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Induced mutagenesis in wheat variety PBW-154

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ABSTRACT

Induced mutagenesis in wheat varieties PBW-154 was studied during the *Rabi* season of 2011-12 at the Agriculture Research Farm, R.B.S. College, Bichpuri, Agra. The seed of wheat variety PBW-154 was subjected to different mutagens. There were seven treatments related with temperature. The treatments of 50^0C and 15^0C enhanced the germination percentage up to 100 and 99 percentage respectively as compared to 93 percentage in control and 0.3 percentage hydroxyl amine treatments. More or less similar effect of the treatments on other parameters viz. root length, shoot length & seedling vigour index was observed. Higher dose of hydroxyl amine was observed to be undesirable.The parameters of variability such as range, mean and CV revealed highest (45-75) range for grains per spike and 100 grain weight (3.31-4.62g)), for plant height the maximum values of 117.86 cm was observed. The CV estimate was high (15.04 percent) for tillers per plant, where as it was lowest (2.77) for days to flowering. The estimates of GCV and PCV were highest for grain per spike and lowest GCV estimates for 100 seed weight. Macro mutations of economic and academic interest were also recovered in present study the recovery of bold shiny seeded mutant by the use of 15ºC temperature and high grain yielder mutants by the use of 15ºC temperature note-worthy.

Key Words: *Genetic advance, Heritability, Mutagenesis, PBW 154, Variability, Wheat*

INTRODUCTION

The extensive researches carried out throughout the world on the frequency and spectrum of mutations induced by a wide range of mutations, both physical and chemical in a number of varieties of bread wheat showed that the total mutation rate was about three times higher in hexaploid wheat then tetra and diploid wheat (Mackey 1954). The bread wheat which is a segmental allohexaploid and combines several of the features auto and allopolyploid offers several advantages in mutation breeding. Mackey (1960) and Swaminathan (1963) concluded that *T. aestivum* is a favorable material for mutation breeding, although Stadler (1930) felt then the hexaploid state of bread wheat may have a masking effect on the phenotype expression of induced mutations. Since even most micro- mutations have a negative selection value, macro-mutations of great economic value were found to be rare. All the available data indicated that the frequency of induction of beneficial mutations is very low, both among spontaneous and induced mutations, therefore, follows that higher is the mutation frequency, greater is the probability of occurrence of mutations of positive selection value. Nevertheless, the estimated value of induced mutant crop varieties now grow by farmer's shows that it has become a paying proposition in that net value of these crops far outshines any costs that conceivably have gone into mutation breeding research. Keeping this in view the present study on mutation of wheat variety PBW 154 was taken up with objectives of studying the seed quality parameters *viz* root length, shoot length, germination percentage and seedling vigour index in mutagenic population in M and to screen out macro mutants of economic and academic

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interest of any M_1 and to study for micro-mutants for grain yield and other related a quantitative trait.

MATERIALS AND METHODS

The seed of wheat variety PBW-154 was used for the present investigation. The treated seeds along with control were shown on 3 December 2011 in RBD with 3 replications of 5 rows each. The row length was 4 meter and the spacing was maintained as 25 × 10 cm and the intercultural operations were done as per need. In the laboratory: 50 seeds of each of the treatments including control were sown in petridishes lined with bloating paper and half filled with water. Each of the treatments was replicated three times. The petridishes were kept in Environmental Growth chambers as a temperature of 25 ± 2^{0}C and at relative humidity of 85 ± 5%. Following treatment mentioned in Table 1 were used for the present study.

Observations to be recorded

In the laboratory

Table 1 Details of mutagenic treatments given to wheat variety PBW-154.

Treatments
T_1: Control
T_2: 50^{0}C temperature treatment to dry seeds
T_3: 15^{0}C temperature treatment to dry seeds
T_4: 50^{0}C for 15 minutes followed by 15^{0}C again for 15 minutes
T_5: Soaking for 2 hours in 0.3% hydroxyl amine solution after soaking 6 hours in distilled water
T_6: Soaking for 6 hour in water after soaking 2 hours in 0.3% hydroxyl and amine
T_7: Soaking for 2 hours in 0.5% hydroxyl amine (chemical mutagen) solution

Germination percentage: In M_1 seeds sown in petridishes were observed for germination on 4th days. The germinated seeds were counted in each of the treatments in each replication and were converted in to percentage.

Seedling length: On 7th day of germination the seedlings of randomly selected 10 germinated seeds in each of the treatments and replications were measured and recorded in cm.

Root length: The root length was measured from the point of emergence up to the root tip of the longest root. It was recorded on 7th days of germination on the seedling selected earlier.

Seedling vigour index (SVI): The seedling vigour index was estimated according to the formula given by Abdul Baki and Anderson (1973) as: SVI = Germination percentage x (Root length + Shoot length)

Observations in the field

Days to ear head emergence: The number of days from the date of sowing more than 50% ear head emergence in each treatments and replications was recorded.

Days to blooming: The number of days from the date of sowing to more than 50% blooming in each of treatments and replications was recorded.

Days to maturity: The number of days from the date of sowing to physiological maturity of the plants was recorded on plot basis.

Plant height (cm) at maturity: Plant height of the plants under selection was measured in centimeter from the soil base to the tip of the ear of main shoot.

Number of tillers per plants: The total number of tillers per plants was counted in each of the treatments.

Spike length (cm): The length of the main ear excluding axis was measured in randomly selected 10 plants per treatment in each of the replications.

Number of spikelets per spike: Total numbers of spikelets of the spikes under observation were counted in the randomly earlier selected plants.

Number of grains/spike: From the tagged plats of each plot, the numbers of seeds per spike were calculated and the average number of seeds per spike was recorded.

Grain yield per plant: All the ear of each of the plants was hand threshed and the grains obtained were weighted in gm.

100 grain weight (gm): The grain yield of totol seed of a plant was divided by the number of seeds and multiplied by 100 to get the test weight (100 seed weight).

Statistical analysis: The means of various characters were converted to percentage over control assuming control value as 100 for the characters under study in M_1 generation.

Analysis of variance: The mean data recorded on plot basis for the above maintained characters and for the characters like spikeletes per spike, grains per spike and grain yield per plant were subjected to plot wise and treatment wise analysis of variance according to Panse and Sukhatme (1961). The significant and non-significant treatment effects were judged with the help of 'F' test given by Fisher (1954).

RESULTS AND DISCUSSION

The present investigation on induced mutagenesis in wheat variety PBW-154. *(Triticum aestivum* L.) was under taken during the *Rabi* season of 2011-12 at the Agriculture Research Farm, RBS College, Bichpuri, Agra, to study the important traits including seed quality. The wheat variety PBW 154 sealed in polythene bags were treated with treatments mentioned in Table 1. The treated seeds along with dry control were sown in the laboratory in petridishes lined with blotting paper and half filled with water. Each of the treatments was replicated three times and the petridishes were kept in environmental growth chamber at 25±2 ^{0}C temperature and 15±5 % relative humidity. In the field the sowing of the seed taken up in RBD with three replications having all the treatments including control. The plot size was of 5 rows with length of 4 m and the spacing was 25x10 cm. In M_1 generation, the observations were recorded on germination percentage, shoot length, root length, and seedling vigor index, in the laboratory and in field, days to blooming, plant height, days to maturity, number of tillers per plant, number of spikelets per spike, spike length, number of grains per spike, 100 seed weight, grain yield per plant characters. Interesting results were obtained in the present study. The sole treatments of 50^{0}C and 15^{0}C enhanced the germination percentage up to 100 and 99 percentage, respectively as compared to 93 percentage in control and 0.3 percentage hydroxyl amine treatments. More or less similar effect of the treatments on other parameters *viz.* root length, shoot length & seedling vigor index were also observed. Higher dose of hydroxyl amine was observed to be undesirable. Some earlier studies such as (Agrawal and Mishra 2001 and Khan *et al* 2003) have also reported similar finds in certain wheat varieties using mutagenic agent gamma rays. It was further observed that means of characters in various treatments such as, days to blooming, ear head emergence and maturity and plant height were reduced due to both physical and chemical mutagenic treatments while estimates of remaining characters were recorded in higher directions. The analysis of variance for ten characters studied indicated significant difference among the treatments. Table 2 indicates about significance of all the ten characters studied after application of mutagens. The difference in estimates then control was higher in 50^{0}C and 15^{0}C sole temperatures and 0.4% hydroxyl amine mutagenic treatments for most of the character. 50^{0}C sole temperature treatments reduced days to maturity significantly. Table 3 indicates about mean root, shoot length, germination percentage and seedling vigor index in lab conditions. The effect of other treatments were significant on grain yield and its directly

contributory character like, tillers per plant, spike length, grains per spike, spikelets per spike and 100 seed weight. A perusal of statistical parameters of variability like range, mean and CV revealed highest (45-75) range for grains per spike and lowest (3.31-4.62 g) for 100 grain weight. The highest value (117.86 cm) was observed for plant height and the lowest 4.08 gm for 100 seed weight. The CV estimate was highest (15.04 percent) for tillers per plant and the lowest (2.77) for days to flowering. The study of parameters of genetic variability *viz* σ^2e, σ^2g, σ^2p, GCV and $h^2_{(b)}$ and excepted genetic advance revealed highest (51.1 g) σ^2e estimate for grain yield per plant and lowest (0.060) for 100 grain weight with σ^2g and σ^2p, highest (83.90-115.55) grains per spike and lowest (0.133 and 0.194) estimates for 100 grain weight. The PCV estimates were higher than their corresponding GCV estimates. The high heritability (broad sense) was

Table 2 Analysis of Variance (ANOVA) for 10 characters studied in M_1 generation of PBW-154.

SV	d.f.	Days of ear Emerg	Days to Blooming	Days to maturity	Plant Height (in cm)	Number of Tillers /Plant	Spike length (in cm)	Number of Grains/ spike	Number of Spikelets /Spike	100 Seed Weight (in gm)	Grain Yield/ Plant
Rep	2	19.190	1.857	33.857	59.165	0.571	2.232	102.186	1.841	0.132	62.113
Treat	6	24.1**	48.38*	54.5**	207.5**	24.1**	10.8**	346.66*	4.8**	0.58*	118.17*
Error	12	12.533	8.690	16.634	29.032	4.555	1.473	94.941	0.808	0.182	34.640

***** and **Significant at 1 and 5 percent level of significance, respectively.

Table 3 Estimates of mean germination percentage, root length, shoot length and seeding vigour index in M_1 generation in lab condition.

Treatment	Character (8^{th} day)			
	Mean shoot length (cm)	Mean root length (cm)	Germination %	Seedling vigor index
T_1 = (Control)	13.45	17.33	93	2862.54
T_2 = (50^0C)	16.33	19.33	100	3566
T_3 = (15^0C)	15.2	18.66	99	3352.14
T_4 = (50^0C+15^0C)	14.65	19.45	99	3375.9
T_5 = 0.3% Hydroxyl amine	14.5	17.65	94	3022.1
T_6 = 0.4% Hydroxyl amine	14.69	18.25	95	3129.3
T_7 = 0.5% Hydroxyl amine	13.25	17.94	93	2900.67

Table 4 Estimation of parameters of genetic variability for the ten characters studied.

Character Treatmen parameter	Days to ear head Emerg	Days to Blooming	Days to maturity	Plant Height (cm)	No. of Tillers/ Plant	Spike length (cm)	No of Grains/ spike	Number of Spikelets Spike	100 Seed Weight (gm)	Yield Per Plant
Range	62-80	70-96	132-116	81.45-108.85	10-18	10.42-15.07	46-82	12-22	3.12-5.56	31.19-51.87
Mean	70.89	0.01	123.52	9.17	15.57	12.59	61.89	18.21	4.44	41.29
C.V.	0.02	92.37	0.01	0.02	0.048	0.038	0.061	0.06	0.04	0.047
σ^2e	83.48	20.33	93.29	158.84	22.67	8.95	559.87	51.65	1.51	148.91
σ^2g	21.98	112.71	17.53	51.06	5.56	1.760	124.18	5.82	0.28	49.02
σ^2p	105.47	5.13	110.82	209.90	28.24	10.71	684.05	57.47	1.80	197.94
GCV	6.61	12.08	3.39	7.66	15.15	10.53	18.00	13.25	12.09	16.95
PCV	14.48	0.18	8.52	15.55	34.12	25.98	42.25	41.62	30.21	34.07
$H^2(b)$	0.20	3.94	0.15	0.24	0.19	0.16	0.18	0.10	0.16	0.24
G.A.	4.40	3.94	3.43	7.26	2.15	1.10	9.78	1.58	0.44	7.17

observed for all the characters under study. The highest (0.86) h^2_b was observed for plant height and days to ear head, while expected Genetic Advance for grains per spike was lowest (0.53) for 100 seed weight. Important macro mutations were also recovered in present study. The recovery of bold shiny seeded and high grain yilder mutant by the use of 50^0C temperature is note-worthy. However, the further testing is needed in the future generation. Thus on the basis of presents investigation one can conclud that 50^0C temperatures is the best treatment for improvement in grain yield per plant and to create variability with 0.5% hydroxyl amine is the best treatment.

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