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Studies on the effect of EMS and Colchicine in M_1 generation of Sesame (*Sesamum indicum* L.) Var. TMV3

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ABSTRACT

Seeds of sesame (*Sesamum indicum* L), genotypeTMV3 were treated with various concentrations of EMS and Colchicine like 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 % and the LD_{50} values observed at 1.0 % of EMS and 0.6 % of Colchicine. Based on their LD_{50} values appreciable concentrations only selected for further study and their effects on various morphological characters such as plant height per plant, number of branches per plant, number of leaves per plant, days to first flowering, number of capsules per plant, number of seeds per capsule and seed yield per plant (g) were measured quantitatively and the results showed that all the characters were consequently or significantly reduced when compared to control and also EMS showed more effective than colchicine.

***Keywords*:** EMS; Colchicine; LD_{50} value; Quantitative characters; M_1 generation

1. INTRODUCTION

Sesame (*Sesamum indicum* L. 2n = 26) is the most important oil yielding plant and one of the oldest crops in the world. Archeological records indicate that it has been used for more than 5000 years (Bedigian, 2004), Sesame belongs to family pedaliaceae and is regarded as the "Queen of oil seeds" by virture of its excellent oil quality. Sesame is mainly grown for grains and oil extraction. Its seeds are rich in protein and oil. The proportion of oil in the seed is of the order of 35 - 63 (Ashri 1998; Baydar *et al*., 1999). The total fat content of the seed (12.5 %) is only second to that of soybean with 14.5 %. Sesame oil is very stable due to the presence of some antioxidants such as sesamin, sesamolin and sesamol (Suja *et al*., 2004).

The concept of mutation as the cause of sudden appearance of a new characteristic was first proposed by the Dutch Botanist Hugo deveries in 1901, following his work on inheritance in the evening primrose *Oenothera lamarckiana*. Mutation may be induced by

some agents such as radiation and certain chemicals and generate genetic variations from which the crop having desired characters can be selected.

The mutation breeding has become an alternative to conventional breeding and it was used for crop improvement of traditional traits e.g., yield, resistance to diseases and pests, but more frequently for diversified uses of crop end - products, enhancing quality and nutritional values and tolerances to a biotic stresses (Savant, 2011). Generally, EMS (Ethyl Methane Sulphonate) is a powerful mutagenic, carcinogenic organic compound. It produces random mutations in genetic material by nucleotide substitution, particularly by quanine alkylation and it produced only point mutation (Okagaki *et al*., 1991). Colchicine is also a highly poisonous alkaloid. It induces mutation in plant through polyploidization (Anuvainola, 2000; Verma and Agarwal, 2009). It inhibits spindle fiber formation and also induced polyploidy in plant cells during cellular division by inhibiting chromosome segregations of mitosis and meiosis (Fig 1).

Figure 1. *Sesamum indicum* L.

2. MATERIALS AND METHODS

Ten sets of three hundred, healthy and dried seeds were soaked in distilled water for two hours and transferred to freshly prepared various concentrations (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 %) of EMS and colchicine solutions for four hours with regular shaking. The treated seeds were carefully removed from the solution and they were

thoroughly washed in tap water for two to four times. The untreated seeds were presoaked in distilled water for six hours and used as control. The treated and untreated seeds were spread over moist germinating paper in petriplates with three replications for each treatment and observed the germination capacity of treated seeds under laboratory conditions. Based on the germination percentage, the LD_{50} value (50 % reduction of germination and seedling size) was observed at 1.0 % of EMS and 0.6 % of colchicine. Based on the LD50 value of both mutagens, only appreciable concentrations (EMS - 0.6, 0.8, 1.0, 1.2, 1.4 % and Colchicine - 0.2, 0.4, 0.6, 0.8, 1.0 %) were selected for field studies and they were sown in separate rows with three replications in a randomized block design to raise the M1 generation. All the necessary plant production methods like irrigation and weeding were carried out during the period of crop growth and also measured the morphological and yield parameters viz., plant height per plant, number of branches per plant, number of leaves per plant, days to first flowering, number of capsules per plant, number of seeds per capsule and seed yield per plant.

3. RESULTS AND DISCUSSION

3. 1. Germination study

Table 1. Determination of LD_{50} Value for EMS and Colchicine in Sesame (*Sesamum indicum* L.). Var. TMV3.

S. No	Treatment (Con. in %)	EMS Treated seeds		Colchicine treated seeds	
		Germination (%)	Percent of decrease / Increase over control	Germination (%)	Percent of decrease / Increase over control
1	Control (Untreated seeds)	95.01 ±2.85	00.00	96.17 ±2.88	00.00
2	0.2	90.00 ±2.70	- 5.27	82.01 ±2.46	- 14.72
3	0.4	85.21 ±2.55	- 10.31	67.45 ±2.02	- 29.86
4	0.6	74.34 ±2.23	- 21.75	**51.32 ±1.53**	**- 46.63**
5	0.8	65.52 ±1.96	- 31.03	46.12 ±1.38	- 52.04
6	1.0	**51.45 ±1.54**	**- 45.84**	34.27 ±1.02	- 64.36
7	1.2	45.17 ±1.34	- 52.45	31.06 ±0.93	- 67.70
8	1.4	36.13 ±1.08	- 61.97	20.18 ±0.60	- 79.01
9	1.6	21.56 ±0.64	- 77.30	17.71 ±0.53	- 81.58
10	1.8	16.18 ±0.48	- 82.97	6.46 ±0.19	- 93.28
11	2.0	11.00 ±0.33	- 88.42	2.18 ±0.06	- 97.73

In the present investigation, the germination percentages were gradually decreased with increasing concentrations of EMS and Colchicine when compared to control (Table 1) and similar results were also reported earlier by Rangaswamy (1973); Rajathi (2008) in sesame. Maximum reduction was observed at higher concentrations of both the mutagens (2.0 %) and the LD_{50} value (50 % reduction of seed germination and seedling size) was observed at 1.0 % of EMS and 0.6 % of Colchicine and the same results were also been reported in sesame by Ganesan, 1995; Rajathi, 2008; Anitha vasline and Saravanan, 2011.

3. 2. Field study

In the M_1 - generation, all the quantitative characters showed the decreasing trend with increasing concentrations of both the chemical mutagens, but in case of flowering date was increased (Delayed flowering) in all the treated progenies when compared to control (Table 2). Similar results were also reported in sesame by Jayamary and Jayabalan (1995); Ganesan (1998); Rahman and Das (1998).

Table 2. Effect of EMS and Colchicine on quantitative characters in M_1 generation of sesame (*Sesamum indicum* L.) Var. TMV3.

Treatment (Con. in %)		Plant height / plant (cm) (Mean ± SE)	No. of branches / plant (Mean ± SE)	No. of leaves / plant (Mean ± SE)	Days to first flowering (Mean ± SE)	No. of capsules / plant (Mean ± SE)	No. of seeds / capsule (Mean ± SE)	Seed yield / plant (g) (Mean ± SE)
Control (0.0)		72.04 ±2.16	7.06 ±0.22	103.12 ±3.09	39.00 ±1.17	74.08 ±2.22	39.74 ±1.19	6.80 ±0.20
EMS	**0.6**	64.15 ±1.92	6.72 ±0.20	89.68 ±2.69	42.00 ±1.26	70.21 ±2.10	34.91 ±1.04	5.56 ±0.16
	0.8	60.15 ±1.80	6.43 ±0.19	78.32 ±2.34	43.00 ±1.29	68.38 ±2.05	30.53 ±0.91	4.86 ±0.14
	1.0	57.36 ±1.72	5.83 ±0.17	71.44 ±2.14	44.00 ±1.32	61.42 ±1.84	28.97 ±0.86	4.26 ±0.12
	1.2	52.42 ±1.57	5.36 ±0.16	65.50 ±1.96	45.00 ±1.35	57.36 ±1.72	24.63 ±0.73	3.83 ±0.11
	1.4	**43.72 ±1.31**	**4.79 ±0.14**	**54.08 ±1.62**	**46.00 ±1.38**	**51.32 ±1.53**	**21.65 ±0.64**	**3.62 ±0.10**
Colchicine	**0.2**	61.81 ±1.85	6.64 ±0.19	74.62 ±2.23	41. 00 ±1.23	61.48 ±1.84	33.81 ±1.01	3.98 ±0.11
	0.4	54.46 ±1.63	6.21 ±0.18	67.32 ±2.01	43.00 ±1.29	58.38 ±1.75	31.51 ±0.94	3.82 ±0.11
	0.6	51.02 ±1.53	5.56 ±0.16	63.35 ±1.90	44.00 ±1.32	52.18 ±1.56	28.63 ±0.85	3.54 ±0.10
	0.8	44.53 ±1.33	5.24 ± 0.15	56.16 ±1.68	46.00 ±1.38	49.04 ±1.47	25.45 ±0.76	3.26 ±0.09
	1.0	**39.68 ±1.19**	**4.37 ±0.13**	**51.73 ±1.55**	**47.00 ±1.41**	**43.63 ±1.30**	**23.32 ±0.69**	**2.96 ±0.08**

SE = Standard Error

The maximum days of first flowering was observed at 1.4 % of EMS and 1.0 % of Colchicine. It may be due to the inhibition effect of both the mutagens on floral hormones and therefore minimum days was observed in control and the same type of results were also

observed previously in sesame by Menash *et al*., (2007) in cow pea, Pavadai and Dhanavel (2004) in Mungbean by Khan and Wani (2005) and Bhendi (Sasi *et al*., 2005). In the present study, all the morphological parameters like plant height per plant, number of branches per plant, number of leaves per plant were showed decreasing trend at higher concentrations level when compared to control and the similar results were also reported in sesame earlier by Prabhakar, 1998; Rajathi, 2008 and Banu *et al*.,2005 in cowpea. Maximum reduction in plant height, number of branches and leaves were observed at 1.4 % of EMS and 1.0 % of Colchicine (Table 2).

In the M_1 generation, all the treated progenies revealed that yield and yield components characters were progressively decreased with different increasing concentrations of chemical mutagens when compared to control plants and the similar results also been proposed earlier by Rangaswamy, 1973 in sesame; soybean in Pavadai and Dhanavel, 2004; cow pea in Banu *et al*., 2005. Maximum yield was obtained from control (Untreated progeny) plants, minimum number of capsules(51.32;43.63), number of seed per capsules(21.65;23.32) and seeds yield per plants (g) (3.62;2.96) were observed at 1.4% of EMS and 1.0% of colchicine (Table 2).

4. CONCLUSION

The present investigation revealed that the seed germination percentage decreased progressively as the concentrations of chemical treatments increased. Maximum reduction was observed at higher concentrations and the LD50 value was observed at 1.0 % of EMS and 0.6 % of colchicine. In the field study, a considerable reduction was observed in all the quantitative traits when compared to control.

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