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Effect of seed treatment by ethyl methane sulphonate (EMS) on fruit quality of papaya (*Carica papaya* L.) cv. Pusa Dwarf

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Abstract

Papaya seeds of cv. Pusa Dwarf were treated with different doses (0.25 %, 0.50 %, 0.75 % and 1.00 %) of Ethyl Methane Sulphonate (EMS) to observe the influence of treatment on fruit quality of papaya. The results revealed that fruit attributes were effectively improved by seed treatment with Ethyl Methane Sulphonate (EMS). EMS treatment @ 0.50 % had fruits with minimum central cavity, maximum fruit length, fruit girth, fruit weight and pulp thickness. Untreated seeds (control) had minimum fruit length, fruit girth, fruit weight and pulp thickness. The fruits obtained from the seeds treated with 0.50 % EMS had significantly maximum TSS, sugar, fat, ash, carbohydrate, protein, carotene and minimum moisture content during both the years of study.

Keywords: Ethyl Methane Sulphonate (EMS), fruit character, fruit quality, papaya.

INTRODUCTION

Papaya (*Carica papaya* L.) is one of the important fruit crops of tropical and subtropical region of the world. Owing to its unique characteristics, papaya cultivation has become very popular among the fruit growers. Being short duration, early maturing, quick growing and dwarf in nature, it can be grown very successfully

in the orchards of major fruit crops (Chattopadhyay, 2012). Due to nutritional and medicinal values, it fetches very good price in the market (Irulappan, 1992). Papaya ranked forth position in production (5382000 MT), first position in productivity (40.7 MT/HA) from 132000 ha area under fruit in India (Anonymous, 2013). Among the breeding techniques, mutation is one of the important methods adopted by plant breeders to create variability in a number of species. Natural mutants have played an important role in creating variability in many species. However, induced mutations have not brought out the desirable results in many of the fruit crops. A number of induced mutations have ended up as chimeras in fruit crops and intrasomatic selections have reversed the mutant effects. A dwarf gynodioecious variety in papaya has been developed by induced mutation of gamma irradiation in papaya (Ram and Srivastava, 1984). Mutation directly affected the genetic structure of plants. Dwarfness and earliness in flowering are important characters for high density planting. Therefore, the present study has been formulated to study the effect of seed treatment with ethyl methane sulphonate on fruit quality of papaya

MATERIALS AND METHODS

The present investigation was conducted at Horticultural Research Centre at SVP University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh during the year 2012-13 and 2013-14. The experiment was laid out in Randomized Block Design with five treatments and three replications. Papaya seeds of cultivars Pusa Dwarf were obtained from IARI, Regional Station Pusa, Samastipur (Bihar) India. Healthy and uniform sized seeds were treated with four concentrations (0.25 %, 0.50 %, 0.75 % and 1.00 %) of ethyl methane sulphonate (EMS). The aqueous solution of different concentrations of EMS was prepared using distilled water. Seeds were soaked in the freshly prepared mutagenic solutions for 6 hours and kept at room temperature with intermittent shaking after prior soaking in distilled water for 6 hours. The seeds at the end of the treatment were washed in running water to make them free from the residues of mutagen sticking to the seed and sown immediately. One hundred treated and non-treated seeds of each sample were sown in polyhouse Jadhav *et al.,* (2012). Five healthy and matured fruits obtained from the plants were used for each treatment for recording various fruit quality attributes (Hang and Chau, 2010; Goldenberg et al, (2014; Elangovan and Pavadai, 2015; Bermego et al, 2012; Hassan et al, 2009 and Figueiredo et al, 2014). The chemical composition of fruit was analysed at Regional Food Research and Analysis Centre, (R-FRAC) Lucknow, U.P. India.

RESULTS AND DISCUSSION

The data pertaining to fruit characters viz. fruit length, fruit girth, fruit weight, central cavity, pulp thickness, number of seeds per fruit of papaya, as influenced by different doses of ethyl methane sulphonate are presented in Table-1.

Table. 1 Effect of ethyl methane sulphonate on physical characters of papaya fruit

Treatment	Fruit Length (cm)		Average Fruit Length (cm)	Fruit Breadth(cm		Average Fruit Breadth (cm)	Fruit Weight (gm)		Average Fruit Weight (gm)	Central Cavity(cm)		Average Central Cavity (cm)	Pulp Thickness(cm)		Average Pulp Thickness (cm)	No. of Seeds/ Fruit		Average No. of Seeds/ Fruit
	2012-1	2013-1		2012-1	2013-1		2012-1	2013-14		2012-1	2013-1		2012-13	2013-14		2012-1	2013-1	
Control	20.75	21.57	21.16	43.39	44.95	44.17	1361.0	1413.61	1387.33	10.73	10.58	10.66	2.87	2.93	2.90	455.62	438.41	447.02
0.25 % EMS	20.82	21.82	21.32	43.48	45.71	44.60	1390.4	1415.83	1403.13	10.69	10.63	10.66	2.90	3.04	2.97	436.77	415.71	426.24
0,50 % EMS	22.57	24.51	23.54	46.43	48.22	47.32	1451.2	1577.31	1514.26	10.64	10.52	10.58	3.15	3.30	3.22	420.82	405.71	413.26
0.75 % EMS	20.84	22.01	21.42	43.12	45.15	44.13	1396.4	1437.86	1417.13	12.70	11.83	12.26	2.99	3.07	3.03	395.18	385.33	390.25
1.00 % EMS	19.98	20.01	19.99	41.53	42.52	42.02	1244.8	1368.71	1306.79	12.97	12.40	12.68	2.67	2.75	2.71	389.74	377.16	383.45
Gen. Mean	**20.99**	**21.98**		**43.59**	**45.31**		**1368.8**	**1442.66**		**11.55**	**11.19**		**2.92**	**3.02**		**419.62**	**404.46**	
SE m±	0.21	0.27		0.65	0.68		20.19	22.33		0.32	0.40		0.04	0.07		5.01	5.23	
C.D. 5%	0.69	0.88		2.12	2.24		65.85	72.85		1.04	1.32		0.14	0.25		16.35	17.06	

Significant differences were found among all the treatments in terms of physical traits of fruits. Maximum fruit length (23.54 cm), fruit girth (47.32 cm), fruit weight (1514.26 gm) and pulp thickness (3.22 cm) was recorded with 0.50 % EMS seed treatment. However, higher doses of EMS (1.00 %) had minimum fruit length (19.99 cm), fruit girth (42.02 cm), fruit weight (1306.79 gm) and pulp thickness (2.71 cm). Minimum central cavity (10.58 cm) was recorded in fruits obtained with 0.50 % EMS seed treatment, while maximum (12.68 cm) with 1.00 % EMS. The maximum number of seeds per fruit (477.02 seeds) was counted with control (un-treated seeds), whereas 1.00 % EMS treatment had fruits with minimum number of seeds per fruit (383.45 seeds) during the year of experiment. It was also observed that the physical characters of papaya were improved with the increase in doses of EMS upto 0.50 %, and thereafter, the fruit quality was reduced. Based on the results, it may be concluded that moderate concentration of EMS (0.50 %) was most effective in improving the physical quality of papaya. Similar effect of EMS on fruit quality was also observed by (Bankapur and Habib, 1997; Hang and Chau, 2010 and Elangovan and Pavadai 2015).

Table. 2 Effect of ethyl methane sulphonate on chemical composition of papaya fruit

Treatment	TSS(°brix)		Average TSS (°brix)	Sugar (%)		Average Sugar (%)	Moisture (%)		Average Moisture (%)	Ash(%)		Average Ash(%)	Fat(%)		Average Fat (%)	Protein (%)		Average Protein (%)	carbohydrate (%)		Average carbohydrate (%)	Carotene (ug/100 gm)		Average Carotene (ug/100 gm)
	pg	2013-14		2012-13	2013-14		2012-13	2013-14		2012-13	2013-14		2012-13	2013-14		2012-13	2013-14		2012-13	2013-14		2012-13	2013-14	
Control	12.54	12.64	12.55	9.91	10.40	10.16	87.86	87.69	87.77	0.590	0.623	0.607	0.143	0.150	0.147	0.547	0.567	0.557	10.85	10.97	10.91	38.31	38.85	38.44
0.25 % EMS	12.66	12.74	12.70	10.12	10.67	10.40	88.60	88.23	88.41	0.660	0.677	0.669	0.147	0.160	0.154	0.553	0.570	0.562	10.87	10.98	10.92	38.89	39.14	39.02
0,50 % EMS	12.71	12.85	12.78	10.62	10.90	10.76	87.58	87.62	87.60	0.743	0.767	0.755	0.167	0.173	0.170	0.623	0.647	0.635	10.91	11.00	10.96	39.09	40.87	39.98
0.75 % EMS	12.02	12.49	12.26	10.15	10.20	10.17	87.87	87.96	87.91	0.700	0.730	0.715	0.143	0.147	0.145	0.563	0.603	0.583	10.48	10.56	10.49	38.33	39.36	38.85
1.00 % EMS	11.25	11.46	11.35	9.60	9.86	9.73	89.56	89.27	89.41	0.533	0.587	0.560	0.123	0.137	0.130	0.487	0.523	0.505	9.40	9.50	9.45	35.13	37.66	36.40
Gen. Mean	**12.24**	**12.44**		**10.08**	**10.41**		**88.29**	**88.20**		**0.645**	**0.677**		**0.145**	**0.153**		**0.551**	**0.582**		**10.50**	**10.60**		**37.95**	**39.17**	
SE m±	0.23	0.14		0.19	0.35		0.30	0.12		0.007	0.005		0.005	0.002		0.009	0.006		0.18	0.30		0.24	0.27	
C.D. 5%	0.75	0.47		NS	NS		0.98	0.41		0.023	0.016		0.015	0.007		0.030	0.019		0.60	1.00		0.80	0.89	

The data given in Table-2 revealed maximum TSS (12.78 °brix), sugar (10.76 %), fat (0.17 %) and carbohydrate (10.96 %) in fruits obtained from 0,50 % EMS followed by 0.25 % EMS (12.70 °brix TSS, 10.40 % Sugar, 0.15 % Fat and 10.92 % Carbohydrate), while, fruits obtained from seed treatment with higher concentration of EMS (1.0%) had minimum TSS (11.35 °brix), sugar (9.73 %), fat (0.13 %) and carbohydrate (9.45 %). However, sugar contents in different treatments of EMS were differed in significantly during both the years of study. The result on chemical attributes are further indicated that the level of moisture percentage was minimum (87.60 %) while ash percentage was maximum (0.75 %) in fruits obtained with 0.50 % EMS as compared to control and other treatments of EMS. Data also indicated that the fruits obtained with 1.00 % EMS had maximum moisture percentage (89.41 %) and minimum protein (0.50%), carotene (36.40 ug/100gm) ash percentage (0.56 %). However, fruits obtained from 0.50% EMS treatment had lesser levels of protein (0.63 %) and carotene (39.98 ug/100gm). The improvement in fruit quality with lower doses of EMS may be due to the fact that EMS at a lower dose induces hormones which are responsible for the improvement to fruit quality. Physiological changes in treated fruits occurred due to ethyl methane sulphonate. The mutagens at higher dose reduced fruit quality which might be due to the inhibitory effect of higher doses of ethyl methane sulphonate. The positive effects of EMS mutagenesis on biochemical composition and nutritional quality of fruits in the present study are also reported by earlier researchers namely, (Bermego et al, 2012; and Kim et al, 2012 a &b) who had reported that gamma-irradiation mutagenesis had varied effects on

internal quality of fruits. The results of present study also indicated the varied effects of gamma irradiation on TSS, acidity and vitamin, without impairing nutritional quality. Similar results with gamma irradiation were also reported by (Goldenberg et al, 2014)) in mandarin fruit**.** The results of the study are also supported by the findings of (Figueiredo et al, 2014) who observed better quality of papaya fruit with irradiation of gamma rays.

CONCLUSION

Among the mutagens used in the study, EMS @ 0.50 % was found to be more effective and showed the stimulatory effect as compared to control and other treatments. The stimulatory effect of EMS at a lower dose is due to the fact that mutagens at lower concentration stimulate enzyme and growth hormone responsible for growth, yield and fruit quality, while, higher concentration of mutagens had inhibitory effect on fruit quality. Hence, fruit yield and quality of genetically modified papaya can be improved significantly through induced mutagenesis by ethyl methane sulphonate.

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