Advances in Bioresearch
Adv. Biores., Vol 9 (5) September 2018: 81-84
©2018 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.9.5.8184

Advances in Bioresearch

ORIGINAL ARTICLE

Study on Gamma Ray Induced Polygenic Variability in Certain Characters of Some Inbreds of Sunflower (*Helianthus annuus* L.)

Chetankumar N. Banakar*, Deepa P. Salunke, Vanishree, Raghunath Patil, I. Shanker Goud, Vikas Kulkarni
Department of Genetics and Plant Breeding, University of Agricultural Sciences Raichur-584102
*Email: chetan3823@gmail.com

ABSTRACT
The experiment was carried out to induce variability in the sunflower inbreds by physical mutagen, i.e., Gamma rays. Progressive decreases in germination and survival with increase in of Gamma ray doses were recorded in M_1 generation. The mean expression and variability in quantitative traits was increased in the M_2 generation. The different mutagenic treatments showed an inconsistent relationship with respect to mean and variability. However, considerable increase in variability in days to 50 % flowering, plant height, head diameter, days to maturity, seed yield per plant and oil content was observed.
***Key words**: Gamma ray, Induced variability, Sunflower*

Received 11.05.2018 Revised 21.06.2018 Accepted 23.08.2018

How to cite this article:
Chetankumar N. Banakar, Deepa P. Salunke, Vanishree, Raghunath Patil, I. Shanker Goud, Vikas Kulkarni. Study on Gamma Ray Induced Polygenic Variability in Certain Characters of Some Inbreds of Sunflower (*Helianthus annuus* L.). Adv. Biores. Vol 9 [5] September 2018: 81-84.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important oil seed crop after groundnut and rape seed mustard with wide adaptation due to its wide tolerance to temperature and moisture variations. Although it is an introduced crop to India, in recent years it has become an important oil seed crop of India and cultivated on an area of 2.06 m.ha with production of 1.13 m.tons [13, 7, 9, 18]. The present study was undertaken in order to create variability for the improvement of sunflower through mutation breeding. The mean, variability, coefficient of variability, heritability and genetic advance were studied.

MATERIAL AND METHODS

The base material for the present study comprised of both the parental (B and R) lines of popular sunflower hybrid RSFH-130 hybrids (CMS-104B and R630), and maintainer lines of RFSH-1hybrid (CMS-103B) and KBSH-44 hybrid (CMS-17B). Selfed seeds of the above mentioned lines were obtained from sunflower scheme, Main Agricultural Research Station, Raichur. Bold and viable dry seeds of uniform size, weighing 100gm each with 12 per cent moisture content were irradiated with 10, 15 and 20kR doses of gamma rays from ^{60}CO source at the gamma chamber of Bhabha Atomic Research Centre, Trombay, Mumbai for the required duration. A total of 100 seeds were sown in each treatment. All plants in the first generation, in each treatment, were observed for the following parameters: germination on the 30th day, survival on the 45th day, pollen fertility, days to 50 % flowering, plant height, head diameter, days to maturity, seed yield per plant and oil content. Seeds obtained from M_1 plants by selfing in each treatment were advanced to raise the M_2 generation as progeny rows. Each plant was raised in one row with the spacing of 60 × 30. The above biometric characters were recorded and individual plant data were used for statistical analysis. Data for each character in all treatments were analyzed separately by an appropriate analysis.

RESULTS AND DISCUSSION

In the present study, biological effects of the mutagenic treatments were determined from observations made on germination and survival percentages in the M_1 generation. Progressive decrease in germination with increase in gamma ray dose was observed in all genotypes (Table 1). The reduction was more pronounced at higher doses of gamma rays. Increasing doses of mutagen causing a progressive increase in biological damage measured in terms of reduction in germination and plant survival in the M_1 generation have been reported in some leguminous crops also [8, 16, 19]. Similar dose-dependent relationship in reducing germination has been observed in the irradiated material of sunflower [20, 14, 10, 11] with regard to morphological traits. Reduction in the fertility of pollen grains from irradiated population is one of the parameters to assess the radiosensitivity and mutagenic effectiveness and efficiency. Reduction was observed in fertility of the pollen grains from irradiated population, as has been reported earlier in many studies (Johanson, 1936 in sunflower). There was no linear relationship between the dose administered and reduction in fertility.

The characters plant height, days to 50% flowering, head diameter, days to maturity and seed yield/plant showed a negative shift from the control to all the doses in all the four genotypes except 10 and 15kR doses in days to maturity of R630 genotype in M_1 generation and such an inhibitory effects were more pronounced in higher doses. Such an inhibitory effects in quantitative characters have been reported in sunflower [4], groundnut [5] and sesame [17].

Table 1. Effect of gamma rays on germination, survival, pollen fertility and Mean values of various characters in M_1 generation.

Genotypes	Dose (kR)	Percent germination		Percent survival		Percent pollen fertility		Days to 50% flowering	Plant height	Head diametre	Days to maturity	Seed yield / plant
		Actual	% over control	Actual	% over control	Actual	% over control					
CMS-104B	0	90.00	100.00	98.89	100.00	98.00	100.00	65	125.1	15.45	103.77	18.12
	10	72.42	80.41	80.73	81.63	90.32	92.16	60	92.2	12.40	100.72	13.74
	15	56.15	62.34	79.20	80.09	91.75	93.62	62	85.4	11.88	95.19	13.58
	20	32.32	35.90	47.26	47.79	90.39	92.23	62	78.7	11.45	94.49	14.12
CMS-103B	0	87.00	100.00	100.00	100.00	99.20	100.00	55	95.8	14.47	92.44	17.80
	10	45.90	52.81	70.09	70.09	85.44	86.12	50	72.0	11.31	91.54	12.74
	15	42.73	49.06	70.18	70.18	88.23	88.94	52	68.6	11.47	90.26	10.49
	20	26.85	30.85	34.65	34.65	87.17	87.87	53	54.8	10.75	90.02	8.36
CMS-17B	0	89.00	100.00	98.88	100.00	94.50	100.00	56	88.3	14.42	103.25	17.04
	10	8.62	9.68	89.29	90.30	83.46	88.31	52	68.0	11.18	98.27	10.92
	15	2.41	2.66	87.50	88.49	84.94	89.88	54	71.1	10.66	94.00	9.83
	20	1.55	1.67	60.00	60.68	85.58	90.56	55	49.0	8.13	92.33	9.01
R630	0	88.00	100.00	97.73	100.00	98.35	100.00	54	85.3	9.01	95.39	12.75
	10	47.00	53.42	81.51	83.40	81.72	83.09	49	65.0	8.31	97.54	9.80
	15	47.50	54.03	85.33	87.31	83.91	85.31	50	55.2	7.13	96.10	8.60
	20	41.61	47.24	84.48	86.44	79.12	80.44	52	68.8	7.02	94.08	9.14

In the M_2 generations of all the genotypes, there was a decrease in the mean values for some of the traits such as days to maturity, head diameter and seed yield per plant in all the doses except in 15kR in days to maturity and 15kR and 20kR doses in oil content in R630 genotype which showed negative shift in mean values from the control group and this may be attributed to differential response of genotypes to the mutagen. In case of plant height, days to maturity and oil content mean values were increased in all the doses in all the four genotypes. Such a shift in positive direction is contrary to the generalized view where a negative shift is usually accepted. However, the mean of treated population showing significant increase in mean values over a control has been reported by Khan [12] in mung bean. Increases in induced variance due to increase in mutagen dose occurred in all the four genotypes for all the characters except in CMS103-B where it recorded decreased variance for oil content at 15kR dose. The low variance may be due to restricted heterozygosity in the mutated genes governing this trait in M_2 generation which may produce greater variability in later generations [10]. However the present study revealed that the linear relationship between dose and both genotypic and phenotypic variances were not maintained for all the

characters in the genotype studied. Similarly, the magnitude of increase in variance also differed for different traits and was inconsistent with varying doses of mutagen in and the same genotype. The trait plant height showed a maximum variance for the treatments in all the four genotypes. Increase in the variability for yield and other quantitative traits have been reported by Giriraj *et al.*[6] in sunflower.

The trend observed for the variance was maintained for the heritability and genetic advance also. Higher heritability and genetic advance was observed for all the characters in higher dose of 20kR treatment than in 15 and 10kR doses (Table 2). The increased heritability and genetic advance in the treated populations in the present study are in conformity with results obtained by: Deshpande *et al*.[4], Jagadeesan *et al*. [10] in sunflower; Chavan and Chopde [1] in sesame; Labana *et al*. [13] in mustard and Mathur *et al.* [15] in groundnut. Hence the population treated with mutagen at higher dose of 20kR dose in all the genotypes can be subjected for selection to obtain desired plant types, high seed yield and oil content progenies. The selected mutants with increased mean values, high heritability and genetic advance for various traits studied in all the genotypes studied may be used for crop improvement programmes.

Table 2. Variability parameters for various characters in M_2 generation.

Genotypes	Dose (kR)	Days to 50% flowering					Plant height						Head diameter			
		Mean	V_P	V_G	H^2 (%)	GA	Mean (cm)	V_P	V_G	H^2 (%)	GA	Mean (cm)	V_P	V_G	H^2 (%)	GA
CMS-104B	0	60.50	29.67	-	-	-	117.1	378.1	-	-	-	18.43	10.53	-	-	-
	10	58.33	33.36	3.69	11.06	1.32	120.5	443.4	64.7	14.5	6.3	14.09	11.60	1.07	9.2	2.21
	15	57.42	37.83	8.16	21.57	2.74	129.2	538.7	160.0	29.7	14.2	12.77	12.95	2.42	18.6	4.99
	20	60.37	44.93	15.26	33.96	4.70	130.4	557.4	178.7	32.0	15.6	13.23	14.99	4.46	29.7	9.20
CMS-103B	0	54.00	18.67	-	-	-	95.1	-	-	-	-	11.8	6.53	-	-	-
	10	50.23	24.87	6.20	24.93	2.56	99.8	115.3	8.65	7.5	1.6	10.54	7.14	0.61	8.5	1.26
	15	51.77	25.49	6.82	26.76	2.79	102.0	126.4	19.79	15.6	3.6	10.41	9.25	2.72	29.4	5.61
	20	51.98	28.85	10.18	35.29	3.91	100.0	127.6	20.97	16.4	3.83	10.53	6.96	0.43	6.1	0.89
CMS-17B	0	55.50	11.67	-	-	-	102.6	-	-	-	-	11.77	5.61	-	-	-
	10	53.96	21.55	9.88	45.85	4.39	109.3	124.7	27.70	22.2	5.1	9.31	6.18	0.57	9.2	1.18
	15	52.67	28.46	16.79	59.00	6.49	110.2	140.3	43.30	30.8	7.5	8.77	5.94	0.33	5.5	0.68
	20	54.46	32.41	20.74	63.99	7.52	114.4	159.0	61.99	38.9	10.1	6.24	8.45	2.84	33.6	5.86
R630	0	59.50	13.67	-	-	-	98.0	-	-	-	-	9.28	5.92	-	-	-
	10	60.88	16.21	2.54	15.67	1.30	103.8	150.7	24.81	16.4	4.1	7.25	7.03	1.11	15.7	2.29
	15	57.92	17.00	3.33	19.59	1.67	108.8	200.0	74.06	37.0	10.8	8.34	7.84	1.92	24.4	3.96
	20	58.17	31.51	17.84	56.62	6.56	114.2	230.0	104.0	45.2	14.1	6.58	8.00	2.08	26.0	4.29

Table 2. (Continued.....)

Genotypes	Dose (kR)	Days to maturity					Seed yield/ plant						Oil content			
		Mean	V_P	V_G	H^2 (%)	GA	Mean (g)	V_P	V_G	H^2 (%)	GA	Mean (%)	V_P	V_G	H^2 (%)	GA
CMS-104B	0	101.2	18.6	-	-	-	26.30	16.84	-	-	-	36.59	2.42	-	-	-
	10	103.3	63.2	44.5	70.5	11.5	20.67	17.66	2.21	4.6	0.40	42.01	4.44	2.02	45.44	1.97
	15	105.5	66.7	48.1	72.1	12.1	20.20	22.99	4.18	26.7	2.65	41.47	6.14	3.72	60.59	3.10
	20	108.2	68.2	49.6	72.7	12.4	19.43	24.51	1.20	31.2	3.20	41.09	8.84	6.42	72.62	4.45
CMS-103B	0	92.3	9.2	-	-	-	19.80	6.53	-	-	-	36.45	1.02	-	-	-
	10	94.0	11.3	2.0	18.4	1.2	16.43	7.14	0.87	8.5	0.47	38.05	2.80	1.78	63.57	2.19
	15	97.4	17.7	8.5	47.8	4.1	12.41	9.25	2.00	29.4	1.85	28.09	1.46	0.44	30.18	0.75
	20	96.25	19.7	10.4	53.0	4.8	10.53	10.96	2.26	40.4	2.76	37.25	8.45	7.43	87.93	5.27
CMS-17B	0	100.8	37.2	-	-	-	21.77	10.80	-	-	-	30.74	0.94	-	-	-
	10	103.4	44.5	7.3	16.4	2.2	18.83	12.57	0.25	14.0	1.03	31.85	1.11	0.17	15.32	0.33
	15	105.1	54.6	17.4	31.9	4.8	15.37	13.97	0.51	22.6	1.75	38.80	2.63	1.69	64.26	2.15
	20	106.4	62.0	24.8	40.0	6.5	13.45	15.43	0.75	30.0	2.43	39.66	4.68	3.74	79.92	3.57
R630	0	91.2	10.2	-	-	-	16.15	6.64	-	-	-	38.35	3.08	-		-
	10	92.9	12.6	2.4	19.3	1.4	15.57	8.12	0.07	18.2	1.07	38.83	6.20	3.12	50.30	2.58
	15	89.7	17.5	7.3	41.6	3.6	15.82	10.47	0.77	36.5	2.44	33.03	6.38	3.30	51.72	2.70
	20	94.6	18.3	8.1	44.2	3.9	14.12	16.39	2.82	59.4	4.97	30.60	8.86	5.78	65.24	4.01

REFERENCES

1. Chavan G V and Chopde P R (1982). Polygenic variability, heritability and genetic advance in irradiated sesame. *Journal. Marathwada Agricultural University*, **7**: 17-19.
2. Damodaran T and Hegde D M (2002). Various issues of area and production of principle crops of India, GOI, Agricultural statistics at a glance. Oilseed situation: A statistical compendium, ICAR, Directorate of Oilseeds Research, India, pp.145.
3. Davis M E (1979). Tissue and cell culture of sweet sorghum. Plant Physiology, **63**: 148.
4. Deshpande S K and Giriraj K (1997). Induced polygenic variation for economic traits in two restorer lines of sunflower (*Heliatnthus annuus*L.). *Helia,* **20**(26): 89-94.
5. Dorairaj M S (1979). Studies on induced mutagenesis in homozygous and heterozygous genotypes in groundnut. (*Arachishypogaea*L.) *Ph.D.* Thesis, Tamil Nadu Agricultural University, Coimbatore, India.
6. Giriraj K, Hirmemath S R and Seetharam A (1990). Induced variability for flowering, seed weight and oil content in parental lines of sunflower hybrid BSH-1. *Indian Journal of Genetics*, **50**(1):1-7.
7. Gregory W C (1955). X-ray breeding of peanuts (*Arachis hypogea* L.). *Agronomy Journal,***47**: 396-399.
8. Gregory W C (1968). A radiation breeding experiment with peanuts. *Radiation Botany*, **8**: 81-147.
9. Habib A F, Chandrasekar M S, Viswanatha K P and Jayaramiah H 1979. Mutation breeding in groundnut (*Arachis hypogea* L.). *In:* Symposium on the Role of Induced Mutations in Crop Improvement, Hyderabad, India.
10. Jagadeesan, S, Kandasamy G, Manivannan N and Muralidharan V 2008. Mean and variability studies in M_1 and M_2 generations of sunflower(*Helianthus annuus* L.). *Helia*, **31**(49): 71-78.
11. Jambhulkar S J and Joshua D C (1999). Induction of plant injury, chimera, chlorophyll and morphological mutations in sunflower using gamma rays. *Helia,***22**(31): 63-74.
12. Khan I A (1988). Mutation studies in mung bean (*Vigna radiata* (L.) Wilczk.). *Legume Research,* 11: 85-88.
13. Labana K S, Chaurasia D D and Singh B (1980). Genetic variability and inter-character association in the mutants of Indian mustard. *Indian Journal of Agriculture Science*. **50**: 803-806.
14. Marcelo F O, Neto A T, Leite R M, Castiglioni, V B R, Neto A L F, Aries C A A and Mandarino, J.M.G., 1998. Mutation breeding in sunflower (*Helianthus annuus*L.) for disease resistance and oil content. (FAO/ IAEA under contract number 9153/RO).
15. Mathur R K, Manivel P, Samder M Y, Gor H K and Chikani B M (2000). Creation of genetic variability through mutation breeding in groundnut. *In:* Proceedings of the DAE-BRNS Symposium on the Use of Nuclear and Molecular Techniques in Crop Improvement. December 6-8, 2000. Bhabha Atomic Research Centre, Mumbai, India, pp. 203-213.
16. Nerkar Y S (1976). Mutation studies in *Lathyrus sativus* L. *Indian Journal of Genetics,***36**: 223-229.
17. Prabhakar L V (1985). Studies on mutagenesis in *Sesamum indicum*L. *M.Sc. (Ag.)* Thesis, Tamil Nadu Agricultural University, Coimbatore, India.
18. Rajan S S (1969). Relative biological effectiveness of monoenergetic fast neutrons on oilseeds. *In:* Proceedings of the Symposium on Radiations and Radioactive Substances in Mutation Breeding, FAO Department of Atomic Energy, Govt. of India, pp. 79-98.
19. Sjodin J (1962). Some observations in X1 and X2 of *Vicia faba* L. after treatment with different mutagens, *Heriditas,* 48: 565-586.
20. Vranceanu A V and Iuoras M (1990). Mutagenesis in sunflower (*Helianthus annuus*L.) breeding. *In:* Plant mutation breeding for crop improvement. Proceedings of an International Symposium on the Contribution of Plant Mutation Breeding to Crop Improvement, International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, Vienna, Austria, 18-22 June 1990, **1**: 431-437.