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Effect of gamma rays and ethyl methane sulphonate on qualitati and quantitative traits in sunflower (*Helianthus annuus* L.) cv.Mord

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Abstract: The studies on induced mutation in sunflower (*Helianthus annuus* L.) cv.morden were performed by exposing the healthy and dry seeds to gamma rays (5,10,15 and 20 KR) and ethyl methane sulphonate (EMS, 0.05, 0.1, 0.15, 0.2%). The mutation frequency and spectrum were observed for plant morphology and yield characters, like plant height, plant habit, head morphology and seed characters in M_2 generation. The data for certain quantitative characters in M_3 generation such as plant height, days to 50% flowering, head diameter, yield per plant, 100-seeds weight and maturity were recorded to assess their usefulness and augmentation in sunflower cultivation and production.

Key words : Mutagens, Plant morphology, Yield characters.

Introduction

The induced mutagenesis has gained prominance for tailoring crop plants with desirable characters. The induction of mutation in sunflower by physical and chemical mutagens has been practised quite intensively in the past two decades. The results recorded to date suggest that the utilization of mutagenesis could be of great advantage in improving the sunflower. The most important effects of physical and chemical mutagenesis are the production of large number of recessive and cytoplasmic mutations, both of which increase the genetic variability in cultivated sunflower (Anaschenko, 1977; Fick, 1978). The mutation induced in sunflower produced a wide range of mutants with useful characters for breeding. The present investigation was undertaken at a private farm in Vallambadugai village of Tamil Nadu to induce viable mutations for quantitative and qualitative traits which could be directly or indirectly employed for the improvement of sunflower.

Materials and Methods

The experimental materials consisted of dry, healthy and genetically pure seeds of sunflower cv. Morden were treated with gamma rays and ethyl methane sulphonate (EMS). Thousand seeds were pre-soaked in distilled water for six hours, later each two hundreds seeds w kept immersed in 0.05, 0.1, 0.15, 0.2% aque solution of EMS treated in 8 hours. For physical mutagen treatment, each 200 dry a healthy seeds were irradiated with 5, 10, and 20 KR r-rays at Bhabha Atomic Resear Centre, Trombay. In M_1 generation, the treat seeds along with control were sown in 30 x 15 c spacing, during *kharif* 2001. The M_1 plan were harvested (on single plant basis) and preserve Eight hundred seeds of each treatment fro M_1 generation were sown in three replicatic in randomised block design with a spacir of 30x15 cm during summer 2001 for M generation. Visual observations were made t isolate different morphological mutants. Th seeds from individual mutant plants as identific in M_2 were sown in three rows, each thre metre long spaced 30x15 cm distances betwee the plants in a randomised block design wit three replications to characterize the mutan at M_3 generation during *kharif* 2002. The untreate seeds were also sown after every third M lines for better comparison. Twenty rando plants were selected in M_3 generations and th data for comparative study in the parent an its mutants for plant height, days to 50% flowerin head diameter, yield per plant, 100-seeds weigl and plant maturity were analysed by t-tes

Table 1. Mutation spectrum in sunflower cv.morden induced by gamma rays (KR), EMS (%) in M_2 generation

Character	Mutation spectrum	Mutation designate	Mutation dose
...ant height	Tall	VR Tl-1	0.1%; 5 KR
	Dwarf	VR Df-2	0.15%; 20 KR
	Smidwarf	VR Sdf-3	0.1-0.15%
...ranching	Dichotomous forked	VR Dcy-4	0.2%
	Branched	VR Bnd-5	0.1-0.2% 10 KR - 20 KR
...eaf morphology	Serrate	VR Srt-6	0.1-15% 10 KR; 15 KR
	Deep serrate	VR Dst-7	0.15%; 15 KR
	Oval	VR Ol-8	0.2%
...eed morphology	Bold	VR Bd-8	0.1-0.15%; 5 - 10 KR
	Small	VR Sd-10	0.15-0.2%; 15-20 KR
	Oval	VR Ol-11	0.2%; 15-20KR
	Long	VR Ly-12	0.2%; 10-15KR
...eed coat colour	Black	VR Bk-13	0.05-0.2%; 10-20KR
	Black with white lines	VR Bwwl-14	0.15-0.2%; 15-20KR
	Black with yellow lines	VR Bwyl-15	0.15-0.2%; 15KR
...aturity	Early maturity	VR Em-16	0.1%; 10-15KR
	Late maturity	VR Lm-17	0.15-0.2%; 20KR
...ield	High yield	VR Hy-18	0.1-0.15%; 10-15KR
...em variation	Forked stem	VR Fs-19	15KR
	Small stem	VR Ss-20	0.15-0.2%; 15-20KR
...ead morpology	Concave	VR Cc-21	0.15%; 15KR
	Convex	VR Cv-22	0.1 & 0.2%; 10-15KR
	Semi convex	VR Scv-23	0.15%; 10-15KR
	Semi concave	VR Scc-24	5-10 KR; 0.15%
...eaf arrangement	Alternate	VR An-25	0.05-0.2%; 5-20KR
	Opposite	VR Os-26	20KR

Table 2. Induced mutation frequency by mutagenic treatments in sunflower M2 generation

Mutagen	Dose	Number of plants studied	Mutation frequency (%)
Gamma rays	5 KR	754	0.53
	10 KR	762	1.44
	15 KR	558	3.04
	20 KR	515	1.94
EMS	0.05%	710	0.28
	0.1%	735	1.36
	0.15%	715	2.37
	0.2%	653	1.99

Results and Discussion

Enhancement of the frequency and spectrum of mutatons in a predictable manner and thereby achieving desired plant characteristics through mutagenesis is an important goal of mutation research (Gustafsson, 1941; Swaminathan, 1969). In the present study, the variations of qualitative and quantitative characters of the plants or their different parts such as leaf, stem, head, seed and yield from the parent plants in M_1 and M_2 generations were denoted as mutations. The mutation spectrum induced by various mutagenic sources are presented in Table 1. Attempts have been made to designate all the

Table 3. Comparison of mean performance of parent cv.morden and its mutants for certain yield and yield traits in M_3 generation (± S.E)

Parent/mutant	Plant height	Days to 50% flowering	Head diameter	100 seeds weight	Yield per plant	Maturity
Parent	108.58±0.74	45.60±0.67	15.60±0.55	4.64±0.25	16.26±1.05	76.80±0.96
VR Tl-1	103.84±1.95	49.40±1.02	13.32±0.78	5.08±0.21	20.10±0.51	75.60±0.50
VR Df-2	45.84±3.51**	48.80±0.86	10.34±0.79	3.94±0.18	8.62±1.18*	78.00±0.70
VR Sdf-3	74.36±7.19	47.40±0.50	13.30±0.68	5.40±0.25	19.98±0.72	76.40±0.92*
VR Dcy-4	79.86±2.18	47.00±0.40	10.48±0.75	3.74±0.15	10.02±0.54	77.60±0.50
VR Bnd-5	81.42±2.16**	48.00±0.44	13.56±0.32	4.78±0.25**	16.34±0.40*	75.80±0.66
VR Srt-6	86.98±3.59	49.20±0.37	14.06±0.59	5.08±0.32	19.72±0.84	75.60±0.67
VR Dst-7	77.46±1.43	46.00±0.44**	12.98±0.67	5.22±0.30	17.92±1.53	78.00±0.70
VR Cd-8	75.98±3.24	47.00±0.70	13.64±0.62	4.84±0.20	13.50±1.74	77.60±0.92**
VR Bd-9	85.88±1.28	45.80±1.06*	14.26±0.82	4.04±0.25	18.46±0.95	78.20±0.86
VR Sd-10	88.24±0.62	48.20±0.48	11.32±0.75	4.14±0.35	18.06±0.95	77.20±1.52*
VR Ovl-11	77.80±0.90	47.60±0.58	12.80±1.04	4.18±0.44	13.30±2.00	78.40±1.02
VR Ly-12	101.36±4.41*	46.60±0.67**	14.30±0.48	4.24±0.36**	17.10±1.74**	76.00±0.70**
VR Bk-13	90.56±2.14	47.00±1.41**	14.54±0.74	4.62±0.27*	21.04±1.101	76.40±0.92*
VR Bwwl-14	73.92±0.39	48.00±0.70	12.28±0.66	4.60±0.23*	18.04±1.38	76.00±0.70**
VR Bwyl-15	74.48±1.05	47.60±0.50	12.60±0.75	4.70±0.24*	19.84±0.73	76.80±0.73*
VR Em-16	101.70±1.77*	48.20±0.73	13.20±0.37	4.64±0.46*	18.20±0.59	70.20±0.86
VR Lm-17	61.56±3.55	47.20±0.58	12.82±1.04	4.04±0.35	18.60±0.84	83.40±1.86
VR Hy-18	89.56±1.25	48.00±0.70	15.06±0.23**	5.80±0.24	21.40±0.65**	76.00±0.70
VR Fs-19	78.66±2.72	47.80±0.66	14.44±0.76	4.90±0.32**	17.68±0.56	75.80±0.66**
VR Ss-20	76.98±0.98	48.40±0.67**	11.02±0.51	3.76±0.38	13.40±1.65	78.40±1.16
VR Cc-21	80.40±2.78	48.00±1.58	12.30±0.33	3.96±0.14	19.72±0.79	76.00±1.14**
VR Cv-22	102.16±1.68**	49.20±0.37	15.50±68*	5.24±0.16	14.62±1.59**	77.80±0.80**
VR Scc-23	83.84±1.96	47.40±0.50	12.82±0.63	5.02±0.22	19.68±1.13	76.00±0.54**
VR Scv-24	101.88±3.73**	48.60±0.60	14.74±0.49**	5.60±0.32	20.38±0.78	77.60±0.67
VR An-25	98.94±0.99	49.20±0.73	14.16±1.02	4.66±0.58*	18.44±1.76	77.20±0.66*
VR Os-26	97.10±1.87	47.80±0.58	13.80±0.89	4.90±0.51**	16.96±1.06**	77.20±1.01*

*; ** Significant at 0.1, 0.5 level respectively (t - test).

26 induced mutants from the variety Morden on the basis of their specific characteristics. Both the macro and micro mutations were induced, some mutant were found quite desirable for certain characters and were regarded as beneficial mutations as they yielded significantly higher than the parent variety. The mutation frequency induced by various doses of γ-rays, and EMS in M_2 generation is shown in Table 2. All the doses of the mutagens yielded mutations at varying frequencies. Maximum mutation frequency was induced by 15 KR of γ-rays and followed by 0.15% of EMS. It was also noticed that 15 KR of γ-rays and 0.15% of EMS were the best doses for inducing mutations from the γ-rays and EMS sources used in the present study. Similar results were reported by many workers in sunflower (Stehno and Kovacik, 1975; Kovacik and Stehno, 1976). Higher dose (15KR) and higher EMS per cent (0.15%) induced highest mutation frequency in the sunflower.

A spectrum of all the mutants recovered at M_2 generation of sunflower cv.Morden is given in Table 3. This table also reveals comparative accounts of mean performance of the parent and its 26 mutants for certain yield and yield attributing traits, for example, plant height, days to 50% flowering, head diameter, yield per plant, 100-seeds weight and plant maturity in M_3 generation. The mutant VR Df-2 was dwarf (45.84 cm) followed by VR Lm-17 (61.56 cm) while VR Cv-22, VR Scv-24, VR Ly-12 and VR Bnd-5 were significantly taller. The days to 50% flowering was significantly higher in the following mutants VR Ss-20, VR Bk-13, VR Ly-12, VR Dst-7 and VR Bd-9. The variations for head diameter were also observed in the mutants lines, the mutants VR Cv-22 (15.50cm) and VR Hy-18 (15.06cm) were significantly better in head diameter followed by VR Scv-24 (14.74cm). The 100-seeds weight was significantly increased the following mutants VR Os-26, VR Fs-19, VR Bnd-5, VR Bwyl-15, VR An-25, VR Em-16, VR Bk-13, VR Bwwl-14 and VR Ly-12. Significantly increased seed yield per plant was noticed in the mutants VR Hy-18, VR Ly-12, VR Os-26 and VR Bnd-5. But the dwarf mutant VR Df-2 recorded significantly lesser yield per plant. Therefore the high yielding mutants may be judiciously utilised in sunflower improvement programme. The maturity of the morden (sunflower) was significantly high in the mutant VR Cv-22.

Earlier studies by Vranceanu and Stoenescu (1982), Shilpa Girhe and Choudhary (2002) and Cecconi *et al.* (2002) resulted in many sunflower mutants which were characterized by an early maturing type with short stem, dwarf types with many leaves, plant height, large head. Hermelin *et al.* (1987), Giriraj et al. (1990), Vranceanu and Luovas (1991), Rajendiran (1993) and Gaj Raj Singh *et al.* (2000) reported many morphological deviations such as plant height changes, abnormal growth in leaves, many branches, abnormal heads, high growth yield in M_1 and M_2 generations in sunflower. These concomitant changes in the morphological frame work of sunflower achieved through mutation can be exploited in sunflower improvement.

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