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INDUCTION OF MUTATION FOR QUANTITATIVE CHARACTERS IN BARLEY

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Using gamma rays and their combined treatments, mutations for polygenic characters were induced in two barley varieties. Six quantitative characters viz. Plant height (cm), number of tillers/plant, spike length (cm), numbers of grains/spike, 1000-grain weight and days to maturity were analysed in M_2 generation. Means were shifted in negative direction for plant height, number of tillers/plant and number of grains/spike, while in positive direction for spike length, 1000-grain weight and days to maturity. The co-efficient of variation was increased many folds in all the mutagenic treatments.

Keywords: Barley; Induced mutagens, Polygenic characters.

Introduction

Mutation breeding is one of the effective method to create new genetic variability in a species. The present paper deals with the effect of gamma rays, EMS and their combinations on various quantitative characters in M_2 generation in two diploid barley varieties.

Materials and Methods

Seeds of two barley varieties viz K-168 and SMV-2 were subjected to 10 kR, 20kR and 30kR of gamma rays; 0.5% - EMS for 6h, 8h and 10h; combined treatments of gamma rays and EMS (10kR + 10h; 20kR + 8h; 30kR + 6h). For each treatment hundred seeds were used. Individual spikes of each M_1 plant were raised as M_2 rows. 10 plants from each spike progeny were randomly selected to analyse the variability for six different quantitative agronomic characters. Estimates of mean, standard error, co-efficient of variation were calculated for each character following standard procedure. The significance of mean differences were tested using Duncan's new multiple range test ($P<0.05$).

Results and Discussion

The results of different mutagens on two barley varieties shows both positive and negative shifts in the mean values and responded similarly in terms of shift in mean values (Table 1 &2).

The mean values of the characters like plant height, tiller number were shifted in negative direction, while the mean values of spike length and 1000-grain weight were shifted in a positive direction. Reduction of plant height and number of tillers in mutagenic treatments confirmed the view that, if no selection was exercised for a particular trait in the past, the mean values should go down due to mutagenic treatments[1]. Another reason for the reduction could be correlated response of plant height as was observed in different triticales[2]. The reduction in plant height and tiller number were significant in chemical treatments which support the earlier observations in wheat and barley[3]. The mean spike length increased insignificantly in EMS and in combination treatments, while it decreased in gamma

Table 1. Variability in some quantitative characters, in M_2 generation, due to various mutagenic treatments in Barley variety K-168 (first line is the mean & standard error and the second line is the range.)

Treatment	Plant height (cm)		No. of tillers/plant		Spike length (cm)		No. of grains/spike		1000-grain weight (g)		Days to maturity	
	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.
Control	^{a}69.42±1.12 (64-72)	3.8	^{a}6.38±1.26 (4-9)	2.6	^{de}8.20±0.89 (8-10)	1.6	^{a}43.44±0.69 (38-46)	6.8	^{e}39.6±0.64 (38.6-40.0)	3.6	^{b}114.22±1.84 (110-118)	8.4
Gamma rays												
10kR	^{b}68.52±1.08 (63-72)	6.4	^{a}6.34±1.24 (4-9)	7.6	^{e}8.18±0.86 (8-10)	6.4	^{b}43.36±0.68 (37-47)	10.2	^{f}39.62±0.62 (38.8-40.0)	4.8	^{b}114.38±1.82 (111-119)	10.6
20kR	^{c}67.48±1.11 (62-72)	7.8	^{b}6.22±1.29 (4-9)	8.4	^{e}8.16±0.93 (8-10)	7.9	^{b}43.34±0.62 (37-47)	10.8	^{g}39.60±0.66 (38.6-40.2)	6.8	^{b}114.46±1.86 (110-120)	11.8
30kR	^{d}66.40±1.14 (62-72)	8.4	^{c}6.14±1.24 (4-8)	9.8	^{e}8.16±0.85 (8-10)	9.2	^{c}43.32±0.60 (36-47)	11.2	^{g}39.60±0.64 (38.4-40.4)	7.6	^{b}114.72±1.80 (114-123)	13.4
EMS (0.5%)												
6h	^{h}53.62±1.08 (50-64)	13.7	^{d}5.02±1.26 (3-9)	16.4	^{cd}8.24±0.94 (7-11)	13.2	^{h}42.44±0.68 (35-48)	18.4	^{d}39.66±0.62 (38.2-40.4)	10.8	^{a}118.62±1.82 (114-123)	17.2
8h	^{i}51.48±1.12 (46-63)	14.5	^{e}4.96±1.31 (3-9)	18.2	^{ab}8.32±0.92 (7-12)	13.8	^{d}43.28±0.66 (35-49)	19.6	^{c}39.68±0.66 (38.2-40.6)	11.4	^{a}119.28±1.86 (115-125)	17.8
10h	^{j}49.46±1.13 (43-63)	15.3	^{f}4.84±1.22 (3-9)	19.6	^{a}8.36±0.86 (7-12)	14.6	^{c}43.32±0.70 (34-50)	21.7	^{b}39.70±0.62 (38.2-40.6)	12.6	^{a}119.78±1.88 (115-128)	18.4
G.R. + EMS												
10KR+10h	^{g}58.28±0.98 (54-66)	16.4	^{h}4.76±1.24 (3-10)	21.4	^{ab}8.32±0.84 (6-13)	18.6	^{c}43.24±0.68 (34-50)	24.4	^{a}39.72±0.64 (38.0-40.6)	15.0	^{b}112.60±1.86 (106-116)	21.8
20kR+8h	^{f}59.34±1.02 (54-67)	17.5	^{g}4.80±1.25 (3-10)	24.0	^{bc}8.28±0.91 (6-13)	18.9	^{c}43.12±0.66 (33-50)	25.8	^{b}39.70±0.60 (38.0-40.6)	15.2	^{b}112.48±1.84 (106-116)	22.4
30 kR+6h	^{e}60.48±1.04 (53-68)	18.4	^{gh}4.78±1.28 (3-10)	23.8	^{c}8.26±0.88 (6-13)	17.8	^{g}42.78±0.62 (33-50)	25.4	^{b}39.70±0.64 (38.0-40.6)	14.8	^{b}113.14±1.82 (107-117)	21.6

Mean in each column with the same letters are not significantly different according to Duncan's new multiple range test ($P< 0.05$).

Table 2. Variability in some quantitative characters, in M_2 generation, due to various mutagenic treatments in Barley variety SMV-2 (first line is the mean & standard error and second line is the range).

Treatment	Plant height (cm)		No. of tillers/plant		Spike length (cm		No. of grains/spike		1000-grain weight (g)		Days to maturity	
	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.	Mean±S.E.	C.V.
Control	^{a}66.14±0.96	3.7	^{a}6.28±0.98	2.4	^{e}8.14±0.78	1.6	^{a}41.66±0.46	6.4	^{f}40.12±0.58	3.4	^{ab}116.30±1.72	7.8
	(62.69)		(5-9)		(8-9)		(34-45)		(39.2-40.4)		(112-121)	
Gamma rays												
10kR	^{b}64.16±0.98	11.2	^{b}6.24±1.10	14.6	^{e}8.14±0.82	12.6	^{b}40.58±0.48	18.6	^{g}40.00±0.60	9.8	^{ab}116.58±1.76	14.8
	(60-68)		(4-10)		(8-9)		(33-48)		(38.8-40.4)		(111-122)	
20kR	^{c}63.24±0.94	11.8	^{c}6.18±1.06	16.8	^{e}8.12±0.76	13.4	^{c}40.44±0.44	21	^{h}39.96±0.60	10.4	^{ab}116.92±1.68	16.4
	(58-67)		(4-10)		(8-10)		(33-48)		(38.8-40.4)		(111-123)	
30kR	^{d}61.44±0.98	12.6	^{d}6.04±1.04	18.6	^{e}8.12±0.74	13.8	^{d}40.32±0.48	22.6	^{h}39.94±0.56	11.6	^{ab}117.26±1.70	17.6
	(56-67)		(4-10)		(7-10)		(33-49)		(68.6-40.4)		(111-124)	
EMS (0.58)												
6h	^{h}51.62±1.02	16.3	^{e}4.86±0.97	22.4	^{d}8.28±0.84	18.2	^{gh}39.56±0.50	24.4	^{e}40.42±0.58	14.2	^{ab}119.48±1.64	20.8
	46-59)		(3-10)		(7-10)		(32-49)		(38.8-41.4)		(114-125)	
8h	^{i}49.48±1.04	16.8	^{f}4.46±0.96	23.6	^{e}8.36±0.82	19.4	^{hi}39.58±0.48	25.2	^{d}40.64±0.60	15.6	^{ab}119.86±1.66	21.6
	(44-58)		(3-10)		(7-11)		(32-50)		(38.8-41.4)		(115-126)	
10h	^{j}47.64±0.98	17.6	^{g}4.32±1.02	24.1	^{a}8.44±0.80	19.7	^{f}39.62±0.44	25.6	^{e}40.72±0.56	16.4	^{a}121.10±1.70	22.4
	(43-49)		(3-11)		(7-12)		(32-50)		(38.6-41.6)		(114-125)	
G.R. + EMS												
10kR+10h	^{g}54.32±0.96	19.8	^{g}4.30±1.04	26.2	^{b}8.40±0.78	21.6	^{e}40.10±0.42	28.2	^{b}41.24±0.58	17.8	^{b}113.26±1.74	26.6
	(50-64)		(3-12)		(6-13)		(32-51)		(40.0-41.6)		(107-118)	
20kR+8h	^{f}55.40±0.95	20.6	^{h}4.28±1.06	28.6	^{bc}8.38±0.76	22.8	^{fi}39.60±0.44	28.4	^{a}41.28±62	18.6	^{b}113.41±1.72	26.8
	(50-65)		(3-12)		(6-13)		(32-51)		(40.0-41.8)		(107-119)	
30 kR+6h	^{e}56.38±1.02	21.4	^{g}4.30±0.97	27.4	^{bc}8.38±0.82	22.4	^{gh}39.56±0.48	27.6	^{b}41.22±0.60	18.4	^{b}114.02±1.68	25.4
	(50-66)		(3-12)		(6-13)		(32-51)		(40.0-41.8)		(107-120)	

Mean in each column with the same letters are not significantly different according to Duncan's new multiple range test ($P < 0.05$)

ray treatments. The number of grains per spike were decreased in all mutagenic treatments specially in SMV-2 variety suggesting that the increase in spike length do not contribute for increase in the number of grains per spike.

The mean value of 1000-grain weight was increased in most of the mutagenic treatments. In SMV-2 the increase was significant in combination treatments. According to Jana and Roy[4], the variation in shift of mean not only depends on the previous history but also on the character itself. The increase in grain weight may be due to reduction in grain shrivelling in mutagenic treated populations.

The mean value of the days to maturity was increased with the increase in dose and duration of physical and chemical mutagnes. In combined treatments the mean values decreased significantly.

The co-efficient of variation was increased in all the mutagenic treatments with the increase in dose and duration of gamma rays and EMS respectively and the difference in co-efficient of variation among the two varieties suggests that different characters of the plants are governed by different genes or set of genes. In some treatments, eventhough the mean values were not altered, the co-efficient of variability was increased to the occurrence of mutations in both the directions. The results indicate that, mutagenic treatments has released considerable genetic variation for all the characters. Among the two varieties of barley the degree of increase in co-efficient of variation is higher in SMV-2 indicating it is more sensitive to mutagens than K-168 variety.

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