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SODIUM AZIDE INDUCED GENETIC VARIABILITY IN M_2 GENERATION OF INDIAN MUSTARD (*Brassica juncea*) *cv*. Pusa mustard 21

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ABSTRACT

Dry, healthy and genetically pure seeds of *Brassica juncea cv*. Pusa mustard 21 were treated with different concentrations of sodium azide (SA) i.e. 0.03%, 0.06% and 0.09% for 18 hrs, with the objective to estimate variability in M_2 generation for quantitative traits.The experiment was conducted in the experimental farm of Agricultural Botany Section, College of Agriculture, Nagpur during *rabi* 2016 and *rabi* 2017.The treated seeds were sown in field along with untreated seeds to raise M_1 generation. M_1 population was harvested plant wise and the seeds were used to raise M_2 generation. In M_2 generation data was recorded on different yield attributing characters like plant height (cm), days to maturity, number of branches plant^{-1}, number of siliqua plant^{-1}, seed yield (g) and 1000 seed weight (g). Data revealed that, the variability in treated population was more than the control for all the quantitative and qualitative characters. Among all the treatments used in the present study, lower concentration of SA i.e. 0.03% was found to be more effective in increasing yield plant^{-1}.

Key words: (*Brassica juncea*, sodium azide, mutation, quantitative traits, effectiveness)

INTRODUCTION

Indian mustard, *Brassic juncea* (L.) Czern and Coss (2n = 2x = 36, genome AABB) is the oldest of the cultivated amphidiploids. It is called as "rai", "raya" or "laha" is one of the important oilseed crops belonging to family Cruciferae *(Syn. Brassicaceae)* and genus *Brassica.* The species probably evolved in the Middle East, where its putative diploid progenitors *Brassica rapa* and *Brassica nigra* are sympatric (Prakash and Hinata, 1980). Mustard is largely self pollinated crop but certain amount (5 - 18%) of cross pollination may take place (Labana and Banga, 1984). Induced mutations have great potentials and serve as a complimentary approach in genetic improvement of crops (Mahandjiev *et al.,* 2001). Chemical mutagenesis is a simple approach to create mutation in plants for their improvement of potential agronomic traits. Among the chemical mutagens, sodium azide is a chemical mutagen that creates point mutations, A. T →G. C, base pair transition and transversion in the genome of plants by producing metabolite and thus produced protein in mutant plant has different function from the normal plant (Al-Qurainy and Khan, 2009). The present study was undertaken to estimate the variability using different concentrations of sodium azide in M_2 generation of Pusa mustard 21.

MATERIALS AND METHODS

Pusa mustard 21 is a variety, low in erucic acid and well adapted to Vidarbha region of Maharashtra. Dry, healthy and genetically pure seeds of *Brassica juncea cv*. Pusa mustard 21 were divided into 4 lots of 300 seeds each for giving the sodium azide treatment, and one lot (300 seeds) among them was control.

Seeds were washed with distilled water after the treatment. The treated seeds were used to raise M_1 generation along with control. In M_1 generation the observations were recorded on germination and per cent mortality. At maturity M_1 population was harvested plant wise. M_2 generation was raised in *rabi* 2016. Four treatments included different doses of SA along with control of Pusa mustard 21. Data was recorded on 30 plants selected at random from each treatment (115 plants from all the treatments) to record observations on yield and yield contributing traits (Table 1.). Statistical analysis was done for Mean, Standard deviation (S.D) and Coefficient of Variation (C.V) by following standard formulas suggested by Singh and Choudhary (1985).

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RESULTS AND DISCUSSION

Data regarding days to maturity showed the mean value for days to maturity decreases in the lower concentrations of SA i.e. 0.03% SA(98.62) and 0.06% SA(98.61) as compared to control and 0.09%. The coefficient of variation increased in all the treatments as compared to control. The early maturity was also observed by Birara *et al.* (2013) in sesame. Landge *et al.* (2009) also isolated several early maturing mutants in M_2 population with EMS, SA and gamma rays in combination.

Data regarding plant height revealed that the plant height was found to be significantly reduced in all the treatments of SA. Mean value for plant height ranged from 156.86 cm to 168.75 cm as compared to control (170.40 cm). In all the treatments studied the coefficient of variation for plant height increased in all the treatments over the control. The range for the coefficient of variation was 14.24 to 16.47%.

The present results of the mean plant height were in correlation with Al-Quirany (2009), Kumar and Dwivedi (2012) and Ali *et al.* (2014), where they reported that the treated plants were significantly shorter as compared to control when treated with SA. The relationship between dose and extent of height reduction among the treatments was not linear (Table 2).

Data regarding mean value of number of siliqua $plant^{-1}$ in M_2 generation showed that the average number of siliqua $plant^{-1}$ was found to increase in all the SA concentrations as compared to control. The mean value for number of siliqua $plant^{-1}$ ranged from 0.03% SA (172.73) to 0.09% SA (216.55), while that of the control was 126.60. The coefficient of variation for the character increased in all the treatments as compared to the control. The highest variation was noticed in 0.06% SA (55.39) and the lowest in 0.09% SA (45.88%), while the same for the control was 23.27%.

Significant variation among the different concentrations of mutagen for the character was also reported by More and Malode (2016) when they studied the comparative effect of EMS on siliqua $plant^{-1}$ in Canola

Table 1. Selection of mutants in M_2 generation from different treatments of Sodium azide

Treatment	Plant No.	Character	Days to Maturity	Plant Height (CM)	No. of branches $plant^{-1}$	No. of siliqua $Plant^{-1}$	1000 Seed weight(g)	Seed yield $plant^{-1}$ (g)
T_1 (0.03%)	1	Appressed siliqua	102	167	3	174		4.2
	2	high yield	102	155	7	295		10.2
	3	high yield	104	165	4	144		4.2
	4	Bold & constricted siliqua	99	173	4	183		4.3
	5	long siliqua	98	175	3	102		4.8
	6	whitish yellow flower	94	165	4	98		3.6
	7	Early maturing, bold seeded	91	180	3	95	3.2	4.4
	8	Tall plant	100	210	4	186		9.6
	9	Appressed & long silqua	101	174	5	22		12.4
	10	Bold seeds	99	135	3	48	3.4	2.2
	11	Bold seeds	99	122	3	157	3	12.8
	12	long siliqua	104	175	4	105		4.4
	13	Multibranched	98	168	8	280		14.8
	14	Bold seeds	99	128	3	48		9.2
	15	high yield	102	145	8	380		18.2
	16	Bold seeds	101	125	3	38	3.6	6.2
	17	Yellow seeds	99	165	5	148		2.2
	18	Bold seeds	98	153	3	146	3.2	13.2
	19	high yielding Tall plant	101	195	5	362		21.4
	20	Early maturity	91	163	4	146		13.2
	21	Early maturity	83	100	1	22		3.6
	22	More siliqua	99	145	3	230		9

contd.

	23	long siliqua	101	180	4	220		15.2
	24	More siliqua	102	195	4	285		16.6
	25	Bold seeds	99	177	4	164	2.8	9.4
	26	Bold seeds	95	140	3	70		9
	27	Multibranched	94	160	9	360		9
	28	High yield, Bold seeds	97	184	4	185	4	13.8
	29	long siliqua	97	187	4	138		4
	30	Appressed siliqua	100	140	4	220		4.9
	31	Early maturing	93	125	4	143		4.6
	32	Bold seeds	98	168	4	252	4	2.6
	33	Dwarf plant	95	105	2	32		2.2
	34	High yield	95	155	8	320	2.6	20.8
	35	Early maturing	84	120	3	67		6
	36	long siliqua	98	125	3	52		3.6
	37	Appressed siliqua	99	165	1	49		2.2
	38	Bold seeds	94	147	3	65	2.8	3.3
	39	Powdery mildew resistance	104	145	3	55		3.2
	40	Powdery mildew resistance	104	130	4	113		4.6
T_2 (0.06%)	1	Early maturing	93	120	2	78		4
	2	Long siliqua, high yielding	99	192	4	282		6
	3	Multi branched	100	150	7	482		24.8
	5	High yield, Long siliqua	98	192	5	410		17.4
	6	Tall , High yielding Bold seed	98	205	6	362	3.6	19.6
	7	Bold seeds	96	172	4	189		9.8
	8	Bold seeds	102	145	3	65	3.8	4
	9	Bold seeds	98	135	4	98	4.1	4.1
	10	High yield	102	185	4	260		13
	11	Appressed siliqua	101	175	4	160		2.5
	12	Constricted siliqua	102	167	3	114		3.2
	13	Early maturing	92	132	3	81		2.2
	14	Long siliqua	95	107	2	57		3.6
	15	Yellow seeds	99	136	3	82		4
	16	Long siliqua	94	128	3	118		5
	17	Bold seeds	99	119	4	132	3.6	1.8
	18	Long siliqua	103	154	5	292		12.8
	19	Tall plant	102	205	4	163		3.6
	20	Long siliqua	100	144	4	225		9.2
	21	Dwarf plant, Long siliqua	101	116	4	86		4.5
	22	Long siliqua	103	168	3	144		5
	23	Bold seeds	102	156	4	177	3.9	4.2
	24	High yield, Long siliqua	100	172	7	360		14.8

contd.

	25	Early maturing	93	140	3	75		2
	26	High yield	98	140	9	380		9.6
	27	Yellow seeds	96	120	2	40		1.6
	28	Bold seeds	97	160	4	140		5.2
	29	Early maturing	93	140	3	136		4
	30	Early maturing	92	145	4	220		6
	31	Dwarf plant	94	115	5	220		5.4
	32	Bold seeds	94	130	4	176	2.6	2.6
	33	Early maturing, Long siliqua	92	175	4	165		6.8
	34	Bold seeds	99	167	3	52	3.4	2.2
	35	Appressed siliqua	98	155	4	182		4.5
	36	Yellow seeds	96	125	2	46		3.2
	37	Yellow seed, Long siliqua	94	115	2	34		7
T_3	1	Appressed siliqua	98	170	3	133		2.4
(0.09%)	2	Dwarf plant	99	110	5	183		2.2
	3	Bold seeds	100	170	4	173		7
	4	Bold seeds	100	140	4	120		7.2
	5	Early maturing	89	155	3	134		4.4
	6	Bold seeds	103	180	2	124	4.2	4.2
	7	Early maturing	87	135	2	47		9.6
	8	Bold seeds	98	175	3	146	4	4
	9	Tall plant	99	205	5	316		12.4
	10	Bold seeds	98	155	5	195		9.6
	11	Long siliqua	99	185	4	175		8
	12	More branched	97	160	7	260		4.4
	13	Early maturing	92	175	4	210		7.2
	15	Bold seeds	101	180	3	85	4.4	4.4
	16	Long siliqua, Bold seeds	103	125	3	50	3.4	4.5
	17	High yield, Constricted siliquae	104	175	5	260		2.4
	18	Early maturing	90	180	5	235		6.8
	19	Tall dense long	99	215	5	417		4
	20	High yield	97	165	8	380		9.2
	21	High yield, bold seeds	100	175	7	480		34.4
	22	Appressed, Early maturing	94	160	4	210		4
	23	Appressed long siliqua	103	160	3	65		3.2
	24	Bold seeds	104	150	4	172	3.2	4.4
	25	Appressed bold seeds	103	160	6	235		7
	26	High yield	102	180	7	383		11.8

contd.

	27	Long siliqua, Bold seeds	101	165	3	165		4
	28	Appressed long siliqua	99	192	4	210		4
	29	Early maturing	92	95	2	42		4
	30	Appressed long siliqua	99	210	6	422		3.3
	31	Long siliqua, Bold seeds	100	165	5	183	3.5	5.2
	32	Bold seeds	101	95	3	42	3.7	1.2
	33	Late dwarf plant	108	100	4	197		1.6
T_4	1	-	104	187	4	177	2.4	4.6
(Control)	2	-	103	170	4	123		4
	3	-	98	150	4	122	2.5	3.7
	4	-	102	165	4	74		4.8
	5	-	99	180	5	108		2.8

Table 2. Effect of sodium azide on different quantitative traits of Indian mustard (*Brassica juncea* cv. Pusa mustard 21)

Characters	Parameters	Concentrations(%) of SA			
		0.03%	0.06%	0.09%	Control
Days to maturity	Mean	98.62	98.61	99.70	99.60
	S.D	4.29	3.42	4.10	2.30
	C.V (%)	4.35	3.47	4.11	2.31
Plant height (cm)	Mean	161.17	156.86	168.75	170.40
	S.D	22.95	25.84	26.40	14.26
	C.V (%)	14.24	16.47	15.64	8.37
Number of branches plant^{-1}	Mean	4.13	4.00	4.32	4.20
	S.D	1.52	1.28	1.30	0.45
	C.V (%)	36.86	32.04	30.03	10.65
Number of siliqua plant^{-1}	Mean	172.73	178.61	216.55	126.60
	S.D	53.20	55.39	45.88	23.27
	C.V (%)	53.20	55.39	45.88	23.27
seed yield plant^{-1} (g)	Mean	8.40	7.59	7.01	3.98
	S.D	7.17	3.70	6.63	7.36
	C.V (%)	59.56	66.52	70.09	19.97
1000 seed weight (g)	Mean	3.27	3.57	3.80	2.45
	S.D	0.52	0.49	0.42	0.07
	C.V (%)	15.91	13.59	10.99	2.89

Data regarding mean value of number of branches plant^{-1} revealed that both the treatments of 0.03 and 0.06% concentrations of SA had negative effect on the average number of branches plant^{-1} except in 0.09% concentration where stimulatory effect was observed. The variation for the character ranges from 30.03 to 36.86% as compared to control (10.65). The highest variation was recorded in 0.03% SA (36.86 %), while lowest was in 0.09% SA (30.03%). The increase in average number of branches plant^{-1} were also reported by Kumar and Dwivedi (2013) where significant positive shift in mean at 0.3% and 0.7% were observed.

Data regarding seed yield plant^{-1} showed that there was significant increase in the grain yield plant^{-1} in all the treatments but it was observed that lower concentrations of sodium azide (0.03% SA) have high stimulatory effect on yield plant^{-1} than control and other treatments. Kumar and Dwivedi (2013) also reported that 0.3% and 0.7% doses of SA were significant and are in positive correlation with seed yield plant^{-1}.

Data regarding the 1000 seed weight showed increase in all treatments over control. The highest mean value for the character was in 0.09% SA (3.80 g) and lowest in 0.03% SA (3.27 g), while the mean 1000 seed weight in untreated seeds was 2.45 g.

The coefficient of variations for the character was found to be increased linearly with increase in concentration. Kumar and Dwivedi (2013) and More and Malode (2016) also reported that there was significant positive correlation of 1000 seed weight when seeds were treated with chemical mutagens.

The present study showed that SA was found to be potent to induce variability in yield contributing character of *Brassica juncea.* It was observed that SA has significant effect on days to maturity, plant height, number of branches plant^{-1}, number of siliqua plant^{-1}, seed yield plant^{-1} and 1000 seed weight. Among all the concentrations used in present study, 0.03% SA was found to be more effective to increase yield plant^{-1}.

From different treatments of sodium azide on Pusa mustard 21, 59 superior mutants were selected mainly on the basis of seed yield plant^{-1}, number of siliqua, seed size and powdery mildew resistance. These mutants will be forwarded to M_3 generation in progeny rows for one or more generations, so that homozygosity will be attained. From there superior mutants can be selected for forwarding to yield trials in further generations.

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