V-8 × V-4	Single	193	48	241	3:1	3.32	0.0684
Heterogeneity						0.09	0.7641

Table 2. Goodness of fit χ^2 test for F₂ Phenotypic classes considering flower color in chickpea

Cross ♀ × ♂	Phenotype of F ₁	Observed frequencies in F ₂ Phenotypic classes				Expected Genetic Ratio	χ^2	P
		Color	Single	Double	Total			
V-4 × V-8	Pink single	Pink	90	20	110	3:1	2.73	0.0984
		White	37	9	46	3:1	0.72	0.3961
V-8 × V-4	Pink single	Pink	133	36	169	3:1	1.23	0.2674
		White	60	12	72	3:1	2.67	0.1022
Heterogeneity						0.70	0.8732	

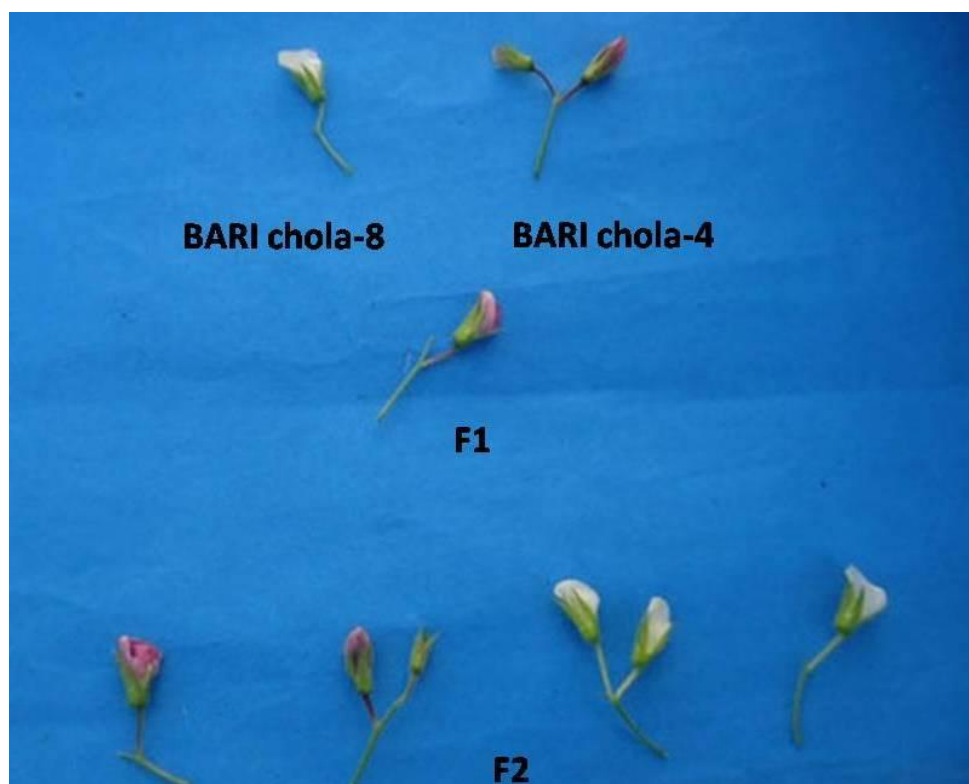


Figure 1. Number of flowers per peduncle and colour of flower in chickpea