International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Biotechnological Study of Mutagenic Effect on Flowering and Fruiting Pattern in Wild Chickpea

Dr. Girish C. Kamble[1], Prof. H. J. Petkar[2], Dr. A. S. Patil[3]

[1]Department of Botany, SRRL Science College, Morshi (Dist-Amravati), India

[2]MCA Department, Dr. BNCPE, Yavatmal, India

[3]Department of Biotechnology, SGB Amravati University,Amravati, India

Abstract: ***The Cicer is one of the important genus with 31 perennials and 9 annuals species. The single species Cicer arietinum is cultivated and considered as an important legume crop. Its cultivation is worldwide and India is single largest producer of this food legume. The available genetic variability has been used extensively in the conventional breeding programme which further narrowed the variability. The wild species is a valuable sources of biotic and abiotic stress. The annual wild species Cicer reticulatum and Cicer echinospermum might be used in the cultigens improvement breeding programme. The wild species has few undesirable charecters and crossabilty barriers. The mutation breeding is useful technique to induce the mutants which can be used in breeding and improvement programme. The T_{12} treatment was found to be fairly good over all other treatments and which might be used in the improvement breeding programme.***

Keywords: *Cicer*, EMS, Phenology, Mutation, ANOVA.

1. Introduction

Chickpea (*Cicer arietium*) is one of the important cool season food legume [11]. It is a sub-tropical, tropical and cool season food legume that ranks third among the pulses in area and production worldwide. India is known as largest single producer of the crop [7]. It not only improove the soil fertility profile and but also weed control [6]. The extensive rxploitation of the available genetic variation in the conventional plant breeding vehture narrowed the genetic variation in this crop [17]. While the wild species despite having valuable sources of biotic stress resistance and abiotic stress tolerance are not used in the reeding programme [13]. The wild species have a few undesirable characters which constraints the use of wild *Cicer* in chickpea breeding programs [9]. Mutation breeding is significant technique to modify and alter the genome with the induction and improvement of economically important traits and elimination of undesirable gene from the elites lines [10]. Mutation breeding has been reported to upgrade the well-adapted plant varieties by altering one or two major traits which enhance the quality [14]. Breeding value of mutants can be improved by uniting different mutant genes in the same genome [8]. The mutants with favorable characters or properties could be incorporated into crossbreeding programme in order to transfer specific gene into the genome of well-established cultivar and to improve their breeding values.. The *C. reticulatum* and *C. echinospermum* are cross compatible with cultivated species. The EMS and gamma radiation have been reported the important agents employed to increase mutation frequency in plants [3]. *C. echinospermum and C. reticulatum* are commonly used in chickpea improvement programmes this has important ramifications for breeders [2].

2. Material and Method

The healthy seeds of *Cicer reticulatum* of Accession Number ICC 17121 were procured from the ICRISAT, Patancheru, India as shown in figure 1.

Figure 1: The Seeds of *Cicer reticulatum*L.

.

Three sets of the dry and healthy seeds were formed and treated as under-

The Seeds of 1st set treated with various concentration of EMS viz. 0.1%, 0.2%, 0.3%and 0.4% formed treatment T_2, T_3, T_4, T_5 respectively. The seeds of 2nd set first treated with chemical mutagen and thereafter subjected to physical mutagenic treatment with various concentration of EMS and doses of gamma rays in 0.1% EMS +5KR, 0.2% EMS +10KR, 0.3% EMS +15KR and 0.4% EMS +20KR forming treatment T_6, T_7, T_8, T_9 respectively. Seeds of 3rd set subjected to various doses of gamma radiation viz. 5KR, 10KR, 15KR, 20KR, 25KR, 30KR formed treatment T_{10}, T_{11}, T_{12}, T_{13}, T_{14} and T_{15} respectively. The untreated normal 4th set scored as control formed treatment T_1.

The treated and untreated seeds were sown in first week of September . The sowing period in India has been reported from September to December [6]. The treated seeds were sown in the field following the randomized block design (RBD) in three replicate to raise M_1 generation [5]. The seed-to-seed and row-to-row distance was maintained at 15

cm and 50 cm respectively. The M_1 generation raised in the field has shown in the figure 2 and figure 3.

Figure 2: T_1 Treatment

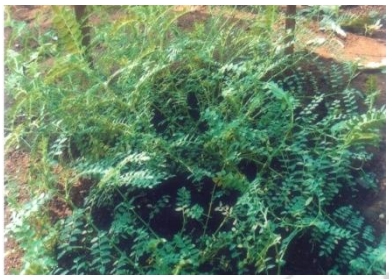

Figure 3: T_{12} Treatment

The data on flowering and fruiting pattern of the treated and as well as untreated control were recorded at the interval of 20 days during flowering and fruiting period.

The data was observed and collected during flowering phase from the 60 days after sowing the seeds in the field for the analysis to deduce mean, standard error (SE), standard deviation (SD) and coefficient of variability (CV). The statistical analysis and computation of various quantitative and qualitative data was executed as per standard statistical procedure and ANOVA [15].

3. Result and Discussion

The early flowering was observed in T_{13} and T_{14} treatments at 60 DAP. The maximum number of flowers was found to be 9.0 in T_{13} and minimum 0.47 in T_7 at 80 DAP, while that of maximum 8.3 in T_8 and minimum 3.8 in T_{10} was observed at 100 DAP. The maximum flower 10.73 in T_6 and 2.46 in T_1 was observed at 120 DAP and depicted in Table 1 for M_1 generation and observed significant. No alteration was observed with respect to flower colour in the present study.

The early pod formation was observed in T_{10}, T_{11}, T_{12}, T_{13}, T_{14} and T_{15} at 80 DAP as compared to control T_1 treatment in M_1 generation. The maximum 8.13 pods per plant were observed in T_{12} treatment of M_1 generation. The maximum pods per plant was observed 16.73 in T_{12} minimum 2.76 in T_6 at 100 DAP and at 120 DAP maximum 16.66 in T_{12} and minimum 6.8 in T_1 was observed and the data presented in Table 2 for M_1 generation.

The mutagenic treatment was found to be nonsignificant with respect to two seeded pod and seed size in M_1 generation while the one seeded pod was observed significant and maximum number of one seeded pod was observed 15.6 in T_{12} and minimum 7.06 in T_{15} in M_1 generation and represented in Table 2.

Number of pods per plants was recorded higher in all the treatment and maximum 16.73 in T_{12} of M_1 population at 100 DAP. Wani and Anis [17] have reported the significant quantitative increase in pod per plant in chickpea induced by lower dose of gamma rays. The higher number of pod per plants has been reported in 25KR gamma radiation followed by 0.1% EMS treatment as compared to control in grasspea [16]. The increase in variability for number of pods per plants following mutagenic treatment has been reported in khesari [12]. An increase in flower, pod, seed followed by the treatment with mutagens like EMS and gamma rays separately as well as in combination has been reported in chickpea (Pusa 212) through the mutation breeding [17].
Mean number of capsule per plant has been reported increased by 49% and seed yield per plant increased by 62% [1]. Similar finding about no significant increase in number of seed per pod in mutant types or lines has been reported in chickpea by Wani and Anis [17].

The seed size was non-significant in the M1 generation. Similar observation has been reported in grasspea [16], however, Singh and Chaturvedi [12] and Chekalin [4] reported increased M_2 and M_3 population mean for seed size in khesari. The mutation inducing many traits could be attributed to the mutation of pleiotropic gene or mutation of gene cluster or chromosomal arrangement as has been reported in chickpea [17]. The observations in present investigation revealed the conformity as reported in chickpea [17].

4. Conclusion

The genetic variability of the crop narrowed considerably and the mutation breeding could serve the basis for variation in the crop. The wild species of the chickpea is important owing to having the resistance to various biotic and abiotic stresses. The useful and desirable morphological and reproductive traits and characters present in wild annual species of chickpea could be tapped and brought into the cultigens for the betterment and improvement of the cultivated chickpea. The wild chickpea could offer promising and prospective traits to the cultigens.

The interspecific cross between the cultigens and wild could improve the quality of the cultigens however, there is crossability barrier and success is very low. The mutagenesis brings the variation in the wild species and such mutant might be appeared suitable for interspecific cross between cultigens and wild towards improvement of the cultivated chickpea.

The T_{12} treatment appeared the fairly good treatment over all other treatments. ANOVA for all the treatments were observed significant for all phenotypic characters except number of two-seeded pod per plant and seedsize ($p<0.05$). The treatment with desirable character could be used in breeding programme. Similarly, ANOVA for genotypes were significant except seed yield biological yield and number of pod per plant ($p<0.05$). The genotypes possessed desirable characters that could be used indirectly in breeding programme. The comparative result on overall variability in M_1 was observed significant except number of two seeded pod and seed size in present investigation.

5. Acknowledgement

The authors are very much thankful to the ICRISAT, Patancheru AP India for providing the seeds of wild chickpea for present investigation. The authors are sincerely grateful to the MCA department, Dr. BNCPE, Yavatmal for providing the computer facility for the computation and analysis of the data in the present investigation. The author is grateful to Dr. A. S. Patil for her kind guidance and encouragement during present study.

References

[1] Abo-Hegazi and Ragab, A. I., 'A programme for improving oilseed in Egypt through Mutation breeding' In: Mutagenesis Basics and Applied (Eds. A B Prasad), Print House (India), Lucknow, 1986.
[2] Berger Jens, Neil C. Turner and Renee P. Buck, "Wild and cultivated *Cicer* species- different evolutionary paths lead to different phonological strategies that can be exploited to broaden the adastation of chickpea (*C. arietinum* L.) in New directions for a diverse planet," *Proc. of the 4th international Crop Science Congress* Brisbane, Australia, 26 Sep-1Oct 2004. (www.cropscience.org.au).
[3] Borkar, A. T. and More, A. D., "Induced flower colour Mutation in *Phaseolus vulgaris* Linn. Thtrough physical and chemical mutagens," *Advances in Bioresearch* 1 (1): pp. 22-28, 2010.
[4] Chekalin, N. M., "Effect of repeated treatment with chemical and physical mutagens of *Lathyrus sativus* L." In: *Praktika khim. mutageneza*, Moscow, USSR, Nauka: 138-145, 1971.
[5] Cochran, William G. and Cox, Gertrude M., Statistical Analysis 'Experimental Design' 2nd Edition , Wiley Classic Library Edition published 1992, A Wiley Interscience Publication John Wiley And Sons Inc, New York Chichester, Brisbane Toranto, Singapore. pp. 106-116, 1992.
[6] Davies, D. R., Berry, G. J., Health, M. C. and Dawkins, T. C. K., In: Pea (*Pisum sativum* L.) (R.J. Summerfield and E.H. Roberts eds.) Williams Collins Sons and Co. Ltd. Landon. U.K.: pp. 147-198, 1985.
[7] Gebisa Ejeta, Randy A. Hautea, Josef-Franz Seitzer, " System wide review of plant breeding methodologies," in the CGIAR, ICRISAT subpanel report, Patancheru ,India March 14-18, 2000. pp. 21-25, 2000.
[8] Gottschalk, W., Experimental mutagenesis in plant breeding. In: Mutagenesis Basics and Applied (Eds. A B Prasad), Print House (India), Lucknow, 1986.
[9] Jaiswal, H. K., Singh, B. D., Singh, A. K. and Singh, R. M., "Introgression of genes for yield and yield traits from *C. reticulatum* into *C. arietinum*," *International Chickpea Newsletter* 14: pp. 5-8, 1986.
[10] Lippert, L. F., Berg, B. O., Cook, A. A., "Three variegated seedlings in the Pepper," *J. Hered.* 55:pp. 78-93, 1964.
[11] Muehlbauer, F. J., Food and grain legumes. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York. pp. 256-265, 1993.
[12] Singh, M. and Chaturvedi, S. N., "Improvement of yield and quality character of khesari da/ by use of mutagens," *Mysore J. of Agric. Sci*., 24: pp. 325-330, 1990.
[13] Singh, K. B., Malhotra, R. S., Halila, H., Knights, E. J., Verma, M. M., "Current status and future strategy in breeding chickpea for resistance to biotic and abiotic stresses," *Euphytica* 73: pp. 137-149, 1994.
[14] Srivastava, P., Marker, S., Pandey, P. and Tiwari, D. K., "Mutagenic effects of sodium azide on the growth and yield characteristics in Wheat (*Triticum aestivum* L. em. Thell.)," *Asian J. Plant Sci.*10 (3): pp. 190-201, 2011.
[15] Sukhatme, P. V. and Amble, V.N., Statistical Method for Agricultural Workers, ICAR, New Delhi : pp.145-156, 1995.
[16] Waghmare, V. N. and Mehra, R. B., "Induced genetic variability for quantitative characters in grasspea (*Lathyrus sativus* L.)," *Indian J. Genet.* 60 (1): pp.81-87, 2000.
[17] Wani, A. A. and Anis, Mohammad, "Gamma Ray- and EMS-Induced Bold-Seeded High-Yielding Mutants in Chickpea (*Cicer arietinum* L.)," *Turk. J. Biol*. 32: pp. 161-166, 2008.

Author Profile

Dr. Girish Charandas Kamble received the M.Sc. and M.Phil. degrees in Botany from SGB Amravati University in 1991 and 1997 respectively. He received UGC teacher fellowship for the Ph. D. degree in Biotechnology from SGB Amravati University in 2014. He is presently working as head and teaching faculty in the department of botany at SRRLSCol, Morshi. He has 15 years teaching experience for UG level and 16 years research experience. He is associated in the research area Cytology, Biotechnology, Hydrobiology, Protein Profiling.

Prof. H. J. Petkar received the B.E. and M.E. degrees in Computer Engineering from SGB Amravati University in 2001and 2009 respectively. She has submitted the Ph. D. thesis on language engineering to MG International Hindi University, Wardha. Presently she is working as Head and AP in MCA department Dr. BNCPE, Yavatmal from 2001. She has 14 years tecaching experience and 12 years research experience. The area of the research is Speech Recognition, Language Engineering, Bioinformatics, Data Ware Housing And Mining.

Dr. A.S. Patil She has done her M.Sc. and Ph.D. in the subject Biotechnology. She is presently working as a teaching faculty in post graduate department of biotechnology, SGB Amravati University, Amravati

Table 1: Effect of EMS and Gamma rays on number of flowers in M_1 Generation

Sr. No	Treatment	Number of Flowers			
		MeanNumber of Flower 60 DAP*	MeanNumber of Flower 80 DAP*	MeanNumber of Flower 100 DAP*	MeanNumber of Flower 120 DAP*
1	T_1	---	6.25	6.39	2.47
2	T_2	---	1.18	6.79	6.07
3	T_3	---	0.72	6.72	7.34
4	T_4	---	0.87	6.85	9.42

5	T_5	---	0.72	6.73	7.95
6	T_6	---	0.72	7.52	10.74
7	T_7	------	0.46	7.86	10.43
8	T_8	---	0.79	8.32	7.22
9	T_9	--	0.52	7.45	9.45
10	T_{10}	--	5.86	3.79	4.01
11	T_{11}	-	6.21	7.34	3.67
12	T_{12}	--	7.45	7.81	3.28
13	T_{13}	4.84	9.01	7.94	3.55
14	T_{14}	6.21	6.84	7.94	4.04
15	T_{15}	---	1.84	5.87	3.27
F-test		Significant	Significant	Significant	Significant
SE(m±)		0.18	0.64	0.55	0.54
CD at 5%		0.04	1.8	1.56	1.53

DAP*- Days After Plantation

Table 2: Effect of EMS and Gamma rays on number of pods per plant and number of seeds per pod in M_1 Generation

Sr. No	Treatment	Mean Number of Pods			Mean No of One-Seeded Pod	Mean No of Two-Seeded Pod	Size of Seed (in gm)
		Number of Pods 80 DAP*	Number of Pods 100 DAP*	Number of Pods 120 DAP*	No of One-Seeded Pod	No of Two-Seeded Pod	Weight of 10 seeds
1	T_1	7.4	10.10	6.9	9.19	0.92	1.463
2	T_2	--	1.56	10.31	9.67	0.67	1.427
3	T_3	--	3.7	10.19	9.39	0.79	1.442
4	T_4	--	3.29	10.32	9.52	0.72	1.471
5	T_5	--	3.29	10.59	9.85	0.72	1.411
6	T_6	--	2,76	10.65	9.87	0.79	1.494
7	T_7	--	3.52	10.87	9.92	0.92	1.435
8	T_8	--	5.71	10.94	10.01	0.92	1.432
9	T_9	--	4.25	10.64	10.12	0.85	1.458
10	T_{10}	1.85	6.7	13.19	12.38	0.79	1.467
11	T_{11}	3.52	7.51	10.52	9.52	1.01	1.448
12	T_{12}	8.14	16.75	16.67	15.59	1.07	1.474
13	T_{13}	3.51	14.7	14.27	13.34	0.94	1.359
14	T_{14}	5.9	16.44	15.07	14.25	0.79	1.311
15	T_{15}	1.41	7.01	8.34	7.07	1.25	1.387
F-test		Significant	Significant	Significant	Significant	Non-Significant	Non-Significant
SE(m±)		0.33	0.62	0.89	0.72	0.22	0.06
CD at 5%		0.95	1.83	2.53	2.07	----	------

DAP*- Days After Plantation