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INDUCED POLYGENIC VARIATION FOR ECONOMIC TRAITS IN TWO RESTORER LINES OF SUNFLOWER (*Helianthus annuus* L.)

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SUMMARY

Two restorer lines of sunflower IV83 (non-branching) and RLC-2 (branching) were irradiated with gamma rays at 10 kR, 15 kR and 20 kR to induce variability for flowering, test weight and oil content. In the M_2 populations of both genotypes, the mean value for oil content was increased but the test weight increase was observed only in IV83 genotype. Shift in mean values was accompanied with increase in range, variance and coefficient of variation for all three traits in the M_2 populations of both genotypes. Increased variation for flowering, test weight and oil content in irradiated population enabled effective selection for desirable genotypes. Early and late flowering lines identified in the present study could be utilized for developing single cross hybrids with different maturity groups (early and late).

Key words: Sunflower, gamma rays, days to flowering, test weight, oil content.

INTRODUCTION

Presently in India single-cross sunflower hybrids have been derived by utilizing branching types of restorer lines as pollen source to ensure pollination over a longer period for hybrid seed production. Branching types of restorer lines in general have low test weight and higher *per se* oil content. Test weight is one of the important direct yield components (Giriraj *et al.*, 1990 and Encheva *et al.*, 1993) and hence improvement in test weight of branching restorer lines would help increase seed yield potential of derived hybrids. Mutagenesis is one of the potential tools to increase variability for characters by isolating desirable economic traits in a short period compared with conventional breeding procedures. In the present investigation, gamma radiation was used to induce variability for flowering, test weight and oil content of branching and non-branching restorer lines.

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MATERIAL AND METHODS

A total of 100 seeds of IV83 (non-branching restorer line of sunflower derived from an exotic hybrid mixture after six generation of selfing) and RLC-2 (branching type derived from selection from Restorer Lines Composite) were irradiated with gamma rays at 10, 15 and 20 kR dose in ^{60}Co gamma cell at Bhabha Atomic Research Centre, Trombay, Bombay. The M_1 generation consisted of all the treated and untreated seeds. The seeds collected from each selfed M_1 plant were planted in unreplicated progeny rows to raise the M_2 generation during the summer season of 1995. Data were recorded on a population basis in each treatment for days to flowering, test weight and oil content. Oil content was estimated on dry seed basis using NMR spectometer.

RESULTS AND DISCUSSION

Analysis of variance indicated significant statistical differences between control and treated lines for all the three agronomic traits. The mean, range and variance are presented in Table 1. There was an apprecibale increase in variability in irradiated M_2 population for all the traits studied, days to flowering, test weight and oil content. A wide range of values, both negative, and positive were recorded at 10 kR dose for all the economic traits in both genotypes. Similarly, Gregory (1956, 1960 and 1961) in groundnut, Vranceanu *et al.*, (1982), Giriraj *et al.*, (1990) and Encheva (1993) in sunflower found that gamma treatments induced variability for quantitative traits in M_2 populations which enabled effective selection for desirable traits. There were changes in mean values of mutagen treated populations as compared with untreated populations. When compared with control in the M_2 populations, a decrease in mean value for days to flowering was observed in both genotypes. With respect to test weight, the decrease in mean value was observed only in RLC-2, while in IV83 the mean value increased in the treated populations as compared with the untreated populations. This can be attributed to the large seed size obtained in the treated populations of IV83 as a result of the reduction in number of seeds per plant and also due to genotype effects for the trait. Similar observations of increased test weight using gamma irradiation was obtained by Giriraj *et al.*, (1990) in sunflower and Mahla *et al.*, (1991) in Indian mustard. All irradiation treatments resulted in increased oil content in the M_2 populations of both genotypes. The negative shift in mean values could be attributed to the occurence of deletions or harmful mutations (Ram *et al.*, 1987). Further shifts in the means varied with genotype, dose and character.

The change in mean values in the mutagen-treated populations was followed by change in variance for all characters. When compared with control, in both genotypes, all mutagenic treatments resulted in increased variance for the three traits studied (Table 1). Similar findings were reported by Soldatov (1971) and Encheva (1983) in sunflower.

The magnitude of induced genetic variability tended to vary with character and also with genotype at the same gamma radiation level (Table 2). Notably, in the treated popoulation of IV93, higher magnitude of induced genetic variability for days to flowering and test weight was observed compared with RLC-2 (Table 2). In the treated population of IV83, a higher magnitude of induced genetic variability for days to flowering and test weight was observed compared with RLC-2 (Table 2). The induced genetic varability for oil content was comparatively high at 10 kR and 15 kR. The studies of Mahla *et al.*, (1990) have also demonstrated that variation induced in the M_2 generation was dependent on variety, mutagen dose and character under study. A critical examination of the results revealed that irradiation induced only a slight enhancement in the genetic component of variation for test weight and oil content (Table 2). Siddiq *et al.*, (1973) also reported that compared with chemical mutagens, physical irraiation treatment induced low heritable variation predominantly due to cryptic chromosomal changes. EMS on the other hand appeared to heave induced a higher frequency of gene mutations.

Although the genetic coefficient of variation is useful to compare the extent of genetic variability for different characters and populations, it is not possible to determine the heritable proportion variation of a given trait (Mahla *et al.*, 1991) Broad sense heritability, therefore, was computed to determine the induced genetic effects which may be passed on to subsequent generations. In the present study, low to high estimates of heritability and genetic advance were recorded in the treated population (Table 2.)

High estimates of heritability were accompanied with high genetic variability and high genetic advance in most of the treated populations. Apparently, the gamma-treated genotypes generated additional variability for improvement of economic traits. Similarly, in Indian mustard, Labana *et al.*, (1980) observed high values of heritability and genetic advance for many quantitative traits in the treated populations. The higher heritability for the quantitative traits enables the plant breeder to base selection on the phenotypic performance of the trait for its improvement. It is apparent from the data presented in Table 3 that 10 kR and 15 kR doses were most effective in producing high test weight and high oil mutant lines in both IV83 and RLC-2 restorer lines. The 10 kR and 15 kR doses also created variability for days to flowering which will be useful in developing hybrids of different maturity groups after assessing the combining ability of selected mutant lines. The results are in agreement with earlier reports (Vranceanu *et al.*, 1982; Giriraj *et al.*, 1990; Encheva, 1993, in sunflower; Kamala, 1990, in sesame; Gregory, 1961; Chandra Mouli and Kale, 1990, in groundnut and Mahla *et al.*, 1991, in Indian mustard).

Table 1: Mean, range and variance for economic traits in M_2 generation of two restorer lines of sunflower

Genotype/Treatment		Days to flowering			Test weight (g)			Oil content (%)		
		Mean	Range	Variance	Mean	Range	Variance	Mean	Range	Variance
IV83										
Control		57 ±0.17	54-60	4.00	4.96±0.03	4.43-5.34	0.10	27.11±0.80	25.80-31.50	7.18
Gamma rays	10 kR	53±0.10	48-63	21.24	4.99±0.02	2.92-7.57	0.66	28.99±0.32	25.10-37.60	11.02
	15 kR	55±0.09	50-60	9.99	5.06±0.02	3.00-6.95	0.71	30.00±0.30	27.00-35.00	9.67
	20 kR	56±0.20	53-65	13.99	5.28±0.04	3.94-7.67	0.67	28.55±0.62	26.30-35.70	1.25
RLC-2										
Control		61±0.16	58-64	4.00	3.55±0.03	3.20-4.11	0.12	28.22±0.78	27.20-32.60	6.76
Gamma rays	10 kR	58±0.15	55-66	11.90	3.18±0.02	2.26-4.35	0.22	29.67±0.44	25.40-38.40	10.69
	15 kR	60±0.22	57-65	6.67	3.45±0.06	2.58-5.08	0.49	31.91±0.87	25.20-39.80	20.98
	20 kR	61±0.69	58-62	4.89	2.78±0.06	2.20-3.10	0.15	28.90±0.89	25.10-30.50	7.24

Table 2: Genetic variance (GV), genotypic coefficient of variation (GCV), heritability (H) and genetiv advance (GA) in induced M_2 populations

Genotype/Treatment		Days to flowering				Test weight (g)				Oil content			
		GV	GCV	H(%)	GA	GV	GCV	H(%)	GA	GV	GCV	H(%)	GA
IV83													
Gamma rays	10 kR	21.24	7.83	81.20	14.57	0.56	15.03	84.55	28.40	3.84	26.74	34.84	8.28
	15 kR	9.99	4.45	59.96	7.11	0.61	15.41	85.63	29.42	2.49	33.45	24.75	5.57
	20 kR	13.99	5.64	71.41	9.84	0.57	14.20	84.78	27.11	5.07	29.34	41.39	2.96
RLC-2													
Gamma rays	10 kR	11.90	4.85	66.39	8.15	0.10	9.79	43.89	13.36	3.93	27.41	36.76	8.41
	15 kR	6.67	2.72	40.03	3.55	0.37	17.54	74.69	31.26	14.22	35.85	67.78	6.43
	20 kR	4.89	1.55	18.20	1.36	0.03	5.79	17.33	4.98	0.48	16.78	6.63	1.44

Table 3: Number of M_2 families showing early and late flowering, high test weight and oil content of parental lines over control

Genotype	Treatment gamma rays	Early	Late	Number of M_2 families with high test weight over control	Number of M_2 families with high oil content over control
IV83					
Mean number of days to flowering in untreated population - 52 DAS	10 kR	51 out of 203 M_2 families	30	95	88
Mean test weight - 4.969	15 kR	21 out of 169 M_2 families	12	77	99
Mean oil content - 27.11%	20 kR	8 out of 50 M_2 families	5	25	22
RLC-2					
Mean number of days to flowering in untreated population - 62 DAS	10 kR	15 out of 90 M_2 families	8	14	8
Mean test weight - 3.559 Mean oil content - 28.22%	15 kR	4 out of 25 M_2 families	2	8	2

CONCLUSION

The study has clearly indicated the effectiveness of gamma irradiation in identifying the desirable genotypes for flowering, test weight and oil content. Early and late flowering mutant lines identified will be useful in developing hybrids with different maturity groups. 10 kR and 15 kR doses were most effective in producing high test weight and high oil mutant lines in both IV83 and RLC-2 restorer lines. The superior mutant lines with desirable agronomic traits will be evaluated for combining ability and use in heterosis breeding programmes.

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VARIACIÓN POLIGÉNICA INDUCIDA PARA CARACTERES ECONÓMICOS EN DOS LÍNEAS RESTAURADORAS DE GIRASOL (*Helianthus annuus* L.)

RESUMEN

Dos líneas restauradoras de girasol , IV83 (sin ramificar) y RCL2 (ramificada) fueron irradiadas con rayos gamma a dosis de 10 Kr, 15 Kr y 20 Kr para inducir variabilidad para floración, peso hetolitrico y contenido de aceite. En poblaciones (M_2) tratadas de ambos genotipos, el valor medio se incrementó para contenido en aceite pero para peso hectolítrico el incremento del valor medio fué observado en el genotipo IV83. El cambio en valores medios fué acompañado de un incremento en intervalo, varianza y coeficiente de variación para los tres caracteres en poblaciones M_2 de ambos genotipos. La variación ampliada para floración peso hectolitrico y contenido en aceite en la población irradiada permitió una selección efectiva para genotipos deseados. Las líneas con floración temprana y tardía aisladas en este estudio podrían ser utilizadas para el desarrollo de híbridos simples con diferentes grupos de maduración (temprano y tardío).

INDUCTION DE VARIABILITÉ POLYGÉNIQUE POUR DES CARACTÉRISTIQUES ÉCONOMIQUES, CHEZ DEUX LIGNÉES RESTAURATRICES DE TOURNESOL (*Helianthus annuus L* .)

RÉSUMÉ

Deux lignées restauratrices de tournesol, IV83 (non ramifiée) et RCL2 (ramifiée) ont été soumises à un rayonnement gamma à des doses de 10 Kr, 15 Kr et 20 Kr pour induire de la variabilité pour la floraison, le poids du grain et la teneur en huile. Dans les populations M_2 traitées des deux génotypes, la valeur moyenne a augmenté pour la teneur en huile et seulement pour le poids du grain chez le génotype IV83. Des variations dans les valeurs moyennes vent liées à l'accroissement du range, de la variance et du coefficient de variation pour l'ensemble des trois caractéristiques dans les populations M_2 traitées des deux génotypes. Une augmentation de la variabilité pour la floraison, le poids du grain et la teneur en huile dans les populations irradiées a rendu possible la sélection de nouveaux génotypes. Des lignées à floraison précoce ou tardive isolées dans cette étude pourront être utilisées pour créer des hybrides simples appartenant à différents groupes de précocité (précoces et tardifs).