"MORPHOLOGICAL ASSESSMENT IN WILD CHICKPEA TREATED WITH MUTAGENIC AGENTS"

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ABSTRACT

The chickpea is the third important legume crop of the world. The wild species of Cicer can be used in the cultivated chickpea breeding programme as a natural resource due to some important traits. Some of the undesirable traits of the wild species restricts its utilization in improvement breeding programme and the crossability barriers in interspecific crossbreeding as well. Mutagenesis is a useful method to bring the desirable traits in the genome and elimination of undesirable traits. The induced mutants with suitable and desirable traits could be used in the breeding programme. The numbers of chemical and physical mutagenic agent are used in the mutagenesis. The gamma rays is one of the physical mutagenic agents widely used to induce the mutation in the various plants.

KEYWORDS- *Wild chickpea, M_3 Generation, Gamma rays, Mutagenic agent.*

INTRODUCTION

Chickpea (*Cicer arietium*) is identified as cool season food legume (Muehlbauer, 1993). It is an important worldwide cultivated pulses crop and India as largest producer (Gebisa *et al.*, 2000).The rotational cropping pattern with legume crop improves the soil fertility (Davies *et al.*,1985). The genetic variation in chickpea has been tapped at large in the conventional breeding programme, narrowed the genetic variation base (Wani and Anis, 2008). Mutagenesis has been reported as useful process to induce and improve the economically important traits and elimination of the undesirable gene from the elites lines (Lippert *et al.*,1964).It is a useful method to cause the genetic variation in a species and to develop the crop varieties in short period (Micke,. 1988). Improvement of the breeding value of mutants could be achieved through the union of the different mutant genes in the same genome (Gottschalk, 1986). The mutants having desirable traits could be used in the hybridization programme to transfer specific gene into the genome of the cultivar variety. Mutagenesis was used to develop cultivars having good stability for exogenous factors and increased productivity (Mlihov and Mehandjiv, 1982). The success rate of crossing hybridization between cultivated and wild species of chickpea has been reported above 75% when wild species used as female parent (Singh and Ocampo, 1997).The mutagenesis could create many mutants alleles with various degree of modification (Brown, 2003). The EMS as chemical mutagen and gamma radiation as physical mutagen have been reported as important mutagens utilized to increase mutation frequency in plants (Borkar and More, 2010). Wild germplasm could be an important source of genetic variation for improvement of cultivar variety (Croser *et al.*, 2003). A few undesirable characters has been mentioned in the wild Cicer which restricts the use of wild Cicer in chickpea breeding programs (Jaiswal *et al.*, 1986). *C. echinospermum* and *C. reticulatum* are commonly used in chickpea improvement programs (Berger *et al.*, 2004).

MATERIAL AND METHOD

The germplasm of wild chickpea *Cicer reticulatum* was procured from the ICRISAT, Patancheru, India. The healthy seeds were treated with various doses of gamma radiation as physical mutagenic agents viz. 5KR, 10KR, 15KR, 20KR, 25KR and 30KR and encoded as T_2, T_3, T_4, T_5 and T_6, respectively while untreated formed T_1.The treated Cicer seeds were sown to raise the M_1 generation to collect M_1 seed yield and sown to raise the M_2 generation and M_2 seed yield was collected to raise M_3 generation. The seeds alongwith the control were sown in the field following randomized block design (RBD) to raise M_3 generation in 3 replicates

(Cochran and Cox, 1992). The seed-to-seed and row-to-row distance was maintained at 15 cm and 50 cm, respectively. Data for various morphological quantitative and qualitative profiles were recorded to analyze and assess mean, standard error (SE), standard deviation (SD) and coefficient of variability (CV) using standard statistical procedure and ANOVA (Sukhatme and Amble, 1995).

RESULT AND DISCUSSION

The mutagenic effect on various phenological character, flowering and fruiting were recorded at regular interval in M_3 generation and represented in the table 1.The maximum mean plant length 21.53 cm was observed in T_4 treatment and minimum 12.98 cm in T_7 treatment of M_3 generation at 20 DAS, The mean maximum stem length 3.28 cm was observed in T_6 and minimum 2.3 cm was observed in T_6 treatment in M_3 generation at 40 days after sowing (DAS).

The mutagenic effect on the primary and secondary branching pattern was observed in M_3 generation. The delayed branching was observed in the treatments T2,T6,T7,T8 over the control as reported previously in chickpea (Kamble and Petkar,2015). The maximum number of primary branches i. e. 3.29 in T_6 treatment 40 DAS , 2.37 in T_3 treatment at 60 DAS in M_3 generation., The variation in length of primary branches were observed in m3 generation and–34.03 cm maximum length in T_5 and 28.3 cm minimum length in T_7 at 60 DAS. The number and length of secondary branches revealed the variation in M_3 generation. The 6.15 as maximum number of secondary branches was observed in T_5 treatment and minimum 4.8 in T_3 at 80 DAS. The maximum length of secondary branches 14.92 cm was observed in T_2 in M_3 generation.

The early flowering was observed in T_5 and T_6 treatments. The maximum number of flowers was found to be 6.83 in T_4 and minimum 4.15 in T_2 at 80 Das. The early pod formation was observed in all treatments as compared to control T_1 treatment in M_3 generation. The maximum 12.94 pods per plant were observed in T_4 treatment of M_3 generation while minimum 6.8 in T_2 during 100 to 120 DAP. The mutagenic treatment was found to be non-significant with respect to two seeded pod and seed size in M_3 generation while the one seeded pod was observed significant and maximum number of one seeded pod was observed 11.52 in T_4 and minimum 6.23 in T_7 treatment.

The plant height has been reported significantly higher in the chickpea treated with gamma rays and EMS (Wani and Anis,2008); in grasspea (Waghmare and Mehra, 2000). The increased plant height has been reported in 10 KR treatment in green gram (Kulshreshtha and Singh, 1984) and increase in branching with increased number of fruits in *Brassica juncea* (Nayar and George, 1969). The minimum plant height was observed in 30 KR treatment as compared to the control in the present assessment. The reduction in internodes length may be due to the reduction of cell length or the reduction of cell number (Weber and Gottschalk, 1973). The similar observation has been reported previously in Rhodes grass treated with gamma rays (Khan,1998), in *Solanum melanogena* (L.) treated with chemical mutagen (Alka *et al.*, 2007; Krishna *et al.*,1984), in mungbean (Ansari *et al.*,1997). The Number of primary and secondary branches were recorded more in T_5, T_6 treatment respectively as compared to control in M_2 generation and in conformity with previous study in grasspea (Waghmare and Mehra, 2000), chickpea (Wani and Anis, 2008, Kamble and Petkar, 2017). It has been reported that the mutation in traits could be attributed to the mutation of pleiotropic gene or mutation of gene cluster or chromosomal arrangement in chickpea (Wani and Anis, 2008).

The quantitative increase in pod per plant has been reported in chickpea treated with gamma rays (Wani and Anis, 2008) , in grasspea treated with gamma rays and EMS in combination (Waghmare and Mehra,2000),in khesari (Singh and Chaturvedi,1990). An increase in flower, pod, seed has been reported in chickpea treated with EMS and gamma rays independantly as well as in combination through the mutation breeding (Wani and Anis,2008). Mean number of capsule per plant and seed yield per plant has been reported as enhanced (Abo-Hegazi and Ragab, 1986). No significant increase in number of seed per pod in mutant types has been reported in chickpea (Wani and Anis,2008, Kamble *et. al.,* 2015). The seed size was non-significant as reported in grasspea (Waghmare and Mehra,2000). The observations in present investigation revealed the conformity as reported in chickpea (Wani and Anis, 2008; Kamble *et. al.,* 2015). The mutation in traits could be attributed to the mutation of pleiotropic gene or mutation of gene cluster or chromosomal arrangement as has been reported in chickpea (Wani and Anis, 2008) and present study revealed the conformity.

CONCLUSION

The gamma radiation is a potent physical mutagenic agent to cause the mutation in the wild chickpea in the present study. It enhances the mutation spectrum in the wild germplasm. The wild species of the chickpea is important on account of the resistance potential to various biotic and abiotic stresses. The useful traits in wild annual species of chickpea could be harnessed for the betterment and improvement of the cultivated variety of chickpea.

The mutagenesis brings the variation in the wild species and mutant may be appeared suitable for interspecific cross. The T_4 treatment appeared as a fairly good treatment among all treatments. ANOVA for the treatments were observed significant ($p<0.05$). The comparative result on overall variability in M_3 generation was observed significant in present study.

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Table 1: Qualitative and quantitative phenology in wild chickpea treated with physical mutagen .

Sr.No.	Treatment	Days for germination (Mean)	Stem Length (Mean)	Plant Length (Mean)	No of Primary Branches (Mean)	Length of Primary Branches (Mean) in cm	No of Secondary Branches (Mean)	Length of Secondary Branches (Mean) in cm	No of Flower (Mean)	No of Pods (Mean)	No of one seeded Pods (Mean)	No of two seeded Pods (Mean)	Size of seed (Mean) in gm
1	T_1	3.30	3.03	21.84	3.03	30.33	4.86	11.74	6.41	10.15	9.33	0.83	1.467
2	T_2	7.00	2.9	16.63	2.63	33.83	4.93	14.92	4.15	6.8	6.52	0.29	1.47
3	T_3	7.37	2.6	19.94	2.37	31.18	4.8	15.24	6.73	8.21	7.08	1.13	1.454
4	T_4	7.23	3.03	21.53	3.08	32.44	5.28	15.87	6.83	12.94	11.52	1.41	1.473
5	T_5	7.77	3.13	19.81	3.16	34.03	6.15	16.44	6.08	12.08	10.62	1.46	1.424
6	T_6	8.37	3.28	18.66	3.29	32.43	5.48	16.41	6.55	10.74	9.42	1.31	1.377
7	T_7	8.13	2.86	12.98	2.86	28.3	5.21	14.94	5.62	7.82	6.23	1.60	1.441
	F-Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NonSig.	NonSig.
	SE(m±)	0.21	0.055	0.004	0.080	0.025	0.007	0.007	0.003	0.006	0.016	0.004	0.002
	CD at 5%	0.65	0.169	0.012	0.248	0.077	0.022	0.022	0.010	0.018	0.050	---	----