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Result of Chemical Mutagenesis on Quantitative as well as Qualitative Traits of Maize (*Zea mays* (L.)

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ABSTRACT

Semi dent maize (Zea mays) variety EV-6098 was treated with different concentrations of chemical mutagens namely, Diethyl Sulphate (DES), Ethyl Methane Sulphonate (EMS) and Ethylene Imine (EI). To do mutations, various concentrations such as 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110 and 120mM for 5 hours were subjected to 300 seed sample of each concentration and with one respective control. The LD_{50} was observed in 60mM of EMS, 50mM of DES and 50mM of EI. The physiological, morphological and different yield attributes were mainly decreased seed germination percentage, seedling survival ratio, days to first tesseling, days to first silking, plant height, number of leaves per plant, number of ears per plant, number of seeds per ear, ear length, and width, 100 seed weight, seed yield per plant, fresh weight per plant and dry weight per plant. The rising concentration of the EMS, DES and EI resulted in reduced physiological and yield attributes have been concerned with chromosomal abnormalities caused to the cell of the maize plant affected by chemical mutagen.

Key words: *Zea mays, Diethyl Sulphate (DES), Ethyl Methane Sulphonate (EMS), Mutagen*

INTRODUCTION

Maize is considered one of the most important staple foods of the world. It is widely cultivated for fodder and forage purposes in tropical and sub tropical zones. The grains of it are a vital source of proteins and vitamins. Maize is extensively produced throughout the world. However, United States of America produces about half of the world total production of Maize probably 42.5%, other countries are China, Brazil, Mexico, India and France. Overall, in the world, the production was near about 900 million tons in 2009, just little more than rice (~700 million tons) and wheat (~650 million tons). In 2009, about 200 million hectares of maize were cultivated worldwide, with output of 6000 kilogram/ hectare. This was the production scenario of maize that was described earlier. Now, we introduce the importance of genetic variability in maize plant. It is one of the most important basic factors which is highly desirable for plant breeding.

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It is observed as a most precious tool to conventional breeding in crop improvement. Mutation breeding has become gradually more famous in recent days as an effective mechanism for progressively crop improvement[1] and is concerned to existing germplasm for variety improvement in all breeding programs. Induced mutations are highly successful in increasing natural genetic resources and are used in developing and under developed varieties of cereals and other crops. These induced mutations supply useful variation for practical crop breeding purpose. Maize grains contain about 75% starch and 28% fat per kilogram. All plant parts of maize plant are used for food source providing proteins, minerals and vitamins.

MATERIAL AND METHODS

The maize seed EV-6098 were collected from Department of Plant Breeding and Genetics, faculty of Agriculture, University of Agriculture Faisalabad. The seeds with uniform size, color and shape and weight were selected for experimental purpose. Three mutagens namely, Ethyl methane sulphonate, Diethyl sulphate and Ethylene Imine were used. Seeds were treated with EMS, DES and EI treatments seeds pre soaked in distilled water for 5 hours at room temperature. Then, we transformed to aqueous concentration of 50mM, 60mM and 70mM of EMS ; 40mM, 50mM and 60mM of DES; ; 40mM, 50mM and 60mM of EI for 5 hours treatments. The seeds were washed in running tap water for 8-10 times. Then, we transferred these seeds to the Petri dishes containing two layers of moist filter paper for germination observation and 300 seeds per treatment were planted per variety with great protection and morphological data were noted. Data consisting on morphological and yield parameters like seed germination, seedling survival, days to first tassel, days to first silking, plant height, number of leaves per plant, number of seeds per plant, 100 seed weight, grain yield per plant, ear length and width, fresh weight per plant and dry weight per plant in all the attributes were keenly noted and compared with control.

RESULT AND DISCUSSION

By comparing to the germination and seedling growth test, EMS, DES and EI produced numerous physiological and physical effects including reduced and late germination rate in comparison to control. Many works have been done in Black gram and Soybean in which dose/concentration dependent inhibition in seed germination have been observed. All the mutagens applied postponed the days to first tesseling respect to treatment levels. A delay of 2-5 days in first tesseling was seen. Higher doses of the mutagens prepared the plant system in such a way in which plant took more days for tesseling as compared to the normal but EI treated plants took more days about 6 days for tesseling in observed plants data because of mutagenesis in maize plant.

All the observed mutagenic treatments resulted in reduced physical, physiological and morphological characters in maize plant because of abnormalities present in chromosomes due to mutagens. All the observed Mean data of experiment is given below in table-1 that is Mean data of M_1 generation. The reduction was more prominent in the case of EMS at 70mM such as it may be due to the toxic effects of mutagens in maize present in physiological attributes. Similar results were obtained by[12]. Same workers reported this work in Blackgram by Ramaswamy[15] and Pavadai and Dhanavel[13] in soybean.

All the mutagens delayed the days to first tesseling and silking without respect of treatment level. A delayed of 5 to 10 days in first tesseling and silking was observed. In our present study, the days to first tesseling and silking was delayed by EMS at higher doses of 70mM, DES and EI at higher concentrations of 60mM. In our experiment, we observed that at lower concentrations of mutagens there was an induction to first tesseling and silking. Similar results have been observed in different crops like soybean, cowpea and okra.

The plant height was deduced with enhancing levels of different concentrations of mutagens and it is concluded that EMS concentration was considered as more effective than DES and EI.

All the morphological attributes of M_1 generation were reduced with increase in concentration of mutagenic treatments. All the treatments decreased the morphological and physiological characters. The reduction was more vital in case of 70mM of EMS.

Table 1: Effect of EMS, DES and EI on quantitative traits of maize (*Zea mays* (L.) M_1 generation [Mean ± SD]

Treatment		Seed germination	Seedling survival	Days to first teaseling	Days to first silking	Plant height	No. of leaves per plant	No. of ears per plant	No. of per grains per plant	100 grains weight	Grain yield per plant	Ear length	Ear breath	Fresh weight	Dry weight
Control		90.22 ±2.79	90.00±2.04	48.42 ±1.36	55.72 ±1.55	153=.1 ±4.68	14.76 ±0.38	2.33 ±0.04	580.21 ±17.25	30.63 ±0.82	180.31 ±5.34	25.82 ±0.62	3.45 ±0.16	630.39 ±18.79	145.38 ±4.21
EMS	50m M	65.66 ±1.87	53.66±1.76	45.34 ±1.48	54.74 ±1.70	120.81 ±3.56	12.08 ±0.36	2.15 ±0.03	542.66 ±16.30	24.79 ±0.77	155.92 ±4.61	14.70 ±0.50	6.76 ±0.1	481.75 ±14.75	125.93 ±3.62
	60m M	49.00 ±1.44	41.66 ±1.28	51.50 ±1.54	60.28 ±1.77	118.90 ±3.44	10.81 ±0.35	1.08 ±0.03	540.77 ±16.37	23.07 ±0.72	127.66 ±3.85	12.20 ±0.39	2.10 ± 0.12	443.79 ±13.37	97.36 ±2.98
	70m M	45.66 ±1.27	37.33 ±1.00	58.32 ±1.71	66.63 ±1.87	95.01 ±2.73	10.56 ±0.34	1.01 ±0.03	420.21 ±12.69	18.24 ±0.57	90.8 3±2.75	10.25 ±0.33	3.48 ±0.10	284.56± 8.59	65.28 ±2.01
DES	40m M	51.3 3±1.83	60.66 ±1.87	44.58 ±1.45	58.74 ±1.64	148.46 ±4.39	12.4 6±0.37	1.26 ±0.03	488.33 ±14.67	26.19 ±0.78	161.09 ±4.89	15.38 ±0.52	5.04 ±0.15	500.36± 15.10	122.35 ±3.73
	50m M	46.33 ±1.47	48.66 ±1.37	45.32 ±1.53	59.22 ±1.71	135.05 ±3.93	11.20 ±0.36	1.15 ±0.03	563.10 ±16.98	24.36 ±0.73	131.58 ±4.00	13.05 ±0.42	4.25 ±0.13	462.21± 13.86	104.77 ±3.50
	60m M	40.66 ±1.15	31.63 ±1.03	51.22 ±1.59	60.82 ±1.79	110.40 ±3.22	10.76 ±0.35	1.02 ±0.03	444.44 ±13.39	20.93 ±0.62	100.34 ±3.04	11.80 ±0.38	3.06 ±0.11	355.84± 10.70	87.85 ±2.66
EI	40m M	69.66 ±1.99	60.00 ±1.92	49.99 ±1.43	55.10 ±1.56	155.6 5±4.51	11.64 ±0.37	1.29 ±0.03	452.66 ±13.72	26.35 ±0.79	162.00 ±5.01	17.30 ±0.54	5.15 ±0.16	522.77± 15.71	126.08 ±4.26
	50m M	55.00 ±1.56	49.33 ±1.41	40.68 ±1.49	57.26 ±1.65	139.30 ±4.11	10.38 ±0.37	1.21 ±0.03	510.70 ±15.29	24.28 ±0.75	142.77 ±4.37	15.81 ±0.47	4.52 ±0.14	497.06± 14.94	116.46 ±3.85
	60m M	46.66 ±1.27	33.00 ±1.08	55.44 ±1.57	59.47 ±1.72	125.00 ±3.69	8.96 ±0.35	1.07 ±0.03	447.55 ±13.48	21.19 ±0.66	114.24 ±3.48	12.20 ±0.39	3.90 ±0.12	386.45± 11.65	96.83 ±2.99

CONCLUSION

The maximum mutagenic quantitative traits were observed at 60mM of EMS following by 50mM of DES and EI. All the mutagens applied have been played an important role in plant breeding through improvement in crop plants. In our experiment, 60mM of EMS, 50mM of DES and EI played an important role in induced mutations by which crop gets improvement in quantitative and qualitative characteristics of *Zea mays*.

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