

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

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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 T₁₂ 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 arietinum*) 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 improve the soil fertility profile and but also weed control [6]. The extensive rpxploitation of the available genetic variation in the conventional plant breeding vecture 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.

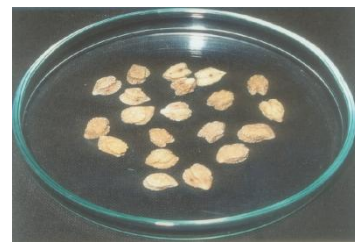


Figure 1: The Seeds of *Cicer reticulatum*L.

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 T₂, T₃, T₄, T₅ 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 T₆, T₇, T₈, T₉ respectively. Seeds of 3rd set subjected to various doses of gamma radiation viz. 5KR, 10KR, 15KR, 20KR, 25KR, 30KR formed treatment T₁₀, T₁₁, T₁₂, T₁₃, T₁₄ and T₁₅ respectively. The untreated normal 4th set scored as control formed treatment T₁.

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 M₁ 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

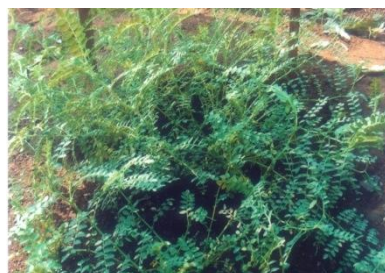


Figure 3: T_{12} Treatment

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 M_1 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 seed size ($p < 0.05$). 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.

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Author Profile

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Table 1: Effect of EMS and Gamma rays on number of flowers in M₁ 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 M₁ 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