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Inheritance of a unique sterile mutant with non-fabaceous yellow flowers and miniature fern like foliage in Chickpea (*Cicer arietinum* L.)

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ABSTRACT

As a physical mutagen, gamma radiations play a vital role in crop improvement. However, mutagenesis is a non-targeted induction of variations in genomes and it could lead to unique mutant phenotypes that can form an important repository for basic science on plant growth and development. The present study reports chickpea (*Cicer arietinum* L.) mutants with fern like miniature foliage and sterile non-fabaceous yellow flowers isolated from M_2 population. Their sister progenies were harvested as single plants and grown as plant to row M_3 progenies to observe the inheritance pattern. In resulting progenies, the ratio of normal plant types to mutant

plant types fitted in a ratio of 3:1. Further as yellow flower mutation associated with miniature foliage, it seems that both characters are tightly linked.

Keywords: Mutagenesis, Chickpea, miniature foliage, non-fabaceous yellow flower

1. INTRODUCTION

Chickpea (*Cicer* sp.) is represented by 49 taxa of which 09 taxa are annuals (Smykal, Coyne, Ambrose et al., 2015). *Cicer arietinum* L. is the only species of this genus which is currently under cultivation as grain legume. It has diploid chromosome number 2n= 2x = 16 (van der Maesen, Maxted, Javadi et al., 2007) with genome size 738-Mb with 28,269 genes (Varshney, Song, Saxena, Azam, et al., 2013). Flowers in the cultivated chickpea are bisexual and self- pollinated with cleistogamous condition which restrict outcrossing (Cubero, 1987, Toker, Canci, and Ceylan, 2006).

Earlier survey of world collection of over 12,000 chickpea accessions indicate that 80.67% accession has pink flower, 18% had white flower and 0.46% had blue flowers (Pundir, Rao, van Der Maesen, 1985). Few other workers also reported similar observations in cultivated chickpea (Yasar, Ceylan, Ikten, Toker, 2014). Flowers have fabaceous corolla with five petals (one standard, two wings and two keels), which are generally polypetalous.

2. MATERIALS AND METHODS

The experimentation were carried out from 2015 to 2018. Air dried seeds with approximately 12% moisture content were irradiated with 300, 400 and 500 Gy gamma rays. Two mutants with open flower, yellow color and miniature fern like foliage were isolated in M_2 from single plant progeny of M_1. The isolated mutants were characterized and variations are noted as comparison with control. Since, the mutants were female sterile, the sister plants were harvested individually and sown as plant to row M_3 progenies. After noting M_3 data for the said mutant, the chi square test was performed.

3. RESULTS AND DISCUSSION

The present study deals with the inheritance of a unique non-fabaceous yellow flowered mutant in gamma irradiated chickpea variety-Vijay. The isolated mutants were characterized and variations were compared with control (table-1). The mutants were observed as female sterile, the sister plants were harvested individually and sown as plant to row M_3 progenies. In M_3 generation out of 226 plants 174 were normal and 52 were with sterile yellow flowers and fernlike miniature foliage. The chi square test of the resulted segregation indicates that it fits well in expected ratio of 3:1 for monogenic inheritance (table-2).

Previously, open flowers with pink petals and reduced leaf size and leaflet numbers have been reported (Pundir and Reddy, 1998, Shrinivasan and Gaur, 2012 and Yaldirim, Canci, Inci, et al., 2013). In these studies open flower mutants always have parental petal color (pink or white) and are reported to be sterile (Canci, Inci, Baloglu, et al., 2017). However, in present study a unique open flower with yellow color and miniature fern like long foliage is reported (Figure 1A & B). An open, yellow flower trait was found to be controlled by single recessive gene. This is the first report of chickpea mutant with yellow colored non-fabaceous flowers. The inheritance pattern of this mutant is presented in table-2. Present study also showed that induced sterility and open flower may be linked traits. Therefore a gene symbol *"ofm- 4"* is designated to the gene controlling the open flower and yellow colored petals of this non-fabaceous mutant of chickpea (variety-Vijay). Further, its inheritance along with miniature fern like foliage suggests that probably both traits are tightly linked.

Table 1 Characters of yellow flowered mutants compared with its parent.

Characters	Parent Variety- Vijay	Mutant
Habit	Semi-spreading	Spreading, semi-spreading, erect
Leaflet Shape	Oval to elliptical	Extremely lanceolate, more dentate margin
Leaflet measurement	0.6 to 1.0 cm long 0.4 to 0.7 cm wide	0.5 to 1.2 cm long 0.2 to 0.5 cm wide
Flower color	Pink	Yellow (smaller than control)
Flower shape	Cleistogamous	Open
No. of Petals	05 (corolla: Fabaceous type)	05 (reduced; non- fabaceous corolla)
Stamens	(9+ 1) ; diadelphous	>10 yellow, free, reduced
Carpels/stigma	Carpel 1, stigma bifid	Highly reduced or Absent

Table 2 Inheritance of sterile yellow flower and fernlike miniature foliage

M_3 progeny of mutant's sister plants				
Observed	Expected	X^2	P	df
F: S	F : S			
174: 52	3:1 (169:57)	0.195	0.659	1

Note: F= Fertile induced sister plants & S= Sterile yellow flowered plants

Figure- 1A: Yellow flowered mutant with fernlike miniature foliage and 1B: compared with parental pink flowered chickpea

4. CONCLUSION

From the results discussed above, it could be concluded that the induced sterility and open flower are probably linked characters. Further, this is first report indicating open, yellow, female sterile, non-fabaceous flower and this trait is probably closely linked with trait of miniature fern like foliage in the species.

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Conflict of Interest

None

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Contribution of Authors

Dr. Deepak K. Koche was the Principal Investigator of the DAE- BRNS funded project. He collected the data, analyze it and prepare manuscript.

Dr. Archana Joshi- Saha was Principal Collaborator for the DAE-BRNS funded project. She has given her input to finalize the manuscript.

REFERENCE

1. Canci H, Inci N. Baloglu E, Fatema OC, Yaldirim T. 2017. Inheritance of Rose-Flowered Mutation in Chickpea (*Cicer arietinum* L.) J. Agri. Sci., 23: 208-212.
2. Cubero JI. Morphology of chickpea. In The Chickpea (eds. Saxena, M. C. and Singh, K. B.), CAB International: 1987. pp 35-66.
3. Pundir RPS, Rao NK. and van Der Maesen LJG. 1985. Distribution of qualitative traits in the world germplasm of chickpea (*Cicer arietinum* L). Euphytica, 34: 697-703.
4. Pundir RPS. and Reddy GV. 1998. Two new traits-open flower and small leaf in chickpea (*Cicer arietinum* L.). Euphytica, 142: 357-361.
5. Smykal P, Coyne CJ, Ambrose MJ, Maxted N, Schaefer H, Blair MW, Berger J, Greene SL, Nelson MN, Besharat N, Vymyslicky T, Toker C, Saxena RK, Roorkiwal M, Pandey MK, Hu J, Li YH, Wang LX, Guo Y, Qiu LJ, Redden RJ and Varshney R K. 2015. Legume crops phylogeny and genetic diversity for science and breeding. Crit. Rev. Plant Sci. 34: 43-104.
6. Srinivasan S. and Gaur PM. 2012. Genetics and characterizations of an open flower mutant in chickpea. J. Heredity, 103: 297-302
7. Toker C, Canci H. and Ceylan FO. 2006. Estimation of outcrossing rate in Chickpea (*Cicer arietinum* L.) sown in autumn. Euphytica, 151:201-205.
8. van der Maesen LJG, Maxted N, Javadi F, Coles S, and Davies AMR. Taxonomy of the genus Cicer revisited. In Chickpea Breeding and Management (eds. Yadav, S. S., Redden, R., Chen, W. and Sharma, B.), CAB International. 2007. pp 14-46.
9. Varshney RK, Song C, Saxena RK, Azam S, Yu S, Sharpe AG, Cannon S, Baek J, Rosen BD, Tar'an B, Millan T, Zhang X, Ramsay LD, Iwata A, Wang Y, Nelson W, Farmer AD, Gaur PM, Soderlund C, Penmetsa RV, Xu C, Bharti, AK, He W, Winter P, Zhao S, Hane JK, Carrasquilla-Garcia N, Condie JA, Upadhyaya HD, Luo MC, Thudi M, Gowda CLL, Singh NP, Lichtenzveig J, Gali KK, Rubio J, Nadarajan N, Dolezel J, Bansal KC, Xu X, Edwards D, Zhang G, Kahl G, Gil J, Singh K B, Datta SK, Jackson SA, Wang J. and Cook DR. 2013. Draft genome sequence of chickpea (*Cicer arietinum*) provides a resource for trait improvement. Nature Biotech., 31: 240-246.
10. Yaldirim T, Canci H, Inci N, Baloglu E, Fatema, OC, Ikten C. and Toker C. 2013. Inheritance of female sterility in induced *Cicer* species. Tur. J. Field Crops, 18: 78-81.
11. Yasar M, Ceylan FO, Ikten C. and Toker C. 2014. Comparison of expressivity and penetrance of the double podding trait and yield components based on reciprocal crosses of kabuli and desi chickpeas (*Cicer arietinum* L.). Euphytica, 196: 331-339.