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THE EFFECT OF GAMMA RAYS ON SOME AGRONOMIC CHARACTERS OF M_2 POPULATIONS IN INBRED LINES OF SUNFLOWER

Numerous works have been reported on the effects of ionizing radiation on plant characters following seed irradiation (4, 5, 6, 10, 13). Common results deal with increase of seed germinations, faster vegetative growth and improved yield. As far as sunflower is concerned, different studies have been carried out. The following results have been observed: in "M_1" population, obtained from seeds irradiation with 1 kilorad gamma, mean seed weight increased but number of seeds per head decreased (9). Seed irradiation with 6500 rads gamma and irradiation of pollens of "M_1" plants with 1000 rads of X rays, using these pollens for crossing "M_1" plants, produced some "M_4" pure lines with larger leaves, higher plants, earlier in maturity, when compared with non irradiated check variety. An increase of 3.5% was also observed for the percentage of oil in some "M_4" lines (1). Seed irradiation with 8 to 40 kilorads of X rays has not decreased the percentage of seed germination but introduced chromosomal aberrations (2). Two mutants were obtained from seed irradiation with 5 and 20 kilorads gamma which were superior in comparison with the check variety for head diameter, mean seed weight and percentage of oil in seeds (7).

The present investigation was undertaken to study some agronomic characters of M_2 populations in two gamma irradiated sunflower inbred lines.

The varieties used in this experiment we-

re two homozigous sunflower lines (S -1 and S-41). The seeds were irradiated with gamma rays at the doses of 6 and 12 kilorads by the Atomic Center of Tehran University. Irradiated seeds were planted at the Agricultural experiment station of the College of Agriculture, Tehran University. Some agronomy characters of "M_1" plants were compared with check varieties (8). A random sample from the seeds of each "M_1" individual plant with parental "S-1" and "S-41" inbred lines were planted in 1975. The experimental design used was a completely randomized block with unequal treatment and five replications. Each replication consisted of one row per parent and 2 row per each M_2 population. Each row was 4 meters long and the distance between them was one meter. Plants on the row were at an interval of 20 cm. The plant height for each individual was measured just before harvesting. Head diameter, seed weight, and 100 seeds weight were recorded for each plant after the harvest. M_2 productive plants which showed morphological changes like big leaves, large heads and short stems were selected.

Extraction of oil: five plants in parents and in "M_2" populations were randomly selected for oil extraction in each replication, two seed samples for each plant were used. The oil content of the seeds was determined according to A.O.A.C. (3).

Protein content: the protein content of the seed cakes of each oil sample was determined according to the procedure of Tavakoli et al. (12). The broad sense heritability was calculated by the formula:

$$H = \frac{VM_2 - VP}{VM_2}$$

where H is heritability, VM_2 and VP are M_2 and parent variances.

Table 1

Analysis of Variance of Different Characters

S.O.V.	Plant height (cm)		Head diameter (cm)		Seed weight (gr)	
	MS	F	MS	F	MS	F
Treatment	103.03	2.27+	3.42	3.78++	121.50	3.28++
Replication	63.41		0.69		6.85	
Error	45.51		0.90		37.10	

S.O.V.	100 seed weight (gr)		% of oil		% of protein	
	MS	F	MS	F	MS	F
Treatment	4.77	21.07++	218.01	16.93++	15.56	5.34++
Replication	0.42		13.35		2.01	
Error	0.22		12.88		2.91	

\+ Significant at the level of 5%.
++ Significant at the level of 1%.

Table 2

The Effect of Gamma Irradiation on Different Characters in M_2 Populations

Variety or M_2	Plant height (cm)	Head diameter (cm)	Seed weight (gr)	100 seed weight (gr)	% of oil	% of protein
S-1	135,926	18,550	57.56	9.67	39.32	51.81
S-1-6 γ	136,782	19.42	55.03	9.59	40.18	51.93
S-1-12 γ	132,146	19.33	54.03	9.25	40.06	51.02
S-41	126,046	19.64	58.18	7.46	28.78	47.38
S-41-6 γ	128,830	20.65	65.65	7.90	30.53	49.36
S-41-12 γ	127,140	20.68	60.25	7.94	28.95	49.40
I.S.M.5%	8.90	1.25	8.03	0.63	4.73	2.23

Table 3

Variance in Parents and M_2 Populations and Heritability (broad sense) of Different Characters

Variety or "M_2"	Plant height				Head diameter				Seed weight			
	Nber of Plants	σ^2P	σ^2G	H%	Nber of Plants	σ^2P	σ^2G	H%	Nber of Plants	σ^2P	σ^2G	H%
S-1	91	353.72	-	-	91	9.73	-	6	91	637.16	-	-
S1-6γ	176	361.62	7.90	2.18	176	10.59	0.86	8.83	176	652.30	15.14	232
S1-12γ	178	402.88	49.16	12.20	178	11.83	2.10	21.58	178	686.51	49.35	718
S-41	90	245.60	-	-	90	12.08	-	-	90	628.63	-	-
S41-6γ	181	298.21	52.61	17.63	181	13.07	0.99	7.57	181	639.92	11.29	176
S41-12γ	177	315.71	70.11	22.20	177	15.27	3.19	20.89	177	695.59	66.96	962

Variety or "M_2"	100 Seed weight				% of oil				% of protein			
	Nber of plants	σ^2P	σ^2G	H%	Nber of Plants	σ^2P	σ^2G	H%	Nmber of Plants	σ^2P	σ^2G	H%
S-1	91	2.10	-	-	25	26.41	-	-	25	16.66	-	-
S1-6γ	176	2.78	0.68	24.46	50	28.72	2.31	8.04	49	18.22	1.56	856
S1-12γ	178	3.05	0.13	31.14	48	34.15	7.74	22.66	48	21.99	53.3	2323
S-41	90	1.34	-	-	24	16.34	-	-	24	16.28	-	-
S41-6γ	181	2.07	0.73	35.26	49	19.78	3.44	17.34	48	17.17	0.89	518
S41-12γ	177	1.87	0.53	28.34	46	18.76	2.42	12.89	44	23.41	7.13	3045

σ^2P = Phenotypic variance

σ^2G = Genetic variance

H = Heritability

The results of the analysis are summarized in Tables 1 to 3.

From these tables, we can draw the following conclusions: The "F" values for all studied characters show a significant difference between the two inbred lines. No significant difference in "M_2" populations for all mentioned characters were observed when compared with their parents. Genetic variability induced by 6 kilorads gamma is lower than 12 kilorads for all characters except for mean weight of seed (Table 3). Estimates of heritability (broad sense) obtained in the M_2 generations are shown in Table 3. The estimates for plant height (2.18 to 22.2%), head diameter (7.57 to 20.89%), seed weight (2.32 to 9.62%), oil content (8.04 to 22.66%) are not high enough to indicate that considerable amount of genetic variability is present in M_2 population. Heritability for mean seed weight (24.46 to 35.26) and percentage of protein (5.18 to 30.45) may be high enough to start a pedigree selection from M_4 population. Productive morphological mutants selected in "M_2" population are more promising than the genetic gain that may occur in late generation by selecting a percentage of plants. These morphological mutant will be evaluated for agronomic characters, percentage of oil and protein in coming generations.

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