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Research Notes

Mutagenic effectiveness and efficiency of gamma rays and ethyl methar sulphonate in sunflower (*Helianthus annuus* L.)

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Sunflower (*Helianthus annuus* L.) is cultivated predominantly as source of oil, vegetable protein (Balmey and Chapman, 1981) and it is furthermore considered as one of the oil crops of major importance in the world because of its moderate production requirement, high-quality oil, protein content and utilization of all the part of the plant (Skoric, 1992). Mutation breeding is the most useful and vital technology of sunflower. Selection of effective and efficient mutagens is very essential to recover high frequency of desirable mutants. Chlorophyll mutations are used to assess various mutagenic parameters of a mutagen because of their easy detectability and frequent appearance following mutagenic treatments. The present paper deals with the various mutagenic parameters like mutation frequency, effectiveness and efficiency of physical gamma rays (γ-rays) and chemical Ethyl methane sulphonate (EMS) treated sunflower, *Helianthus annuus* L.

The seeds of certified sunflower variety Morden (*Helianthus annuus* L.) was obtained from Tamil Nadu Agricultural Research Station, Bhavanisagar. EMS and γ-rays were selected for the mutation study. Each samples comprising 200 dry and well filled seeds of uniform size of the sunflower were treatedwith γ-rays (5,10,15, 20 KR) and EMS (0.05, 0.1, 0.15, 0.2%). γ-rays treatment was made in Bhaba Atomic Research Centre, Trombay. The treated seeds along with control were sown immediately in the field to raise M_1 generation. Different biological parameters like germination, survival and fertility were recorded in M_1 generation. In M_2 generation, the M_1 seeds as well as control progenies were screened for lethal chlorophyll mutations during the first 5 weeks after germination, whereas viable chlorophyll and morphological mutations were scored throughout the crop duration. Mutation frequency wa calculated as percentage of mutated M_2 progeni for both chlorophyll and morphological mutatic in each treatment. The mutagenic effectiveness an efficiency were computed using the formul suggested by Konzak *et al.* (1965).

In M_1 generation, three important biologica parameters were recorded as percentage ove control (Table 1). Konzak *et al.* (1965) define the effectiveness of mutagens as a measu of frequency of mutations induced by a u dose/concentration of mutagen. The mutagen effectiveness was considerably high in EM treatment and markedly low in γ-rays treatmen in the genotype. Similar observations were mad previously by researchers working with alkylatin agents and radiations in sunflower (Giriraj *et al.* 1990), in lentil (Sarkar and Sharma, 1987), in macrosperma lentil (Solarki and Sharma, 1994) and in wheat and triticales (Reddy, 2000). The biologically comparable doses are most appropriate for comparing the genetic effects of various mutagens and their efficiency and effectiveness at comparable level of damage.

In the present study, effectiveness of mutagenic doses differed considerably (Table 2). With all doses/concentration of both γ-rays and EMS, mutagenic effectiveness decreased with increase in dose/concentration. It was found that the lowest concentration of EMS (0.05%) was the most effective for induction of mutations followed by the lowest doses of γ-rays (5 kR). The mean values of mutagenic effectiveness for γ-rays were only 0.97. With regard to EMS, the mean values were high (1.69). The order of effectiveness of mutagens was EMS (1.69) > γ-rays (0.97), with clearly showed the superiority of the EMS over other doses of γ-rays.

Table 1. Effect of mutagens on germination, plant survival and seed fertility in M1 generation of sunflower

	Treatment	Germination (%)	Plant survival (%)	Seed fertility (%)
Control		100	100	100
EMS				
	0.05%	81.0	75.6	78.2
	0.1%	72.8	66.8	69.4
	0.15%	68.7	51.4	55.8
	0.2%	50.2	42.4	39.6
γ-rays				
	5 KR	85.6	77.4	72.2
	10 KR	74.8	68.6	65.4
	15 KR	62.8	55.4	52.5
	20 KR	45.7	38.4	35.2

Note : Data presented as percentage of control

Table 2. Mutagenic effectiveness and efficiency of gamma rays and EMS in sunflower

	Treatment	Sterility %	Mutated %	Mutagenic effectiveness	Mutagenic efficiency
EMS					
	0.05%	21.8	10.9	2.19	0.50
	0.1%	30.6	19.4	1.95	0.63
	0.15%	44.2	20.5	1.37	0.46
	0.2%	60.4	25.4	1.27	0.42
	Mean	39.2	19.0	1.69	0.50
γ-rays					
	5 KR	27.8	6.25	1.25	0.22
	10 KR	34.6	10.72	1.07	0.31
	15 KR	47.5	12.23	0.81	0.26
	20 KR	64.8	15.44	0.77	0.24
	Mean	43.67	11.16	0.97	0.26

The efficiency of mutagens was worked out mutation rate in relation to M_1 damage. Effectiveness and efficiency are two different properties of mutagens. A highly effective mutagen may not necessarily show high efficiency and *vice versa*. In both the chemical and physial mutagens (10 kR) medium dose / (0.1%) medium concentration was found to be most efficient. Efficiency increased with increase in dose/ concentration from the lowest dose/concentration (5 kR/0.05%) to medium dose/concentration (10 kR/0.1%) but declined drastically with further increase in dose from medium to the highest dose/concentration (20 kR/0.2%). This shows that the highest doses/concentration of all the mutagens causing maximum sterility is least efficient of all the three doses used. The medium concentration of EMS was found to be the most efficiency (0.63) for mutation induction, followed by the medium dose of γ-rays (0.31). The mutagenic efficiency increase at the medium concentration of EMS, and medium dose of γ-rays suggests that the increase in seed sterility was in a lower magnitude than the response for mutation induction. The study revealed that the EMS was highly efficient compared to the γ-rays, thereby confirming earlier studies of Gautam *et al.* (1992) in mungbean; Reddy

and Annadurai (1991) in lentil. With regard to efficiency also, the trend observed among the mutagens was similar to that of effectiveness. Both the mutagenic effectiveness and efficiency (relating to injury) were high at lower dose/ concentration of γ-rays/EMS. The greater efficiency of lower dosage of mutagen is due to the fact the injury and lethality increase with an increase in the mutagen dosage at a faster rate than the mutation (Nerkar, 1977). Higher efficiency and effectiveness of mutagen indicate relatively less biological damage (injury, lethality, sterility etc.) in relation to mutation induced.

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