Intervarietal Differences of Barley (*Hordeum vulgare* L.*) in* Response to Hydrazine Hydrate.

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Abstract

Assessing the impact of mutagens for creating variations in crops like Barley (*Hordeum vulgare* L.) is an important criterion in the contemporary world where food insecurity and malnutrition is alarming at the doors of various nations. In the present research, mutations were induced in two varieties (BH-393 and PL-172) of *Hordeum vulgare* L. by treating the seeds with hydrazine hydrate (Hz) at 0.01%, 0.02%, 0.03% and 0.04 % concentrations. It was found in both varieties (BH-393 and PL-172) that seed germination, seedling height, number of branches, spike length and yield increased at lower concentrations (0.01 and 0.02)% and per cent injury increased with increasing concentration of mutagen (14.14 % - 86.82% in BH-393 and (8.69% -19.56% in PL - 172.

Keywords: Food insecurity, mutations,hydrazine hydrate, yiel, *Hordeum vulgar* L.

Introduction

Food insecurity is becoming major constraint for the development of national building programmes in various countries, including India. With an increase in human population the ghost of hunger are making its impact among millions of people all around. The rescue lies in tailoring the better varieties of crop plants, high in nutrition and yield, and induced mutagenesis is one of those novel techniques, which impart variations in subject crops through sustainable approach. By inducing mutations, vast amount of genetic variabilities have been generated in crop plants which have played a significant role in plant breeding and genetic studies (Kumar and Singh, 2003). More than 3200 mutant cultivars have been developed through this approach (Pierre, 2012). Induced mutations have been utilized to achieve success in improving plant yield as well as plant architecture. Both dwarfness and compactness of a genotype ensure more plants per unit area, thereby significantly contributing the production and productivity. Induction of chemical mutation has been studied by many researchers in the past (Haque and Godward, 1985). Keeping in view the above facts, the present study was carried out in the Department of Botany, Aligarh Muslim University, Aligarh.

Material and Methods

Seeds of both the varieties of Barley (BH-393 and PL-172) were presoaked in distilled water for 9 hours and were treated with freshly prepared solution of 0.01, 0.02 ,0.03 and 0.04 percent hydrazine hydrate (Hz)), a base analogue manufactured by Qualigens Fine Chemicals, Mumbai, for 6 hours. Treated seeds were thoroughly washed in tap water .Controls were maintained by treating the seeds in distilled water only. After mutagenic treatments, seeds from each treatment and control were sown in pots. Data on seed germination and on certain quantitative traits, viz., plant height (in cm), days to maturity, fertile branches per plant, total yield per plant were analyzed statistically to find out variation in M1 population. Three replications were maintained for each treatment. Each replication had a total of seven seeds. Ten separate seeds for each concentration were spread over moist cotton in petriplates. These petriplates were then kept in BOD incubator at 20^{o}C in order to find out seed germination and seedling growth.

The statistical analysis was done to find out Mean, Standard error, Standard deviation and Co-efficient of variation in the control and treated population.

Results and Discussion

The germination started second day after sowing in control and in mutagen treated population of the Varieties PL -172 and PH -393. Lower concentrations 0.01% & 0.02 % of Hz enhanced seed germination whereas the higher concentrations 0.03% & 0.04 % decreased the germination considerably in both the varieties. In the control of variety PL-172, seed germination was recorded to be 19.04%. The percentage of seed germination was 47.61% and 4.76 % at 0.01 % and 0.04% respectively (Table 1). The percentage of seed germination was 33.33 and 4.76% with the same concentration in the variety PH-393. 14.28% seed germination was recorded in control of variety BH-393 and PL-172. Data on seed germination was recorded in both pots as well in petriplates. In both the cases, variety BH-393 was found to be more sensitive than the variety PL-172.

Data recorded on seedling height (cm) of the two varieties of barley are given in the Table 2. The study of seedling height in petriplates after 9 days of sowing showed that various Hz treatments caused reduction in seedling height in barley. The percentage injury in seedling height increased with mutagen concentration. Variety PH-393 was found to be more sensitive than the variety PL-172. In the variety PH-393, the % injury ranged from 14.14 -86.82 % whereas it was 8.69 -19.56 % in the variety PL-172.

Various types of morphological varieties namely dwarf, tall, increased number of branches ,variation in size and colour of leaves and spike length (Plate I) were isolated from Hz treated population of barley varieties PL-172 & PH-393. The maximum number of variants was noticed for plant height and leaf morphology. Variety PH-393 produced higher number of morphological variations than the variety PL-172(PLATE-1)

Fig. 1. Higher no of branches (0.02% Hz) in PL-172

Fig. 2. Tall plants (0.03 %Hz) in BH-393

Fig. 3. Spike of control and mutagen treated plant . (PL-172)

Fig. 4. Leaves of control and mutagen treated plant showing variation in size. (BH-393)

Fig. 5. Leaves of control and mutagen treated plant showing variation in colour (PL-172)

The effect of various treatments of Hz on certain quantitative traits namely plant height (cm), fertile branches per plant and yield per plant are presented in Tables 3-5.Data revealed that mean values and co-efficient of variation differed with various mutagenic treatments. Mean values for plant height (cm) ,fertile branches per plant and yield is decreased with increase in mutagenic concentration in both the varieties .Co-efficient of variation was in general recorded higher for fertile branches per plant followed by yield and plant height. Lower concentration of the mutagen were found to be more effective in increasing the variation in the quantitative traits in both the varieties of Barley, where as the higher concentration of Hz produced injurious effects on various traits.

In the present study, the dose dependent reduction in various biological parameters viz., seed germination and seedling height was noticed with increasing concentration of Hz in M1 generation of barley. The reduction in seed germination might have arisen due to inhibition of physiological and biological processes including enzymatic activity (Kurobane *et al.*, 1979), hormonal disproportion (Chrispeels and Varner, 1967)and hampering mitotic processes (Ananthaswamy, 1971). In M_1 generation, the seedling growth also showed a declining trend from lower to higher concentrations. The inhibition of seedling growth was reported due to auxin obliteration and change in ascorbic acid content (Usuf and Nair, 1974), destruction of apical meristem (Petal and Shah, 1974), transitory deferral of cell division (Evans and Scott, 1964) and reduction in the level of amylase activity (Reddy and Vityavathi, 1985). The separation in seedling growth may be the consequences of either physiological or due to chromosomal abnormalities caused by the mutagen.

Morphological variants Viz. plant height, number of fertile branches, leaf size and colour are among the most common variations noticed in Hz treated population of Barley. The possible cause of these morphological variations may be due to chromosomal aberrations or most probably gene mutation.

The mutagen induced genetic variability for quantitative traits in different crops plants such as chickpea (Wani *et al.*, 2012), *Vicia faba* (Parveen *et al.*, 2012)**,** *Lathyrus sativus* (Waghmare and Mehra, 2000) has been already assessed in the past.In the present study, there was a considerable increase in mean number of fertile branches per plant. The increase in variability for number of branches following mutagenesis has been reported in various crop plants. (Gottschalk and Kaul, 1980; Khan and Wani, 2005; Khan and Goyal, 2009; Kharkwal and Khan, 2003; Kozgar and Khan, 2009; Wagmera and Mehra, 2000). The increase in yield per plant in present study was due to an increase in number of fertile branches. Similar results have been reported by Wani *et al.,* (2012)

Conclusion

The extent of variation in mean values and C.V for various quantitative traits studied in present study was not same in the two varieties showing the varietal differences. Variety PH-393 was found to be more sensitive than the variety PL-172. Higher dose of Hz produced adverse effects on all the parameters studied. On the other hand, lower concentrations of the mutagen had beneficial effects. Therefore, it is suggested that lower concentration of Hz should be used for any breeding programme of Barley. Mean and co-efficient of variation for quantitative traits of Barley provides ample evidence that mutagenic treatments could alter the mean value and create additional genetic variability for polygenic traits.

Table 1. Effect of mutagen on seed germination in control and treated population of barley in M_1 generation

Variety PL-172				
Seed Germination			% Of Inhibition	
Treatments	In Pots	In Petriplates	In Pots	In Petriplates
Control	19.04	50	-	-
0.01 % Hz	47.61	60	+ 150.05	+20.00
0.02 % Hz	19.04	70	0.00	+40.00
0.03 % Hz	19.04	50	0.00	0.00
0.04 % Hz	4.76	50	-75.00	0.00
Variety PL-393				
Seed Germination			% Of Inhibition	
Treatments	In Pots	In Petriplates	In Pots	In Petriplates
Control	14.28	50	-	-
0.01 % Hz	33.33	50	+ 133.40	0.00
0.02 % Hz	23.80	30	+66.66	+40.00
0.03 % Hz	14.28	50	0.00	0.00
0.04 % Hz	4.76	30	-66.66	-40.00

Table 2. Effect of mutagen on seedling height (cm) in control and treated population of barley in M_1 generation

Variety PL-172				
Treatments	Root length (cm)	Shoot length (cm)	Total length (cm)	% of inhibition
Control	18.00	5.00	23.00	-
0.01 % Hz	17.00	5.00	22.00	-4.34
0.02 % Hz	16.50	4.60	21.00	-8.69
0.03 % Hz	15.00	6.30	21.30	-8.69
0.04 % Hz	14.00	4.50	18.50	-19.56
Variety BH-393				
Treatments	Root length (cm)	Shoot length (cm)	Total length (cm)	% of inhibition
Control	15.50	5.00	20.50	-
0.01 % Hz	15.50	5.00	20.50	0.00
0.02 % Hz	17.00	6.00	23.00	+12.19
0.03 % Hz	13.00	4.60	17.60	-14.14
0.04 % Hz	4.50	2.30	6.80	-66.82

Table 3. Effect of mutagen Hz on plant height (cm) of barley in M_1 generation.

Variety PL-172					Variety BH -393			
Treatments	Mean ± S.E	Shift in $\bar{x}$	S.D	C.V%	Mean ± S.E	Shift in $\bar{x}$	S.D	C.V %
Control	34.00±1.03	-	3.28	9.64	31.10±0.65	-	2.07	6.65
0.01 % Hz	48.30±1.62	+14.30	5.15	10.66	52.10±1.16	+21.00	3.67	7.04
0.02 % Hz	45.90±1.34	+11.90	4.24	9.23	51.10±1.01	+20.50	3.21	6.22
0.03 % Hz	57.70±0.64	+23.70	2.05	3.55	60.40±0.64	+29.30	2.05	3.39
0.04 % Hz	44.40±0.63	+10.40	2.00	4.50	59.80±1.12	+28.70	3.54	5.91

Table 4. Effect of mutagen Hz on fertile branches per plant of barley in M_1 generation.

Variety PL-172					Variety BH -393			
Treatments	Mean ± S.E	Shift in $\bar{x}$	S.D	C.V%	Mean ± S.E	Shift in $\bar{x}$	S.D	C.V%
Control	12.60±0.39	-	1.24	47.69	3.40±0.61	-	1.95	57..35
0.01 %Hz	3.90±0.44	+1.30	1.41	47.00	2.80±0.44	+0.64	1.4	5.00
0.02 %Hz	2.80±0.74	+0.20	0.74	25.00	2.90±0.35	+0.50	1.13	38.96
0.03 %Hz	5.00±0.77	+2.40	0.77	15.40	4.00±0.70	+1.10	2.23	55.75
0.04 %Hz	2.90±1.30	+0.30	1.30	44.82	4.30±0.93	+0.90	2.96	68.83

Table 5. Effect of mutagen Hz on yield (g) of barley in M_1 generation.

Variety PL-172					Variety BH -393			
Treatments	Mean ± S.E	Shift in $\bar{x}$	S.D	C.V%	Mean± S.E	Shift in $\bar{x}$	S.D	C.V%
Control	4.64±0.03	-	0.12	2.58	4.30±0.54	-	1.71	39.76
0.01 %Hz	3.89±0.004	+0.80	0.013	0.33	4.33±1.29	+0.30	4.69	108.30
0.02 %Hz	3.80±1.13	+0.84	3.60	94.73	3.88±0.11	+0.42	0.42	10.82
0.03 %Hz	3.90±1.44	+0.74	4.58	17.43	4.41±0.82	+0.11	0.026	0.58
0.04 %Hz	4.22±0.016	+0.42	0.053	1.25	4.21±0.31	+0.09	0.042	0.99

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