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A COMPARATIVE STUDY OF CHEMICALLY INDUCED MICROMUTATIONAL VARIABILITY IN M_2 GENERATION OF RAPESEED AND MUSTARD

P. K. PANDA AND P. K. SUBUDHI

Department of Plant Breeding and Genetics College of Agriculture and Technology Bhubaneswar 751003

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ABSTRACT

Micromutational variability induced by EMS and DES in one variety each of rapeseed (TS-29) and mustard (BM 35-9-9) was analysed for six polygenic traits of economic importance. Variability considerably increased for siliquas/plant, siliqua length, seeds/siliqua, and seed yield/plant. The rapeseed variety was more responsive to mutagenic treatment than the mustard variety, and DES increased micromutational variability to a greater extent than EMS.

Key words: Micromutation, variability, chemical mutagens, rapeseed, mustard.

Even though the selection efficiency for quantitatively inherited traits is generally lower than for the characters controlled by major genes, induced mutations have been shown to be effective in generating useful variability for polygenic traits. Inspite of procedural difficulties, the usefulness of micromutations in crop improvement have been demonstrated [1, 2]. Genetic variation induced in polygenic traits in *Brassica* has been studied by many workers [3–7]. The present investigation aims to assess the polygenic variability induced by EMS and DES for various traits in rapeseed (*Brassica juncea*) and mustard (*B. campestris*).

MATERIALS AND METHODS

The experiment material comprised M_2 generation following treatment of one variety each of mustard (*Brassica juncea*) and rapeseed (*Brassica campestris* var. *toria*): BM 35-9-9 and TS-29, respectively, with two alkylating chemicals along with controls. The mutagens were ethyl methane sulphonate (EMS) at 0.25%, 0.50%, 0.75% and diethyl sulphate (DES) at 0.05%, 0.10% and 0.15% concentrations. Six hundred healthy seeds were soaked in distilled water for 6 hrs at room temperature (21.5°C). After the treatment, seeds were thoroughly washed in tap water and space planted in field. The M_2 generation was grown with four replications

in randomized block design taking equal quantity of bulked seeds from treated as well as control populations of M_1 generation. The 0.75% EMS treatment was discarded due to high lethality.

In M_2 generation, observations on plant height, primary branches, siliquas/plant, siliqua length, seeds/siliqua and seed yield/plant were taken from 20 random plants in each replication. Analysis of variance was carried out taking character means to judge the significant differences between treatments. The magnitude and direction of variability of different traits in M_2 generation were assessed through the estimation of range, phenotypic variance and coefficient of variation (Tables 1, 2).

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences among treatments, including control, for all the characters except siliqua length, seed yield/plant in the var. TS-29, whereas significant differences were observed for only two characters (siliquas/plant and seed/siliqua) in mustard var. BM35-9-9. On the whole TS-29 (Table 1) showed significant reduction in plant height, siliqua length and seeds/siliqua, and significant increase in number of primary branches and siliquas/plant in various treatments of EMS and DES. Number of siliquas/plant invariably increased in all treatments. Treatment with 0.50% EMS changed mean values of four traits, whereas 0.25% EMS, 0.10% DES and 0.15% DES had effects on three traits. However, BM 35-9-9 (Table 2) showed poor response in respect of change in different character means. Only 0.15% DES treatment increased siliquas/plant and decreased seeds/siliqua significantly. The shift in mean due to mutagenic treatment has also been reported by various workers [3, 8, 9] as a result of increase in frequency of mutations and magnitude of change caused by each mutation [10].

In order to ascertain the direction of induced variation, range was compared with the control for different characters. In TS-29 (Table 1) the range increased for plant height, siliquas/plant, siliqua length, seed yield/plant, but decreased for primary branches and seeds/siliqua in the EMS treatments. Range was also widened for plant height, siliquas/plant, seeds/siliqua and siliqua length in DES treatments. The range for many characters increased at the lowest dose of DES. The widening of range for siliquas/plant indicated induction of mutation in both directions. In general, variability increased to a greater extent with the lower dose of DES. Both the varieties were responsive for increase in the variation induced by the two mutagens.

The magnitude of induced variability as measured by phenotypic variance and coefficient of variation (CV) varied from character to character even at the same dose. In general variance for siliquas/plant, siliqua length, seeds/siliqua and seed yield/plant increased for plant height and primary branches decreased significantly in different treatments. DES increased variance of many traits to a greater extent than EMS.

Table 1. Range, mean, phenotypic variance and coefficient of variation for different polygenic traits in M_2 generation of toria variety TS-29

Character	EMS			DES		
	control	0.25%	0.50%	0.05%	0.10%	0.15%
Plant height:						
Range (cm)	40–73	45–82	43–72	40–81	43–68	38–72
Mean (cm)	58.35	58.09	56.50	59.54	55.20*	53.71*
Variance	67.90	70.90	70.73	56.25	44.09*	43.16*
CV (%)	14.12	14.49	14.89	12.60	12.03	12.23
Primary branches/plant:						
Range	1–5	1–4	1–4	1–5	1–4	1–5
Mean	2.50	2.65*	2.63*	2.54	2.55	2.85*
Variance	0.76	0.41**	0.59	0.81	0.40**	0.99
CV (%)	34.86	24.09	29.31	35.44	24.88	34.91
Siliquas/plant:						
Range	26–107	20–183	22–158	20–278	19–173	25–169
Mean	56.10	66.88*	71.51*	64.56*	67.16*	70.95*
Variance	509.86	755.15*	1101.58**	1839.55**	1143.12**	913.25**
CV (%)	40.25	41.09	46.41	66.43	50.34	42.59
Siliqua length:						
Range (cm)	3.5–5.5	2.5–5.0	2.5–5.0	3.0–6.0	2.5–6.0	3.0–6.0
Mean (cm)	4.36	4.06	3.94*	4.44	4.33	4.40
Variance	0.32	0.31	0.46	0.56*	0.66*	0.36
CV (%)	13.16	13.67	17.20	16.95	18.80	13.70
Seeds/siliqua:						
Range	7–21	6–17	5–18	3–19	5–18	5–21
Mean	12.86	11.04*	11.33*	12.35*	11.43*	11.73
Variance	8.94	9.59	12.32	13.25*	15.52*	10.43
CV (%)	23.25	28.05	30.98	29.47	34.47	27.54
Yield/plant:						
Range (g)	0.15–2.50	0.45–3.20	0.40–3.45	0.15–6.70	0.50–4.60	0.60–4.08
Mean (g)	1.22	1.49	1.32	1.53	1.21	1.43
Variance	0.28	0.35	0.43*	1.23**	0.70**	0.53**
CV (%)	43.44	39.59	49.24	72.75	68.59	51.05

*P = 0.05, **P = 0.01.

The estimates of CV indicated that magnitude of induced variability was higher in the var. TS-29 than in BM 35-9-9. DES was more effective in inducing variability for quantitative traits in var. TS-29. Both EMS and DES were equally effective in BM 35-9-9. However the

Table 2. Range, mean, phenotypic variance and coefficient of variation for different polygenic traits in M_2 generation of mustard variety BM 35-9-9

Character	EMS			DES		
	control	0.25%	0.50%	0.05%	0.10%	0.15%
Plant height:						
Range (cm)	90–145	95–140	80–145	85–130	92–145	100–138
Mean (cm)	111.83	114.63	116.21	110.81	116.95	115.95
Variance	115.56	124.55	161.54	142.09	95.84	127.92
CV (%)	9.12	9.73	10.94	10.76	8.37	9.75
Primary branches/plant:						
Range	1–6	1–7	2–6	2–5	2–6	2–6
Mean	3.38	3.18	3.06	3.14	3.26	3.36
Variance	0.99	0.94	0.77	0.76	0.61*	0.90
CV (%)	29.58	30.39	28.62	27.66	23.76	28.04
Siliquas/plant:						
Range	45–242	35–325	35–260	24–357	26–442	6–468
Mean	111.08	108.16	95.28	107.34	117.70	130.33*
Variance	2426.55	2916.00	2428.52	2868.67	3661.46*	6371.23**
CV (%)	44.34	49.93	51.72	49.89	51.41	61.24
Siliqua length:						
Range (cm)	2.8–5.0	3.0–5.0	3.0–5.5	3.0–5.0	2.8–6.0	2.3–5.0
Mean (cm)	3.94	4.02	4.07	3.93	4.13	3.78
Variance	0.24	0.23	0.40*	0.28	0.36*	0.30
CV (%)	12.55	11.88	15.40	13.34	14.63	14.67
Seeds/siliqua:						
Range	8–16	6–15	6–16	5–16	5–18	5–16
Mean	11.50	10.88	10.85	10.61	11.25	10.38*
Variance	3.06	3.84	4.04	6.10**	6.35**	5.15*
CV (%)	15.22	18.01	18.53	23.28	22.40	21.87
Yield/plant:						
Range (g)	0.10–8.49	0.70–8.10	0.88–7.40	0.31–8.73	0.74–14.75	0.02–12.88
Mean (g)	3.19	2.99	2.87	2.80	3.36	3.29
Variance	3.24	2.99	2.72	3.92	4.67	6.30**
CV (%)	56.43	57.86	57.49	70.71	64.29	76.29

*P = 0.05, **P = 0.01.

smaller M_2 variance and larger CV in some of the treatments may be due to concurrent changes in mean along with variance. Sangwan [11] demonstrated that variation induced in M_2 was dependant on variety, mutagen dose, and the character under study.

The result of this study demonstrate the potentiality of induced variability for polygenic traits in both the mustard as well as rapeseed varieties, which can form good base for selection. However, the response of rapeseed variety was comparatively greater than the mustard variety. Differential sensitivity of mustard varieties to different mutagenic treatments has been reported [12, 13]. The range of concentrations used in DES was optimum for generating sufficient variability for economic traits. This mutagen also proved to be better (less lethal) than EMS in terms of the amount of physiological damage in M_1 generation. The differential response of varieties to DES and EMS may be due to difference in their genetic make up leading to differential response to the two alkylating compounds.

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